사단법인 대한스포츠의학회 제67차 추계학술대회

사단법인 대한스포츠의학회
The Korean Society of Sports Medicine

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회 제67차 추계학술대회

일시. 2025년 10월 18일(토)~ 19일(일)   장소. 서울 올림픽 파크텔

주최·주관. 사단법인 대한스포츠의학회
평 점. 18일(토): 의협 3점, 인증 30점 / 19일(일): 의협 6점, 인증 60점

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[제조의뢰자] 온코닉테라퓨틱스

[제조판매원] 제일약품

[공동판매원] 동아ST

의약품상세정보 QR코드

JAQ-2410-C-057

Abbreviation. P-CAB Potassium-Competitive Acid Blocker.

Reference. 1. Hwang I *et al.*, Randomised clinical trial: Safety, tolerability, pharmacodynamics and pharmacokinetics of zastaprazan (JP-1366), a novel potassium-competitive acid blocker, in healthy subjects. *Aliment Pharmacol Ther.* 2023;57(7):763-772.

[제조의뢰자] 온코닉테라퓨틱스(주) 서울특별시 강남구 테헤란로 26길 12, 11층 **[제조판매원]** 제일약품(주) 공장: 경기도 용인시 처인구 백암면 청강가창로 7 (B동 외) 본사 : 서울특별시 서초구 사평대로 343 Tel. 080-555-7171

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※ 제품에 대한 자세한 정보는 제품에 동봉된 제품설명서 및 식품의약품안전처 의약품안전나라 (https://nedrug.mfds.go.kr/index)를 참고하시기 바랍니다.

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Drug Information

성분 및 함량 Rabeprazole Sodium 10mg + Sodium Bicarbonate 400mg

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언제든지! 병용 가능합니다
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언제든지! 기간 제한 없이!!
처방 가능합니다[4]

Rabiet
(Rabeprazole sodium) Tab.

Drug Information

(실제 사이즈)

제품명	라비에트 정 (Rabiet)	유효성분·함량	Rabeprazole 10mg, 20mg	용법·용량	1회 10~20mg, 1일 1~2회 투여
효능·효과	위궤양, 십이지장궤양 , 미란성 또는 궤양성 위식도역류질환, 위식도역류질환의 증상 완화, 위식도역류질환의 장기간 유지요법, Helicobacter pylori에 감염된 소화기 궤양 환자에 대한 항생제 병용요법, 졸링거 엘리슨 증후군				

※ 자세한 사항은 제품설명서 전문을 참고해주세요

Reference 1) Adachi K, et al. J Gastroenterol. 2003;38:830-835. 2) Furuta K, et al. Digestion. 2016;93:107-116.
3) Sugimoto M, et al. Clin Exp Gastroenterol. 2012;5:49-59. 4) 식약처 허가사항(20.08)

RAB-EX17-2008

일반의약품 | 조제용

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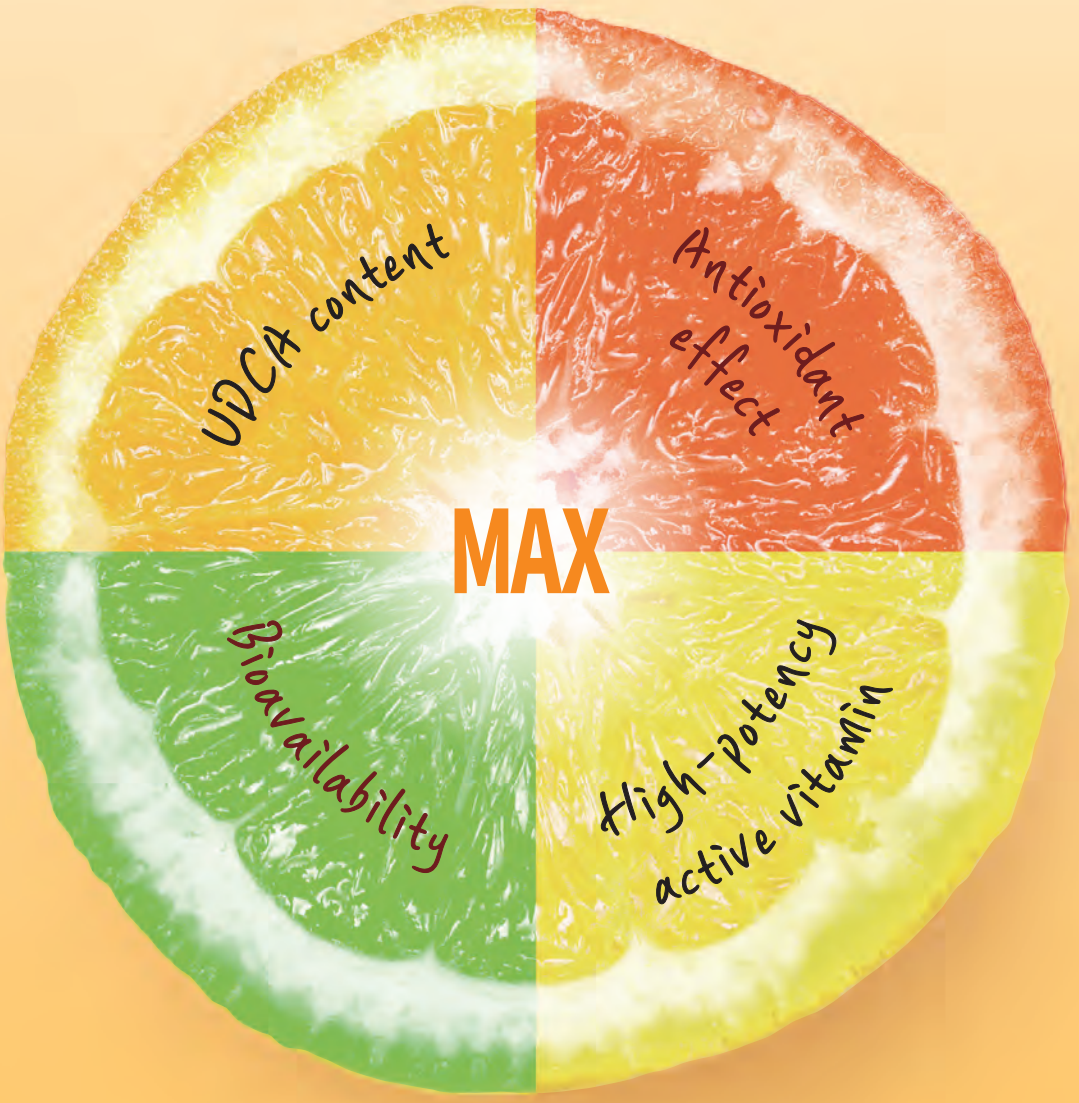

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※제품에 대한 자세한 정보는 최신의 제품설명서를 참고하시기 바라며, 홈페이지 또는 의약품통합정보시스템(nedrug.mfds.go.kr)을 통해 확인하실 수 있습니다.

References) 1. Ha CW et al. BMC Musculoskelet Disord. 2017 May 26;18(1):223 **2.** Lee JK et al. Rheumatol Int. 2017 Nov;37(11):1807-1815. **3.** LG Chem. Data on file Synovian® PMS report. LG-HAPMS001 (14 Jan. 2020) **4.** Jang KM et al. Curr Med Res Opin. 2021 Sep;37(9):1573-1580. **5.** L2024 Synovian® Periodic Safety Update Report. Total cumulative sales volume from 2014-2024

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TRK-BR-A002-01-OCT25

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- 글루코코르티코이드 유발성 골다공증의 치료[2)]
- 안드로겐 차단요법을 받고 있는 비전이성 전립선암 환자의 골 소실 치료[2)]
- 아로마타제 저해제 보조요법을 받고 있는 여성 유방암 환자의 골 소실 치료[2)]

Product Information[2)]

성분·함량	1mL 중 Denosumab 60mg	용법·용량	1시린지를 매 6개월마다 피하주사	포장 정보	1개 X 프리필드시린지(1mL)/박스
사용 기간	제조일로부터 36개월	저장 방법	밀봉용기, 동결을 피하여 차광, 냉장(2~8℃)		

Ref 1) Chung YS, et al. *Bone*. 2025 Mar;192:117371. **2)** 식품의약품안전처. 오보덴스프리필드시린지(데노수맙) 허가사항(2025년 4월 기준)
[성상] 무색 내지 약간 노란색이고, 투명하며 입자를 거의 포함하지 않는 액이 무색 투명한 프리필드시린지에 들어 있는 주사제 **[원료약품 및 그 분량]** 이 약 1 프리필드시린지(1 mL) 중, 주성분: 데노수맙(별규) 60 mg, 첨가제: 히스티딘, 히스티딘염산염, 폴리소르베이트20, 소르비톨, 주사침, 용제: 주사용수 **[효능·효과]** 1. 폐경 후 여성 골다공증 환자의 치료 2. 남성 골다공증 환자의 골밀도 증가를 위한 치료 3. 글루코코르티코이드 유발성 골다공증의 치료 4. 안드로겐 차단요법을 받고 있는 비전이성 전립선암 환자의 골 소실 치료 5. 아로마타제 저해제 보조요법을 받고 있는 여성 유방암 환자의 골 소실 치료 **[용법·용량]** 이 약은 보건의료 전문가에 의해 투여되어야 한다. 이 약 1 시린지(데노수맙 60 mg)를 매 6개월마다 상완, 허벅지 위쪽 또는 복부에 피하 주사한다. 모든 환자는 칼슘 1000 mg과 비타민D 400 IU 이상을 매일 복용해야 한다. 정기 투여일에 이 약을 투여하지 못했을 경우, 가능한 빨리 투여한다. 그 후, 마지막 투여일자로부터 매 6개월 마다 투여한다. **[사용상의 주의사항]** 이 약은 프롤리아프리필드시린지(데노수맙)을 대조약으로 한 동등생물의약품이다. **[포장단위]** 1개 x 프리필드시린지(1 mL)/박스 **[저장방법]** 밀봉용기, 동결을 피하여 차광, 냉장(2 ~ 8 °C) 보관 **[사용기한]** 외부포장을 참조하십시오. **[수입자]** 삼성바이오에피스(주), 대한민국, 인천광역시 연수구 송도교육로 76 **[제조의뢰자]** 삼성바이오에피스(주), 대한민국, 인천광역시 연수구 송도교육로 76 ※ 자세한 의약품정보는 식품의약품안전처 의약품통합정보시스템 (https://nedrug.mfds.go.kr → 「의약품 등 정보」 → 「의약품 및 화장품 품목정보」 → 「의약품등 정보검색」) 을 참조하십시오.
※ 이 첨부문서 개정일자 이후 변경된 내용은 식품의약품안전처 의약품통합정보시스템(https://nedrug.mfds.go.kr)에서 확인할 수 있습니다.

SBMA_2025_04_01_643_P HM.Design 2504_01 OBO-H-2503-02

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03 규격

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혁신 솔루션 개발

PARTNERSHIP

통합적 전문성을 활용하여
사람들을 제품 및 서비스에 연결

Viatris(비아트리스) 회사 관련 문의 (한국)
비아트리스 그룹의 한국 법인(한국화이자업존㈜)
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VIATRIS

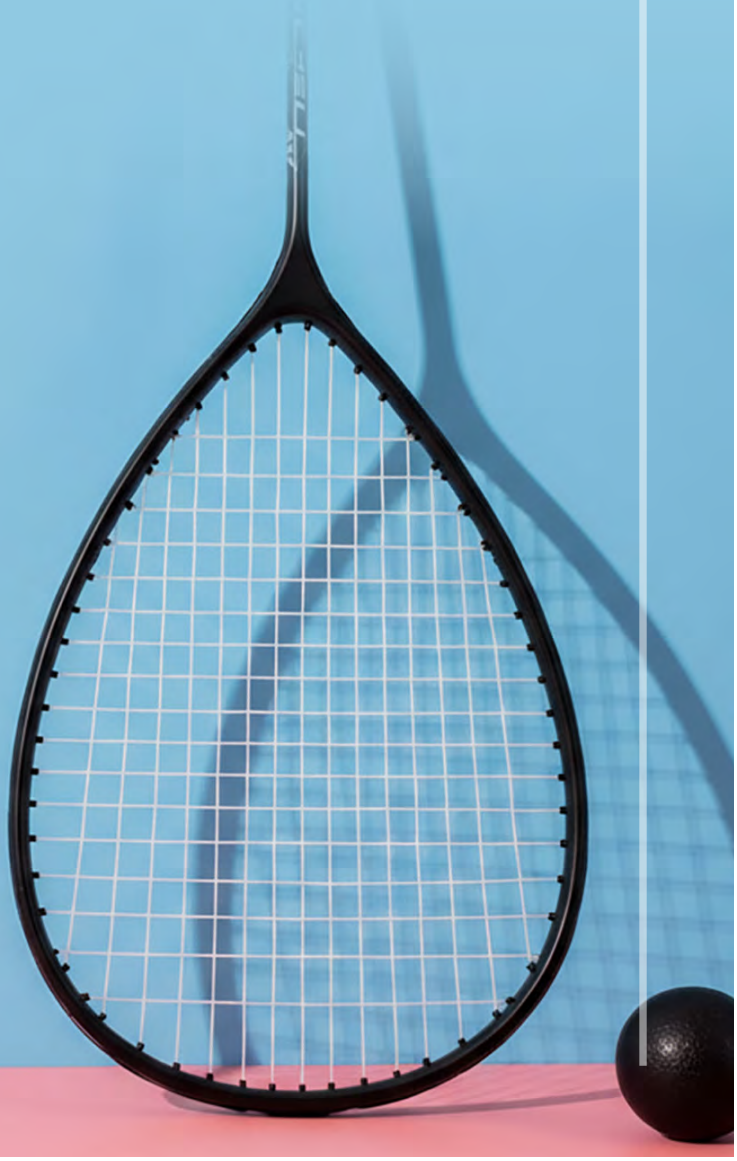
The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회
제67차 추계학술대회

일시. 2025년 10월 18일(토)~ 19일(일)　장소. 서울 올림픽 파크텔

주최·주관. 사단법인 대한스포츠의학회

평　　점. 18일(토): 의협 3점, 인증 30점 / 19일(일): 의협 6점, 인증 60점



사단법인 대한스포츠의학회
The Korean Society of Sports Medicine

Invitation

스포츠의학을 사랑하는 회원 여러분

대한스포츠의학회 제67차 추계학술대회가 오는 2025년 10월 18일과 19일, 서울 올림픽파크텔에서 개최됩니다.

이번 학술대회는 스포츠 손상의 현장 평가와 응급처치, 전방십자인대 재건술 후 최신 재활 전략, 다학제적 통합 접근(영양, 심리, 디지털 혁신) 등 다양한 주제를 심도 있게 다루고자 합니다. 또한 고령 스포츠인의 관절염과 골다공증 관리, 수술 후 기능 회복을 위한 시각적 피드백 운동 적용 등, 스포츠의학 분야 최신 연구 성과와 임상 경험이 공유될 예정입니다.

스포츠의학은 단순히 손상 치료를 넘어, 운동과 재활을 통한 삶의 질 향상과 국민 건강 증진에 크게 기여하고 있습니다. 특히 현장에서의 적절한 대응, 수술 후 효과적인 회복, 고령화 사회에서 증가하는 근골격계 질환의 관리까지 우리 학회의 학문적 역할과 책임은 더욱 커지고 있습니다.

이번 학술대회가 이러한 과제들을 함께 고민하고 최선의 치료 방안을 모색하는 뜻깊은 자리가 되리라 확신합니다.

학회의 발전은 회원 여러분의 적극적인 참여와 관심으로 이루어집니다. 바쁘신 일정에도 함께해 주셔서, 스포츠의학의 현재와 미래를 함께 나누고 풍성한 학문적 교류의 장을 만들어 주시기를 부탁드립니다.

대한스포츠의학회 회원 여러분 및 스포츠의학에 관심있는 여러분들의 적극적인 참여와 성원을 부탁드립니다.

감사합니다.

2025년 9월

(사)대한스포츠의학회 회장 **하철원**

Program at a glance

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<tr><td>08:00-09:00</td><td></td><td></td><td></td></tr>
<tr><td>09:00-09:40</td><td></td><td></td><td></td></tr>
<tr><td>09:40-10:00</td><td></td><td></td><td></td></tr>
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<tr><td>11:00-12:50</td><td></td><td></td><td></td></tr>
<tr><td>12:50-13:00</td><td colspan="3">개회사&인사말</td></tr>
<tr><td>13:00-14:00</td><td>심포지엄 1:
스포츠 손상의 현장 평가 및
응급처치 - 대한스포츠
의학회 인증 SAT 역할</td><td>심포지엄 2:
전방십자인대 재건술 후
운동 기반 재활의 최근 발전 동향</td><td rowspan="2">초음파 실습
hands-on session 1:
견관절 및 주관절</td></tr>
<tr><td>14:00-15:00</td><td>심포지엄 3:
스쿼시, 부상 없는 미래를 꿈꾸다</td><td>자유연제 구연 1</td></tr>
<tr><td>15:00-15:30</td><td colspan="3">Coffee break</td></tr>
<tr><td>15:30-16:30</td><td>심포지엄 4:
야구선수에서 팔꿈치 손상</td><td>심포지엄 5:
스포츠인의 슬개대퇴관절 문제</td><td>초음파 실습
hands-on session 2:
슬관절 및 햄스트링</td></tr>
<tr><td>16:30-17:30</td><td>심포지엄 6:
AI • 디지털혁신을 통한
생활체육 활성화와 건강증진</td><td>자유연제 구연 2</td><td>초음파 실습
hands-on session 3:
족부족관절</td></tr>
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Program at a glance

	19일(일요일)			
시간/홀	올림피아홀 (메인홀)	런던홀	서울홀	로마홀
07:50-08:00	개회사 & 인사말			
08:00-09:00	ICL1. 스포츠 손상 재활의 다학제 통합 전략: 영양, 심리, 디지털 혁신	심포지엄 7: 대한스포츠의학회 SAT 프로그램의 이해와 실제	심포지엄 8: 고령 스포츠의 관절염, 골다공증의 치료	심포지엄 9: 수술 후 기능 회복을 위한 시각적 피드백 운동의 임상적 적용
09:00-09:40	해외연자 초청 강연			
09:40-10:00	Coffee break			
10:00-11:00	심포지엄 10: 야구에서의 어깨 탈구: 진단부터 치료까지	심포지엄 11: 장애인 스포츠 의학 - 분류, 손상 양상 및 실제적 치료	DCC (Doping Control Center) 초청 심포지엄: 과학의 실천, 선수 보호와 공정한 경기 정신 수호	스마트폰 IMU 및 AI 기반 운동 모니터링 실습: Honest Measure 적용과 현장 활용
11:00-12:00	2028 LA 올림픽 채택 기념 대한스쿼시연맹 초청 심포지엄: 유리벽 안의 전쟁 - 스쿼시를 해부하다			
12:00-13:00	런천세미나 (12:00-12:10), 기념 촬영 및 점심 식사, MOU			
13:00-14:00	자유연제 구연 3 - 최우수 연제 후보 구연			
14:00-15:00	심포지엄 12: Orthobiologics (PRP, stem cells, collagen) in sports athletes	심포지엄 13: 도구를 활용한 척추 질환에 대한 전략적 접근법과 해결책	심포지엄 14: 여성 선수를 위한 스포츠의학: 성별에 따른 맞춤형 접근	심폐소생 응급처치 (CPR) 실습 I
15:00-15:30	Coffee break			
15:30-16:30	심포지엄 15: 특정 스포츠 손상에서 난치성 과제: 뼈와 결합된 힘줄 골과 결합된 힘줄	심포지엄 16: 도핑 방지 문제에 관한 최신 업데이트	자유연제 구연 4	심폐소생 응급처치 (CPR) 실습 II
16:30-17:30	ICL 2. 스포츠 손상에서의 견열 손상	심포지엄 17: 연속혈당측정기를 활용한 맞춤형 신체활동 전략		테이핑의 실제 적용
17:30-17:45	시상식 및 폐회사			

서울홀 — 10월 18일(토요일)

12:50-13:00	**개회사&인사말**		
13:00-14:00	**심포지엄 1: 스포츠 손상의 현장 평가 및 응급처치 - 대한스포츠의학회 인증 SAT 역할** **On-field Evaluation and Emergency Management of Sports Injuries - The Role of a Certified Sports and Athletic Trainer (SAT) by the KSSM**	**좌장: 하병원 하철원, 한림대강남성심병원 김원희**	
13:00-13:15	두부외상 Traumatic brain injury	SRC재활병원 김은국	17
13:15-13:30	안면부 외상 Facial injury	국군수도병원 황 건	23
13:30-13:45	심장 콜랩스 Cardiac collapse	순천향대 부천병원 김호중	27
13:45-14:00	토의 Discussion		
14:00-15:00	**심포지엄 3: 스쿼시, 부상 없는 미래를 꿈꾸다** **Squash: Dreaming of an Injury-Free Future**	**좌장: 솔병원 나영무, 순천향대부천병원 이영구**	
14:00-14:15	스쿼시에서의 상지의 부상: “라켓을 휘두르는 팔, 혹사 당하는 어깨와 팔꿈치” Upper limb injuries in squash: ‘The racket-swinging arm, overworked shoulders and elbows’	진천국가대표선수촌 메디컬센터 유중진	33
14:15-14:30	스쿼시에서의 하지의 부상: “순간 스텝이 부르는 비극- 무릎과 발목의 위험” Lower Limb Injuries in Squash: ‘The Tragedy of Instantaneous Steps - The Perils to Knees and Ankles’	국가대표정형외과 이 준	39
14:30-14:45	스쿼시에서의 허리 척추 손상: “허리가 무너지면 경기도 무너진다, 척추 손상의 함정” Lower Back Spinal Injuries in Squash: “When your back collapses, your game collapses: The pitfalls of spinal injury”	진천국가대표선수촌 메디컬센터 김세용	45
14:45-15:00	토의 Discussion		
15:00-15:30	**Coffee break**		
15:30-16:30	**심포지엄 4: 야구선수에서 팔꿈치 손상** **Elbow injuries in baseball players**	**좌장: 서남병원 이석현, 고려대구로병원 문준규**	
15:30-15:45	UCL 손상의 개요와 보존적 치료 Overview of Ulnar Collateral Ligament (UCL) Injury and non-operative treatment	세종스포츠정형외과 금정섭	53
15:45-16:00	895명 엘리트 야구 선수에서의 UCL 수술 방법들에 따른 결과 분석 및 고찰 Analysis of UCL reconstruction in 895 elite baseball players	CM병원 이상훈	
16:00-16:15	실패한 UCL 재건 후 리비전 수술 전략 Revision Surgery Strategies After Failed UCL Reconstruction	네온정형외과 박진영	
16:15-16:30	토의 Discussion		
16:30-17:30	**심포지엄 6: AI · 디지털혁신을 통한 생활체육 활성화와 건강증진** **Revitalising Community Sports and Enhancing Health through AI and Digital Innovation**	**좌장: 계명대학교 김기진, 서울대학교 김연수**	
16:30-16:45	AI디지털 헬스케어 트렌드와 스포츠과학의 역할 Trends in AI Digital Healthcare and the Role of Sports Science	동국대학교 조용인	
16:45-17:00	AI 기반 예측 모델을 이용한 운동의 구현과 중재의 설계 Generating Human Motion and Designing Interventions Using AI-Based Predictive Models	서울대학교 안주은	
17:00-17:15	빅데이터 기반 생활습관 분석과 개인 맞춤형 운동지도 Big Data-Based Lifestyle Analysis and Personalized Exercise Guidance	온심 이일석	
17:15-17:30	토의 Discussion7		

런던홀 — 10월 18일(토요일)

12:50-13:00 **개회사&인사말**

13:00-14:00 **심포지엄 2: 전방십자인대 재건술 후 운동 기반 재활의 최근 발전 동향**
Recent Advances in Exercise-Based Rehabilitation Following ACL Reconstruction
좌장: 고려대안암병원 장기모, 명지병원 임길병

13:00-13:15 전방십자인대 손상 후 관절유래성 근육 억제 예방을 위한 재활 전 훈련의 중요성
Importance of Prehabilitation to Prevent Arthrogenic Muscle Inhibition after ACL Injury
고려대구로병원 스포츠의학실 김현종

13:15-13:30 이식 유형에 따른 재활 전략: 실제적 고려 사항
Rehabilitation Strategies According to Graft Type: Practical Considerations 서울점프정형외과 박재범

13:30-13:45 ALL 재건술을 통한 전방십자인대 재건술 후 임상적 및 기능적 결과
Clinical and Functional Outcomes after ACL Reconstruction with ALL Reconstruction
고려대안암병원 스포츠의학센터 이진혁

13:45-14:00 토의 Discussion

14:00-15:00 **자유 연제 구연 1**
Free paper presentation 1 **좌장: 양산부산대병원 이창형, 중앙보훈병원 여의동**

14:00-14:12 MUCL 재건술 단독 수술과 VEOS 병행 수술에서 이소성 골화 발생 위험 비교 분석
Which surgery has a higher risk of heterotopic ossification: isolated MUCL reconstruction or simultaneous MUCL and VEOS surgery 청담리온정형외과 심창헌

14:12-14:24 슬관절 OCD 환자에서의 autologous bone peg 를 사용한 고정술의 임상적 결과 Clinical Outcomes of Arthroscopic Fixation Using Autologous Bone Pegs for Osteochondritis Dissecans of the Knee 세종스포츠정형외과 김주환

14:24-14:36 만성 외측 발목 불안정증 환자에서 변형 브로스트롬 수술과 운동 기반 치료의 비교 결과
Comparative Outcomes of Modified Broström procedure and Exercise-Based Treatment in Patients with Chronic Lateral Ankle Instability 건국대병원 이유빈

14:36-14:48 한국 엘리트 야구선수를 대상으로 한 Hybrid UCL 재건술 후 기능적 결과
Functional Outcomes Following Hybrid UCL Reconstruction in Elite Korean Baseball Players
세종스포츠정형외과 금정섭

14:48-15:00 토의 Discussion

15:00-15:30 **Coffee break**

15:30-16:30 **심포지엄 5: 스포츠인의 슬개대퇴관절 문제**
Patellofemoral problems in sports athletes **좌장: 서울바른세상병원 임홍철, 서울대학교 최호천**

15:30-15:50 증례 발표 1
Case presentation 1 SNU서울병원 이상훈

15:50-16:10 증례 발표 2
Case presentation 2 한양대병원 이진규

16:10-16:30 증례 발표 3
Case presentation 3 한양대구리병원 정규성

16:30-17:30 **자유연제 구연 2**
Free paper presentation 2 **좌장: 서울아산병원 최경효, 인하대병원 류동진**

16:30-16:42 전방십자인대 재건술과 동반된 내측측부인대 손상의 비수술적 치료의 2년 추시 임상 결과
Nonoperative Management of Medial Collateral Ligament Injury in Combined Anterior Cruciate Ligament Reconstruction Provides Satisfactory Clinical Outcomes at 2 Year Follow Up 고려대구로병원 박뿌리

16:42-16:54 6주간 불안정한 하중을 이용한 점진적인 균형 훈련이 만성 발목 불안정성 대상자의 균형, 근력, 기능 수행력에 미치는 영향
Effects of 6-Week Progressive Balance Training Using Unstable Loads on Balance, Strength, and Functional Performance in Subjects with Chronic Ankle Instability 부경대학교 서가은

16:54-17:06 Relative Energy Deficiency in Sport (REDs): The Importance of Carbohydrate Availability UC Irvine Brian Kim

17:06-17:18 Taekwondo Medicine: Comprehensive Injury and Illness Prevention Strategies for Taekwondo Athletes from World Taekwondo Experience UC San Francisco Dae Hyoun Jeong

17:18-17:30 토의 Discussion

로마홀 — 10월 18일(토요일)

13:30-15:00	**초음파 실습 hands-on session 1: 견관절 및 주관절**	좌장: 한양대구리병원 조영훈 인스트럭터: 고대안산병원 김현곤, 고대안산병원 조성현
15:00-15:30	**Coffee break**	
15:30-16:30	**초음파 실습 hands-on session 2: 슬관절 및 햄스트링**	좌장: 조선대병원 김동휘 인스트럭터: 도곡타워정형외과 정의엽, 계명대병원 김두한
16:30-17:30	**초음파 실습 hands-on session 3: 족부족관절**	좌장: 충남대병원 강 찬 인스트럭터: 서울의료원 김기천, 아주대병원 서영욱

올림피아홀 — 10월 19일(일요일)

07:50-08:00 **개회사 & 인사말**

08:00-09:00 **ICL1. 스포츠 손상 재활의 다학제 통합 전략: 영양, 심리, 디지털 혁신**
Multimodal Strategies in Sports Injury Rehabilitation: Nutrition, Mind, and Digital Innovation
좌장: 한양대병원 김미정, 고려대구로병원 강 석

08:00-08:15 스포츠 손상 후 영양대사 전략
Fueling Recovery: Nutritional and Metabolic Strategies after Sports Injuries — 영남대 생활과학연구소 이시형

08:15-08:30 스포츠 손상 재활의 인지행동적 접근
Mind Reconstruction: Cognitive Behavioral Approaches in Sports Injury Rehabilitation — 에버엑스 의학부 최치현

08:30-08:45 스포츠 손상 재활의 디지털 치료제 활용
igital Innovation: Application of Digital Therapeutics in Sports Injury Rehabilitation — 한양대병원 박재현

08:45-09:00 토의 Discussion

09:00-09:40 **해외연자 초청 강연 (메인홀)** — **좌장: 성빈센트병원 김준성, 문영래정형외과병원 문영래**

09:00-09:40 Sports injury in baseball — Medical College of Wisconsin Craig C. Young

Q&A

09:40-10:00 **Coffee break**

10:00-11:00 **심포지엄 10: 야구에서의 어깨 탈구: 진단부터 치료까지**
Shoulder dislocation in baseball, from diagnosis to treatment — **좌장: 네온정형외과 박진영, 문영래정형외과병원 문영래**

10:00-10:15 어깨 탈구의 메커니즘 및 영상학적 진단, 보존적 치료의 적응증과 방법
Mechanism of shoulder dislocation, radiological diagnosis, indications and methods for conservative treatment
좋은삼선병원 조형래

10:15-10:30 관절와순 파열의 수술 결정, 언제 해야하나요? 첫탈구도 하나요?
When should surgery be considered for a labrum tear? Is it necessary even for a first dislocation?
세종스포츠정형외과 금정섭

10:30-10:45 관절경하 관절와순 봉합시에 후관절낭 중첩(remplissage)의 적응증은?
What are the indications for posterior capsular overlap (remplissage) during arthroscopic capsular suturing?
청담리온정형외과 이제형

10:45-11:00 토의 Discussion

11:00-12:00 **2028 LA 올림픽 채택 기념 대한스쿼시연맹 초청 심포지엄: 유리벽 안의 전쟁 - 스쿼시를 해부하다**
The War Within the Glass Wall - Dissecting Squash — **좌장: 닥터핏 박원하, 하병원 하철원**

11:00-11:15 스쿼시 종목 소개: “초고속 스포츠, 스쿼시를 말하다.”
Squash Introduction: The Ultra-Fast Sport, Squash Explained — 대한민국 국가대표 스쿼시팀 감독 강호석

11:15-11:30 스쿼시 선수의 부상 회복기: “부상은 또 하나의 상대- 코트로 돌아온 선수의 이야기”
A Squash Player’s Recovery from Injury: ‘Injury is Another Opponent
- The Story of a Player Returning to the Court’ — 대한스쿼시연맹 이년호

11:30-11:45 스쿼시 다빈도 부상 및 관리:”어디까지 다칠 수 있나? 스쿼시 부상의 실제 이야기”
Common Squash Injuries and Management: ‘How Bad Can It Get? Real Stories of Squash Injuries’
대한민국 국가대표 스쿼시팀 트레이너 김정수

11:45-12:00 토의 Discussion

12:00-13:00 **런천세미나 (12:00-12:10), 기념 촬영 및 점심 식사, MOU**

13:00-14:00 **자유연제 구연 3 - 최우수 연제 후보 구연**
Free paper presentation 3 - Best paper candidates presentation — **좌장: 용인세브란스병원 이태임, 고려대구로병원 배지훈**

13:00-13:12 일차 전방십자인대 재건술 후 대퇴사두근의 근피로도가 부상 전 및 수술 후 스포츠 활동 수준 회복에 미치는 영향 : 2년 추시 비교연구
Quadriceps work fatigue was a significant predictor of the return to preinjury and postoperative sports levels following primary ACL reconstruction using hamstring autograft or tibialis anterior allograft
고려대안암병원 이진혁

13:12-13:24	슬개대퇴통증 치료를 위한 운동-인지행동치료 병합 디지털 치료기기의 무작위 대조 연구 A Randomized Controlled Trial of a Digital Therapeutic Combining Exercise and Cognitive-Behavioral Therapy for Patellofemoral Pain	에버엑스 이상희
13:24- 13:36	인공지능 기반 모델링을 통한 엘리트 남자 역도 선수의 도핑 관련 경기력 이상 탐지 Artificial Intelligence-Based Modeling for Detecting Doping-Related Performance Anomalies in Elite Male Weightlifting	연세대학교 주윤태
13:36-13:48	잔존 반월연골판의 양과 질이 우수할수록 자가 골연골 이식술 이후 연골이 우수하게 유지된다: 평균 6년 추시 후향적 비교 연구 Better meniscal volume and quality reduce cartilage degeneration following autologous osteochondral transfer: A retrospective comparative study with a mean 6-year follow-up.	충북대병원 이효열
13:48-14:00	토의 Discussion	
14:00-15:00	**심포지엄 12: 스포츠손상에서 orthobiologics 를 이용한 치료 방법** **Orthobiologics treatment for sports injuries**	**좌장: 분당척병원 성상철, 한양대병원 이진규**
14:00-14:15	스포츠인의 무릎 부상에서 orthobiologics 를 이용한 치료 방법 Orthobiologics treatment for knee injuries in athletes	계명대동산병원 김두한
14:15-14:30	스포츠인의 발목 부상에서 orthobiologics 를 이용한 치료 방법 Orthobiologics treatment for ankle injuries in athletes	건양의대 송재황
14:30-14:45	스포츠인의 어깨 부상에서 orthobiologics 를 이용한 치료 방법 Orthobiologics treatment for shoulder injuries in athletes	삼성서울병원 김수철
14:45-15:00	토의 Discussion	
15:00-15:30	**Coffee break**	
15:30-16:30	**심포지엄 15: 특정 스포츠 손상에서 난치성 과제: 뼈와 결합된 힘줄 골과 결합된 힘줄** **A Refractory Challenge in Sports Specific Injury: Tendon with Bone**	**좌장: 아산재건정형외과의원 조우신, 이경태 정형외과 이경태**
15:30-15:42	발뒤꿈치의 지속적인 통증(검도): 뼈돌기가 동반된 아킬레스건염 Insertional Achilles tendinitis with haglund deformity	웰본 정형외과 김준범
15:42-15:54	발목 뒤 숨은 통증의 주범(발레): 무용수 건초염 그리고 삼각골 증후군 Flexor Hallucis Longus tendinitis with OS trigonum	부천 본본정형외과 제갈혁
15:54-16:06	지긋지긋한 앞무릎 통증(축구): 오스굿씨병과 슬개건염 Patella tendinitis with Osgood Schlatter disease	한양대구리병원 정규성
16:06-16:18	발목 접지른 후 발생한 중족부 내측부 통증(농구): 주상골 골절, 부주상골 증후군, 후경골건염 Posterior tibialis tendinitis with Accessory Navicula	서울의료원 김기천
16:18-16:30	토의 Discussion	
16:30-17:30	**ICL 2. 스포츠 손상에서의 견열 손상** **Avulsion fracutres in sports injury**	**좌장: 부민병원 서경묵 , 노원을지대병원 양기원**
16:30-16:42	수부 견열 손상 Hand avulsion injurie	고려대안산병원 오치훈
16:42-16:54	고관절 견열 손상 Hip avulsion injuries	노원을지대병원 김진우
16:54-17:06	슬관절 견열 손상 knee avulsion injuries	충북대병원 이효열
17:06-17:18	족부족관절 견열 손상 Foot and ankle avulsion injuries	영남대병원 박철현
17:18-17:30	토의 Discussion	
17:30-17:45	**시상식 및 폐회사**	

런던홀 — 10월 19일(일요일)

07:50-08:00	**개회사 & 인사말**	
08:00-09:00	**심포지엄 7: 대한스포츠의학회 SAT 프로그램의 이해와 실제** **Understanding and Implementing the SAT Program of KSSM**	**좌장: 명지병원 김용균, 이대목동병원 권지은**
08:00-08:20	SAT 이론 프로그램과 NATA 프로그램의 비교 Comparison of the SAT Theory Programme and the NATA Programme	진천선수촌 배중현
08:20-08:40	SAT 실습 프로그램의 특성과 차별점 Characteristics and Distinctive Features of the SAT Practice Programme	서울의료원 김기천
08:40-09:00	토의 Discussion	
09:00-09:40	**해외연자 초청 강연 (메인홀)**	
09:40-10:00	**Coffee break**	
10:00-11:00	**심포지엄 11: 장애인 스포츠 의학: 분류, 손상 양상 및 실제적 치료** **Para Sports Medicine: Classification, Injury Patterns, and Practical Management**	**좌장: 강동경희대병원 김동환, 한양대구리병원 한승훈**
10:00-10:20	대한민국 패럴림픽의 지속성장을 위한 스포츠 과학지원 Sports Science Support for the Sustainable Growth of the Republic of Korea's Paralympic Movement	대한 장애인 체육회 안영환
10:20-10:40	장애인 운동선수에게 흔히 발생하는 스포츠 손상과 재활 전략 Common Sports Injuries in Para-athletes and Rehabilitation Strategies	경희대병원 소윤수
10:40-11:00	토의 Discussion	
11:00-12:00	**2028 LA 올림픽 채택 기념 대한스쿼시연맹 초청 심포지엄: 유리벽 안의 전쟁 - 스쿼시를 해부하다** **The War Within the Glass Wall - Dissecting Squash (메인홀)**	
12:00-13:00	**런천세미나 (12:00-12:10), 기념 촬영 및 점심 식사, MOU (메인홀)**	
13:00-14:00	**자유연제 구연 3 - 최우수 연제 후보 구연** **Free paper presentation 3 - Best paper candidates presentation (메인홀)**	
14:00-15:00	**심포지엄 13: 도구를 활용한 척추 질환에 대한 전략적 접근법과 해결책** **Strategic approaches and solutions for spinal disease using props**	**좌장: 부경대학교 김영훈, 동아대병원 이종화**
14:00-14:15	척수 손상 후 기능 회복을 위한 도구 활용 운동 전략 Exercise Strategies Incorporating Props for Functional Recovery Following Spinal Cord Injury	국립재활원 이준민
14:15-14:30	비특이적 만성요통에 대한 소도구 적용을 위한 전략 Strategies for the application of Propsin non-specific chronic low back pain	리본필라테스 허진희
14:30-14:45	척추 질환에 대해 소도구를 이용한 단계적 접근 Astep-by-step approach to spinal disease using props	삼성서울병원 서용곤
14:45-15:00	토의 Discussion	
15:00-15:30	**Coffee break**	
15:30-16:30	**심포지엄 16: 도핑 방지 문제에 관한 최신 업데이트** **Current update of anti-doping issues**	**좌장: 일산백병원 양윤준, SRC재활병원 김은국**
15:30-15:50	개정된 금지목록 Revised Prohibited List	KADA TUE 위원장 이승림
15:50-16:10	TUE 현황 및 사례 TUE Status and Case Studies	서울보라매병원 오범조
16:10-16:30	토의 Discussion	

런던홀 — 10월 19일(일요일)

16:30-17:30	**심포지엄 17: 연속혈당측정기를 활용한 맞춤형 신체활동 전략** **Personalised physical activity strategy utilising continuous glucose monitoring** **좌장: 구로성심병원 김병성, 한양대병원 박훈기**	
16:30-16:45	스포츠의학에서 연속혈당측정기(CGM)의 활용 The Role of Continuous Glucose Monitoring (CGM) in Sports Medicine	카카오헬스케어 한민규
16:45-17:00	비만·대사질환 예방과 관리를 위한 CGM 활용 연구 Research on the Use of CGM for the Prevention and Management of Obesity and Metabolic Disorders	동아대학교 박현태
17:00-17:15	연속혈당측정기의 임상적 활용 Clinical Applications of Continuous Glucose Monitoring Systems	서울보라매병원 오범조
17:15-17:30	토의 Discussion	
17:30-17:45	**시상식 및 폐회사 (메인홀)**	

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회
제67차 추계학술대회

10월 18일(토요일)

서울홀

사단법인 대한스포츠의학회
The Korean Society of Sports Medicine

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 1: 스포츠 손상의 현장 평가 및 응급처치 - 대한스포츠의학회 인증 SAT 역할

On-field Evaluation and Emergency Management of Sports Injuries - The Role of a Certified Sports and Athletic Trainer (SAT) by the KSSM

좌장: 하병원 하철원, 한림대강남성심병원 김원희

김은국

학력

경희대학교 의학과 학사
경희대학교 의학과 재활의학 석사
경희대학교 의학과 재활의학 박사

주요경력

2004 아테네 올림픽 대한민국 선수단 주치의
2006 토리노 동계올림픽 대한민국 선수단 주치의
2010 밴쿠버 동계올림픽 대한민국 선수단 주치의
2010 광저우 아시안게임 대한민국 선수단 주치의
2011 아스타나-알마티 동계아시안게임 대한민국 선수단 주치의
2015 광주 하계 유니버시아드 대회 대한민국 선수단 주치의
2016 리우 하계 패럴림픽 대한민국 선수단 주치의
2016 Shorttrack Worldcup 4 (ISU) Medical Advisor
2017 삼순, 터키 데플림픽 대한민국 선수단 주치의
2018 드레스덴 European shorttrack championship (ISU) Medical Advisor
2018 폴란드 shorttrack junior world championship (ISU) Medical Advisor
2018 평창 동계올림픽 피겨/쇼트트랙 경기장 의료책임자
2018 평창 동계 패럴림픽 대한민국 선수단 주치의
2018 인도네시아 파라 아시안게임 대한민국 선수단 주치의
2019 소피아 Shorttrack world championship (ISU) Medical Advisor
2020 로잔 Youth Winter Olympic Games Short Track Speed Skating Medical Advisor
2022 베이징 동계올림픽 쇼트트랙 경기장 IOC technical delegation
2024 강원 Youth Winter Olympic Games Short Track Medical Advisor
2024 파리 하계 패럴림픽 대한민국 선수단 주치의

현재 소속 및 직위

SRC 재활병원장, 국제빙상연맹 (ISU) Medical Advisor, 대한장애인체육회 등급분류 위원장

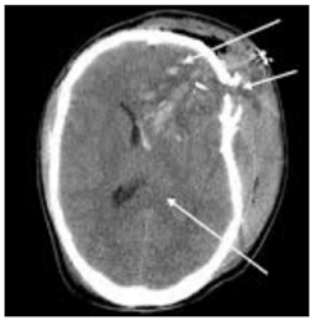
대표논문

1. Effects of Neuromuscular Training on the Rear-foot Angle Kinematics in Elite Women Field Hockey Players with Chronic Ankle Instability. Journal of Sports Science and Medicine. 2017
2. Effects of a 6-Week Neuromuscular Rehabilitation Program on Ankle-Evertor Strength and Postural Stability in Elite Women Field Hockey Players With Chronic Ankle Instability. Journal of Sport Rehabilitation, 2017
3. Ultrasonographic Cross-Sectional Area of Spinal Nerve Roots in Cervical Radiculopathy. American Journal of Physical Medicine and Rehabilitation, 2015

두부외상
Traumatic brain injury

SRC재활병원
김은국

Severe TBI in Sports?



Definition of Concussion

- A complex **pathophysiological** process affecting the **brain**
  - either by a **direct blow** to the head, face, neck,
    or with an 'impulsive' force **transmitted to the head**
  - rapid onset of **short-lived** impairment of neurologic function that resolves spontaneously
  - largely reflect a **functional** disturbance **rather than a structural** injury
    - no abnormality on standard structural neuroimaging studies
  - a **graded** set of clinical Sx that may or may **not involve LOC**
    - sequential **resolution** of Sx, but sometimes **prolonged**

Definition of Concussion

- **mild traumatic brain injury** and **concussion**
  - often used interchangeably, a subset of TBI
  - refer to **different injury** constructs in the **sporting** context
  - historical term
  - **low velocity injuries** that cause brain shaking
  - particularly with **repetitive occurrences**
  - may have **longer-term neuropsychological sequelae**

Epidemiology

- **Substantially underreported**
  - athletes' **lack of awareness** of Sx or **significance** of concussion
  - personal desire and **outside pressure** to continue playing
  - adverse professional and financial consequences
- American football, rugby, soccer, boxing, wrestling, basketball, field hockey…
- 1.6 ~ 3.8 **million** concussions per year in US
- Seasonal concussion rate of **15%** among US highschool footballers
  - may be as high as **30–45%**

Etiology and Risk factors

- Feature of sports-related concussion
  - lower-velocity impacts → **disorientation** > LOC
- Risk factors
  - **elite** sports > leisure activity
  - **games** > practice
  - **high school** athletes > university-level athletes
  - **female** > male

Dx of acute concussion

- Concussion is **evolving and rapidly changing**
- Dx, Mx and RTP decisions: **clinical judgment**
  - at present, there is **no perfect diagnostic test or marker**
- **A range of domains**
  - clinical sx: somatic (headache), cognitive (feeling like in a fog), emotional (lability)
  - physical signs: LOC, amnesia
  - cognitive impairment: slowed reaction times
  - neurobehavioral features: irritability
  - sleep disturbance: insomnia
- If **any one** or more of these components is present, a concussion should be **suspected**

Sideline evaluation

- **Challenging responsibility**
  - rapid assessment in the midst of competition
  - elusiveness and variability of presentation
  - athlete eager to play
  - reliance on symptoms
  - difficulty in making a timely diagnosis
  - specificity and sensitivity of sideline assessment tools

Sideline evaluation – Remember!!

- Assess athlete **responsiveness**, **airway**, **breathing**, and **circulation**
- Do **not attempt to move** an unconscious/unresponsive athlete (other than what is required for airway management) unless trained to do so
- Assessment for a **spinal injury** is a critical part of the initial **on-field evaluation - NOT attempt to assess the spine** unless trained to do so
- Do **not remove a helmet or any other equipment** unless trained to do so safely

Sideline evaluation

- When a player shows **ANY features of the concussion**
  - evaluated **onsite (1)**, and particular attention to exclude a **cervical spine injury**
  - safely removed from practice or play and need urgent referral to an **appropriate disposition**
  - **Then (2),** an assessment should be made using the **SCAT6**
  - the player should **NOT** be left **alone** following the injury
  - **serial monitoring (3)** for deterioration is essential over **the initial few hours**
  - **not** be allowed to return to play **on the day of injury**

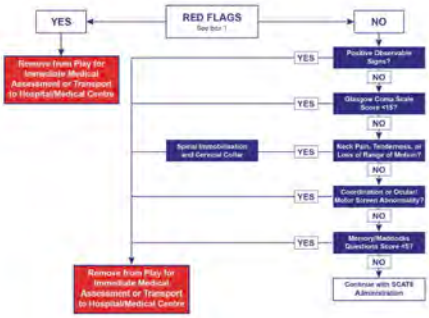
Sideline evaluation – red flag sign

- Activation of **emergency procedures and urgent transport** to the nearest hospital required

Box 1: Red Flags

- Neck pain or tenderness
- Seizure or convulsion
- Double vision
- Loss of consciousness
- Weakness or tingling/burning in more than 1 arm or in the legs
- Deteriorating conscious state
- Vomiting
- Severe or increasing headache
- Increasingly restless, agitated or combative
- GCS <15
- Visible deformity of the skull

Sideline evaluation



Sideline evaluation

Step 1: Observable Signs

Witnessed ☐ Observed on Video ☐

Lying motionless on playing surface	Y	N
Falling unprotected to the surface	Y	N
Balance/gait difficulties, motor incoordination, ataxia: stumbling, slow/laboured movements	Y	N
Disorientation or confusion, staring or limited responsiveness, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N
Impact seizure	Y	N
High-risk mechanism of injury (sport-dependent)	Y	N

Step 2: Glasgow Coma Scale

Typically, GCS is assessed once. Additional scoring columns are provided for monitoring over time, if needed.

Time of Assessment:

Date of Assessment:

Best Eye Response (E)			
No eye opening	1	1	1
Eye opening to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best Verbal Response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best Motor Response (V)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion/withdrawal to pain	4	4	4
Localised to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma Score (E + V + M)			

Sideline evaluation

Step 3: Cervical Spine Assessment

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed and spinal precautions taken.

Does the athlete report neck pain at rest?	Y	N
Is there tenderness to palpation?	Y	N
If NO neck pain and NO tenderness, does the athlete have a full range of ACTIVE, pain free movement?	Y	N
Are limb strength and sensation normal?	Y	N

Step 4: Coordination & Ocular/Motor Screen

Coordination: Is finger-to-nose normal for both hands with eyes open and closed?	Y	N
Ocular/Motor: Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Are observed extraocular eye movements normal? If not, describe:	Y	N

Sideline evaluation

Step 5: Memory Assessment Maddocks Questions[1]

Say *"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"*

Modified Maddocks questions (Modified appropriately for each sport: 1 point for each correct answer)

What venue are we at today?	0	1
Which half is it now?	0	1
Who scored last in this match?	0	1
What team did you play last week/game?	0	1
Did your team win the last game?	0	1
Maddocks Score		/5

Note: Appropriate sport-specific questions may be substituted

Sideline evaluation - Off Field

- Evaluation of **cognitive function** is essential
  - attention and memory function
    - but, cognitive deficit is **not** necessary for acute Dx
  - standard orientation questions (eg, time, place, person) is **unreliable** in the sporting situation
  - **not** replace comprehensive neuropsychological testing
    - subtle deficits may exist **beyond the acute episode**
    - for rapid screening, not a standard tool

Concussion Management

- **No specific medical therapies** for concussion
  - **hydration** and the temporary use of **mild analgesics**
- Physical and cognitive rest until the acute Sx resolve
- Cognitive rest
  - avoidance of scholastic work, videogames, computing, **text messaging, SNS..**
- No return to play **on the day of concussive injury**
  - **delayed onset of symptoms**, esp. NP deficits may not be evident on the sidelines

Injury Prevention

- **Protective equipment**: mouthguards and helmets
  - reduction in impact forces to the brain: prevent head/face injury
  - **no reduction** in concussion incidence
  - ➔no evidence that protective equipment will prevent concussion
  - Helmets-evidence for risk reduction in skiing/snowboarding
  - **risk compensation**: more dangerous play and paradoxical increase
- Rule change: effective, but??
- **Neck strength increase**??
- **Knowledge transfer**

황 건

학력

1977.03-1983.02 서울대학교 의과대학 학사
1987.03-1989.02 서울대학교 의과대학 의학석사(해부학)
1989.03-1992.02 서울대학교 의과대학 의학박사(해부학)

현재 소속 및 직위

국군수도병원 성형외과
전문임기제 가급

주요경력

1986.05-1986.02	서울대학교병원 인턴
1987.03-1991.02	서울대학교병원 성형외과 레지던트
1993.03-1997.02	인하대병원 성형외과 조교수
1997,03-2002.02	인하대병원 성형외과 부교수, 한국과학재단 Post-doc fellow
1997.03-1998.02	Oregon Health Science University Visiting Scholar
2008.03-2015.02	인하대병원 성형외과 과장
2011.03-2023.02	인하대병원 성형외과 펠로우교수
2023.02-현재	국군수도병원 성형외과 전문임기제 가급
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2000.12-현재	노인의학 분과전문의
2005.06-현재	수부외과 세부전문의
2014.01-현재	외상외과 세부전문의
2015.01-현재	대한민국 의학한림원 정회원
2020.12-2021.11	대한두개안면학회 회장
2021.01-2021.12	대한외상학회 회장
2003.12	서울대학교 의과대학 함춘의학상 수상
2018.04	과학기술훈장 진보장 수훈
2020.12	제1회 대한해부학회 학술상
2023.12	국군수도병원 최다 SCI 논문 실적 표창장

연구분야 및 연구실적

주로 성형외과 영역에서 필요한 수술해부학에 대한 논문들을 SCIE 등재학술지에 제1저자나 교신저자로서 500편 이상 발표하였으며, Researchgate에서 6,726회 인용되었음(2025년 9월 기준). 국군수도병원에서 2024년에만 32편의 논문을 썼음. 이외에도 의학용어 정리작업에 앞장서서 2006년 의학용어위원장으로서 대한의사협회 발행 필수 의학용어집을 발간하는 등 이러한 공로를 인정받아 2018년 과학기술훈장 진보장을 수훈하였음.

안면부 외상
Facial injury

국군수도병원
황 건

- To review the epidemiology, diagnostic heuristics, and field management of sports-related facial injuries for sideline physicians.

Purpose

- Facial injuries: 3-29% of sports injuries
- Sports injuries: 11.3-42.1% of facial fractures

Epidemiology

- Nasal bone fractures: most common in all sports (40-60.5%)
- Mandibular fractures: martial arts (33.3%), soccer (11.1%)
- Orbital bone fractures: basketball (20.0%), ice sports (18.2%)
- Zygoma fractures: martial arts (13.3%), soccer (10.0%)

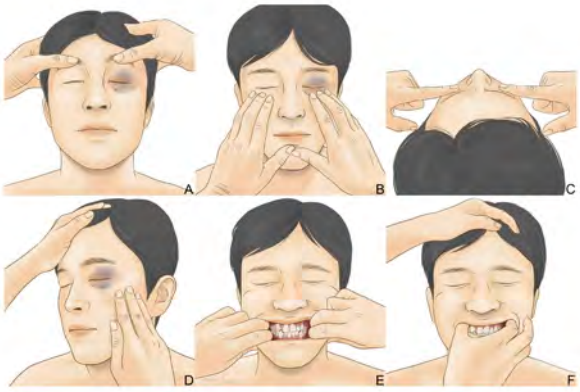
Epidemiology

Table 1. Epidemiology of sports related orbital, nasal bone fracture

Author	Year	Fracture		Cause	N	%
Hwang	2009	Orbit		Trauma	225	57.6
				Traffic accident	61	15.6
				Sports	42	10.7
				Slip or fall down	34	8.7
				Work related	23	5.9
				Other	6	1.5
				Total	391	100.0
Hwang	2017	Nasal bone	Adult	Fight	1977	36.3
				Traffic accident	1130	20.8
				Sports	830	15.3
				Fall	728	13.4
				Intended injury	132	2.4
				Work-related	127	2.3
				Collision	98	1.8
				Other	419	7.7
				Total	5441	100.0
			Children	Sports	71	59.3
				Other	16	13.3
				Fight	13	10.8
				Traffic accident	10	8.3
				Collision	6	5.0
				Fall	4	3.3
				Total	120	100.0

- Facial lacerations may injure:
  - nerves (facial and trigeminal)
  - salivary ducts (parotid or submandibular)
  - lacrimal apparatus
- Facial fractures are inspected by:
  - palpating the bony prominences bilaterally

Diagnosis

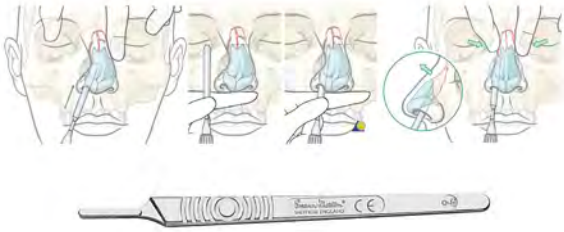


- If the player does not have to return to the court:
  - wound should be cleansed
  - surgical adhesives can be applied in the field
- If return to play is an issue:
  - sutures are recommended rather than surgical adhesives

Management of simple laceration

- Involving a gross deformity:
  - immediate closed reduction may not be necessary unless airway competency is compromised
- Severe cases:
  - immediately by closed reduction should be evaluated by a trained plastic surgeon

Management of nasal bone fractures



- In sports, facial injuries are prone to be missed, but their importance should not be neglected.
- Sideline physicians should be aware of the relatively high frequency of facial injuries, including facial bone fractures.
- They should have the knowledge needed to manage these injuries, and must prepare emergency management kits.

Conclusion

김호중

학력

조선대학교 의학과 박사

연세대학교 일반대학원 의학과 석사

연세대학교 일반대학원 의학과 박사

주요 경력

평창동계올림픽 아이스하키 CMO

항저우아시안게임 선수촌 의사

국제 태권도, 탁구, 유도 등 CMO

현재 소속 및 직위

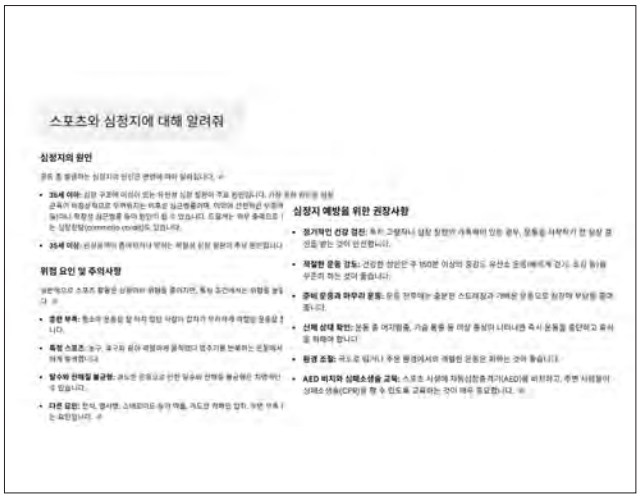
순천향의대 부천병원 응급의학과 교수

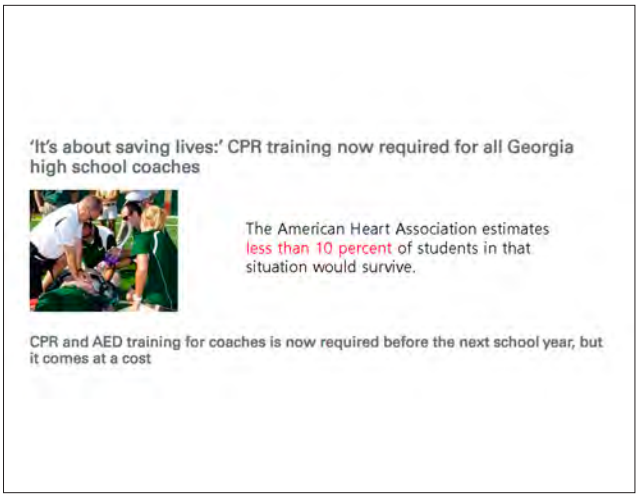
대한체육회 의무의원

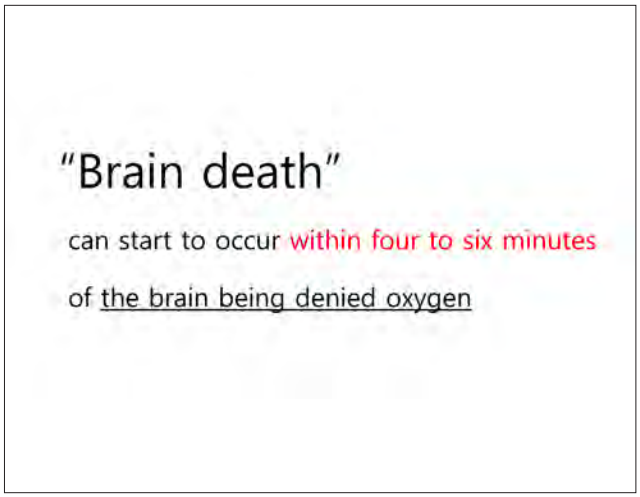
대한스포츠의학회 SAT 부회장

심장 콜랩스
Cardiac collapse

순천향대 부천병원
김호중







Do Sports Teams Need Defibrillators?

According to the British Heart Foundation, every year in the UK around 60,000 people suffer a cardiac arrest ou hospital. Withou immediate treatr survival rate can low as a few perc However, if a def is used right awa chances of survi become much be The UK Resuscit Council's guidelir the use of autom external defibrilla state.

What does this have to do with sports first aid?

이게 스포츠 응급처치와 무슨 상관이 있나요?

It is not a stupid question. After all, heart conditions tend to afflict older people and the demographic for sportspeople is generally quite young. However, remember that the strenuous physical activity involved in sport does place a strain on the heart. While for most healthy people this is not a problem, a small number of sportspeople will have an undiagnosed heart condition of which they remain unaware until something happens. In fact, apart from direct injuries incurred during play, the most common cause of death in young sportspeople is some kind of cardiac event. In many of these cases, early defibrillation would have saved their lives.

Cleveland Clinic

Athlete's Heart

- Athlete athletes
- Athlete change when y

Hypertrophic cardiomyopathy

- Can cause sudden cardiac death in athletes.
- The amount of space inside of your left ventricle gets smaller.
- Left ventricle wall is thicker than in people with athlete's heart.

Athlete's heart

- Doesn't cause sudden cardiac death in athletes.

's Heart

When should I go to the ER?

You should call 911 if you think you may be having a heart attack. You should also call 911 if you see someone collapse and not respond.

Regular Practice

Nurs

The immense importance of this point cannot be overstated. Regular practice of CPR techniques helps ingrain these skills, making them readily accessible tools when the need arises.

Factors of ca resuscitatior healthcare p review

Aminuddin Jurdi, * †, Siti Noo

Incorporating Refresher Courses

Consistent scheduling of refresher courses can serve as a platform for enhancing skills and knowledge learned during initial CPR training.

Simulated Emergency Scenarios

The simulation of real-life emergency situations can be an effective tool for instilling CPR skills. The pressure and unpredictability of these scenarios will embed the procedures deeper into the cognitive framework.

Peer Learning and Assessment

Encouraging a culture of peer learning can stimulate the sharing of knowledge and experiences, strengthening the retention of CPR skills. Regular peer assessments can further verify that each professional is enhancing their skill level.

Innovative Training Tools

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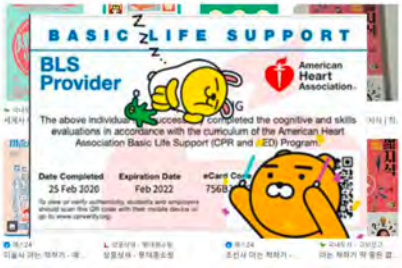
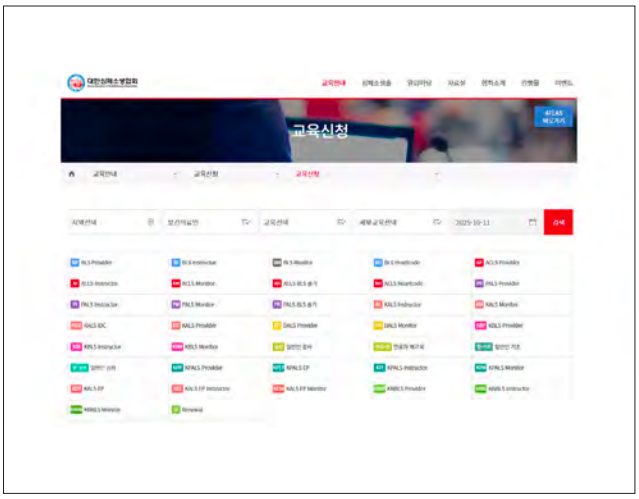


대한스포츠의학회
The Korean Society of Sports Medicine

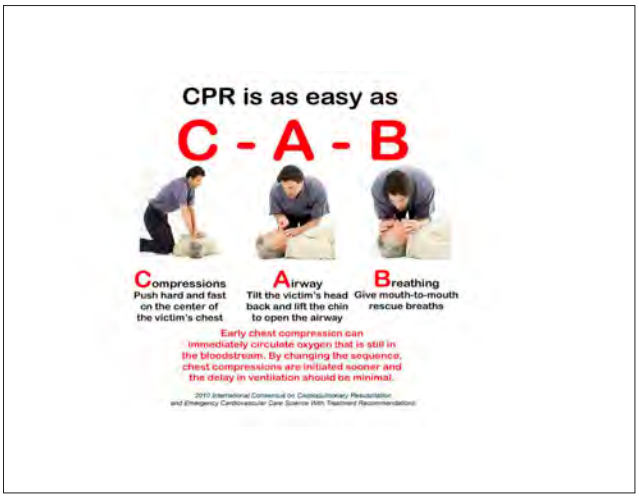
- 워크숍 세션

신청 일자	신청 장소	세션명	인원	등록비
18일(토)	강마홀	초음파 실습 Hand on session 1: 견관절 및 주관절	30명	30,000원
		초음파 실습 Hand on session 2: 슬관절 및 앱스트링		
		초음파 실습 Hand on session 3: 족부족관절		
19일(일)	강마홀	스마트폰 IMU 및 AI 기반 운동 모니터링 실습	30명	20,000원
19일(일)	모아홀	심폐소생 응급처치(CRP) I	20명	20,000원
		심폐소생 응급처치(CRP) II		
19일(일)	모아홀	테이핑의 실제적용	30명	20,000원

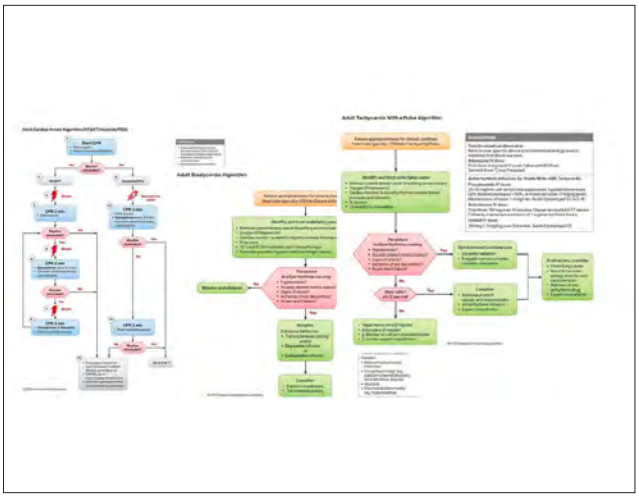
* 마감되지 않은 세션의 현장 등록이 가능 할 수 있으며, 가능 여부는 학술대회 당일, 등록 데스크로 문의 바랍니다.


교육신청


Chain of Survival 소생의 고리


CPR is as easy as
C - A - B
Compressions
Push hard and fast on the center of the victim's chest
Airway
Tilt the victim's head back and lift the chin to open the airway
Breathing
Give mouth-to-mouth rescue breaths
Early chest compression can immediately circulate oxygen that is still in the bloodstream. By changing the sequence, chest compressions are initiated sooner and the delay in ventilation should be minimal.


High-Quality CPR
Chest compression fraction >80%
Compression rate of 100-120/min
Compression depth of > 5 cm (adults)
> 1/3 chest AP (children)
Avoid excessive ventilation
Allow complete chest recoil between compressions




전기 충격기 (AED)

Equipement and Knowledge

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 3: 스쿼시, 부상 없는 미래를 꿈꾸다
Squash: Dreaming of an Injury-Free Future

좌장: 솔병원 나영무, 순천향대부천병원 이영구

유중진

학력

한양대학교 의학과 학사

IOC diploma in sports medicine

IOC Drugs in sports certification

FIFA Diploma in Football Medicine

주요 경력

2018~2020 대한민국 국가대표 진천천수촌 CM병원

2017~2020 대한민국농구협회 남자 성인 국가대표팀 팀닥터

2021.1~11 CM 병원 정형외과

2022 제 19회 항저우 아시아경기대회 국가대표 선수단 주치의

도핑예방 의료보건 전문가(한국도핑방지위원회)

현 대한체육회 의무위원

현 대한민국 농구협회 의무위원회 의무위원

현 대한민국 컬링협회 의무위원회 의무위원

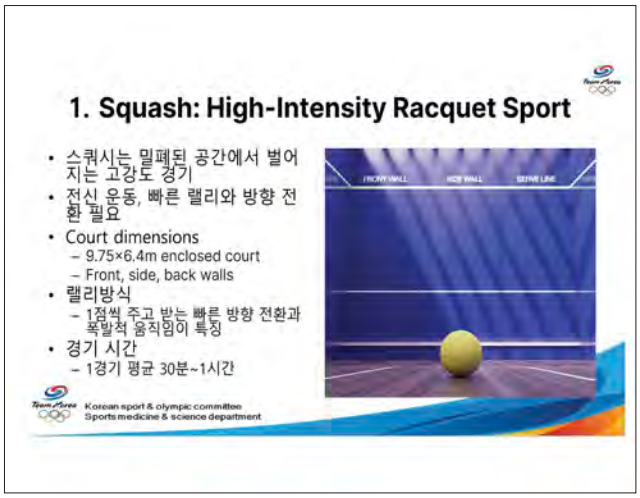
현 대한민국 라크로스연맹 의무위원회 의무위원

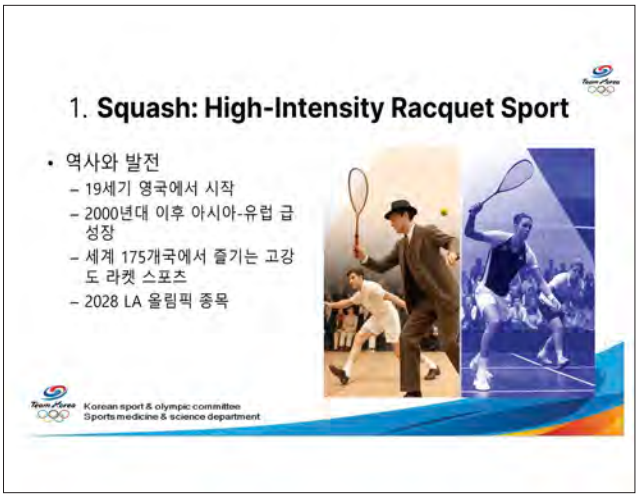
현재 소속 및 직위

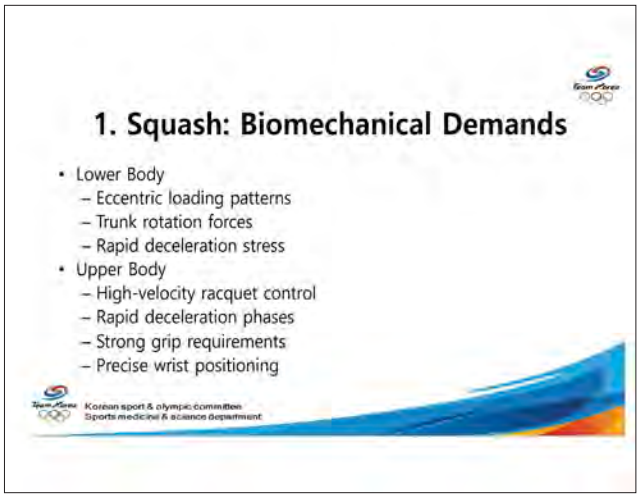
2021.11 ~ 현재 대한체육회 진천선수촌 부속의원 정형외과

스쿼시에서의 상지의 부상:
“라켓을 휘두르는 팔, 혹사 당하는 어깨와 팔꿈치”
Upper limb injuries in squash: ‘The racket-swinging arm, overworked shoulders and elbows’

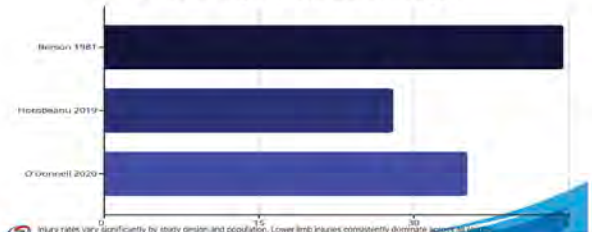
진천국가대표선수촌 메디컬센터
유중진







2. Squash
- Overall injury Epidemiology -



Injury rates vary significantly by study design and population. Lower limb injuries consistently dominate across studies.

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2. Overall Injury Frequency in Squash
-Key Studies-

Study (Year)	Design	Injury Rate	Key Findings
Berson et al., 1981	Survey + Medical Records	44.5% seasonal	Lower limb > Upper limb
Chard & Lachmann, 1987	Clinic Attendance	Acute trauma predominant	Knee/lumbar/muscle/ankle
Horobeanu et al., 2019	6-year cohort	7.28/1000h training	Time-loss injuries in juniors
O'Donnell et al., 2020	Retrospective surveillance	Elite competition data	Lower limb 76%, Upper limb 16%

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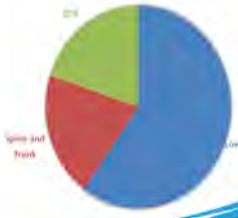
2. Injury Frequency in Squash
- Body part -

- Lower limb: 60%
- Spine and Trunk: 20%
- Upper limb: 20%



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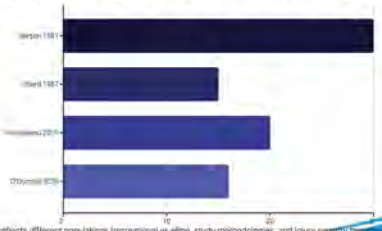
2. Injury Frequency in Squash
-Upper Limb Injury Distribution by Study-



Variation reflects different populations (recreational vs elite), study methodologies, and injury severity.

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2. Injury Frequency in Squash
-Study-by-Study Upper Limb Analysis-

Study	UL %	Primary Site	Key Diagnoses
Berson 1981	~30%	Wrist/Elbow	Contusions, sprains, tendinopathy
Chard 1987	Minor	Lateral epicondyle	Grip/repetitive extension
Horobeanu 2019	~20%	Shoulder/Elbow	Overuse + growth-related
O'Donnell 2020	~16%	Shoulder/Elbow	Impingement, lateral epicondylitis

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2. Injury Frequency in Squash
-Upper Limb Injury Distribution-

Shoulder Complex
Impingement, rotator cuff pathology

Elbow Region
Lateral epicondylitis predominant

Wrist/Hand
Tendinopathies, TFCC injuries

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3. Detailed review of upper limb injuries
-Injury Mechanism of Shoulder -
1. Repetitive Overhead Motion
– Subacromial impingement risk
– Posterior-medial impingement
2. Deceleration Stress
– Rotator cuff eccentric loading
– Posterior inferior capsule strain
3. Scapular dysfunction
– Humeral head superior migration
– Altered movement patterns
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3. Detailed review of upper limb injuries
-Pathology Spectrum of Shoulder -
• Rotator cuff
– Tendinopathy, partial tears
– Eccentric Overload during deceleration
• Impinegment Syndromes
– Subacroimal compression
– Posterior-medial impingement
• Labral pathology
– SLAP lesions
– Capsular instability patterns
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3. Detailed review of upper limb injuries
-Injury Mechanism of Elbow -
• Lateral epicondylitis
– Repetotove wrist patterns
– Padial deviation patterns
– Supination stress
– Strong grip requirements
• Contributing Factors
– Raquat vibration transmission
– Backhand deceleration forces
– Equipment specifications
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3. Detailed review of upper limb injuries
-Pathology Spectrum of Wrist and Hand -
• Tendinopathies
– FCR, FCU, ECU involvement
– De Quervain;s tenosynovitis
• TFCC injuries
– Ulnocarpal instability
– High-torque loading patterns
• Overuse Patterns
– Fixed wrist angle repetition
– Racquet head control demands
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4. Prevention Strategies: Shoulder
• Mobility enhancement
– Thoracic spine and scapular mobility
– Posterior capsule flexibility
• Strength balance
– External-internal rotation ratio correction
– Spapular stabilizer strengthening
• Deceleration Training
– Eccentric external rotation exercises
– Progressive loading protocols
• Technical Coaching
– Minimize excessive wrist extension
– Reduce shoulder impingement positioning
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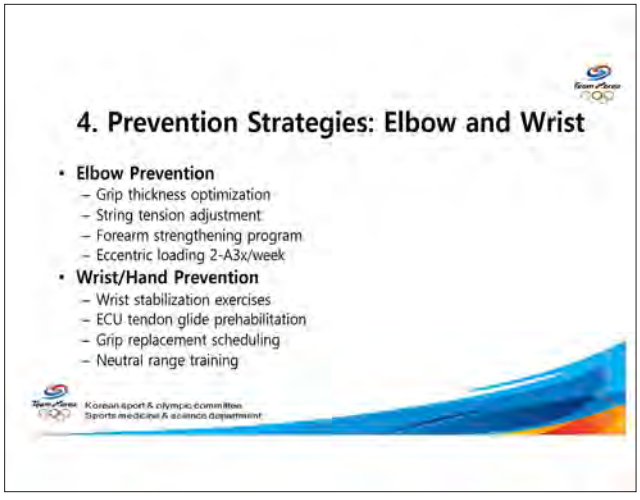
4. Prevention Strategies: Elbow and Wrist
• Elbow Prevention
– Grip thickness optimization
– String tension adjustment
– Forearm strengthening program
– Eccentric loading 2-A3x/week
• Wrist/Hand Prevention
– Wrist stabilization exercises
– ECU tendon glide prehabilitation
– Grip replacement scheduling
– Neutral range training
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Reference

- Finch & Eime, Int J Sports Med. 2000
- Berson, Br J Sports Med. 1981
- Goh et al., BMJ Open SEM. 2020
- Musa et al., S Afr J Sports Med. 2016
- Okhovatian et al., Pak J Med Sci. 2009
- Abdullah et al., Asian J Sports Med. 2015
- 김언호 외, 한국체육학회지, 2019

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Thank you for your attention

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이 준

학력

전북대학교

주요 경력

프로축구 K리그 제주SK 주치의

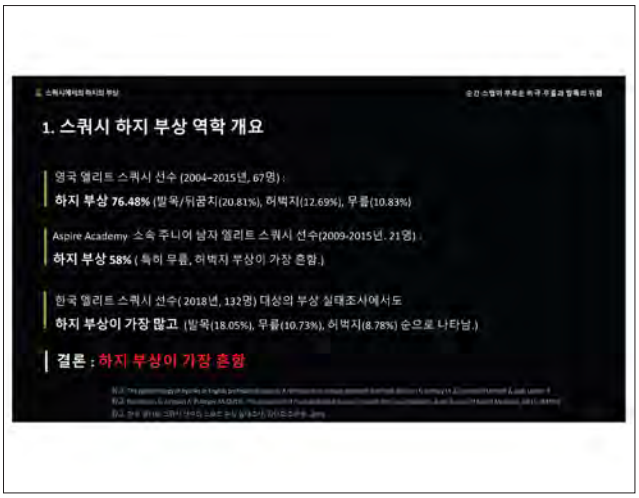
2024 강원동계청소년올림픽 venue doctor

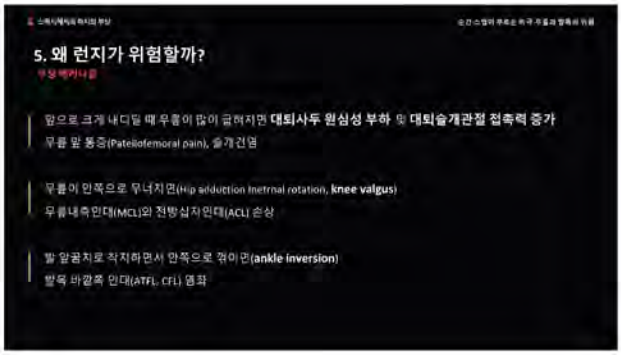
현재 소속 및 직위

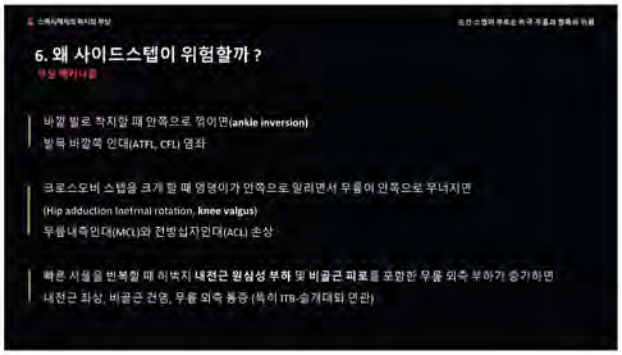
국가대표정형외과

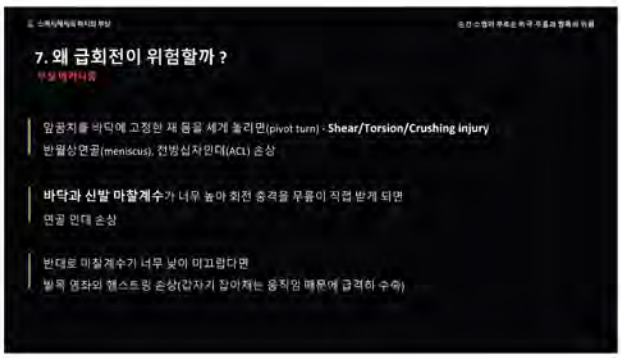
스쿼시에서의 하지의 부상:
“순간 스텝이 부르는 비극- 무릎과 발목의 위험”
Lower Limb Injuries in Squash: ‘The Tragedy of Instantaneous Steps – The Perils to Knees and Ankles’

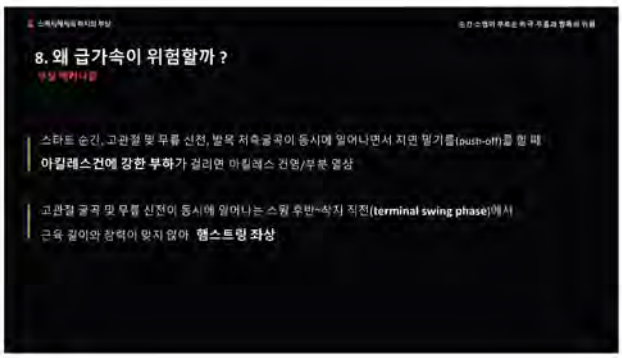
국가대표정형외과
이 준

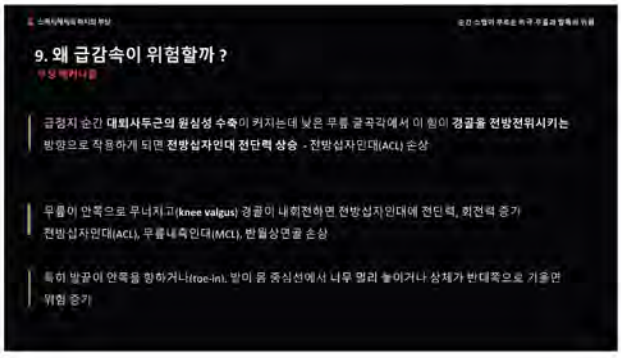


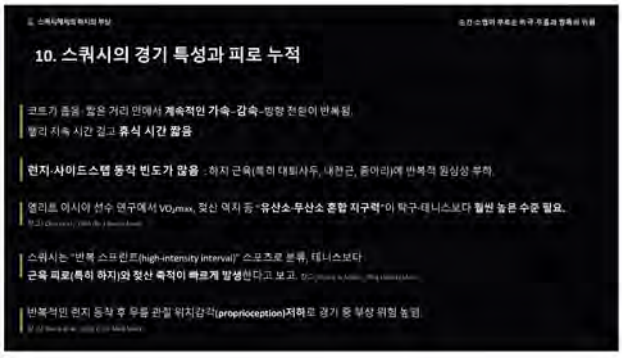

5. 왜 런지가 위험할까?
앞으로 크게 내디딜 때 무릎이 많이 굽혀지면 대퇴사두 원심성 부하 및 대퇴슬개관절 접촉력 증가
무릎 앞 통증(Patellofemoral pain), 슬개건염
무릎이 안쪽으로 무너지면(Hip adduction Inetrnal rotation, knee valgus)
무릎내측인대(MCL)와 전방십자인대(ACL) 손상
발 앞굼치로 착지하면서 안쪽으로 꺾이면(ankle inversion)
발목 바깥쪽 인대(ATFL, CFL) 염좌


6. 왜 사이드스텝이 위험할까 ?
바깥 발로 착지할 때 안쪽으로 꺾이면(ankle inversion)
발목 바깥쪽 인대(ATFL, CFL) 염좌
크로스오버 스텝을 크게 할 때 엉덩이가 안쪽으로 말리면서 무릎이 안쪽으로 무너지면
(Hip adduction Inetrnal rotation, knee valgus)
무릎내측인대(MCL)와 전방십자인대(ACL) 손상
빠른 서클을 반복할 때 허벅지 내전근 원심성 부하 및 비골근 피로를 포함한 무릎 외측 부하가 증가하면
내전근 좌상, 비골근 건염, 무릎 외측 통증 (특히 ITB-슬개대퇴 연관)

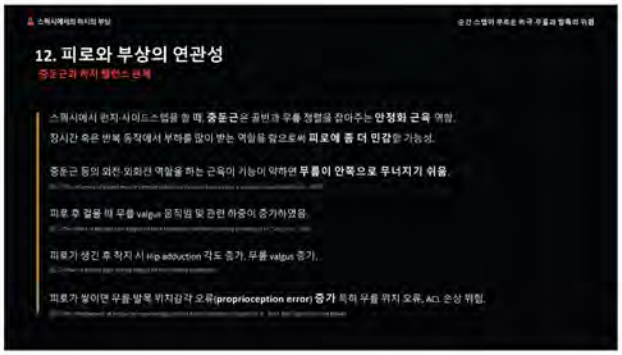

7. 왜 급회전이 위험할까 ?
앞굼치를 바닥에 고정한 채 몸을 세게 돌리면(pivot turn) - Shear/Torsion/Crushing injury
반월상연골(meniscus), 전방십자인대(ACL) 손상
바닥과 신발 마찰계수가 너무 높아 회전 충격을 무릎이 직접 받게 되면
연골 인대 손상
반대로 마찰계수가 너무 낮아 미끄럽다면
발목 염좌와 햄스트링 손상(갑자기 잡아채는 움직임 때문에 급격히 수축)

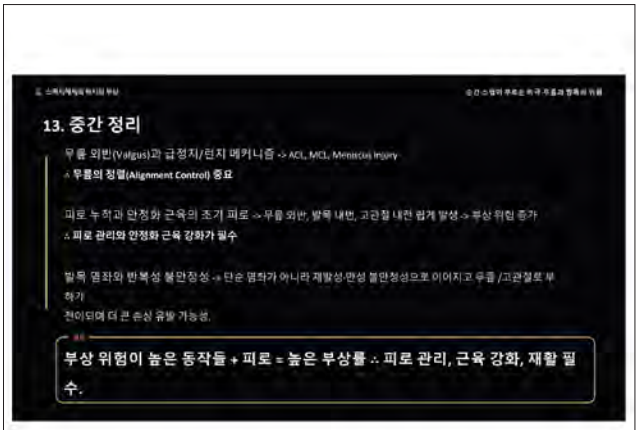

8. 왜 급가속이 위험할까 ?
스타트 순간, 고관절 및 무릎 신전, 발목 저측굴곡이 동시에 일어나면서 지면 밀기를(push-off)를 할 때
아킬레스건에 강한 부하가 걸리면 아킬레스 건염/부분 염상
고관절 굴곡 및 무릎 신전이 동시에 일어나는 스윙 후반~착지 직전(terminal swing phase)에서
근육 길이와 장력이 맞지 않아 햄스트링 좌상

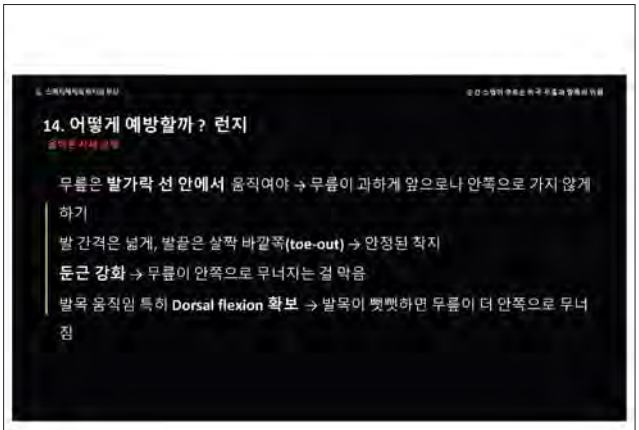

9. 왜 급감속이 위험할까 ?
급정지 순간 대퇴사두근의 원심성 수축이 커지는데 낮은 무릎 굴곡각에서 이 힘이 경골을 전방전위시키는
방향으로 작용하게 되면 전방십자인대 전단력 상승 - 전방십자인대(ACL) 손상
무릎이 안쪽으로 무너지고(knee valgus) 경골이 내회전하면 전방십자인대에 전단력, 회전력 증가
전방십자인대(ACL), 무릎내측인대(MCL), 반월상연골 손상
특히 발끝이 안쪽을 향하거나(toe-in), 발이 몸 중심선에서 너무 멀리 놓이거나 상체가 반대쪽으로 기울면
위험 증가

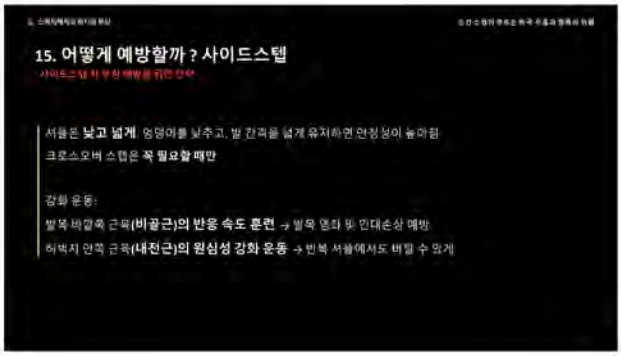

10. 스쿼시의 경기 특성과 피로 누적
코트가 좁을 : 짧은 거리 안에서 계속적인 가속-감속-방향 전환이 반복됨.
랠리 지속 시간 길고 휴식 시간 짧음
현지 사이드스텝 동작 빈도가 많음 : 하지 근육(특히 대퇴사두, 내전근, 종아리)에 반복적 원심성 부하.
엘리트 이시아 선수 연구에서 VO2max, 젖산 역치 등 "유산소-무산소 혼합 지구력"이 탁구·테니스보다 훨씬 높은 수준 필요.
스쿼시는 "반복 스프린트(high-intensity interval)" 스포츠로 분류, 테니스보다
근육 피로(특히 하지)와 젖산 축적이 빠르게 발생한다고 보고.
반복적인 런지 동작 후 무릎 관절 위치감각(proprioception)저하로 경기 중 부상 위험 높음.


11. 스쿼시의 경기 특성과 피로 누적
테니스
활동:휴식 비율 1:3 (운동 10초 → 휴식 30초)
넓은 코트, 포인트 간 휴식 20-25초
배드민턴
활동:휴식 비율 1:2
템포 조절 가능, 셔틀콕 교체로 짧은 휴식
스쿼시
활동:휴식 비율 1:1~2:1
휴식보다 운동 시간이 길거나 비슷
포인트 간 휴식 10-15초 (테니스의 절반)
활동:휴식 비율 비교
결론: 짧고 강한 인터벌이 쉴 틈 없이 이어지고 회복 시간이 짧음.


12. 피로와 부상의 연관성
스쿼시에서 런지·사이드스텝을 할 때, 중둔근은 골반과 무릎 정렬을 잡아주는 안정화 근육 역할.
장시간 혹은 반복 동작에서 부하를 많이 받는 역할을 함으로써 피로에 좀 더 민감할 가능성.
중둔근 등의 외전·외회전 역할을 하는 근육이 기능이 약하면 무릎이 안쪽으로 무너지기 쉬움.
피로 후 걸을 때 무릎 valgus 움직임 및 관련 하중이 증가하였음.
피로가 생긴 후 착지 시 Hip adduction 각도 증가, 무릎 valgus 증가.
피로가 쌓이면 무릎·발목 위치감각 오류(proprioception error) 증가 특히 무릎 위치 오류, ACL 손상 위험.

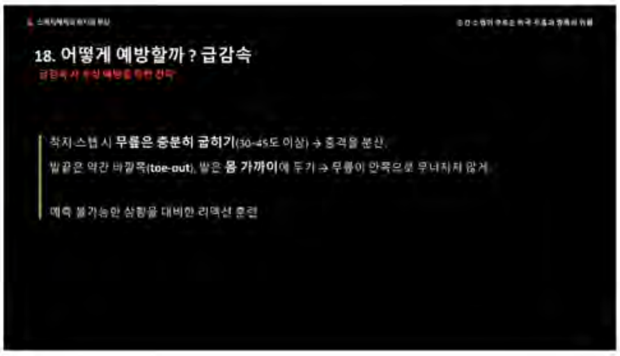

13. 중간 정리
무릎 외반(Valgus)과 급정지/런지 메커니즘 -> ACL, MCL, Meniscus Injury
∴ 무릎의 정렬(Alignment Control) 중요
피로 누적과 안정화 근육의 조기 피로 -> 무릎 외반, 발목 내번, 고관절 내전 쉽게 발생 -> 부상 위험 증가
∴ 피로 관리와 안정화 근육 강화가 필수
발목 염좌와 반복성 불안정성 -> 단순 염좌가 아니라 재발성·만성 불안정성으로 이어지고 무릎/고관절로 부하가
전이되며 더 큰 손상 유발 가능성.
부상 위험이 높은 동작들 + 피로 = 높은 부상률 ∴ 피로 관리, 근육 강화, 재활 필수.

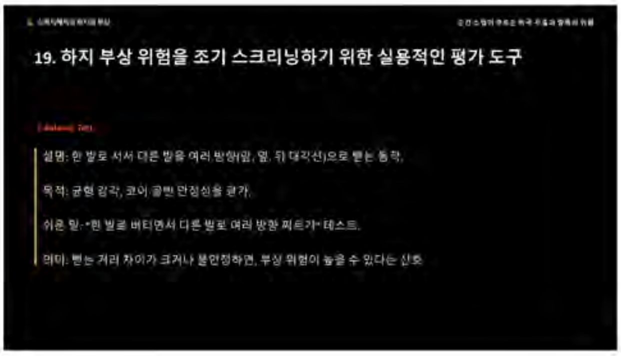

14. 어떻게 예방할까 ? 런지
무릎은 발가락 선 안에서 움직여야 → 무릎이 과하게 앞으로나 안쪽으로 가지 않게 하기
발 간격은 넓게, 발끝은 살짝 바깥쪽(toe-out) → 안정된 착지
둔근 강화 → 무릎이 안쪽으로 무너지는 걸 막음
발목 움직임 특히 Dorsal flexion 확보 → 발목이 뻣뻣하면 무릎이 더 안쪽으로 무너짐

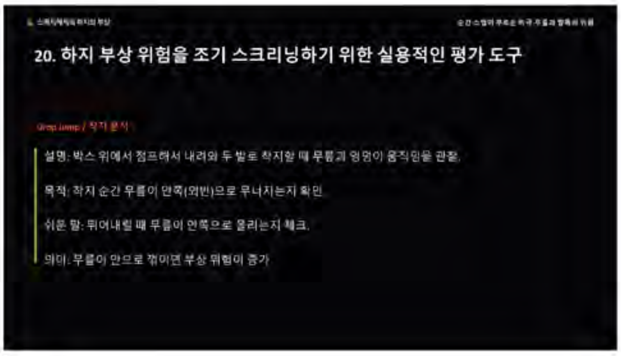

15. 어떻게 예방할까 ? 사이드스텝
서둘은 낮고 넓게: 엉덩이를 낮추고, 발 간격을 넓게 유지하면 안정성이 높아짐
크로스오버 스텝은 꼭 필요할 때만
강화 운동:
발목 바깥쪽 근육(비골근)의 반응 속도 훈련 → 발목 염좌 및 만대손상 예방
허벅지 안쪽 근육(내전근)의 원심성 강화 운동 → 빈복 서동에서도 버틸 수 있게

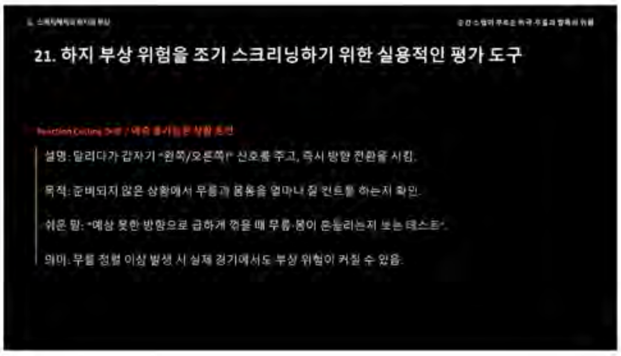

16. 어떻게 예방할까 ? 급회전
발·지면 마찰 관리 : 코트 청결·논미킹 아웃솔 마모도 체크
회전은 발꿈치 들고 전족부로 '가볍게'—고정된 발에서 큰 체간 회전 금지


17. 어떻게 예방할까 ? 급가속
동작 교정: 첫 2-3보는 짧고 빠르게, 발끝은 중립~약간 toe-out
과도한 긴 보폭/내전(adduction) 회피
근력 강화
햄스트링 원심성 강화
내전근 강화
아킬레스건 지구력

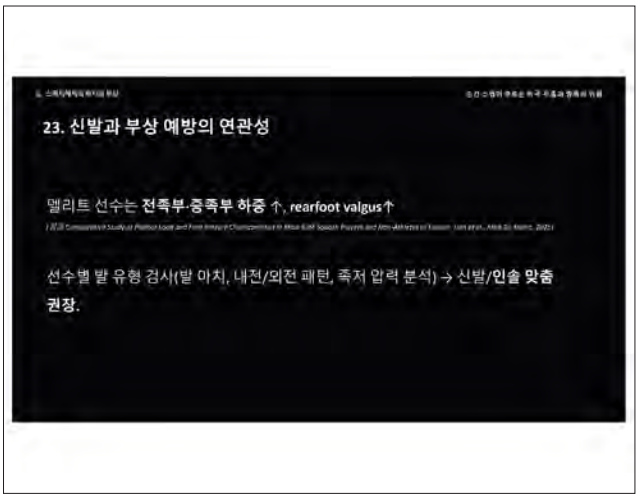

18. 어떻게 예방할까 ? 급감속
착지·스텝 시 무릎은 충분히 굽히기(30-45도 이상) → 충격을 분산.
발끝은 약간 바깥쪽(toe-out), 발은 몸 가까이에 두기 → 무릎이 안쪽으로 무너지지 않게.
예측 불가능한 상황을 대비한 리액션 훈련


19. 하지 부상 위험을 조기 스크리닝하기 위한 실용적인 평가 도구
설명: 한 발로 서서 다른 발을 여러 방향(앞, 옆, 뒤 대각선)으로 뻗는 동작.
목적: 균형 감각, 코어·골반 안정성을 평가.
쉬운 말: "한 발로 버티면서 다른 발로 여러 방향 찌르기" 테스트.
의미: 뻗는 거리 차이가 크거나 불안정하면, 부상 위험이 높을 수 있다는 신호


20. 하지 부상 위험을 조기 스크리닝하기 위한 실용적인 평가 도구
Drop Jump / 착지 분석
설명: 박스 위에서 점프해서 내려와 두 발로 착지할 때 무릎과 엉덩이 움직임을 관찰.
목적: 착지 순간 무릎이 안쪽(외반)으로 무너지는지 확인.
쉬운 말: 뛰어내릴 때 무릎이 안쪽으로 몰리는지 체크.
의미: 무릎이 안으로 꺾이면 부상 위험이 증가


21. 하지 부상 위험을 조기 스크리닝하기 위한 실용적인 평가 도구
설명: 달리다가 갑자기 "왼쪽/오른쪽!" 신호를 주고, 즉시 방향 전환을 시킴.
목적: 준비되지 않은 상황에서 무릎과 몸통을 얼마나 잘 컨트롤 하는지 확인.
쉬운 말: "예상 못한 방향으로 급하게 꺾을 때 무릎·몸이 흔들리는지 보는 테스트".
의미: 무릎 정렬 이상 발생 시 실제 경기에서도 부상 위험이 커질 수 있음.


22. 신발과 부상 예방의 연관성
스쿼시 신발의 주요 특징
논마킹(non-marking) 고무 아웃솔
낮은 프로파일(low-to-the-ground)
측면 안정성(side support) 강화
중창(midsole)의 충격흡수 기능
가벼움(lightweight)


23. 신발과 부상 예방의 연관성
멜리트 선수는 전족부·중족부 하중 ↑, rearfoot valgus ↑
선수별 발 유형 검사(발 아치, 내전/외전 패턴, 족저 압력 분석) → 신발/인솔 맞춤 권장.


TAKE HOME MESSAGE.
하지 부상이 가장 흔함 대부분 Non-contact injury.
다른 라켓스포츠와 비교시 스쿼시의 부상 발생률이 상대적으로 높음.
경기 시간 대부분 런지, 사이드스텝, 급회전, 급가속·감속·방향 전환
피로도가 높음: 짧고 강한 인터벌이 실 등 많이 이어지고 회복 시간이 짧음
무릎의 정렬(Alignment Control) 중요
파로 관리와 중둔근 등 안정화 근육 강화가 필수
발 각도은 넓게, 압끝은 살짝 바깥쪽(toe-out)
과지 부상 위험 조기 스크리닝 및 발 유형 검사에 따른 신발/인솔 맞춤 권장


[스쿼시에서의 하지 부상]
순간 스텝이 부르는 비극
무릎과 발목의 위험
국가대표정형외과 이준
감사합니다.

김세용

학력

동남보건대학교 물리치료과 전문학사

용인대학교 물리치료학과 학사

용인대학교 재활복지대학원 물리치료학과 석사 과정

IOC Diploma in Sports Physical Therapies

주요 경력

2025 라인-루르 하계세계대학경기대회 본부임원 (의무)

2024 파리 하계올림픽 사전훈련캠프 본부임원 (의무)

2023 항저우 아시안게임 본부임원 (의무)

2020 서울체육중학교 부상예방 강사

2019 배드민턴 전영오픈, 스위스오픈 의무지원

현재 소속 및 직위

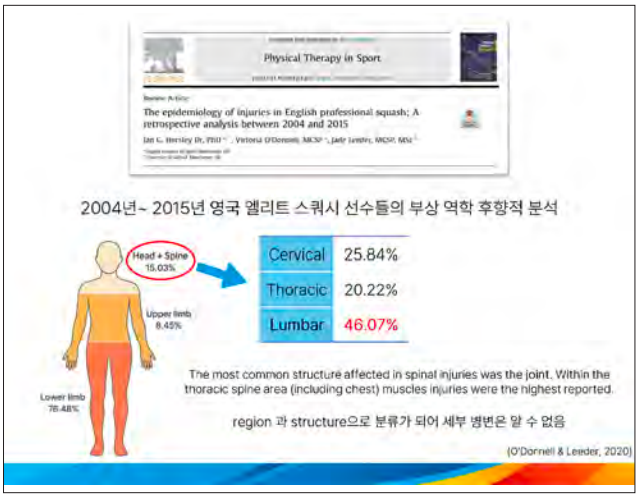
대한체육회 메디컬센터 주무

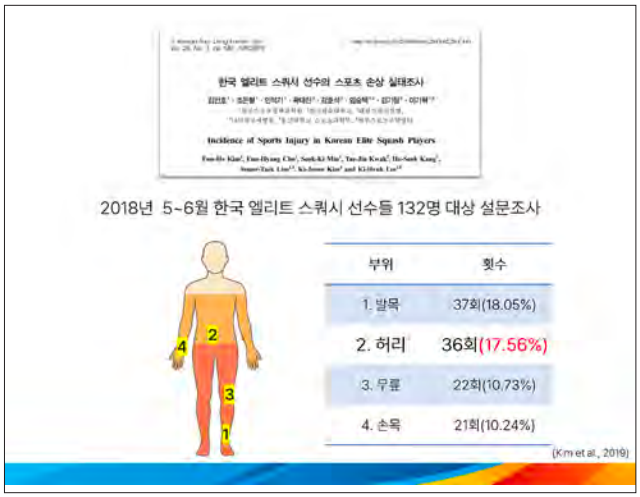
대표논문

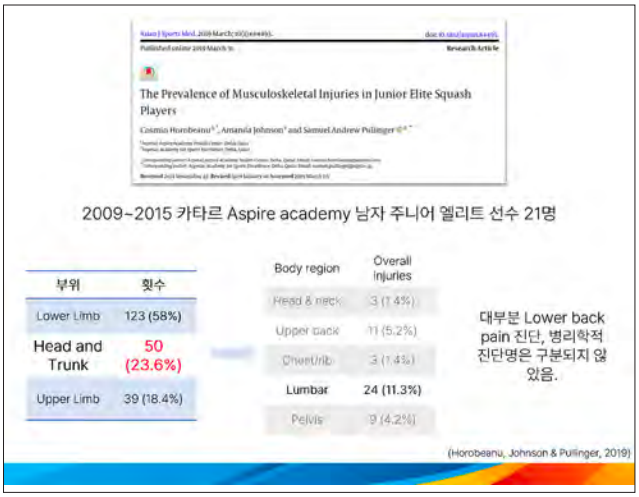
Junghyun Bae, Sukil Kim, Seungrim Yi, Jungjin Yu, Hyunchul Kim, Seungsoo Woo, Hyoungjoo Choi, Seyong Kim. Team Korea injury and illness surveillance at the 2024 Paris Olympic Games

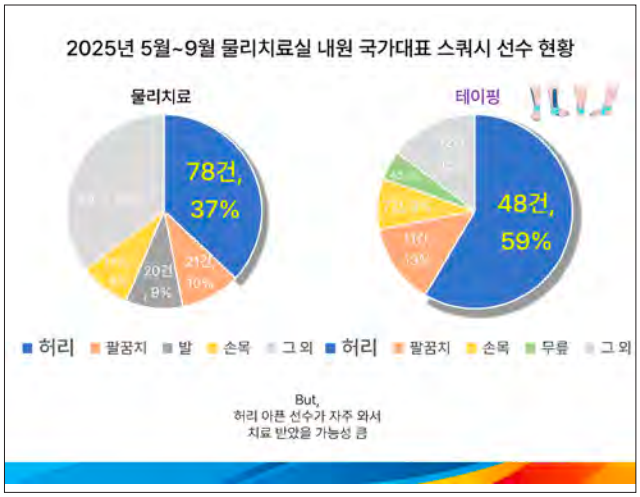
스쿼시에서의 허리 척추 손상:
“허리가 무너지면 경기도 무너진다, 척추 손상의 함정”
Lower Back Spinal Injuries in Squash:
“When your back collapses, your game collapses:
The pitfalls of spinal injury”

진천국가대표선수촌 메디컬센터
김세용

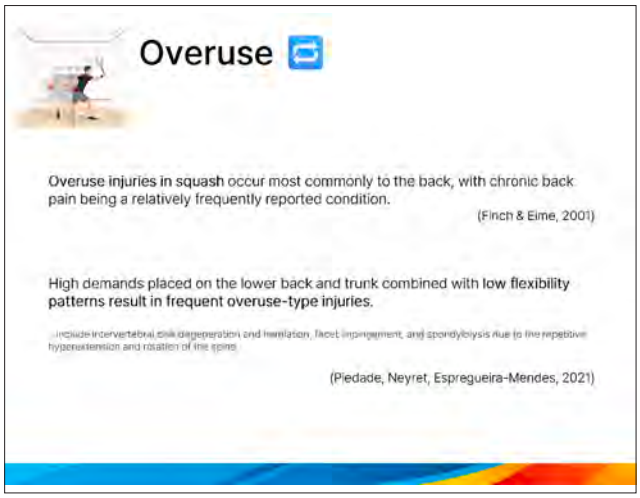


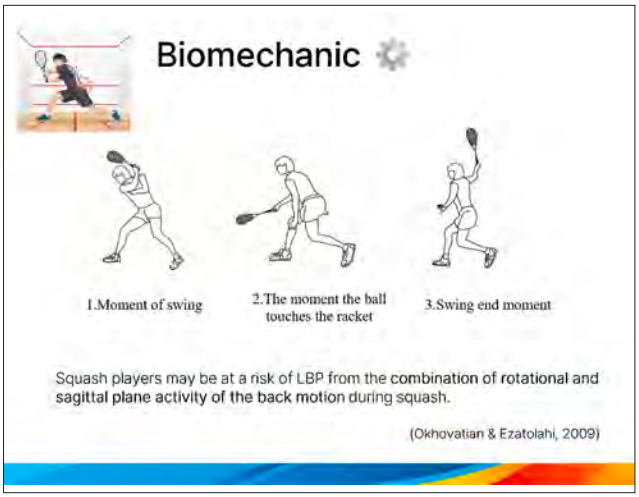


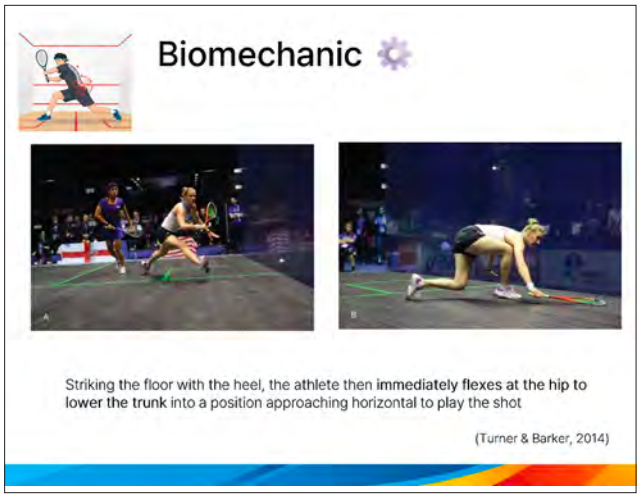

The Prevalence of Musculoskeletal Injuries in Junior Elite Squash Players
2009~2015 카타르 Aspire academy 남자 주니어 엘리트 선수 21명
부위 횟수
Lower Limb 123 (58%)
Head and Trunk 50 (23.6%)
Upper Limb 39 (18.4%)
Body region Overall injuries
Head & neck 3 (1.4%)
Upper back 11 (5.2%)
Chest/rib 3 (1.4%)
Lumbar 24 (11.3%)
Pelvis 9 (4.2%)
대부분 Lower back pain 진단, 병리학적 진단명은 구분되지 않았음.
(Horobeanu, Johnson & Pullinger, 2019)


2025년 5월~9월 물리치료실 내원 국가대표 스쿼시 선수 현황
물리치료
78건, 37%
테이핑
48건, 59%
허리 팔꿈치 발 손목 그 외 허리 팔꿈치 손목 무릎 그 외
But,
허리 아픈 선수가 자주 와서
치료 받았을 가능성 큼


왜 허리가 아플까?
Overuse
Biomechanic
gradual-onset injury caused by repeated micro trauma
without a single, identifiable event responsible for the injury


Overuse
Overuse injuries in squash occur most commonly to the back, with chronic back pain being a relatively frequently reported condition.
(Finch & Eime, 2001)
High demands placed on the lower back and trunk combined with low flexibility patterns result in frequent overuse-type injuries.
(Piedade, Neyret, Espregueira-Mendes, 2021)


Biomechanic
1.Moment of swing
2.The moment the ball touches the racket
3.Swing end moment
Squash players may be at a risk of LBP from the combination of rotational and sagittal plane activity of the back motion during squash.
(Okhovatian & Ezatolahi, 2009)


Biomechanic
Striking the floor with the heel, the athlete then immediately flexes at the hip to lower the trunk into a position approaching horizontal to play the shot
(Turner & Barker, 2014)

Biomechanic

Trunk flexion, shoulder abduction, shoulder medial rotation, and racket-related angle may be the primary biomechanical factors affecting squash accuracy control and performance

(Huang et al., 2024)

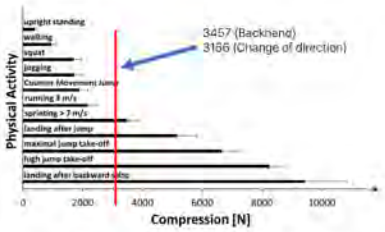
몸통 굽힘과 회전이 경기 중 빈번하게 나오며,
정확도와 퍼포먼스를 위한 핵심 요소


ORIGINAL ARTICLE

The mechanical loading of the spine in physical activities

Robin Schäfer · Katharina Trompeter · Daniela Fett · Kai Heinrich · Johannes Funken · Steffen Willwacher · Gert-Peter Brüggemann · Petra Platen

- Perform sports specific movement and daily activities repeat 3 times.
- EMG and mathematical process → Outcome L4/L5 compression & torque
- 스쿼시처럼 trunk flexion, rotation, pivot, direction change가 많은 필드하키 결과 값을 참조



- Backhand, change direction 시 L4/L5에 체중대비 5.0, 4.8배의 기계적 부하
- Connective tissue will be damaged and destroyed, when the mechanical load limit of only one tissue component is reached or exceeded.
- Injury may be spontaneous due to a current overload or gradual and accumulative after several repetitive microtraumas with submaximal loads.

(Schäfer et al., 2023)

어떻게 관리하면 좋을까?

- Physiotherapy & Massage
  치료 기기의 효과는 개별적이고, 치료자의 숙련도에 따라 차이 있음
- Movement, Strength & Conditioning
  통증을 고려한 적절한 운동이 통증 조절과 회복에 효과적이다
- Drug
  통증 완화를 위한 보조 수단으로 사용. 도핑 규정 반드시 확인
- Supplementation
  균형 잡힌 영양 관리가 통증 회복에 중요한 역할
- Sleep
  수면의 질적인 부분. 시간 부족은 통증 만큼도 ↑. 충분한 수면 통해 회복
- Psychosocial intervention
  통증을 스스로 조절하는 힘을 기를 수 있도록 돕기
- Surgery
  통증과 관련된 구조적 문제가 확인되었을 때 고려

Intervention

Strength training as superior, dose-dependent and safe prevention of acute and overuse sports injuries: a systematic review, qualitative analysis and meta-analysis

Strength training programmes reduced sports injuries by an average of 66% and were, with 95% certainty, able to more than halve the risk of sports injury.

10% increase in strength training volume reduced the risk of injury by more than four percentage points.

(Lauersen, Andersen & Andersen, 2018)

Intervention

Whole kinetic chain are important in order for prevention of injuries including squats for leg strengthening, to recruit power generation, and load absorption; trunk rotations; scapular stabilization; and shoulder and wrist co-contractions.

Weak and inflexible abdominal and back muscles may predispose to these muscles being injured.

(Piedade, Neyret, Espregueira-Mendes, 2021)

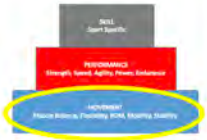
Intervention

Any change in the activation of the core muscles affects the ability of badminton players to maintain postural control when performing lunge motions.

Healthy players demonstrated a greater pre-impact activity of the paraspinal muscles during the forehand backward lunge, suggesting a better neuromuscular control of the core muscles and feedforward activation.

(Huang et al., 2014)

(Villa et al., 2012)



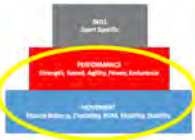
(Performance pyramid, FMS)

Supine Rotation

Hip and back flexibility

Prone Rotation

Hip and back flexibility



(Performance pyramid, FMS)

Kneeling Lunge

Hip mobility, trunk control

Thumbs Up

Back and shoulder strength

(Performance pyramid, FMS)

Glider

Hamstring eccentric contraction + trunk flexion

Side Lunge

Lower limb strength
Hip flexibility and control

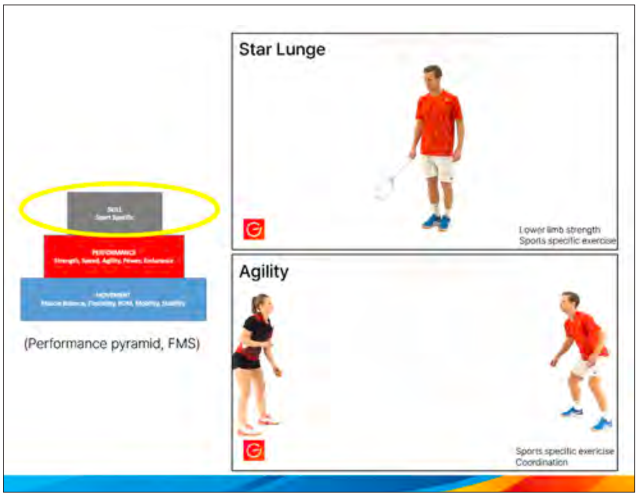
(Performance pyramid, FMS)

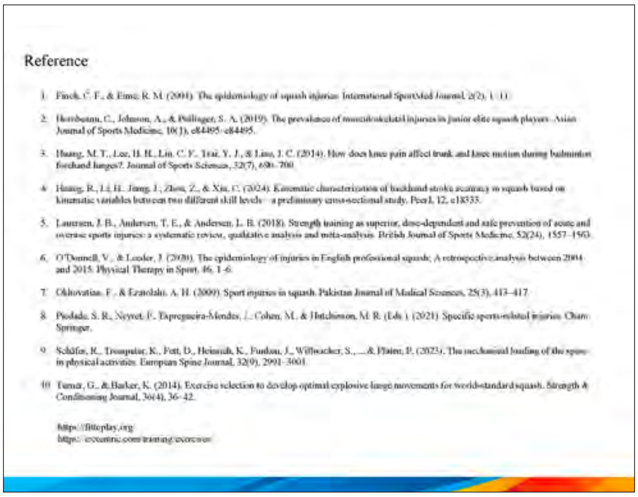
Lunge Rotation

Rotational stability
Hip, knee, trunk control

Kneeling Rotation Throw

Rotational strength




Reference

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The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 4: 야구선수에서 팔꿈치 손상
Elbow injuries in baseball players

좌장: 서남병원 이석현, 고려대구로병원 문준규

금정섭

학력

건국대학교 의과대학 의학과 학사

건국대학교 의과대학 의학대학원 석사

건국대학교 의과대학 의학대학원 박사 수료

주요 경력

대한스포츠의학회 홍보위원

LG 트윈스 필드닥터

기아타이거즈, 한화이글스 의료 자문의

장애인 농구협회 이사

대한 육상연맹 의무위원

대한 컬링협회 의무과학위원회 위원

현재 소속 및 직위

세종스포츠정형외과 원장

UCL 손상의 개요와 보존적 치료
Overview of Ulnar Collateral Ligament (UCL) Injury and non-operative treatment

세종스포츠정형외과
금정섭

어깨 전방 탈구는 젊은 운동선수에서 가장 흔히 발생하는 외상 중 하나로, 야구에서도 빈번히 방생하고 있고, 첫 탈구 이후 재발 위험이 높은 것으로 알려져 있다. 첫 탈구 환자의 치료 전략은 전통적으로 보존적 치료가 우선되었으나, 최근 연구에서는 조기 수술(early stabilization)이 재탈구율 감소와 경기 복귀율 향상에 유의미한 영향을 미친다고 보고되고 있다.

기존 문헌 중 첫 탈구 환자를 대상으로 한 무작위 대조 연구(RCT), 전향적 코호트 연구, 및 컨센서스 가이드라인을 분석해보면, 보존적 치료군의 재탈구율은 20세 이하 접촉 스포츠 선수에서 70-90%로 보고되었으며, 10년 이상 추적 연구에서도 50% 이상의 재발률이 유지되었다(Hovelius 2008, Robinson 2006). 반면, 조기 관절경적 Bankart 봉합술을 시행한 환자군의 재탈구율은 10% 미만으로, 경기 복귀율 및 주관적 안정성 점수에서 유의한 향상을 보였다(Jakobsen 2007, Kirkley 1999). 특히 25세 미만, 접촉 또는 overhead 스포츠 선수, 골 결손이 동반된 경우는 재발 위험이 높아 조기 수술이 권장되었다(Burkhart 2000, Bottoni 2002, Owens 2007). ISAKOS 및 ASES 컨센서스에서도 고위험군에서는 첫 탈구라도 조기 수술을 권장하고 있다(Boileau 2012).

첫 탈구 환자에서의 수술 여부는 모든 환자에게 동일하게 적용될 수 없으며, 환자의 연령, 활동 수준, 스포츠 종목, 영상학적 소견을 종합적으로 고려해야 한다. 젊은 연령대의 운동선수 및 구조적 결손이 동반된 고위험군에서는 조기 수술이 장기 예후와 커리어 보호에 유리하다. 따라서 첫 탈구 환자라도 “개별화된 위험도 평가를 통한 선택적 조기 수술”이 향후 어깨 안정성과 재손상 예방에 핵심적인 전략으로 제시될 수 있다.

895명 엘리트 야구 선수에서의 UCL 수술 방법들에 따른 결과 분석 및 고찰
Analysis of UCL reconstruction in 895 elite baseball players

CM병원
이상훈

박진영

학력

서울대학교 의학과 학사

서울대학교 의학전문대학원 석사

서울대학교 의학전문대학원 박사

주요 경력

(전) 대한스포츠의학회 회장

(전) 대한올림픽위원회 의무위원

(전) 세계견주관절학회 조직위원장

(현) 세계견주관절학회 이사

현재 소속 및 직위

네온 정형외과, 원장

실패한 UCL 재건 후 리비전 수술 전략
Revision Surgery Strategies After Failed UCL Reconstruction

네온정형외과
박진영

Introduction

- With the rise of primary UCL recon, the incidence of revision UCL surgery has also increased
- Revision cases typically occur in high-level throwing athletes
- Revision rate: approximately 1–14%

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Indications

- Similar to primary UCL recon
- Pain with valgus stress
- Positive moving valgus stress test
- 1mm > valgus laxity on stress radiographs or ultrasound

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Contra-indications

- Follows general contraindications of surgery
  - Infection, nerve injury, flexor-pronator muscle deficiency…

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Contra-indications

RISK FACTOR

- Younger age at initial reconstruction
- Shorter status
- Increased frequency of fastball use
- Less experience in MLB before initial reconstruction

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Contra-indications

RISK FACTOR

- Fewer pitches throughout first year after surgery
- Longer time to RTP
- Increased number of games pitched
- Decreased number of innings pitched

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Pre-operative Planning

- Prior surgery
  - Technique, graft type, flexor-pronator repair/debridement, olecranon osteophyte
- Ulnar nerve decompression and/or transposition
- Throwing rehabilitation following the primary surgery

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Physical examination

- Palpation along the length of the UCL to specify location of any tears
  - humeral vs. ulnar-side graft failure, post-operative change
- Valgus stress (>1mm)

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Physical examination

- Nerve examination
  - Tinel test, stability throughout elbow motion
- Flexor/pronator strength test strength test

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Radiography

- Stress X-ray
  - Compare medial joint opening with valgus stress
- MRI
  - Ideal image modality
  - MRI will like vary depending on the amount of time elapsed

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Radiography

- 3D CT
  - Provides the prior ulnar & humeral tunnels, bone quality

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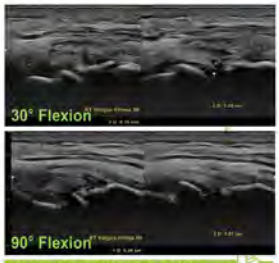
Stress Ultrasound

- Dynamic assessment of the instability
- >1 mm is abnormal and indicate graft failure compared with contralateral



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Approach

- Previous surgical incision often can be used
- Caution for medial antebrachial cutaneous, ulnar nerve
  - Scarring, distort anatomy

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Graft selection

- Gracilis autograft
  - Larger diameter→ initial strength↑ but epicondyle Fx↑
- Contralateral palmaris longus
- Allograft tendon

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Description of the technique

- Ulnar tunnel widening is less common

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Description of the technique

- Mid-substance graft problem + good tunnel position and bone stock
  →Same surgical technique used for the primary procedure
- Previous tunnel unusable if cortical thinning, bone loss, or fracture present

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Description of the technique

- Care should be taken during ulnar nerve handling
  - scarring and adhesion
- Muscle fiber is splitted from medial epicondyle to sublime tubercle
- Previous suture materials can be removed.

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Description of the technique

- In most cases, the initial graft tissue is still present and hypertrophied
- The graft often needs to be debulked to make new tunnels and pass a new graft

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Tunnel position : humeral side

- Bone tunnel created centrally beneath the original AOL(anterior oblique ligament) insertion
- New graft positioned to maintain isometry throughout elbow motion

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Tunnel position : ulnar side

- Ulnar tunnel should be located distal to the joint line and equidistant on both sides of the sublime tubercle
- Sublime tubercle morphology can change because of enthesophyte
  - More hypertrophic posteriorly

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Tunnel position : ulnar side

- The medial ulnar ridge
  - Consistent palpable ridge distal to the sublime tubercle
  - Useful guide to the proper tunnel location of the sublime tubercle

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Tunnel position

- Small curettes are used to identify the prior tunnels
- Previous tunnel can be reused if position and bone quality are adequate

Three passage docking technique with palmaris longus

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Tunnel position

- If malpositioned tunnels are encountered, then new tunnels are created in the anatomic position

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Description of the technique

- Tourniquet down prior to closure to obtain hemostasis and prevent hematoma, adhesion
  - Especially around the ulnar nerve hematoma
- Small Hemovac drain
  - Scar tissue can bleed excessively

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Humeral Bone Loss, Insufficiency, or Fracture

- Medial epicondyle Fx
  - can be treated with 3.5–4.5 mm compression screws
  - >1yr : UCL may healed
  - <1yr : fixed immediately to prevent graft retraction
- Graft compromised
  - Suture anchor fixation is an option to avoid redrilling tunnels

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Ulnar Bone Loss, Insufficiency, or Fracture

- Another bone tunnel along the sublime tubercle on ulna can be possible
- Ulnar-side revision option is interference screw, in the DANE TJ technique

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Ulnar Bone Loss, Insufficiency, or Fracture

- Cortical button technique on the ulnar sided is useful
  - single ulnar-sided drill hole is started on the sublime tubercle at the UCL insertion
  - aimed 30° posterolateral to avoid the posterior interosseous nerve
  - The cortical button is locked with a docking technique

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Complications

- High rate of complication because of the formation of scar tissue and adhesions
  - Transient ulnar nerve neuropraxia
  - Medial epicondyle fracture
  - Stiffness
  - Heterotopic ossification
  - Graft or implant failure

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Post-operative Care

- Delayed rehabilitaion is needed

	Revision	Primary surgery
Posterior splint removal	10days	5days
Initiation ITP	6months	4months
Full recovery	1.5years	1year

  - Throwing at maximum distance is not recommended during ITP

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Outcome

Study	n	RTP (Same/Pro)	Time to RTP	Career impact	Revision rate
Dines 2008 AJSM	n=15	33% (same-level)	-	Complications 40%	-
Marshall 2015 AJSM	MLB n=33	65.5%	-	Career 0.8 years shorter, win and inning pitched↓	-
Liu 2016 JSES	MLB n=31	42% (>10 games)	21 mo	Career↓, fewer innings	13%
Wilson 2015 J Hand surg Am	n=271	-	-	Career (4.9yr vs. 2.5yr)	15%

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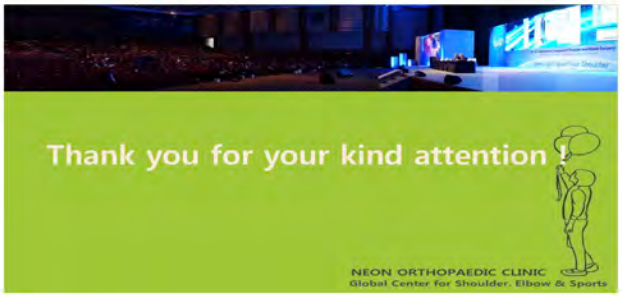

Thank you for your kind attention

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사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 6: AI·디지털혁신을 통한 생활체육 활성화와 건강증진

Revitalising Community Sports and Enhancing Health through AI and Digital Innovation

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좌장: 계명대학교 김기진, 서울대학교 김연수

조용인

학력

인하대학교 체육교육과 학사

인하대학교 일반대학원 체학학과 석사

인하대학교 일반대학원 체육학과 박사

주요 경력

스포츠 분야

- 암환자 애프터케어 솔루션(신체활동 및 관리), 무선심박계 등 기획/개발
- 국민체육진흥공단 스포츠산업기술 R&D 평가위원
- 학생건강체력평가제도(PAPS) / 태권PAPS 개발

AI 분야

- NIA 국제개발협력사업 컨설턴트 (AX, SI, 보건의료 분야)
- NIA 자율주행, 로봇 AI학습데이터 구축 사업 PM, 스마트경로당 구축 사업 PM
- 의료AI 기업 AI솔루션 및 플랫폼 서비스 개발/컨설팅

현재 소속 및 직위

동국대학교 스포츠문화학과 겸임교수

대표논문

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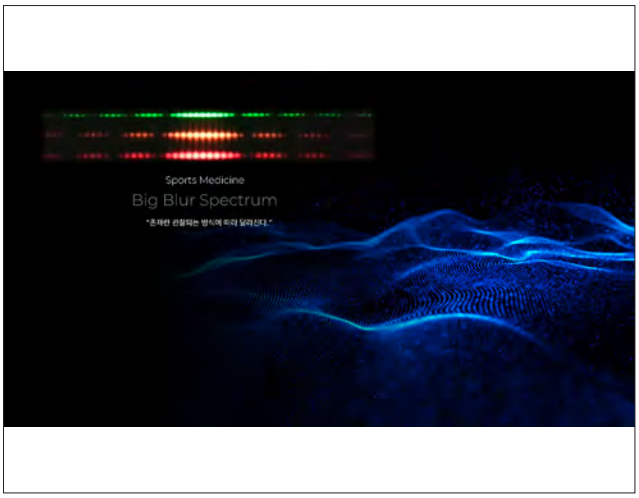
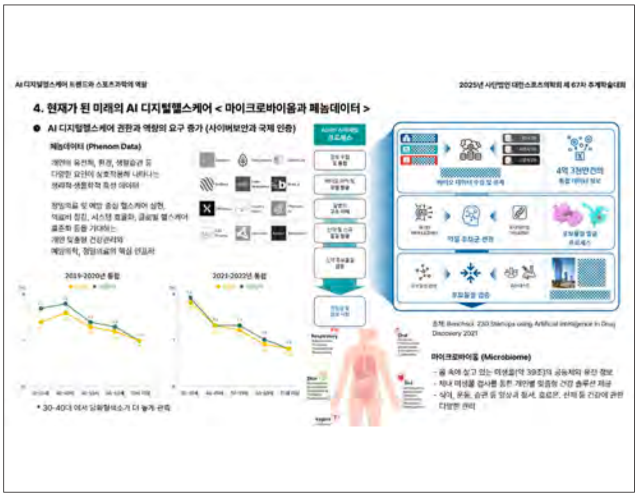
AI디지털 헬스케어 트렌드와 스포츠과학의 역할
Trends in AI Digital Healthcare and the Role of Sports Science

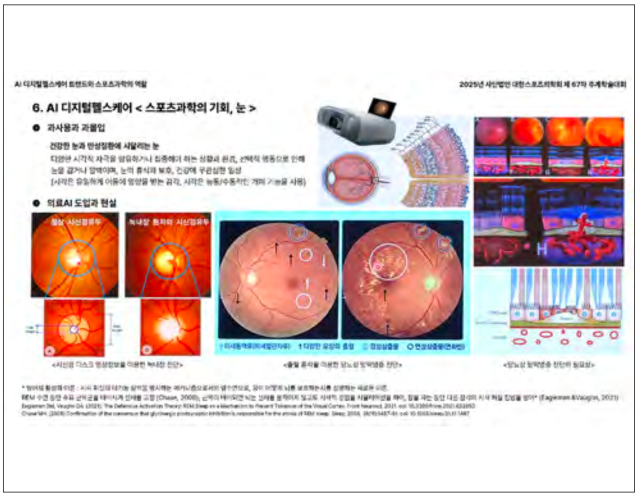
동국대학교
조용인




3. AI 디지털헬스케어의 확산
변화하는 정책과 사업
과학기술정보통신부
스마트시티 사업 분야

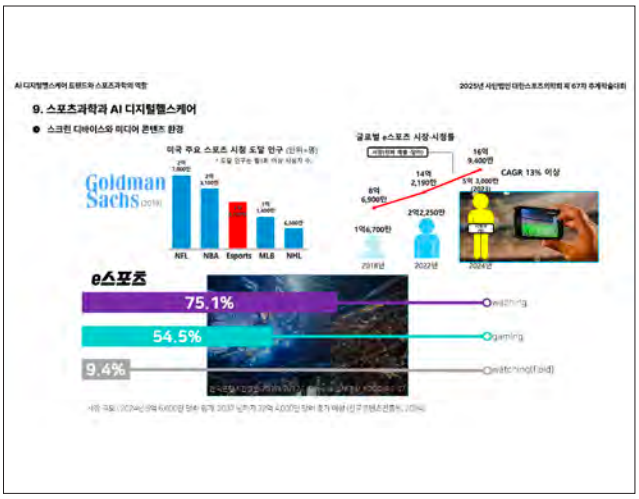

4. 현재가 된 미래의 AI 디지털헬스케어 < 마이크로바이옴과 페놈데이터 >
AI 디지털헬스케어 권한과 역할의 요구 증가 (사이버보안과 국제 인증)
페놈데이터 (Phenom Data)
2019-2020년 통합
2021-2022년 통합
마이크로바이옴 (Microbiome)

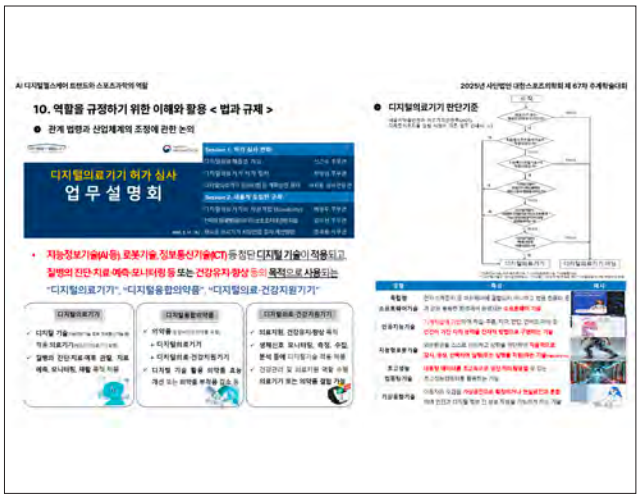

5. 스포츠과학과 AI 디지털헬스케어
만성질환
만성질환 유병률 지속 증가
28.6%
고혈압 유병률
14.5%
당뇨병 유병률
사회 경제적 부담 지속 증가
21조원


6. AI 디지털헬스케어 < 스포츠과학의 기회, 눈 >
과사용과 과몰입
의료AI 도입과 현실


7. AI 디지털헬스케어와 만성질환
눈과 만성질환
기술동향
지레 AI 진단 보조
신장 AI 진단
심혈관 AI 진단
안구질환 AI 진단
AI 안저 검사


8. AI 디지털헬스케어와 만성질환 < 일상과 퍼포먼스, 컨디셔닝 >
눈과 디지털헬스케어
Big Blur / Spectrum


AI 디지털헬스케어 트렌드와 스포츠과학의 역할
2025년 사단법인 대한스포츠의학회 제 67차 추계학술대회
9. 스포츠과학과 AI 디지털헬스케어
스크린 디바이스와 미디어 콘텐츠 환경
미국 주요 스포츠 시청 도달 인구
Goldman Sachs
NFL
NBA
Esports
MLB
NHL
글로벌 e스포츠 시장·시청층
CAGR 13% 이상
e스포츠
75.1%
54.5%
9.4%
watching
gaming
watching(Paid)


AI 디지털헬스케어 트렌드와 스포츠과학의 역할
2025년 사단법인 대한스포츠의학회 제 67차 추계학술대회
10. 역할을 규정하기 위한 이해와 활용 < 법과 규제 >
관계 법령과 산업체계의 조정에 관한 논의
디지털의료기기 허가 심사
업 무 설 명 회
디지털의료기기 판단기준


2025년 사단법인 대한스포츠의학회 제 67차 추계학술대회
Korean Society of Sports Medicine
The Roles of Sports Science
in AI Digital Healthcare Trends
Big Blur Spectrum
경청해 주셔서 감사합니다.

안주은

학력

서울대학교 기계항공공학부 학사
MIT 공과대학원 기계공학과 석사
MIT 공과대학원 기계공학과 박사

주요 경력

절강대학교 스포츠엔지니어링 프로그램 자문위원
한국인 인체 동작분석 데이터센터 전문위원
한국운동역학회 상임이사
Sports Industry Global Conference 기조강연
The 7th Global Taekwondo Leaders Forum 기조강연

현재 소속 및 직위

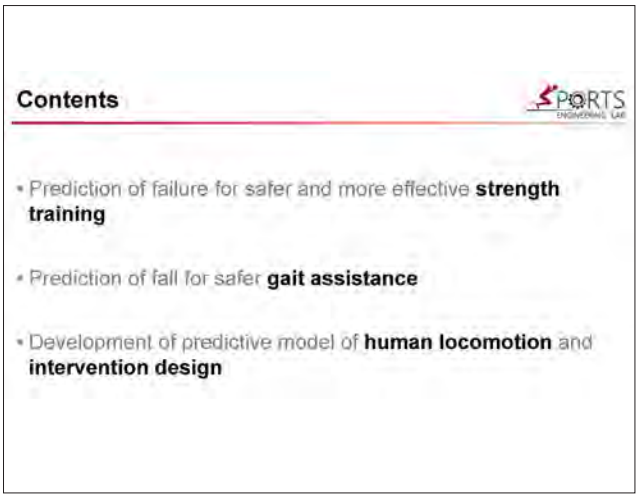
서울대학교 체육교육과 교수

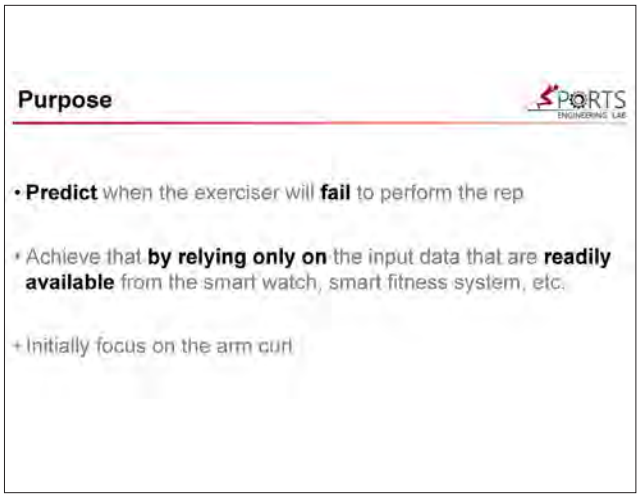
대표논문

1. H. Kim, J. Ahn*, “Technologically advanced running shoes reduce biomechanical factors of running related injury risk”, Scientific Reports, 2025
2. J. Ahn, H. Jung, J. Moon, C. Kwon, J. Ahn*, “A comprehensive assessment of a passive back support exoskeleton for load handling assistance”, Scientific Reports, 2025
3. J. Moon, J. Ahn*, “The effect of sampling methods on the validity and reliability of the estimation of the orbital stability of human gait”, Royal Society Open Science, 2025

AI 기반 예측 모델을 이용한 운동의 구현과 중재의 설계
Generating Human Motion and Designing Interventions Using AI-Based Predictive Models

서울대학교
안주은





Data acquisition

10 Participants X 6 Trials (3 Trials each Arm) X 4 Data (3 Success & 1 Failure) X 2 Days

Data of about 500 trials

Data acquisition

Failure: below 90% of average ROM of first 3 reps

1st	2nd	3rd	4th	5th	6th	7th	8th	9th
✓	✓	✓	✓	✓	✓	✓	✓	✗

Success Data

Failure Data

Models predicting arm curl failure

5 features

Mean Velocity(MV)

Mean Propulsive Velocity(MPV)

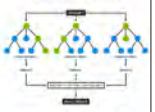
Peak velocity

MV loss = $MV_{previous} - MV_{current}$

MPV loss = $MPV_{previous} - MPV_{current}$

Prediction

Random Forest



Accuracy > 92%

Time = 0.46 s

Various wearables for gait assistance

The device **detects** the wearer's **intention** based on **mechanical inputs** and **augments** the **"recognized" intended motion**

However, is the detection always accurate?

"She is posing for photographs."

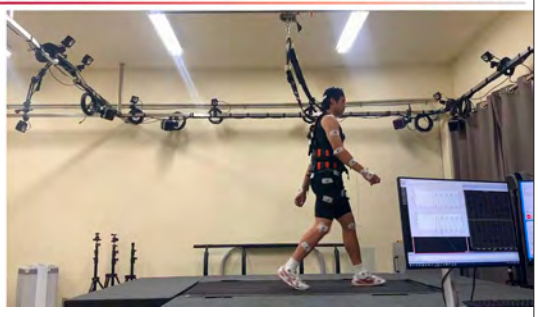
Really?

However, is the detection always accurate?

Purpose

- **Detect fall**
- Achieve that **by relying only on** the input data that are **readily available** from the sensors embedded in the wearable device
- Achieve that sufficiently **quickly** (less than 50 ms)

Data acquisition



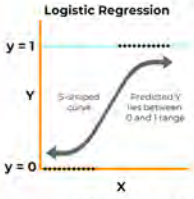
Models identifying falls

Features

Lower limb kinematics that can be measured by the exoskeletons

Prediction

Logistic Regression



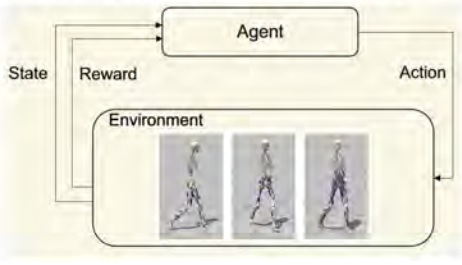
Accuracy > 87% Time = 0.0021 s

Inverse analysis using musculoskeletal models

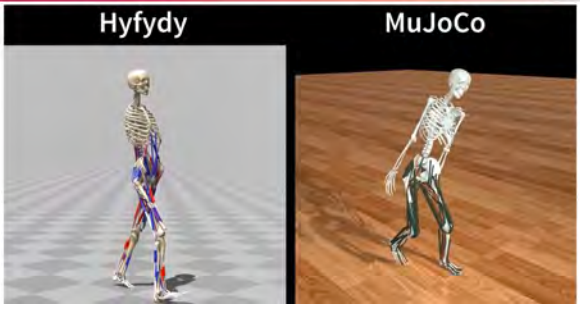
Joint kinematics, GRF, etc. → Musculoskeletal simulation → Muscle force, joint load, etc.

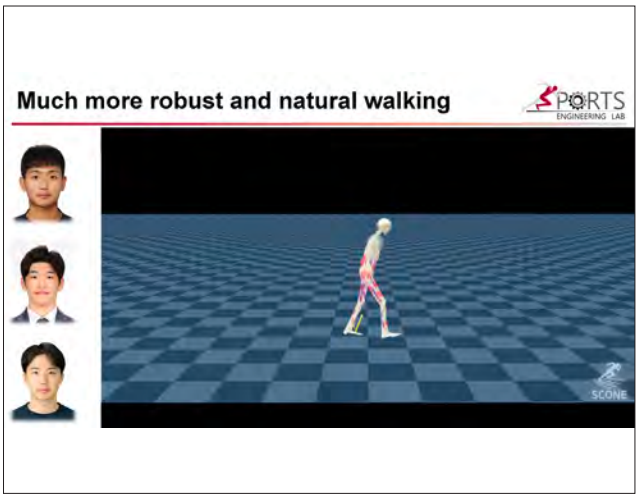
Predictive models mimicking human motion

Simulate human motion using reinforcement learning

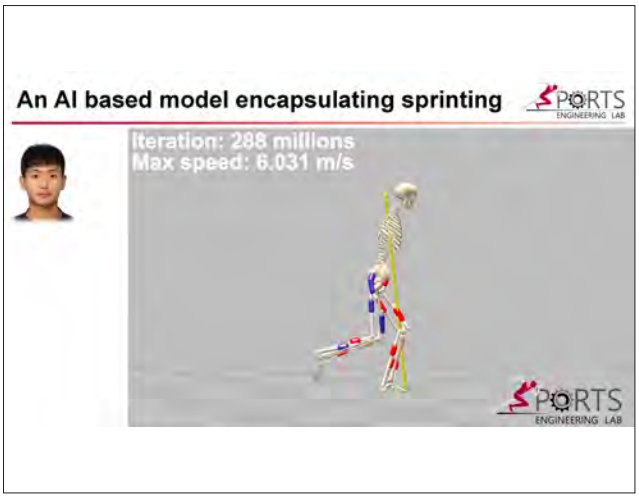


Previous models




Much more robust and natural walking
SPORTS ENGINEERING LAB
SCONE


Possible application
SPORTS ENGINEERING LAB


An AI based model encapsulating sprinting
SPORTS ENGINEERING LAB
Iteration: 288 millions
Max speed: 6.031 m/s
SPORTS ENGINEERING LAB


Thank You
SPORTS ENGINEERING LAB

이일석

학력

동신대학교 운동처방학과 학사

고려대학교 의용과학대학원 스포츠의학과 석사

주요 경력

전 보건복지부 한국건강증진개발원 신체활동 위원(전국 보건소 사업)

전 하늘병원 스포츠컨디셔닝센터 실장

전 스포츠클라이밍 국가대표팀 트레이너

전 GS칼텍스 배구단 트레이너

전 KB국민은행 사격단 트레이너

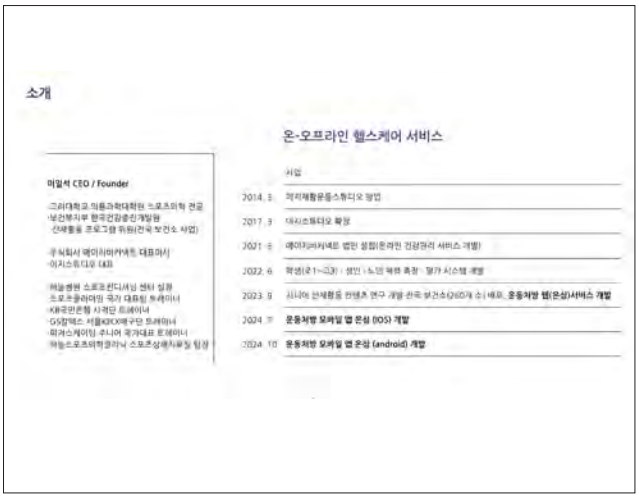
현재 소속 및 직위

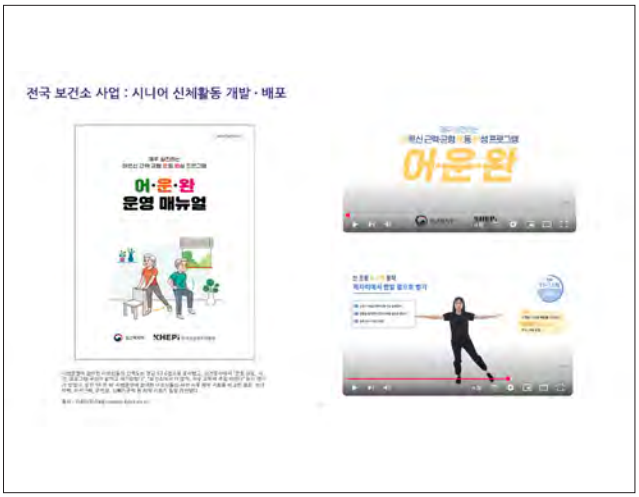
현 주식회사 에이치비커넥트 대표이사

현 이지스튜디오 대표

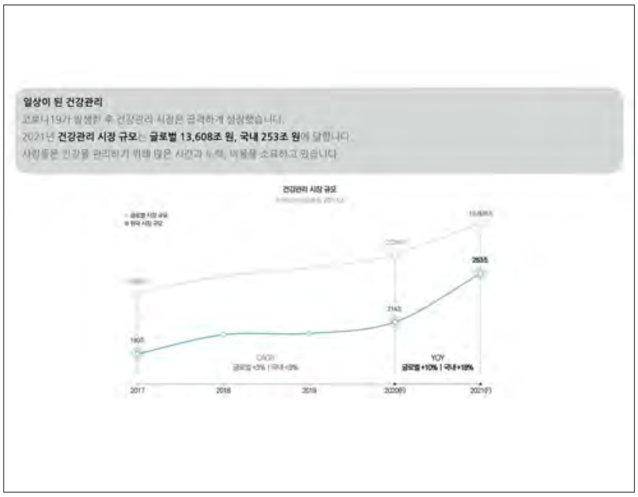
빅데이터 기반 생활습관 분석과 개인 맞춤형 운동지도
Big Data-Based Lifestyle Analysis and Personalized Exercise Guidance

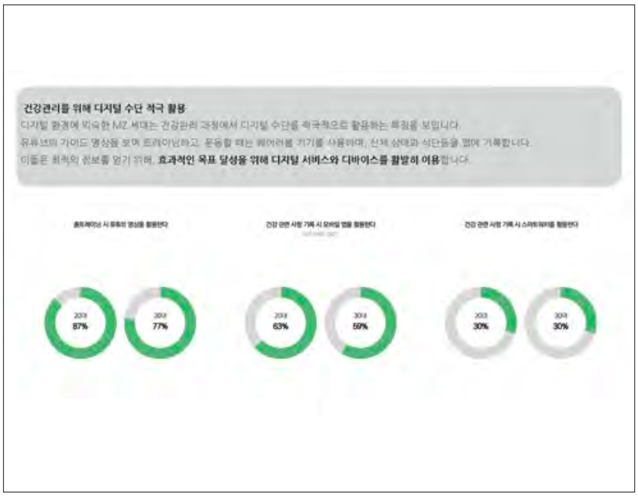
온심
이일석



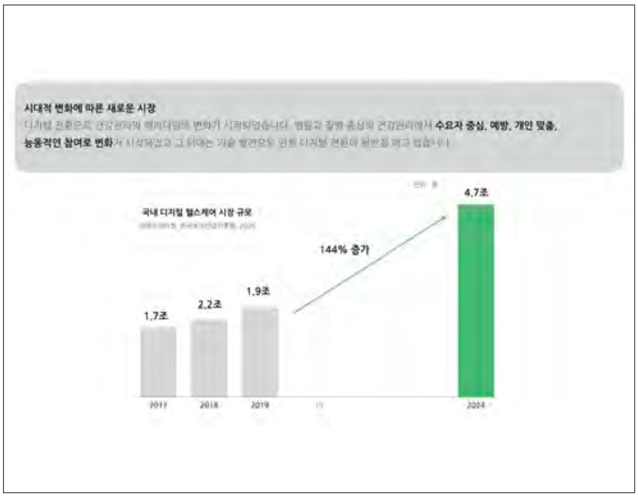


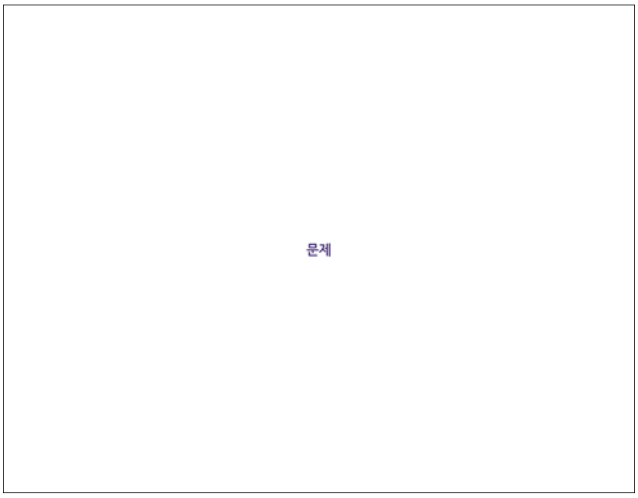

시대 변화

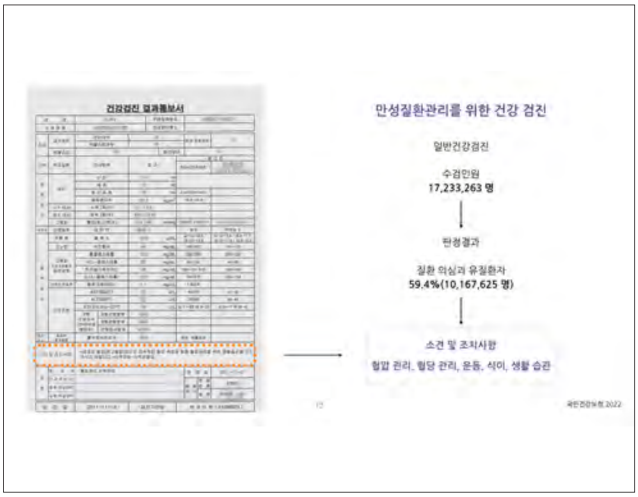

일상이 된 건강관리
코로나19가 발생한 후 건강관리 시장은 급격하게 성장했습니다.
2021년 건강관리 시장 규모는 글로벌 13,608조 원, 국내 253조 원에 달합니다.
사람들은 건강을 관리하기 위해 많은 시간과 노력, 비용을 소요하고 있습니다.
건강관리 시장 규모
253조
214조
190조
YOY
글로벌+10% | 국내+18%
2017
2018
2019
2020(E)
2021(F)

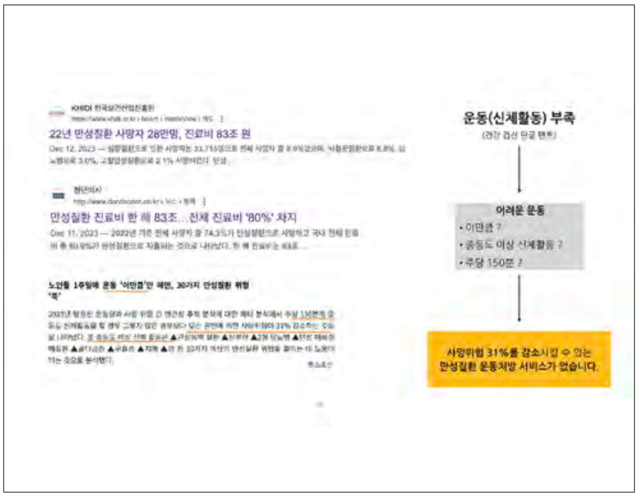

건강관리를 위해 디지털 수단 적극 활용
디지털 환경에 익숙한 MZ 세대는 건강관리 과정에서 디지털 수단을 적극적으로 활용하는 특징을 보입니다.
유튜브의 가이드 영상을 보며 트레이닝하고, 운동할 때는 웨어러블 기기를 사용하며, 신체 상태와 식단등을 앱에 기록합니다.
이들은 최적의 정보를 얻기 위해, 효과적인 목표 달성을 위해 디지털 서비스와 디바이스를 활발히 이용합니다.
20대
87%
30대
77%
20대
63%
30대
59%
20대
30%
30대
30%


건강관리의 디지털 전환
운동하기, 나만의 루틴 만들기와 같은 건강관리를 위해 모바일 앱을 적극 활용하며, 나에게 맞는 최적의 서비스들을 찾으며 적극 수용합니다.
Challenge
아침 루틴

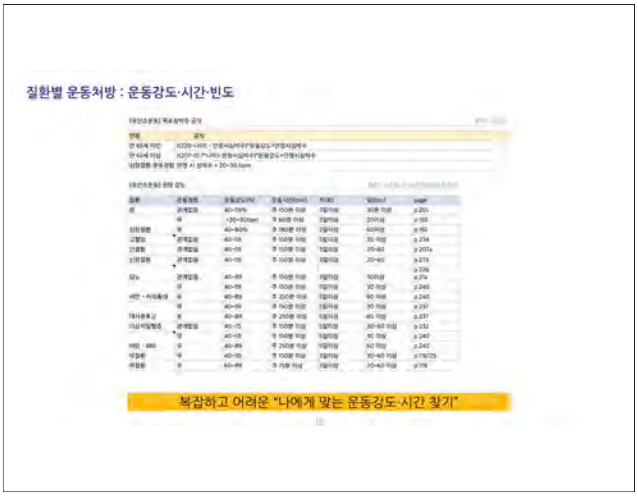

시대적 변화에 따른 새로운 시장
수요자 중심, 예방, 개인 맞춤,
능동적인 참여로 변화
국내 디지털 헬스케어 시장 규모
144% 증가
1,7조
2,2조
1,9조
4,7조
2017
2018
2019
2024


문제

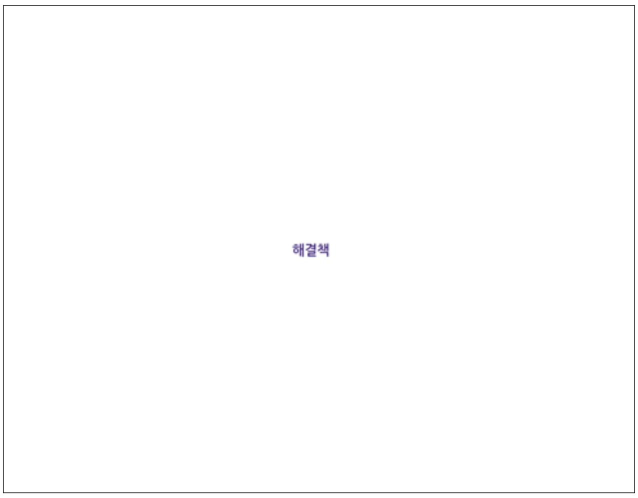

건강검진 결과통보서
만성질환관리를 위한 건강 검진
일반건강검진
수검인원
17,233,263 명
판정결과
질환 의심과 유질환자
59.4%(10,167,625 명)
소견 및 조치사항
혈압 관리, 혈당 관리, 운동, 식이, 생활 습관

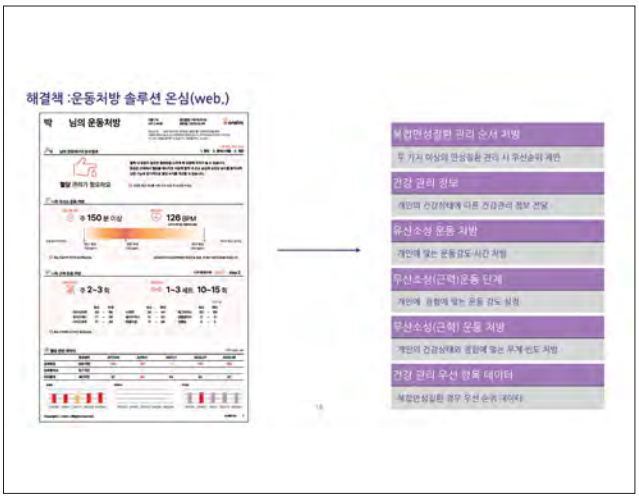

22년 만성질환 사망자 28만명, 진료비 83조 원
만성질환 진료비 한 해 83조…전체 진료비 '80%' 차지
운동(신체활동) 부족
어려운 운동
• 이만큼 ?
• 중등도 이상 신체활동 ?
• 주당 150분 ?
사망위험 31%를 감소시킬 수 있는
만성질환 운동처방 서비스가 없습니다.

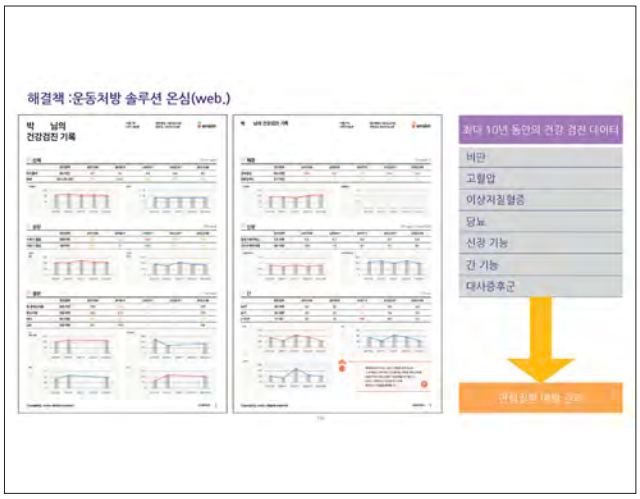

암
고혈압
복부비만
심장 질환
이상지질혈증
당뇨
비만
근감소증
신장 질환
간 질환
대사증후군
헬스
걷기
런닝
홈트
만성질환자들에게는 생명 연장의 문제입니다.
"나는 내 건강에 맞는 운동을 잘하고 있는 걸까.?"

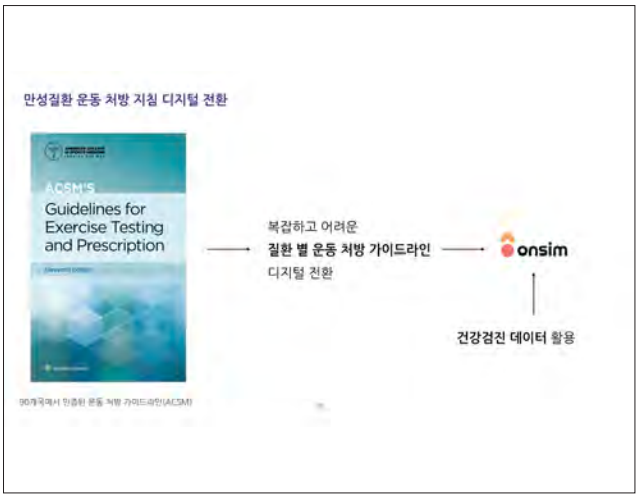

질환별 운동처방 : 운동강도·시간·빈도
복잡하고 어려운 "나에게 맞는 운동강도·시간 찾기"


만성질환 인구 증가
2,007만 명
만성질환 인구 증가로
사회적·경제적 문제 직면
내 건강을 잘 모름
적정
29.1%
경계
27.5%
성인 70%
건강정보 이해 및 활용 역량 부족
건강정보의 과잉
65.8
53.5
부족
경계
적정
헬스리터러시 수준별
정보 탐색 과정의 어려움 경험 정도
개인 입장에서 본인에게 가장 적합한 솔루션을 제공하는 건강 관리 서비스 필요


해결책


해결책 :운동처방 솔루션 온심(web.)
박 님의 운동처방
≥ 150 분 이상
126 BPM
≥ 2-3 회
1-3 세트, 10-15 회
복합만성질환 관리 순서 처방
두 가지 이상의 만성질환 관리 시 우선순위 제안
건강 관리 정보
개인의 건강상태에 따른 건강관리 정보 전달
유산소성 운동 처방
개인에 맞는 운동강도·시간 처방
무산소성(근력)운동 단계
개인에 맞는 운동 강도 설정
무산소성(근력) 운동 처방
개인의 건강상태와 경험에 맞는 무게 반도 처방
건강 관리 우선 항목 데이터
복합만성질환 경우 우선 순위 데이터


해결책 :운동처방 솔루션 온심(web.)
박 님의
건강검진 기록
최대 10년 동안의 건강 검진 데이터
비만
고혈압
이상지질혈증
당뇨
신장 기능
간 기능
대사증후군

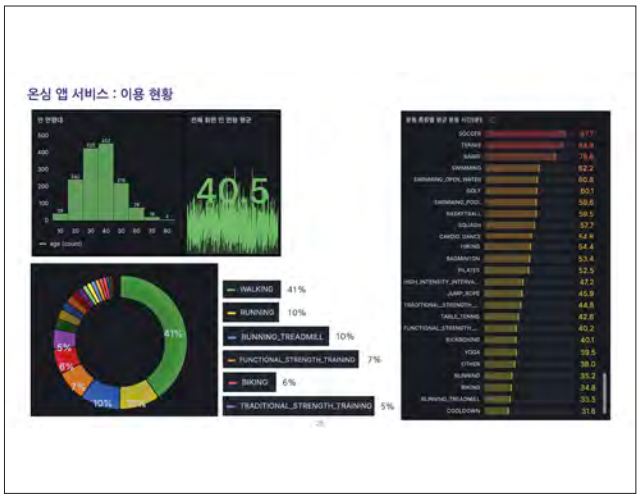

만성질환 운동 처방 지침 디지털 전환
ACSM'S
Guidelines for
Exercise Testing
and Prescription
복잡하고 어려운
질환 별 운동 처방 가이드라인
디지털 전환
onsim
건강검진 데이터 활용
90개국에서 인증된 운동 처방 가이드라인(ACSM)

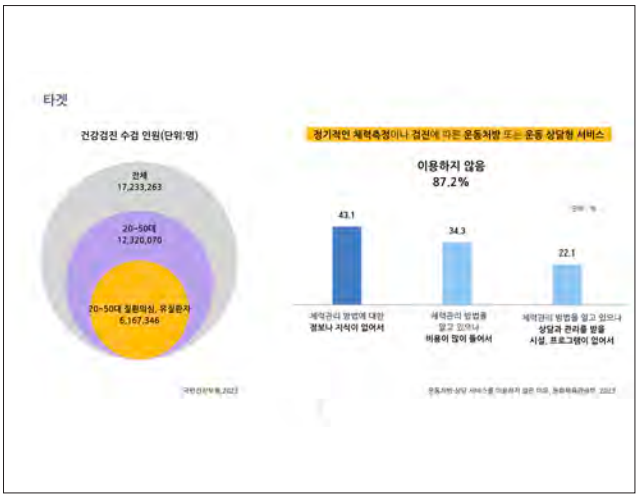

온심 앱 서비스
결과지 형태의 웹 서비스
모바일 앱 서비스 "온심"

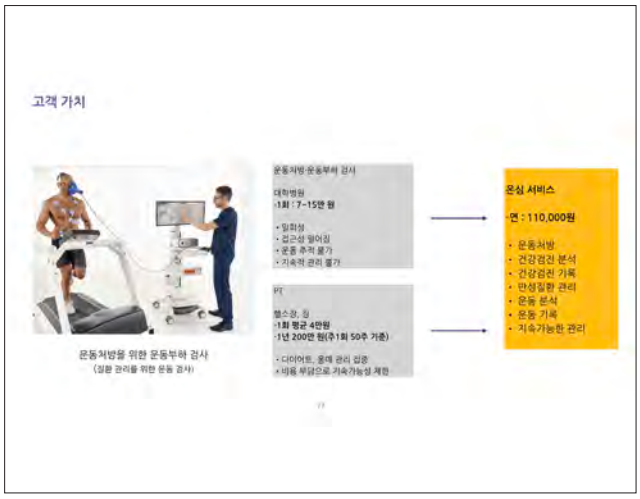

온심 앱 서비스 : 유저 시나리오
1. 건강검진 분석
검진 결과 분석으로 관리해야 하는
질환을 탐색하고 우선 순위를 제안
2. 질환 선택
검진 결과 외 질환 선택
암, 심장질환, 근감소증
3. 맞춤 운동처방
해당 질환에 따라 유산소·무산소 운동
강도·시간·반도·기간 처방


온심 앱 서비스 : 유저 시나리오
4. 근력운동 프로그램
개인의 질환에 효과적이고 안전한
운동 프로그램 제안
5. 운동분석
신체활동을 분석하여 안전하고,
질환에 효과적인 운동을 하는지 분석
6. 주간 기록
운동처방 기준으로 운동 달성도를
주 단위 기록
7. 통계
12주 간의 운동 추이 확인


온심 앱 서비스 : 이용 현황
1,400여 명의 검진결과 분석 기반 운동 처방 내용(복합질환 포함)


온심 앱 서비스 : 이용 현황
40.5
WALKING 41%
RUNNING 10%
RUNNING_TREADMILL 10%
FUNCTIONAL_STRENGTH_TRAINING 7%
BIKING 6%
TRADITIONAL_STRENGTH_TRAINING 5%


타겟
건강검진 수검 인원(단위:명)
전체
17,233,263
20~50대
12,320,070
20~50대 질환의심, 유질환자
6,167,346
정기적인 체력측정이나 검진에 따른 운동처방 또는 운동 상담형 서비스
이용하지 않음
87.2%
43.1
34.3
22.1
체력관리 방법에 대한 정보나 지식이 없어서
체력관리 방법을 알고 있으나 비용이 많이 들어서
체력관리 방법을 알고 있으나 상담과 관리를 받을 시설, 프로그램이 없어서


고객 가치
운동처방을 위한 운동부하 검사
(질환 관리를 위한 운동 검사)
온심 서비스
·연 : 110,000원
· 운동처방
· 건강검진 분석
· 건강검진 기록
· 만성질환 관리
· 운동 분석
· 운동 기록
· 지속가능한 관리


사례(건강검진센터 협력)
onsim
1. 병원 · 검진센터
운동처방 상담
2. 가정
운동 시행
3. 병원 · 검진센터
정기 검사

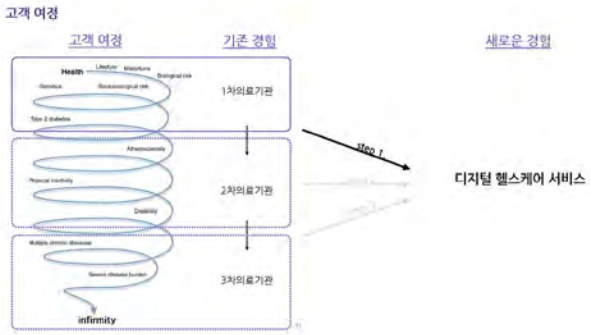

"나는 내 질환에 맞는 운동을 잘하고 있는 걸까.?"
그 동안 위 서비스들을 통해 답을 찾을 수 있었나요?

헬스케어의 오랜 과제
개인화, 예방 중심

의료 데이터의 유통 · 분배 문제를 풀어
수요자 중심의 헬스케어 경험 제공

1,106.4 TB

한 사람이 기대 수명(84세) 주기 동안 생산하는 의료 데이터



감사합니다.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

10월 18일(토요일)

런던홀

사단법인 대한스포츠의학회
The Korean Society of Sports Medicine

The 67th Autumn Conference of Korean Society of Sports Medicine
사단법인 대한스포츠의학회
제67차 추계학술대회

심포지엄 2: 전방십자인대 재건술 후 운동 기반 재활의 최근 발전 동향

Recent Advances in Exercise-Based Rehabilitation Following ACL Reconstruction

좌장: 고려대안암병원 장기모, 명지병원 임길병

김현종

학력

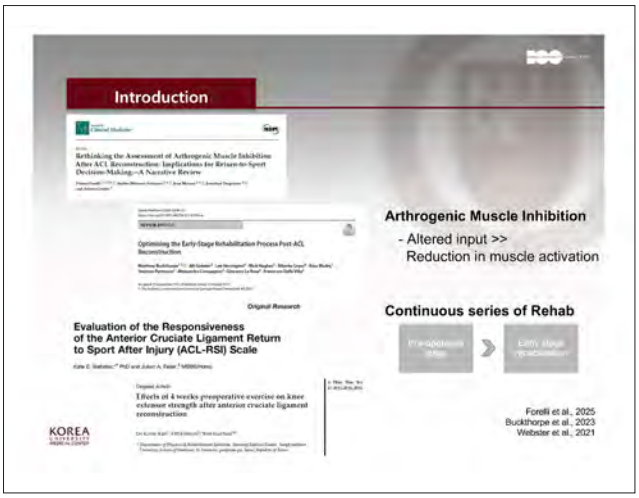
연세대학교 물리치료학과 학사

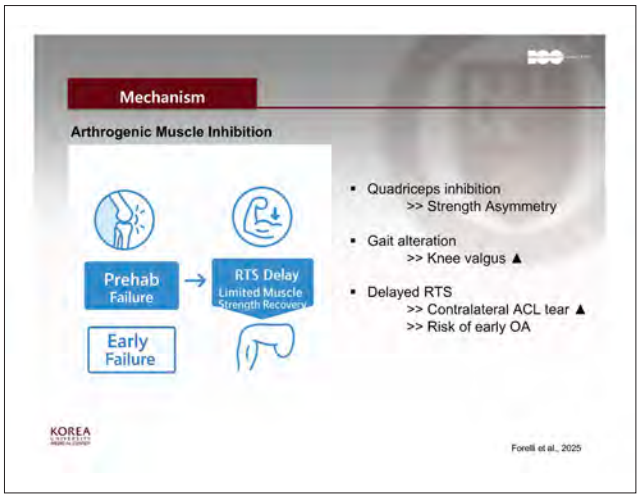
현재 소속 및 직위

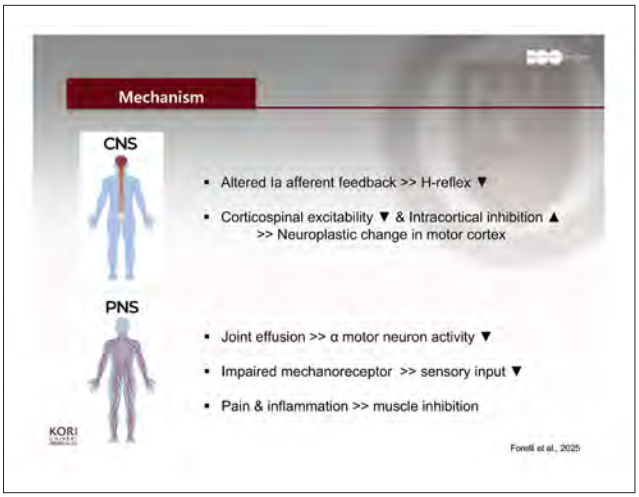
고려대학교 구로병원 스포츠의학실 물리치료사

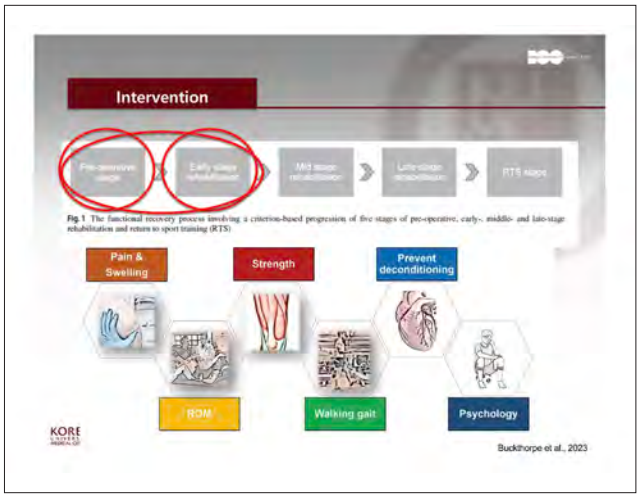
전방십자인대 손상 후 관절유래성 근육 억제 예방을 위한 재활 전 훈련의 중요성
Importance of Prehabilitation to Prevent Arthrogenic Muscle Inhibition after ACL Injury

고려대구로병원 스포츠의학실
김현종









Intervention

Table 1. A summary of the Preop exercise program

Exercise category	Exercise	Repetitions and sets
Cardio exercise	Stationary bike	20 min
Range of motion exercise	Seat flexion/extension	10 min
	Wall slides	
Strengthening exercise		
Open-chain strengthening	Short arc extension	10×2
	Straight leg raises	10×2
	Leg curl (isometric)	10×2
Close-chain strengthening	Leg extension (ROM 30–80°)	10×2
	Leg press	15×2
	Half squat	15×2
Balance/Proprioception	Single-leg standing	30 sec×3
	Balance board	30 sec×3

Potts et al., 2021
Kim et al., 2015

Intervention

Research	Duration	Result (Prehab Group)	P-value
Bilzen et al., 2010	5 weeks 2-4 sessions/week	Quad peak torque & work 8.2-11.1% increase	p<0.05 KOOS-ADLS score ↑
Keays et al., 2006	6 weeks	Quad peak torque significantly increased	p<0.001
Aggarwal & Adhya, 2016	4 weeks 6 sessions/week	Quad peak torque & work greater than control group	p<0.05
Kim et al., 2015	4 weeks 3 sessions/week	3M post OP: Quad strength(60°/s, 180°/s) & Hop Test improvement	p<0.033
Shaarani et al., 2013	6 weeks 4 sessions/week	Hop test, Quad CSA significant increase	p<0.0004

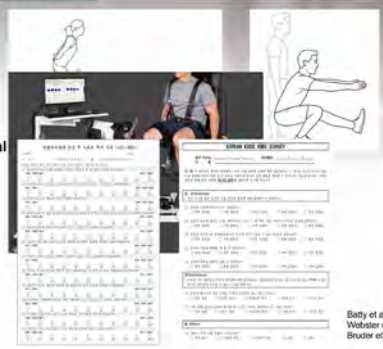
Carter et al., 2020

Assessment

Functional

Strength

Psychological



Batty et al.,2019
Webster et al., 2021
Brudor et al., 2023

Case

General Information

- **Name:** 이0훈 / Male / 17
- **Onset:** 24.06.01
- **Hx:** Pre-rehab since 24.07.12

MRI : 24.06.06 MRI : 25.01.04

- **Dx:** Rupture of anterior cruciate ligament (Left)
  Tear of lateral meniscus
- **OP Date:** Arthroscopic ACL reconstruction (25.01.23)

Case

Intervention 1 : 10 ~ 15 min

Pressure on painful points in quadriceps.

Pressure on hamstring painful points.

Pressure on painful points on triceps suralis.

Pressure on painful points in tensor fasciae latae.

Case

Table 1. A summary of the Preop exercise program

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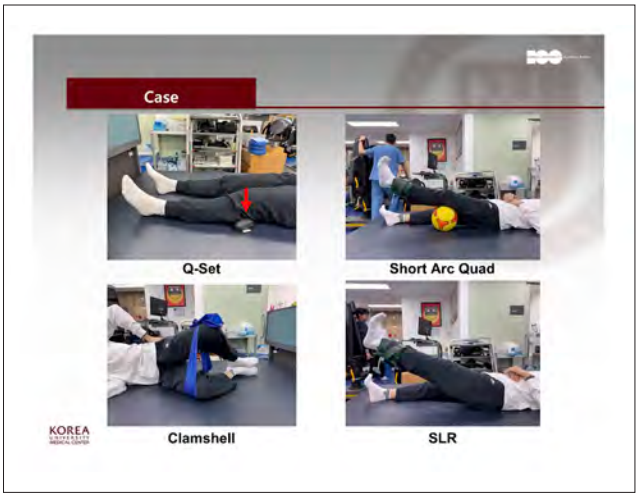
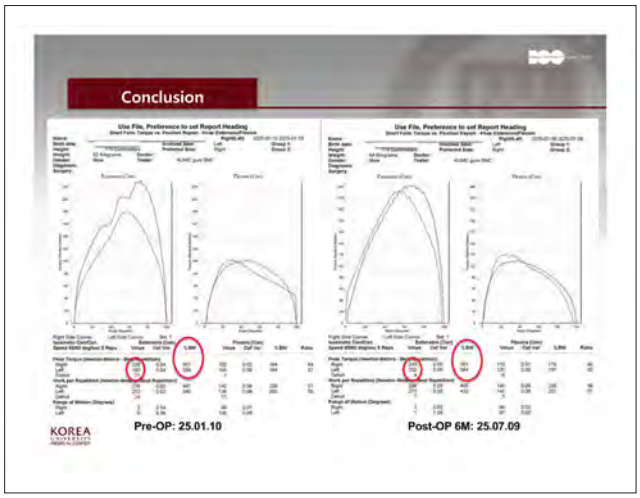
	Balance board	30 sec×3

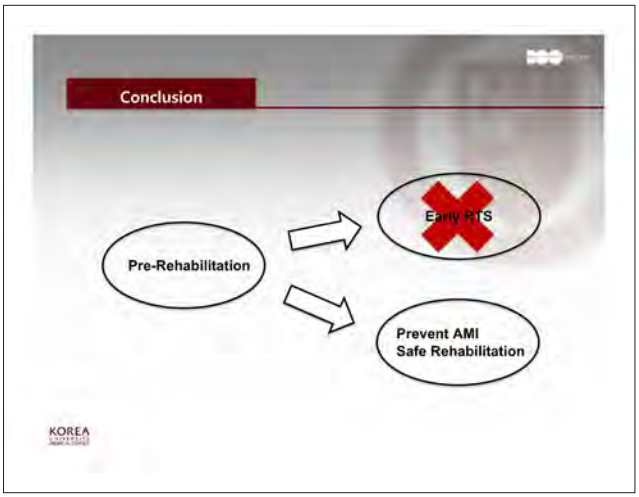
Potts et al., 2021
Kim et al., 2015


Case
Q-Set
Short Arc Quad
Clamshell
SLR
KOREA


Case
Isometric
Extension / Flexion
Single Leg Stand / Balance
KOREA


Case
Treatment Goal
Muscle strengthening Quadriceps & Gluteus
(Hamstring begin at April)
Balance(Proprioception) training
Quadriceps muscle strength : 125% BW
LSI > 90%
KOREA
Buckthorpe et al., 2023


Conclusion
Pre-OP: 25.01.10
Post-OP 6M: 25.07.09
KOREA


Conclusion
Pre-Rehabilitation
Early RTS
Prevent AMI
Safe Rehabilitation
KOREA


KOREA
We think the Unthinkable
KOREA
UNIVERSITY

박재범

학력

신구대학교 물리치료학과 학사

한국체육대학교 사회체육대학원 스포츠재활전공 체육학과 석사

주요 경력

울백병원 스포츠메디컬 센터 근무 (2018~2023)

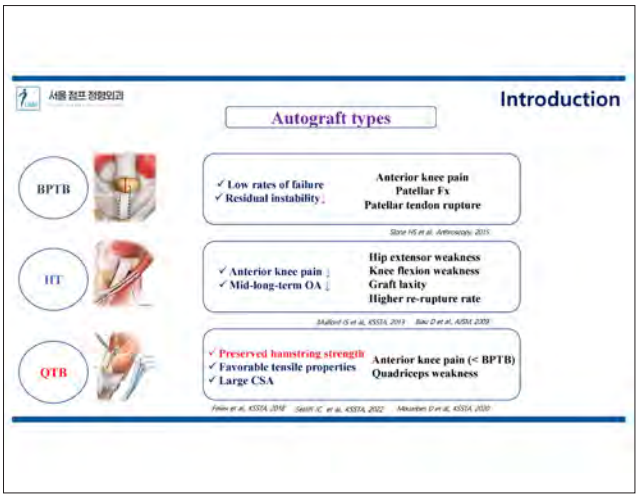
서울점프정형외과 PMC운동센터 근무(2023~)

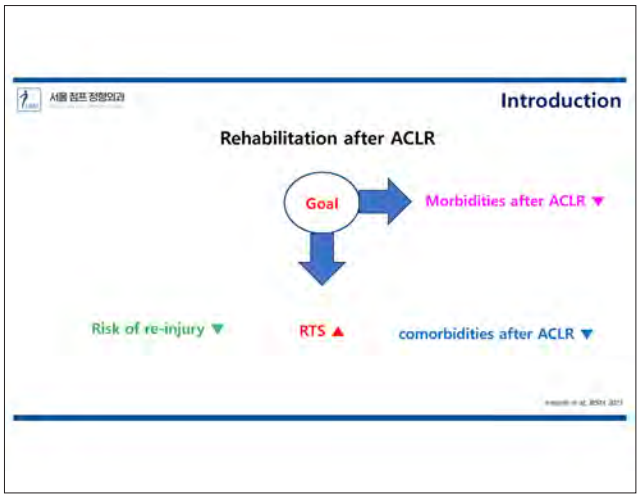
현재 소속 및 직위

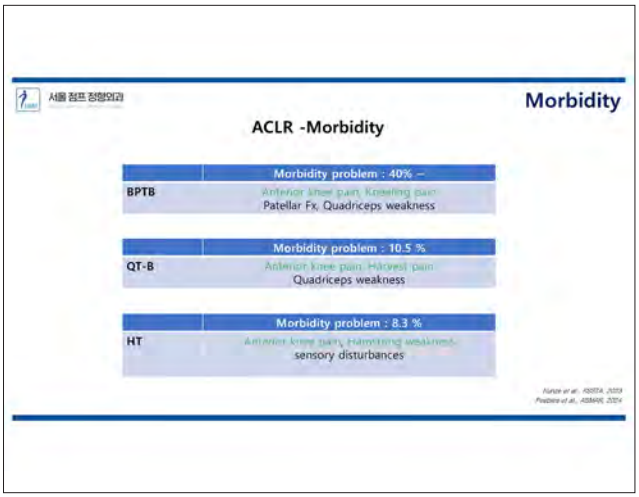
서울점프정형외과 PMC운동센터 / 실장

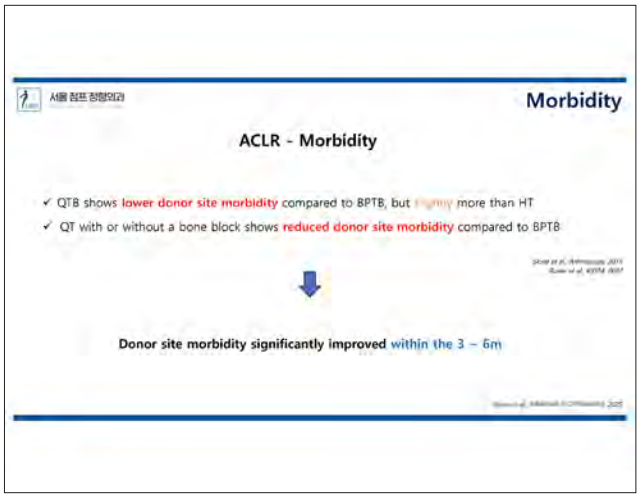
이식 유형에 따른 재활 전략: 실제적 고려 사항
Rehabilitation Strategies According to Graft Type: Practical Considerations

서울점프정형외과
박재범









서울 정프 정형외과

QT-B Morbidity

Comparison of knee extensor strength after anterior cruciate ligament reconstruction using either quadriceps tendon or hamstring tendon autografts

Horteur H et al., EJOST, 2022

A Prospective Randomized Controlled Trial Investigating Quadriceps Versus Hamstring Tendon Autograft in Anterior Cruciate Ligament Reconstruction

Ebert et al., AJSM 2024

서울 정프 정형외과

QT-B Morbidity

Q-Harvest
↓
Q-muscle force imbalance
↓
Functional limit
↓
Anterior knee pain

Harvest pain
↓
Strength exercise limit (CKC, OKC)
↓
Quadriceps weakness

✓ Harvest healing
↓
✓ Q-muscle strengthening

서울 정프 정형외과

Harvest healing factor

✓ QTB - specific considerations

Interventions are targeted to improve RF strength and load tolerance of the QT

Tendon healing phases

Healing Phase	Duration	Exercise Recommendations
Inflammatory Phase	0–1 wk	✓ Excessive load avoided ✓ Pain-free passive movements
Proliferative Phase	1–3 wks	✓ Light active exercises ✓ Gentle stretching initiated
Remodeling Phase	3–6 wks and beyond	✓ Higher-intensity active loading and stretching

Khan KI Scott et al, BJSM 2009
Diermeier et al, KSSTA, 2020

서울 정프 정형외과

Harvest healing factor

Stretching- load on the RF and QT (1wks~)

✓ **Mobilize the graft harvest site**

✓ **Stimulate quadriceps tendon remodeling**

Diermeier et al, KSSTA, 2020
Sole et al, JOPT, 2021

서울 정프 정형외과

Harvest healing factor

Quadriceps activation

Q-setting

Goal: Quadriceps activation while **creating tension** within the harvest site (**1wks~**)

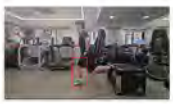
✓ Active tension in the harvest site will promote remodeling of the tendon

Rudavsky et al., J Physiother, 2014
Diermeier et al, KSSTA, 2020

서울 정프 정형외과

Harvest healing factor

RF Target exercise: Split squat (6wks~)



Involve hip flexion 90° of the forward leg
→ **Minimize contribution of the RF**

✓

Involve leg → rear leg (hip extension)
→ **Maximum contribution of the RF**

Diermeier et al, KSSTA, 2021

서울 참프 정형외과

HT Morbidity

- ✓ Reported that the rate of decrease in hamstring strength
  → Reach up to 30%
- ✓ Resisted hamstring strengthening is delayed
  → Soft tissue healing, to limit irritation to the hamstring donor site
- ✓ Recommendation
  → Resistive hamstring exercises should be delayed for 6 ~ 8 weeks

서울 참프 정형외과

HT Morbidity

- ✓ Decreased deep flexion strength and rotational stability

Hamstring weakness

Deep flexion 90° ↑ strength > knee flexion strength 0 ~ 60°

➢ Lead to more pronounced functional limitations than ADL

Athletes ACLR → damping ability ↓ in the hamstring muscles

➢ Negatively affect dynamic stability

서울 참프 정형외과

HT Morbidity

- ✓ Decreased deep flexion strength and rotational stability

Prone active curl
after 3weeks

Standing active curl
after 5weeks

Resistance curl
after 7weeks

Tibia IR sensory input

Rotational stability exercise

서울 참프 정형외과

Consideration of rehabilitation

- Range of motion
- Weight bearing
- Strength exercise
- Return to sports

서울 참프 정형외과

Range of motion

✓Early mobilization can improve knee flexion, extension ROM without knee laxity, regardless of the graft type used

PROM AAROM AROM

Stretching- load on the RF and QT (1wks~)

서울 참프 정형외과

Range of motion

- ✓ Disruption of the extensor mechanism
  → Persistent extensor Weakness, ROM limitations

✓ Knee extension deficit 5°

- Joint loading ▲
- Mechanical stress and shearing forces ▲
- Q-muscle weakness
- Lower muscle torque
- PFP

Quadriceps activation while harvest site creating tension

서울 정프 정형외과

Weight bearing

- ✓ Anterior tibial translation was not occurred during body weight shift exercise after ACLR
- ✓ Q / H co-contraction is important in reducing shear force

Simple Weight shifting

PWB with crutch

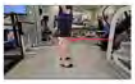
FWB

Normal walking from 4weeks

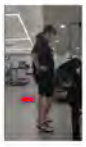
서울 정프 정형외과

Weight bearing

Quadriceps activation WB



Knee hyperextension WB



Quadriceps disable WB

- ✓ Hyperextension may lead to increased looseness or graft failure after ACLR

서울 정프 정형외과

Strength exercise: OKC

- ✓ Knee extension 40°-0°
  : Minimal ~ no hamstring muscle activity
  → ant. tibial translation
- ✓ OP 6wks~ 12wks
  OKC exercise interventions do not appear to significantly impact knee laxity

⬇

45 ° ~90 ° is safe

서울 정프 정형외과

Strength exercise: OKC

OKC Quadriceps Resistance Training / Graft Fixation	Intra-Articular	**OKC Exercise with Interference Screw Fixation (B-QT)** • ABOM: as tolerated • OKC quadriceps resistance exercise with distal tibial load: ▪ 45-90+ degrees weeks 3-4 ▪ 0-45+ degrees weeks 4-6+ **OKC Exercise with Suspensory Fixation (S-QT)** • ABOM: as tolerated • OKC quadriceps resistance exercise with distal tibial load: ▪ 45-90+ degrees weeks 3-10 ▪ 0-45+ degrees weeks 10-12+

- ➢ Graft osteointegration with the QTB- ACLR : accelerated resistance training approach within the first **4-6wks**

→ **Utilization of the B-QT with interference screw fixation may further justify this clinical decision**

서울 정프 정형외과

Strength exercise: OKC

✓ OP 6wks~ : Resistance exercise

Knee extension machine (90°~0°)

Continue to load the quadriceps tendon

서울 정프 정형외과

Strength exercise: OKC

- **HT autograft**

-Semitendinosus autograft harvest causes reduced strength and atrophy in the hamstrings

10~30% weakness of knee flexion strength

- **QTB autograft**
  - Save the knee flexor strength

서울 정프 정형외과

Strength exercise: OKC

- Hamstring exercise (QT / HT)

Prone active curl
after 1weeks / after 3weeks

Standing active curl
After 1weeks / after 5weeks

Resistance curl
Tolerable~ / after 7weeks

서울 정프 정형외과

Strength exercise: CKC

- CKC knee extension, through co-contraction less shear stress, increased stability occurs across the knee joint

➡ CKC seems to produce less shear force than OKC
Faster than OKC

서울 정프 정형외과

Strength exercise: CKC

- Technique variations of the squat may affect ACL loading / anterior knee pain

✓ Ankle ROM(DF) deficit
✓ Ankle-knee-hip co-work ▼

✓ Trunk flexion angle (30° ↓)

서울 정프 정형외과

Strength exercise: CKC

Sagittal plane exercise: squat, lunge

⬇

Transverse plane motion limit

⬇

Hip abductor, ER weakness

⬇

ACL loading / anterior knee pain

서울 정프 정형외과

Strength exercise: CKC

✓ OP 6wks~ : Progressive Eccentric exercise
✓ High tensile load limit within the first 6–8 weeks as tendon–bone healing occurs

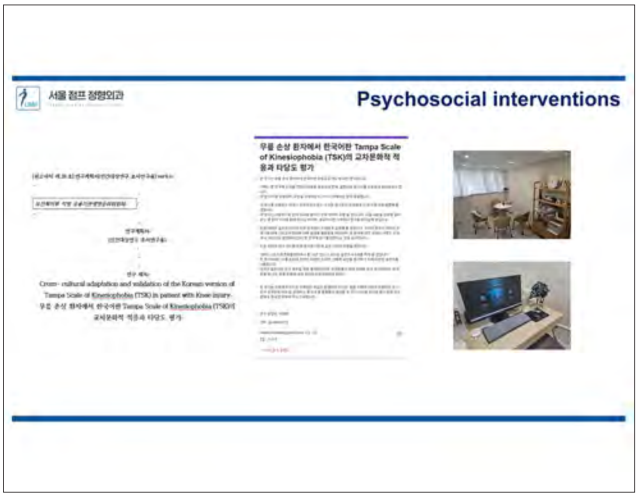
RF Target exercise

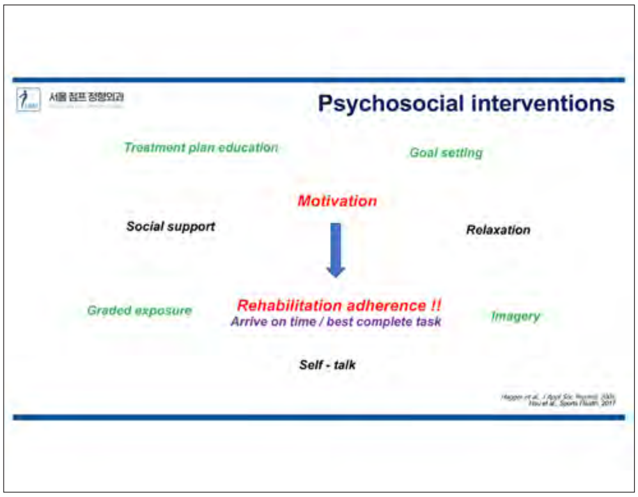
✓ Involve leg → rear leg
→ Maximum contribution of the RF

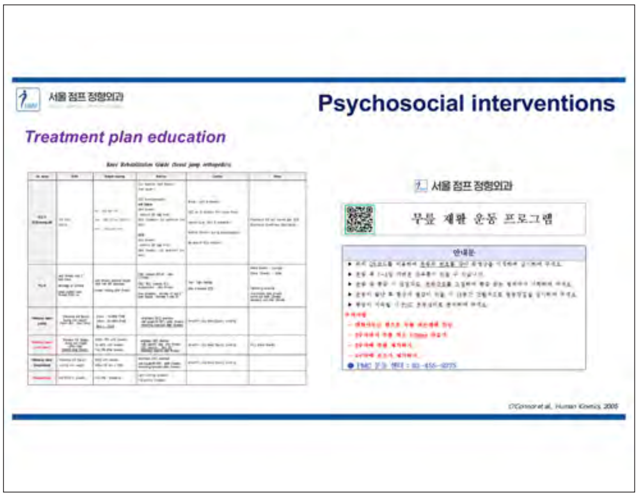
서울 정프 정형외과

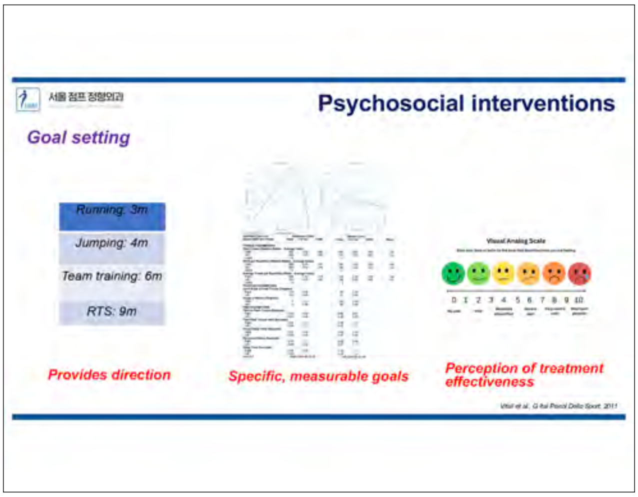
Strength exercise: CKC

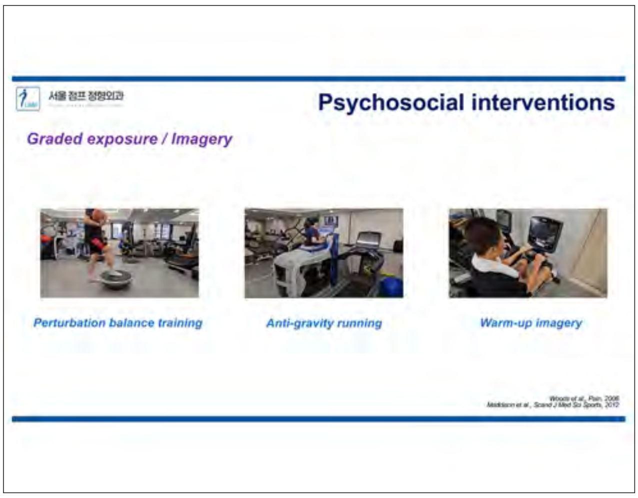
✓ OP 6wks~ : Progressive rotational stability ex


서울 점프 정형외과
Psychosocial interventions
무릎 손상 환자에서 한국어판 Tampa Scale of Kinesiophobia (TSK)의 교차문화적 적응과 타당도 평가
Cross- cultural adaptation and validation of the Korean version of Tampa Scale of Kinesiophobia (TSK) in patient with Knee injury
무릎 손상 환자에서 한국어판 Tampa Scale of Kinesiophobia (TSK)의 교차문화적 적응과 타당도 평가


서울 점프 정형외과
Psychosocial interventions
Treatment plan education
Goal setting
Motivation
Social support
Relaxation
Graded exposure
Rehabilitation adherence !!
Arrive on time / best complete task
Imagery
Self - talk


서울 점프 정형외과
Psychosocial interventions
Treatment plan education
서울 점프 정형외과
무릎 재활 운동 프로그램
O'Connor et al., Human Kinetics, 2005


서울 점프 정형외과
Psychosocial interventions
Goal setting
Running: 3m
Jumping: 4m
Team training: 6m
RTS: 9m
Visual Analog Scale
0 1 2 3 4 5 6 7 8 9 10
Provides direction
Specific, measurable goals
Perception of treatment effectiveness


서울 점프 정형외과
Psychosocial interventions
Graded exposure / Imagery
Perturbation balance training
Anti-gravity running
Warm-up imagery
Woods et al., Pain, 2006


THANK YOU FOR YOUR ATTENTION
YouTube
서울점프정형외과
검색
UMP
서울 점프 정형외과

이진혁

학력

고려대학교 물리치료학과 학사

고려대학교 교육대학원 체육교육전공 석사

고려대학교 보건과학대학원 재활과학전공 박사

주요 경력

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2020. 우수 구연상 (대한관절경학회)

현재 소속 및 직위

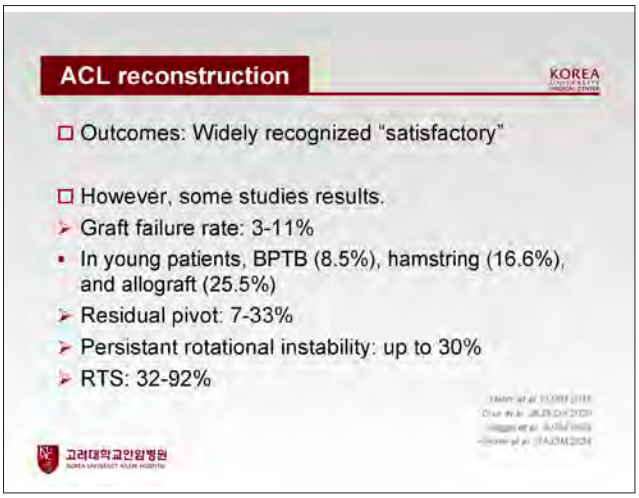
고려대학교 안암병원 스포츠의학센터 스포츠의학사

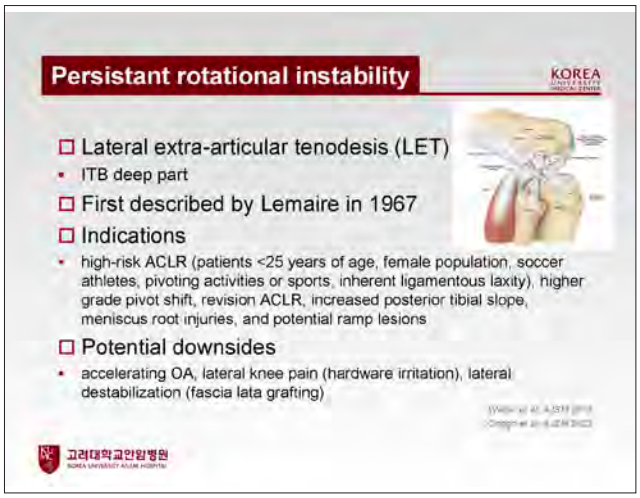
대표논문

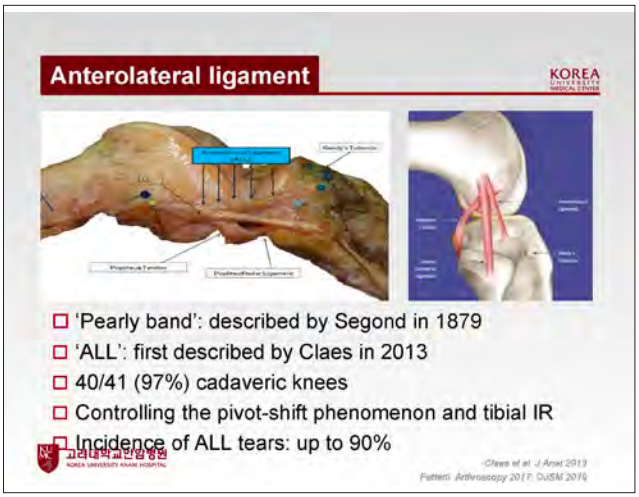
1. Lee JH, Lee GB, Chung WY, Jang K. Quadriceps muscle fatigue is associated with return to preinjury sports following primary ACL reconstruction with hamstring autograft and tibialis anterior allograft. Orthop J Sports Med, 2025 accepted.
2. Lee JH, Rhim HC, Lee SJ, Kang CH, Han SB, Jang K. Comparison of Dynamic Postural Stability in Autografts Versus Allografts Following Anterior Cruciate Ligament Reconstruction With Remnant Preservation: A Prospective Study With 1-Year Follow-up. Orthop J Sports Med. 2025 Jan 20;13(1):23259671241303752.
3. Lee JH, Lee GB, Chung WY, Han SB, Jang K. Addition of anterolateral ligament reconstruction to primary anterior cruciate ligament reconstruction could benefit recovery of functional outcomes. Sci Rep. 2024 May 20;14(1):11440

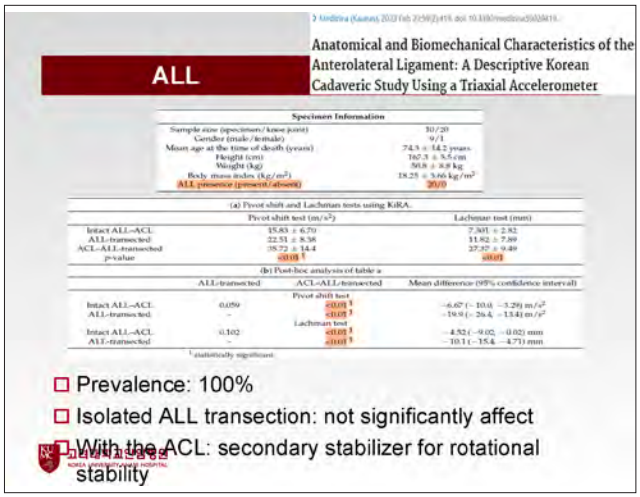
ALL 재건술을 통한 전방십자인대 재건술 후 임상적 및 기능적 결과
Clinical and Functional Outcomes after ACL Reconstruction with ALL Reconstruction

고려대안암병원 스포츠의학센터
이진혁









ALL reconstruction

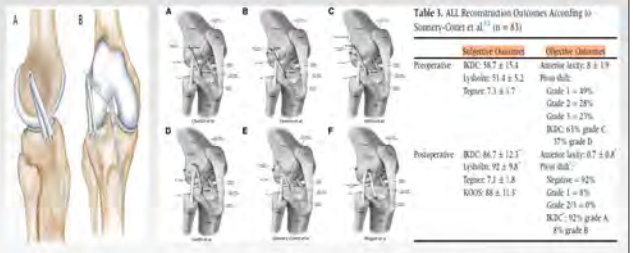


Table 3. ALL Reconstruction Outcomes According to Sonnery-Cottet et al[12] (n = 83)

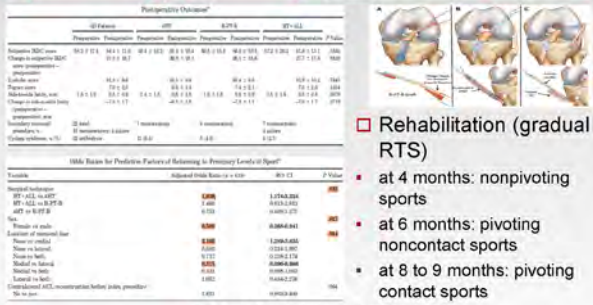
	Subjective Outcomes	Objective Outcomes
Preoperative	IKDC: 56.7 ± 15.4 Lysholm: 51.4 ± 5.2 Tegner: 7.3 ± 1.7	Anterior laxity: 8 ± 1.9 Pivot shift: Grade 1 = 19%, Grade 2 = 28% Grade 3 = 23%, IKDC: 61% grade C 15% grade D
Postoperative	IKDC: 86.7 ± 12.1 Lysholm: 92 ± 9.8 Tegner: 7.2 ± 1.8 KOOS: 88 ± 11.5	Anterior laxity: 0.7 ± 0.8 Pivot shift: Negative = 92% Grade 1 = 8% Grade 2/3 = 0% IKDC: 92% grade A 8% grade B

- ALL reconstruction: better knee biomechanics and stability

DePhillipo et al. Arthroscopy 2017 (systematic review)

Comparison of Graft type

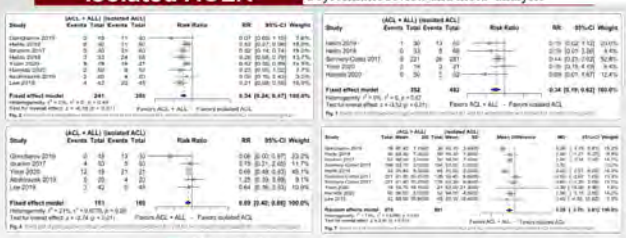
Anterolateral Ligament Reconstruction Is Associated With Significantly Reduced ACL Graft Rupture Rates at a Minimum Follow-up of 2 Years: A Prospective Comparative Study of 502 Patients From the SANTI Study Group



- Rehabilitation (gradual RTS)
  - at 4 months: nonpivoting sports
  - at 6 months: pivoting noncontact sports
  - at 8 to 9 months: pivoting contact sports
- HT+ALL: higher 1.94ts > HT
- Female: lower 41% < Male
- LM > MM

Combined ACLR vs. Isolated ACLR

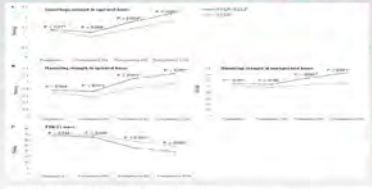
Clinical outcomes of combined anterior cruciate ligament and anterolateral ligament reconstruction: a systematic review and meta-analysis

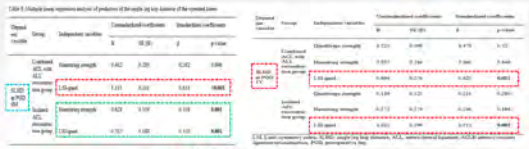


- 10 articles
- Compared with Isolated ACLR
  - Post-op Pivot shift & Lachman: reduced 66% and 44%
  - Rerupture rate: reduced 66%
  - RTS: higher 18%, but did not differ
  - Lysholm score: higher score

Additional ALLR

Addition of anterolateral ligament reconstruction to primary anterior cruciate ligament reconstruction could benefit recovery of functional outcomes



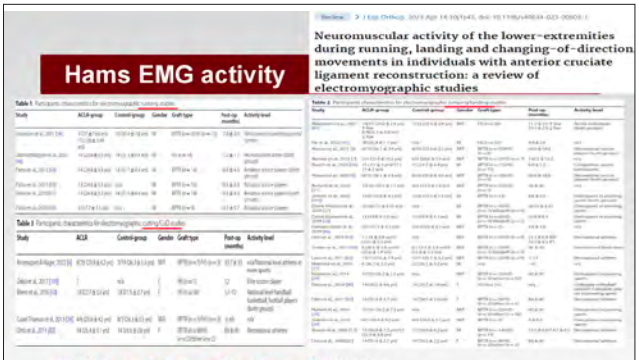


- At 6 & 12 months, better quadriceps strength, hamstring strength, TSK-11 scores, and SLHD for the combined ACLR group
- Post-op 1 year Pivot shift was better in cmbinded ACLR group

- At 6 & 12 months,
  - combined ACLR group: LSI-quad
  - isolated ACLR group: Hamstring strength and LSI-quad

Hams EMG activity

Neuromuscular activity of the lower-extremities during running, landing and changing-of-direction movements in individuals with anterior cruciate ligament reconstruction: a review of electromyographic studies



- "**Hamstrings-dominant**"strategy
  - Protective mechanism against graft re-injury by reducing anterior shear forces at the knee

Systematic & meta-analysis

The addition of Anterolateral Ligament Reconstruction to Primary Hamstring Au-
lograft ACLR Improves Objective Rotatory Stability and Reduces Graft Rupture
Rates: a Systematic Review and Meta-analysis

Baseline characteristics

Parameters	ACLR	ACLR–ALLR	p-value
Age (years)	27.06 ± 3.37	25.00 ± 3.19	**< 0.0001**
Male (%)	70.05%	71.33%	0.2268
BMI	23.62 ± 2.66	23.52 ± 2.72	0.7671
FU (months), range	31.87 ± 13.36 (12–60)	31.01 ± 13.25 (12–60)	0.2608
Injury-to-surgery interval (months	6.86 ± 5.41	6.20 ± 5.49	0.3554
Athlets prevalence (%)	46.39% (258/122)	53.60% (306/133)	0.5771

Outcome data

Outcome	ACLR	ACLR-ALLR	p-value
Anterior Drawer (events/total)	18/156	9/164	0.0738
Lachman (%)	21/195 (10.77%)	9/193 (4.67%)	**0.0371**
STSD (mm)	1.80 ± 1.36	1.04 ± 0.65	**< 0.0001**
Pivot Shift (%)	36/348 (10.40%)	9/288 (2.08%)	**0.00003**
Graft Re-rupture (%)	34/475 (11.37%)	12/466 (2.58%)	**< 0.00001**
Complications (events/total)	32/203	44/173	0.8888

- 12 articles
- ALL-R: better outcomes

Our preferred ACLR rehabilitation


scientific reports

OPEN Addition of anterolateral ligament reconstruction to primary anterior cruciate ligament reconstruction could benefit recovery of functional outcomes

Department of Sports Medical Center, Ansan Hospital, Korea University College of Medicine

ACL Reconstruction Rehabilitation Protocol

Phase 1: Immediately post-operatively to week 6

Goals: The recovery period following the surgery

- Pain controlling, reducing swelling, recovering the range of motion, and normalizing gait pattern
- Control inflammation, swelling and pain
- Quadriceps activation
- Initial quadriceps/hamstring strengthening (without a leg)
- Active and passive knee ROM
- Exercises for core, hip and calf muscles
- Education for walking with crutches & Restore normal gait on stable (level) surface

Exercises:

- Modalities (ice, transcutaneous electrical nerve stimulation (TENS), interferential current therapy (ICT), ultrasound (US))
- Patella mobilization
- Quad sets
- Self passive active ROM (wall slides, heels sliders, heel prop, extension overpressure)
- Ankle pump
- FWB-> TWB gait training (with and without crutches and brace)
- Straight leg raises with neuromuscular electrical stimulation (NMES)
- Terminal knee extension (CKC-> OKC, consider NMES)
- Calf/Hamstring stretching and strengthening
- 4-direction (flexion, extension, addiction, abduction) leg strengthening in full extension with elastic band

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Important of knee extension

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- **Full extension**
- Failure to regain full extension in the first few weeks(3wks) after ACL reconstruction is a recognized risk factor for adverse long-term outcome
- **AMI(Quadriceps Arthrogenic Muscle Inhibition)** is believed to be responsible for the failure of quadriceps activation that is associated with hamstring contracture


Fig. 1. Knee extension deficit evaluation of right knee (asterisk) with patient in supine position.

JR Diekfuss et al. Arthrosc Tech 2018

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Interventions

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FIGURE 1. (A) A low-load, long-duration stretch to restore the patient's full passive knee extension. A 4.5-kg weight is used for 30 to 45 minutes, with a bolster placed under the ankle to create a stretch. (B) Commercial device (Extensastretcher, DMA, Inc, Atlanta, GA) to improve extension range of motion and prevent compensatory hip external rotation.


FIGURE 2. Prone hang. Begin without weight for 10 minutes and progress to increased weight around the ankle and longer durations as needed for the desired result. A belt above the hips, wrapped around the table, may also be used to help avoid compensations at the hip during the activity.

Wilk et al. JOSPT 2012
Adams et al. JOSPT 2012

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Most promising interventions for AMI

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- AMI contributes to quadriceps atrophy

DA Rice & PJ McNair, Semin Arthritis Rheum 2010

- **Most promising interventions**
- Exercise, Cryotherapy, TENS, and NMES

DA Rice & PJ McNair, Semin Arthritis Rheum 2010
Sonnery-Cottet et al. Br J Sports Med 2019

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Early vs. delayed WB

Delayed versus Accelerated Weight-bearing Rehabilitation Protocol Following Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis

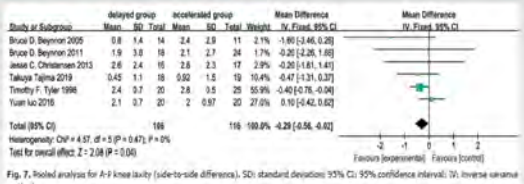
Fig. 7. Pooled analysis for A-P knee laxity (side-to-side difference). SD: standard deviation; 95% CI: 95% confidence interval; IV: inverse variance method.

- Early WB: full within 2 wks
- Delayed WB: full after 2 wks
- Greater laxity and bone tunnel widening than delayed weight-bearing rehabilitation

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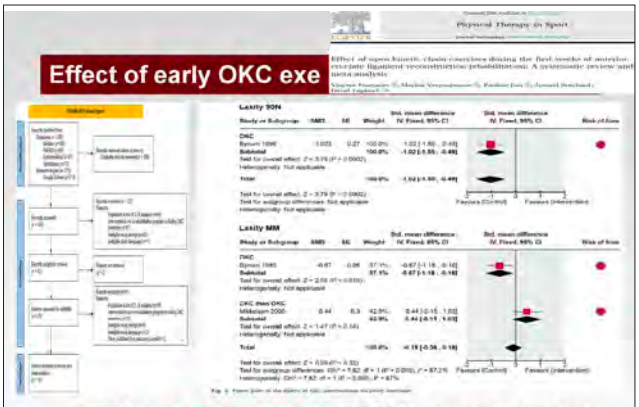
Effect of early OKC exe



- OKC, beneficial effects on PROMs, strength, function, and return to play, especially when performed at least 4 weeks after surgery in rehabilitation programs

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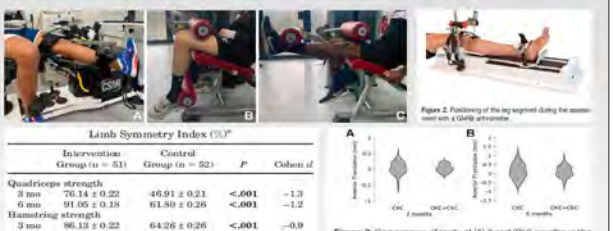
Graft laxity & OCK

Evaluation of Muscle Strength and Graft Laxity With Early Open Kinetic Chain Exercise After ACL Reconstruction: A Cohort Study



Limb Symmetry Index (%)

	Intervention Group (n = 51)	Control Group (n = 52)	P	Cohen d
Quadriceps strength				
3 mo	76.14 ± 0.22	46.91 ± 0.21	<.001	−1.3
6 mo	91.05 ± 0.18	61.80 ± 0.26	<.001	−1.2
Hamstring strength				
3 mo	86.13 ± 0.22	64.26 ± 0.26	<.001	−0.9
6 mo	91.80 ± 0.17	82.42 ± 0.24	.024	−0.4

Figure 3. Comparison of laxity at (A) 3 and (B) 6 months in the intervention and control groups (the width of the plots indi-

- Using a Hams autograft
- Started at post-op 4 wks, 3 times per week
- Evaluation at 3 and 6 ms
- Laxity: not significant at 3 and 6 months

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Effective OCK exe

Anterior cruciate ligament strain and tensile forces for weight-bearing and non-weight-bearing exercises: a guide to exercise selection

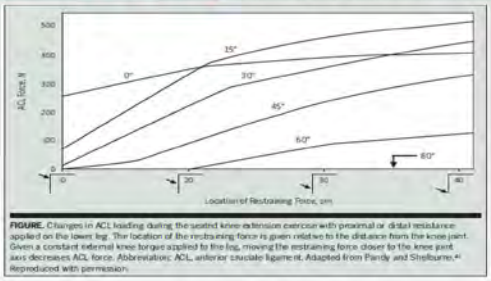

FIGURE. Changes in ACL loading during the seated knee extension exercise with proximal or distal resistance applied on the lower leg. The location of the restraining force is given relative to the distance from the knee joint. Given a constant external knee torque applied to the leg, moving the restraining force closer to the knee joint axis decreases ACL force. Abbreviation: ACL, anterior cruciate ligament. Adapted from Pandy and Shelburne.[4] Reproduced with permission.

- 2 times at angles less than 30° knee flexion angle
- No ACL loading at knee flexion angles greater than 60°

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Tunnel widening

Tunnel enlargement after anterior cruciate ligament surgery

- **Accelerated Rehabilitation**
- ✓ Early full WB
- ✓ Immediate unlimited ROM
- ✓ Early strengening exe: full extension
- ➢ Tendon to bone healing
  - 8 to 12 wks: graft tunnel motion (windshield wiper effect and bungee cord effect)
- ✓ Early return to activity: 4 to 6ms

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Comparison of Bone tunnel

- ACLR+ALL
- ACLR

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High knee flexion and Tibial IR strength weakness

- Hamstring tendon harvest causes significant weakness of hamstring muscle strength at high knee flexion angles(18M follow-up

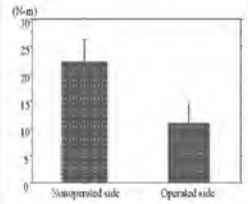

Figure 2. Isometric peak torque of the hamstrings in the non-operated and operated knees (measurement in the prone position at 110° of knee flexion with maximum plantar flexion of the ankle).

➢Minimum 2 years follow-up

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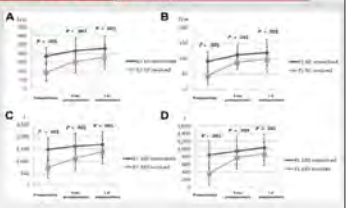
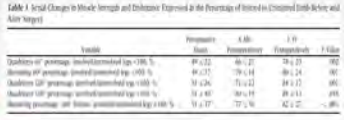
Recovery hamstring strength

Serial changes in knee muscle strength after anterior cruciate ligament reconstruction using hamstring tendon autografts



- Knee muscle strength recovered progressively
- But did not fully recover (80% of uninjured leg) even 1 year after surgery
- This recovery pattern of hamstring muscle strength was also seen at deep knee flexion of 100°



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Hamstring regeneration

Medial hamstring tendon regeneration following harvest for anterior cruciate ligament reconstruction: fact, myth, and clinical implication

FIGURE 1. Regenerated hamstring tendons are on the right. They terminate as a diffuse web-shaped insertion at the level of the gastrocnemius. (Reprinted with permission.[33])

- Most significant strength deficits
  - Deep knee flexion and tibial IR
  - Knee flexion strength is minimally affected
- Hamstring tendon regeneration does indeed occur, but with structural and functional alterations

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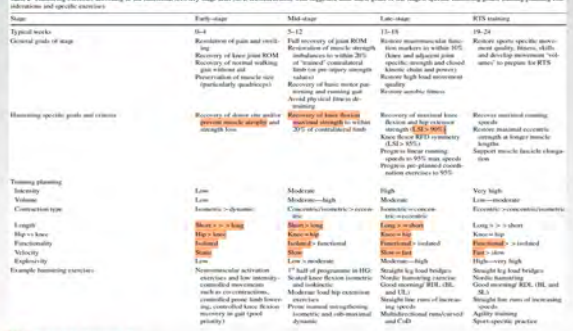
Hamstring exercise

Recommendations for Hamstring Function Recovery After ACL Reconstruction



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Return to sports

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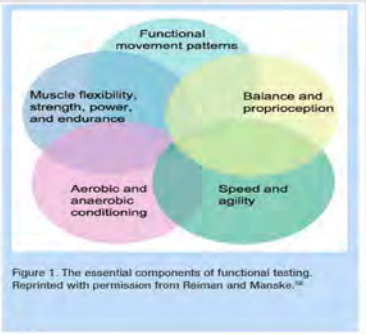

Figure 1. The essential components of functional testing. Reprinted with permission from Reiman and Manske.[56]

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Reiman & Manske. Athletic training 2013

Isokinetic strength test

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- Isokinetic muscle strength tests (90% recovery)

Beynnon. J Bone Joint Surg Am 2002

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Postural stability test

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- Dynamic postural stability (ICC = 0.77 to 0.83)

Lee et al. Knee Surg Sports Traumatol Arthrosc 2015

- Assess star excursion balance test (SEBT, associated with lower extremity muscle strength)

Clegg et al. JOSPT 2015

- Poor postural stability is important predictor for reinjury after ACLR

Palmieri et al. Am J Sports Med 2010

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Return to sports

- Functional performance tests
  (80 to 90% recovery)
- LSI= Involved leg/ Uninvolved leg x 100
  (ICC= 0.77 to 0.99)
- 6M hop tests
  - Single Leg Hop for Distance
  - Triple Hop for Distance=(summation)
  - Triple Cross-over Hop for Distance
  - 6M Timed Hop

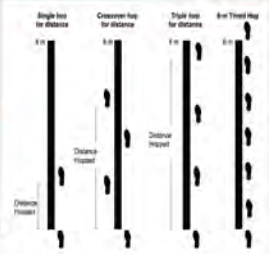

Figure 2. The 4 single-legged hop tests: single hop for distance, crossover hop for distance, triple hop for distance, and 6-m timed hop.

Reid LA, J Orthop Sports Phys Ther 1987
Gustavsson et al. Knee Surg Sports Traumatol Arthrosc 2006

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Functional performance test

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Evaluation for return to sport

- ☐ Isokinetic muscle performance tests
- ☐ Postural stability tests
  - Pre, 3rd month, 6th month, 9th month, 1st year
- ☐ Functional performance tests

➢ One single functional performance test may also be insufficient in the dynamic assessment of a patients functional level

Reid LA, J Orthop Sports Phys Ther 1987

- ☐ Quality of movement (dynamic knee valgus)

Dekkers et al. Orthop J Sports Med 2016
Weber et al. Phys Ther 2014

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Take home message

- ☐ ALLR: improved translation & rotational stability
- ☐ Stability & Function: ACLR+ALL > Isolated ACLR

- ☐ Important factors of rehabilitation
  - ✓ Regain Full extension
  - ✓ Early Quad reactivation
    - Load: proximal >> distal tibia
  - ✓ Regain deep flexion Hams strength
    - Short length >> Long length
    - Hip >> Knee joint

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Thank you for your attention

KU MEDICINE

고려대학교안암병원

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

자유 연제 구연 1

Free paper presentation 1

좌장: 양산부산대병원 이창형, 중앙보훈병원 여의동

MUCL 재건술 단독 수술과 VEOS 병행 수술에서 이소성 골화 발생 위험 비교 분석

Which surgery has a higher risk of heterotopic ossification: isolated MUCL reconstruction or simultaneous MUCL and VEOS surgery

청담리온정형외과

심창헌

목적(Background)

Heterotopic ossification (HO) is a known complication following elbow surgery, particularly in procedures involving the medial ulnar collateral ligament (MUCL) and valgus extension overload syndrome (VEOS). While it is commonly hypothesized that simultaneous VEOS procedures with MUCL reconstruction could elevate the risk of heterotopic ossification due to increased surgical exposure and soft tissue trauma, direct comparative studies evaluating this risk remain limited. The aim of this study is to investigate whether the addition of simultaneous VEOS procedures to MUCL reconstruction leads to a significantly higher incidence of HO. By evaluating postoperative outcomes in patients who underwent either isolated MUCL reconstruction or combined MUCL and VEOS surgery, we aim to provide evidence-based guidance for surgical decision-making in this population.

대상 및 방법(Methods)

A retrospective cohort study was conducted including patients who underwent either isolated MUCL reconstruction (M group) or combined MUCL and VEOS procedures (MV group). Postoperative radiographs and clinical records were reviewed to assess the presence of HO. The primary outcome was the incidence of radiographically confirmed HO. Secondary analyses included perioperative variables potentially associated with HO development.

결 과(Results)

A total of 264 patients were included (M group: n=107; MV group: n=157). HO was identified in 4.67% of the M group and 8.28% of the MV group. There was no statistically significant difference in HO incidence between the two groups (p=0.27). Multivariate analysis controlling for confounding variables such as

surgical duration and prior elbow trauma revealed no independent association between combined procedures and increased HO risk.

결 론(Conclusion)

Contrary to previous reports, the addition of VEOS surgery to MUCL reconstruction does not appear to increase the risk of heterotopic ossification. These findings suggest that simultaneous surgical management of MUCL and VEOS may be performed without heightened concern for HO development, provided appropriate perioperative management is employed.

슬관절 OCD 환자에서의 autologous bone peg 를 사용한 고정술의 임상적 결과
Clinical Outcomes of Arthroscopic Fixation Using Autologous Bone Pegs for Osteochondritis Dissecans of the Knee

세종스포츠정형외과
김주환, 차민석

목적(Background)
Fixation surgery for high-grade osteochondritis dissecans (OCD) of the knee is performed to preserve the articular cartilage and facilitate successful return to sports. Various fixation techniques have been reported, including the use of metallic headless screws, bioabsorbable screws, and suture anchors. However, clinical outcomes following fixation using autologous bone pegs—a technique with biological advantages—have been rarely reported. The purpose of this study is to present the clinical outcomes of OCD fixation using autologous bone pegs.

대상 및 방법(Methods)
This study included 15 patients who underwent more than one year of follow-up between 2021 and 2024. Preoperative data collected included the patient's primary sport, patient-reported outcome (PRO) scores, and lesion characteristics—such as size, grade, and location—based on preoperative MRI. Postoperative evaluations included PRO scores, time to return to running, and time to return to sports. Postoperative complications were also documented. Additionally, MOCART scores were assessed on follow-up MRI to evaluate cartilage repair status.

결 과(Results)
The mean age of the patients was 15.2 ± 3.1years, and the mean follow-up period was 17.2 ± 12.1 months. Lesion locations included the medial femoral condyle (MFC) in 5 patients, trochlea in 6 patients, and the lateral femoral condyle (LFC) in 4 patients. According to the International Cartilage Repair Society (ICRS) classification, 9 patients had Grade 4 OCD lesions, and 6 patients had Grade 3 lesions. The preoperative IKDC score was 42.04 ± 20.57. The postoperative IKDC score was 85.4, showing a statistically significant

improvement compared to the preoperative value. (P<.0001) The mean time to return to running after surgery was 5.4 ± 0.9 months, and the mean time to return to sports was 7.6 ± 2.2 months. The postoperative MOCART score was 72.0 ± 10.4.Two patients required reoperation due to persistent joint effusion during the follow-up period. In both cases, fracture of the head portion of the autologous bone peg was identified as the underlying cause.

결 론(Conclusion)

Bone peg fixation technique for osteochondritis dissecans of the knee resulted in favorable clinical outcomes.

만성 외측 발목 불안정증 환자에서 변형 브로스트롬 수술과 운동 기반 치료의 비교 결과

Comparative Outcomes of Modified Broström procedure and Exercise-Based Treatment in Patients with Chronic Lateral Ankle Instability

건국대학교병원 정형외과 족부관절센터 건국대학교병원 스포츠의학센터

이유빈, 김우섭, 조승익, 박병선, 강은비, 배주원, 정홍근

목적(Background)

Chronic lateral ankle instability (CLAI) frequently follows ankle sprains and is initially managed with conservative rehabilitation. However, surgical intervention may be warranted when symptoms persist. This study compared short-term functional outcomes of conservative treatment and the modified Broström procedure (MBP) in CLAI patients.

대상 및 방법(Methods)

Sixty patients were assigned to either a conservative treatment group (n=30) or MBP group following failed conservative treatment (n=30). The MBP group underwent 4 weeks of postoperative immobilization prior to rehabilitation. Outcomes were evaluated pre-treatment and at 3 months using the American Orthopaedic Foot and Ankle Society score, Karlsson score, visual analog scale, isokinetic dynamometry for muscle strength, and Y-balance test.

결 과(Results)

Both groups showed significant improvements in clinical scores ($p<0.05$). The MBP group demonstrated enhanced dynamic stability and significant gains in the posteromedial, posterolateral, and composite Y-balance scores ($p<0.05$). In the conservative group, Y-balance performance improved across all directions with better limb symmetry index. Muscle strength improved in all directions in the conservative group, whereas only eversion strength increased significantly in the MBP group ($p<0.05$).

결 론(Conclusion)

Exercise-based treatment showed comparable or superior short-term outcomes to the modified Broström procedure in some measures, including muscle strength and balance symmetry.

한국 엘리트 야구선수를 대상으로 한 Hybrid UCL 재건술 후 기능적 결과
Functional Outcomes Following Hybrid UCL Reconstruction in Elite Korean Baseball Players

세종스포츠정형외과
금정섭

목적(Background)
팔꿈치의 척측 측부 인대(UCL) 손상은 특히 투수를 포함한 엘리트 오버헤드 스포츠 선수에서 흔히 발생합니다. 최근 전통적인 인대 재건술에 내부 보강(suture tape augmentation)을 병합한 hybrid UCL 재건술이 생체역학적 안정성과 경기 복귀율 향상 가능성으로 주목받고 있습니다.

대상 및 방법(Methods)
2021년부터 2023년까지 hybrid UCL 재건술을 받은 한국 프로야구선수 70명을 후향적으로 분석하였습니다. 수술은 modified docking 기법을 이용한 3-strand 재건술이 적용되었으며 자가건과 내부 보강 테이프(FiberTape®)를 사용하여 시행되었습니다. 최소 12개월의 추시가 이루어졌으며, 기능 평가는 안정성, 근력, 통증, 구속 증가를 포함한 10점 척도로 정량화하였습니다.

결 과(Results)
총점은 평균 8.5 ± 1.1점이었으며, 전체의 87.1%가 8점 이상을 기록했습니다. 51.4%는 수술 전보다 투구 구속이 증가하였습니다. 복귀 시기와 구속 증가 사이에는 통계적으로 유의한 상관관계($r = 0.25$, $p = 0.038$)가 나타났습니다. 반면, 안정성, 근력, 통증과 복귀 시기 간에는 유의한 상관관계가 없었습니다.

결 론(Conclusion)
3-strand 자가건과 내부 보강을 이용한 hybrid UCL 재건술은 한국 엘리트 야구선수에서 뛰어난 주관적 만족도와 기능 회복을 보였습니다. 재활 기간이 길수록 구속 증가와 연관되었으며, 개별화된 복귀 전략의 중요성을 시사합니다.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 5: 스포츠인의 슬개대퇴관절 문제

Patellofemoral problems in sports athletes

좌장: 서울바른세상병원 임홍철, 서울대학교 최호천

이상훈

소속

SNU서울병원 (대표원장)

학력

서울대학교 의예과
서울대학교 의학과
서울대학교 의학대학원 정형외과학 석사
서울대학교 의학대학원 정형외과학 박사

경력 및 연수

1995-1996 서울대학교병원 수련의
1997-2001 서울대학교병원 정형외과 전공의
2001-2002 서울대학교병원 정형외과 전임의
2002-2003 충무병원 정형외과
2003-2004 서울대학교병원 정형외과 임상강사
2004-2011 서울대학교병원 정형외과 임상조교수
2011-2012 서울대학교병원 정형외과 임상부교수
2010-2012 Exchange scholar, Orthopaedic Surgery, University of Pittsburgh Medical Center (UPMC)
Researcher, stem cell research center, UPMC
피츠버그의대 스포츠메디컬센터 펠로우쉽
피츠버그대학교 줄기세포연구센터 펠로우쉽
2012-2016 서울대학교 정형외과학교실 부교수

면허 및 자격증

1995 의사면허증 : 보건복지부
2001 정형외과 전문의자격증 : 보건복지부
2007 스포츠의학 세부전문의 자격증 : 대한스포츠의학회

대외 활동

대한컬링연맹 의무위원장
한국프로축구연맹 의무위원
LG트윈스 필드주치의
대한골프의학연구회 학술자문위원

증례 발표 1
Case presentation 1

SNU서울병원
이상훈

이진규

주요 경력

한양대학교 서울병원 서울 전임 교수 2017년 3월 ~ 현재

한양대학교 서울병원 서울 임상 교수 2013년 3월 ~ 2017년 2월

한양대학교 서울병원 서울 슬관절 전임의 2011년 3월 ~ 2013년 2월

(현)학회 및 스포츠단체 분야 활동

- International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine(ISAKOS, faculty)
- 대한스포츠의학회 / 국제위원 / 이사
- 대한스포츠과학 운동의학회 / 이사
- 대한정형스포츠학회 / 스포츠과학 위원
- 대한정형외과학회 / 학회지 심사위원
- 대한관절경학회 / 학술위원
- 대한슬관절학회 / 학회지 심사위원 / 학술위원 / 학술홍보위원
- 대한농구협회 / 의무위원 / 국가대표 주치의
- 대한배구협회 / 의무위원 / 국가대표 주치의

스포츠 이벤트 활동 경력

- 2018 평창 동계올림픽 triathlon F.O.P physician
- 2019 FIFA U-17 World Cup 남자 축구대표팀 주치의
- 2020 도쿄 올림픽 여자 농구대표팀 주치의
- 2022-202 WTA Korea Open tennis tournament medical director

증례 발표 2
Case presentation 2

한양대병원
이진규

정규성

학력

한양대학교 의학과 학사

한양대학교 일반대학원 의학과 석사

한양대학교 일반대학원 의학과 박사

주요 경력

대한스포츠의학회 분과 전문의, 편집위원회 간사

K 리그 프로축구연맹 의무위원 (슬관절)

한국전력 빅스톰 프로배구단 팀닥터

대한핸드볼협회 의무위원회 필드닥터

평창동계올림픽 바이애슬론 의무지원

현재 소속 및 직위

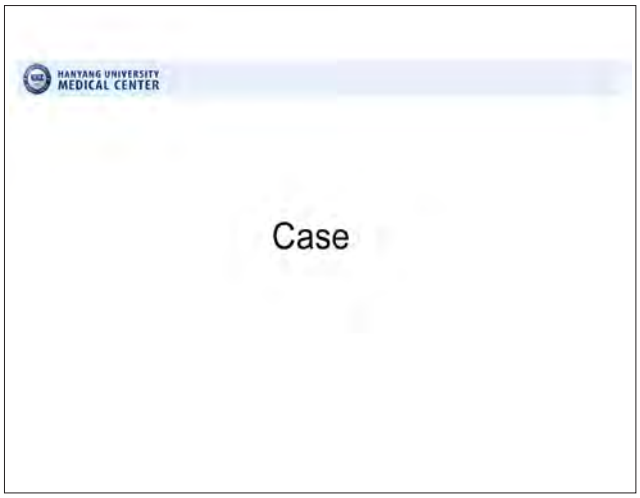
한양대학교 구리병원 정형외과 부교수

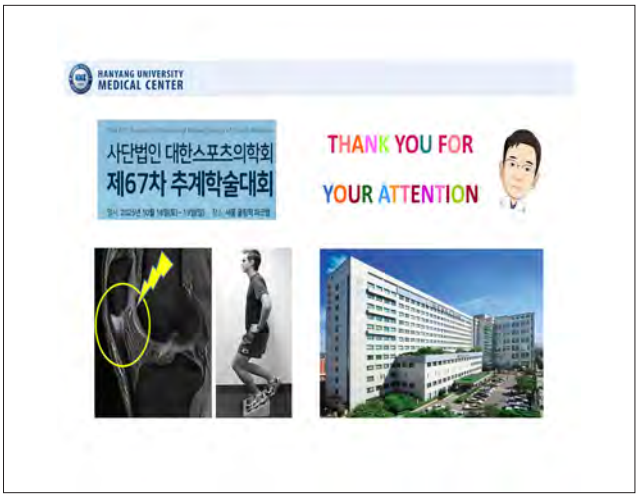
대표논문

1. Comparison of Clinical and Radiologic Results Between Partial Meniscectomy and Refixation of Medial Meniscus Posterior Root Tears: A Minimum 5-Year Follow-up
   ; Chung KS, Ha JK, Yeom CH, Ra HJ, Jang HS, Choi SH, Kim JG
   ; Arthroscopy. 2015 Oct;31(10):1941-50
2. Are Muscle Strength and Function of the Uninjured Lower Limb Weakened After Anterior Cruciate Ligament Injury? Two-Year Follow-up After Reconstruction.
   ; Chung KS, Ha JK, Yeom CH, Ra HJ, Lim JW, Kwon MS, Kim JG
   ; Am J Sports Med. 2015 Dec;43(12):3013-21
3. Root Repair Versus Partial Meniscectomy for Medial Meniscus Posterior Root Tears: Comparison of Long-term Survivorship and Clinical Outcomes at Minimum 10-Year Follow-up.
   ; Chung KS, Ha JK, Ra HJ, Yu WJ, Kim JG
   ;Am J Sports Med. 2020 Jul;48(8):1937-1944

증례 발표 3
Case presentation 3

한양대구리병원
정규성





The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

자유연제 구연 2

Free paper presentation 2

좌장: 서울아산병원 최경효, 인하대병원 류동진

전방십자인대 재건술과 동반된 내측측부인대 손상의 비수술적 치료의 2년 추시 임상 결과

Nonoperative Management of Medial Collateral Ligament Injury in Combined Anterior Cruciate Ligament Reconstruction Provides Satisfactory Clinical Outcomes at 2 Year Follow Up

[1]고려대학교 구로병원 정형외과, [2]고려대학교 구로병원 스포츠의학실

[1]박뿌리, [1]손정호, [2]박세현, [1]배지훈

목적(Background)

The purposes of this study were to investigate the clinical results of nonoperative management of concomitant MCL injury to ACL reconstruction (ACLR) and to compare those results with those results of isolated ACL reconstruction without a MCL injury.

대상 및 방법(Methods)

A total of 138 patients (Male 112, mean age 28.4 years old) were included by the study criteria. The patients were classified as 2 groups whether MCL injury was combined. ACL-MCL injury was Group 1 (n=27), and isolated ACL injury was Group 2 (n=111). 2-year clinical outcomes included patient-reported outcomes (PROM- Lysholm score, Tegner activity level, and IKDC 2000 subjective score), Quadriceps/ Hamstring muscle strength deficit, return to sports (RTS) and graft maturation. We asked patients if they returned to the any type of sports at 2-year after ACLR. The healing status of ACL graft was evaluated on second-look arthroscopy using four parameters: graft continuity, tension, synovial coverage, and vascularization. Those parameters were compared between two groups. Statistical significance was set at p-value < 0.05.

결 과(Results)

At 2-year follow-up, no significant differences of Lysholm score (81 vs 82; p=.816), Tegner activity level (7.4 vs 6.8; p=.366), IKDC 2000 subjective score (74 vs 78; p=.285), quadriceps strength deficit (13.4% vs 12.1%; p=.792), hamstring strength deficit (10.2% vs 6.6%; p=.363), and rates of return to sports (78% vs

82%; p=.365) were observed between group 1 and 2. On the second-look arthroscopic examination, only graft tension parameter (1.2 vs 1.6; P=.028) showed significant difference, but graft continuity (1.2 vs 1.6; p=.453), synovial coverage (1.1 vs 1.5; p=.151), vascularization (1.0 vs 1.1; p=.652) parameters and KUMC graft maturation score (5.4 vs 5.9; p=.075) showed no significant difference. During the study period, there were no complications and revision surgeries in both groups.

결 론(Conclusion)

Nonoperative treatment for MCL injuries combined ACL reconstruction is an effective treatment and provides similar clinical outcomes to those of isolated ACL reconstruction without an MCL injury.

6주간 불안정한 하중을 이용한 점진적인 균형 훈련이 만성 발목 불안정성 대상자의 균형, 근력, 기능 수행력에 미치는 영향

Effects of 6-Week Progressive Balance Training Using Unstable Loads on Balance, Strength, and Functional Performance in Subjects with Chronic Ankle Instability

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[3]국립부경대학교 체육진흥원, [4] 양산부산대학교병원 물리치료실
서가은[1], 문성환[1], 이지원[1], 류무리[1], 유일영[2], 김수용[4], 최호경[3], 김태규[2]

목적(Background)

발목 염좌는 일반 인구에서도 흔히 발생하며, 높은 재발률로 인해 만성 발목 불안정성(CAI)으로 이어진다. CAI는 균형과 기능 수행력을 저해해 재손상 위험을 높이며, 이에 효과적인 재활 전략이 필요하다. 하지만 기존 균형 훈련은 지면 불안정성이나 감각 자극에 초점을 두었으며, 실제 환경에서는 외부 하중이 동반된 조건에서의 균형 유지가 많이 요구된다. 특히 불안정한 하중은 코어 및 하지 근육 활성화를 유도해 균형과 감각 기능 향상에 기여할 수 있다. 이에 본 연구는 CAI 성인을 대상으로 6주간 안정한 하중을 이용한 균형 훈련(PSB)과 불안정한 하중을 이용한 균형 훈련(PUB)이 근력, 기능 수행력, 균형에 미치는 영향을 비교하고자 한다.

대상 및 방법(Methods)

CAIT, IdFAI 설문지를 통해 만성발목불안정성 대상자를 선정하였으며, 2.30대 성인 남녀 24명을 대상으로 무작위로 PSB(n=12), PUB(n=12) 두 그룹으로 나누었다. 본 연구에서는 30,120°/sec 동심성 및 편심성 발등굽힘, 발바닥굽힘, 안쪽번짐, 가쪽번짐 근력, 사이드 홉 테스트, 8자 홉 테스트, 트리플 크로스오버 홉 테스트, 정적 균형, 동적 균형을 측정하였다. 두 집단 간 차이는 독립표본 t검정 또는 Mann-Whitney U 검정을 통해 분석하였고, 집단 내 사전·사후는 대응표본 t검정 또는 Wilcoxon 부호순위 검정을 사용하여 분석하였다. 상호작용 효과를 확인하기 위해 이원 반복측정 분산분석(RMANOVA) 또는 일반화 추정 방정식(GEE)을 활용하였으며, 통계적 유의 수준은 .05로 설정하였다.

결 과(Results)

훈련프로그램 적용 후 정적 균형은 PSB 그룹(p=.019)과 PUB 그룹(p=.005) 모두 유의하게 향상되었으며, 동적 균형 또한 PSB 그룹(p=.005)과 PUB 그룹(p=.032) 모두 유의한 향상이 나타났다. 발등굽힘 근력의 경우, 30˚/s 및 120˚/s 편심성 근력이

PSB 그룹(p=.041, p=.026)과 PUB 그룹(p=.034, p=.015) 모두에서 유의하게 증가하였다. 발바닥굽힘 근력에서는 PUB 그룹에서 30˚/s 및 120˚/s 동심성(p=.007, p=.001) 및 편심성 근력(p=.006, p=.003)이 모두 유의하게 향상되었고, PSB 그룹은 120˚/s 동심성 근력만 유의하게 증가하였다(p=.039). 발목 안쪽번짐 및 가쪽번짐 근력에서는 유의한 차이가 나타나지 않았다. 기능 수행력에서는 사이드 홉, 8자 홉, 트리플 크로스오버 홉 테스트 모두에서 양 그룹의 수행 시간이 유의하게 개선되었으며(모두 p<.05), 이 중 8자 홉(p=.047)과 사이드 홉(p=.023) 테스트에서는 훈련 후 PUB 그룹에서 더 큰 향상이 나타났다.

결 론(Conclusion)

PSB 훈련과 PUB 훈련 모두 CAI 대상자의 근력, 기능 수행력, 균형을 개선하는데 효과적인 프로그램임을 확인하였다. 또한 PUB 훈련프로그램은 발바닥굽힘 근력 향상을 통한 기능 수행력 향상에 더 효과적인 훈련임을 확인하였다.

Relative Energy Deficiency in Sport (REDs): The Importance of Carbohydrate Availability

UC Irvine
Brian Kim

Background
Relative Energy Deficiency in Sport (REDs), encompassing what has also been referred to as the Female and Male Athlete Triad, reflects the complex relationship between energy availability, hormonal function, and bone health.

Methods
This session will highlight emerging insights into carbohydrate availability as a key factor influencing performance, injury risk, and overall metabolic health. Special attention will be given to practical strategies for optimizing carbohydrate intake, including its role in maintaining iron status in high-level athletes.

Results
Prior elegant research studies have established a causal link between low energy availability and the disruption of the hypothalamic-pituitary axis. Several recent studies have demonstrated nearly independent effects of low carbohydrate availability, making the case that low energy availability outcomes resulting in REDs may be mainly due to poor carbohydrate intake. Studies on performance shed doubt on the long term benefits of carbohydrate-restricted diets in endurance athletes. Additionally, low carbohydrate has been implicated as a contributor to iron deficiency in athletes due to hepcidin upregulation.

Conclusions
High-performance models for elite athletes may benefit from close attention to the role of carbohydrate

availability within periodized sports nutrition plans. Further research should aim to establish risk assessment tools for low carbohydrate availability and explore its role in iron repletion in iron deficient athletes.

Keywords: REDs, carbohydrate availability, energy availability, sports nutrition, sports performance

Taekwondo Medicine: Comprehensive Injury and Illness Prevention Strategies for Taekwondo Athletes from World Taekwondo Experience

UC San Francisco
Dae Hyoun Jeong

Background
Taekwondo, a Korean martial art and Olympic sport, presents distinctive challenges due to its intense physical demands, high rates of training- and competition-related injuries, and weight-category pressures. Athletes require comprehensive, sport-specific care strategies to ensure optimal performance, prevent injury and illness, and support long-term health outcomes.

Methods
Drawing from experience as Immediate Past Chair of the World Taekwondo Medical and Anti-Doping Committee (2017–2024), this presentation synthesizes key medical and safety protocols developed for elite Taekwondo athletes. Topics include emergency action planning, venue-based medical services, point-of-care ultrasound (POCUS) integration, dental trauma prevention, mental health screening, anti-doping initiatives, and rapid weight loss prevention.

Results
These interventions have enhanced emergency preparedness, improved triage through POCUS, enabled earlier injury recognition, and increased awareness around concussion, cervical spine injury, and dental trauma. They have also led to better management of serious injuries and improved recovery and rehabilitation outcomes. Reductions in both rapid weight loss practices and doping violations were observed. Case examples will illustrate improved athlete safety and timely return-to-play decisions.

Conclusions
With strengthened medical policies, Taekwondo has become a safer sport. Comprehensive,

multidisciplinary care models tailored for combat sports can significantly enhance athlete safety, well-being, and performance, and may serve as a framework for other high-intensity, tournament-based sports.

Keywords: Taekwondo, injury and illness prevention, rapid weight loss, point-of-care ultrasound

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회
제67차 추계학술대회

10월 19일(일요일)

올림피아홀

사단법인 대한스포츠의학회
The Korean Society of Sports Medicine

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

ICL1. 스포츠 손상 재활의 다학제 통합 전략: 영양, 심리, 디지털 혁신

Multimodal Strategies in Sports Injury Rehabilitation: Nutrition, Mind, and Digital Innovation

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좌장: 한양대병원 김미정, 고려대구로병원 강 석

이시형

학력

연세대학교 식품영양학과 학사

Loughborough University Sport and Exercise Nutrition 석사

Waseda University Sports and Exercise Nutrition 박사

주요 경력

2014.08~2014.10	2014 인천 아시아&장애인 아시아 경기대회 조직위원회
2015.06~2015.07	2015 광주 하계 유니버시아드 대회 조직위원회
2023.03~2025.08	부산스포츠과학센터 연구원
2023.03~	Waseda Institute of Sports Nutrition Adjunct Researcher
2023.03~	한국운동영양학회 이사
2025.01~	대한지역사회영양학회 스포츠영양분과 이사

현재 소속 및 직위

영남대학교 생활과학연구소 연구교수

대표논문

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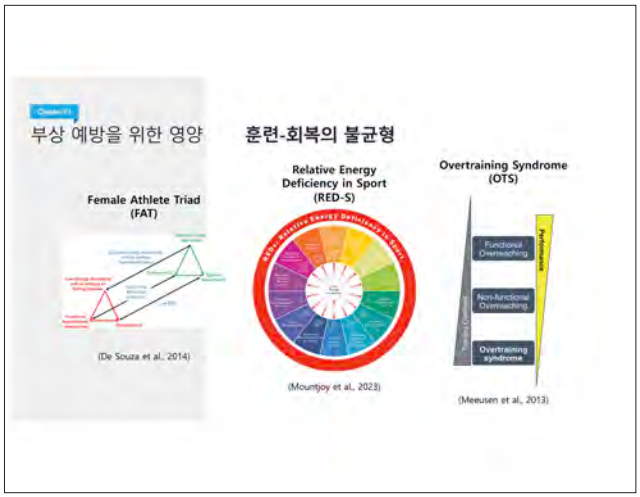
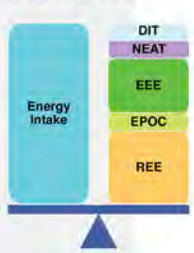
2. Lee, Sihyung., Moto, Kuniko., Han, Seungah., Oh, Taewoong., & Taguchi, Motoko. Within-day energy balance and metabolic suppression in male collegiate soccer players. Nutrients, 13(8), 2644.
3. Lee, Sihyung., Moto, Kuniko., Han, Seungah., Oh, Taewoong., & Taguchi, Motoko. Association of low energy availability and suppressed metabolic status in Korean male collegiate soccer players: A pilot study. American Journal of Men's Health, 14(6).

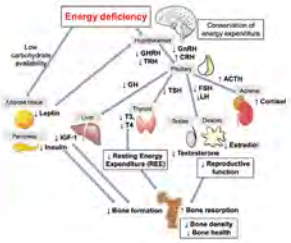
스포츠 손상 후 영양대사 전략
Fueling Recovery: Nutritional and Metabolic Strategies after Sports Injuries

영남대 생활과학연구소
이시형



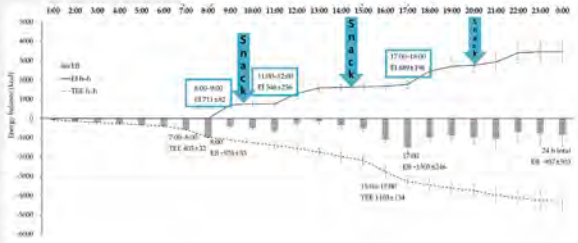
부상 예방을 위한 영양





(Adapted from Dipla et al., 2021)

부상 예방을 위한 영양 에너지 | 식사 빈도 증가를 통한 에너지 균형 유지 및 영양소 결핍 방지



부상 예방을 위한 영양 탄수화물 | 글리코겐 저장량 회복 면역기능 유지

- ✓ 하루 체중 1kg 당 5~7g
- ✓ 운동 후 체중 1kg 당 1.0~1.2g
- ✓ High Glycemic Index 권장
- ✓ 단백질과 병행 섭취
- ✓ 스포츠음료, 에너지바, 스무디/쉐이크 등

부상 예방을 위한 영양 단백질 | 근육량 유지 및 회복 신체 시스템 기능 유지

- ✓ 하루 체중 1kg 당 1.2~2.0g ~10g 필수아미노산(BCAA 등) 포함
- ✓ 운동 후 3~5시간 동안 0.3g/kg 분할 섭취
- ✓ 유제품, 저지방 육류, 가금류, 생선류, 계란, 두부, 콩

부상 예방을 위한 영양

수분 | 체수분 균형 유지

- ✓ 운동 후 체중 감소량의 1~1.5배 섭취

비타민 | 항산화효과, 근육 회복

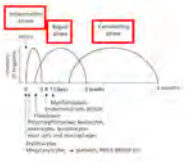
무기질 | 에너지 대사, 신체 조직 유지

- ✓ 항산화물질, 칼슘, 비타민D
- ✓ 과일+채소 스무디/주스, 식이보충제 활용

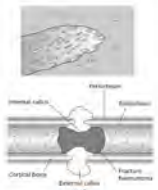
부상 회복을 위한 영양

골격근
Degenerative
Regenerative
Maturation

부상 회복 과정



건, 인대
Inflammation
Repair
Remodeling



뼈
Primary
Secondary

Frontera(2008)

부상 회복을 위한 영양

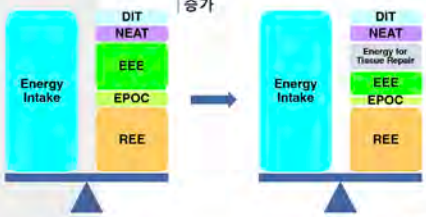
재활 과정

- ✓ 고정(immobilization)
  감퇴(atrophy)
  조직재생(tissue repair)
- ✓ 재운동화(reathletization)
  readaptation to training
  psychological improvement

Giraldo-Vallejo(2023)

부상 회복을 위한 영양

에너지 | 증가 요인 : 근단백질 합성
감소 요인 : 운동량 감소, 과잉 섭취 시 체지방 증가



Giraldo-Vallejo(2023)

부상 회복을 위한 영양

단백질 | **조직 재생, 상처 회복**
근감소 방지 및 근육 성장

- ✓ 하루 체중 1kg 당 1.6~3.0g
- ✓ 1회 섭취량 체중 1kg 당 0.3g/kg
  (20~30g with leucine ~3g)
- ✓ 하루 4~6회 나누어서 섭취
  취침 전 Casein

Giraldo-Vallejo(2023)

부상 회복을 위한 영양

크레아틴 | **근육 내 크레아틴 수준 유지 또는 증가**
재활/회복 시간 단축 및 운동수행력 유지

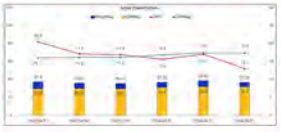
오메가-3 | **급성 염증 반응으로 인한 부작용 방지**

콜라겐
Vit C | **콜라겐 합성 촉진**
관절 기능 향상

Vit D | **뼈 건강 유지**
운동 적응, 근기능, 면역 기능 조절 등

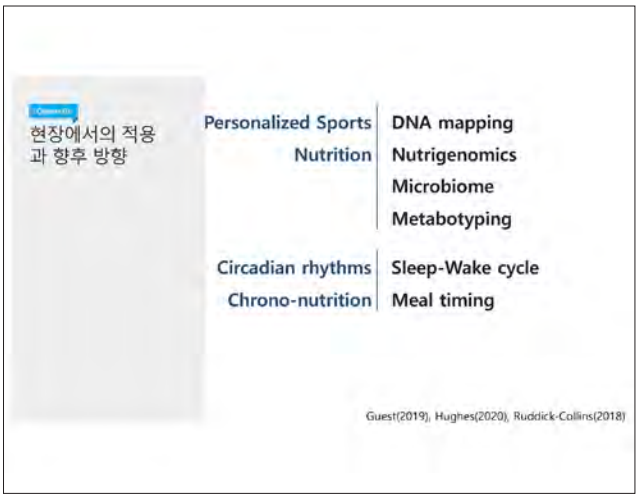
현장에서의 적용
과 향후 방향

Example) 10 years old male skater (short-track speed skating)
Training : 5 am - 7:30 am & 4 pm - 8:30 pm
Rest : Weekends & Monday
Sleep : 10 pm - 4 am
Intervention → 30 min nap (+4 h weekends)
Meal : Breakfast, Lunch, Late Dinner(after training)
Intervention → Snack (9 am, 3 pm)



현장에서의 적용
과 향후 방향

Training > Recovery
↓
Training ≒ Recovery


현장에서의 적용
과 향후 방향
Personalized Sports Nutrition
DNA mapping
Nutrigenomics
Microbiome
Metabotyping
Circadian rhythms
Chrono-nutrition
Sleep-Wake cycle
Meal timing
Guest(2019), Hughes(2020), Ruddick-Collins(2018)


대한스포츠의학회 제67차 추계학술대회
Fueling recovery :
Nutritional and Metabolic Strategies after Sports Injuries
스포츠 손상 후 영양·대사 전략
수고하셨습니다.

최치현

학력

서울대학교 의과대학 학사 (2002~2009)

서울대학교 임상의학과학 석사 (2017~2019)

주요 경력

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서울특별시보라매병원 정신건강의학과 교수 (2019~2022)

서울대학교병원 정신건강의학과 전임의 (2017~2019)

서울대학교병원 정신건강의학과 전공의 (2013~2017)

현재 소속 및 직위

㈜ 에버엑스 의학파트장

대표논문

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스포츠 손상 재활의 인지행동적 접근
Mind Reconstruction: Cognitive Behavioral Approaches in Sports Injury Rehabilitation

에버엑스 의학부
최치현

COI Disclosure

Name of First Author: Chi-hyun Choi

The authors have no financial conflicts of interest to disclose concerning the presentation

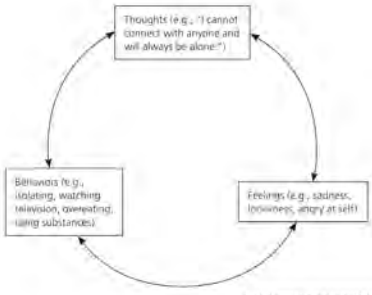
차례

- Concept of Cognitive Behavioral Therapy (CBT)
- CBT in chronic pain management
  - Evidence for Digital CBT in Musculoskeletal Pain
- Cognitive behavioral approaches in sports injuries

Basic Assumptions of CBT

- Emotions and behaviors are not determined by events themselves
  - They are shaped by each individual's subjective interpretation of the situation.
- Psychological problems often stem from distorted and dysfunctional thinking
  - Maladaptive beliefs and thought patterns underlie emotional distress.
- Problematic patterns in thinking and behavior
  - These lead to negative emotions and functional impairments in daily life.

https://commons.wikimedia.org/wiki/File:Glass_of_water.jpg



https://www.aafp.org/pubs/afp/issues/2015/1101/p807.html

(비합리적인) 자동적 사고란?

- 자동적 사고 (automatic thought)
  - 감정과 행동방식에 결정적인 영향을 미치면서도 의식적으로 알아차리기가 어려운 생각
  - 인식이 어렵고 무비판적으로 수용되는 경향
    - 예를 들어, 지하철에서 누군가에게 밀쳐진 상황...
  - Cognitive distortion이 있을 수 있음
    - all or nothing, catastrophizing, over-generalization, mental filter, emotional reasoning, mind reading, "should" statement...

스포츠 손상 후 나타날 수 있는 인지적 오류 예시

- All or nothing (흑백 사고)
  - "완전히 회복하지 못하면 아무 의미 없어."
- Catastrophizing (파국화)
  - "이번 부상 때문에 내 운동선수 인생은 끝이야."
- Over-generalization (과잉 일반화)
  - "한 번 다쳤으니 앞으로 계속 다칠 거야."
  - "내가 중요한 순간마다 항상 이런 식이야."
- Mental filter (정신적 여과)
  - 재활 과정에서 잘해낸 부분은 무시하고, 통증이 심했던 단 하루만 떠올리며 "난 진전이 없어."라고 생각함
- Emotional reasoning (감정적 추론)
  - "오늘 너무 불안하고 우울하니까 분명히 재활도 잘 안 되고 있는 거야."
  - "자신감이 안 드니까 내가 나아지고 있다는 증거가 없을 거야."
- Mind reading (마음 읽기 오류)
  - "코치가 날 보고 실망했을 거야."
  - "팀 동료들은 내가 다시 뛰지 못할 거라고 생각하고 있을 거야."
- "Should" statements ("해야 한다" 사고)
  - "나는 다치면 안 됐어. 내 잘못이야."

What is CBT

- Definition
  - A goal-oriented, problem-focused psychotherapy
  - Aims to change thoughts, emotions, and behaviors, helping patients adopt more adaptive patterns to improve function and quality of life
- Key Features
  - Structured and systematic approach
  - Enhances coping skills and problem-solving ability
  - Focuses on generating, applying, and evaluating alternative strategies
  - Encourages patients to identify the most effective coping methods for daily life
    - Skill training through structured practice

Table 2. Core Components and Characteristics of Cognitive Behavior Therapy

One 60- to 90-minute session per week, typically for eight to 12 weeks

Symptom measures are collected frequently

Treatment is goal-oriented and collaborative; patient is expected to be an active participant

Treatment is focused on changing current problematic or maladaptive thoughts or behaviors

Weekly homework assignments

https://www.aafp.org/pubs/afp/issues/2015/1101/p807.html

Effects of CBT in Psychiatry and other problems

- CBT effectively targets symptoms of anxiety, depression, PTSD, ADHD, autism, obsessive-compulsive and tic disorders, personality disorders, eating disorders, and insomnia in children, adolescents, and adults.
- Numerous meta-analyses and reviews have demonstrated that CBT reduces psychiatric symptoms and functional impairments, and improves quality of life.
- In addition, it has been examined as an adjunctive treatment for medical problems in which behavior change could enhance outcomes.

https://www.aafp.org/pubs/afp/issues/2015/1101/p807.html

Limitations of CBT

- Cognitive demands
  - Less effective for individuals with intellectual disability, severe psychosis, or preschool children
- Focus on logic and short-term intervention
  - Higher risk of relapse
  - Reduced effectiveness in cases of personality disorders or deeper psychopathology
  - Limited in addressing insight and relational dynamics
- High participant motivation required
  - Adherence rate: 60–80% (drop-out rate: 20–40%)
  - Even lower adherence in real-world settings
- Therapist factors
  - Time- and labor-intensive
  - Requires high level of training and skill

CBT in Chronic Pain Management

- The CBT model of chronic pain is based in the theory that individual beliefs, attitudes, and expectations affect emotional and behavioral reactions to life experiences.
  - Psychological factors play a significant role in chronic pain
- Thought that patients have about their personal pain problem.
  - Patients believe that pain signifies injury, so activity should be avoided.
- Self-efficacy - a belief about one's ability to perform a specific behavior
  - High self-efficacy : lower levels of pain, higher pain thresholds, increased exercise performance, and more positive coping efforts.
- Acceptance of pain
  - Lower pain intensity, less pain-related anxiety and avoidance, less depression, less disability, more daily uptime, and better work status.

Psychological factors in chronic pain

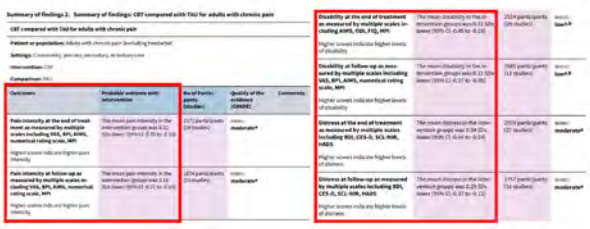
- Cognitive factors
  - Catastrophizing
  - Fear of movement & physical activity
- Behavioral factors
  - Avoidance behavior
  - Lack of coping strategies
- Emotional factors
  - Depression & anxiety
  - Decreased pain threshold (allodynia)

Effectiveness of psychological intervention on chronic pain

- Chronic pain excluding headache
- CBT compared with active control
- CBT compared with Treatment As Usual (TAU)
- At the end of the treatment
- During follow-up (6~12 months)

- Pain intensity
  - e.g., Visual Analogue Scales (VAS)
- Disability
  - e.g., Brief Pain Inventory (BPI) interference items
- Distress
  - e.g., Beck Depression Inventory (BDI)

CBT compared with TAU



CBT compared with active control

Evidence for Digital CBT in Musculoskeletal Pain

- Guided internet-based CBT for chronic pain improves disability and psychological distress; benefits persist to follow-up in many trials (Terpstra, J. A. et al., 2022).
  - *This refers to internet-based CBT interventions, not to app-based digital therapeutics in the regulatory sense.*
- The Rise-uP trial demonstrated that a digital treatment approach using the Kaia back pain app achieved superior clinical outcomes compared to standard care, with patients experiencing 46% pain reduction versus 24% in controls at 12 months (Priebe et al., 2024).
  - *The Kaia App includes education, exercise, and mindfulness modules, but it is not a CBT intervention.*

CBT for chronic pain app/web

https://hellobetter.de/en/online-courses/chronic-pain

Key Considerations Developing CBT in Digital Therapeutics for Musculoskeletal Pain

- Adherence is critical
  - Engagement and sustained participation determine effectiveness.
- Patient motivation matters
  - Readiness and willingness to practice CBT skills influence outcomes.
- Integration with physical rehabilitation
  - CBT strategies should be aligned with exercise and physiotherapy goals.
- Usability and accessibility
  - Simple design, clear instructions, and user-friendly features increase uptake.

Effects of Psychological Interventions on the Prevention of Sports Injuries

A Meta-analysis

Shanshan Li,* PhD, Qianjin Wu,* MA, and Zichao Chen,*† PhD
Investigation performed at Institute of Sport Science, Sichuan University, Chengdu, Sichuan Province, China

Background: Studies have shown that preventive psychological interventions can reduce the occurrence of sports injuries.

Purpose: To systematically evaluate the published literature on the effects of psychological interventions on rates of sports injuries and propose a set of psychological interventions to reduce such injuries.

Study Design: Systematic review; Level of evidence, 1.

Methods: A total of 11 randomized controlled trials and intervention control trials involving 1287 participants were included. A random-effects model was used to analyze the data. Pooled results were expressed as effect sizes and 95% CIs. Bias and heterogeneity among the studies were assessed, and sensitivity and subgroup analyses were performed.

Results: Meta-analysis suggested that preventive psychological interventions effectively prevented the occurrence of sports injuries (effect size, −0.55; $P < .001$), although the studies showed substantial heterogeneity ($I^2 = 94.2\%$; $P < .001$), which could not be attributed to specific variables. Nevertheless, sensitivity analysis suggested that overall results were reliable. No significant risk of publication bias was found.

Conclusion: Preventive psychological interventions moderately reduced the risk of sports injuries. Risk screening also significantly reduced the risk of sports injuries. These interventions should focus on cognitive behavior and be administered in 1 to 6 sessions over 7 to 12 weeks for 60 minutes per session.

Keywords: cognitive behavior; psychological intervention program; sports injuries

The Orthopaedic Journal of Sports Medicine, 2020

- Psychological interventions significantly reduced sports injury incidence (effect size = −0.55, p < .001).
- By Type of Intervention
  - Cognitive Behavioral Therapy (CBT): effect size −0.71 (most effective)
  - Stress Management: effect size −0.36 (trend only)
  - Combination Training: effect size −0.26 (small effect)
- Intervention Characteristics
  - Duration: most effective when delivered over 7–12 weeks (effect size −0.69)
  - Number of sessions: most effective with 1–6 sessions (effect size −0.73)
  - Length of sessions: more effective when ≤60 minutes (effect size −0.57)

REVIEW

Psychosocial interventions help facilitate recovery following musculoskeletal sports injuries: a systematic review

Sonora M. Gennaro[a]*, Symone M. Brown[a] and Mary K. Mulcahey[a]

[a]Tulane University School of Medicine, New Orleans, LA, USA; [b]Department of Orthopaedic Surgery, Tulane University School of Medicine, New Orleans, LA, USA

ABSTRACT

Context: Recent research demonstrates a connection between psychological factors and return to play following a musculoskeletal sports injury. Although it has been shown that psychological factors can influence when and if an athlete returns to play, it is unclear if the implementation of psychosocial interventions during the recovery process can address these factors and potentially increase the likelihood of return to play after physical recovery from injury.

Objective: To examine the efficacy of interventions designed to address psychosocial factors that influence return to play after sports injuries.

Methods: A systematic review was performed in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. Pubmed, Embase, and Google Scholar databases were searched from the earliest entry through May 2018. Search terms included (psychology) "sports injury," "anterior cruciate ligament injury," (anterior cruciate ligament reconstruction,) "intervention," "return to play," and (return to sport). Studies were included and reviewed if they reported on the efficacy of a psychosocial intervention program in injured athletes.

Results: Initial searches of Pubmed, Embase, and Google Scholar databases identified 569 articles, 329 articles, and 34,400 hits, respectively. After inclusion and exclusion criteria were applied, eight articles remained that met inclusion criteria. Interventions of relaxation/guided imagery, positive self-talk, goal setting, counseling, emotional control, disclosure, and modeling videos were found to be effective interventions for promoting recovery after a musculoskeletal sports injury. These interventions facilitated positive mood changes, pain management, exercise compliance, and rehabilitation adherence. No study examined the effect of psychosocial interventions on return to play.

Conclusion: This systematic review demonstrates that psychosocial interventions can facilitate post-injury recovery in athletes by promoting a positive emotional state and rehabilitation adherence. Further research is necessary to determine the most effective psychosocial interventions for specific psychological factors, the ideal duration of interventions, the best method of implementation following a sports injury, and the impact of these interventions on return to play.

ARTICLE HISTORY

Received 27 July 2017
Accepted 15 March 2018

KEYWORDS

Sports injury; psychology; intervention; recovery; return to play

- **Aim of the Review**
  - To examine whether psychosocial interventions actually facilitate recovery after musculoskeletal sports injuries.
- **Key Findings**
  - Improved mood and reduction of anxiety and stress
  - Better pain management and functional performance
  - Increased rehabilitation adherence and completion of exercise tasks
  - Enhanced self-efficacy and confidence in recovery
  - Reduction of negative emotions (depression, anger, grief)

CONSENSUS STATEMENT

50 Years of Research on the Psychology of Sport Injury: A Consensus Statement

Ulrika Tranaeus[1,2,3] · Adam Gledhill[4] · Urban Johnson[5,6] · Leslie Podlog[7,8] · Ross Wadey[9] · Diane Wiese Bjornstal[10] · Andreas Ivarsson[5,6]

Abstract

Factors influencing sport injury risk, rehabilitation outcomes, and return to sport processes have been the focus in various research disciplines (sports medicine, psychology and sociology). One discipline, with over 50 years of scholarship is the psychology of sport injury. Despite the research in this field, there is no evidence-based consensus to inform professional practice. The aim of this original and timely consensus statement is to summarize psychological sport injury research and provide consensus recommendations for sport practitioners seeking to implement psychological principles into clinical practice. A total of seven experts with extensive experience established the consensus objectives and identified three psychology of sport injury sub-domains: risk, rehabilitation and return to sport. The researchers, grouped in pairs, prepared initial drafts of assigned sub-domains. The group met in Stockholm, and the three texts were merged into a draft and revised in an iterative process. Stress responses are the strongest psychological risk factor for acute injuries. Intra- and interpersonal factors, as well as sociocultural factors, are demonstrated psychosocial risk factors for overuse injuries. Stress management and mindfulness interventions to prevent injuries have been successfully implemented. The rehabilitation process may influence athlete's cognitive, emotional, and behavioural responses. Social support, mindfulness-acceptance-based practices, and cognitive-behavioural based interventions program-related negative outcomes. Return to sport includes various stages and different trajectories. Returning athletes typically experience concerns regarding competence, autonomy, and relatedness. It is recommended that athletes focus on the physical, technical, and psychological demands of their sport as they progress to (un)reasonably uncertain activities. Interdisciplinary collaborations (e.g., sports medicine and psychology) would be beneficial in enhancing clinical practice and improving athlete outcomes.

- 1) Injury risk
  - Stress responses = strongest risk factor for acute injuries
  - Overuse risk linked to personality (perfectionism, anxiety), poor coach-athlete relationship, lack of support, pain normalization
  - Effective prevention: stress management, mindfulness, acceptance-based practices
- 2) Rehabilitation
  - Positive factors: self-efficacy, optimism, resilience
  - Negative factors: catastrophizing, fear of re-injury, strong athletic identity
  - Effective interventions: CBT, mindfulness, relaxation, guided imagery, goal setting, positive psychology practices
- 3) Return to sports
  - Multiple trajectories
  - Competence, autonomy, relatedness
  - Stage-based progression is needed.

Take-home message

- Cognitive-Behavioral Therapy (CBT) is a goal-oriented and solution-focused treatment that helps individuals change their thoughts (cognition), emotions, and behaviors. It aims to improve functioning and quality of life by promoting more adaptive patterns of thinking and behavior.
- Psychological interventions, including CBT, may be helpful for conditions in which outcomes can be influenced by changes in thoughts and behaviors, such as chronic pain and sport injury rehabilitation.

박재현

학력

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서울대학교 의과대학교 의학대학원 의학과 석사

서울대학교 의학대학원 의학과 박사

주요 경력

대한스포츠의학회 정회원 및 스포츠의학 인증전문의

대한스포츠의학회 국제교류위원회, 학술위원회 위원

대한신경근골격초음파학회 제도위원회 위원장

현재 소속 및 직위

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한양대학교 구리병원 재활의학과

조교수

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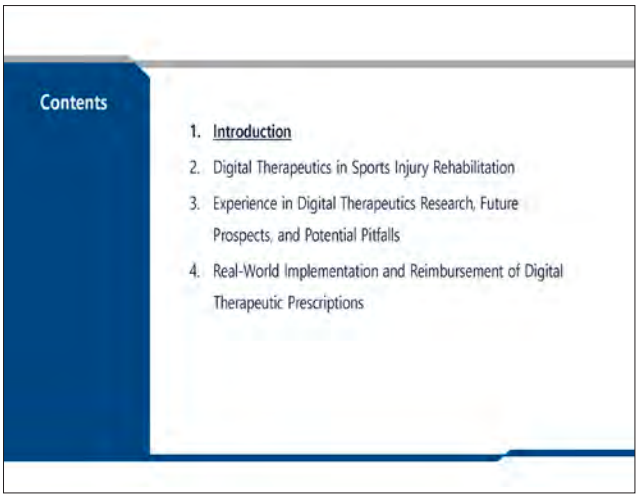
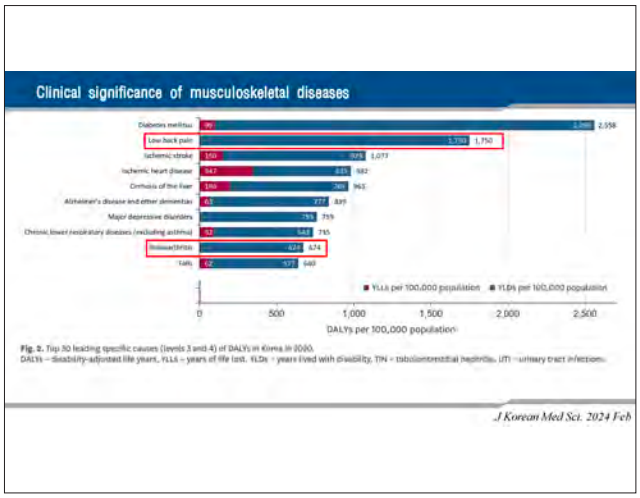
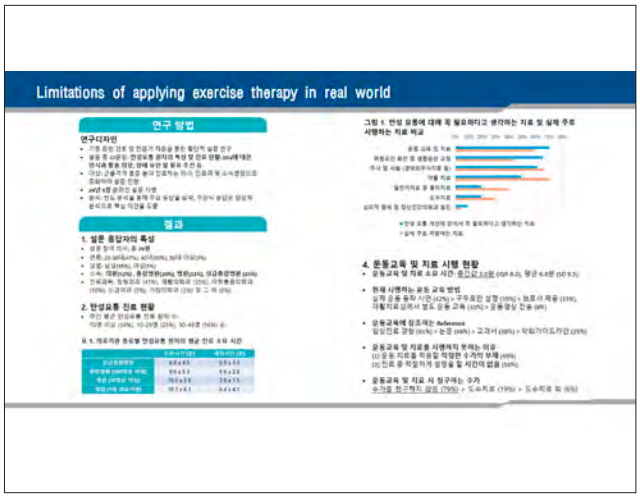
2. Kang DH, Park JH, Yoon C, Choi CH, Lee S, Park TH, et al. Multidisciplinary Digital Therapeutics for Chronic Low Back Pain Versus In-Person Therapeutic Exercise with Education: A Randomized Controlled Pilot Study. J Clin Med. 2024;13(23).
3. Park, J. H., Park, J. Y., Lee, G. S., & Cha, R. H. (2024). Efficacy of intradialytic neuromuscular electrical stimulation and oral nutritional supplementation in hemodialysis patients: a multicenter, randomized controlled trial. Korean Journal of Nephrology.

스포츠 손상 재활의 디지털 치료제 활용
igital Innovation: Application of Digital Therapeutics in Sports Injury Rehabilitation

한양대병원
박재현







Contents

1. Introduction
2. Digital Therapeutics in Sports Injury Rehabilitation
3. Experience in Digital Therapeutics Research, Future Prospects, and Potential Pitfalls
4. Real-World Implementation and Reimbursement of Digital Therapeutic Prescriptions

Definition of digital health related terminologies (1)

Digital health

- The use of digital, mobile and wireless technologies to support the achievement of health objectives.
- Digital health describes the general use of information and communications technologies (ICT) for health and is inclusive of both mHealth and eHealth.

Electronic health (eHealth)

- "The cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research"

Mobile health (mHealth)

- medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices

Arch Physiother. 2023 Jun 4;13(1):1

Definition of digital health related terminologies (2)

Telehealth

- the delivery of health care services, where patients and providers are separated by distance
- a wider variety of remote healthcare services beyond the doctor-patient relationship

Telemedicine

- the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers

Telecare

- technologies and related services at a distance are accessed by or provided for people and/or their carers at home or in the wider community, in order to facilitate empowerment or the provision of care and/or support in relation to needs associated with their health and well-being

Arch Physiother. 2023 Jun 4;13(1):1

Definition of digital therapeutics

Digital therapeutics – "The Digital Therapeutics Alliance"

- Digital therapeutics (DTx) deliver evidence-based therapeutic interventions that are driven by high quality software programs to prevent, manage, or treat a medical disorder or disease.
- They are used independently or in concert with medications, devices, or other therapies to optimize patient care and health outcomes.

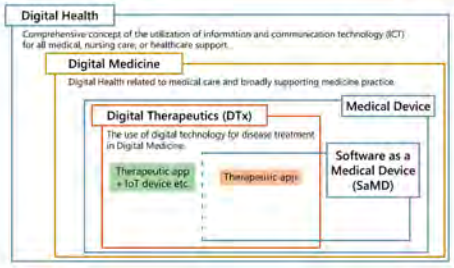
디지털치료기기(Digital therapeutics) – 식품의약품안전처

- 의학적 장애나 질병을 예방, 관리, 치료하기 위해 환자에게 근거 기반의 치료적 개입을 제공하는 소프트웨어 의료기기 (SaMD)
- 디지털치료기기의 사용은 치료적 개입이 필요한 "환자"를 대상으로 함
- 소프트웨어 의료기기(Software as a Medical Devices, SaMD): 하드웨어에 종속되지 않고 의료기기의 사용목적에 부합하는 기능을 가지며 독립적인 형태의 소프트웨어만으로 이루어진 의료기기

Telerehabilitation

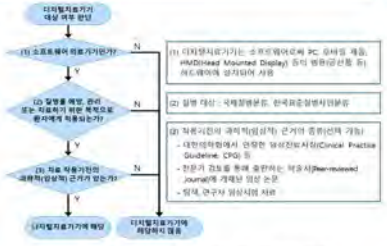
- the delivery of rehabilitation services via information and communication technologies

Digital health-related terminologies



Hypertens Res. 2023 Sep;46(9):2126-2134

디지털치료기기 판단기준



< 그림. 디지털치료기기 대상여부 판단기준 및 절차 >

디지털치료기기 허가 심사 가이드라인 - 식품의약품안전처

DTx related clinical research studies

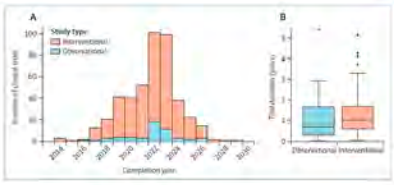
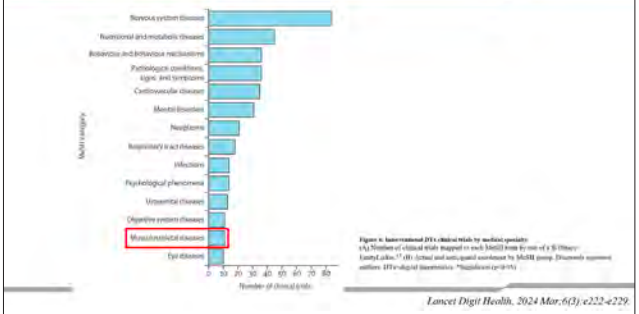


Figure 2: Overview of DTx clinical trials
(A) Number of trials completed or expected to complete between 2014 and 2030. The dashed line indicates the current year. (B) Duration of completed interventional and observational trials. DTx=digital therapeutics.

Lancet Digit Health. 2024 Mar;6(3):e222-e229.

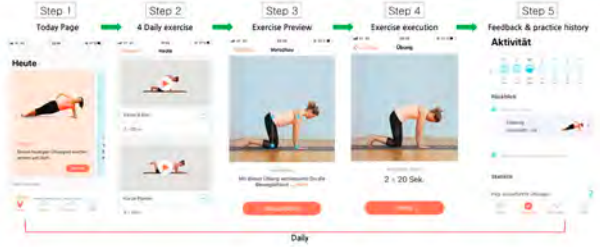
DTx related clinical research studies



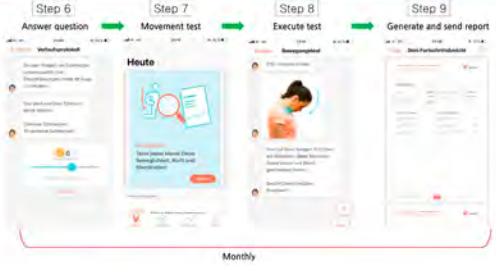
Lancet Digit Health. 2024 Mar;6(3):e222-e229.

DTx for musculoskeletal diseases (ViViRA)

DTx for musculoskeletal diseases (ViViRA)



DTx for musculoskeletal diseases (ViViRA)



DTx for musculoskeletal diseases (ViViRA)

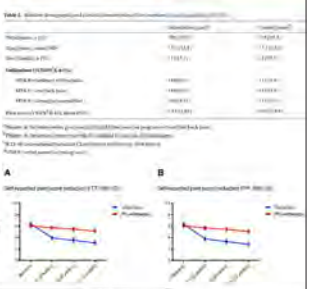
The Effect of an App-Based Home Exercise Program on Self-reported Pain Intensity in Unspecific and Degenerative Back Pain: Pragmatic Open-label Randomized Controlled Trial

Nonspecific low back pain

diagnosis of a unspecific or degenerative pain of the lower back (International Classification of Diseases, 10th edition M42.6, M42.1, M42.9, M53.2, M53.8, M53.9, M54.4, M54.5, M54.6, M54.8, M54.9, M99.02, M99.03, M99.04, M99.82, M99.83, M99.84, M99.92, M99.93, and M99.94):

12w F/U

Intervention : 3 month of ViViRA app (n=108)
Control : 6-12 physiotherapy in 12ws (n=105)

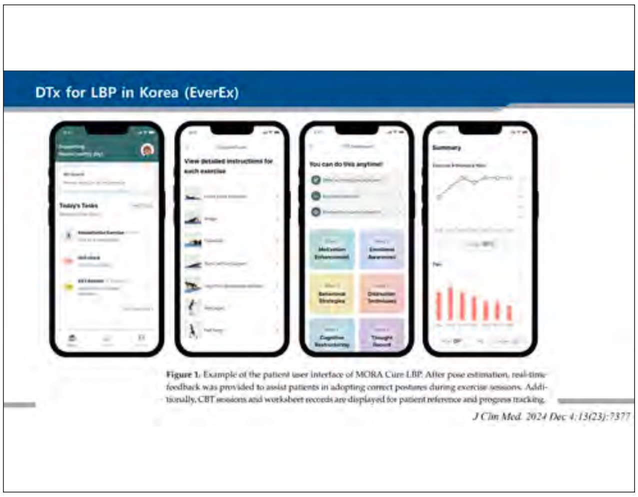


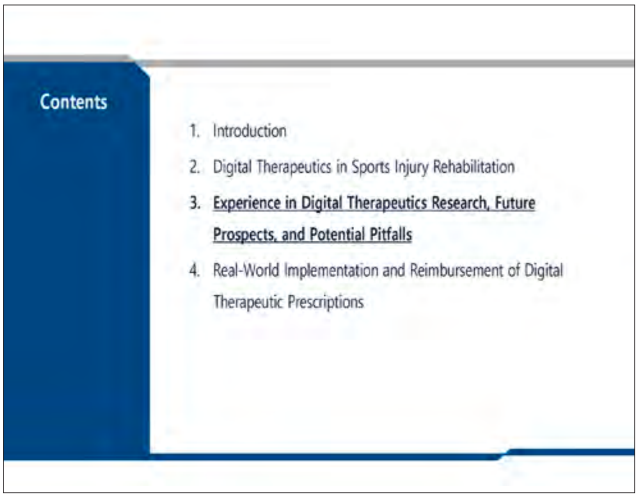
J Med Internet Res. 2022 Oct 28;24(10):e41899.

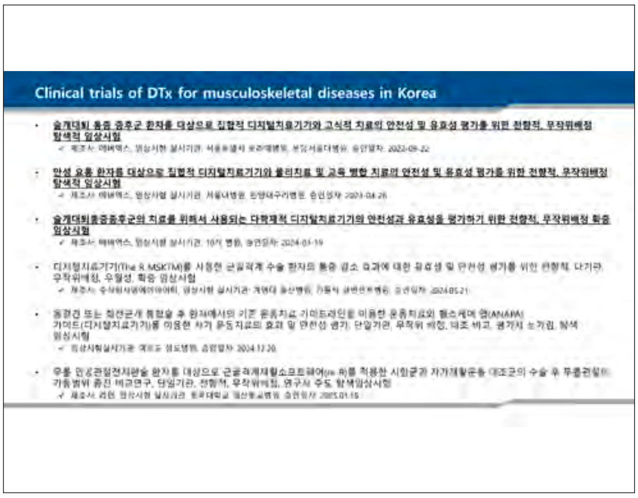

DTx in Korea
아시아경제
디지털 치료제 국내 확산 '초기 단계', 92개 제품 임상 중
디지털의료기 허가 7년만에 1→388건...AI·DTx 임상 급증
"고령화 · 디지털헬스 · 정신건강 강화"···APEC 보건과경제 고위급회의 공동성명문 채택
식약처 DTx 제품 임상시험계획승인 현황
에버엑스 등 5건 근골격계 재활 2023년 4월
합계 15개 분야 52개 업체 92건


Clinical trials of DTx for musculoskeletal diseases in Korea
• 슬개대퇴 통증 증후군 환자를 대상으로 집합적 디지털치료기기와 고식적 치료의 안전성 및 유효성 평가를 위한 전향적, 무작위배정 탐색적 임상시험
✓ 제조사: 에버엑스, 임상시험 실시기관: 서울특별시 보라매병원, 분당서울대병원, 승인일자: 2022-09-22
• 만성 요통 환자를 대상으로 집합적 디지털치료기기와 물리치료 및 교육 병합 치료의 안전성 및 유효성 평가를 위한 전향적, 무작위배정 탐색적 임상시험
✓ 제조사: 에버엑스, 임상시험 실시기관: 서울대병원, 한양대구리병원, 승인일자: 2023-04-26
• 슬개대퇴통증증후군의 치료를 위해서 사용되는 다학제적 디지털치료기기의 안전성과 유효성을 평가하기 위한 전향적, 무작위배정 확증 임상시험
✓ 제조사: 에버엑스, 임상시험 실시기관: 10개 병원, 승인일자: 2024-03-19
• 디지털치료기기(The R.MSKTM)를 사용한 근골격계 수술 환자의 통증 감소 효과에 대한 유효성 및 안전성 평가를 위한 전향적, 다기관, 무작위배정, 우월성, 확증 임상시험
• 동결견 또는 회전근개 봉합술 후 환자에서의 기존 운동치료 가이드라인을 이용한 운동치료와 헬스케어 앱(ANAPA) 가이드(디지털치료기기)를 이용한 자가 운동치료의 효과 및 안전성 평가: 단일기관, 무작위 배정, 대조 비교, 평가자 눈가림, 탐색 임상시험
✓ 승인일자: 2024.12.20
• 무릎 인공관절전치환술 환자를 대상으로 근골격계재활소프트웨어(re-R)를 적용한 시험군과 자가재활운동 대조군의 수술 후 무릎관절의 가동범위 증진 비교연구, 단일기관, 전향적, 무작위배정, 연구자 주도 탐색임상시험
✓ 승인일자: 2025.01.15


Clinical trials of DTx for musculoskeletal diseases in Korea
• 디지털 치료기기(4DEVE DTx)를 사용한 요추 수술 후 허리 통증 감소 효과 검증을 위한 단일기관, 전향적, 우월성, 공개, 무작위배정, 탐색 임상시험
✓ 제조사: SYM헬스케어, 임상시험 실시기관: 고려대학교 의과대학부속 구로병원, 승인일자: 2025-05-21
• 디지털 치료기기(4DEVE DTx)를 사용한 만성 무릎 통증 환자의 통증 감소 효과에 대한 안전성 및 유효성 평가를 위한 단일기관, 전향적, 우월성, 공개, 무작위배정, 확증 임상시험
✓ 제조사: SYM헬스케어, 임상시험 실시기관: 고려대학교 의과대학부속 구로병원
• VAROrehave의 근감소증 선별도구로서의 유효성 및 안전성 확인을 위한 단일 눈가림(데이터 분석가 1), 단일군 설계, 전향적, 다기관 확증임상시험
• 소아 사경 환자의 고개 기울어짐을 정량적으로 회복시키기 위해 사용되는 'ACESO' 디지털 치료기기의 안전성 및 유효성을 평가하기 위한 전향적 확증 임상시험
• 근감소증 환자에서 무릎 관절 각근력(신전력) 개선을 위한 디지털치료기기의 안전성 및 유효성 평가, 다기관, 전향적, 무작위배정, 평행, 확증 임상시험


DTx for LBP in Korea (EverEx)
Figure 1. Example of the patient user interface of MORA Cure LBP. After pose estimation, real-time feedback was provided to assist patients in adopting correct postures during exercise sessions. Additionally, CBT sessions and worksheet records are displayed for patient reference and progress tracking.
J Clin Med. 2024 Dec 4;13(23):7377


Contents
1. Introduction
2. Digital Therapeutics in Sports Injury Rehabilitation
3. Experience in Digital Therapeutics Research, Future Prospects, and Potential Pitfalls
4. Real-World Implementation and Reimbursement of Digital Therapeutic Prescriptions


Clinical trials of DTx for musculoskeletal diseases in Korea
• 슬개대퇴 통증 증후군 환자를 대상으로 집합적 디지털치료기기와 고식적 치료의 안전성 및 유효성 평가를 위한 전향적, 무작위배정 탐색적 임상시험
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• 동결견 또는 회전근개 봉합술 후 환자에서의 기존 운동치료 가이드라인을 이용한 운동치료와 헬스케어 앱(ANAPA) 가이드(디지털치료기기)를 이용한 자가 운동치료의 효과 및 안전성 평가: 단일기관, 무작위 배정, 대조 비교, 평가자 눈가림, 탐색 임상시험
• 무릎 인공관절전치환술 환자를 대상으로 근골격계재활소프트웨어(re-R)를 적용한 시험군과 자가재활운동 대조군의 수술 후 무릎관절의 가동범위 증진 비교연구, 단일기관, 전향적, 무작위배정, 연구자 주도 탐색임상시험

DTx for patellofemoral pain - MORA cure PFP

Efficacy of a Mobile Multidisciplinary Digital Therapeutic Application for Patellofemoral Pain: A Randomized Controlled Trial

Participants: PFP lasting for at least 3 months but less than 2 years

12w F/U

Intervention : 8 weeks of digital therapeutics, MORA cure (PFP) (n=13)
Control : disease education materials and a 30-min, in-person exercise education session (n=13)

Figure 1. Multidisciplinary digital therapeutics MORA Cure (PFP), incorporating personalized exercise therapy and self-guided cognitive behavioral therapy for patellofemoral pain..

Article accepted

DTx for patellofemoral pain - MORA cure PFP

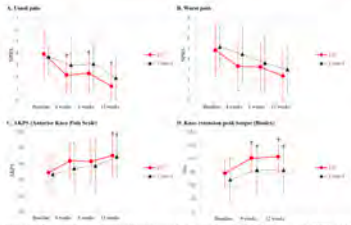


Figure 3. Comparison of clinical outcomes between the digital therapeutics (DT) and control groups over 8 weeks of treatment.

Article accepted

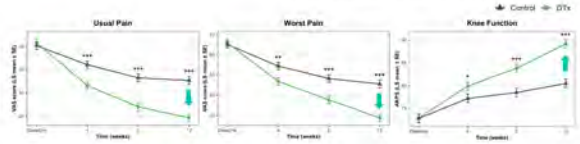
DTx for patellofemoral pain - MORA cure PFP

A Multicenter Randomized Controlled Trial for a Novel Digital Therapeutic for Treatment of Patellofemoral Pain, a Dilemma in Orthopedics.

Prospective, multicenter RCT (N = 216)
DTx (Digital Therapeutic) group
- MORA Cure (PFP) for 8 weeks

Control group
- Single in-person exercise (> 15mins) Exercise education materials, Daily exercise logged manually in diaries

Duration
- 8-week treatment + 4-week follow-up



Manuscript in preparation

Digital therapeutics for LBP - MORA cure LBP

Article
Multidisciplinary Digital Therapeutics for Chronic Low Back Pain Versus In-Person Therapeutic Exercise with Education: A Randomized Controlled Pilot Study

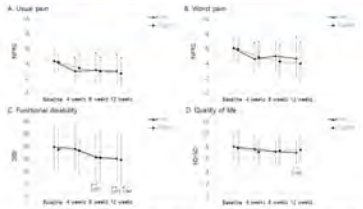
Participants: LBP (NRS > 3) persisting for 12 weeks or more

12w F/U

Intervention : 8 weeks of digital therapeutics, MORA cure LBP (n=20)
Control : in-person exercise therapy, up to four sessions (n=23)

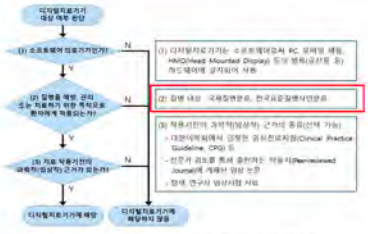
J Clin Med. 2024 Dec 4;13(23):7377

Digital therapeutics for LBP - MORA cure LBP



J Clin Med. 2024 Dec 4;13(23):7377

Barriers in DTx for musculoskeletal rehabilitation

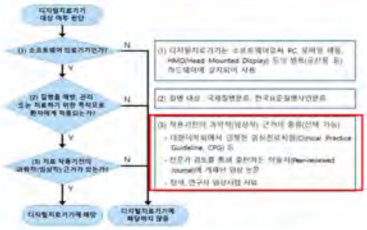


< 그림. 디지털치료기기 대상여부 판단기준 및 절차 >

Barriers in DTx for musculoskeletal rehabilitation

Diagnosis code of LBP

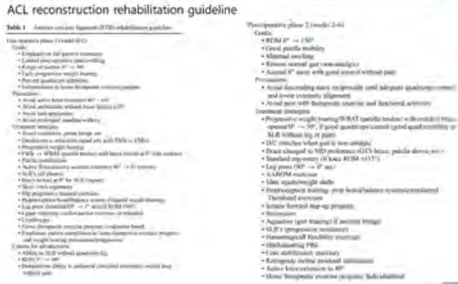
Barriers in DTx for musculoskeletal rehabilitation



< 그림. 디지털치료기기 대상여부 판단기준 및 절차 >

Barriers in DTx for musculoskeletal rehabilitation

ACL reconstruction rehabilitation guideline



Curr Rev Musculoskelet Med (2017) 10:289–296

Barriers in DTx for musculoskeletal rehabilitation

- Exercise for LBP
  - ✓No single exercise technique has superiority over others for patients with subacute and chronic LBP

Phys Ther 2020, 99:1383

  - ✓Comparison between exercise modalities
    - In a 2021 network meta-analysis of 217 trials evaluating specific exercises recommended by clinicians to address chronic low back pain in over 20,000 patients, three exercise modalities (Pilates, McKenzie therapy, functional restoration) had greater benefit in improving pain intensity and functional limitations compared with other exercise treatments
    - However, results were reported with moderate certainty, and limitations included within-study risk of bias and heterogeneity

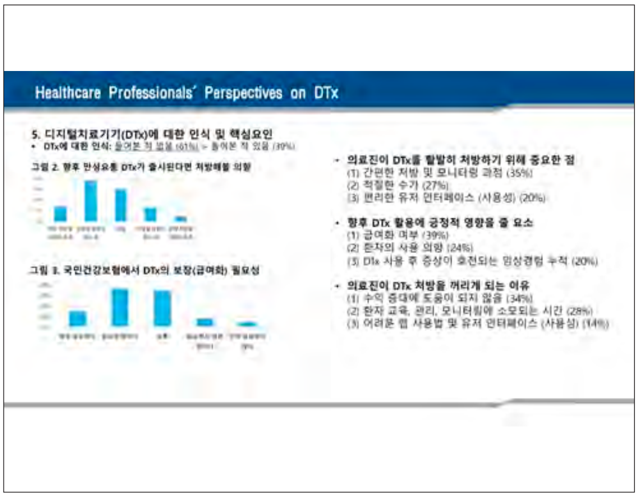
J Physiother 2021, 67:252

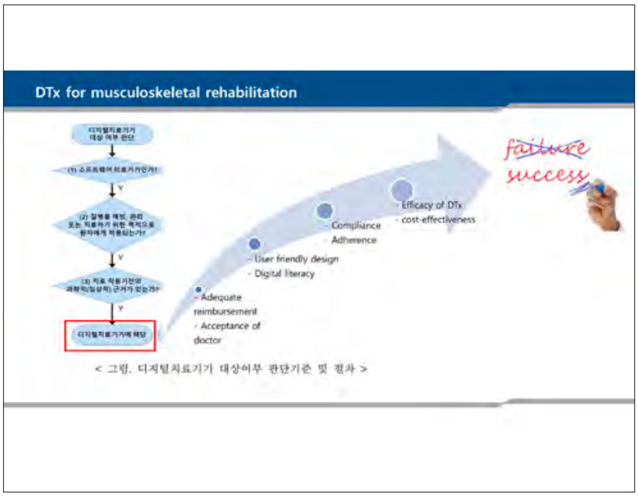
Compliance of digital solution

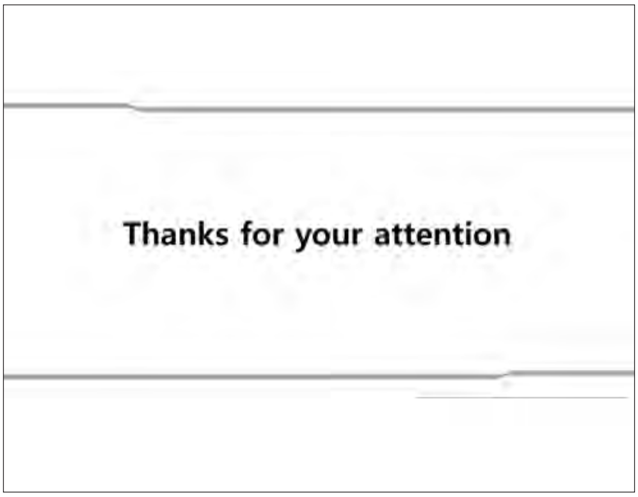
- Compliance of participants
  - ✓기존에 운동 경험이 있거나 운동에 관심 있는 사람의 순응도 높음
  - ✓원래 하던 취미나 운동으로 복귀를 원하는 사람의 경우 순응도 높음
  - ✓유튜브 등을 통해 운동을 검색해본 경험 있는 사람들은 순응도 높음
  - ✓운동을 통한 치료 효과는 대개 천천히 나타나는데, 빠른 효과를 원하는 사람의 경우 순응도가 떨어짐
  - ✓육체 노동을 하는 직업을 가진 사람의 경우 평소에 신체를 사용하는 시간이 길기 때문에 따로 운동을 더 하기 부담스러워 함.
- Digital literacy
  - ✓고령
- Importance of personalization
  - ✓어떤 환자는 너무 똑같은 운동이 반복되고 운동이 길다고 불평
  - ✓반면 어떤 환자는 운동이 자주 바뀌어 따라가기 어렵다고 불평
  - ✓그 환자에게 충분히 가능할 것 같은 운동인데, 어렵다고 못 따라하기도

Contents

제품명 (영문)	개발사	적응증	허가 연도
솜즈 (Somzz)	에임메드	불면증	2023
슬립큐 (SleepQ)	웰트	불면증	2023
비비드브레인 (VIVID Brain)	뉴냅스	시야장애 (VR 기반)	2024
이지브리드 (EasyBreath)	쉐어앤서비스	호흡재활 (COPD, 천식, 폐암)	2024
소리클리어 (SoriCLEAR)	뉴라이브	이명	2025
앵자이렉스 (Anzeilax)	[illegible]	범불안장애	2025
코그테라 (Cogthera)	이모코그	경도인지장애	2025
섭식장애 치료앱	웰트	섭식장애	2025
블루케어 (BlueKare)	[illegible]	우울증	2025


Healthcare Professionals' Perspectives on DTx
5. 디지털치료기기(DTx)에 대한 인식 및 핵심요인
• DTx에 대한 인식: 들어본 적 없음 (61%) > 들어본 적 있음 (39%)
그림 2. 향후 안성요홍 DTx가 출시된다면 처방해볼 의향
그림 3. 국민건강보험에서 DTx의 보장(급여화) 필요성
• 의료진이 DTx를 활발히 처방하기 위해 중요한 점
(1) 간편한 처방 및 모니터링 과정 (35%)
(2) 적절한 수가 (27%)
(3) 편리한 유저 인터페이스 (사용성) (20%)
• 향후 DTx 활용에 긍정적 영향을 줄 요소
(1) 급여화 여부 (39%)
(2) 환자의 사용 의향 (24%)
(3) DTx 사용 후 증상이 호전되는 임상경험 누적 (20%)
• 의료진이 DTx 처방을 꺼리게 되는 이유
(1) 수익 증대에 도움이 되지 않음 (34%)
(2) 환자 교육, 관리, 모니터링에 소모되는 시간 (28%)
(3) 어려운 앱 사용법 및 유저 인터페이스 (사용성) (14%)


DTx for musculoskeletal rehabilitation
디지털치료기기 대상 여부 판단
Y
Y
Y
디지털치료기기에 해당
- Adequate reimbursement
- Acceptance of doctor
- User friendly design
- Digital literacy
- Compliance
- Adherence
- Efficacy of DTx
- cost-effectiveness
failure
success
< 그림. 디지털치료기기 대상여부 판단기준 및 절차 >



The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회
제67차 추계학술대회

해외연자 초청 강연

좌장: 성빈센트병원 김준성, 문영래정형외과병원 문영래

Craig C. Young

Education

1980 - 1984 B. S., Biological Sciences cum laude, University of California, Irvine

1984 - 1988 M.D., University of California, San Diego School of Medicine

Postgraduate Training and Fellowship Appointments

1988 - 1991 Residency, Family Medicine, University of California, Los Angeles
Los Angles, CA

1991 - 1992 Fellowship, Sports Medicine, The Cleveland Clinic Foundation
Cleveland, OH

1994 - 1996 Advanced Faculty Development Program, Medical College of Wisconsin,
Milwaukee, WI

Faculty Appointments

1992 - 1998 Assistant Professor, Departments of Orthopaedic Surgery & Family and Community Medicine, Medical College of Wisconsin, Milwaukee, WI

1998 - 2006 Associate Professor, Departments of Orthopaedic Surgery & Family and Community Medicine, Medical College of Wisconsin, Milwaukee, WI

2004 - current Associate Clinical Professor of Health Sciences, Marquette University
Milwaukee, WI

2006 - 2010 Professor, Departments of Orthopaedic Surgery & Family and Community Medicine, Medical College of Wisconsin, Milwaukee, WI

2010 - 2021 Professor with Tenure, Departments of Orthopaedic Surgery & Family and Community Medicine, Medical College of Wisconsin, Milwaukee, WI

2019 - current Honorary Senior Researcher, WITS Institute for Sport & Health,
University of the Witwatersrand, Faculty of Health Sciences,
Johannesburg, South Africa

2021 - present Professor (Part-time), Departments of Orthopaedic Surgery & Family and Community Medicine, Medical College of Wisconsin, Milwaukee, WI

Administrative Appointments

1992 - 2021 Medical Director, Sports Medicine, Medical College of Wisconsin;
Milwaukee, WI

2021- current Senior Medical Advisor of Sports Medicine, Medical College of Wisconsin;
Milwaukee, WI

Peer Reviewed Workshops/Presentations:

International Peer Reviewed Workshops/Presentations:

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Sports injury in baseball

Medical College of Wisconsin
Craig C. Young

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 10: 야구에서의 어깨 탈구: 진단부터 치료까지

Shoulder dislocation in baseball, from diagnosis to treatment

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좌장: 네온정형외과 박진영, 문영래정형외과병원 문영래

조형래

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주요 경력

부산시 체육회 의무위원

롯데 자이언츠 야구단 팀닥터

KBO 팀닥터 필드닥터 협의회 총무이사

현재 소속 및 직위

좋은삼선병원 부원장, 정형외과 과장

좋은삼선병원 어깨관절 스프츠의학 센터장

대표논문

1. Ulnar Collateral Ligament Reconstruction and Posterior Osteophyte Resection through Single Medial Incision Korean J Sports Med 2025
2. Atypical Spondylolysis of the Fifth Lumbar Vertebra in Baseball Players. Korean J Sports Med. 2021.
3. Osseous Erosion by Spinoglenoid Ganglion Cyst in Adolescent Baseball Player. Korean J Sports Med. 2021.
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5. Traumatic Posterior Rotator Cuff Tear in the Pre-existing Chronic Supraspinatus Tendon Tear. Korean J Sports Med. 2019.
6. Is It Safe to Inject Corticosteroids into the Glenohumeral Joint After Arthroscopic Rotator Cuff Repair? American J Sports Med. 2019.

어깨 탈구의 메커니즘 및 영상학적 진단, 보존적 치료의 적응증과 방법
Mechanism of shoulder dislocation, radiological diagnosis, indications and methods for conservative treatment

좋은삼선병원
조형래

Introduction

Sports-related shoulder dislocations occur from high-impact collisions, falls, or repetitive overhead motions in sports like football, hockey, basketball, swimming, and gymnastics. The high mobility of the shoulder joint makes it prone to dislocations, especially in contact sports or sports with falls. Treatment involves immediate medical care for relocation, followed by a sling for support and physical therapy to regain strength and mobility.

Causes of shoulder dislocation in sports activity

1) Contact and Collision Sports: High-impact sports such as football, rugby, hockey, and basketball pose a risk due to direct blows and collisions that force the upper arm bone (humerus) out of the shoulder socket (glenoid).
2) Falls: Falls onto an outstretched arm, common in skiing, cycling, gymnastics, and volleyball, can dislodge the shoulder joint.
3) Repetitive Overhead Movements: Athletes who frequently perform overhead motions, including swimmers, baseball pitchers, and tennis players, can develop shoulder instability and weaken ligaments, increasing their risk of dislocation.
4) Trauma: A sudden, forceful movement or a direct blow to the shoulder can cause the humerus to pop out of the glenoid socket.

* Sports at High Risk: Football, Basketball, Hockey, Rugby, Gymnastics, Skiing, Swimming, Baseball Pitching, and Volleyball.

Mechanism of shoulder dislocation

(1) Anterior dislocation

The most common type of shoulder dislocation, accounting for over 95% of cases, typically involves a traumatic event.

- Arm position: The injury most often occurs when the arm is in an abducted (raised away from the body) and externally rotated position.
- Force vector: This position, combined with a posteriorly directed force, levers the humeral head out of the socket.
- Common causes:
  - Falling on an outstretched hand
  - A direct blow to the back of the shoulder
  - Contact sports such as football or rugby

(2) Posterior dislocation

A much rarer type of dislocation (2–5% of cases), this can be more difficult to diagnose, as the signs are often subtle.

- Arm position: The mechanism is typically axial loading of an arm that is in a position of adduction, flexion, and internal rotation
- Force vector: The humeral head is forced posteriorly in relation to the glenoid
- Common causes
  - Violent muscle contractions: Occurs during seizures or from an electric shock, where the stronger internal rotator muscles overpower the weaker external rotators.
  - Trauma: A fall on an outstretched hand or a direct blow to the front of the shoulder

(3) Inferior dislocation (Luxatio Erecta)

This is the least common and often most severe type of shoulder dislocation, with a high rate of associated nerve and blood vessel injury

- Arm position: The arm is locked in a position of forced hyperabduction (raised almost 180 degrees). The name “luxatio erecta” means “upward dislocation,” referring to the position of the arm.
- Force vector: The mechanism is extreme hyperabduction, which levers the humeral neck against the acromion (part of the shoulder blade), forcing the humeral head out of the socket.
- Common causes:
  - Trauma from a fall or vehicle accident.
  - Falling from a height

Associated damage and injury factors

Regardless of the direction, the extreme force required to dislocate the shoulder often causes additional damage to the surrounding soft tissues and bones.

- Rotator cuff tear: In older patients especially, the trauma of a dislocation can cause significant tears in the rotator cuff muscles and tendons.
- Ligament and labrum damage: The impact can stretch or tear the ligaments and the glenoid labrum (the cartilage rim of the socket), leading to long-term shoulder instability.
- Hill-Sachs lesion: This is a compression fracture or dent in the back of the humeral head, caused when it collides with the edge of the glenoid during an anterior dislocation.
- Bankart lesion: A Bankart lesion is a tear of the front part of the labrum, and is often accompanied by a fracture of the glenoid rim (bony Bankart).
- Chronic instability: After the first dislocation, particularly in younger patients, the damaged ligaments can make the joint loose and more susceptible to recurrent dislocations.

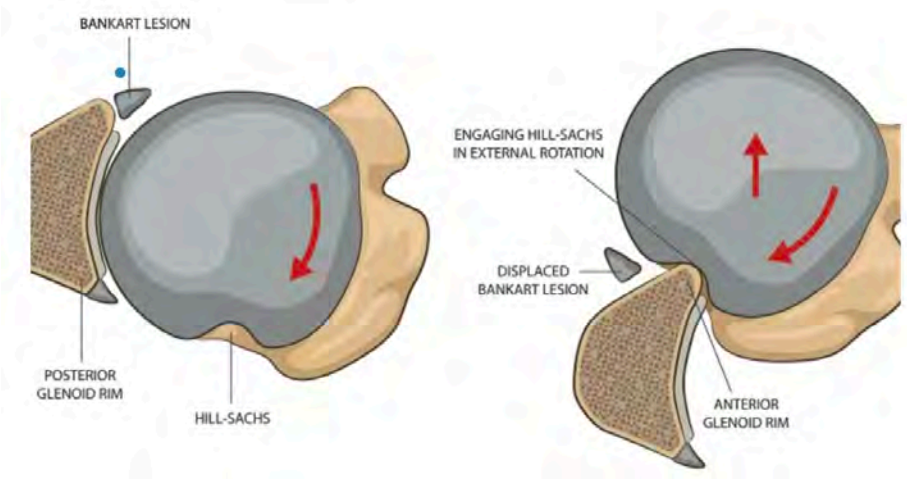

Fig.2. Schematic descriptions of Bankar and Hill-Sachs lesion

Radiological Diagnosis of Shoulder dislocation

1) Radiologic signs of anterior shoulder dislocation

The most common type of shoulder dislocation, anterior dislocations, account for over 95% of all cases.

Primary findings (on X-ray):

- AP view: The humeral head is displaced from the glenoid and lies inferior to the coracoid process.
- Scapular Y-view: The humeral head is positioned anterior to the intersection of the scapular processes.
- Axillary view: The humeral head is seen anterior to the glenoid fossa

Associated injuries and signs:

- Hill-Sachs lesion: An impaction fracture on the posterolateral aspect of the humeral head. It appears as a cortical depression or flattening and is pathognomonic for anterior dislocation.
- Bankart lesion: A tear of the anteroinferior labrum, often accompanied by a fracture of the glenoid rim (bony Bankart lesion). A bony Bankart is sometimes visible on a Garth or West Point view.
- Greater tuberosity fracture: An avulsion fracture of the greater tuberosity of the humerus may also

be present.

2) Radiologic signs of posterior shoulder dislocation

Posterior dislocations are much less common and often missed on initial examination if an axillary or Y-view is not obtained.

Primary findings (on X-ray):

- AP view: May appear normal. Clues include the humeral head being fixed in internal rotation, which creates a “lightbulb” appearance due to the spherical shape of the humerus in this view.
- Scapular Y-view: The humeral head is posteriorly displaced relative to the glenoid.
- Axillary view: Shows the humeral head located posteriorly to the glenoid.

Associated injuries and signs:

- A Reverse Hill-Sachs (Trough) lesion is an impaction fracture on the anteromedial humeral head, sometimes seen on the AP view as a vertical line called the “trough line sign”.
- A Reverse Bankart lesion is a fracture of the posterior glenoid rim.
- The Rim sign is a widened glenohumeral joint space (over 6 mm) seen on the AP view.

3) Role of advanced imaging

Following initial X-rays, further imaging may be necessary to assess soft tissue damage or bone defects, particularly when considering surgery or in cases of recurrent instability.

A CT scan is useful for visualizing and measuring bone defects such as Hill-Sachs and bony Bankart lesions.

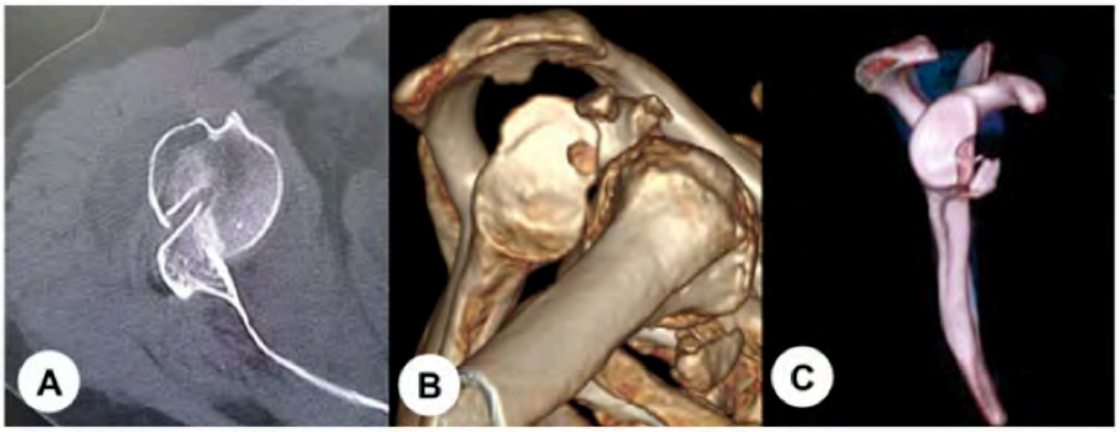

Fig. 3. Computed tomography of shoulder dislocation. (A) Axial image, and three dimensional reconstruction images in (B) anterior dislocation and (C) bony Bankart lesion.

An MRI scan (or MR arthrography) is considered the best method for evaluating soft tissue injuries like labral tears, capsular injuries, and rotator cuff tears that are not visible on X-rays.

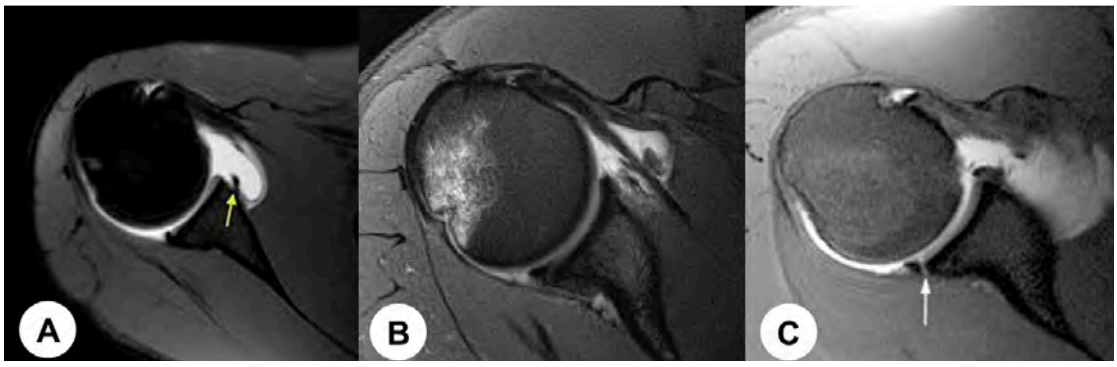

Fig. 4. Magnetic resonance images of the associated injuries of shoulder dislocation. (A) Bankart lesion. (B) Hill-Sach lesion. (C) posterior labral tear (reverse Bankart lesion).

Indication and Methods for Conservative Treatment

Conservative treatment for shoulder dislocation is generally appropriate for older, less active individuals and for first-time dislocations without significant associated injuries. However, in young athletes or cases with severe soft tissue damage, a discussion about surgical options is warranted

Generally favorable indicators include:

- Older age: Patients over 40 to 50 years old have a lower risk of recurrence and are often successfully treated conservatively.
- First-time dislocation: The decision for conservative versus surgical management is most common after a person's first dislocation.
- Lower activity levels: For individuals who do not engage in demanding overhead activities or contact sports, the risk of re-injury is lower.
- Absence of major associated injuries: Conditions that would require surgery include:
  -Significant tears of the labrum (Bankart lesions) or rotator cuff.
  - Large Hill-Sachs lesions (a compression fracture of the humeral head).
  - Glenoid bone loss.
  - Nerve or vascular damage.

Methods for conservative treatment

Conservative treatment for shoulder dislocation involves initial joint reduction followed by a period of rest, immobilization, and a structured rehabilitation program to restore range of motion and strength. This non-surgical approach is favored for first-time dislocations in older patients or less-active individuals.

Immediately following a shoulder dislocation, follow below steps:

- Closed reduction: This procedure is performed by a medical professional to manually and gently reposition the humerus (upper arm bone) back into the shoulder socket. It is usually done in an emergency department under local anesthesia to relax the muscles and ease pain.

- Imaging: X-rays are typically taken before and after reduction to assess the dislocation and check for any related injuries like fractures.
- Pain management: Over-the-counter non-steroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen or naproxen, can be used to manage pain and reduce inflammation. Long-term use should be avoided. Ice packs can also be applied to the shoulder for 15–20 minutes at a time to help with swelling.

Recovery phase

After the initial pain and swelling subside, the shoulder needs to be protected to allow the soft tissues to heal.

Immobilization

- A sling or brace is used to immobilize the shoulder for a period of rest, typically one to three weeks.
- While some studies have investigated immobilizing the arm in external rotation versus internal rotation to reduce the rate of re-dislocation, the evidence is not conclusive.

Physical therapy

After the initial immobilization period, a physical therapist will design a supervised rehabilitation program to help restore full function.

Phase 1: Rest and immobilization (0–2 weeks)

The initial phase focuses on allowing the shoulder capsule and surrounding soft tissues to heal.

- Immobilization: wear a sling to support the arm and limit movement.
- Pain management: Use ice and anti-inflammatory medication as directed to control pain and swelling.
- Gentle motion: You may begin simple exercises for the hand and wrist to prevent stiffness.

Phase 2: Early mobilization (2–6 weeks)

This phase introduces gentle exercises like pendulum swings and assisted flexion to restore range of motion. Isometric exercises may also be used to build strength safely.

Phase 3: Strengthening and stability (6–12 weeks)

Focus shifts to strengthening shoulder stabilizers with exercises such as resistance band rotations for the rotator cuff and scapular squeezes for shoulder blade control. Resistance is progressively increased.

Phase 4: Functional and sport-specific training (12+ weeks)

This phase prepares the shoulder for sport-specific movements using activities like medicine ball throws and plyometrics for explosive movements. Athletes will gradually return to practice, starting with non-contact drills.

Return to activity

- Recovery time can take several months, depending on the severity of the injury.
- Returning to strenuous activities too soon can increase the risk of re-injury.

● Strengthening exercises and proper form can help prevent future dislocations

Risk of re-dislocation

The risk of a repeat dislocation is high, especially for young, active individuals. Factors increasing this risk include being younger at the time of the first dislocation, participating in contact or overhead sports, and having untreated injuries like a Bankart or Hill-Sachs lesion. For those under 20, the recurrence rate can be very high.

Return to sports after shoulder dislocation

Returning to sports after a shoulder dislocation requires meeting specific, objective criteria, not just waiting out a set amount of time. Studies show that athletes who use a criteria-based approach have significantly lower rates of re-injury. A multi-stage evaluation assesses pain, range of motion, strength, stability, and psychological readiness.

- Assessment criteria

Pain

● The shoulder must be consistently pain-free during movements related to the athlete's sport and daily activities.

Range of motion (ROM)

● The shoulder should have a functional and symmetrical range of motion compared to the uninjured side.
● Overhead athletes may have some natural differences in rotation between their arms, but overall total motion should be within normal limits.
● There should be no apprehension (fear of the shoulder re-dislocating) with passive motion.

Strength

● Strength should be symmetrical or nearly symmetrical to the uninjured side, with a target of at least 80–90% strength in the injured shoulder. Key areas to test include:
  - Rotator cuff muscles
  - Bilateral scapular (shoulder blade) stabilizers
  - External and internal rotation strength

Functional testing

Specific tests are used to assess an athlete's power, agility, and stability under load, mimicking athletic movements. Examples include:

● Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST): Tests upper body stability and agility by having the athlete in a push-up position and tapping opposite hands across the body. The goal is a certain number of touches in 15 seconds.
● Seated Shot Put Test: Measures upper-body power by having the athlete propel a weighted ball for

distance while seated against a wall.

- Y-Balance Test of the Upper Quarter (UQ-YBT): Assesses upper-body balance and stability by having the athlete balance on one hand while reaching in multiple directions with the other.

Psychological readiness

- Mental preparedness is a critical factor for a safe return to sport. The athlete must be confident in the shoulder's stability and not have a significant fear of re-injury (kinesiophobia), which can affect performance. Questionnaires like the Shoulder Instability-Return to Sport after Injury (SIRSI) can help assess this.

The gradual "3 P" return-to-sport progression

Athletes should be evaluated for a stepwise progression rather than an immediate return to full competition.

- Performance: The initial phase of returning to activity, focusing on achieving full strength and function through rehabilitation and sports-specific drills.
- Practice: The athlete slowly integrates back into full team practice, starting with low-intensity drills and controlled movements before advancing to full-intensity practice and scrimmages.
- Play: After demonstrating readiness in practice, the athlete can return to competitive play, but with the understanding that they must continue their maintenance and prevention exercises.

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금정섭

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대한스포츠의학회 홍보위원

LG 트윈스 필드닥터

기아타이거즈, 한화이글스 의료 자문의

장애인 농구협회 이사

대한 육상연맹 의무위원

대한 컬링협회 의무과학위원회 위원

현재 소속 및 직위

세종스포츠정형외과 원장

관절와순 파열의 수술 결정, 언제 해야하나요? 첫탈구도 하나요? When should surgery be considered for a labrum tear? Is it necessary even for a first dislocation?

세종스포츠정형외과
금정섭

배경

야구 투수에서 발생하는 척측측부인대(ulnar collateral ligament, UCL) 손상은 투구 동작 중 반복되는 외반 부하로 인한 과사용 손상으로 알려져 있다. 최근 영상기법의 발전과 함께 손상의 위치(location)와 파열 정도(grade)에 따라 다양한 치료 전략이 제시되고 있으며, 특히 부분파열의 경우 비수술적 치료가 점차 강조되고 있다.

부분파열(Grade I-II) 및 근위부(Proximal) 손상을 중심으로, 치료 프로토콜, 재활 과정, 생물학적 치료의 효과, 예후 및 수술 전환율에 대한 연구를 분석한 결과, 부분파열 또는 근위부 손상의 경우, 구조화된 재활 프로그램(Thrower's Ten, flexor-pronator 강화, 코어 및 견갑 안정화)과 단계적 투구 복귀 프로그램(interval throwing program)을 병행한 비수술 치료에서 평균 RTP(return to play) 79.7%, RTLP(return to same level play) 77.9%의 성공률이 보고되었다.

특히 PRP(platelet-rich plasma) 병용 치료군에서는 12주 이내 동일 수준 복귀율이 80-88%까지 향상되는 경향을 보였다. 반면, 원위(distal) 파열 및 완전파열(complete tear)의 경우 보존적 치료 실패율이 높아 수술 전환이 권장되었다. 주요 실패 예측 인자는 MRI상 원위부 파열, 50% 이상 섬유 손상, 동반 신경 증상(ulnar neuritis) 및 반복적 투구로 인한 만성 불안정성이었다.

UCL 손상의 보존적 치료는 부분 및 근위 파열에서 효과적인 1차 치료 옵션으로, 체계적 재활 및 단계적 투구 복귀를 통해 약 80% 수준의 성공적인 경기 복귀가 가능하다.

그러나 원위부·완전 파열, 조직 퇴행, 동반 병변이 존재할 경우 초기부터 수술적 치료를 고려해야 하며, 향후 보다 표준화된 재활 프로토콜과 생물학적 치료의 장기 예후에 대한 추가 연구가 필요하다 하겠다.

이제형

학력

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건국대학교병원 견주관절, 스포츠 클리닉 전임의

주요 경력

두산베어스 프로야구단 주치의

KB손해보험스타즈 프로배구단 주치의

여자야구 국가대표팀 주치의

현재 소속 및 직위

청담리온정형외과 원장

대표논문

1. Does anchor placement on the glenoid affect functional outcome after arthroscopic Bankart repair? 2018 AJSM
2. Return to play after arthroscopic treatment for shoulder instability in elite and professional baseball players , 2019, JSES
3. Bridge Tenodesis: A Secure fixation technique for biceps long head tendinopathy during arthroscopic rotator cuff repair using a suture-bridge technique/ 2016 Arthroscopic technique

관절경하 관절와순 봉합시에 후관절낭 중첩(remplissage)의 적응증은?

What are the indications for posterior capsular overlap (remplissage) during arthroscopic capsular suturing?

청담리온정형외과

이제형

Hill-Sachs lesion은 전방 탈구 시 상완골 대결절(posterolateral humeral head)이 관절와 전연(anterior glenoid rim)에 충돌하면서 생기는 압박성 함몰골절(impaction fracture)입니다. 이 결손이 작고 glenoid와의 상호작용이 없는 경우는 문제가 되지 않지만, 결손이 크거나 전방 와순 봉합 후에도 관절와와 맞닿으며 걸리는 경우(engaging lesion)에는 재탈구가 쉽게 발생합니다.

Yamamoto는 cadaveric 연구에서, 팔이 외전+외회전 시 glenoid가 상완골 두에 닿는 영역을 'glenoid track'이라 명명했습니다. 정상 glenoid track 폭은 glenoid 폭의 약 83%이며, glenoid bone loss가 존재하면 track 폭이 좁아집니다. Hill-Sachs 병변의 내측 경계가 glenoid track보다 내측(off-track)으로 위치하면 engagement가 발생합니다.

Remplissage는 '채워 넣기(fill in)'의 의미로, 관절경하로 Hill-Sachs 결손부 내에 극하근(infraspinatus)과 후관절낭(posterior capsule)을 앵커로 봉합하여 결손부를 관절강에서 비활성화하는 술식입니다. 이로써 engagement를 방지하고 안정성을 향상시킵니다.

적응증으로는 Engaging Hill-Sachs lesion(외전-외회전 시 glenoid rim과 접촉하며 engagement가 발생하는 경우), Off-track Hill-Sachs lesion(Glenoid track 계산상 off-track일 경우), 전방 glenoid bone loss 가 20-25% 이하인 경우, 재탈구(recurrent instability) + Hill-Sachs 병변의 존재 그리고 Contact athletes / high-risk sports 등에서 시행 가능 합니다. 절대적 금기로는 glenoid bone loss 25% 이상, humeral head bone loss 40% 이상 이며, 상대적 금기로는 후방 캡슐 강직, 오버헤드 투구 선수의 경우입니다.

Reference

1. Yamamoto N, et al. JBJS Am. 2007;89:819-824.
2. Purchase RJ, et al. Arthroscopy. 2008;24(6):723-726.
3. Boileau P, et al. J Shoulder Elbow Surg. 2012;21(6):761-769.
4. Di Giacomo G, et al. Arthroscopy. 2014;30(1):90-98.
5. Cho NS, et al. Am J Sports Med. 2016;44(12):3188-3194.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

2028 LA 올림픽 채택 기념 대한스쿼시연맹 초청 심포지엄:
유리벽 안의 전쟁 - 스쿼시를 해부하다
The War Within the Glass Wall - Dissecting Squash

좌장: 닥터핏 박원하, 하병원 하철원

강호석

학력

세종대학교 체육학과 학사

경기대학교 교육대학원 체육교육학과 석사

경기대학교 일반대학원 레저스포츠학과 박사

주요 경력

스쿼시국가대표 감독

국가대표지도자협의회 회장

한국 스포츠 코칭학회 부회장

함께하는 스포츠포럼 이사

전)대한체육회 교육위원회

현재 소속 및 직위

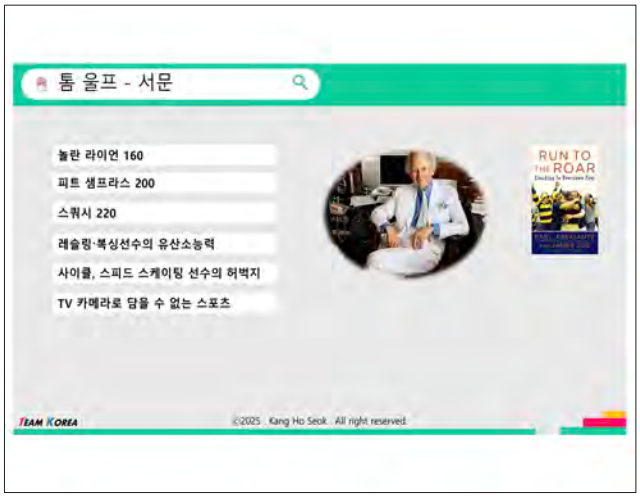
대한스쿼시연맹 스쿼시국가대표 감독

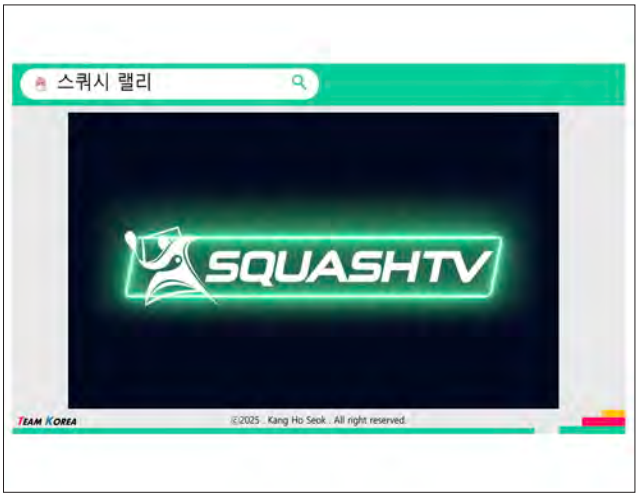
대표논문

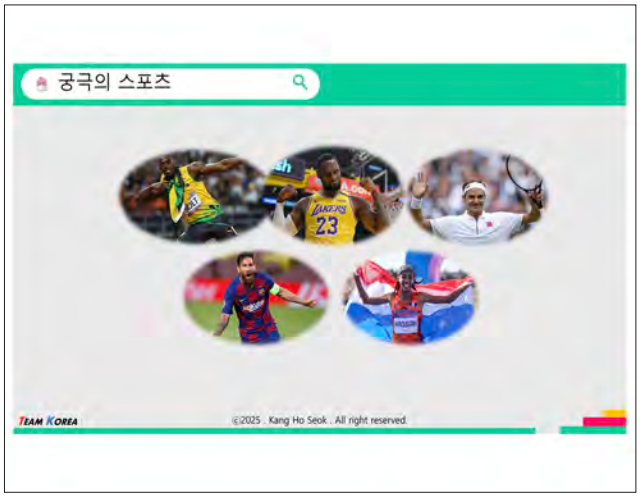
1. 스포츠 코칭 정서지능 척도 개발 -체육과학연구지-
2. 지도자의 동기부여방식에 따른 학생선수들의 자기결정동기, 스트레스와 탈진 -코칭능력개발지-
3. Heart Rate Variability Biofeedback and Cognitive Restructuring for SelfRegulation: A Case Study -International Journal of Disabilities Sports and Health Sciences -
4. implications of artificial intelligence in

스쿼시 종목 소개: “초고속 스포츠, 스쿼시를 말하다.”
Squash Introduction:
The Ultra-Fast Sport, Squash Explained

대한민국 국가대표 스쿼시팀 감독
강호석







미국대학 스쿼시 랭킹

순위	남자부	여자부
1	**University of Pennsylvania**	**Harvard University**
2	**Princeton University**	**Princeton University**
3	**Trinity College**	**Drexel University**
4	Yale University	University of Pennsylvania
5	Harvard University	Trinity College
6	University of Virginia	Yale University
7	Drexel University	Cornell University
8	Columbia University	Columbia University
9	Cornell University	University of Virginia
10	Dartmouth College	Tufts University

- ✓ 1920 하버드 예일 정기전시작
- ✓ 1930대 대학스쿼시협회창설
- ✓ 1956-57 시즌 Ivy League 챔피언쉽
- ✓ 모든 아이비리그 대학이 남녀 스쿼시 팀 보유

아이비리그의 **오랜 전통과 경쟁력**은 스쿼시를 엘리트 스포츠로 격상시켰으며, 많은 주니어 선수들이 아이비리그 입학을 목표로 할 정도로 큰 **명성과 역사**를 자랑

스쿼시 선수 학력

순위	성명	출신대학
1	알리 파라그	하버드
5	마완 엘 소바기	브리스톨
8	빅터 크루잉	하버드
10	요셉 이브라힘	프린스턴
11	알리 아부 엘레이네	뉴팬

순위	성명	출신대학
5	올리비아 위버	프린스턴
8	시바상가리	코넬
9	아만다 소비	하버드
10	조지아 케네디	하버드
16	엘리사 알베스	뉴팬




미국여자대표팀

- •Olivia Weaver 스탠포드 졸
- •Amanda Sobhy 하버드 졸
- •Marina Stefanoni 하버드 재
- •Caroline Fouts 하버드 재

스쿼시의 운동생리학

1. 심혈관 부하 (Cardiorespiratory Load)
•경기 중 평균 심박수: 최대의 81–92%
•경기 시간의 약 25%에서 VO_2max 90% 초과
•최고 수준의 심폐 지구력 요구
출처: *Journal of Sports Science & Medicine (jssm.org)*

2. 에너지 시스템 (Energy System)
혼합형 에너지 대사(유산소 + 무산소)
혈중 젖산 농도: 평균 8 mmol/L 이상
VO_2max: 남자 약 60–70 mL/kg/min, 여자 약 50 mL/kg/min
→ 약 15–17 METs 수준의 고강도 운동

3. 경기 내 패턴 (Match Physiology)
랠리 지속: 평균 15–30초
휴식: 5–10초 (불완전 회복)
세트 간 휴식: 90초
→ *"고강도 인터벌 운동(Repeated Sprint Effort)"* 패턴 반복

4. 핵심 요약 (Summary)
•스쿼시는 유산소 기반 위에 무산소 파워가 결합된 종목
•지속적 고심박·고젖산 환경 속에서 경기 진행
•요구 능력:
- 심폐 지구력 (Cardiorespiratory endurance)
- 무산소 파워 (Anaerobic power)
- 빠른 회복 능력 (Recovery capacity)

결론:
스쿼시는 "심폐-근육 대사 기능이 통합된 궁극의 인터벌 스포츠"로, 스포츠의학적 연구 가치가 매우 높은 종목이다.


올림픽 진입과 세계적 위상 확대

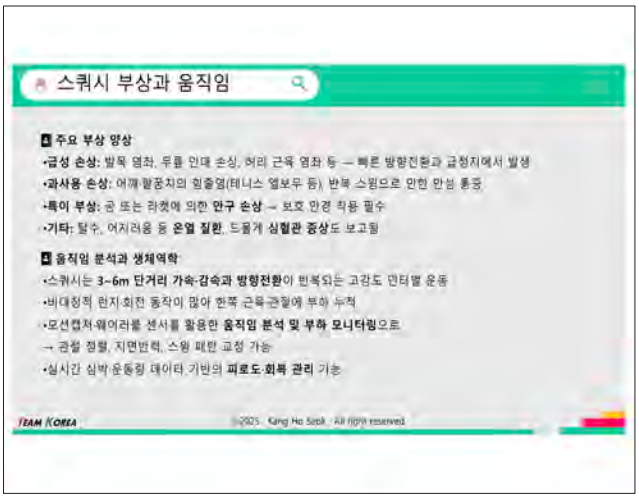
세계적 보급:스쿼시는 현재 185개국, 약 2천만 명 이상이 즐기는 글로벌 스포츠로 성장함.
초기에는 영국·미국 중심이었으나, 이집트·말레이시아·인도·콜롬비아·페루 등 비서구권까지 확산.

올림픽 진입: 국제스쿼시연맹(WSF)은 IOC 인정을 받아 꾸준히 올림픽 편입을 추진해왔으며,
2023년 IOC 총회에서 LA 2028 올림픽 정식 종목으로 승인됨.
→ 스쿼시는 2028년 첫 올림픽 경기를 치르게 될 예정.

프로 무대:프로페셔널 스쿼시 협회(PSA)가 연간 월드 투어 운영.
대표 대회: 월드 오픈($130), 브리티시 오픈, US 오픈, 홍콩 오픈 등.
→ 세계 최정상 선수들이 참여하는 국제적 투어 체계 확립.

아시아 및 한국의 성장: 아시안게임 정식 종목(1998 방콕 대회 이후)으로 자리 잡음.
말레이시아, 인도, 홍콩 등은 엘리트 육성 강세.
2023 월드주니어 남자 개인 2위, 단체 2위로 꾸준한 상승 중
한국은 엘리트층은 얇지만 동호인 증가세 뚜렷하며,2026년 세계남자단체선수권(청주 개최)로 아시아 내 위상 강화 중.

스쿼시 경기장


스쿼시 부상과 움직임
주요 부상 양상
•급성 손상: 발목 염좌, 무릎 인대 손상, 허리 근육 염좌 등 — 빠른 방향전환과 급정지에서 발생
•과사용 손상: 어깨·팔꿈치의 힘줄염(테니스 엘보우 등), 반복 스윙으로 만한 만성 통증
•특이 부상: 공 또는 라켓에 의한 안구 손상 → 보호 안경 착용 필수
•기타: 탈수, 어지러움 등 온열 질환, 드물게 심혈관 증상도 보고됨
움직임 분석과 생체역학
•스쿼시는 3~6m 단거리 가속·감속과 방향전환이 반복되는 고강도 인터벌 운동
•비대칭적 런지·회전 동작이 많아 한쪽 근육·관절에 부하 누적
•모션캡처·웨어러블 센서를 활용한 움직임 분석 및 부하 모니터링으로
→ 관절 정렬, 지면반력, 스윙 패턴 교정 가능
•실시간 심박·운동량 데이터 기반의 피로도·회복 관리 가능
TEAM KOREA
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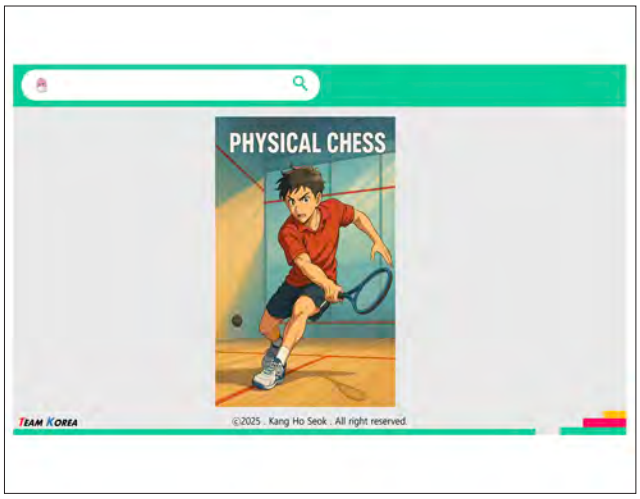
PHYSICAL CHESS
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이년호

학력

한국체육대학교 사회체육학과 학사

국민대학교 교육대학원 체육교육학 석사

주요 경력

2018년 자카르타-팔렘방 아시안게임 스쿼시 국가대표

2018년 회장배 전 한국스쿼시선수권대회 일반부우승

제91,92,93,94 전국체육대회 남자 일반부 우승

2010년 광저우 아시안게임 스쿼시 국가대표

현재 소속 및 직위

스쿼시지도자

대표논문

IPA를 이용한 스쿼시동호인의 라켓구매 시 선택속성 평가

스쿼시 선수의 부상 회복기:
“부상은 또 하나의 상대 - 코트로 돌아온 선수의 이야기”
A Squash Player’s Recovery from Injury:
‘Injury is Another Opponent -
The Story of a Player Returning to the Court’

대한스쿼시연맹

이년호

소개

- 이년호
- 경력

- 스쿼시국가대표 10년
- 10, 18 아시안게임 출전
- 전국체전 금메달 5개

스쿼시 경기영상

SQUASH GAME

- Rally Time 20~60s
- 1set 12~20min
- Rest 4~10s
- lunge

1rally 15
1GAME :200~300

- 허벅지 근육 파열
- 아킬레스건 파열
- 무릎 십자인대파열

부상 발생 상황

- - 허벅지 근육 파열

(대퇴사두근/햄스트링 손상)

* 회복 예상 3~6개월

- - 아킬레스건 파열

* 회복 예상 6~12개월

- - 무릎 십자인대파열

* 회복 예상 6~12개월

그 밖에 발생되는 요인

상지(팔,어깨)	허리·몸통	기타
• 어깨 충돌 증후군 / 회전근개 손상 • 팔꿈치 부상 (엘보우)	• 허리 근육 긴장/염좌 • 디스크(추간판 탈출증) 악화	• 안면/눈 부상 • 타박상/찰과상 • 탈수/열사병

치료 과정

- - 휴식과 안정
- - 물리치료 및 약물치료
- - 재활훈련

재활 중 어려움

- 통증과 재발 두려움
- 체력 저하
- 경기 감각 상실

- 심리적 충격 동반

심리적 지원

- - 스포츠 심리 상담
- - 팀 동료와 가족 격려
- - 멘탈 회복의 중요성

복귀 후 성과

- - 점진적 경기력 회복
- - 새로운 훈련 루틴 정립
- - 부상 관리 및 예방 습관

교훈 & 메시지

- - 재활의 중요성
- - 부상도 성장의 기회
- - 전문적인 치료와 재활 없이는 복귀불가

김정수

학력

동국대학교 체육교육과 학사

주요 경력

국가대표 스쿼시 팀 트레이너

한양중학교 축구부 트레이너

동국대학교 축구부 파견 트레이너

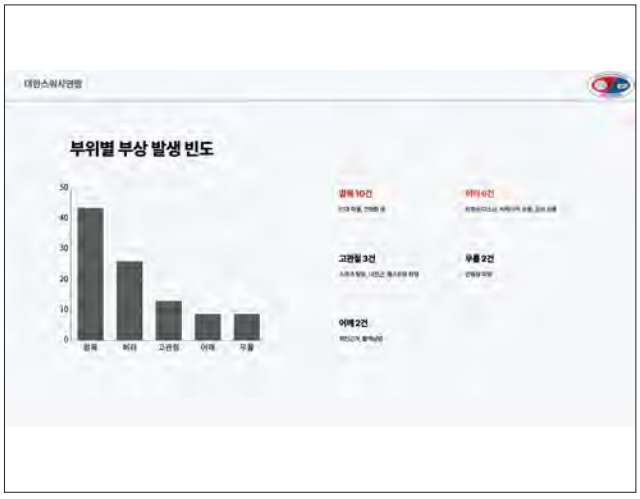
동국대학교 스포츠의학 동아리 회장

현재 소속 및 직위

국가대표 스쿼시 팀 트레이너

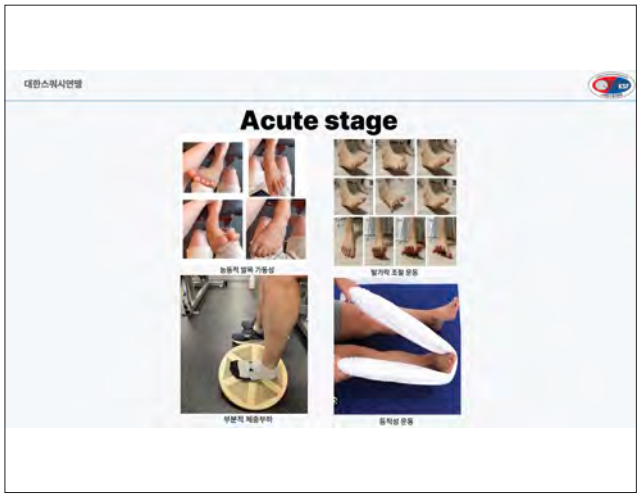
스쿼시 다빈도 부상 및 관리:
“어디까지 다칠 수 있나? 스쿼시 부상의 실제 이야기”
Common Squash Injuries and Management:
‘How Bad Can It Get? Real Stories of Squash Injuries’

대한민국 국가대표 스쿼시팀 트레이너
김정수




대한스워사연맹
발목 부상
01 외측 인대 파열 3건
02 건병증 3건
03 족저건막염 2건
04 기타 2건


대한스워사연맹
외측인대 파열 재활
Acute
Recovery
Strength
Functional
HSR
스포츠 특이적

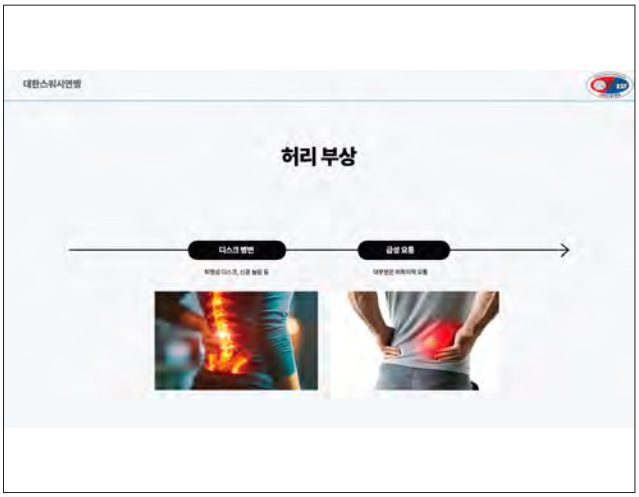

대한스워사연맹
Acute stage


대한스워사연맹
Recovory stage


대한스워사연맹
Strength stage


대한스워사연맹
Functional stage


재활 방법
건병증/족저건막염
1 건병증
-45sec 이상 Isometric + 통증 관리
-Eccentric 운동 및 HSR 운동 진행
2 족저건막염
- 족저건막 + 아킬레스건 스트레칭
- 족저건막 스트레칭된 상태에서의 Claf raise
- 발 아치 회복


허리 부상


디스크 병변 - Mckenzie Method
Centralization
Peripheralization


벡켄지 운동 - Extension
Step 1 - Prone lying
Step 2 - Prone on elbows
Step 3 - Prone press up
Step 4 - Hip hinge exercises
Step 5 - SL deadlift
Step 6 - Sports specific


급성 요통(Chronic LBP)
But!


부하량의 변화
지난주 부하량
이번주 부하량
• 대회 종료 후 휴식
• 기타 부상으로 인한 휴식
• 갑작스러운 운동량 변화
• 첫돈 경기
매주 10%의 부하 증가가 적절


결론
선수가 특수적인 상황에도 과부화를 느끼지 않게 훈련 강도 조절
허리 통증으로 인한 휴식 치명


참고문헌 및 사진

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

자유연제 구연 3 - 최우수 연제 후보 구연

Free paper presentation 3

- Best paper candidates presentation

좌장: 용인세브란스병원 이태임, 고려대구로병원 배지훈

일차 전방십자인대 재건술 후 대퇴사두근의 근피로도가 부상 전 및 수술 후 스포츠 활동 수준 회복에 미치는 영향 : 2년 추시 비교연구

Quadriceps work fatigue was a significant predictor of the return to preinjury and postoperative sports levels following primary ACL reconstruction using hamstring autograft or tibialis anterior allograft

고려대학교 안암병원 스포츠의학센터 고려대학교 안암병원 정형외과

이진혁, 이규빈, 정우용, 변상우, 장기모

목적(Background)

It is unclear whether patients who return to preinjury sports levels two years after primary anterior cruciate ligament reconstruction (ACLR) have better functional outcomes than those who do not. In particular, the specific factors among functional outcomes that influence the return to preinjury and postoperative sports levels remain controversial. To compare functional outcomes such as muscle and functional performances, and patient-reported outcomes (PROs) between patients who returned to preinjury sport levels two years following primary ACLR and those who did not. Furthermore, we aimed to determine the predictors of functional outcomes related to the return to preinjury or postoperative sports levels two years postoperatively.

대상 및 방법(Methods)

Fifty male patients (26 successfully returned vs. 24 did not return) were enrolled in this study. The criteria for study participants were general patients with a preoperative Tegner activity level ≥6, and we classified patients who returned to their preinjury sports levels using the Tegner activity level and sports activity rating scale after surgery. At the 2-year follow-up evaluation, functional outcomes such as knee muscle strength, work fatigue, single-leg hop distance (SLHD), limb symmetry index (LSI), Lysholm score, International Knee Documentation Committee (IKDC) score, Knee injury and Osteoarthritis Outcome Score (KOOS) Sport and Recreation subscale, and KOOS quality of life were compared between the groups. Multiple linear regression analysis was performed to identify predictors affecting return to preinjury and postoperative sports levels.

결 과(Results)

Work fatigue of quadriceps muscles (Cohen's d: −0.86, 95% CI: −12.2 to −2.5, p = 0.004), SLHD (Cohen's d: 1.21, 95% CI: 17.8–48.8, p < 0.001), IKDC score (Cohen's d: 2.14, 95% CI: 6.4–27.2, p < 0.001), and KOOS sport and recreational function subscale (Cohen's d: 1.05, 95% CI: 6.6–22.0, p < 0.001) were better in patients who returned to preinjury sports levels than those who did not. Work fatigue of quadriceps muscles (R2 = 0.110 and β = −0.332) and SLHD (R2 = 0.084 and β = 0.290) were a predictor for preoperative Tegner activity scale, whereas work fatigue of quadriceps muscles (R2 = 0.157 and β = −0.397), SLHD (R2 = 0.283 and β = 0.532), and IKDC score (R2 = 0.452 and β = 0.672) were predictors for postoperative Tegner activity scale.

결 론(Conclusion)

The work fatigue, SLHD, IKDC, and KOOS sport and recreational subscale were better in patients who returned to preinjury sports levels than in those who did not. Work fatigue of the quadriceps muscle and SLHD were predictors of return to preinjury sports levels, whereas work fatigue of the quadriceps muscle, SLHD, and IKDC were predictors of postoperative sports levels. Therefore, clinicians and therapists should keep in mind the importance of work fatigue to successfully return to their preinjury sports levels and reach their current high sports levels postoperatively two years after primary ACLR, and endurance and neuromuscular trainings should be considered.

슬개대퇴통증 치료를 위한 운동 -인지행동치료 병합 디지털 치료기기의 무작위 대조 연구

A Randomized Controlled Trial of a Digital Therapeutic Combining Exercise and Cognitive-Behavioral Therapy for Patellofemoral Pain

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목적(Background)

Patellofemoral pain (PFP) frequently persists despite conservative care. This study evaluated the effectiveness of a digital therapeutic (DTx) combining exercise and cognitive-behavioral therapy (CBT) for chronic PFP.

대상 및 방법(Methods)

In this multicenter randomized trial, 216 adults with PFP were assigned to an 8-week mobile-based DTx program (MORA Cure PFP) or a control group receiving face-to-face education and an exercise material. Outcomes assessed at baseline, weeks 4, 8, and 12 included pain intensity (VAS, 0-100), knee function (AKPS), quality of life (EQ-5D-5L), and psychological measures (PCS, PHQ-9). All outcomes are reported as least-squares means.

결 과(Results)

For usual pain, significant between-group differences emerged at week 4 and widened thereafter, with LS means decreasing from 51.5 to 19.3 in the DTx group versus 50.3 to 35.3 in controls by week 12. Statistically

significant improvements were also observed in worst pain, knee function, quality of life, depressive symptoms, and pain catastrophizing in the DTx group. Exercise adherence (≥3/week) was 80.9% in the DTx group and 71.3% in controls, and CBT session completion was 74.6%.

결 론(Conclusion)

This trial demonstrates that a digitally delivered combination of exercise and CBT significantly improves pain, function, mental health, and quality of life in patients with PFP, supporting its potential for real-world musculoskeletal care.

인공지능 기반 모델링을 통한 엘리트 남자 역도 선수의 도핑 관련 경기력 이상 탐지

Artificial Intelligence-Based Modeling for Detecting Doping-Related Performance Anomalies in Elite Male Weightlifting

연세대학교 체육교육학과

주윤태, 김예희, 이주현, 서상훈

목적(Background)

Doping remains a persistent threat to fairness and integrity in elite sports. While the Athlete Biological Passport (ABP) monitors biomarkers over time, it faces challenges such as biological variability and operational burden. The Athlete Performance Passport (APP) has been proposed to flag suspicious competition results, but current frameworks are mostly conceptual and lack analytical rigor. This study aimed to address this gap by applying AI-based models to detect abnormal performance patterns in elite male weightlifters using demographic and competition data.

대상 및 방법(Methods)

A total of 26,293 competition records, including 1,358 from sanctioned athletes, were analyzed. K-Means clustering was performed using age, weight class, and total lifted weight. Three nonparametric regressors—Decision Tree, Random Forest, and K-Neighbors—were trained on non-sanctioned data to predict total lifted weight per kilogram of bodyweight. The best model was used to compute residuals, which were compared between groups using the Mann-Whitney U test and Cliff's Delta.

결 과(Results)

Four clusters were identified based on performance characteristics. The K-Neighbors model achieved the highest predictive accuracy ($R^2 = 0.70$) and was applied within each cluster. Across all clusters, sanctioned athletes exhibited significantly higher residuals ($p < 0.01$), with Cliff's Delta ranging from −0.113 to −0.487.

결 론(Conclusion)

AI-based modeling can effectively identify competition-level performance anomalies, providing a scalable tool for supporting data-driven anti-doping strategies.

잔존 반월연골판의 양과 질이 우수할수록 자가 골연골 이식술 이후 연골이 우수하게 유지된다: 평균 6년 추시 후향적 비교 연구

Better meniscal volume and quality reduce cartilage degeneration following autologous osteochondral transfer: A retrospective comparative study with a mean 6-year follow-up.

[1]충북대학교병원 정형외과 [2]서울아산병원 정형외과

이효열[1], 김종민[2], 이범식[2], 송주호[2]

목적(Background)

Autologous osteochondral transfer (AOT) surgery yields favorable outcomes with appropriate patient selection. Although several factors influencing surgical outcomes have been identified, the effect of meniscal volume and quality on AOT outcomes remains unclear. We Hypothesized that better meniscal status would be associated with reduced deterioration of cartilage repair over time following AOT.

대상 및 방법(Methods)

Patients who underwent AOT between March 2002 and March 2021 were retrospectively reviewed. Inclusion criteria were: (1) magnetic resonance imaging (MRI) at 1-2 years postoperatively for evaluation of meniscal status, and (2) follow-up MRI after at least 2 years. Meniscal lesions were addressed during surgery, and postoperative residual meniscal status was graded using a 6-point scale (0-3 for volume, 0-3 for quality). Patients were divided into better meniscus (BM) and poorer meniscus (PM) groups using a cutoff score of 2.5, derived from a time dependent receiver operating characteristic (ROC) curve that maximized early deterioration in the Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) score after AOT. Follow-up intervals were categorized into early (1-2 years), short-term (2-5 years), mid-term (5-10 years), and long-term (>10 years). Structural outcomes including MOCART scores, joint space width (JSW), and cartilage T2 relaxation times, and patient-reported outcome measurements (PROMs) including Lysholm score, IKDC subjective score, Tegner activity scale, and visual analog scale (VAS) for pain were compared.

결 과(Results)

Among 35 eligible patients, 22 were classified into the BM group and 13 into the PM group. Significant group-by-time interaction effects were observed for MOCART scores (p = 0.048) and JSW (p = 0.031); the BM group showed higher MOCART scores from the short-term and wider JSW from the mid-term follow-up. In contrast, no significant group differences were found in T2 relaxation times or PROMs.

결 론(Conclusion)

Meniscal lesions should be properly addressed when performing AOT, as residual meniscal status after surgery was associated with progression of cartilage degeneration. In contrast, T2 relaxation times and PROMs were not correlated, indicating a limited relationship between structural and clinical outcomes.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 12: 스포츠손상에서 orthobiologics 를 이용한 치료 방법

Orthobiologics treatment for sports injuries

좌장: 용인세브란스병원 이태임, 고려대구로병원 배지훈

김두한

학력

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계명대학교 대학원 의학석사

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주요 경력

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대한스포츠의학회 국제교류위원회 위원

대한정형외과 스포츠의학회 의무협력위원회 위원

대한농구협회 의무위원회 위원

대한빙상경기연맹 의무위원회 위원

현재 소속 및 직위

계명대학교 의과대학 정형외과 조교수

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스포츠인의 무릎 부상에서 orthobiologics 를 이용한 치료 방법
Orthobiologics treatment for knee injuries in athletes

계명대동산병원
김두한

Introduction

Knee injuries are among the most common conditions encountered in sports medicine, ranging from ligament sprains and meniscus tears to cartilage and subchondral bone lesions. Traditional treatments—such as rest, physical therapy, and surgical reconstruction—focus mainly on mechanical restoration. However, they often fail to regenerate native tissue or halt degenerative progression. Orthobiologics, defined as biological substances that enhance the body's natural healing response, have emerged as a promising adjunct or alternative to conventional therapies. These include platelet-rich plasma (PRP), bone marrow aspirate concentrate (BMAC), adipose-derived products, and cell-based cartilage repair techniques.

1. Concept and Classification

Orthobiologics are derived from autologous or allogenic biological sources and act by stimulating cell proliferation, angiogenesis, and extracellular matrix synthesis. They can be broadly classified as follows:

Category	Example	Key Components	Target Tissue
Blood-derived	PRP, PPP	Growth factors (PDGF, TGF-β, VEGF)	Tendon, cartilage, muscle
Bone-marrow-derived	BMAC	MSCs, cytokines	Bone, cartilage, ligament
Adipose-derived	SVF, MFAT	MSCs, pericytes	Cartilage, soft tissue
Cell-based	ACI, MACI, minced cartilage	Chondrocytes	Cartilage defects

2. Biological Rationale

Tissue regeneration requires three key elements: cells, scaffolds, and signaling molecules. Orthobiologics can provide one or more of these elements:

- PRP delivers concentrated platelets that release growth factors to promote healing.
- BMAC provides mesenchymal stem cells capable of differentiating into chondrocytes or osteoblasts.
- Adipose tissue offers a rich, easily accessible source of regenerative cells.
- Cartilage-based techniques aim to re-establish hyaline-like cartilage at defect sites.

The biological effect depends on preparation technique, concentration, and delivery method. Understanding these variables is critical for reproducible clinical outcomes.

3. Clinical Applications

1) Ligament Injuries
   - PRP may enhance graft maturation and reduce tunnel widening in ACL reconstruction.
   - BMAC or PRP can be injected in partial ACL tears to accelerate healing.
2) Meniscal Lesions
   - PRP injections or fibrin-PRP scaffolds can promote healing of peripheral tears.
   - Emerging data support adjunctive use with meniscal root repair.
3) Cartilage Defects and Osteoarthritis
   - PRP, BMAC, and adipose-derived products have demonstrated pain relief and improved function in early OA.
   - For focal defects, minced cartilage, BMAC-augmented microfracture, or cell-based ACI/MACI can restore articular surface integrity.
4) Bone and Subchondral Pathology
   - Combined intraosseous PRP or BMAC injections can modulate the subchondral bone environment, delaying progression to advanced OA.

4. Limitations and Future Perspectives

Despite their popularity, orthobiologics face significant challenges:

- Heterogeneity in preparation protocols and product composition
- Lack of standardized outcome measures
- Regulatory and cost issues

Conclusion

Orthobiologics represent a bridge between biological science and clinical orthopaedics. A sound understanding of their mechanisms, indications, and limitations is essential for safe and effective application. As evidence grows, these therapies are expected to play an increasingly central role in

personalized management of knee injuries—especially in athletes seeking faster recovery and long-term joint preservation.

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송재황

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주요 경력

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대한정형외과스포츠학회 정회원

현재 소속 및 직위

건양대병원 정형외과 부교수

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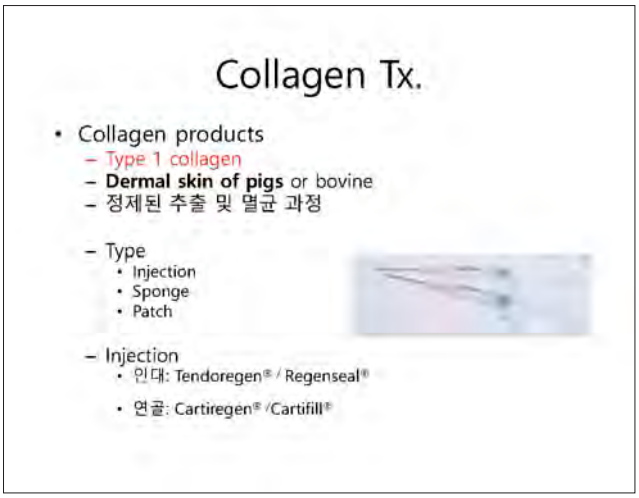
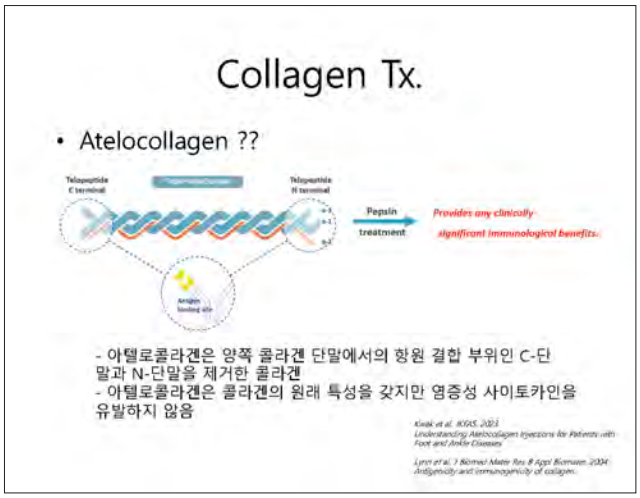
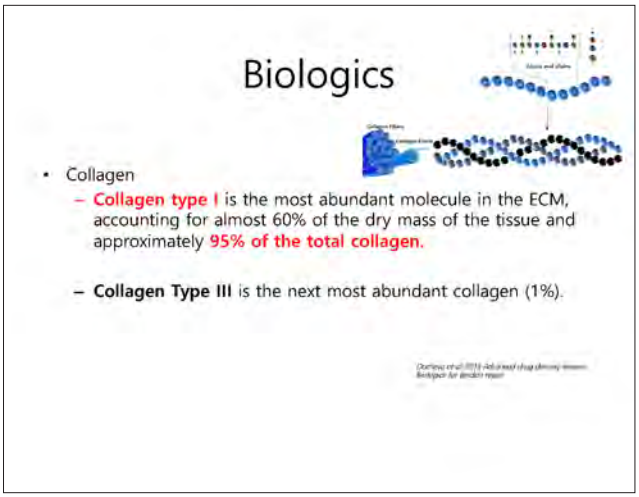
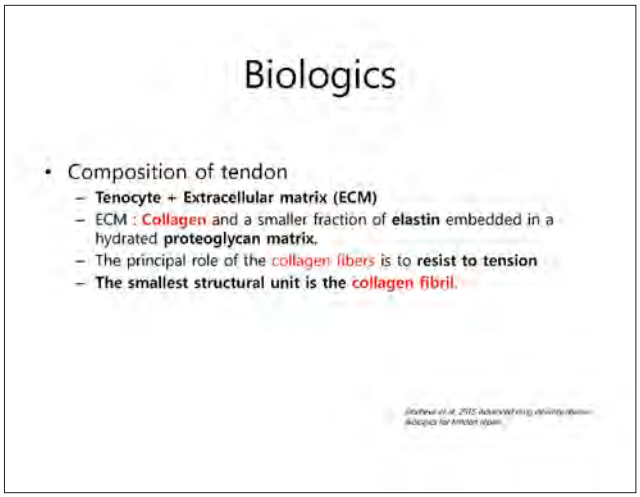
스포츠인의 발목 부상에서 orthobiologics 를 이용한 치료 방법
Orthobiologics treatment for ankle injuries in athletes

건양의대
송재황







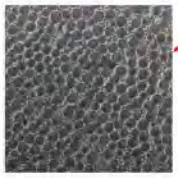


Biologics

- Hierarchial organization
  - **Collagen fibril**
  - Collagen fiber
  - Fascicle
  - Whole tendon

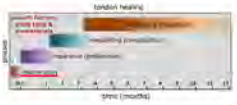
Biologics

- Collagen fibril
  - 10 nm ~ 500 nm.
  - **Ultrastructure analysis by TEM**



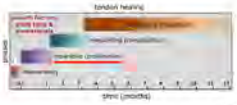
Biologics

- Inflammatory phase
  - Formation of a hematoma shortly after injury
  - **Inflammatory cells** such as **neutrophils, macrophages, and monocytes** are attracted to the injury site by **pro-inflammatory cytokines**
  - Secreted angiogenic factors initiate the formation of a vascular network



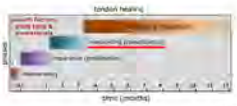
Biologics

- Proliferative phase
  - **Synthesis of abundant ECM components**, including proteoglycan and collagens (mostly **collagen type III**)



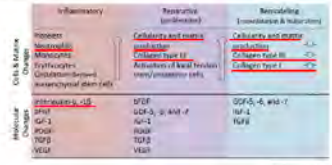
Biologics

- Remodelling phase
  - 6–8 weeks after injury
  - Decrease in cellularity and matrix production
  - **Replacement of collagen type III by collagen type I.**



Biologics

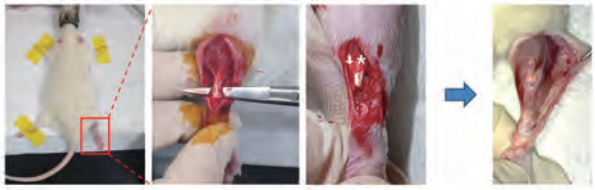
- Key cells & molecules
  - Contribute to the replacement of the initial fibrous tissue with more a tendon regeneration.



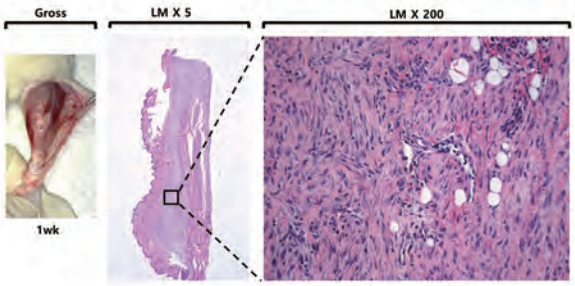
Achilles tendon rupture (ATR)

정말 힘줄 치유에 효과가 있을까??

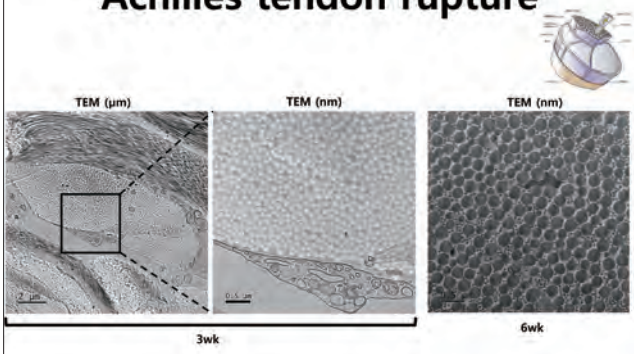
Achilles tendon rupture



Achilles tendon rupture



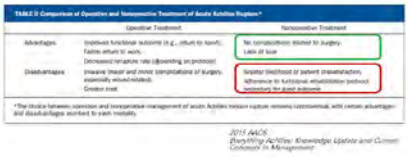
Achilles tendon rupture



ATR treatment

- Conservative
- Open repair (conventional)
- Minimally invasive repair

ATR treatment



ATR treatment

- Acute ATR
  - Open repair VS **Conservative Tx.**
    - Randomized controlled trial of 112 patients
    - **The nonsurgical group had more rerupture.**
    - The patients who had conservative Tx. reported a **worse quality of life** during treatment

Moller et al. 2001 JBJS
Acute rupture of tendon Achilles. A prospective randomised study of comparison between surgical and non-surgical treatment

Need of adjuvant treatment for acceleration of Achilles tendon healing in conservative Tx.

Conservative Tx.

- **46/M**
  - 내원 당일 축구하다가 우측 발목 후방부 통증

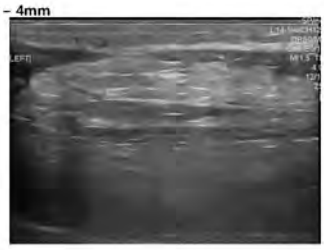
- 2wk full PF cast
- 4wk gradually neutral cast
- 4wk CAM brace

Conservative Tx.

- **4wks sono – 3.7mm**

Conservative Tx.

- **6wk sono – 4mm**



Conservative Tx.

- **8wk gross**

Conservative Tx.

- **3m sono – 4.5mm**

Conservative Tx.

- 4m sono – 12mm

Collagen Tx.

- Atelcollagen Tx. on rotator cuff tear

Atelocollagen Enhances the Healing of Rotator Cuff Tendon in Rabbit Model

AJSM 2017

Atelocollagen Injection Improves Tendon Integrity in Partial-Thickness Rotator Cuff Tears

A Prospective Comparative Study

OJSM 2020

Collagen Tx.

- Collagen Tx. on Achilles tendon healing
  - Experimental study using collagen sponge

Effect of a Simple Collagen Type I Sponge for Achilles Tendon Repair in a Rat Model

AJSM 2016

- **Collagen sponge**
- **For the open surgery**

Collagen Tx.

- Atelocollagen Tx. on open repair of ATR

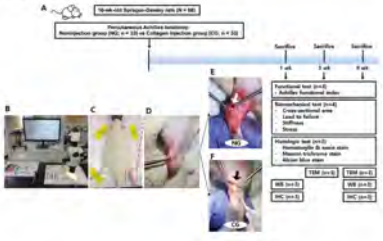
What if using for the conservative treatment ?

Collagen Tx.

- Non-collagen injection VS Atelocollagen injection
  - Hypothesis
    - Type I atelocollagen injection may enhance Achilles tendon healing.
  - Purpose
    - To compare **non-collagen group** and **collagen injection group** in a conservative treatment model of ATR

Collagen Tx.

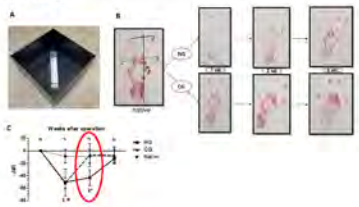
- Non-collagen injection VS Atelocollagen injection
  - Experimental protocol



Tendoregen®

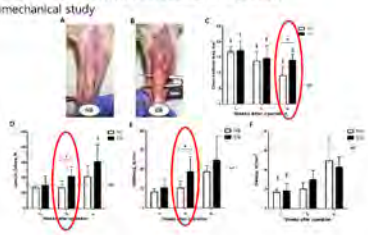
Collagen Tx.

- Non-collagen injection VS Atelocollagen injection
  - Functional study



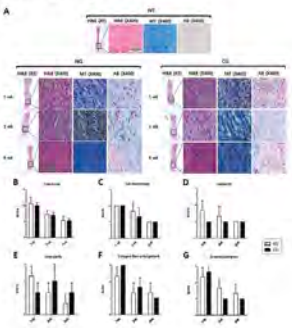
Collagen Tx.

- Non-collagen injection VS Atelocollagen injection
  - Biomechanical study



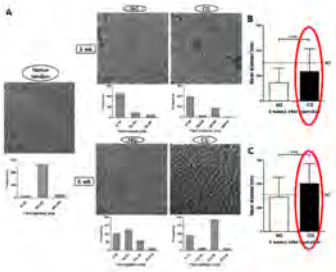
Collagen Tx.

- Non-collagen injection VS Atelocollagen injection
  - Histological study



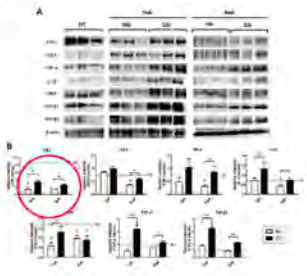
Collagen Tx.

- Non-collagen injection VS Atelocollagen injection
  - TEM analysis



Collagen Tx.

- Non-collagen injection VS Atelocollagen injection
  - Western blot



Collagen Tx.

- The present data
  - In early phase, collagen type I was significantly increased in the collagen injection group based on quantitative analysis.

Collagen Tx.

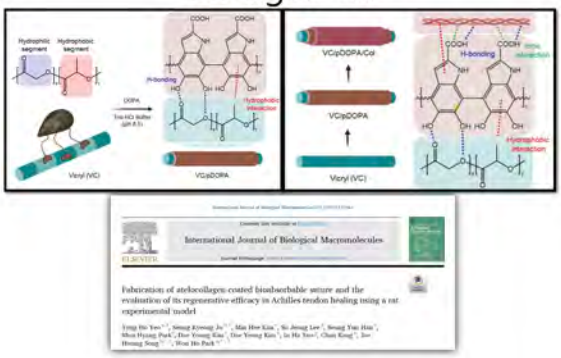
An Atelocollagen Injection Enhances the Healing of Nonoperatively Treated Achilles Tendon Tears

An Experimental Study in Rats

Seong Kyeong Jo,* MD, In Ha Yoo,† MD, Hyeon Yeong Park,† MD, Chan Kang,§ MD, PhD, Seung Yun Han,§ MD, PhD, Ji Hyun Moon,§ MD, Won Ho Park,¶ MD, PhD, Yong Ho Yeo,¶ MD, Sangmi Jun,# PhD, Yoon-Sun Yi,¶ Su Jeong Lee,** MD, PhD, Jung Yeon Tae,†† MD, and Jae Hwang Song,*†‡ MD, PhD
Investigation performed at Konyang University Hospital, Daejeon, Republic of Korea

OJSM 2023

Collagen Tx.

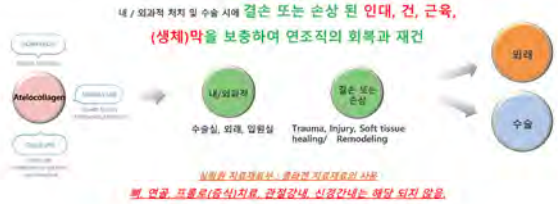


Clinical application

- Type 1 collagen

Collagen	Function or Application	Tissue or Organ	Molecular Composition *
Type I	the organic part of the bone, membranes for guided tissue regeneration	Skin, bone, teeth, tendon, ligament, vascular ligature	$[\alpha 1(I)]_2\alpha 2(I)$
Type II	the main constituent of cartilage, cartilage repair, and arthritis treatment	cartilage	$[\alpha 1(II)]_3$
Type III	the main constituent of reticular fibers, hemostats, and tissue sealants	muscle, blood vessels	$[\alpha 1(III)]_3$
Type IV	the major component of the basement membrane, attachment enhancer of cell culture, and diabetic nephropathy indicator	basal lamina, the epithelium-secreted layer of the basement membrane	$[\alpha 1(IV)]_2\alpha 2(IV)$ $[\alpha 3(IV)]_2\alpha 4(IV)$ $[\alpha 5(IV)]_2\alpha 6(IV)$

Clinical application



Clinical application

Table 1. Atelocollagen Treatment for Musculoskeletal Diseases

Body part	Condition/disease	Reference
Knee	Osteoarthritis	De Luca et al.[20], Lee et al.[21], Volpi et al.[22]
	Medial collateral ligament tear	Jang and Kim[11]
Lumbar spine	Lumbar spinal fusion	Gadomski et al.[23]
	Acute lumbar spine pain	Pavelka et al.[24]
Shoulder	Partial-thickness rotator cuff tears	Kim et al.[15], Chae et al.[16], Jeong et al.[17]
Foot & ankle	Lateral ankle ligament tear	Jin et al.[10]
	Plantar fasciitis	Kim et al.[12], Corrado et al.[13], Jiménez-Cano et al.[45]
	Osteochondral lesion of talus	Lee et al.[14], Tan et al.[19], Kim et al.[46]
	Metatarsalgia	Dhinsa et al.[47]

Kwak et al. KJSAS. 2021
Understanding Atelocollagen Injections for Patients with Foot and Ankle Disease

Clinical application

- Ligament
  - In vivo 실험
    - Cell 이동 촉진
    - Angiogenesis 강화
  - Ankle ligament
    - Conservative Tx. & Operative Tx. 가능
    - Needs further study..

Kwak et al. JKSAS. 2021
Liang et al. JCTR. 2006

Clinical application

- Plantar fasciitis and Achilles tendinopathy
  - No strong evidence
  - Kim et al.
    - 16 patients with plantar fasciitis
    - 1ml collagen injection at 1, 2, 4 week
    - 3-month US and elastography
    - PF 두께 감소 및 탄성도 증가

Kwak et al. JKFAS, 2023
Kim et al. Ultrasound Q, 2020

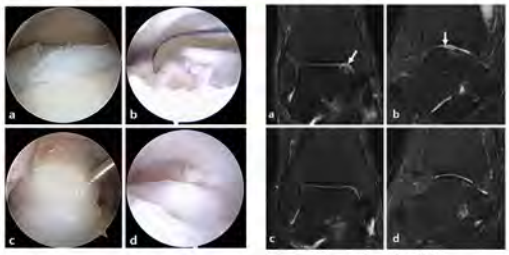
Clinical application

- Osteochondral lesion of talus (OLT)
  - No strong evidence
  - Lee et al.
    - Microfracture
    - Atelocollagen injection (n=22) VS Control (n=23)
    - 2 year F/U
    - Atelocollagen injection group showed superior cartilage healing by MRI

Kwak et al. JKFAS, 2023
Lee et al. BMC musculodisorders, 2020

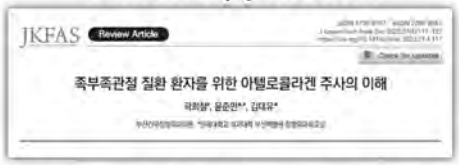
Clinical application

- Osteochondral lesion of talus (OLT)



Kwak et al. JKFAS, 2023
Lee et al. BMC musculodisorders, 2020

Clinical application


JKFAS Review Article

족부족관절 질환 환자를 위한 아텔로콜라겐 주사의 이해

- 족부족관절 영역에서의 임상적 연구는 미흡하며, 표준화된 주사법과 치료법이 아직 확립되지 않음.
- 아직까지 장기 주시 결과 및 전향적 연구가 없고 합병증 여부에 대한 추가 연구가 필요함.

Kwak et al. JKFAS, 2023

Clinical application

- 현재 심평원에서 공지된 사용 지침
  - 발목에서의 콜라겐 주사 치료
    - 인대, 힘줄의 수술적 / 비수술적 치료에 대한 기록 : 인정 비급여
    - OLT : 허가 X (오직 무릎 대퇴과 연골 손상만 가능)

주의 사항

1. (시술 8시간 이후) 시술 부위 통증, 부종, 뻑뻑함 등 환자에 따라 불편 有 -> 환자마다 반응 너무 다름
2. 시술 후 통증 지속적으로 경감(평균 2~3일, 환자에 따라 1주일까지 불편 할 수 있음)
3. 고온의 열 치료나 사우나 같은 장기간 고온의 노출 시 콜라겐 효과 사라짐(1주일간 제한)
4. 통증 주위 반복된 활동이나 무리가 가는 활동 제한

텐도리젠 외래 사용 준비

[허가사항] 내 / 외과적 치치 및 수술 시에 결손 또는 손상 된 인대, 건, 근육,(생체)막을 보충하여 연조직의 회복과 재건을 목적으로 사용

[사용방법] 1) 주입 전, 감염 예방을 위하여 무균소작 부위 및 시술부위 소독
2) 사용 시, 주사기 마개를 오른쪽으로 돌려 제거한 뒤, 동봉된 주사침을 고정
3) 주입 시, 필요량에 따라 천천히 주입
4) 사용 후, 남은 내용물과 주사기는 의료기기 폐기물 기준에 따라 폐기

COLTRIX

3 Way를 이용하여 lidocaine과 혼합하여 사용 가능

Clinical application

- Open Achilles tendon repair

Clinical application

- Open Achilles tendon repair

Clinical application

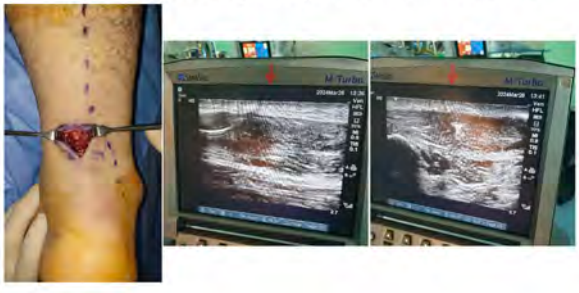
- Open Achilles tendon repair

Clinical application

- US guided mini-open repair of Achilles tendon

Clinical application

- US guided mini-open repair of Achilles tendon



Clinical application

- US guided mini-open repair of Achilles tendon

Clinical application

- US guided mini-open repair of Achilles tendon

Clinical application

- US guided mini-open repair of Achilles tendon

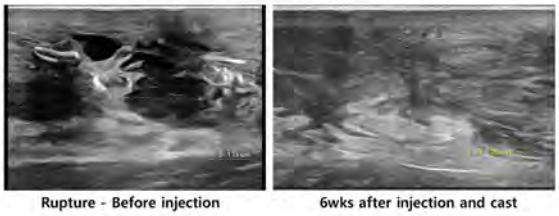
Clinical application

Clinical application

- US-guided Atelocollagen injection + NWB cast for 6wks (gradually neutral cast)

Clinical application

- Improvement of Achilles tendon healing in F/U US on post-injection 6 weeks
- Restoration of ankle plantarflexion power +



Rupture - Before injection　　6wks after injection and cast

Clinical application

- Lateral Ankle Instability -> MBO

Clinical application

- Ankle Fx. with deltoid lig. rupture

Clinical application

- Ankle Fx. with deltoid lig. rupture

Clinical application

- Lateral ligament complex injury

PRP

- **Platelet rich plasma (PRP) Tx.** on tendon healing
  - Biologic molecules in PRP

Molecule	Source	Function
PDGF	Platelets, macrophages	Chondrocyte chemotaxis, MSC proliferation, angiogenesis, chondrogenesis
VEGF	Platelets, macrophages, neutrophils	Angiogenesis, endothelial migration
TGF-β	Platelets, macrophages	MSC and fibroblast proliferation, production of collagen, re-epithelialization
EGF	Platelets, macrophages, plasma	Re-epithelialization, organization of granulation tissue
FGF	Platelets	Endothelial proliferation, angiogenesis, collagen production
IGF	Plasma	Cell proliferation, production of proteoglycans, collagen
MMPs	Macrophage, Neutrophils	ECM turnover, tissue remodeling, and recruitment of proliferative cells

PDGF, platelet-derived growth factor; VEGF, vascular endothelial growth factor; TGF-β, transforming growth factor-β; EGF, endothelial growth factor; FGF, fibroblast growth factor; IGF, insulin-like growth factor; MMPs, matrix metalloproteinases.; ECM, extracellular matrix.

Kia et al. 2018 Current reviews in musculoskeletal medicine "Platelet-rich plasma: review of current literature on its use for tendon and ligament pathology."

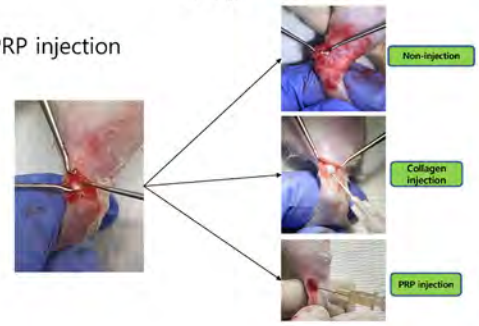
PRP

- **PRP Tx.** on tendon healing
  - Local autologous PRP injection may have beneficial effects on initial **rotator cuff tendon-to-bone healing** and enhance initial tendon-to-bone healing remodeling.

Chen et al. 2012 Acta Orthop Traumatol Turc "Effect of platelet-rich plasma on tendon-to-bone healing after rotator cuff repair: an in vivo experimental study."

PRP

- PRP injection



PRP

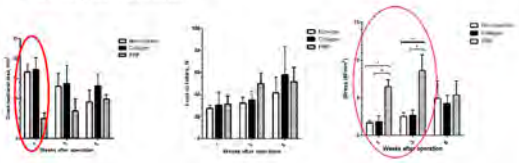
- PRP injection
  - PRP Preparation
    - Donor rats
    - Whole blood collected from abdominal aorta
    - **Prosys PRP kit®**
    - Centrifuge

PRP

- PRP injection
  - PRP Preparation
    - Confirmation of platelet count by ADVIA hemotology system
    - Platelet count of PRP was 3 times higher than that of whole blood.

PRP

- PRP injection
  - Biomechanical results



- PRP injection may have beneficial effect on reducing swelling of tendon in early phase after Achilles tendon rupture with favorable biomechanical properties.

PRP

- **PRP Tx.** on tendon healing

PDRN

- Polydeoxyribonucleotide (PDRN)
  - 송어(39%), 백연어(57%) 및 철갑상어(4%)의 정소에서 추출
  - 50~1,500 kDa의 저 분자량을 가지는 DNA 분체로 구성
  - **아데노신 A2 수용체**에 결합하여 **VEGF의 합성을 유도**하고 콜라겐 섬유를 생산하는 **fibroblast 생성을 촉진**

Kim et al. JKOA, 2024

PDRN

- 작용 기전

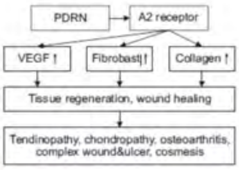


Table 1. PDRN Studies on Rotator Cuff Tendinopathy

Author	Study design	Model	Result
Hwang et al.[illegible]	In vivo	Rat model (rotator cuff tear)	Increase tendon-bone healing Decrease fatty degeneration
Ryu et al.[illegible]	Clinical study (retrospective)	Chronic rotator cuff disease patients (PDRN prolotherapy, n=32)	Improve VAS and SPADI
Yoon et al.[illegible]	Clinical study (retrospective)	Refractory non-traumatic rotator cuff disease patient (PDRN injection n=55, continued conservative n=51)	Improve VAS, SPADI, consumption of pain killer

PDRN, polydeoxyribonucleotide; VAS, visual analog scale; SPADI, shoulder pain and disability index.

Kim et al. JKOA, 2024

PDRN

- Achilles rupture
  - Expression of **collagen type I was increased** to a great degree in the PDRN-treated group
  - With significantly **greater tendon thickness** at 2 and 4 weeks**, tensile stress** was also significantly increased at 2 and 4 weeks.

Table 2. PDRN Studies on Achilles Tendinopathy

Author	Study design	Model	Result
Kang et al.[illegible]	In vivo randomized controlled trial	Rat model (Achilles tendon rupture)	Increase resistance to mechanical stress Increase the cross-sectional area of the tendon
[illegible] et al.[illegible]	In vivo randomized controlled trial	Rat model (Achilles tendon rupture)	Decrease proinflammatory factors and increase anti-inflammatory factors Decrease Von Frey filament pain test

PDRN, polydeoxyribonucleotide.

Kang et al. JOR, 2025

PDRN

- Plantar fasciitis
  - Kim 등의 연구에서는 대조군 vs 실험군(1.5 ml PDRN을 족저근막 부착부의 내측에 주사) 비교
  - PDRN을 주사한 **그룹에서 VAS 및 임상적 결과가 4주 및 12주에서 유의한 개선**을 보였으며, 주사와 관련된 합병증은 보이지 않았다.
  - PDRN의 혈관생성유도 및 항염증 작용으로 인한 것으로 사료됨.

Table 4. PDRN Studies on Plantar Fasciitis

Author	Study design	Model	Result
Kim and Chung[illegible]	Clinical study (randomized controlled trial)	Plantar fasciitis n=[illegible] (normal saline n=20, PDRN n=20)	Improve VAS and MOXFQ
Lee et al.[illegible]	Clinical study (randomized controlled trial)	Plantar fasciitis n=44 (corticosteroid n=22, PDRN n=22)	At the one- and two-months follow-up, the corticosteroid group showed better outcomes. At six months, there was no difference.

Kim et al. JKOA, 2024

PDRN

- Wound healing
  - PDRN은 **신생혈관 촉진 및 염증 감소의 기능으로 창상 치유를 개선**
  - PDRN이 뉴클레오타이드 및 뉴클레오사이드를 생성하여 DNA 형성을 유발시키며 정상 세포 분화 및 성장을 재활성화

Author	Study design	Model	Result
[illegible] et al.[illegible]	In vitro	Human fibroblast	Activate cell growth
[illegible] et al.[illegible]	In vitro	Human fibroblast	Activate DNA proliferation
[illegible] et al.[illegible]	In vitro	Human pre-adipocyte	Activate cell proliferation
Galeano et al.[illegible]	In vivo	Diabetes rat model [illegible]	Increase wound tensile force Increase expression of VEGF
Jeong et al.[illegible]	In vivo	Rat model	Decrease infiltration of inflammatory cell Increase collagen
Shin et al.[illegible]	In vivo	Diabetes rat model (C57BL/KSJ-db/db)	Increase collagen density Increase VEFG Decrease inflammatory cell count
Lee et al.[illegible]	In vivo	Rat model	Increase VEFG and CD31
[illegible] et al.[illegible]	Clinical study (randomized controlled trial)	Skin graft donor site (PDRN n=20, controlled n=20)	Activate re-epithelialization Shorten wound healing period
Squadrito et al.[illegible]	Clinical study (randomized controlled trial)	Diabetes ulcer (PDRN n=[illegible], controlled n=[illegible])	Activate re-epithelialization Shorten wound healing period
Kim et al.[illegible]	Clinical study (randomized controlled trial)	Diabetes ulcer (PDRN n=[illegible], controlled n=[illegible])	Increase oxygen in tissue Decrease inflammatory cell count
Kim et al.[illegible]	Clinical study (randomized controlled trial)	Pressure ulcer (PDRN n=11, controlled n=12)	Decrease wound size Improve PUSH

PDRN, polydeoxyribonucleotide; DNA, deoxyribonucleic acid; VEGF, vascular endothelial growth factor; CD, cluster of differentiation antigen; PUSH, pressure ulcer scale for healing.

Kim et al. JKOA, 2024

김수철

학력

중앙대학교 의학과 학사

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주요 경력

대한스포츠의학회 학술위 위원

현재 소속 및 직위

삼성서울병원 정형외과 견주관절분야 임상조교수

스포츠인의 어깨 부상에서 orthobiologics 를 이용한 치료 방법
Orthobiologics treatment for shoulder injuries in athletes

삼성서울병원
김수철

Rotator cuff tears are a prevalent cause of shoulder pain and functional impairment in sports players. The etiology of rotator cuff tears includes intrinsic degeneration related to aging, repetitive overhead activities, acute trauma, and biomechanical contributors such as scapular dyskinesis.

It is important to note that tendon healing in rotator cuff tears does not occur after neonatal tissue regeneration. Scar tissue formation at the tendon-bone interface disrupts the mechanical stability of the original attachment site. Therefore, it is crucial to preserve and restore the original tendon, whenever possible, using orthobiologics. [1]

1. Collagen Therapy

Collagen is a principal structural protein found in connective tissues such as tendons, ligaments, cartilage, bone, and skin. Among its five primary types, Type I collagen is the most abundant—comprising approximately 70% of total collagen—and is predominantly located in tendons, skin, and bone. Collagen-based scaffolds have been developed to support the deposition of reparative cells, including fibroblasts and osteoblasts. These scaffolds create a three-dimensional matrix that facilitates cellular adhesion, proliferation, and extracellular matrix synthesis, thereby enhancing tissue regeneration.

However, collagen derived from non-human sources carries potential immunogenicity, particularly due to antigenic epitopes located at the N- and C-terminal regions. To address this issue, telopeptide-removed Type I collagen—commonly sourced from porcine or bovine dermis or tendon—is used to reduce antigenicity while maintaining bioactivity.

The hypothesized therapeutic benefits of collagen include scaffolding support for tendon healing, stimulation of fibroblast activity, and induction of a localized inflammatory response that promotes tissue repair. Preclinical studies have demonstrated improved mechanical strength and histological quality of repaired tendons following atelocollagen administration. Clinical data have also shown

promising outcomes. [2]

2. Acellular Dermal Matrices Therapy

Acellular dermal matrices (ADMs) are derived from cadaveric human skin through a decellularization process that preserves the extracellular matrix while minimizing immunogenicity. These matrices serve as biologically compatible scaffolds that facilitate reepithelialization, neovascularization, and fibroblast proliferation without eliciting substantial inflammatory responses.

Traditionally, human ADM has been utilized in the form of patch augmentation during rotator cuff repair to reinforce the repair site and enhance biological healing. More recently, injectable forms of ADM have emerged and are being investigated for their regenerative potential in the context of tendon healing. Early studies suggest that ADM injections may contribute to tissue remodeling and improved tendon quality, although further high-level evidence is warranted.

3. Platelet-Rich Plasma Therapy

Platelet-rich plasma (PRP) is defined as a plasma fraction of autologous blood with a platelet concentration that is three to five times higher than baseline, typically reaching up to 1,000,000 platelets/μL. PRP is obtained via centrifugation, which separates the platelet-rich layer from the rest of the blood components.

Platelet-rich plasma (PRP) therapy has garnered significant attention for its potential to enhance tissue healing, particularly in musculoskeletal injuries such as rotator cuff tears. Upon activation, platelets release a variety of growth factors and cytokines from their alpha granules, which play pivotal roles in the healing process. Key bioactive molecules released include Platelet-Derived Growth Factor (PDGF), Transforming Growth Factor-Beta (TGF-β), Vascular Endothelial Growth Factor (VEGF), and Fibroblast Growth Factor (FGF). [3]

PRP has garnered increasing interest for its role in promoting tendon healing, particularly in the setting of arthroscopic rotator cuff repair. Clinical studies have reported that PRP application can improve postoperative pain, enhance functional recovery, and reduce retear rates. The therapeutic effects of PRP are mediated by the release of various growth factors and cytokines, which stimulate angiogenesis, tenocyte proliferation, and extracellular matrix remodeling at the repair site. [3]

4. Cellular based therapy

Mesenchymal stem cells (MSCs) have garnered considerable attention in orthopedic applications due to their potential to differentiate and promote the regeneration of target tissues. Various sources of MSCs are currently utilized, including bone marrow, adipose tissue, synovial fluid, umbilical cord blood, and placental tissue. In vitro studies have demonstrated that MSCs can differentiate into osteogenic, chondrogenic, tenogenic, myogenic, and adipogenic lineages; however, their clinical efficacy remains under investigation.

Jo et al. evaluated the therapeutic effects of adipose-derived stem cell (ADSC) injections in 20 patients

with partial rotator cuff tears, administering varying concentrations of ADSCs. [4] Compared with baseline, the mid- and high-dose ADSC groups exhibited approximately 80% improvement in shoulder pain and disability scores at 6 months post-injection. Furthermore, arthroscopic assessment revealed reductions in joint and bursal defect volumes of 83% and 90% in the mid- and high-dose groups, respectively. Although these preliminary findings suggest that cell-based therapy may represent a promising non-surgical treatment option for rotator cuff pathology, further investigations with larger cohorts and long-term follow-up are warranted.

Conclusion

Various orthobiologic therapies—including collagen scaffolds, acellular dermal matrices, platelet-rich plasma, and mesenchymal stem cells—offer promising strategies to enhance tendon healing and restore the native tendon-bone interface in rotator cuff tears. While preclinical and early clinical studies have demonstrated encouraging results, high-quality randomized trials and long-term outcome data are still required to establish their definitive clinical efficacy and optimal indications.

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The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 15: 특정 스포츠 손상에서 난치성 과제: 뼈와 결합된 힘줄 골과 결합된 힘줄

A Refractory Challenge in Sports Specific Injury: Tendon with Bone

좌장: 아산재건정형외과의원 조우신, 이경태 정형외과 이경태

김준범

학력

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충남대학교 의학전문대학원 정형외과학과 박사

주요 경력

현, 대전하나시티즌 프로축구단 팀 주치의

현, 대한핸드볼협회 의무위원회 간사

현, 대한스포츠의학회 인증의관리위원회 위원

2017년 독일 세계선수권대회 여자 핸드볼 국가대표 팀 주치의

2019년 독일 세계선수권대회 남자 핸드볼 남북 단일팀 팀 주치의

현재 소속 및 직위

대전 웰본정형외과 대표원장

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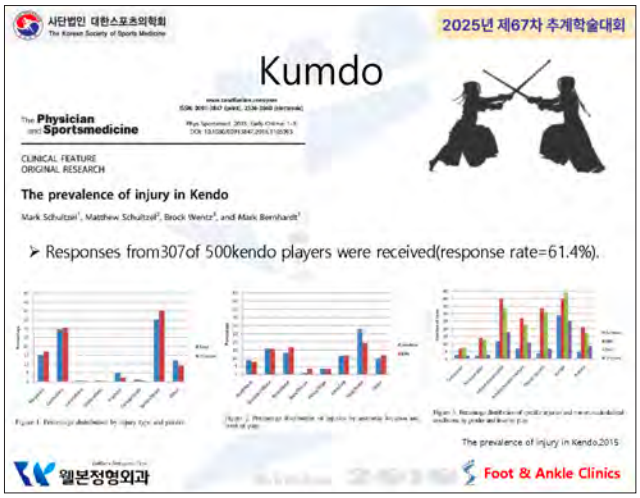
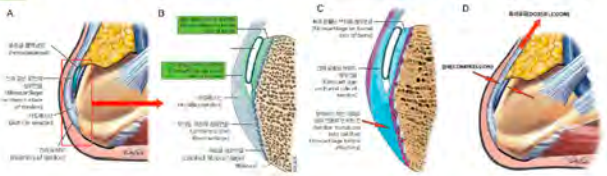
발뒤꿈치의 지속적인 통증(검도): 뼈돌기가 동반된 아킬레스건염
Insertional Achilles tendinitis with haglund deformity

웰본 정형외과
김준범



사단법인 대한스포츠의학회 2025년 제67차 추계학술대회

Insertional achilles tendinopathy(IAT)



- 건은 증가된 섬유연골에 적응하고 부하가 과도하면 건병증을 보이게 된다.
- 압박이 되고 장기간의 자극이 이어지면, 건은 골화가 발생할 수 있다.
- 임상 평가 – 촉진, 환지 동작시 부착부에 큰 통증을 일으킨다.
- 초음파, MRI
- 족배굴곡을 제한하면서 단계별 부하 프로그램, ESWT, 경화치료, Eccentric exercise.
- **반복적인 스트레칭은 부착부에 압력 부하를 주기 때문에 권고하지 않는다.**

웰본정형외과 Foot & Ankle Clinics

사단법인 대한스포츠의학회 2025년 제67차 추계학술대회

Insertional achilles tendinopathy vs Haglund`s deformity

Journal of Orthopaedic Surgery and Research

RESEARCH Open Access

Correlations between insertional Achilles tendinopathy and haglund's deformity: MRI and radiographic findings

Conclusion Achilles tendon thickness of more than 6.1 mm and intratendinous abnormality of over 48.6% were confirmed to be diagnostic cutoff values for IAT. Haglund's deformity was determined as a risk factor of IAT requiring surgery. Both radiographic parameters of Haglund's deformity using the bump height and the bump-calcaneus ratio were useful in predicting the presence of IAT on MRI.

웰본정형외과 Foot & Ankle Clinics

사단법인 대한스포츠의학회 2025년 제67차 추계학술대회

IAT with Haglund`s deformity

Mechanism	Action
기계적 마찰(Mechanical irritation)	돌출된 종골 상부(bony prominence)가 아킬레스건의 삽입부를 지속적으로 압박 및 마찰하여 염증 및 퇴행 유발
부착부 스트레스 집중 (Insertional stress concentration)	Haglund 변형으로 인해 아킬레스건 부착부에 장력이 비정상적으로 집중됨
혈류 감소 (Reduced vascularity)	부착부 건 내 혈류가 제한되며, 치유 지연 및 퇴행성 변화 가속화
건·점액낭 복합체의 충돌(Compression of tendon–bursa complex)	Retrocalcaneal bursa의 염증과 함께 부착부 건염이 동반되는 경우가 많음

→ Haglund's deformity는 IAT의 "기계적 유발 요인(mechanical trigger)"로 작용한다.

Tang et al. Journal of Orthopaedic Surgery and Research 2025

웰본정형외과 Foot & Ankle Clinics

사단법인 대한스포츠의학회 2025년 제67차 추계학술대회

Comparisons

Types	Without Haglund's deformity	With Haglund's deformity
Location of pain	Midportion of achilles	Insertional portion
Main cause	Overuse, degeneration	Friction of the prominence
Conservative Tx.	보존적 치료에 호전 가능	보존적 치료에 저항, 수술적 교정 필요 가능성 ↑
Operation	Simple excision	calcaneal exostectomy 병행 필요

Tang et al. Journal of Orthopaedic Surgery and Research 2025

웰본정형외과 Foot & Ankle Clinics

사단법인 대한스포츠의학회 2025년 제67차 추계학술대회

Summary

- Haglund deformity은 Insertional achilles tendionpathy의 주요 해부학적 위험 인자이다.
- 종골 후상부의 돌출이 클수록 아킬레스건의 퇴행성 변화가 심하다.
- 검도와 같은 종목의 경우, Haglund deformity가 동반되어 있는지 미리 예측하는 것이 부상에 예방에 중요하다고 볼 수 있다.
- MRI상 건 두께(≥6.1mm)와 ITD ratio(≥48.8%)는 IAT 진단의 유용한 기준이며, Haglund 교정술을 병행한 치료가 효과적일 수 있다.

웰본정형외과 Foot & Ankle Clinics

사단법인 대한스포츠의학회 2025년 제67차 추계학술대회

Thank you for your attention !!

웰본정형외과 Foot & Ankle Clinics

제갈혁

학력

한양대학교 의과대학 의학과 학사

주요 경력

국립현대무용단 자문의

(재) 전문무용수지원센터 무용재활트레이너 양성과정 전문강사

유니버셜발레단 줄리아발레아카데미 주치의

여자청소년핸드볼 세계선수권대회 국가대표팀 팀닥터 2018

대한정형외과 초음파학회 학술위원

현재 소속 및 직위

본본정형외과 대표원장

대표논문

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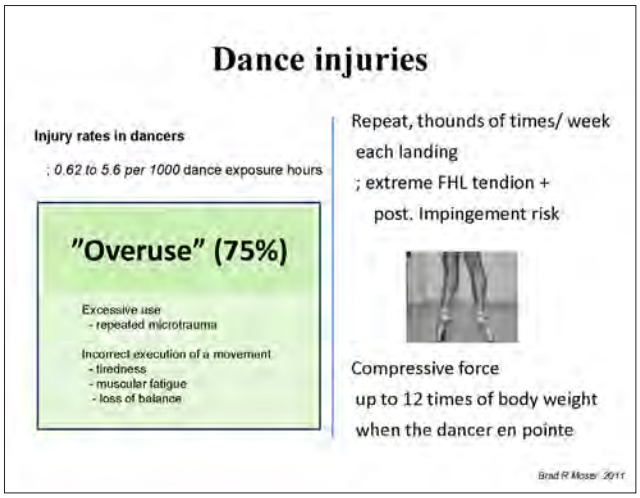
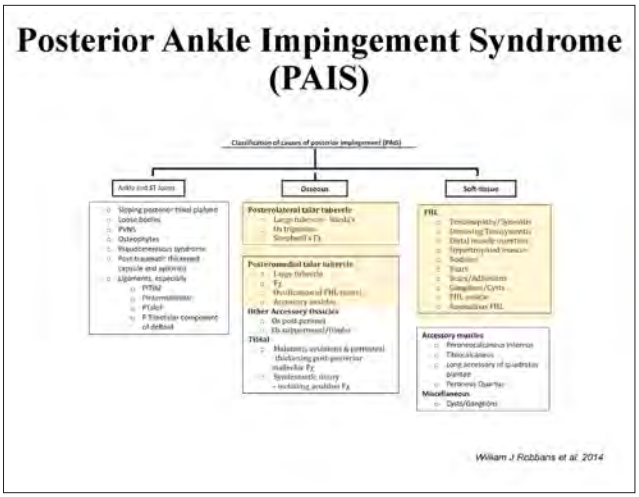
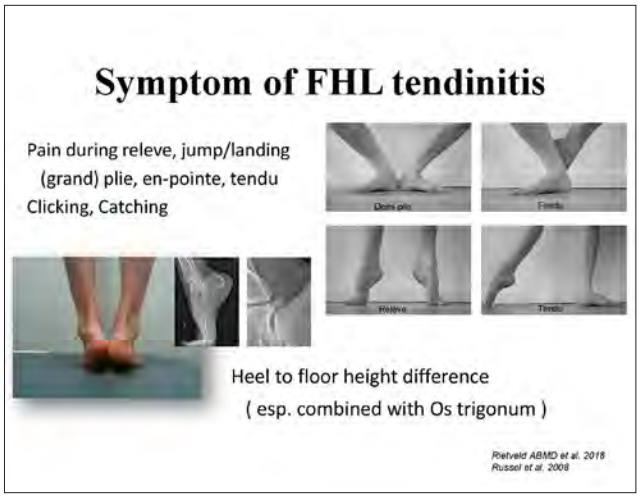
발목 뒤 숨은 통증의 주범(발레): 무용수 건초염 그리고 삼각골 증후군
Flexor Hallucis Longus tendinitis with OS trigonum

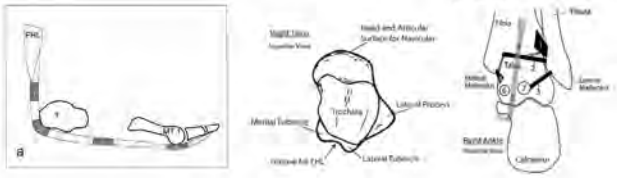
부천 본본정형외과
제갈혁





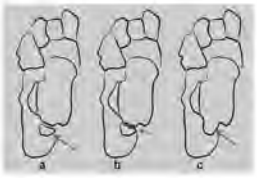


Posterior ankle anatomy



Petersoen et al. 2003
Russell et al. 2010
WG Hamilton. 2008

Posterior ankle anatomy



Stieda process

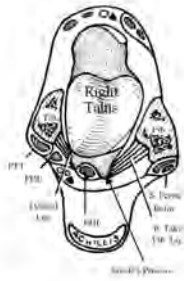
1) Compression by tibia
2) Avulsion by PTFL
3) Non-avulsion

3-1) gradual detach by repetitive P/F

3-2) sudden P/F

Russell et al., 2010
Ribbans et al. 2014

Posterior ankle anatomy



- first to describe in 1804
- first article relating OT to impingement injuries in ballet dancers in 1974
- 2nd ossification
- Failure of fusion
- Fibrocartilage connection
- 2nd m/c accessory bone, foot
- 1.7~49%, mostly Asx./7~11%
- bilateral 50%
- PTFL, PTCL origin
- Articulation w calcaneus post. facet

Sharpe et al. 2020
Russell et al., 2010
WG Hamilton. 2008

Ankle position in ballet performance

grand plie

Extreme plantar flexion in the demi-pointe and en pointe positions and subsequent movement through the plie or grand plie position in one repetitive motion over time

-> Can cause irritation and inflammation

demi plie en pointe

Johnani VM et al. 2022
Brad R Moser. 2011

Pathophysiology

Stretch-related injury : complicated injury combined with pulley friction

Mechanical impingement & compression at post. talar tubercle (acting as a pulley)

- microtrauma by bending friction : fraying, partial attrition
- Synovical irritation tenosynovitis

Petersoen et al. 2003

Pathophysiology

Stenosing tenosynovitis in tunnel

Synovial sheath fibrosis or thickening at fixed fibro-osseous tunnel

; inflammatory response, edema -> fibrous adhesion

microtrauma : fraying, partial attrition, tenosynovitis

Ankle Joint Arthroscopy, Springer

Pathophysiology

Chronic ankle instability

1) increased pulley friction &
decreased impinge threshold
d/t turning angle in pulley change
space
when talus ant. Translation & inversion
elevated friction, contact pressure

2) function as 2nd dynamic stabilizer
during esp. en pointe, landing
; tendon traction, bending stress

3) FHL early activation d/t
proprioception dysfunction

Achilles tendinopathy

ankle plantarflexion synergist

imbalance load sharing
- load shifting
- FHL chronic overuse
(**functional overload**)

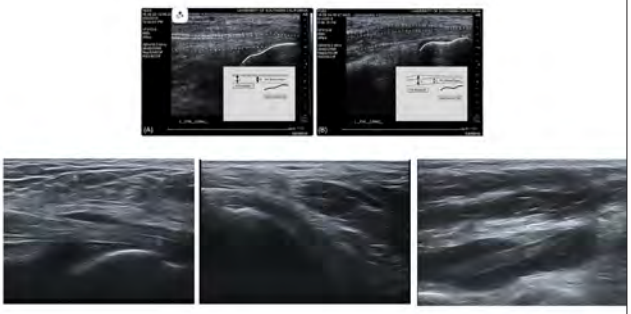
P/Ex. & x-ray

demi-pointe position in x-ray
- check bony approximation
- check the size, OT / Stieda process

Diagnosed clinically

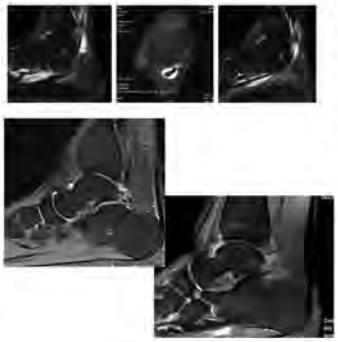
Brad R. Moser. 2011
Rietveld ABM et al. 2018
Michelson JD et al. 2021

Ultrasound



Pamela Mikkelsen et al. 2024

MRI



MRI is recommended when a dancer presents with posterior ankle impingement to further evaluate the extent and dimensions of the os trigonum, Stieda process, stress injury, and/or soft tissue mass or synovial hypertrophy causing the impingement.

The MRI can be used to further identify the areas of edema and inflammation. consequently, the structures in the posterior aspect of the ankle being impinged.

Pamela Mikkelsen et al. 2024

Conservative Treatment

- **Activity modification**
  ; restrict en pointe, releve position or control the strength
  exercise modification (dose control)
- **Biomechanical unloading**
  ; reduce forefoot overload
  strengthening exercise, intrinsic foot muscle
- **Tendon stretching**
- **Medication**
- **Physical therapy**
- **Injection**

Clinical Orthopaedics and Related Research

What Is the Efficacy of a Nonoperative Program Including a Specific Stretching Protocol for Flexor Hallucis Longus Tendonitis?

James D. Michelson MD, Jacob W. Bornkamp BA, Mark D. Charlson MD, Stephen J. Mercer DPM, Lara M. Stone DPM

Q1) what proportion of patients thus treated opted not to have surgery?

Success rate : 44% (180/409)
Surgery avoidance
56% (164/259) in stretching
14% (16/114) in non-stretching

Q2) The factors associated with patient's decision to undergo surgery

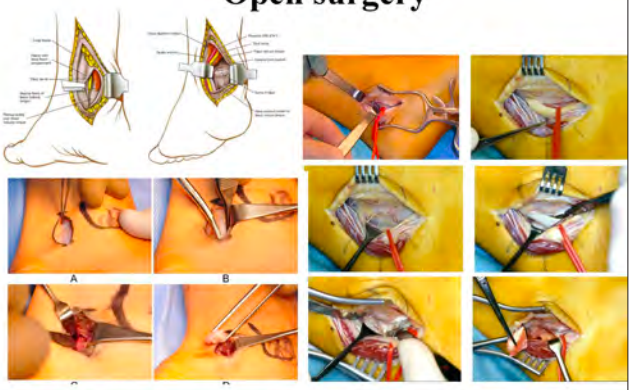
Table 4. Multivariable regression for predictive factors for the decision to have surgery*

Predictive factor	OR (95% CI)	p value
Posteromedial ankle pain	1.78 (1.12-2.83)	0.01
Arch tenderness	0.56 (0.34-0.92)	0.02
max VAS (before treatment)	1.15 (1.06-1.25)	0.001
Clinical hallux rigidus[1]	2.4 (1.16-4.97)	0.02
FHL stretches	0.15 (0.08-0.27)	<0.001
Predictive value	67.5%	

Surgical Treatment

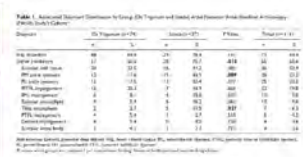
- Failure to conservative Tx. For 3~6 months
- depending on the cause.
  ; os trigonum, low-lying muscle belly, cyst etc.
  associated dz. : CAI
- Only post impingement : lateral approach
- Only FHL or Combination with FHL and impingement : medial
- Arthroscopic release

Open surgery



Textbook: Surgical exposures in foot and ankle ankle surgery Rietveld ABMD et al. 2018 Hyer J et al. 2016

Arthroscopic release



Superior visualization in identifying and addressing associated lesions.

PAIS is often multifactorial, and arthroscopy allows thorough evaluation and treatment of these concomitant conditions

Nacime Salmao Barbachan Mansur et al. 2024

Summary

- **FHL pathology**
  pain originate from friction impingement at retrotalar pulley
  often progress to stenosing tenosynovitis
  interface pathology, tendon hypertrophy
  os trigonum is a co-lead actor
- **First conservative Treatment**
  target gliding restoration and load control
  stretching / strengthening exercise
- **Surgical Treatment when conservative Tx. Fails**
  decompression and address combined pathology

정규성

학력

한양대학교 의학과 학사

한양대학교 일반대학원 의학과 석사

한양대학교 일반대학원 의학과 박사

주요 경력

대한스포츠의학회 분과 전문의, 편집위원회 간사,

K 리그 프로축구연맹 의무위원 (슬관절)

한국전력 빅스톰 프로배구단 팀닥터

대한핸드볼협회 의무위원회 필드닥터

평창동계올림픽 바이애슬론 의무지원

현재 소속 및 직위

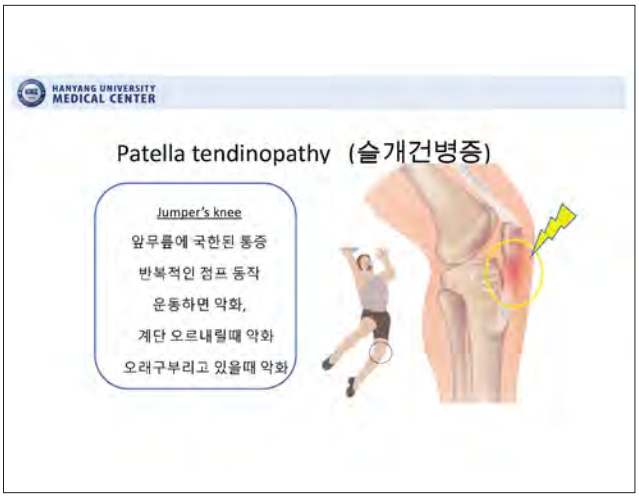
한양대학교 구리병원 정형외과 부교수

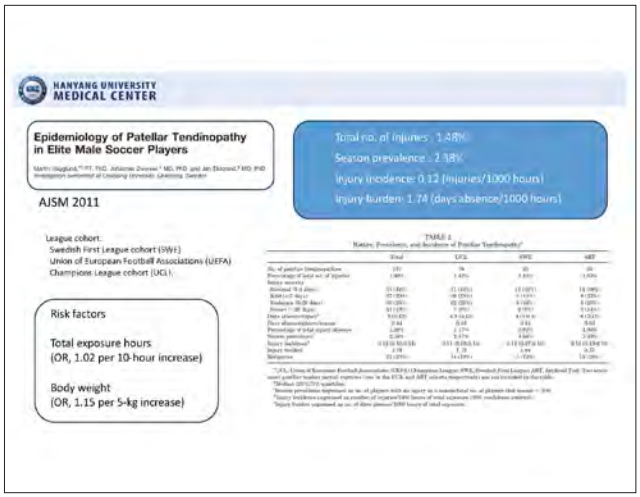
대표논문

1. Comparison of Clinical and Radiologic Results Between Partial Meniscectomy and Refixation of Medial Meniscus Posterior Root Tears: A Minimum 5-Year Follow-up
   ; Chung KS, Ha JK, Yeom CH, Ra HJ, Jang HS, Choi SH, Kim JG
   ; Arthroscopy. 2015 Oct;31(10):1941-50
2. Are Muscle Strength and Function of the Uninjured Lower Limb Weakened After Anterior Cruciate Ligament Injury? Two-Year Follow-up After Reconstruction.
   ; Chung KS, Ha JK, Yeom CH, Ra HJ, Lim JW, Kwon MS, Kim JG
   ; Am J Sports Med. 2015 Dec;43(12):3013-21
3. Root Repair Versus Partial Meniscectomy for Medial Meniscus Posterior Root Tears: Comparison of Long-term Survivorship and Clinical Outcomes at Minimum 10-Year Follow-up.
   ; Chung KS, Ha JK, Ra HJ, Yu WJ, Kim JG
   ;Am J Sports Med. 2020 Jul;48(8):1937-1944

지긋지긋한 앞무릎 통증(축구): 오스굿씨병과 슬개건염
Patella tendinitis with Osgood Schlatter disease

한양대구리병원
정규성





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Patellar tendinopathy in young elite soccer- clinical and sonographical analysis of a German elite soccer academy

2017

Prevalence of patellar tendinopathies : 13.4%

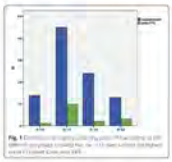
75% of players : Pain of their dominant leg

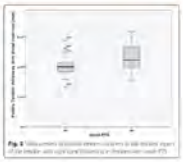
Duration of symptoms of 12 weeks

Youth elite players (age < 23 years),

199 male youth soccer players

(mean age 15.97 / BMI 21.24)





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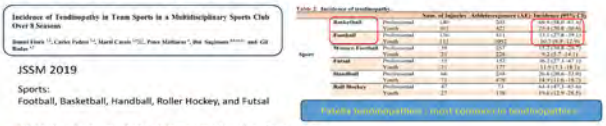
Incidence of Tendinopathy in Team Sports in a Multidisciplinary Sports Club Over 8 Season

JSSM 2019

Sports:
Football, Basketball, Handball, Roller Hockey, and Futsal



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Epidemiology

40%-50% among High level volleyball players

35%-40% among basketball players

Average duration of pain : 3 years

15 years' f/u ; 53% of patella tendinitis patients quitting their sports career d/t knee pain

Lian et al, AJSM, 2005

Jyrki Kettunen et al, AJSM, 2002

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신체검사

압통 - 가장 중요함 !

Bassett sign

쭉 펴서 누르면 통증이 있지만,
구부리고 누르면 통증이 없어진다

- PFPS (patellofemoral pain syndrome)과 감별
  - Patellofemoral grinding test
  - Patellofemoral compression test
- Hoffa's fat pad (impingement syndrome)
- Meniscus tear : McMurray test, Apley test

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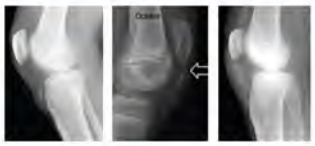
Diagnosis



X-ray – 별 이상 없음

감별 - Osgood Schlatter's Ds,
Sinding-Larsen-Johansson Syndrome,
Intratendinous calcification

MRI – 음영 변화, 두꺼워 보임

초음파 – 저신호 음영, 두꺼워보임, 신생혈관

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Patella tendinopathy

치료는 어떻게 해요?

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Current treatment for tendinopathy

- Medication (NSAIDs...)
- Injection
  - Prolotherapy
  - Steroid
  - PDRN (일명 DNA 주사)
  - PRP (platelet rich plasma)
  - Collagen supplement injection
  - PRP

Eccentric exercise

Physical therapy
- Heat
- Electrical stimulation
- Laser therapy (pulsed/continuous)
- Ultrasound
- ESWT
- Eccentric exercise
- Orthosis

Surgery
- Tendon debridement (open, arthroscopy)
- Patella tendon stimulation (drilling, decortication)
- Multiple longitudinal tenotomy

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Pathophysiology of tendinopathy

Triggers

Mechanical overuse	Intrinsic factors	Extrinsic factors
Vigorous and repetitive excessive loading	Normal aging	Workplace, sports, daily life
Muscle imbalance	Gender	Smoking
Malalignment	Body weight and height	Alcohol
Training errors	Hormonal background	Bad nutritional habit
	Genetic constitution	Environmental factors(cold weather, faulty footwear and equipment)
	Pre-existing disorders	Pharmacological agents
	Prior tendon injuries	

Steinmann S, et al. Int J Mol Sci 2020

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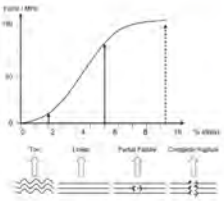
Tendinopathy : cause of injury



Overload of the tendon tissue
↓
Micro-trauma
(non-uniform stress)
↓
Abnormal loading
↓
Fiber degeneration
↓
Poor vascular supply

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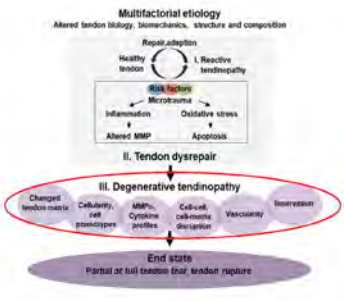

Steinmann S, et al. Int J Mol Sci 2020

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흔하게 부르는

"Patella tendinitis , 슬개건염"

단순 염증 인가요 ?

만성 건 손상 :

왜 약물, 주사 등이 주 치료가 아니고

운동요법(exercise)이 주치료인가요?

염증 치료에

초점을 맞추면

치료가 잘 안됩니다

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Patella tendinopathy

제일

효과적인 치료는

무엇인가요?

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Exercise – eccentric exercise

Treatment Options for Patellar Tendinopathy: A Systematic Review

Strong Evidence!!

Treatment of patellar tendinopathy—a systematic review of randomized controlled trials

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Eccentric exercise

Load

- Impossible to standardize the rate of increase of the load
- If the eccentric loading exercise can be performed without experiencing any minor pain or discomfort
- will be increased by adding weight

Speed

✓ Low velocity eccentric loading

Generates less injurious heat within the tendon

Not exceed the elastic limit of the tendon

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Heavy slow resistance training

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eccentric training

Heavy slow resistance training

- Tendon tissue normalization
- Collagen turnover & production ↑
- Improve the clinical outcomes

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How heavy?

- High loading intensities

: 15RM~6RM (RM : 최대 반복 횟수로 6-15회 할 수 있는 무게)

How often?

15RM-6RM 강도의 무게로
이틀정도에 1번정도의
반복 횟수로 하는 것을 권장

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Energy storage exercise

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Management of Tendinopathy

(AJSM, 2009)

REVIEW

A treatment algorithm for managing Achilles tendinopathy: new treatment options

(BJSM, 2007)

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Current trends in tendinopathy management

Tanusha B. Cardoso [a, *], Tania Pizzari [b], Rita Kinsella [b], Danielle Hope [c], Jill L. Cook [b]

기존에 알려진

Eccentric exercise & Heavy slow resistance training

Energy storage exercise

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Energy storage exercise

Stage 1 Isometric exercise

Relieves tendon pain

Can be used before provocative activities

Should be held for ***30~45 s*** and repeated five times

2-min rest

To allow muscle and brain recovery

Body weight resistance as a home-based exercise program

Can be repeated more than once a day

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Energy storage exercise

Stage 2 Isotonic & heavy slow resistance exercises

Isotonic exercises: improve muscle strength and tendon stiffness

Isotonic exercises should be completed slowly

Alternate days

4 sets of 6~8 single leg repetitions

This stage should be pain free for tendon, although some muscle soreness is possible

The motor cortex: affected by increasing the eccentric to concentric ratio (slightly longer eccentric phase) shown to increase neuroplasticity

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Energy storage exercise

- Stage 3 Increase in speed & energy storage exercises

A gradual increase in faster functional movements 2~3 times a week with body weight only and involve whole kinetic chain movements

Monitoring of load response

key at this stage as speed adds significant load on the tendon

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Energy storage exercise

- Stage 3 Increase in speed & energy storage exercises

The response of the tendon to a load
(e.g. hopping) or
hallmark sign (morning pain and stiffness)
the day after faster loads

→ tolerating the load ?

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Energy storage exercise

Stage 4 Energy storage & release or sport specific exercises

Sports specific drills
Slowly introduced and progressed until return to sport specific activities

Energy storage and release or sport specific exercises can replace stage 3 exercise
but stage 1 and 2 exercises should be maintained twice a week
ex) 3-day cycle with energy storage
Release exercises on day 1
Cross training on day 2
Isotonic exercise on day 3

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흔하게 부르는
"Patella tendinitis , 슬개건염"
단순 염증 인가요 ?

만성 건 손상 :
왜 약물, 주사 등이 주 치료가 아니고
운동요법(exercise)이 주치료인가요?

염증 치료에
초점을 맞추면
치료가 잘 안됩니다

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Treatment of Tendinopathy

Exercise in tendinopathy
- Tendon tissue normalization
- Collagen turnover & production
- Improve the clinical outcomes ↑

Eccentric exercise
Combine
(Concentric + Eccentric)
+
Heavy slow resistance exercise
+
Energy storage exercise

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Osgood-Schlatter disease

(오스굿씨 병)

무슨 병인가요?

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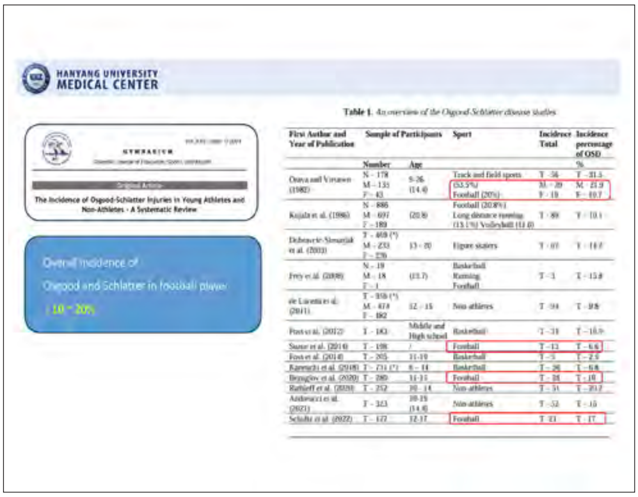
Osgood-Schlatter disease

Type of **osteochondrosis** first described
by Osgood and Schlatter in 1903

Traction apophysitis (**repeated contractions**)

Most common overuse of the lower limb injuries
among **children and adolescents**

Self-limiting pathology
But, Nearly 40% of patients : pain after long-term follow up,
(chronification of knee pain & the appearance of tendinosis)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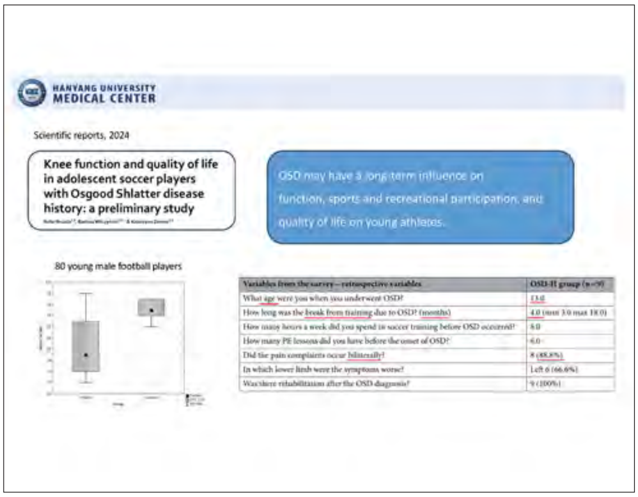
The Incidence of Osgood-Schlatter Injuries in Young Athletes and Non-Athletes - A Systematic Review
Overall incidence of Osgood and Schlatter in football player : 10 ~ 20%
Table 1. An overview of the Osgood-Schlatter disease studies
First Author and Year of Publication | Sample of Participants (Number, Age) | Sport | Incidence Total | Incidence percentage of OSD %
Orava and Virtanen (1982) | N - 178, M - 135, F - 43 | 9-26 (14.4) | Track and field sports (53.5%) Football (20%) | T - 56, M - 39, F - 19 | T - 31.5, M - 21.9, F - 10.7
Kujala et al. (1986) | N - 886, M - 697, F - 189 | (20.8) | Football (20.8%) Long distance running (13.1%) Volleyball (11.0) | T - 89 | T - 10.1
Dubravcic-Simunjak et al. (2003) | T - 469 (*), M - 233, F - 236 | 13 - 20 | Figure skaters | T - 67 | T - 14.7
Frey et al. (2008) | N - 19, M - 18, F - 1 | (13.7) | Basketball Running Football | T - 3 | T - 15.8
de Lucena et al. (2011) | T - 956 (*), M - 474, F - 482 | 12 - 15 | Non athletes | T - 94 | T - 9.8
Post et al. (2012) | T - 183 | Middle and High school | Basketball | T - 31 | T - 16.9
Sauer et al. (2014) | T - 198 | / | Football | T - 13 | T - 6.6
Foss et al. (2014) | T - 205 | 11-19 | Basketball | T - 5 | T - 2.5
Kaneuchi et al. (2018) | T - 731 (*) | 8 - 14 | Basketball | T - 26 | T - 6.8
Brzozowska et al. (2020) | T - 280 | 11-15 | Football | T - 28 | T - 10
Rathleff et al. (2020) | T - 252 | 10 - 14 | Non athletes | T - 51 | T - 20.2
Andreucci et al. (2021) | T - 323 | 10-15 (14.4) | Non athletes | T - 52 | T - 16
Schultz et al. (2022) | T - 177 | 12-17 | Football | T - 21 | T - 17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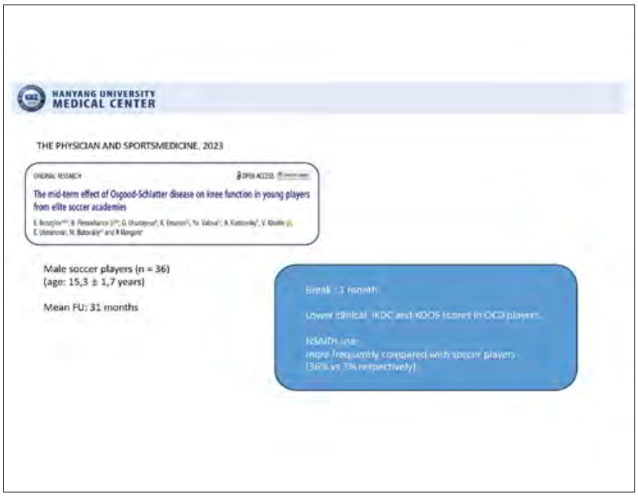
Scientific reports, 2024
Knee function and quality of life in adolescent soccer players with Osgood Shlatter disease history: a preliminary study
OSD may have a long term influence on function, sports and recreational participation, and quality of life on young athletes.
80 young male football players
Variables from the survey – retrospective variables | OSD-H group (n=9)
What age were you when you underwent OSD? | 13.0
How long was the break from training due to OSD? (months) | 4.0 (min 3.0 max 18.0)
How many hours a week did you spend in soccer training before OSD occurred? | 8.0
How many PE lessons did you have before the onset of OSD? | 6.0
Did the pain complaints occur bilaterally? | 8 (88.8%)
In which lower limb were the symptoms worse? | Left 6 (66.6%)
Was there rehabilitation after the OSD diagnosis? | 9 (100%)


HANYANG UNIVERSITY MEDICAL CENTER
THE PHYSICIAN AND SPORTSMEDICINE, 2023
The mid-term effect of Osgood-Schlatter disease on knee function in young players from elite soccer academies
Male soccer players (n = 36)
(age: 15,3 ± 1,7 years)
Mean FU: 31 months
Break : 1 month
Lower clinical IKDC and KOOS scores in OCD players
NSAIDs use:
more frequently compared with soccer players
(36% vs 3% respectively)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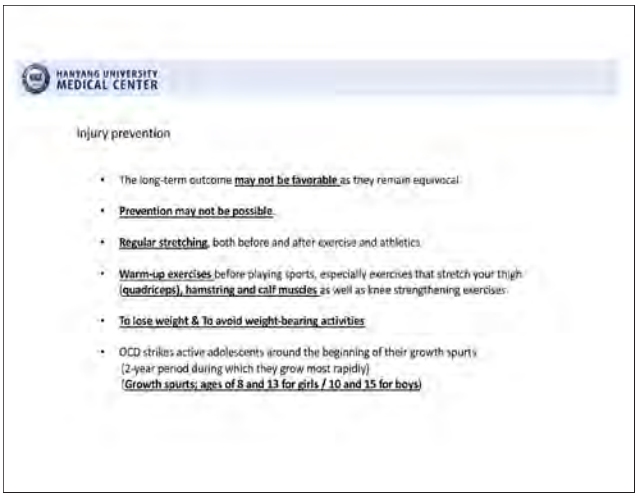
Treatment & Recovery
Self limiting course
(usually complete recovery is expected with closure of the tibial growth plate)
First, immobilization of the joint
Second, functional treatment
: increased formation of ossicles on non-immobilization of the joint
Physiotherapeutic exercise
: loss of training and the possibility to avoid muscular atrophy of the affected leg
Surgical treatment
: remove the symptomatic ossicle must be endured in unresolved cases
(failure of extensive nonoperative management)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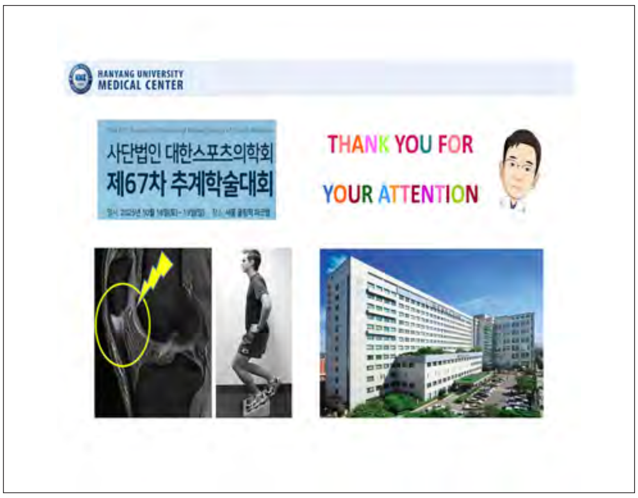
Injury prevention
The long-term outcome may not be favorable as they remain equivocal
Prevention may not be possible
Regular stretching, both before and after exercise and athletics
Warm-up exercises before playing sports, especially exercises that stretch your thigh (quadriceps), hamstring and calf muscles as well as knee strengthening exercises
To lose weight & To avoid weight-bearing activities
OCD strikes active adolescents around the beginning of their growth spurts
(2-year period during which they grow most rapidly)
(Growth spurts; ages of 8 and 13 for girls / 10 and 15 for boys)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사단법인 대한스포츠의학회
제67차 추계학술대회
THANK YOU FOR
YOUR ATTENTION

김기천

학력

한양대학교 의학과 학사

한양대학교 의학대학원 석사

한양대학교 의학대학원 박사

주요 경력

제주 유나이티드 FC 책임 주치의 : 2010-01-01 ~ 2012-03-31

2015 타오위안아시아태평양농아인경기대회 주치의 : 2015-10-03 ~ 2015-10-09

KSSM & JSCSM Travelling fellowship : 2018-10-29 ~ 2018-11-04

대한 스포츠의학회 : 국제위원회 간사 2017~2018

IOWA 주립대학 정형외과 연수 : 2022.1 ~ 2022. 12

2023년 투어 주치의 활동이력 : 2023-04-06 ~07 롯데렌터카 여자오픈

2024년 투어 주치의 활동이력 : 2024-10-25 서울 경제 레이디스 클래식

2025년 투어 주치의 활동이력 : 2025-08-16~17 메디힐 · 한국일보 챔피언십

현재 소속 및 직위

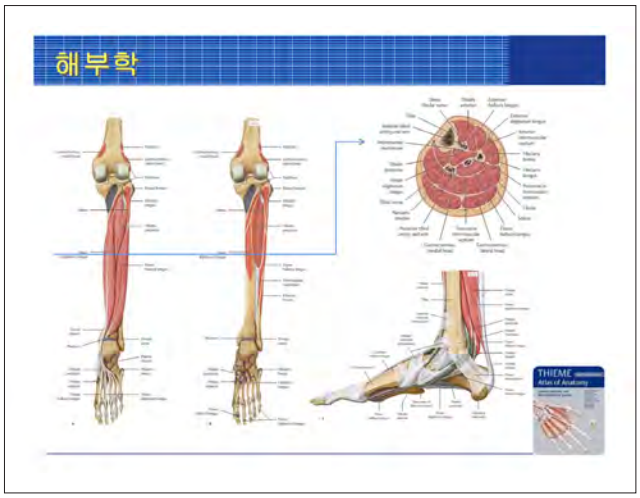
서울의료원 정형외과 과장 (2013~)

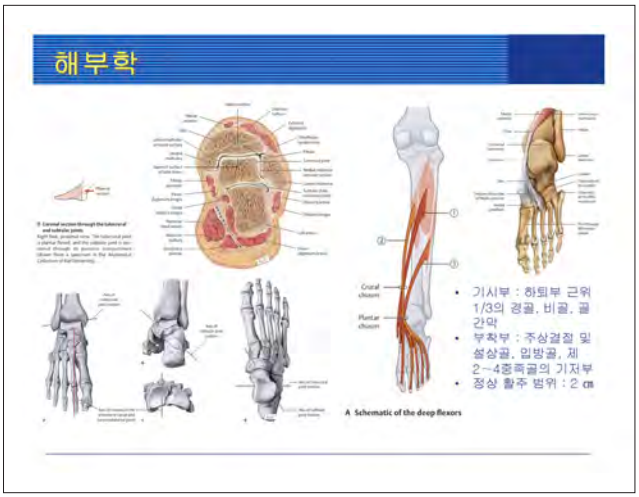
대표논문

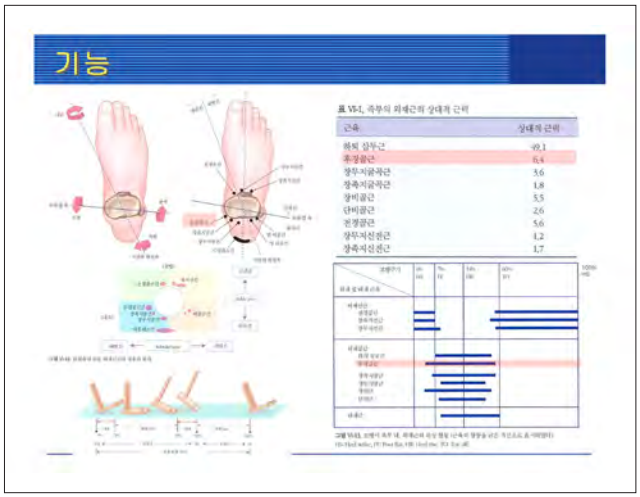
1. The preliminary report about the modified supramalleolar tibial osteotomy for asymmetric ankle osteoarthritis. Koo JW, Park SH, Kim KC, Sung IH.J Orthop Surg (Hong Kong). 2019 Jan-Apr;27(1):2309499019829204. doi: 10.1177/2309499019829204
2. Factors Associated With Recurrent Fifth Metatarsal Stress Fracture. Foot and Ankle International. Kyung-tai Lee, MD, PhD, Young-uk Park, MD, PhD, Hyuk Jegal, MD, KiChunKim,MD,Ki-wonYoung,MD,PhD,Jin-suKim,MD,PhD,1645-1653,Nov,2013
3. Midterm Outcome of Modified Kidner Procedure. Foot and Ankle International. Kyung Tai Lee, MD ; KiChunKim,MD; YoungUkPark,MD; SeungMinPark,MD; YoungKooLee,MD,122-127,Feb,2012

발목 접지른 후 발생한 중족부 내측부 통증(농구): 주상골 골절, 부주상골 증후군, 후경골건염 Posterior tibialis tendinitis with Accessory Navicula

서울의료원
김기천







Locking & unlocking

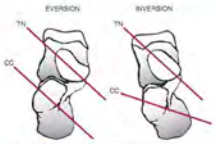


Figure 1-28 Function of transverse tarsal joint, as described by Elftman H: The transverse tarsal joint and its control, Clin Orthop Relat Res 16:41-46, 1960.) demonstrates that when the calcaneus is in eversion, the resultant axes of talonavicular (TN) and calcaneocuboid (CC) joints are parallel. When the subtalar joint is in an inverted position, the axes are nonparallel, giving increased stability to the midfoot.

Mann's Surgery of the Foot and Ankle 9th p21

역학

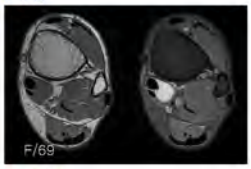
- 발병률 : 3.3 ~ 10%. 하지만 증상이 진행된 다음에 주로 진단되어서 실제로는 더 높을 것으로 예상됨
  (Kohls-Gatzoulis J, Woods B, Angel JC, et al. The prevalence of symptomatic posterior tibialis tendon dysfunction in women over the age of 40 in England. Foot Ankle Surg 2009;15:75–81.)
- 진행성 질환
- 동반 질환 : HTN, DM, Obesity
  (Chimenti RL, Tome J, Hillin CD, et al. Adult-acquired flatfoot deformity and age-related differences in foot and ankle kinematics during the single-limb heel-rise test. J Orthop Sports Phys Ther 2014;44:283–90.)
  (Holmes GB, Mann RA. Possible epidemiological factors associated with rupture of the posterior tibial tendon. Foot Ankle 1992;13:70–9.)
  (Rosenberg ZS, Jahss MH, Noto AM, et al. Rupture of the posterior tibial tendon: CT and surgical findings. Radiology 1988;167:489–93.)

임상적 특징

- 원인
  - 급성 : 드물다, 외상(염좌, 연열 골절)
  - 과사용 : 반복적, 과도한 걷기 달리기, 점프(발레무용수, 중년 여성)
- 임상 특징
  - 족관절 내측 후방 ~ 중족부 내측 통증, 부종, 압통
  - 마찰음(Crepitus)
  - 저항성 내번시 통증
  - 근력 약화
  - Single heel raise test : Supination (-), toe tip standing (-)

검사

- MRI



- 초음파

Staging

- 후경골건염과 편평족

Table 1. Johnson and Strom Classification, 1989[7]

Variable	Stage I mild, medial pain
Examination	Mild swelling and tenderness along PTT
Swelling and tenderness	
Heel-rise test	Mild weakness
"Too many toes" sign	Absent
Deformity	Absent
Pathologic features	Normal tendon length; paratenonitis
Images	No changes
Treatment	Conservative, tenosynovect

Abbreviations: FDL, flexor digitorum longus; PTT, posterior tibial t

Table 2. Burns et al Classification, 2007[1]

Stage	Subtype	Most characteristic clinical findings	Most characteristic radiographic findings	Treatment
I	A	Normal anatomy Tenderness along PTT	Normal	Immobilization, NSAIDs, prosthesis Orthosis Tenosynovectomy ±Extensor lengthening ±Gastrocsoleus-specific pharmacotherapy
	B	Normal anatomy Tenderness along PTT	Normal	Immobilization, NSAIDs, erythromycin Orthosis
	C	Signs HF valgus Tenderness along PTT	Signs HF valgus	Tenosynovectomy Immobilization, NSAIDs, prosthesis Orthosis Tenosynovectomy
II	A1	Supple HF valgus Flexible forefoot varus Possible pain along PTT	HF valgus Many line disruption Loss of talonavicular pitch	Orthosis Medial displacement calcaneal osteotomy Tendon Achilles and FDL transfer if deformity not reducible only with ankle plantarflexion Orthosis Medial displacement calcaneal osteotomy and FDL transfer Cotton osteotomy
	A2	Supple HF valgus Fixed forefoot varus Possible pain along PTT	HF valgus Many line disruption Loss of talonavicular pitch	
	B	Supple HF valgus Forefoot abduction	HF valgus Talonavicular uncovering Forefoot abduction	
	C	Supple HF valgus Fixed forefoot varus Medial column instability First-ray dorsiflexion with HF correction	HF valgus First TMT joint plantar gapping	
III	A	Sinus tarsi pain Rigid HF valgus Pain in sinus tarsi	Subtalar joint space loss HF valgus Angle of Gissane obtuse	Custom bracing if not operative candidate Triple arthrodesis
	B	Rigid HF valgus Forefoot abduction Pain in sinus tarsi	Subtalar joint space loss HF valgus Angle of Gissane obtuse Forefoot abduction	Custom bracing if not operative candidate Triple arthrodesis ± lateral column lengthening
IV	A	Supple clinician valgus	Talocrural valgus HF valgus	Surgery for HF valgus and associated deformity Deltoid reconstruction
	B	Rigid clinician valgus	Talocrural valgus HF valgus	TTC fusion or peroneal fusion

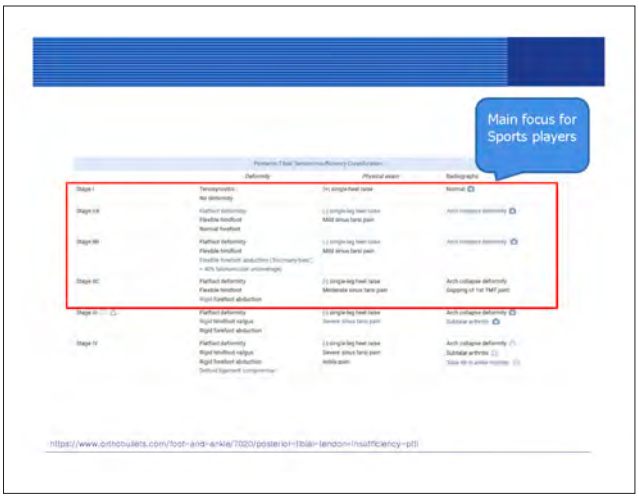
Abbreviations: FDL, flexor digitorum longus; HF, hind foot; NSAIDs, nonsteroidal anti-inflammatory drugs; PTT, posterior tibial tendon; TAL, tendo-Achilles lengthening; TMT, tarsometatarsal; TTC, triple-tendon fusion.

Progressive Collapsing Foot Deformity (PCFD)

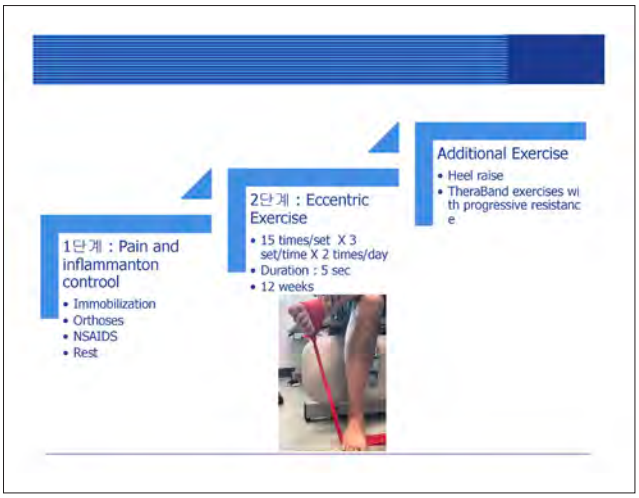
Table 3. Consensus Group Classification of Progressive Collapsing Foot Deformity.

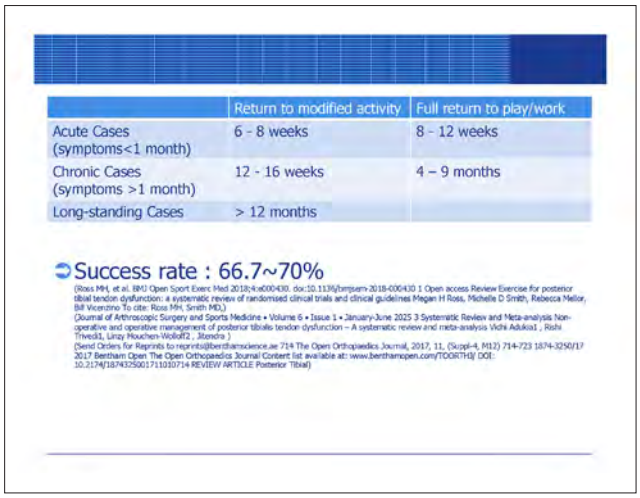
Stage of the deformity		
Stage I (flexible)		Stage II (rigid)
Types of deformity (classes – isolated or combined)		
	Deformity type/location	Consistent clinical/radiographic findings
Class A	Hindfoot valgus deformity	Hindfoot valgus alignment Increased hindfoot moment arm, hindfoot alignment angle, foot and ankle offset
Class B	Midfoot/forefoot abduction deformity	Decreased talar head coverage Increased talonavicular coverage angle Presence of sinus tarsi impingement
Class C	Forefoot varus deformity/medial column instability	Increased talus–first metatarsal angle Plantar gapping first TMT joint/NC joints Clinical forefoot varus
Class D	Peritalar subluxation/dislocation	Significant subtalar joint subluxation/subfibular impingement
Class E	Ankle instability	Valgus tilting of the ankle joint

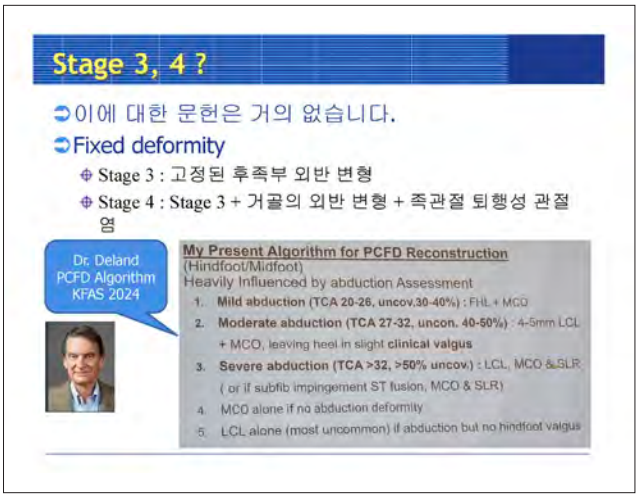
Abbreviations: NC, naviculocuneiform; TMT, tarsometatarsal.


Main focus for Sports players

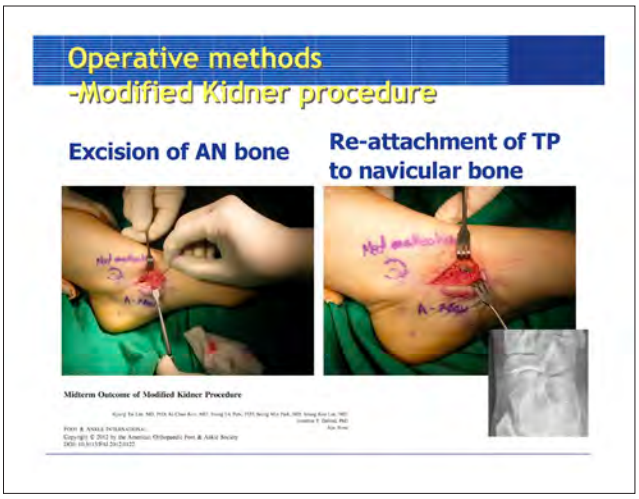

Exercise for posterior tibial tendon dysfunction: a systematic review of randomised clinical trials and clinical guidelines
Isotonic ankle strengthening, balance and stretching
↑ Ankle DF ROM
Foot Function Index (FFI) (pain, disability and activity limitations) ➔ No improvement
Eccentric strengthening combined with stretching and orthoses : reduced FFI – pain, disability, and total scorew


1단계 : Pain and inflammanton controol
Immobilization
Orthoses
NSAIDS
Rest
2단계 : Eccentric Exercise
15 times/set X 3 set/time X 2 times/day
Duration : 5 sec
12 weeks
Additional Exercise
Heel raise
TheraBand exercises with progressive resistance


Return to modified activity
Full return to play/work
Acute Cases (symptoms<1 month)
6 - 8 weeks
8 - 12 weeks
Chronic Cases (symptoms >1 month)
12 - 16 weeks
4 – 9 months
Long-standing Cases
> 12 months
Success rate : 66.7~70%


Stage 3, 4 ?
이에 대한 문헌은 거의 없습니다.
Fixed deformity
Stage 3 : 고정된 후족부 외반 변형
Stage 4 : Stage 3 + 거골의 외반 변형 + 족관절 퇴행성 관절염
Dr. Deland PCFD Algorithm KFAS 2024
My Present Algorithm for PCFD Reconstruction
(Hindfoot/Midfoot)
Heavily Influenced by abduction Assessment
1. Mild abduction (TCA 20-26, uncov.30-40%) : FHL + MCO
2. Moderate abduction (TCA 27-32, uncon. 40-50%) : 4-5mm LCL + MCO, leaving heel in slight clinical valgus
3. Severe abduction (TCA >32, >50% uncov.) : LCL, MCO &SLR (or if subfib impingement ST fusion, MCO & SLR)
4. MCO alone if no abduction deformity
5. LCL alone (most uncommon) if abduction but no hindfoot valgus


감별해야 할 질환 중 ➔ 부주상골증후군
Congenital anomaly
Incidence : 2 ~ 12 %
Bilaterality : 70~80 %
Type II m/c
Symptomatic synchondrosis
By 2nd trauma
Frequently associated with Flat foot


Operative methods
-Modified Kidner procedure
Excision of AN bone
Re-attachment of TP to navicular bone
Midterm Outcome of Modified Kidner Procedure


Thank you !
감사합니다 !

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

ICL 2. 스포츠 손상에서의 견열 손상
Avulsion fracutres in sports injury

좌장: 부민병원 서경묵 , 노원을지대병원 양기원

오치훈

학력

2006 ~ 2010 한국과학기술원(KAIST) 화학과 학사

2011 ~ 2015 차의과학대학교 의학전문대학원 의학과 의무석사

주요 경력

2025 ~ 고려대학교 안산병원 정형외과 임상조교수

2024 ~ 2025 고려대학교 안산병원 정형외과 임상강사

2024 ~ 대한수부외과학회 수부외과 세부전문의

2023 ~ 2024 차의과학대학교 분당차병원 정형외과 전임의

2020 ~ 2023 대한민국 육군 군의관

2016 ~ 2020 차의과학대학교 분당차병원 정형외과 전공의

2015 ~ 2016 차의과학대학교 분당차병원 인턴

현재 소속 및 직위

2025 ~고려대학교 안산병원 정형외과 임상조교수

대표논문

1. Oh CH, Jang I, Ha C, Hong IT, Jeong S, Han SH. Open Reduction and Internal Fixation of Distal Radius Fractures with Complete Intra-articular Involvement and Diaphyseal Extension. Clin Orthop Surg. 2024 Dec;16(6):979-986. https://doi.org/10.4055/cios23385
2. CH Oh, DE Shin, S Yoon, J Oh,Y Lee, S Lee, Comparison of Whole Trunk Muscle Mass between Healthy and Lumbar Herniated Nucleus Pulposus Patients Using Abdominal Pelvic Computed Tomography. Front Med (Lausanne) . Jul 18 2023. 10.3389/fmed.2023.1190021
3. Oh CH, Kim J, Kim J, et al. The Association of Low Skeletal Muscle Mass with Complex Distal Radius Fracture. J Clin Med. Sep 22 2022;11(19)doi:10.3390/jcm11195581

수부 견열 손상
Hand avulsion injurie

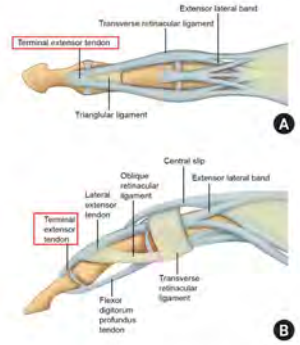
고려대안산병원
오치훈

Contents

- Mallet finger
- Jersey finger
- PIP joint
  - volar plate avulsion
  - fracture dislocation
  - central slip avulsion
- Finger collateral ligament injury
- Thumb collateral ligament injury
  - UCL (Skier's thumb)
  - RCL

Mallet finger

- **Most common closed tendon injury** of the finger
- The deformity is often unnoticed at the moment of injury
- Suddenly flexes the extending DIP joint



Mallet finger

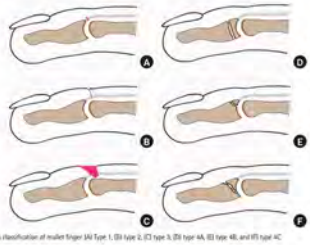


Table 1. Doyle's classification of mallet finger

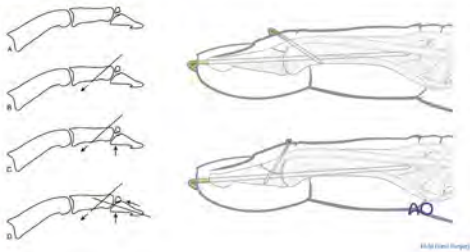
Type	Characteristics
Type 1	Closed injury, with or without small dorsal avulsion fracture
Type 2	Open injury, laceration of tendon
Type 3	Open injury with loss of skin, subcutaneous cover, and tendon substance
Type 4	Mallet finger
A	Transphyseal plate fracture in children
B	Hyperflexion injury with fracture of articular surface of 20% to 50%
C	Hyperextension injury with fracture of the articular surface > 50% and with early or late volar subluxation of distal phalanx

Mallet finger

- Conservative treatment
  - The DIP joint is splinted in **full extension for 6 to 8 weeks**, followed by progressive weaning of the splint.
- Average DIP joint **extensor lag of 8.3 degrees** at 5-year follow-up in 31 patients. *Okafor B, J Bone Joint Surg Br.1997*
- Using a premade plastic splint for 8 weeks, 20% of patients had an **extensor lag of more than 10 degrees** *Crawford GP. J Hand Surg Am, 1984*
- Noncompliant with proper splinting

Mallet finger

- Operative treatment

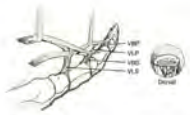


Mallet finger

Jersey finger

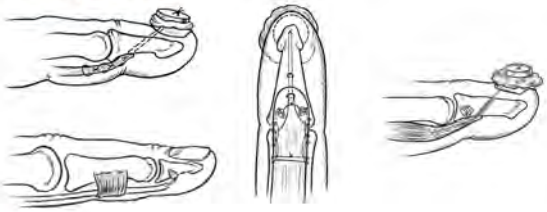
- Avulsion injury of flexor digitorum profundus (FDP) tendon
- Forced hyperextension DIP joint while the finger is actively flexing
- Most often occurs in the **ring finger**

Jersey finger



- Type I: The FDP tendon is avulsed from its insertion and **retracts into the palm.**
- Type II: The profundus tendon is avulsed from its insertion, but the stump remains within the digital sheath, implying that the **vinculum longum is still intact**.
- Type III: A **bony fragment** is attached to the tendon stump, which **remains within the flexor sheath.**

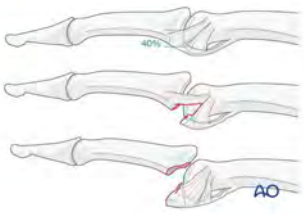
Jersey finger



Jersey finger

PIP joint - volar plate avulsion

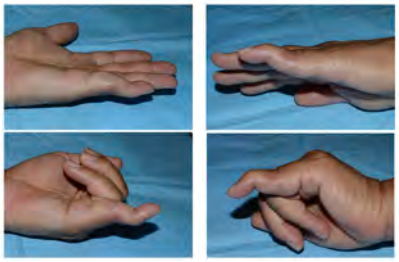
PIP joint - volar plate avulsion

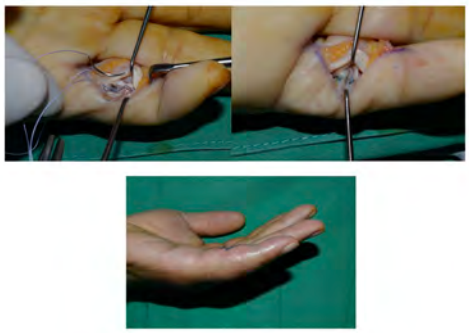


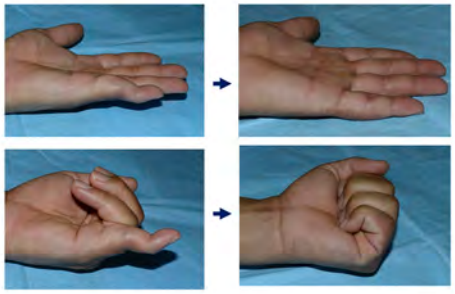
PIP joint - volar plate avulsion

- Injuries with questionable stability **may be augmented with 3 weeks of dorsal block splinting**, **allowing full flexion exercises** within the splint.

Swan neck deformity : PIPJ volar plate instability







PIP joint - fracture dislocation

- Dorsal V-sign
- Fracture-dislocations
  - with 40% or more of articular surface

PIP joint - fracture dislocation

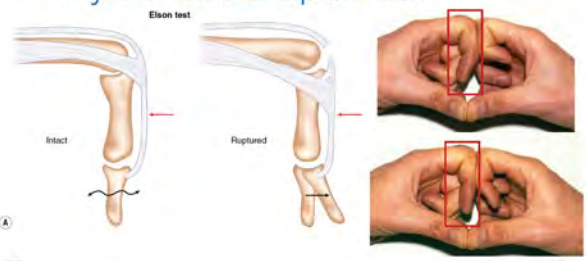
- Conservative Tx.
  - dorsal block splinting
  - allowing active flexion
  - joint is stable with no more than a 30-degree extension block
  - fragment < 40% of the articular surface
- Achieve stability > 30 degrees of flexion
  - risk for late **flexion contracture** ↑↑

PIP joint - fracture dislocation

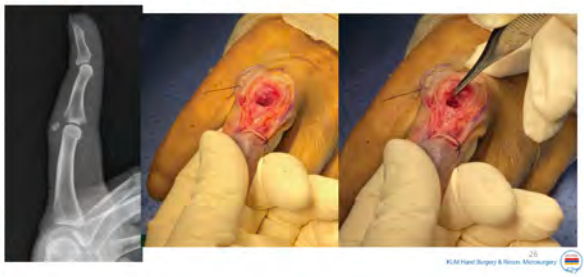
PIP joint - fracture dislocation

PIP joint - fracture dislocation

PIP joint - central slip avulsion



PIP joint - central slip avulsion



PIP joint - central slip avulsion

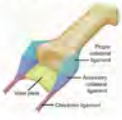
Finger collateral ligament injury

- Grade I: Pain, but **no laxity**
- Grade II: **Some laxity, but a firm endpoint** and stable arc of motion
- Grade III: Gross instability; **no firm endpoint**

Finger collateral ligament injury

- Passive stability
- More than 20 degrees of deformity
  - complete collateral ligament disruption
  - at least one other secondary stabilizer

Kiefhaber TR. J Hand Surg Am. 1986



Finger collateral ligament injury

- Usual sequela of ligament injury of the PIP joint
  - **Stiffness**
  - **Not instability**
- There is no clear evidence that surgical repair of these ligaments is necessary to promote improved long-term stability and range of motion

Thumb UCL injury

- Particularly among skiers and ball-handling athletes
- UCL injuries to be 10 times more common than RCL injuries
- Sudden, forced radial deviation (abduction)

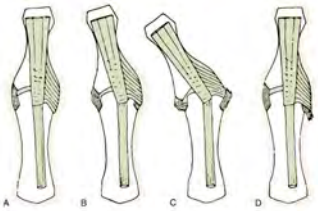
Moberg F, Stener B. Acta Chir Scand. 1953

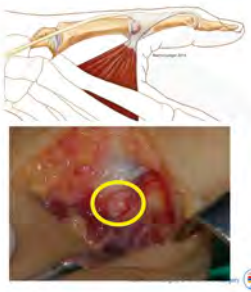
Thumb UCL injury

- Fractures involving
  - more than 10% of the articular surface
  - and may require fixation ≥ displaced 2 mm or more
  - associated with articular incongruity

Thumb UCL injury

- Stener lesion





Thumb UCL injury

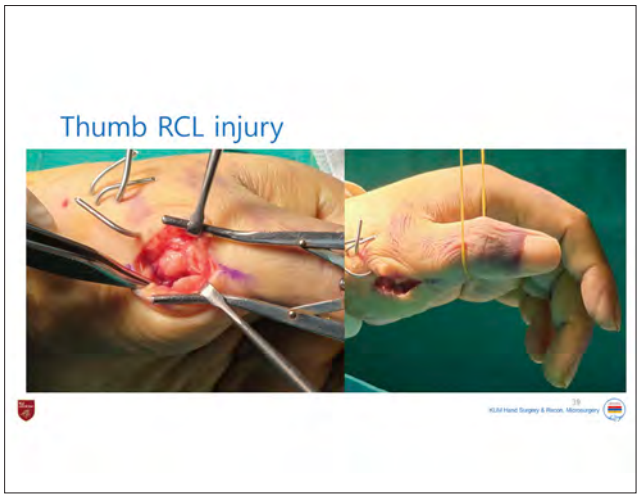
- Conservative Tx.
  - acute partial ruptures of the UCL
  - effectively treated by a 4-week period of continuous immobilization
  - thumb spica cast or splint to immobilize
  - Strenuous activity with the thumb is avoided for 3 months after the injury
  - common for patients to have a degree of aching pain on the ulnar side of the MP joint for ≥ 6 months after the injury

Thumb UCL injury

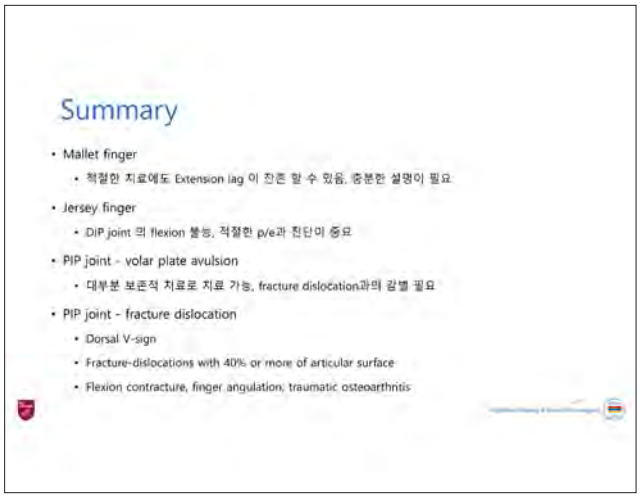
- Operative Tx.
  - recommended for repair of complete tears
  - as a more predictable and perhaps quicker path to recovery


Thumb RCL injury


Thumb RCL injury


Thumb RCL injury


Thumb UCL injury


Summary
• Mallet finger
• 적절한 치료에도 Extension lag 이 잔존 할 수 있음, 충분한 설명이 필요
• Jersey finger
• DIP joint 의 flexion 불능, 적절한 p/e과 진단이 중요
• PIP joint - volar plate avulsion
• 대부분 보존적 치료로 치료 가능, fracture dislocation과의 감별 필요
• PIP joint - fracture dislocation
• Dorsal V-sign
• Fracture-dislocations with 40% or more of articular surface
• Flexion contracture, finger angulation, traumatic osteoarthritis

Summary

- PIP joint - central slip avulsion
  - Button hole deformity, elson test +
- Finger collateral ligament injury
  - Finger stiffness
- Thumb collateral ligament injury
  - UCL - Stener lesion
  - Partial tear – conservative Tx., complete tear or instability – operative Tx.

Thank you for your attention!

KOREA UNIVERSITY MEDICINE

KUMC Hand Surgery & Recon. Microsurgery

김진우

학력

차의과학대학교 의학과 학사

차의과학대학교 의학대학원 정형외과학 석사

차의과학대학교 의학대학원 정형괴과학 박사

주요 경력

대한정형외과학회 홍보위원

대한고관절학회 진료지침위원

대한골대사학회 FLS 위원

대한관절경학회 학술위원

대한정형통증의학회 학술위원

현재 소속 및 직위

노원을지대학교병원 정형외과 부교수

대표논문

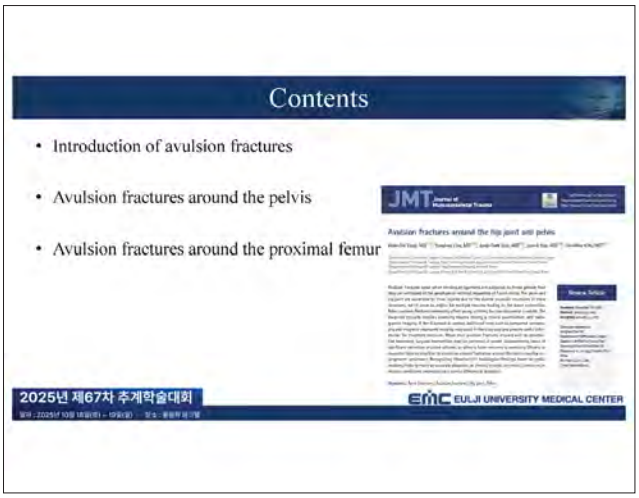
Kim JW, Park KS, Lee YK, Ha YC, Baek SH. Multiple screw fixation versus cementless bipolar hemiarthroplasty for femur neck fracture using a nationwide hip fracture registry. Sci Rep. 2021 Nov 2;11(1):21461. doi: 10.1038/s41598-021-01046-3.

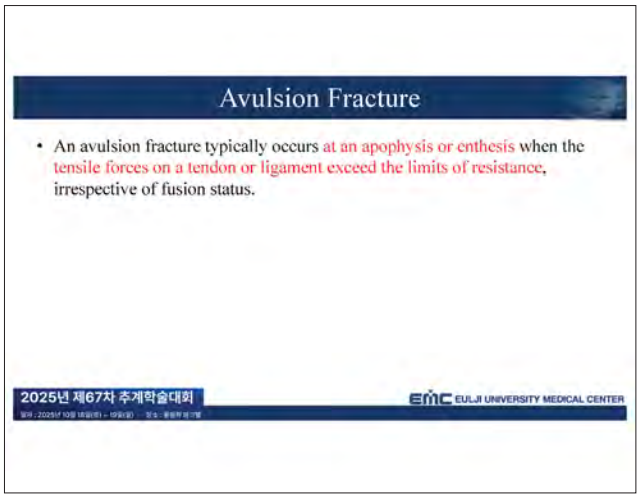
Kim JW, Yoon SY, Lee JH, Lee SC, Serious Clinical Outcomes of COVID-19 Related to Acetaminophen or NSAIDs from a Nationwide Population-Based Cohort Study, Int J Environ Res Public Health. 2023 Feb 21;20(5):3832. doi: 10.3390/ijerph20053832.

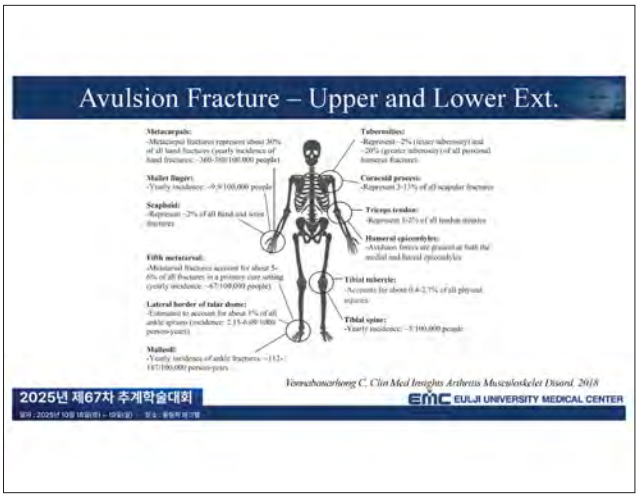
Kim JW, Yoo JI, Kim JT, Choy WS, Cha Y. Clinical and Radiological Characteristics of Lesser Trochanter Splitting Irreducible Intertrochanteric Fractures, Clin Orthop Surg. 2023;15:e24. Forthcoming. English. Published online Apr 12, 2023. https://doi.org/10.4055/cios22325

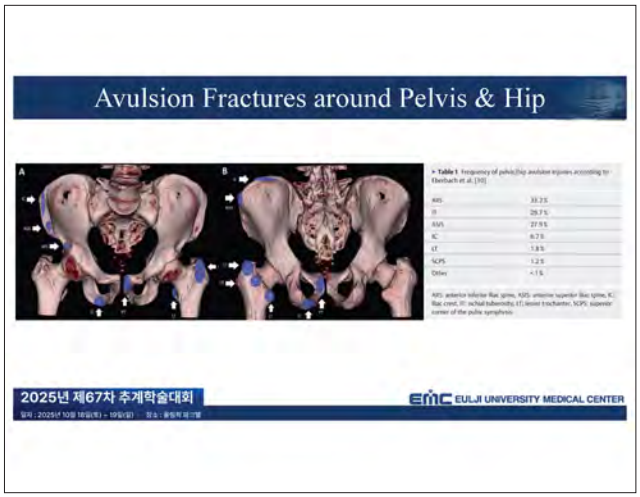
고관절 견열 손상
Hip avulsion injuries

노원을지대병원
김진우









Avulsion Facture of the Iliac Crest

- From the anterior superior iliac spine to the posterior superior iliac spine
- **The site of attachment for the anterior abdominal wall muscles**
- Results from forceful eccentric contraction of muscles in lateral flexion and rotational movement of the trunk, causing excessive strain of the abdominal muscles
- Only about 1–2 % of all avulsion injuries of the pelvis/hip region
- **Excellent outcome with conservative management**
- Surgical management may be considered
  - Heavily displaced fragments (more than 30mm)
  - Require rapid rehabilitation with quick return to sports activities

Avulsion Facture of the Anterior Superior Iliac Spine

- **The origin of the sartorius muscle and in parts of the tensor fascia lata**
- 28 % of all pelvic avulsion injuries
- **Sprinters or jumpers are typical athletes at risk**
- The avulsed fragment is typically displaced distally and laterally and might be falsely mistaken as an avulsion injury of the AIIS.
- Can lead to marked hematoma and excessive callus formation that might lead to meralgia paresthetica due to compression of the lateral cutaneous nerve

Avulsion Facture of the Anterior Superior Iliac Spine

- Conservative treatment in minimally displaced fractures – usually rapid healing
- **Surgical management with open reduction and screw fixation** may be considered in widely displaced avulsions with a gap of more than 15–20 mm
  - The initial recovery period may then be shorter with an earlier return to sports,
  - But the outcome in the mid-term may not be significantly different

Avulsion Facture of the ASIS - Case

- M/17 내원 당일 뛰다가 갑자기 통증 발생 하여 내원

Avulsion Facture of the ASIS - Case

- M/17 내원 당일 뛰다가 갑자기 통증 발생 하여 내원

f/u 3mo f/u 6mo f/u 1yr

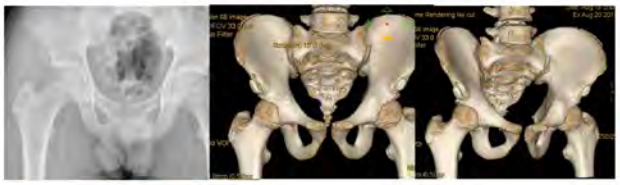
Avulsion Facture of the Anterior Inferior Iliac Spine

- **The origin of the straight head of the rectus femoris muscle**
  the reflected head arises from a groove above the rim of the acetabulum
- **Common in sports like soccer**
  - sprinting, jumping, or kicking
- About 20 - 25 % of all pelvic avulsion injuries
- Potential extensive heterotopic callus formation at the superior aspect of the acetabulum
  - Cause femoroacetabular impingement due to a narrowing of the space between the greater trochanter and the acetabular roof

J. M. Ryan, et al., Arthroscopy, 2014

Avulsion Facture of the AIIS - Case

- M/15 축구하다 공을 찬 이후 통증 발생하여 내원



2025년 제67차 추계학술대회 EMC EULJI UNIVERSITY MEDICAL CENTER

Avulsion Facture of the AIIS - Case

- M/15 축구하다 공을 찬 이후 통증 발생하여 내원

f/u 3mo f/u 6mo f/u 2.6yr

2025년 제67차 추계학술대회 EMC EULJI UNIVERSITY MEDICAL CENTER

Avulsion Facture of the AIIS – Op. Case

- M/28 2019.09. 축구하던 중 좌측 고관절 통증으로 인하여 타병원 방문. 시행한 영상검사상 골절소견 확인되었으나 보존적치료 진행. 이후 통증 악화되어 외래 방문. f/u 영상검사상 AIIS avulsion fracture nonunion 관찰되어 수술적 치료 위해 입원.

Courtesy by Prof. 김태영

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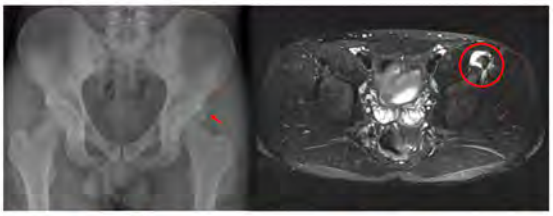
Avulsion Facture of the AIIS – Op. Case

- Initial X-ray and MRI (2019.09.20)



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Avulsion Facture of the AIIS – Op. Case

- Preop X-ray and CT (2020.04.07)

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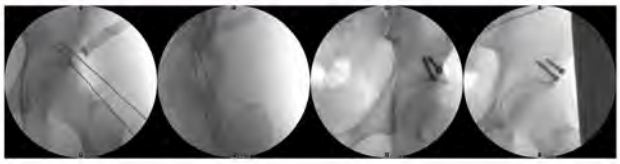
Avulsion Facture of the AIIS – Op. Case

- Op day (2020.04.08)



2025년 제67차 추계학술대회 EMC EULJI UNIVERSITY MEDICAL CENTER

Avulsion Facture of the AIIS – Op. Case

- Op day (2020.04.08)

2025년 제67차 추계학술대회 EMC EULJI UNIVERSITY MEDICAL CENTER

Avulsion Facture of the AIIS – Op. Case

- Post Op X-ray (2020.04.08)

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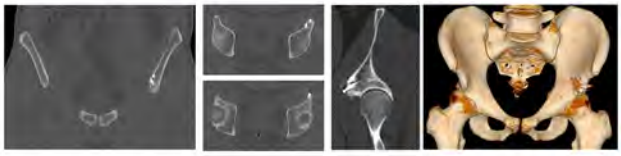
Avulsion Facture of the AIIS – Op. Case

- POD 6mo CT (2020.10.05)



2025년 제67차 추계학술대회 EMC EULJI UNIVERSITY MEDICAL CENTER

Avulsion Facture of the Ischial Tuberosity

- Common site for pelvic avulsions especially in adolescents
- The site of insertion of the hamstring muscle group
  - **The long head of the biceps femoris, the semitendinosus & semimembranosus**
- Athletes in **competitive sports, such as soccer players, runners and dancers**
  - Forceful active contraction of the hamstrings during powerful flexion of the hip joint with the knee in extension or sudden and excessive passive lengthening
- The pain is **more pronounced during sitting** compared to standing upright

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Avulsion Facture of the Ischial Tuberosity

- No clear guideline on the management ; Most centers favor **conservative Tx**
- **Operative treatment with open reduction and internal fixation**
  - Only if the avulsed fragment is widely displaced.
  - A publication by Singer et al. suggests a displacement of more than 15mm as an indication for operative management

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Avulsion Facture of the Ischial Tuberosity

- **Sciatica** may occur, which is related to irritation of the sciatic nerve by the avulsed bony fragment and/or hypertrophic bony callus formation or HO
- Consecutive narrowing of the ischiofemoral space may be the development of an **ischiofemoral impingement syndrome**
  - Refers to the impingement of soft tissues, primarily the quadratus femoris muscle, between the ischial tuberosity and lesser trochanter of the femur.

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Avulsion Facture of the Ramus & Symphysis Pubis

- The long and short adductor muscles from the pubic body & the inferior ramus
  - **The adductor longus, adductor brevis, and gracilis, and the distal rectus abdominis**
    - The adductor longus muscle > adductor brevis and the pectineus
    - The gracilis and adductor magnus muscles are rarely involved

Avulsion Facture of the Ramus & Symphysis Pubis

- **Chronic overuse and repetitive microtrauma**, and rarely due to sudden forceful contraction against resistance.
- It typically occurs in soccer, ice hockey, and tennis players
- **Athletic pubalgia**
  - Localized unilateral pain to the groin and can be relatively nonspecific d/t chronic status
- DDx; Osteitis pubis, sportsman's hernia, acetabular labral tears, and lumbar spine disease
- **Treatment is usually conservative**
  - Comprising the ceasing of sports activities and decreased weight bearing for a few weeks until a gradual increase of strain is tolerated.

Avulsion Facture of the Greater Trochanter

- **Rare** entity even among apophyseal avulsions of the pelvis in adolescents
- Occurs after **a sudden forceful change of direction**
- Conservative Tx in adolescents
  - Restricted ROM and refraining from sports for about 6 weeks with a subsequent slow increase of stress
- **Open reduction and internal fixation** might be necessary
  - Wide displacement of the GT, especially in traumatic fractures of the GT region d/t a direct impact after a fall in the elderly

Avulsion Facture of the Lesser Trochanter

- Rare injury pattern encountered in young athletes
- About 1–3% of all avulsion injuries of the hip region
- **A forceful and abrupt contraction of the iliopsoas** muscle may result in avulsion Fx. especially in **competitive track & field athletes or soccer players**
- Conventional radiographs demonstrate the displaced lesser trochanter
- Further evaluation by CT or MRI is usually not necessary.
- Caution must be taken when lesser trochanter avulsion is seen in adults, as it can represent a pathologic avulsion fracture due to metastatic involvement

Avulsion Facture of the Lesser Trochanter - Case

Take Home messages

- Avulsion injuries are common injuries at the pelvic region especially in adolescent athletes, due to not yet ossified apophysis.
- Excellent anatomical knowledge is essential for proper diagnostic evaluation and predicting the mechanism of injury.
- Imaging plays a crucial role in diagnosing avulsion injuries
  - X-ray and using MRI and CT for anatomical details by utilizing multiplanar capabilities
- Most avulsion injuries can be adequately treated by conservative Tx
- Operative management due to faster recovery and shorter return to play
  - Widely displaced bone fragments/apophyses or significant tendon retraction in a competitively active athlete

이효열

학력

전남대학교 의과대학 의학과 학사

울산대학교 대학원 의학과 박사

주요 경력

대한민국 아이스하키 대표팀 주치의

대한민국 농구 대표팀 주치의

한국프로여자골프협회 투어 주치의

서울아산병원 정형외과 전임의

현재 소속 및 직위

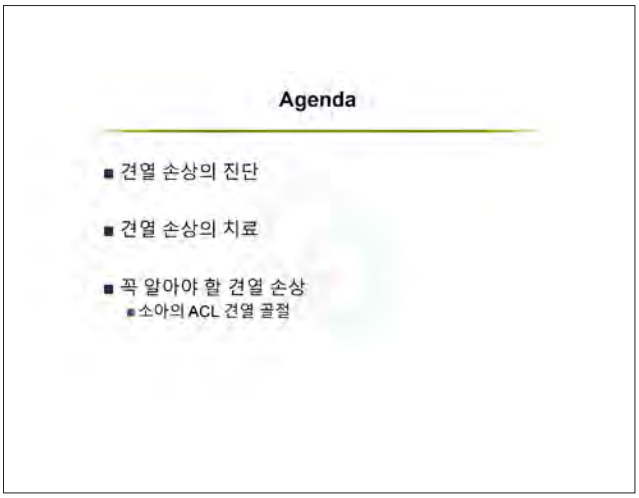
충북대학교병원 정형외과 조교수

대표논문

1. Autologous Osteochondral Transfer Demonstrates Satisfactory Clinical Outcomes and Durable Cartilage Properties: A Mean 4-Year Follow-up Using Quantitative MRI. Orthopaedic journal of sports medicine. 2025.08.
2. Lee HY, Kim JM, Lee BS, Song JH, Bin SI. Lateral Meniscal Allograft Transplantation Shows a Long-Term Chondroprotective Effect on Quantitative Magnetic Resonance Imaging T2 Mapping at 7-Year Minimum Follow-Up. Arthroscopy. 2024.
3. Lee HY, Kim JM, Lee BS, Song JH, Bin SI. Non-extruded grafts result in better cartilage quality after lateral meniscal allograft transplantation: quantitative 3-T MRI T2 mapping.. The American journal of sports medicine. 2023.

슬관절 견열 손상
knee avulsion injuries

충북대병원
이효열



견열 손상의 진단: Case 1

- LCL and Popliteal tendon avulsion Fx.
- MM tear (midbody~root)

CHUNGBUK NATIONAL UNIVERSITY HOSPITAL

Agenda

- 견열 손상의 진단
- 견열 손상의 치료
- 꼭 알아야 할 견열 손상
  - 소아의 ACL 견열 골절

견열 손상의 치료

- 절반만 뿌리 손상된 경우
  - <2mm 골편 전위

- 가만 놔둬도 살긴 산다.

→ 보존적치료

- 완전히 뿌리 손상된 경우
  - >2mm 골편 전위

- 통째로 다시 심어줘야한다.

→ 수술

- 나무 자체가 부러진 경우
  - 인대 자체 파열

- 새로운 나무를 심어야한다.

→ 인대 재건술

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견열 손상의 치료: Case 1

- LCL and Popliteal tendon avulsion Fx.
- MM tear (midbody~root)

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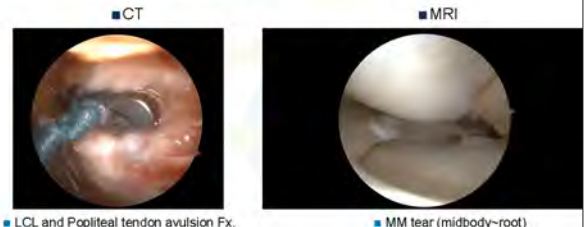
견열 손상의 치료: Case 1



- LCL and Popliteal tendon avulsion Fx.
- MM tear (midbody~root)

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견열 손상의 치료: Case 1

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MCL & PCL avulsion Fx.
+ MM PH tear

견열 손상의 치료: Case 2

- M/24, motorcycle TA
- Consult from trauma surgeon

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견열 손상의 치료: Case 2

- M/24, motorcycle TA
- Consult from trauma surgeon

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견열 손상의 치료: Case 2

- M/24, motorcycle TA
- Consult from trauma surgeon

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견열 손상의 치료: Case 2

- Pullout fixation
- MMPH repair
- MCL fixation

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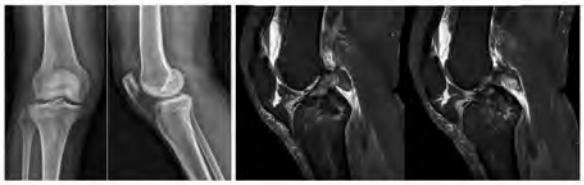
ACL & PCL avulsion Fx.
+ lateral tibia plateau Fx.

견열 손상의 치료: Case 3

- F/46, fall down



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견열 손상의 치료: Case 3

- F/46, fall down

- Rafting screw
- Rim plating

- ACL and PCL pullout fixation

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ACL, MCL, LCL, PLT avulsion Fx.
+ degloving injury

견열 손상의 치료: Case 4

- M/39, motorcycle TA

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견열 손상의 치료: Case 4

- M/39, motorcycle TA

CHUNGBUK NATIONAL UNIVERSITY HOSPITAL

견열 손상의 치료: Case 4

- M/39, motorcycle TA

CHUNGBUK NATIONAL UNIVERSITY HOSPITAL

Agenda

- 견열 손상의 진단
- 견열 손상의 치료
- 꼭 알아야 할 견열 손상
  - 소아의 ACL 견열 골절

Pediatric ACL avulsion Fx.
(cartilaginous avulsion)

Which one has ACL avulsion Fx. ?

M/7 M/7

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M/7 ACL avulsion Fx.

- M/7

- 태권도장 멀리 뛰기 후, Painful swelling
- Local clinic 방문하여 XR 시행
- "괜찮다", splint 적용
- 1달 후 extension deficit 15°

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M/7 ACL avulsion Fx.

수상 시 타병원 X-ray

수상 6주 째 X-ray

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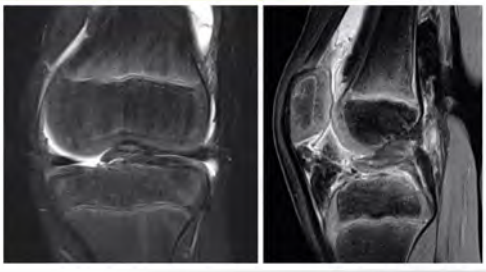
M/7 ACL avulsion Fx.



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ACL avulsion Fx.

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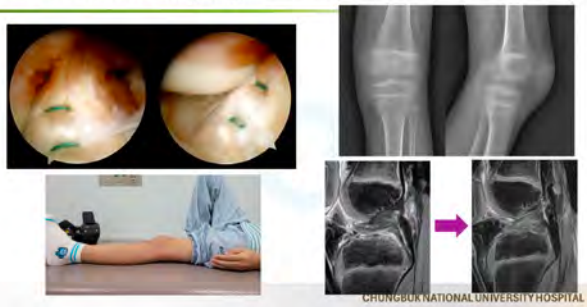
ACL avulsion Fx. (neglected case)



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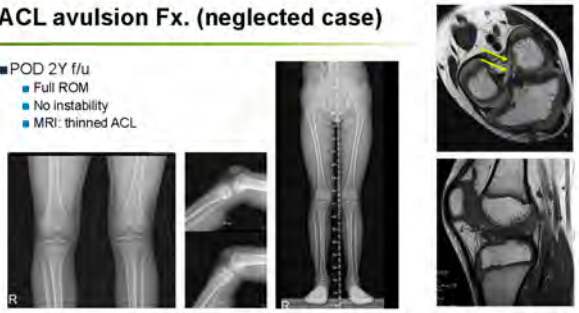
ACL avulsion Fx. (neglected case)

- POD 2Y f/u
  - Full ROM
  - No instability
  - MRI: thinned ACL



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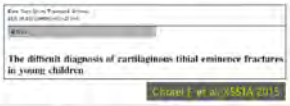
Key messages

1. 무릎 견열 골절은 대부분 고에너지 손상
   - 최소 교통사고
   - 스포츠 손상에 의한 견열 골절은 흔치 않음

2. 8세 이하 소아 (초등 저학년)에서 ACL 견열골절
   - 스포츠 손상에 의해 발생 가능!
   - 진단이 쉽지 않음!
   - 보존적 치료 결과 좋지 않음



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경청해주셔서 감사합니다.

충북대학교병원

박철현

학력

영남대학교 의학대학 학사 취득

영남대학교 의과대학 의학대학원 석사 취득

영남대학교 의과대학 의학대학원 박사 취득

주요 경력

Reviewer of American Journal of Sports Medicine

Reviewer of American Orthopedic foot and ankle surgery

Editorial Review Board of Cartilage

현재 소속 및 직위

영남대병원 정형외과학교실 주임교수

대표논문

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2. Park CH, Lee WC. Donor site morbidity after lateral ankle ligament reconstruction using anterior half of peroneus longus autograft tendon. Am J Sports Med. 45(4): 922-928, 2017.
3. Park CH, Yan HF, Park JJ, Chang MC. Mini-open Repair for Acute Achilles Tendon Rupture: Ring Forceps vs the Achillon Device. Am J Sports Med. 49(13): 3613-3619, 2021.

족부족관절 견열 손상
Foot and ankle avulsion injuries

영남대병원
박철현

1. Introduction

Avulsion injuries refer to trauma in which a ligament, tendon, or joint capsule pulls off a fragment of bone from its attachment site due to excessive tensile force. The foot and ankle region is particularly susceptible because of its complex anatomy and the high mechanical stresses experienced during movement. Such injuries commonly occur in sports activities, ankle sprains, and rotational trauma, and their severity can range from small cortical fragment avulsions to significant articular disruptions.

2. Mechanism of Injury

Acute traumatic mechanism: A sudden traction force on a tendon or ligament leads to the separation of bone at its insertion.

Repetitive microtrauma: Chronic tensile stress weakens the cortical bone, resulting in partial avulsions that may evolve into complete fragment separation.

Common injury positions:

Inversion injury: Lateral malleolus, base of the fifth metatarsal

Eversion injury: Medial malleolus, deltoid ligament insertion

Dorsiflexion injury: Anterior process of the calcaneus

Plantarflexion injury: Posterior talar process, peroneal tendon avulsion

3. Anatomical Classification and Common Sites

(1) Ankle Region

Medial malleolar avulsion – due to traction of the deltoid ligament

Lateral malleolar tip avulsion – involving the anterior talofibular ligament (ATFL) or calcaneofibular

ligament (CFL)

Posterior malleolar avulsion – caused by tension on the posterior inferior tibiofibular ligament (PITFL)

(2) Hindfoot

Anterior process of the calcaneus – bifurcate ligament traction during inversion-dorsiflexion injuries

Posterior process of the talus – posterior talofibular ligament traction or forced plantarflexion (Shepherd or Stieda fracture)

Sustentaculum tali – rare; related to deltoid or spring ligament traction

(3) Midfoot

Navicular tuberosity avulsion – tibialis posterior tendon traction

Cuboid avulsion – peroneus longus tendon or bifurcate ligament involvement

Lisfranc avulsion – traction on the Lisfranc ligament at the base of the second metatarsal

(4) Forefoot

Base of fifth metatarsal (pseudo-Jones fracture) – peroneus brevis tendon traction

Sesamoid avulsion fracture – flexor hallucis brevis or plantar plate traction

4. Diagnosis

(1) Clinical Findings

Local tenderness and swelling

Point tenderness over the ligament or tendon insertion

Restricted motion or joint instability

Frequently misdiagnosed as a simple ankle sprain

(2) Imaging Evaluation

Plain radiographs: AP, lateral, and oblique views are essential; small fragments may mimic accessory ossicles.

Computed tomography (CT): Useful for evaluating fragment size, displacement, and articular involvement.

Magnetic resonance imaging (MRI): Identifies associated ligament or tendon injuries, bone marrow edema, and soft tissue involvement.

Ultrasonography: Can visualize dynamic tendon movement and real-time avulsion injuries.

5. Management

(1) Conservative Treatment

Indicated for nondisplaced fragments and stable joints.

Immobilization: Short leg cast or walking boot for 2–4 weeks.

Rehabilitation: Gradual weight-bearing, proprioceptive training, and strengthening exercises.

Prognosis: Most cases heal within 6–8 weeks with full recovery.

(2) Surgical Treatment

Indicated for displaced fragments (>2–3 mm), articular involvement, or instability due to major ligament or tendon attachment injury.

Fixation methods: Screws, K-wires, suture anchors, or tension band wiring.

Examples:

Lateral malleolar tip avulsion with ATFL injury → suture anchor repair.

Large anterior calcaneal process avulsion → screw fixation.

Comminuted fifth metatarsal base avulsion → intramedullary screw or tension band fixation.

6. Complications

Chronic ankle instability

Nonunion or malunion of the avulsion fragment

Persistent pain from unhealed ossicles

Post-traumatic arthritis

Tendon dysfunction (e.g., peroneus brevis or tibialis posterior insufficiency)

7. Recent Insights and Rehabilitation

Recent literature highlights that even small avulsion fragments may serve as radiologic markers of significant ligamentous injury. Thus, these injuries should not be dismissed as trivial findings. MRI evaluation is essential to assess the integrity of associated soft tissues. Early rehabilitation emphasizing proprioception and peroneal muscle strengthening has been shown to reduce the risk of recurrent instability and chronic pain.

8. Conclusion

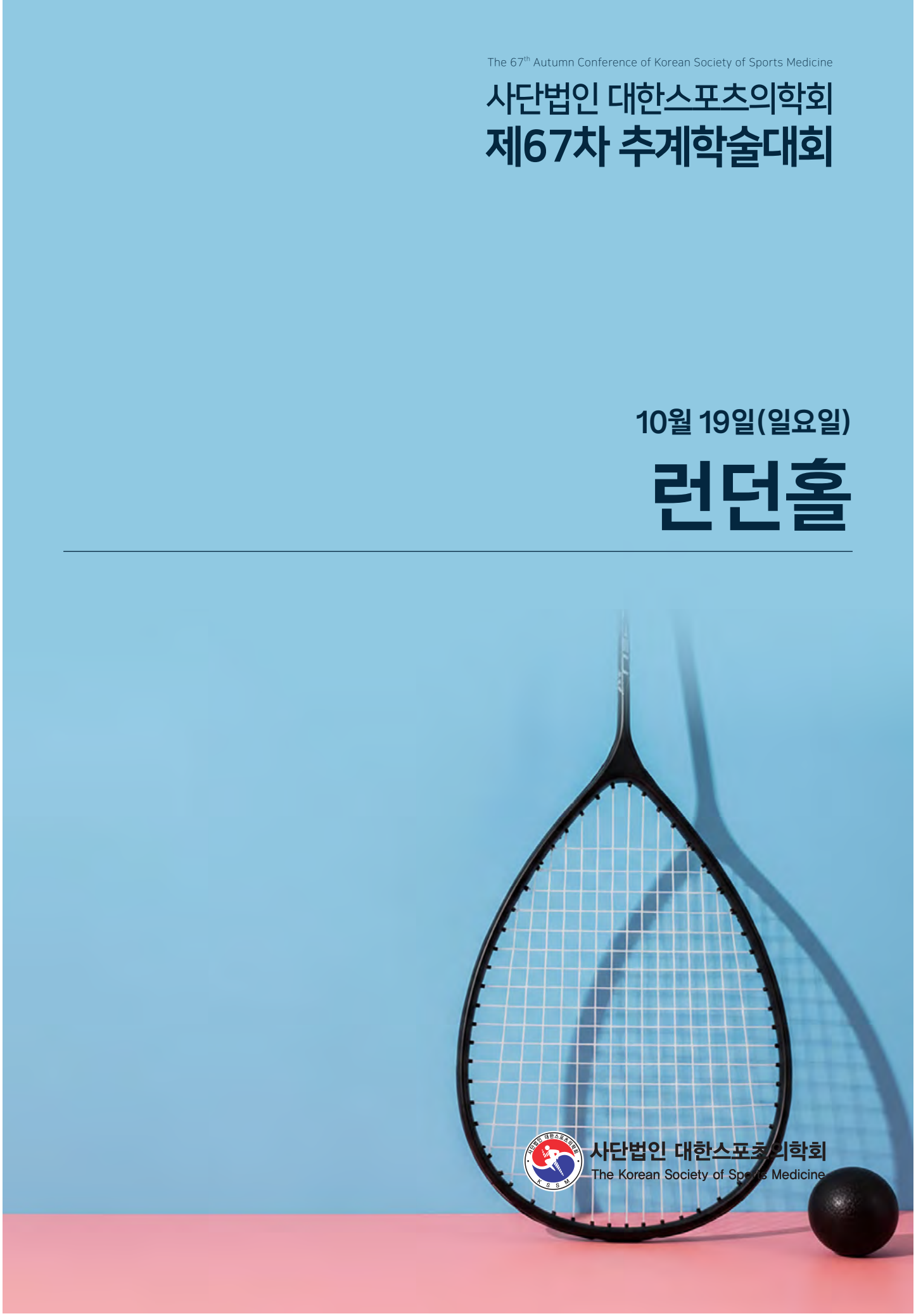
Foot and ankle avulsion injuries, though sometimes subtle on imaging, often represent critical damage to the stabilizing structures of the lower extremity. Accurate diagnosis, based on careful clinical and imaging assessment, is essential to determine the appropriate treatment strategy. Early recognition, proper management, and functional rehabilitation are key to restoring stability and preventing long-term complications.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회
제67차 추계학술대회

10월 19일(일요일)

런던홀



The 67th Autumn Conference of Korean Society of Sports Medicine
사단법인 대한스포츠의학회
제67차 추계학술대회

심포지엄 7: 대한스포츠의학회 SAT 프로그램의 이해와 실제
Understanding and Implementing the SAT Program of KSSM

좌장: 명지병원 김용균, 이대목동병원 권지은

배중현

학력

중앙대학교 의과대학 학사

중앙대학교 의과대학 재활의학 석사

가톨릭대학교 의과대학 예방의학 박사 수료

주요 경력

2024 파리올림픽 주치의

2025 하얼빈 동계아시아경기대회 주치의

2025 라인루르 하계세계대학경기대회 주치의

전 솔병원 진료원장

전 빙상경기연맹 의무위원

현재 소속 및 직위

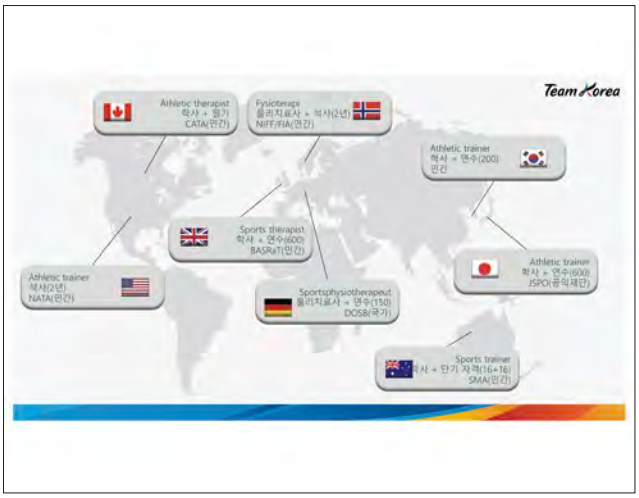
대한체육회 진천국가대표선수촌 메디컬센터 재활의학과

대표논문

Bae, J., et al. (2025). “Team Korea injury and illness surveillance at the 2024 Paris Olympic Games.” Injury Epidemiology 12(1): 55.

SAT 이론 프로그램과 NATA 프로그램의 비교
Comparison of the SAT Theory Programme and the NATA Programme

진천선수촌
배중현

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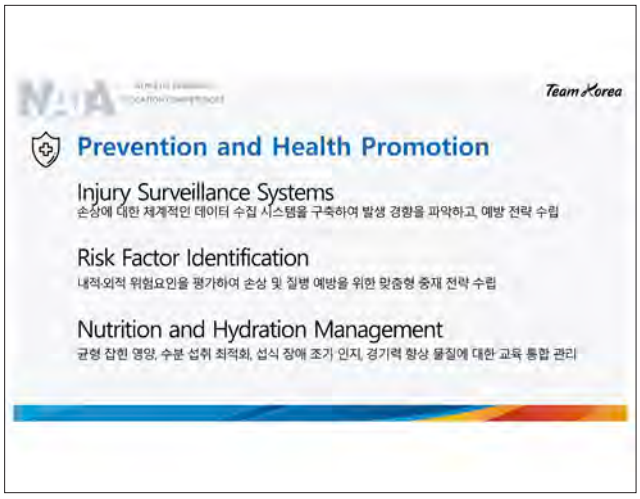
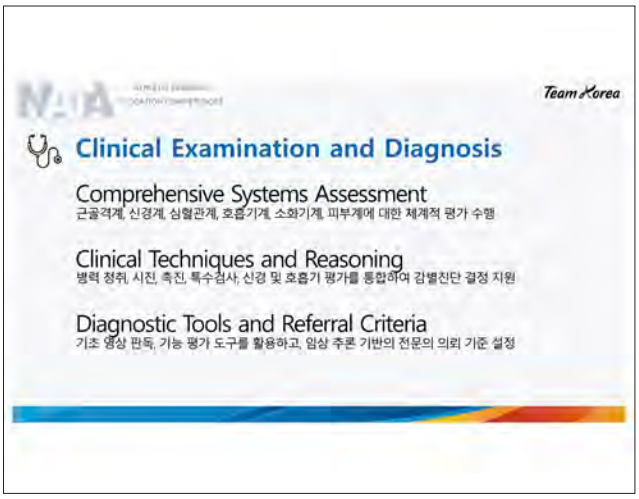
The History and Evolution of Athletic Training Education in the United States
AMA
인정(1990)


Team Korea
Evidence-Based Practice
Prevention and Health Promotion
Clinical Examination and Diagnosis
Acute Care
Therapeutic Interventions
Psychosocial Strategies and Referral
Healthcare Administration
Professional Development and Responsibility

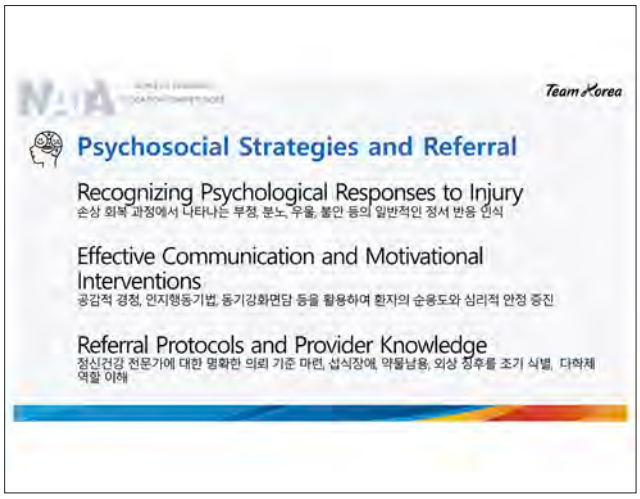

Team Korea
Evidence-Based Practice
Formulating Clinical Questions
PICO/PIO 틀을 활용하여 명확하고 답변 가능한 임상 질문을 구성하고, 체계적인 근거 탐색 유도
Literature Searching Techniques
PubMed, CINAHL 등의 데이터베이스에서 Boolean 연산자를 사용하여 문헌 효율적 탐색, 종합
Critical Appraisal and Integration
PEDro, Oxford scale 등의 도구를 사용해 연구의 질 평가, 임상 전문성과 환자 가치에 근거 통합


Team Korea
Prevention and Health Promotion
Injury Surveillance Systems
손상에 대한 체계적인 데이터 수집 시스템을 구축하여 발생 경향을 파악하고, 예방 전략 수립
Risk Factor Identification
내적·외적 위험요인을 평가하여 손상 및 질병 예방을 위한 맞춤형 중재 전략 수립
Nutrition and Hydration Management
균형 잡힌 영양, 수분 섭취 최적화, 섭식 장애 조기 인지, 경기력 향상 물질에 대한 교육 통합 관리


Team Korea
Clinical Examination and Diagnosis
Comprehensive Systems Assessment
근골격계, 신경계, 심혈관계, 호흡기계, 소화기계, 피부계에 대한 체계적 평가 수행
Clinical Techniques and Reasoning
병력 청취, 시진, 촉진, 특수검사, 신경 및 호흡기 평가를 통합하여 감별진단 결정 지원
Diagnostic Tools and Referral Criteria
기초 영상 판독, 기능 평가 도구를 활용하고, 임상 추론 기반의 전문의 의뢰 기준 설정


Team Korea
Acute Care
Emergency Scene Management
응급 상황 발생 시 구조자의 안전을 확보하고 위험 요소를 신속히 파악, 체계적인 현장 평가 수행
Vital Signs and Airway Control
산소포화도 및 혈당 포함 활력징후 모니터링, OPA, NPA, 상후두기기(supraglottic devices) 등 기도 확보 도구 활용
Critical Emergency Interventions
심폐소생술(CPR), 자동심장충격기(AED) 사용, 출혈 조절, 상처 처치, 척추 고정, 응급 냉각, 에피네프린 투여 등 수행


Team Korea
Therapeutic Interventions
Rehabilitation Techniques
통증 및 부종 조절, 관절 가동성 증진, 온열전기·초음파 치료 등 치료적 물리치료 기법 적용
Exercise Program Prescription
근력, 지구력, 균형, 신경근 조절 향상을 위한 개인 맞춤형 운동 프로그램 설계
Manual Therapy and Medication Management
도수치료, 테이핑, 보행 분석을 포함하고, 약물 보관·투약·작동학 및 치료 전략에 대한 지식 통합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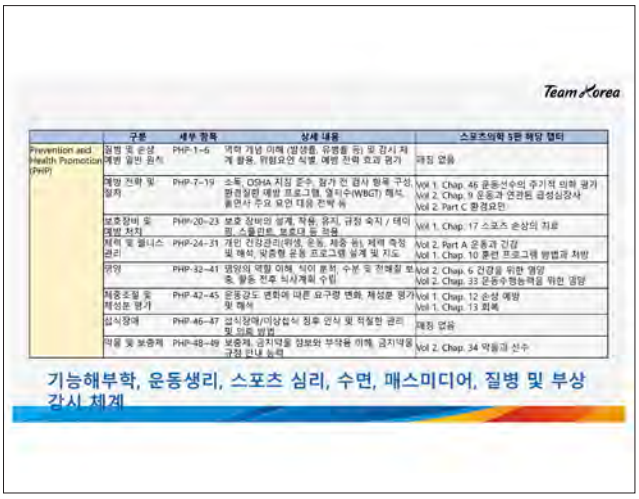
Psychosocial Strategies and Referral
Recognizing Psychological Responses to Injury
손상 회복 과정에서 나타나는 부정, 분노, 우울, 불안 등의 일반적인 정서 반응 인식
Effective Communication and Motivational Interventions
공감적 경청, 인지행동기법, 동기강화면담 등을 활용하여 환자의 순응도와 심리적 안정 증진
Referral Protocols and Provider Knowledge
정신건강 전문가에 대한 명확한 의뢰 기준 마련, 섭식장애, 약물남용, 외상 정후를 조기 식별, 다학제 역할 이해


Team Korea
Healthcare Administration
Healthcare System Context
다양한 의료 전달 체계 속에서 선수트레이너의 역할과 다학제 협업 구조 이해
Business and Risk Management
전략 기획, 예산 관리, 시설 안전, 리스크 관리, 법적 준수를 기반으로 지속 가능한 운영 수행
Regulatory and Emergency Planning
개인정보보호법(HIPAA), 보험 청구, 감염 관리, 고용법을 준수하고, 응급 대응 프로토콜 수립


Team Korea
Professional Development and Responsibility
Lifelong Learning and Competence
지속적인 전문성 개발을 통해 변화하는 기준에 적응하며, 정규 교육과 성찰적 실천 병행
Governance and Regulatory Compliance
NATA, BOC, CAATE의 운영 체계를 이해하여 자격 유지 및 법적 직무 범위 준수
Ethical Standards and Advocacy
윤리 강령을 바탕으로 의사결정, 전문가 협업, 의뢰 과정 등을 수행하며, 전문 직역 옹호와 지역사회 참여 실천


Team Korea
구분 세부 항목 상세 내용 스포츠의학 5판 해당 챕터
Prevention and Health Promotion (PHP)
질병 및 손상 예방 원칙 PHP-1-6 역학 개념 이해 (발생률, 유병률 등) 문 감시 체계 활용, 위험요인 식별, 예방 전략 효과 평가 해당 없음
예방 전략 및 절차 PHP-7-19 소독, OSHA 지침 준수, 참가 전 검사 항목 구성, 환경질환 예방 프로그램, 열지수(WBGT) 해석, 올바른 주요 외인 대응 전략 숙
Vol 1. Chap. 46 운동선수의 주기적 의학 평가
Vol 2. Chap. 9 운동과 연관된 급성심장사
Vol 2. Part C 환경요인
보호장비 및 예방 처치 PHP-20-23 보호 장비의 설계, 착용, 유지, 규정 숙지 / 테이핑, 스플리트, 보호대 등 적용
Vol 1. Chap. 17 스포츠 손상의 치료
체력 및 웰니스 관리 PHP-24-31 개인 건강관리(위생, 운동, 체중 등), 체력 측정 및 해석, 맞춤형 운동 프로그램 설계 및 지도
Vol 2. Part A 운동과 건강
Vol 1. Chap. 10 훈련 프로그램 방법과 처방
영양 PHP-32-41 영양의 역할 이해, 식이 분석, 수분 및 전해질 보충, 활동 전후 식사계획 수립
Vol 2. Chap. 6 건강을 위한 영양
Vol 2. Chap. 33 운동수행능력을 위한 영양
체중조절 및 체성분 평가 PHP-42-45 운동강도 변화에 따른 요구량 변화, 체성분 평가 및 해석
Vol 1. Chap. 12 손상 예방
Vol 1. Chap. 13 회복
섭식장애 PHP-46-47 섭식장애/이상섭식 징후 인식 및 적절한 관리 및 의료 연결
해당 없음
약물 및 보충제 PHP-48-49 보충제, 금지약물 정보와 부작용 이해, 금지약물 규정 판단 능력
Vol 2. Chap. 34 약물과 선수
기능해부학, 운동생리, 스포츠 심리, 수면, 매스미디어, 질병 및 부상 감시 체계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김기천

학력

한양대학교 의학과 학사

한양대학교 의학대학원 석사

한양대학교 의학대학원 박사

주요 경력

제주 유나이티드 FC 책임 주치의 : 2010-01-01 ~ 2012-03-31

2015 타오위안아시아태평양농아인경기대회 주치의 : 2015-10-03 ~ 2015-10-09

KSSM & JSCSM Travelling fellowship : 2018-10-29 ~ 2018-11-04

대한 스포츠의학회 : 국제위원회 간사 2017~2018

IOWA 주립대학 정형외과 연수 : 2022.1 ~ 2022. 12

2023년 투어 주치의 활동이력 : 2023-04-06 ~07 롯데렌터카 여자오픈

2024년 투어 주치의 활동이력 : 2024-10-25 서울 경제 레이디스 클래식

2025년 투어 주치의 활동이력 : 2025-08-16~17 메디힐 · 한국일보 챔피언십

현재 소속 및 직위

서울의료원 정형외과 과장 (2013~)

대표논문

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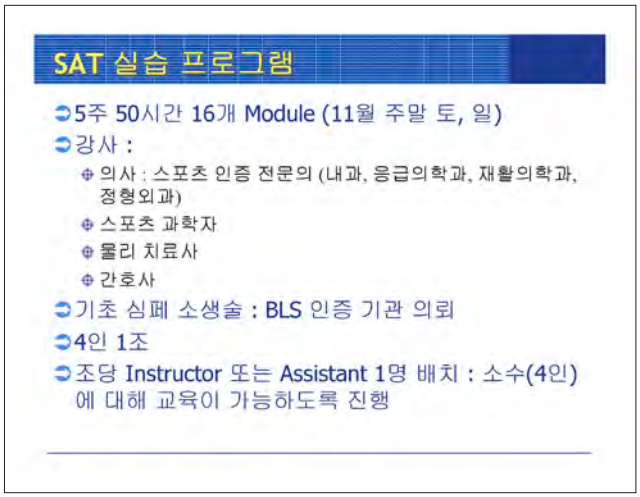
SAT 실습 프로그램의 특성과 차별점
Characteristics and Distinctive Features of the SAT Practice Programme

서울의료원
김기천



Injury Prevention and Management

Immediate care and acute injury management

- 2. 활력징후 평가
- 3. 심폐소생술 및 AED 사용, 기도 관리
- 4. 급성 상처 관리
- 5. 발열성 질환 평가 및 관리
- 6. 급성 척추 및 사지 손상 평가 및 관리
- 7. 두부 외상 평가 및 관리
- 8. 보조기, 부목 및 보조기구 적용
- 9. 환자 이송 방법

Sports taping and bracing techniques

- 1. 스포츠 테이핑

Rehabilitation and Performance Enhancement

10. 어깨 기능 향상 프로그램
11. 팔꿈치 기능 향상 프로그램
12. 고관절·허벅지 기능 향상 프로그램
13. 무릎 기능 향상 프로그램
14. 발·발목 기능 향상 프로그램
15. 코어 근육 기능 향상 프로그램

Medical Record

16. 부상 및 질병 감시 체계 - 의무기록 작성법

모듈	주제	주요 실습 및 활동	시간
1	스포츠 테이핑	발목, 손목, 엄지, 무릎 테이핑 예방 및 기능적 테이핑 실습	5
2	활력징후 평가	맥박, 혈압, 호흡수, 체온 측정, 디지털 기기 사용, 이상 소견 인지	2
3	심폐소생술 및 AED 사용, 기도 관리	성인/소아 심폐소생술	5
4	급성 상처 관리	출혈 조절, 상처 세척, 드레싱, 붕대, 감염 예방	4
5	발열성 질환 평가 및 관리	발열 및 증상 인지, 체온계 사용, 현장 관리 및 이송 기준	2
6	급성 척추 및 사지 손상 평가 및 관리	경추 평가, 로그롤, 척추 고정, 골절 인지, 부목 고정 실습	4
7	두부 외상 평가 및 관리	뇌진탕 평가(SCATS 등), 위험 신호 인지, 복귀 기준 응급 대처	3
8	보조기, 부목 및 보조기구 적용	발목/무릎/손목 보조기 착용, 목발, 지팡이, 삼각건 사용, 기구별 실습	3

모듈	주제	주요 실습 및 활동	시간
9	환자 이송 방법	안전한 들기/이동, 로그롤, 스쿱 스트레처, 의자 이송, 수기 이송, 상태별 이송법, 팀워크	3
10	어깨 기능 향상 프로그램	어깨 안정화 운동, 가동성·근력 강화, 티라밴드·소도구 실습	3
11	팔꿈치 기능 향상 프로그램	팔꿈치 스트레칭, 근력 강화, 테니스/골프 엘보 예방, 도수·저항운동 실습	2
12	고관절·허벅지 기능 향상 프로그램	고관절 가동성, 근력 강화, 허벅지 스트레칭, 밸런스 운동, 소도구 실습	3
13	무릎 기능 향상 프로그램	무릎 안정화, 근력 강화, 밸런스·점프 트레이닝, 실전 적용 실습	3
14	발·발목 기능 향상 프로그램	발목 가동성, 근력 강화, 프로프리오셉션, 밸런스 운동, 테이핑·소도구 실습	3
15	코어 근육 기능 향상 프로그램	코어 안정화, 근력 강화, 매트 운동, 플랭크, 브릿지 등, 소도구 실습	3
16	부상 및 질병 감시 체계 - 의무기록 작성법	부상 및 질병 감시 체계 이론 및 실습	2

실습 장소 : 명지 병원 재활센터

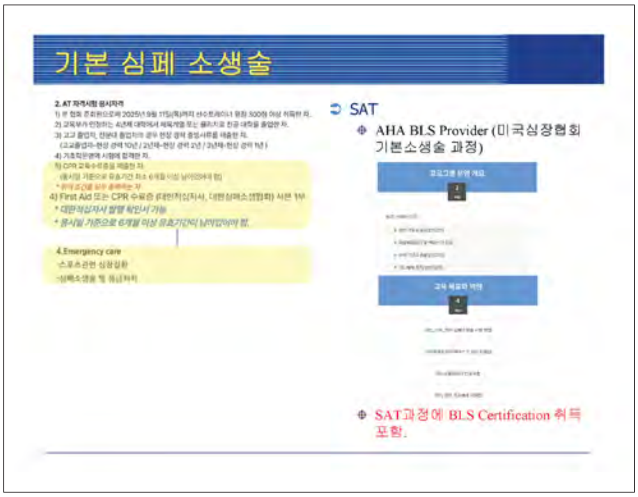
실제 진행

- 강사진의 시간, BLS 교육 의뢰등의 사정을 따라 module순서를 조정
- 실습 물품은 학회, 실습 기관의 지원으로 충분하고 충실한 교육이 되도록 지원
- 시험
  - Slide 시험

국내 SAT 유사 자격 연수 비교

	한국선수트레이너협회 (KATA)	대한선수트레이너협회 (R-KATA)	건강운동관리사 (문체부)	대한운동사협회 (KACEP)
자격증	선수트레이너	선수트레이너	건강운동관리사	운동사
교육시간	총 250시간 이상	250시간	200분	약 2개월
교육대상	체육/보건계열 전공자 선수/지도자 경력보유자	체육/보건계열 전공자 등	체육분야 전문학사이상	운동학분야 전문학사이상
커리큘럼	• 운동역학과 스포츠상해 • 스포츠마사지 • AT의 원론 • 스포츠카이로프랙틱 • 스포츠심리학 • 영양학 • 실습	• 선수 관리 : 수기요법, 테이핑, 스포츠물리치료, 선수상담, 회복 • Emergency Care : 스포츠관련 상장질환, CPR 및 응급처치	연수내용은 연수기관별 상이 (연세대학교, 부경대학교, 순천향대학교, 조선대학교)	Application Competence: 운동학의 현장적용능력 향상을 위한 처치방법 및 상황대처능력(행동요령) ECG, 운동처방, 재활
기타요구사항	ECC(Emergency Cardiac Care/ CPR 혹은 응급처치 등)관련 교육 이수증	First Aid 또는 CPR 수료증 (대한적십자사, 대한심폐소생협회) 사본. First Aid 또는 CPR 수료증 (대한적십자사, 대한심폐소생협회) 사본		CPR 및 응급처치 교육은 대한적십자사 응급처치 일반과정 교육이수증으로 대체


특정 운동 트레이너 협회 실습 교육
AT교육 내용
1.Sports medicine
2.Athletic training
4.Emergency care
5.Special considerations
Athletic training
• Shadowing
• PNF (Proprioceptive, Neuromuscular, Facilitation)
• Accessibility
• Ex-Athletes Trainer → Higher sympathy
Management of athletes
• Sports Message
• Instructor : Many experienced senior trainer


기본 심폐 소생술
2. AT 자격시험 응시자격
4.Emergency care
SAT
AHA BLS Provider (미국심장협회 기본소생술 과정)
SAT과정에 BLS Certification 취득 포함.


앞으로의 방향
<AT자격시험 실기시험 항목 및 평가기준안내>
실기 시험의 항목을 구체화하고, 실제 실기를 검증하는 것
강사, 교육생의 feedback을 통해 실제 현장에서 원하는 SAT를 양성하는 프로그램으로 발전 도모


Thank you !
감사합니다 !

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 11: 장애인 스포츠 의학: 분류, 손상 양상 및 실제적 치료

Para Sports Medicine: Classification, Injury Patterns, and Practical Management

좌장: 강동경희대병원 김동환, 한양대구리병원 한승훈

안영환

학력

남서울대학교 운동건강학과 졸업

경희대학교 체육대학원 스포츠의학과 석사

건국대학교 일반대학원 체육학과 박사

주요 경력

2024.8. 파리패럴림픽 현지 선수단 과학지원

2023.11. 항저우장애인아시안게인 현지 선수단 과학지원

2022.2. 베이징동계패럴림픽 현지 선수단 과학지원

2021. 8. 도쿄패럴림픽 현지 선수단 과학지원

2018.10. 인도네시아자카르타장애인아시안게임 현지 선수단 과학지원

2018.2. 평창동계패럴림픽 현지 선수단 과학지원

2016.9. 리우패럴림픽 현지 선수단 과학지원

현재 소속 및 직위

대한장애인체육회 이천선수촌 스포츠과학팀 연구사

대한민국 패럴림픽의 지속성장을 위한 스포츠 과학지원
Sports Science Support for the Sustainable Growth of the Republic of Korea's Paralympic Movement

대한 장애인 체육회
안영환

선수단을 지원하는 현장에서 과학적 접근은 선수단의 경기력을 향상시키는 중요한 요인으로 작용하며 스포츠 수행 능력을 높여 최상의 결과를 만들어 내는데 필요한 분야이다.

대한민국 하계패럴림픽 성적은 2000년 시드니패럴림픽 9위를 달성한 이유 지속적으로 하락하였으며, 이를 극복하기 위한 전략으로 생리학, 심리학, 역학, 의학, 공학 등 다양한 스포츠과학분야에서의 지원에 힘쓰고 있다.

대한장애인체육회는 2012년부터 대학 및 연구기관과의 협력을 통해 스포츠과학분야를 적극 도입하였고, 2023년 부터는 한국스포츠과학원 내 장애인밀착지원팀을 구성하여, 대한장애인체육회 스포츠과학팀, 의학팀 인원들과 협업을 통해 장애인국가대표 선수단을 지원하고 있다. 또한 이천선수촌 내 장비지원센터, 저산소트레이닝장, 체력측정실, 회복실, 의학실등을 확장 또는 신규 설치하여, 스포츠과학 영역을 지속적으로 확장해 나가고 있다.

본 발표에서는 실제 장애인체육회 스포츠과학팀 및 의학팀에서 진행하고있는, 스포츠과학 지원 현장 사례를 소개하였다. 국가대표 선수로서 이천선수촌에 입촌 시, 맞춤형 장비를 설계 지원하고, 메티컬체크를 통해 국가대표 선수로서 몸상태 및 부상부위를 확인하고 있으며 ,종목특성을 고려한 체력측정을 진행하고 있다. 또한 측정결과를 바탕으로 이천선수촌 전담 트레이너들이 체력훈련을 진행하고있다. 체력 훈련 후 고산소 챔버 및 크라이테라피 기법을 이용하여 선수단의 획복 또한 진행하고 있으며, 장비지원부터 회복지원까지 하나의 프로세스를 통해 국가대표선수단을 관리하고 있다.

본 발표에서는 이천선수촌의 스포츠과학지원 프로세스에 초첨을 맞추었으며, 장기적으로 장애인국가대표선수단의 경기력향상을 위해 다양한 영역의 전문가들이 모여 장애인스포츠과학 시스템의 발전에 보탬이 되기를 기원하다.

주요키워드 : 패럴림픽, 장애인국가대표, 장애인스포츠과학, 장애인스포츠의학

소윤수

학력

경희대학교 의과대학 졸업 2008년 2월

경희대학교 일반대학원 의학과 석사졸업 2016년 9월

경희대학교 일반대학원 의학과 박사졸업 2019년 2월

주요 경력

2017년~ 대한장애인체육회 이천 선수촌 촉탁의

2023년 항저우 아시안 패러게임 팀닥터

현재 소속 및 직위

경희의료원 재활의학과 조교수 2022년 9월~

장애인 운동선수에게 흔히 발생하는 스포츠 손상과 재활 전략
Common Sports Injuries in Para-athletes and Rehabilitation Strategies

경희대병원
소윤수

Anatomic Location of Injury
- Upper Limb

- Primary Injury Site: The upper limb accounted for **over half of all injuries (50.2%)** at the London 2012 Summer Games.
- **Most Common Injury**: **Shoulder injuries** were the most frequently reported, making up 17.7% of all injuries.
- Consistent Trend: This pattern of **upper limb and shoulder injuries** was also observed at the Rio 2016 Summer Games.

Shoulder Injuries in Wheelchair Athletes

- **most common site** of injury for athletes who compete in wheelchairs.
- **Range of Prevalence:**
  - **19%** across multiple wheelchair sports.
  - **Up to 72%** in female wheelchair **basketball athletes**.
- **Contributing Factors:** While the shoulder is the most common site of **pain**, some reports suggest that **underlying C- spine pathologies** can contribute to these symptoms.

Sport-Specific Injury Patterns

- **Beyond the Upper Limb**
- **Varying Injury Sites:** injury patterns can differ significantly by **specific sport** or **impairment group**.
- **Example: Standing Volleyball**
  - **Foot and ankle injuries** were the most common (21%).
  - This was followed by the shoulder (18%), wrist and hand (18%), and the knee (14%).
  - Injury distribution was **not linked to the type of impairment.**

Injury Patterns in **Visual Impairment**

- **Focus on Lower Limb Injuries**
- **Sport: Football** for athletes with visual impairment.
- **Primary Injury Site:** A 4-year study of Brazilian footballers with visual impairment found that the **lower limb** was the most common site of injury, accounting for **80% of all reported injuries.**
- **Other Injuries:** Head (8.6%), spine (5.7%), and upper limb (5.7%) injuries were less common.

Early Research & The London 2012 Study

- **First study (1992):** Reported an overall **injury rate (IR) of 9.3 injuries per 1000 participation hours.**
- **Limitations:** This study was based on self-reported symptoms and lacked sport-specific details.
- **London 2012: The First Comprehensive Study**
  - **Scale:** Captured data from 3565 athletes across 20 sports.
  - **Key Finding:** Documented an overall injury incidence rate of **12.7 injuries per 1000 athlete-days**.

High and Low-Risk Sports (London 2012)

- **Highest Injury Rates**
  - **Football 5-a-side:** 22.4 injuries/1000 athlete-days
  - **Goalball:** 19.5 injuries/1000 athlete-days
  - **Powerlifting:** 19.3 injuries/1000 athlete-days
- **Lowest Injury Rates**
  - **Sailing:** 4.1 injuries/1000 athlete-days
  - **Rowing:** 3.9 injuries/1000 athlete-days
  - **Shooting:** 2.2 injuries/1000 athlete-days

Acute vs. Chronic Injuries

- **Acute Injuries:** most common injury type at recent Winter and Summer Paralympic Games (Sochi 2014, Rio 2016, Pyeongchang 2018).
- **Sport Variation:** Differences exist between **contact sports (more acute) and endurance sports (more chronic).**
- **Data Collection:** Competition surveys tend to report **more acute injuries,** while longitudinal surveys report more chronic injuries.
- **Contrasting Trend:** The Vancouver 2010 Winter Paralympic Games were an exception, with the **majority of injuries (57.5%) being reported as chronic overuse injuries.**

Health problems in elite Para athletes – A prospective cohort study of 53,739 athlete days

- A prospective cohort study of elite Para athletes over a 124-week period
- 122 elite German Paralympic athletes (48% female, mean age 28 years).
- A total of 438 health problems were reported, split almost evenly between illnesses (51%) and injuries (49%).
- **Female Athletes:** Demonstrated a **two-fold greater risk** of sustaining a substantial health problem compared to male athletes.
- **Experience Level:** A lower risk of sustaining a substantial health problem was associated with having **more than 5 years of elite training experience**.

Summer Games Diagnoses

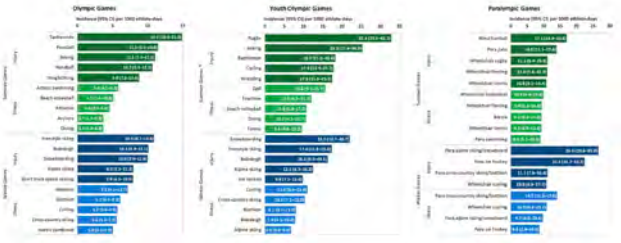
- **Common Injury Types**
- **Strains & Sprains:** A 2009 review of Summer Paralympic sports found that **strains (25%) and sprains (22.8%)** were the most common injury types.
- **Data Limitations:** Most studies used self-reported data, and there was significant variation in the reported percentages.
- **"Muscle Spasms":** In some longitudinal studies of **visually impaired athletes**, frequently reported, but their exact cause remains unclear.

Winter Games Diagnoses & Locations

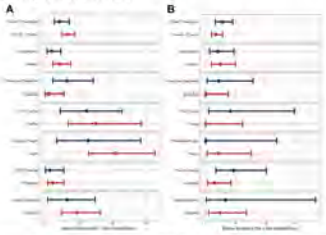
- **Common Diagnoses**
- **Most Common: Sprains (32%), fractures (21%), strains (14%),** and lacerations (14%) were most common at the 2002 Winter Games.
- **Sport-Specific:** Fractures, contusions, and concussions are more prevalent in high-speed, high-impact sports like **alpine skiing and ice sledge hockey.**
- **Upper vs. Lower Limb**
  - **Similar Rates:** The incidence of **upper and lower limb injuries was similar** at the 2014 and 2018 Winter Games.
  - **Speculation:** This similarity may be due to fewer sports **involving wheelchairs in the Winter Games.**

Injury and illness epidemiology in elite athletes during the Olympic, Youth Olympic and Paralympic Games: a systematic review and meta-analysis

- 13 Paralympic Games
- **Incidence Rate: 14.3 per 1,000 athlete-days (95% CI 9.9 to 20.7).**
- **Cumulative Incidence: 18.2 per 100 athletes (95% CI 13.6 to 24.4).**
- **Mean Injury Proportion: 15.9% of athletes.**
- **By Gender:** Incidence rates were similar between females (14.9) and males (13.9).
- **Most Affected Body Regions** (by incidence rate):
  - **Upper Limb:** 4.5
  - **Lower Limb:** 4.2
  - **Trunk:** 1.6



Comparative Analysis of Injury and Illness Rates Among Team USA Athletes at the Tokyo 2020 Summer Olympic and Paralympic Games



- Paralympic Athletes: The upper limb had the highest injury rate (IR, 5.4 per 1000 athlete-days).
- The most common specific locations were the shoulder and wrist/hand (both IR, 1.8)
- No differences in injury or illness rates were found, even in direct comparisons between **specific analogous sports.**

The Orthopaedic Journal of Sports Medicine, 13(1)

Figure 1. Incidence of (A) injury and (B) illness by analogous sports for Team USA athletes competing in the Tokyo 2020 Summer Olympic and Paralympic Games. Dots represent incidence rate values, and bars indicate 95% CIs.

1521

A Comparison Of Injuries And Illnesses Among Team USA Athletes At The 2024 Paris Games

Ashley N. Triplett[1], Eric G. Post[1], Travis Anderson[1], Olivia Sannoh[1], Alexis D. Gidley[1], Heather K. Vincent, FACSM[2], Amber T.

- **Higher Incidence in Paralympic Athletes**
- Paralympic athletes experienced significantly higher rates of both injury and illness compared to their Olympic counterparts.
- **Injury Incidence:** Approximately **40% higher** for Paralympic athletes compared to Olympic athletes (Incidence Ratio [IR], 1.4).
- **Illness Incidence:** Nearly **twice as high** for Paralympic athletes compared to Olympic athletes (IR, 1.9).

Medical Considerations for SCI -Autonomic Dysreflexia (AD)

- **Definition:** A medical emergency caused by **unregulated sympathetic nervous system** activity after a spinal cord injury at or **above the T6 level.**
- **Triggers: Noxious stimuli** below the level of injury (e.g., **full bladder or bowel, pressure sores**) can trigger a reflexive sympathetic response.
- **Symptoms: Headache, skin flushing, and sweating** above the level of injury.
- **Management:**
  - **Immediately remove** the athlete from competition.
  - Sit the person **upright and remove restrictive clothing.**
  - Find and remove the **source of the noxious stimulus**

Medical Considerations for Spinal Cord Injuries (SCI)-Entrapment & Hypotension

- **Upper Extremity Entrapment Neuropathies:** Wheelchair athletes are at increased risk.
  - **Carpal Tunnel Syndrome:** Most common, with a prevalence over 50%.
  - **Ulnar Nerve Entrapment:** Second most common, affecting **Guyon's canal** or the **cubital tunnel.**
  - **Prevention:** Use a relaxed grip, padded gloves, and proper technique.
- **Orthostatic Hypotension (OH):** Occurs in most SCI patients due to venous pooling.
  - **Symptoms:** Dizziness, light-headedness, and potential fainting.
  - **Prevention:** Use lower limb **compression stockings**, **abdominal binders**, and maintain hydration.

Medical Considerations for Spinal Cord Injuries (SCI)-Visceral Issues

- **Bladder Dysfunction:** A common condition that may require catheterization.
  - **Complications:** Increased risk of **urinary tract infections** and **kidney stones.**
  - **Signs:** Fatigue, fever, discomfort, or an **increase in muscle spasticity**. These can also be the first signs of Autonomic Dysreflexia.
- **Bowel Dysfunction:** Athletes must maintain their regular bowel programs to avoid incontinence.
  - **Management:** It is crucial to time the **bowel program to evacuate** before competition to prevent impacts on performance.
  - Clinicians should counsel athletes on the importance of **proper bowel and bladder management.**

Medical Considerations for Cerebral Palsy

- **Cerebral Palsy (CP):** both wheelchair and ambulatory sports.
- The condition **covers a broad spectrum**, and while some athletes may have **cognitive, speech, or sensory disturbances,** others may have fully intact cognition.
  - **Thermoregulation:** prevent **heat and cold-related injuries**, as **communication or cognitive disorders** can prevent them from **reporting symptoms** of intolerance.
- **Dermatologic:** Athletes with CP, particularly those in wheelchairs, are susceptible to skin issues like **pressure sores** and skin breakdown.
  - **Prevention:** Frequent position changes, padding vulnerable areas, and diligent monitoring are key. Athletes with a pressure ulcer should not return to sports until the wound is completely healed.

Medical Considerations for CP -Nervous System & Musculoskeletal

- **Nervous System:** Many athletes with CP have **epilepsy**.
- **Stress can induce seizures**, and anti-epileptic drugs can cause other issues like **vision problems and low bone density**.
- **Musculoskeletal:**
  - **Coordination:** Muscle imbalances lead to **poor coordination**, **spasticity**, and a higher risk of **overuse injuries**.
  - **Osteopenia:** Reduced bone density is common, requiring assessment before contact sports.
- **Cardiovascular:** reduced **cardiorespiratory endurance** and use more energy than their able-bodied counterparts.
- **Medications:** Many medications are banned by WADA and require a **Therapeutic Use Exemption (TUE)**.

Medical Considerations for Visually Impaired

- **Musculoskeletal:** These athletes are susceptible to **acute injuries** of the **lower extremities.**
- **Overuse Injuries:** They are also at risk for **chronic overuse injuries** due to altered biomechanics, poor proprioception, and loss of the visual component of balance.

Common Medical Issues & Injuries

- **Wheelchair Athletes:** Prone to **upper extremity injuries** (rotator cuff, carpal tunnel) from repetitive use. They are also at risk for **autonomic dysreflexia**, osteoporosis, and pressure sores.
- **Amputees:** May have injuries to the **residual limb** or the **intact limb** (e.g., plantar fasciitis).
- **Cerebral Palsy:** Susceptible to **knee, foot, and ankle injuries** due to spasticity and muscle imbalances.
- **Visually Impaired:** Prone to **lower extremity injuries** (ankle sprains, fractures) from poor balance and proprioception.

Rehabilitation & Care

Rehabilitation Team & Care

- **Rehab Team:** A variety of **medical professionals**, including **athletic trainers**, **physical therapists**, and **surgeons**.
- **Goals & Planning:** The rehabilitation plan should include achievable goals and a progressive exercise program to minimize risk.
- **Treatment Nuances: similar to those for able-bodied athletes**, nuances exist. For example, "rest" for a wheelchair athlete can impact their daily life.
- **Spasticity:** Spasticity treatment (stretching, medication, injections) should consider its functional benefits.
- **Residual Limb Care:** Amputees require education on prosthetic care, including wound care and minimizing edema.

Rehabilitation Team & Plan

- **Integrated Care Team:** They must be knowledgeable **in both musculoskeletal injuries and neurorehabilitation.**
- **The Classification Process:** A team of healthcare professionals performs both a **neuromuscular evaluation** (assessing muscle strength, range of motion, posture) and a **functional evaluation** (observing sport-specific activities) to classify athletes based on their abilities.
- **Goal-Setting:** A progressive, **athlete-centered rehabilitation** plan should be created with achievable goals, involving the athlete and **their family/caregivers.**
- It's crucial to minimize risks, as an injury can have significant consequences for a disabled athlete's daily life.

Treatment Strategies and Prevention

- **Overuse Injuries: PRICE!** similar to that for able-bodied athletes: anti-inflammatory medication, ice, and rest.
- **Rest:** For wheelchair athletes, complete rest can negatively impact their mobility, transfers, and independence. Treatment must be a balanced approach that considers **both recovery and functionality**.
- **Preventative Strategies:** Wheelchair users often develop **muscle imbalances**—**tight anterior muscles** (pectorals, biceps) and **weak posterior muscles** (rhomboids, latissimus dorsi).
- Programs should include **strengthening, stretching, and posture training**. Other modalities like ultrasound or corticosteroid injections may also be used.

Managing Spasticity and Amputation

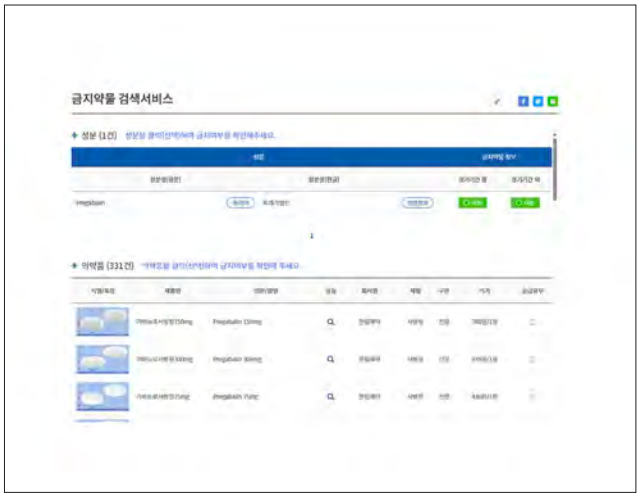
- **Spasticity: provide functional benefits** (e.g., assisting with transfers and ambulation). Treatment should consider these benefits.
- Initial approaches include **stretching, range of motion exercises, and splinting.**
- **Medications (e.g., baclofen) or botulinum toxin injections** may be used for more severe cases.
- **Amputee Care: Proper care of the residual limb** is essential.
- Athletes should be educated on **managing limb shape, wound care, minimizing swelling, preventing contractures, and controlling pain.**
- They should also be taught how to properly **use and care for their prosthesis** and encouraged to contact their prosthetist with any issues.

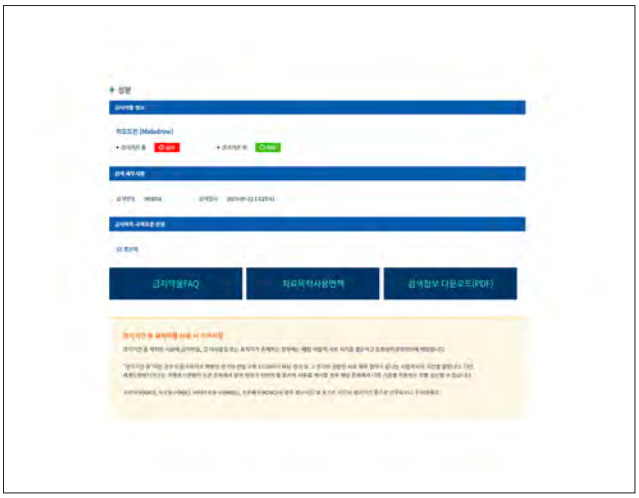
Treating Athletes with Pain

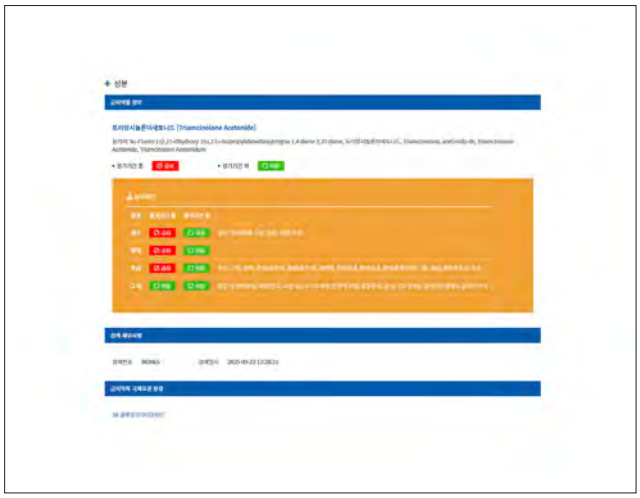
- **Common Pain Conditions:** Paralympic athletes often have pre-existing pain conditions, such as **shoulder pain** in wheelchair users, **neuropathic pain** from SCI, or **lower back pain.**
- **Medications:** Athletes may use various medications for pain management, including **NSAIDs, muscle relaxants, and anti-epileptics.**

Anti-Doping & TUEs

- **Regulation:** The **IPC** and **WADA** regulate anti-doping in Paralympic sports through testing, education, and sanctions.
- **Testing:** Doping control involves urine and/or blood samples, which can be collected anytime. Athletes are responsible for knowing which medications are permitted.
- **Therapeutic Use Exemptions (TUEs):** A TUE allows an athlete to use a prohibited substance for a legitimate medical condition. An independent panel reviews applications to ensure the athlete meets the criteria.







Conclusion and Holistic Approach

- **Tailored Treatment:** Rehabilitation and treatment goals can vary immensely **depending on the athlete's disability, specific injuries, sport, and equipment.**
- **Knowledgeable Team:** It is crucial for the medical team to have a **comprehensive understanding** of all aspects of the treatment approach to ensure athletes can safely return to their sports.
- **Interdisciplinary Collaboration:** The successful rehabilitation of a parathlete is a collaborative effort, with each **medical professionals**, including **athletic trainers, physical therapists,** and **surgeons** playing a vital role in helping the athlete achieve their goals.

Take home message

- Injury focus: Upper limb, 특히 어깨가 가장 흔하며 종목·손상 유형에 따라 하지는 종목별로 달라진다(사각징에 축구는 하지 80%).
- 급성 손상이 대화 조사에서 더 흔하지만, 장기 추적 시 과사용 손상도 많다—종목 특성(접촉 vs 지구력).
- SCI: 자율신경 과반사(AD), 방광·장 문제를 경기 전 체크.
- CP: 경련·피부관리·체온조절을 동시 관리하고, 기능적 이득을 주는 경직은 경과관찰.
- Rehab strategy: "완전 휴식"보다 기능 보존형 회복.
- Doping/TUE: 약물·주사 경로는 사전 확인, 필요 시 TUE 준비.
- Team approach: 근골격·신경재활에 숙련된 다학제 팀이 목표지향·단계적 제공.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 13: 도구를 활용한 척추 질환에 대한 전략적 접근법과 해결책

Strategic approaches and solutions for spinal disease using props

좌장: 부경대학교 김영훈, 동아대병원 이종화

이준민

학력

연세대학교 보건과학과(물리치료전공) 학사
고려대학교 융합과학대학원 스포츠의학과 석사
고려대학교 융합과학대학원 스포츠운동의학과 박사

주요 경력

대구스포츠과학센터 의무지원위원
대한컬링협회 경기력향상위원
대한장애인컬링협회 등급분류위원
대한요트협회 생활체육·청소년육성위원
대한중추신경계물리치료학회 척수손상재활 강사

현재 소속 및 직위

국립재활원 Gait lab, 주무관
고려대학교 융합과학대학원 스포츠의학과 외래교수
한국복지사이버대학교 운동재활치료학과 외래교수

대표논문

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2. Lee, J. M., Kim, E. J., & An, S. H. (2025). Functional Performance Tests to Predict Limited Community Ambulation in Stroke Survivors with Supervised Indoor Walking: Discriminative and Predictive Validity. NeuroRehabilitation, 10538135251366659.
3. An, S. H., Kim, E. J., Yang, S. P., Choi, S. J., & Lee, J. M. (2025). Comparative reliability, concurrent and convergent validity, and predictive value of the 6-min walk test over 15 and 30 m in patients with subacute stroke. International Journal of Rehabilitation Research, 48(3), 187-193.

척수 손상 후 기능 회복을 위한 도구 활용 운동 전략
Exercise Strategies Incorporating Props for Functional Recovery Following Spinal Cord Injury

국립재활원
이준민

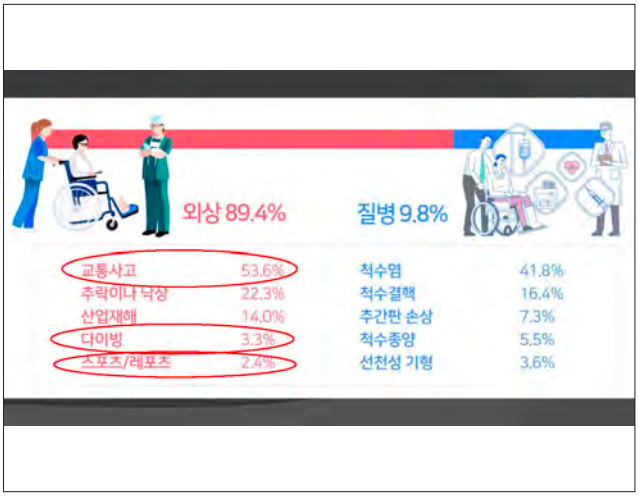
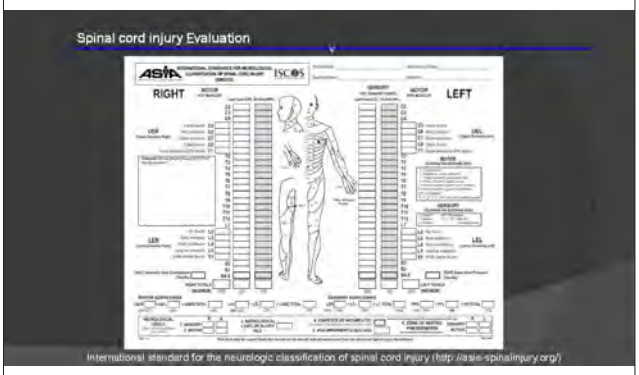


Fig. 1 Plate X and XI of the Edwin Smith papyrus including the five cervical spinal injury cases in hieratic script [7]


상황을 바꾸는 것이 불가능할 때
우리는 스스로를 변화시켜야 한다.
_빅터 프랭클


Exercise Strategies for Functional Recovery Following Spinal Cord Injury
- 단순한 근육 강화가 아니라 움직임을 복원하고 삶의 질을 되돌리는 과정
- 신경계와 근골격계가 통합된 전신 움직임 체계를 변화
TORONTO
22


Spinal cord injury Evaluation
RIGHT
LEFT
International standard for the neurologic classification of spinal cord injury (http://asia-spinalinjury.org/)


Spinal cord injury Evaluation
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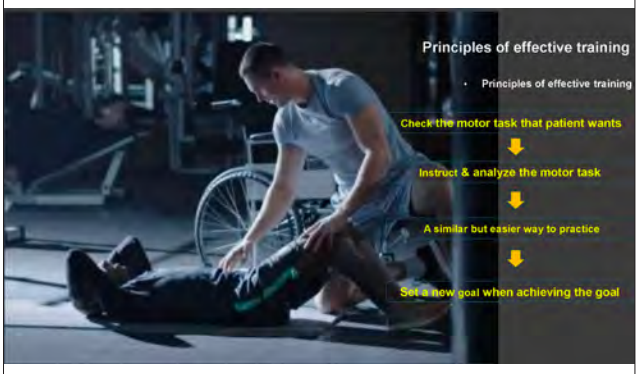
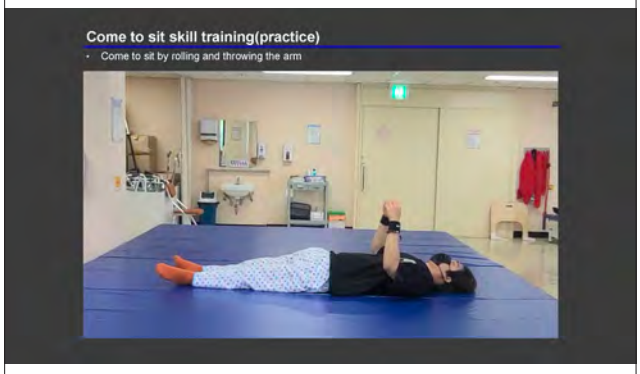
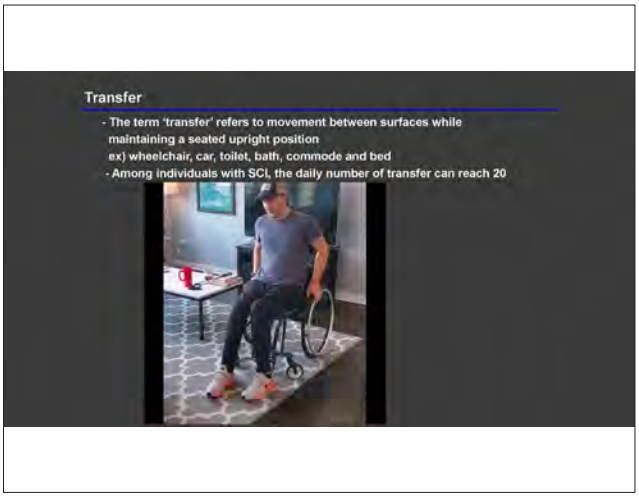
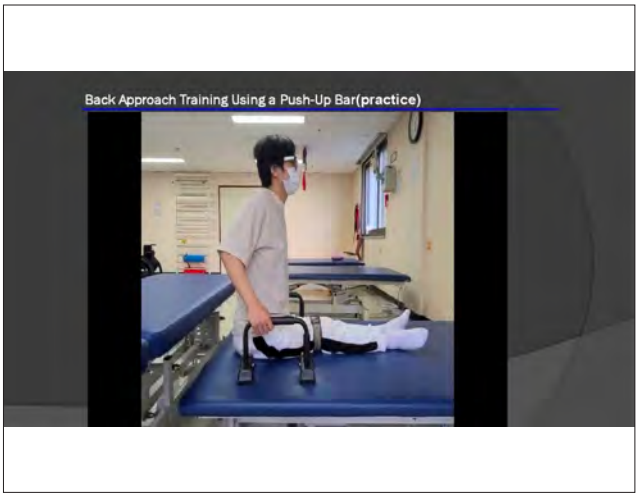
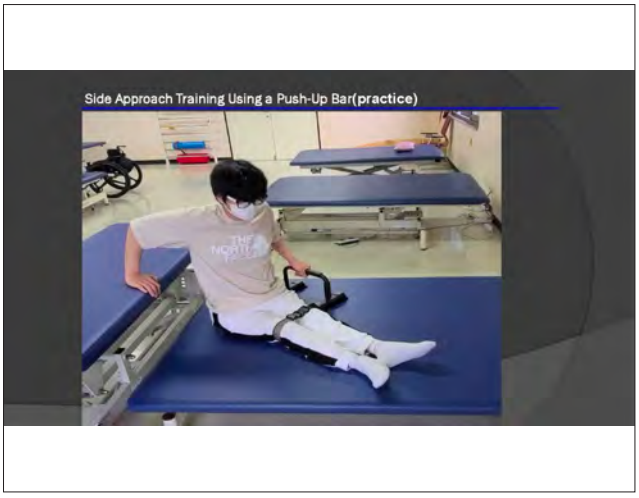
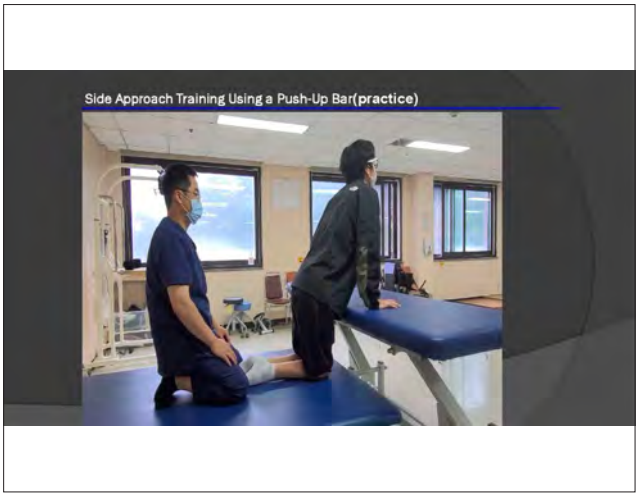

Principles of effective training
Principles of effective training
Check the motor task that patient wants
Instruct & analyze the motor task
A similar but easier way to practice
Set a new goal when achieving the goal

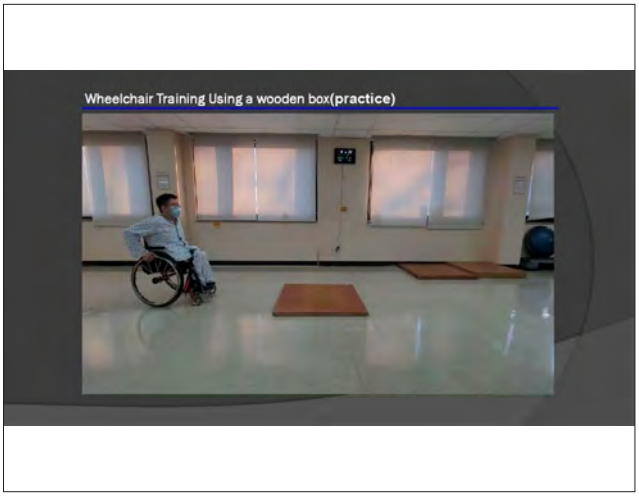

Come to sit skill training(practice)
Come to sit by rolling and throwing the arm


Transfer
- The term 'transfer' refers to movement between surfaces while maintaining a seated upright position
ex) wheelchair, car, toilet, bath, commode and bed
- Among individuals with SCI, the daily number of transfer can reach 20


Back Approach Training Using a Push-Up Bar(practice)


Side Approach Training Using a Push-Up Bar(practice)


Side Approach Training Using a Push-Up Bar(practice)


Wheelchair Training Using a wooden box(practice)


Gait Training Using a Balance-pad / Step-box(practice)
Mid Stance(R) / Initial swing, mid swing(L)
Initial swing (R) / Mid Stance(L)


Transfer W/C->Exo


골키퍼 장갑 벗고 소총 든 유연수 '맛진 사격 선수 되겠습니다' [IS 스타]
OMEGA
CHO Eun Hyo
LOWTHIAN T.
KOR
CAN

허진희

학력

경북전문대학교 물리치료학과 전문학사

고려대학교 융합과학대학원 스포츠의학과 석사

주요 경력

물리치료사 4년

필라테스강사 10년차

필라테스교육강사

필라테스지점운영

현재 소속 및 직위

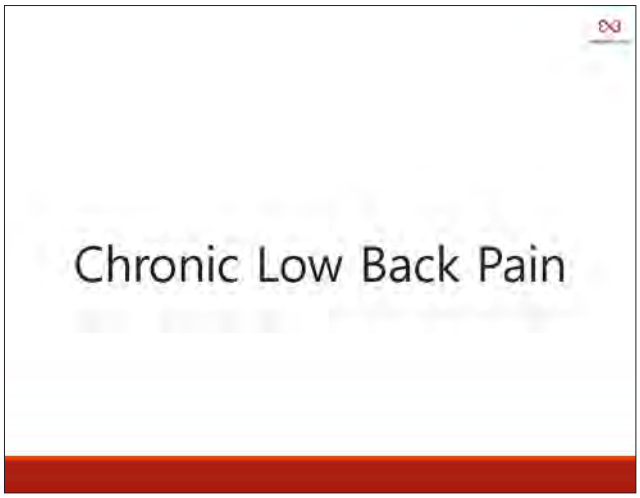
리본필라테스 전무이사 & 교육강사

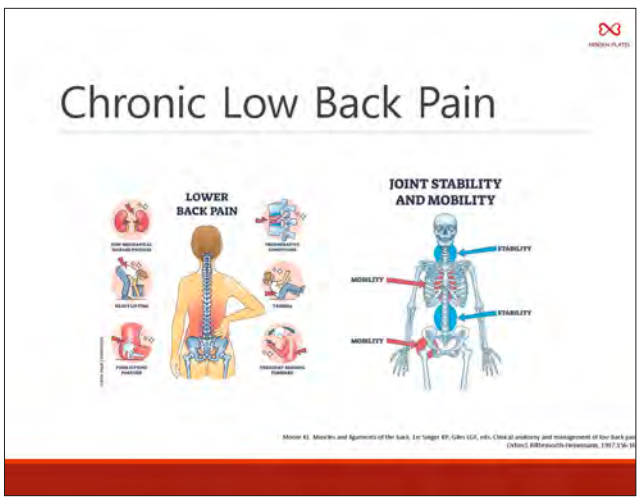
대표논문

아쿠아백 도구 운동이 만성 요통을 가진 중년 여성의 통증, 기능장애, 균형 능력, 심리사회적 요인에 미치는 영향 (The Effects of Aquabag-Based Dynamic Stabilization Exercise on Pain, Disability, Balance, and Psychosocial Factors in Middle-Aged Women with Chronic Low Back Pain)

비특이적 만성요통에 대한 소도구 적용을 위한 전략
Strategies for the application of Propsin non-specific chronic low back pain

리본필라테스
허진희





Pops

논문 제목 (year, Title)	대상 / N	중재 (Intervention)	주요 결과 (Result)
Comparison of the Effects of Joint Mobilization, Gym Ball Exercises, and Breathing Exercises on Fabrich Relaxation Phenomenon and Pain in Patients With Chronic Low Back Pain	36명	관절가동술 vs 짐볼운동 vs 호흡운동 (12주)	3그룹 모두 FRR·MVAS 개선, 짐볼 그룹이 통증 감소 효과 가장 큼
The Effects of Lumbar Stabilization Exercises on a Swiss Ball in Patients with Mechanical Low Back Pain	40명 (여30, 남10) 20-60세	스위스볼 vs 바닥 요추 안정화 운동 (4주, 주3회 총 6회)	스위스볼 그룹에서 NPS·MQ 모두 유의한 개선 ($p<.05$)
Changes in Transversus Abdominis Muscle Thickness, Low Back Pain, and Standing Balance after Foam Roller Exercise in Female Adults: A Randomized Controlled Trial	24명 여성	폼롤러 운동 vs 매트 운동	복횡근 두께↑, 근활성력↑, 요통↓ — 요통에만 및 균형 향상 효과
Resistance Training in Addition to Multidisciplinary Rehabilitation for Patients with Chronic Pain in the Low Back: Study Protocol	100명	탄성밴드 저항운동 + 일반 재활 운동 (12주프로그램 이후 9주 가정기반 지속)	저항운동 추가 시 기능장애(ODI) 개선(감소) 및 근력 향상 삶의 질 향상
Small Ball Exercise Program for Patients With Chronic Nonspecific Low Back Pain: A Randomized Clinical Trial	30명 (남16, 여14)	스몰볼 운동 vs 일리엄스 운동 (10회 중재 후 2주 추적)	두 그룹 모두 개선, 스몰볼 그룹의 통증·ODI 개선 추적 2주 후에도 효과 지속
The Effects of an Exercise with a Shift on the Lumbar Spine and Hip Movements Patterns During Forward Bending in Patients with Lumbar Flexion Syndrome	18명	스틱을 이용한 전굴 운동 vs 무도구 전굴	요추 굴곡↓, 고관절 굴곡↑ 움직임 패턴 개선 — 요추 부담 감소, 운동조절 효과
Effectiveness of BOSU Ball Exercises on Pain and Disability in Subjects with Chronic Low Back Pain at the End of Four Weeks	45명 (18-35세)	BOSU볼을 이용한 6가지 크어, 근력 운동 (주 1회 4주간 총 12회)	통증(VAS), 기능장애(ODI) 모두 유의하게 감소 ($p<.05$)

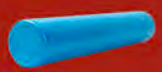
PROPS

고유수용감각(Proprioception), 협응력(Coordination)
근력 및 근지구력(Strength & Endurance), 척추 안정성(Spinal Stability)
균형능력(Balance), 유연성(Flexibility), 자세 교정(Posture Alignment)
심리적 효과(Psychological Benefits)

- 간편성 (Simplicity) , 접근성 (Accessibility) , 적용성(Applicability), 실용성 (Practicality)

Form roller	1980년대	근막이완, 유연성 증가, 고유수용감각 자극, 코어 강화
MAGIC CIRCLE (Pilates ring)	20세기 중반	근력 강화(내전/외전 근육, 정지 및 저항), 균형 조절, 스트레스 및 안정성 증진 보조
Swiss ball	1900년대	근력 및 관절 강화운동, 균형 훈련, 척추의 유연성 안정성 향상
Band	1850년대	재활 운동 용이, 근력 강화, 근지구력 증진, 보조 저항 운동, 관절 안정화, 운동 범위 증진
bosu	1999년대	균형 훈련, 안정성 훈련, 코어 강화, 기능적 운동 보조 등

Strategies for the application of props in non – specific chronic low back pain



FORMROLLER

Self-Myofascial Release Using a Foam Roller

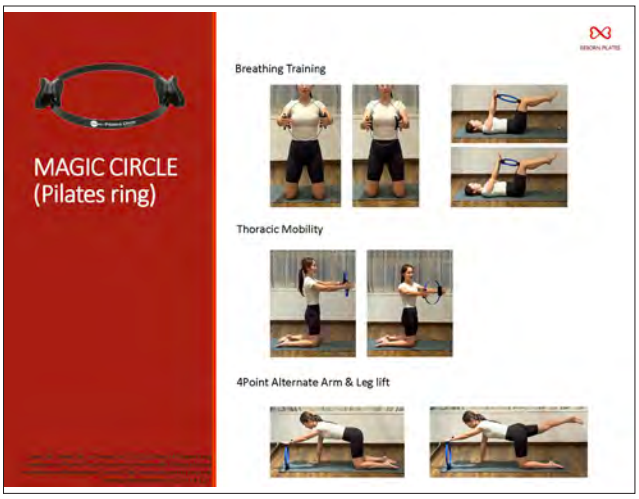
Foam Roller Training

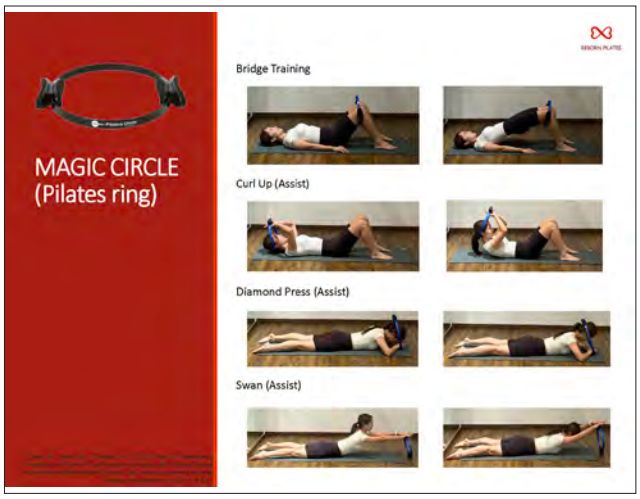
TONING BALL

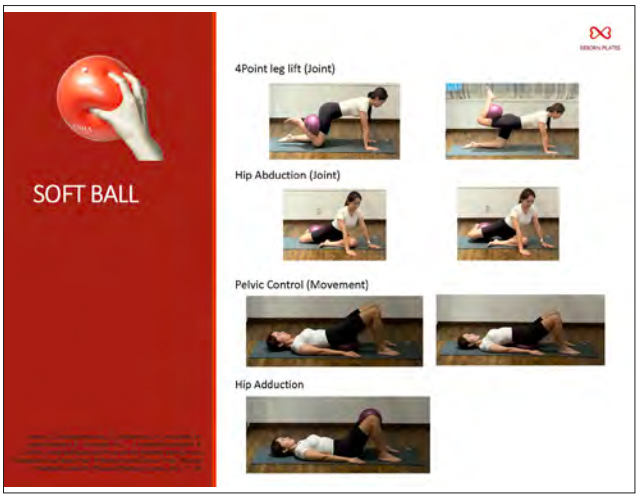
Pelvic Control

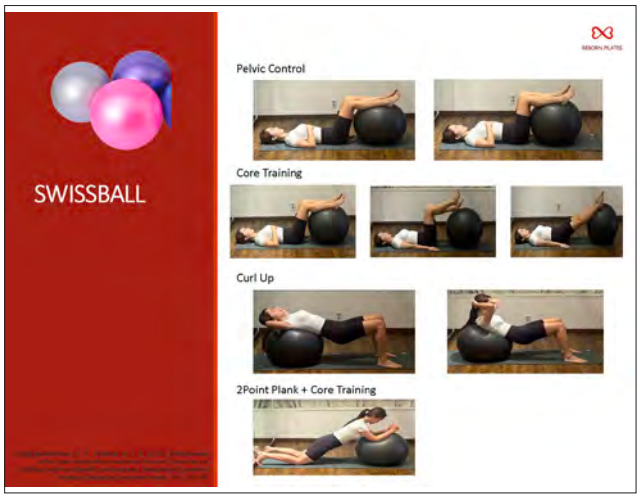
4Point Plank

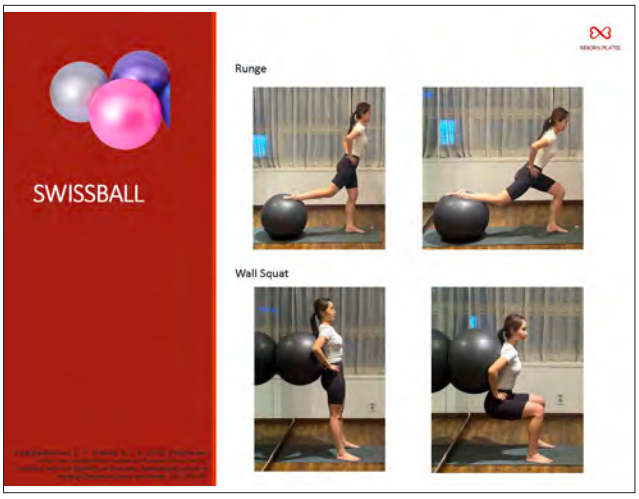
4Point Alternate arm & leg lift

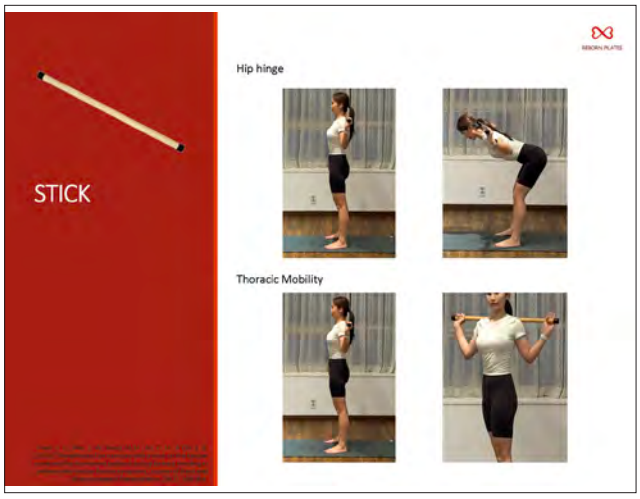

MAGIC CIRCLE
(Pilates ring)
Breathing Training
Thoracic Mobility
4Point Alternate Arm & Leg lift

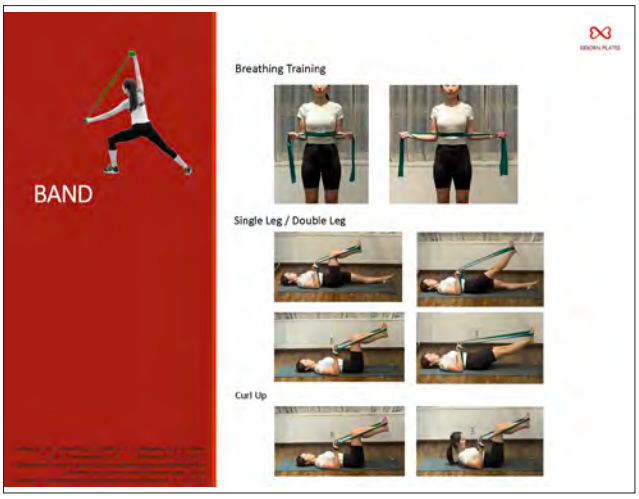

MAGIC CIRCLE
(Pilates ring)
Bridge Training
Curl Up (Assist)
Diamond Press (Assist)
Swan (Assist)

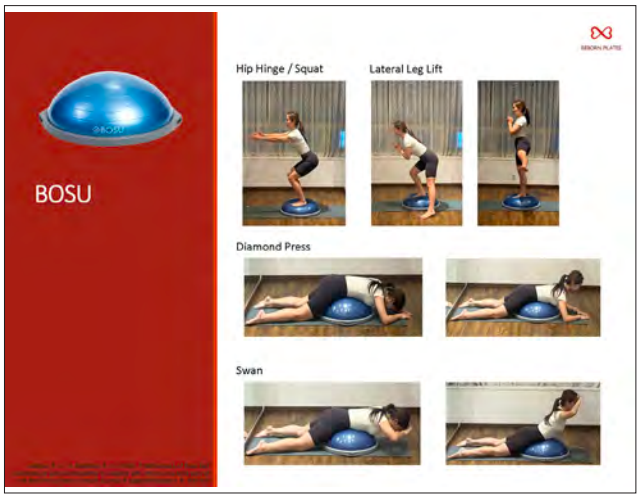

SOFT BALL
4Point leg lift (Joint)
Hip Abduction (Joint)
Pelvic Control (Movement)
Hip Adduction

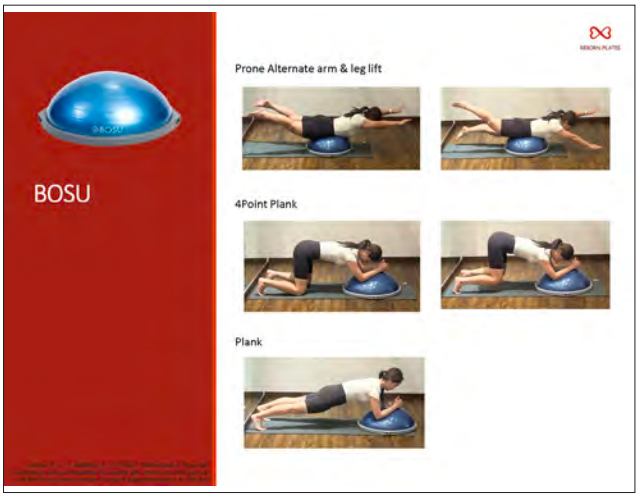

SWISSBALL
Pelvic Control
Core Training
Curl Up
2Point Plank + Core Training


SWISSBALL
Runge
Wall Squat


STICK
Hip hinge
Thoracic Mobility


BAND
Breathing Training
Single Leg / Double Leg
Curl Up


BOSU
Hip Hinge / Squat
Lateral Leg Lift
Diamond Press
Swan


BOSU
Prone Alternate arm & leg lift
4Point Plank
Plank


Thank you for your attention

서용곤

학력

삼육대학교 생활체육학과 학사

고려대학교 의용과학대학원 스포츠의학과 석사

고려대학교 일반대학원 사회체육학과 박사

주요 경력

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현) 문화체육진흥원 자문위원

현) 대한자세의과학협회 학술이사

현재 소속 및 직위

삼성서울병원 척추센터 건강운동관리사

대표논문

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3. Seo YG, Oh S, Kim HY, Jang M, Jeon MH, Sung J. Effects of Change in 6-Minute Walking Distance on Hospital Clinical Events in Patients with Pulmonary Arterial Hypertension: A Retrospective Cohort Study. Korean J Sports Med 2025; 43:145-152.

척추 질환에 대해 소도구를 이용한 단계적 접근
Astep-by-step approach to spinal disease using props

삼성서울병원
서용곤

척추 질환은 크게 구조적 문제와 기능적 문제로 구분할 수 있다. 구조적 문제는 디스크 탈출, 척추관 협착증, 척추 전방전위증, 후관절 증후군, 인대 골화증 등 해부학적 손상에 기인하며, 기능적 문제는 장시간의 잘못된 자세로 인한 근육 불균형이 주요 원인으로 작용한다. 이러한 근육 불균형은 고유수용성 감각 기능의 저하 및 움직임의 제한을 초래하며, 결과적으로 신체 기능의 전반적인 감소로 이어진다. 이에 따라 척추 질환의 기능적 향상을 위해서는 지속적이고 체계적인 중재(intervention)가 필수적이다.

척추 질환의 치료는 보존적 치료와 수술적 치료로 나뉘며, 보존적 치료에는 생활습관 개선, 운동 요법(exercise therapy), 약물 치료, 시술 등이 포함된다. 이 중 운동 요법은 가장 널리 활용되는 중재 방법으로, 특히 디스크 질환과 척추관 협착증 환자에게 효과적이며 운동 형태는 Pilates, Yoga, Tai Chi, 기구를 활용한 연부조직 가동술, lumbar stabilization exercise, motor control training 등 다양하게 적용되고 있으며 이러한 중재는 통증 완화 및 기능적 향상에 긍정적인 영향을 미친다고 보고되었다.

운동 중재의 핵심 원칙은 기능적 회복을 위한 단계적 접근이다. 만성 요통은 척추 질환 환자들이 가장 흔히 호소하는 증상으로, 기능 저하와 삶의 질 감소를 동반한다. 따라서 운동 중재의 초기 단계에서는 통증 완화가 우선적으로 고려되어야 하며, 이후 고유수용성 감각 기능 저하로 인한 허리의 불안정성을 해결하기 위한 요추 안정화 운동이 필요하다. 안정화가 이루어진 후에는 기본적인 움직임에 대한 기능 회복을 도모하고, 마지막 단계에서는 일상생활 및 스포츠 활동에서 요구되는 복잡한 동작 수행 능력을 향상시키는 운동이 포함되어야 한다.

근골격계 환자에게 적용되는 운동 중재에서는 Swiss ball, elastic band, stick, BOSU ball등 다양한 소도구가 활용된다. 이러한 소도구는 척추 안정화 근육의 활성도를 높이고, 제한된 가동 범위 내에서도 다양한 움직임을 유도할 수 있어 효율적인 운동 수행을 가능하게 한다. 특히 감각 자극의 향상과 접근성 측면에서 소도구는 기존 운동 방식보다 더 효과적인 대안이 될 수 있다.

단계적 운동 접근에 따라 소도구를 적절히 활용하는 것은 척추의 움직임 개선에 있어 매우 효과적인 전략이며, 휴대가 용이한 특성으로 인해 가정에서도 쉽게 적용할 수 있어 임상적 활용도가 높다. 따라서 소도구는 단순한 보조기구를 넘어 척추 기능 개선을 위한 핵심 도구로 인식되어야 하며, 이러한 관점에서 소도구 기반의 단계적 운동 접근법은 척추 질환 환자에게 매우 유용한 임상적 중재 방법으로 권장될 수 있다.

본 강의에서는 척추 질환 환자를 위한 단계적 운동 접근법에 따른 소도구 활용의 임상적 유용성과 그 의미를 고찰하고자 한다.

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The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 16 : 도핑 방지 문제에 관한 최신 업데이트

Current update of anti-doping issues

좌장: 일산백병원 양윤준, SRC재활병원 김은국

이승림

학력

서울대학교 의학과 학사

서울대학교 의과대학원 의학과 석사

서울대학교 의과대학원 의학과 박사

주요 경력

현 대한스포츠의학회 부회장

현 KADA TUE 위원장

전 국립경찰병원장

2024 파리올림픽 CMO(chief medical officer)

K리그, KHA, KLPGA, KBL 의무위원

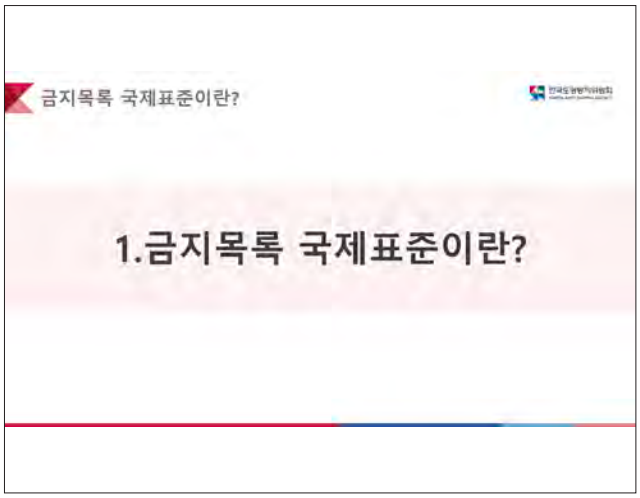
2003 타르비시오, 2007 토리노. 2009 하얼빈 동계유니버시아드 주치의

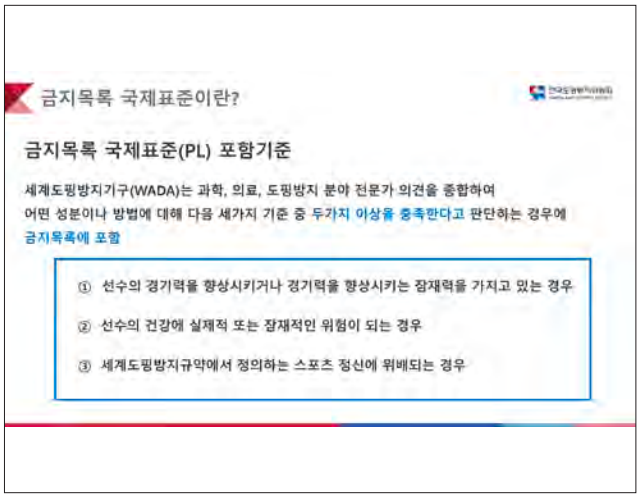
현재 소속 및 직위

대한체육회 평창동계훈련센터 국가대표 주치의사

개정된 금지목록
Revised Prohibited List

KADA TUE 위원장
이승림





금지목록 국제표준이란?

금지목록 구성요소

상시금지 — S0~S5
- S0. 비승인약물
- S1. 동화작용제
- S2. 펩티드호르몬, 성장인자, 관련 약물 및 유사제
- S3. 베타-2 작용제
- S4. 호르몬 및 대사변조제
- S5. 이뇨제 및 은폐제

M1~M3
- M1. 혈액 및 혈액성분의 조작
- M2. 화학적 물리적 조작
- M3. 유전자 및 세포도핑

경기기간 중 금지 — S6~S9
- S6. 흥분제
- S7. 마약
- S8. 카나비노이드
- S9. 글루코코르티코이드

특정종목 금지 — P1
- P1. 베타차단제

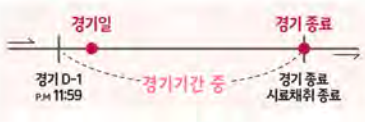
모니터링 약물

금지목록 국제표준이란?

경기기간 중이란?(전문체육, 프로스포츠)

- 전문체육 선수

선수가 참가하기로 예정된 경기의 전일 오후 11:59부터 해당 경기 및 그 경기와 관련된 시료채취 절차가 끝나는 시점까지의 기간



금지목록 국제표준이란?

경기기간 중이란?(전문체육, 프로스포츠)

- 프로스포츠 선수

종목별 프로스포츠 단체가 주최·주관하는 공식경기의 리그, 단일경기 또는 대회의 시작일 전날 오후 11:59부터 마지막 경기종료일까지

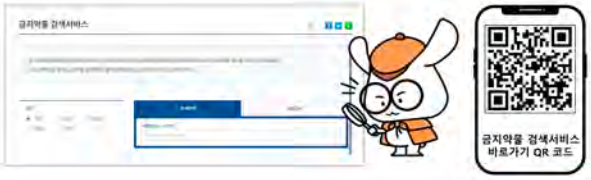
경기기간 외 | 경기기간 중 (KBO 시범경기, 정규시즌, 포스트시즌, 올스타리그 전 기간) | 경기기간 외

★ 프로스포츠의 경우, '경기기간 중' 기간에 '경기기간 외'로 보는 예외조항이 있음!

금지약물 검색서비스

WORLD ANTI-DOPING AGENCY play true + 약학정보원

- 국내의약품에 한해 검색서비스 제공
- 건강기능식품, 보충제, 한약재 **확인 불가**
- 국외의약품은 Global DRO에서 확인 가능



금지목록이란?

2. 2026년도 금지목록 국제표준 주요 변경사항

금지목록이란?

① Salmeterol 흡입 시 허용 기준 변경

2026 금지목록 국제표준 주요 변경사항

① Salmeterol 흡입 시 예외적 허용 기준 변경

살메테롤 [salmeterol]

- 경기기간 중 ⊘ 금지
- 경기기간 외 ⊘ 금지
- 예외: 24시간 동안 최대 200mcg은 허용(2025ver.)

⚠ 예외!

S3의 Salbutamol, Formoterol, Salmeterol, Vilanterol을

흡입으로 사용하는 경우 → 예외적 용량 허용

(단, 이뇨제 및 은폐제와 함께 사용되는 경우, 예외사항과 관계없이 치료목적사용면책 필요)

2026 금지목록 국제표준 주요 변경사항

① Salmeterol 흡입 시 예외적 허용 기준 변경

★ 2026 ver.

: 200mcg/24h → 100mcg/8h 초과하지 않는 200mcg/24h

- 치료 효과를 넘어선 잠재적 운동 능력 향상 효과를 막기 위해 수정
- 최대 투여량(24시간동안 200mcg)은 변경되지 않음

금지목록이란?

② M1.4. 일산화탄소(CO)의 비진단적 사용 금지

2026 금지목록 국제표준 주요 변경사항

② M1.4. 일산화탄소(CO)의 비진단적 사용 금지

- 불법적 사용, 자연적 연소과정(흡연), 환경(배기 가스), 진단 절차로 인한 흡입을 구분하기 위해 추가
- 헤모글로빈양 측정이나 폐확산능 측정과 같은 진단 목적의 일산화탄소의 사용은 금지되지 않음

금지목록이란?

③ M1. 채혈 예외규정 명확화

2026 금지목록 국제표준 주요 변경사항

③ M1. 채혈 예외규정 명확화

M1.1. 모든 분량의 자가혈액, 동종혈액, 또는 이종혈액 및 모든 출처의 적혈구 제제를 순환계에 투여 또는 재주입하는 방법은 금지방법에 해당

★ 2026 ver.

혈액 및 혈액성분의 채취는 다음을 제외하고 금지에 해당

1) 의료 및 도핑관리의 분석 목적
2) 국가의 관련 규제기관이 인증한 혈액관리기관에서 기증 목적으로 사용되는 경우

2025 ver.

성분채집술(apheresis)를 포함한 혈액 또는 혈액 성분의 기증은 해당 국가의 관련 규제 기관이 인증한 혈액관리기관에서 시행될 경우 금지되지 않음

금지목록이란?

④ 예시 및 내용 추가

2026 금지목록 국제표준 주요 변경사항

④ 기타 예시 및 내용 추가

EXAMPLE

S1. 동화작용제
- 금지된 스테로이드의 에스터(esters) 형태 금지가 명확화

S2. 펩티드호르몬, 성장인자, 관련 약물 및 유사제
- Pegmolesatide가 EPO 유사물질의 예시로 추가

S4. 호르몬 및 대사변조제
- α-naphthoflavone 또는 7,8-benzoflavone으로 알려진 2-Phenylbenzo[h]chromen-4-one이 aromatase inhibitor의 예시로 추가
- BAM15로 알려진 5-N,6-N-bis(2-fluorophenyl)-[1,2,5]oxadiazolo[3,4-b]pyrazine-5,6-diamine이 AMP-activated protein kinase(AMPK)의 예시로 추가

2026 금지목록 국제표준 주요 변경사항

④ 기타 예시 및 내용 추가

EXAMPLE

S6. 흥분제
- 2-[Bis(4-fluorophenyl)methylsulfinyl]acetamide (flmodafinil)과 2-[bis(4-fluorophenyl) methylsulfinyl]-N-hydroxyacetamide (fladrafinil) 이 S6.A 비특정 흥분제에 추가됨
  * 이 승인되지 않은 물질들은 Modafinil과 Adrafinil의 강력한 유사체이며, 보충제로 판매되고 있음

S9. 글루코코르티코이드
- 지속 방출형 제형(sustained-release)의 글루코코르티코이드의 사용은 장기간 흡수로 인해 배출기간 이후에도 검출될 수 있음

2026 금지목록 국제표준 주요 변경사항

④ 기타 예시 및 내용 추가

EXAMPLE

M3. 유전자 및 세포 도핑
- 유전자 변형 세포 뿐 아니라 세포 구성 요소(핵, 미토콘드리아, 리보솜 등)의 사용 또한 금지

모니터링 프로그램
- Semaglutide의 소변 모니터링에는 Tirzepatide 모니터링도 포함

감사합니다.

오범조

Education

Ph.D. Candidate in Medicine (Occupational and Environmental Medicine), Seoul National University, Graduate School of Medicine, Korea (Dissertation in progress, degree expected Feb 2026)

Master of Public Health (Genetic Epidemiology), Seoul National University, Graduate School of Public Health, Korea (2011)

Bachelor of Science in Medicine, Seoul National University, College of Medicine, Korea (2007)

Bachelor of Science in Microbiology, Seoul National University, Korea (2003)

Licenses & Certifications

- Board Certified, Family Medicine, Korea (2010-present)
- Specialist Certification, Obesity Management (Korean Society for the Study of Obesity)
- Certified in Smoking Cessation Treatment (Korean Academy of Family Medicine)
- Advanced Certificate, Sports Medicine (Korean Society of Sports Medicine)

1. Han S, Oh B, et al. Accelerometer-Based Physical Activity and Health-Related Quality of Life in Korean Adults: Observational Study Using KNHANES. JMIR Public Health Surveill. 2024.
2. Oh B, et al. Physical Activity Patterns and Associated Factors Measured by Global Physical Activity Questionnaire Survey among Korean Adults. 2020.
3. Lee CH, Yi GH, Oh BJ, et al. Mobile health, physical activity, and obesity. Medicine (Baltimore). 2018;97(37):e12345.
4. Oh J, Lim J, Lee SH, Oh B, et al. Results from South Korea's 2018 Report Card on Physical Activity for Children and Youth. J Phys Act Health. 2018;15(Suppl 2):S409-S410.
5. Oh B, et al. Lack of health checkups hinders the diagnosis of chronic diseases during COVID-19. BMC Public Health. 2024.
6. Oh B, et al. Clinical Evaluation and Management of Non-Responders to Anti-Obesity Medications: Pathophysiological Insights and Clinical Strategies. AOM. 2025.

TUE 현황 및 사례
TUE Status and Case Studies

서울보라매병원
오범조

치료목적사용면책(Therapeutic Use Exemption, TUE)은 선수의 치료적 필요와 공정한 경기의 원칙을 조화시키기 위한 제도로, 도핑 방지 체계에서 핵심적인 역할을 한다. 본 강의에서는 국내외 TUE 제도의 현황과 최근 변경 사항을 살펴보고, 실제 사례를 통해 신청 및 승인 과정에서 발생하는 주요 쟁점들을 논의한다. 특히 질환의 진단 기준, 대체 치료 가능성 평가, 심사 절차의 투명성 확보 등과 관련한 실무적 쟁점을 중심으로 다룰 예정이다. 이를 통해 스포츠 현장에서의 의학적 판단과 도핑 규정의 균형점을 탐색하고, 팀닥터 및 현장 의료진이 숙지해야 할 실질적 가이드라인을 제시하고자 한다.

The 67th Autumn Conference of Korean Society of Sports Medicine
사단법인 대한스포츠의학회
제67차 추계학술대회

심포지엄 17: 연속혈당측정기를 활용한 맞춤형 신체활동 전략

Personalised physical activity strategy utilising continuous glucose monitoring

좌장: 구로성심병원 김병성, 한양대병원 박훈기

한민규

Professional Experience

2022 – (현재) 카카오헬스케어, 상무이사

2021 – 2022 지아후이 국제병원 가정의학과 (중국 상하이시)

2016 - 2021 SK 국제의료센터, 원장 (중국 우시시)

2015 – 서울대병원 운영 세종시립의원 부원장

2014 - 2015 서울대병원 가정의학과 조교수

2012 - 2014 서울대병원 가정의학과 전임의

Education

2005 서울대학교 의과대학 졸업

2014 서울대학교 보건학 석사

스포츠의학에서 연속혈당측정기(CGM)의 활용
The Role of Continuous Glucose Monitoring (CGM) in Sports Medicine

카카오헬스케어
한민규

연속혈당측정기(Continuous Glucose Monitoring, CGM)는 실시간으로 포도당 변화를 측정, 기록하는 바이오센서 기술이다. 처음 당뇨병 환자의 저혈당/고혈당을 관리하기 위해 처음 도입되었고, 이후 축적된 의학적 근거를 바탕으로 생활습관관리의 효과적인 툴로서 확대 적용되고 있다.

스포츠 의학의 관점에서 본다면, 혈당은 에너지 대사의 즉각적인 지표이기 때문에 스포츠 퍼포먼스, 피로도, 운동 후 회복에 영향을 미치거나 이들을 반영할 수 있다. 따라서 CGM을 통해 연속된 혈당 변화를 측정함으로서 개인의 대사 반응을 정밀하게 모니터링하고 훈련 전략을 세밀하게 조정하려는 등의 시도가 가능하다. 아래는 대표적인 적용의 사례들이다.

1. 운동 강도 및 지속시간에 따른 혈당 반응 분석
2. 경기 전·중·후 탄수화물 섭취 전략 수립
3. 저혈당 및 에너지 고갈 위험 조기 예측
4. 지구성 운동에서의 글리코겐 소모 패턴 추적 등

또한 향후에는 CGM 데이터를 다른 생체신호 (심박수, 젖산 농도, 산소 소모량 등) 및 웨어러블 데이터와 결합, 분석함으로써 운동 수행과 대사 상태를 통합적으로 이해하고 예측하는 정밀 스포츠의학(Precision Sports Medicine) 접근이 가능해질 것으로 기대된다.

박현태

학력

동아대학교 체육학과 학사

동아대학교 대학원 체육학과 석사

도쿄대학교 대학원 교육학연구과 박사 (신체·건강교육학 전공)

주요 경력

국립노화의료연구센터(NCGG, 일본) 운동기능부활연구실 실장 (2010.07 - 2014.05)

도쿄도 노인종합연구소(TMIG, 일본) 연구원 (2005.04 - 2010.06)

한국운동생리학회 편집위원장 / 한국운동영양학회 부회장 (현직)

한국 근감소증학회 기획이사

골대사학회/ 일본 낙상예방학회 평의원

대한 스포츠의학 운동과학회 간행이사

현재 소속 및 직위

동아대학교 (전)건강과학대학장 건강관리학과 교수

동아대학교 대외국제처장

동아대학교 부설 디지털헬스케어 연구소 소장

대표논문

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2. Thapa N, Park HJ, Yang JG, Son HE, Jang M, Lee JH, Kang SW, Park KW, Park H. The effect of a virtual reality-based intervention program on cognition in older adults with mild cognitive impairment. Journal of Clinical Medicine. 2020.
3. Park H, Jeong MK, Park KW, Lee K, Kim S, Chae K, Park MH, Koh SH, Na HR. Effects of Combined Physical and Cognitive Exercises on Cognition and Mobility in Patients with Mild Cognitive Impairment: A Randomized Clinical Trial. Journal of Clinical Neurology. 2020.

비만 · 대사질환 예방과 관리를 위한 CGM 활용 연구
Research on the Use of CGM for the Prevention and Management of Obesity and Metabolic Disorders

동아대학교
박현태

Obesity and metabolic diseases represent one of the most pressing global public health challenges, contributing significantly to cardiovascular morbidity and premature mortality. This lecture presents comprehensive evidence for utilizing continuous glucose monitoring (CGM) technology as a behavioral change tool for preventing obesity and metabolic diseases. With global obesity rates tripling over the past 50 years and a substantial proportion of Korean adults classified as at-risk for metabolic syndrome, traditional lifestyle intervention programs have demonstrated substantial limitations including low participation rates and insufficient personalization. The CGM devices has dramatically enhanced accessibility, opening unprecedented opportunities for preventive applications in non-diabetic populations.

This lecture synthesizes multilayered evidence including meta-analyses of randomized controlled trials, the CGM cohort data establishing reference ranges for non-diabetic populations, exercise timing optimization studies, and large-scale digital health interventions. Key findings demonstrate that CGM-based interventions achieve clinically significant metabolic improvements in HbA1c and time-in-range. Personalized exercise timing aligned with individual peak glucose patterns resulted in substantial peak glucose reduction with high long-term adherence. CGM-guided immediate post-meal walking reduced postprandial glucose peaks and recovery time substantially, while sedentary interruption strategies demonstrated superior efficacy compared to conventional continuous exercise protocols.

The lecture will also discuss practical interpretation of CGM metrics in preventive contexts, application of evidence-based exercise timing and nutrition strategies, and design methodologies for implementing CGM-integrated intervention programs. Real-world implementation cases across diverse populations including healthy individuals, prediabetes, obesity, and elite athletes will be examined to evaluate effectiveness. An intermittent CGM sampling approach combined with AI-based prediction models achieves high

pattern prediction accuracy, offering a cost-effective and scalable solution. Critical limitations including absence of interpretation guidelines for non-diabetic populations, sensor accuracy considerations, psychological impacts of continuous monitoring, and data privacy concerns will be thoroughly discussed. Finally, the lecture will provide actionable frameworks for cost-effectiveness research supporting high-risk populations, methodologies for health program integration, and precision prevention strategies that transform real-time glucose data into sustainable behavioral change.

오범조

Education

Ph.D. Candidate in Medicine (Occupational and Environmental Medicine), Seoul National University, Graduate School of Medicine, Korea (Dissertation in progress, degree expected Feb 2026)

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4. Oh J, Lim J, Lee SH, Oh B, et al. Results from South Korea's 2018 Report Card on Physical Activity for Children and Youth. J Phys Act Health. 2018;15(Suppl 2):S409-S410.
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6. Oh B, et al. Clinical Evaluation and Management of Non-Responders to Anti-Obesity Medications: Pathophysiological Insights and Clinical Strategies. AOM. 2025.

연속혈당측정기의 임상적 활용
Clinical Applications of Continuous Glucose Monitoring Systems

서울보라매병원
오범조

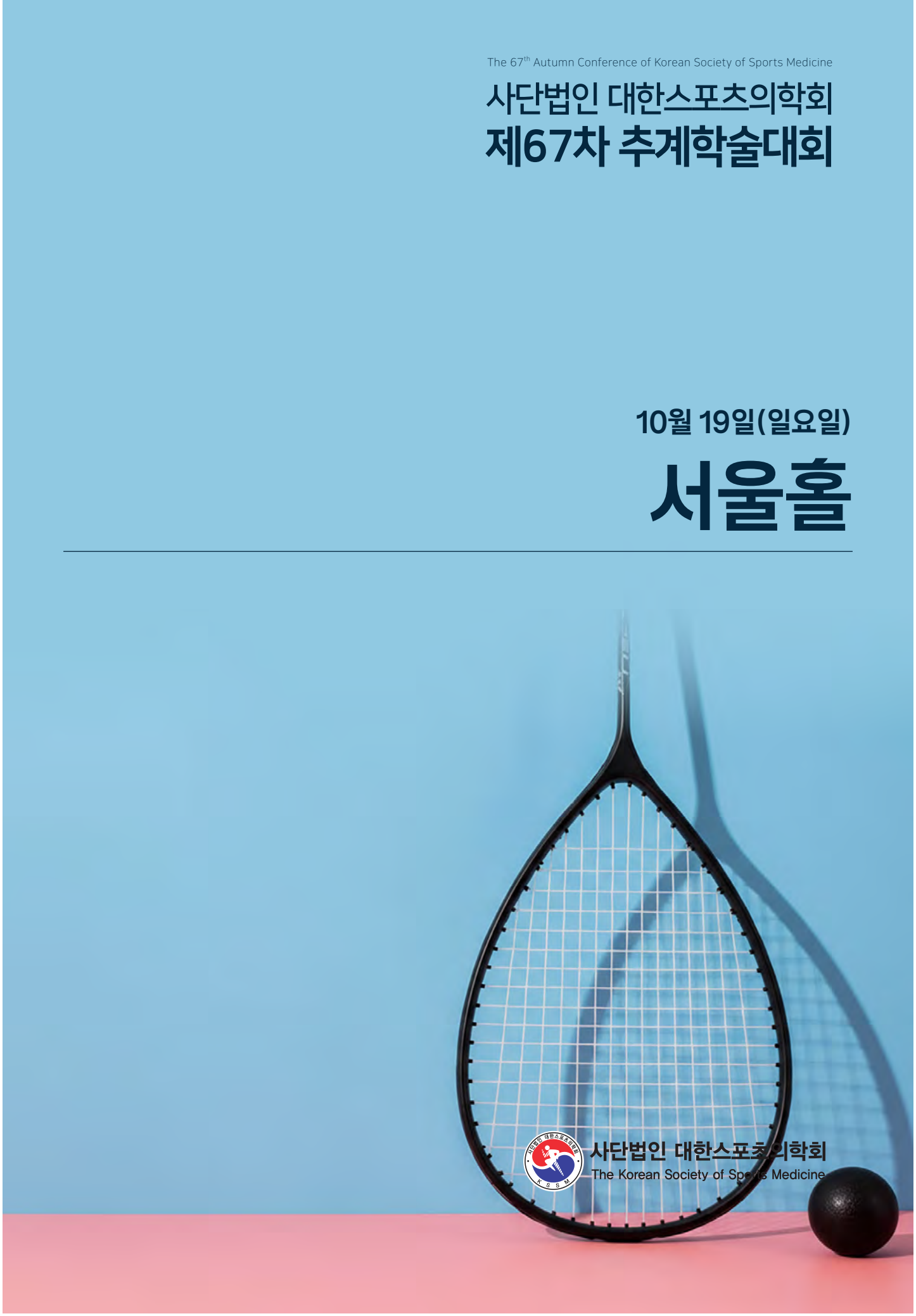
연속혈당측정기(Continuous Glucose Monitoring, CGM)는 혈당 변동성을 실시간으로 파악할 수 있는 기술로, 당뇨 관리뿐 아니라 운동선수의 신체활동과 에너지 대사 조절에도 유용하게 활용되고 있다. 본 강의에서는 CGM의 기본 원리와 데이터 해석 방법을 소개하고, 운동 강도·시간·영양섭취와의 상호작용을 분석한 최신 연구 결과를 검토한다. 또한 실제 임상 및 스포츠 현장에서 CGM을 활용하여 운동 전·중·후 혈당 변화를 모니터링하고, 이를 바탕으로 개인 맞춤형 훈련 및 영양 전략을 수립하는 구체적 적용 사례를 제시한다. 이러한 접근은 운동 수행력 향상과 저혈당 예방에 기여할 수 있는 새로운 패러다임으로 평가된다.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회
제67차 추계학술대회

10월 19일(일요일)

서울홀



The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 9: 고령 스포츠인의 관절염, 골다공증 치료

Osteoarthritis and osteoporsis in aging athletes

좌장: 일산백병원 이언숙, 한양대구리병원 정규성

박용범

학력

중앙대학교 의학과 학사

중앙대학교 일반대학원 의학과 석사

성균관대학교 일반대학원 의학과 박사 (정형외과학)

주요 경력

대한스포츠의학회 분과전문의

대한정형외과 스포츠의학회 학술위원

대한관절경학회 분과편집위원회 간사, 학술위원

Editorial Board, Arthroscopy, the journal of arthroscopic & related surgery

Editorial Board, APKASS (Asia-Pacific Knee, Arthroscopy, Arthroplasty, Shoulder and Sports Medicine Society)

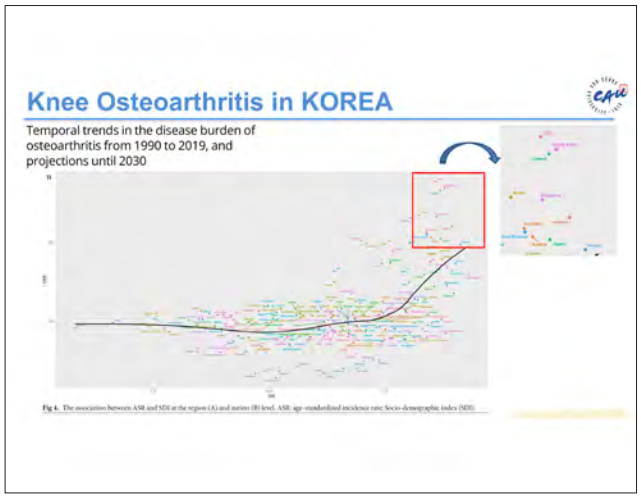
현재 소속 및 직위

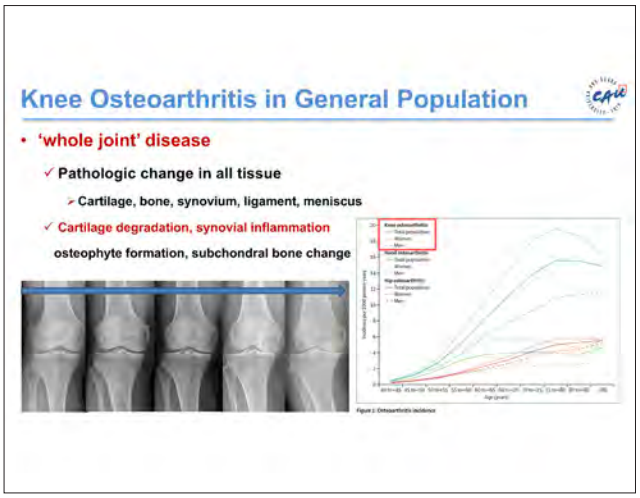
중앙대학교 의과대학 정형외과학교실 교수

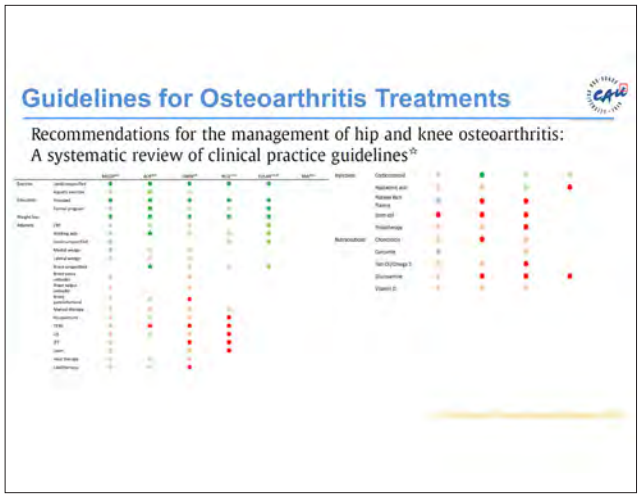
중앙대학교광명병원 정형외과 과장, 관절센터장

고령 스포츠인의 관절염 치료
Osteoarthritis treatment in aging athletes

중앙대광명병원
박용범

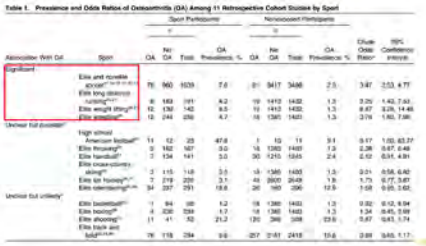






Knee Osteoarthritis in Athletes

Is Participation in Certain Sports Associated With Knee Osteoarthritis? A Systematic Review



Knee Osteoarthritis in Athletes

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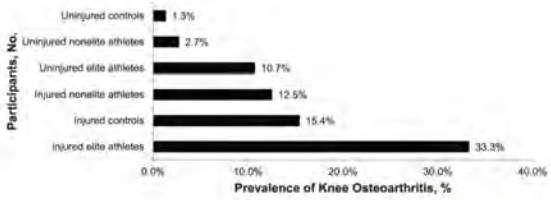


Treatment of Knee OA in Aging Athletes

- OA has No CURE

According to the experts...

EVERYONE should receive education to be active, exercise, & manage their weight

SOME may benefit from drugs or injections

FEW need surgery

Start with targeted rehab and load management; it's still the most reliable path back to play.

CASES

양재혁

학력

고려대학교 의학과 학사

고려대학교 의학대학원 의학과 석사

고려대학교 의학대학원 의학과 박사

주요 경력

대한정형외과 스포츠학회 – 척추분과 간사, 학술위원회 위원

대한정형외과학회 – 척추 분과 고시위원

대한골다공증학회 – 부총무

대한척추외과학회 편집위원회 총무

현재 소속 및 직위

고려대학교 안암병원 정형외과 교수

고려대학교 안암병원 척추센터 센터장

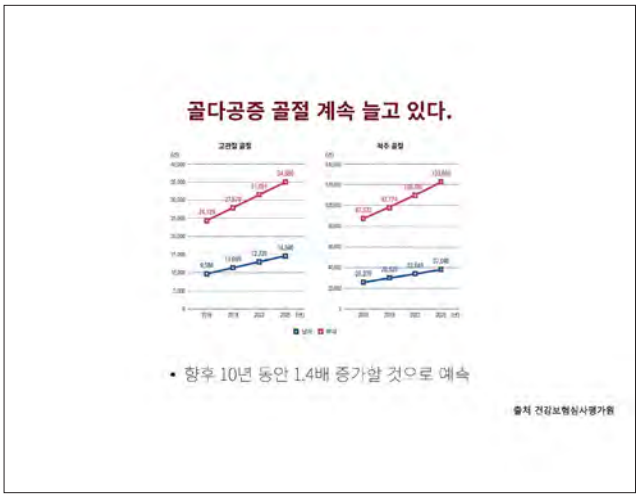
고려대학교부속 척추측만증연구소 소장

대표논문

1. Kim HJ, Lee HR, Suh SW, Chang DG, Yang JH.Associations between flexibility, stretching habits, and spine injuries in professional golfers: a nationwide, cross-sectional study. J Orthop Surg Res. 2025.
2. Lee HR, Kim HJ, Lee S, Chang DG, Yang JH. Characteristics of spinal injury in professional golfers in South Korea: a nationwide cross-sectional study. BMJ Open. 2025
3. Lee HR, Kang M, Park JM, Yang JH. Comparative Radiologic and Morphologic Analysis of Posterolateral Fusion and Percutaneous Pedicle Screw Fixation for Thoracolumbar Junction Burst Fractures. J Clin Med. 2025

고령 스포츠인의 골다공증 치료
Osteoporosis treatment in aging athletes

고려대안암병원
양재혁



운동하는 우리…
어떻게 골밀도에 대처하고 관리 ??

1장. 운동 요법

병태생리에 기초한 처방의 원칙과 실제

운동이 신체에 미치는 효과

긍정적 효과	필수 요소
✓근골격계 강화	✓안전한 운동 방법
✓근력 능력 향상	✓운동의 위험 관리
✓심폐대사 개선	✓개별적 운동 프로그램

골대사의 생리적 원리

운동이 뼈에 미치는 효과

직접 경로
뼈에 기계적 자극을 주어 골형성 촉진

간접 경로
근력·균형 향상으로 낙상 위험 감소

운동의 입증된 효과

낙상 위험 감소
균형·근력 훈련 병행 시

골밀도 증가
척추·대퇴경부 부위

무작위대조연구와 메타분석에서 일관되게 확인된 결과입니다. (근거 자료 필요할 상입)

골다공증을 고려한 운동 처방의 3가지 핵심요소

유산소 운동

저항 훈련

균형·유연성 운동

유산소 운동 처방

강도

- 자각운동강도 12-14/20 (대화 가능하되 호흡 다소 가빠짐)

빈도

주 3~5일

시간

30-60분

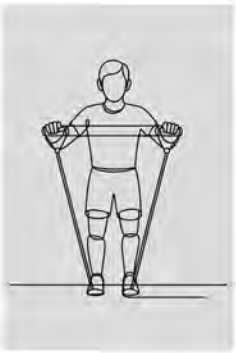
권장 종목

- 걷기·빠르게 걷기
- 계단 오르기
- 저충격 댄스

→ 고관절·요추에 적절한 부하

저항 훈련 처방

대근육군 다관절 동작	8-12회 × 2-3세트
스쿼트, 힙한지, 푸시·풀 중심	주 2-3회 비연속 요일
도구 조합	
밴드·덤벨·머신 상황별 활용	



균형·유연성 훈련

강도 증가의 원칙

1	2	3
시간 증가	**빈도 증가**	**강도 증가**
먼저 운동 시간 늘리기	다음으로 주당 횟수 늘리기	마지막으로 강도 높이기

2-4주 간격의 작은 단계로 진행하며, 통증·피로·수면 악화 시 10-20% 강도 후퇴

2장. 운동 시 주의사항

기능 향상의 가속도와 손상 위험의 균형

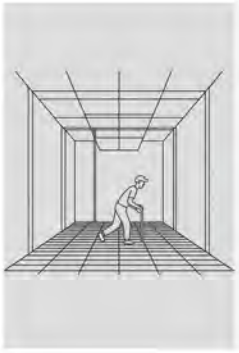
첫 방문 평가 항목

1. **낙상력**
   과거 낙상 경험 확인
2. **통증 지도**
   통증 부위·강도 파악
3. **척추 변형**
   후만·측만 평가
4. **신경학적 징후**
   감각·운동 이상 확인
5. **심혈관 위험**
   기저질환 평가

운동 중 주의해야 할 동작 (연령 고려)

척주 과굴곡 윗몸일으키기, toe-touch 회피	**과회전** 급격한 회전 동작 금지
고충격 점프 반복적인 점프 동작 제한	**전굴 리프팅** 전굴 상태 중량 들기 금지

특히 기존 척주 압박골절이나 현저한 후만이 있는 경우 더욱 엄격히 적용



환경 위험 관리

- **보조구·신발**
  적절한 장비 선택
- **실내외 환경**
  조명·미끄럼·장애물 점검
- **감독 체계**
  동반자·지도자 배치

통증 관리 프로토콜

- **통증 평가**
  숫자평가척도 5 이상 또는 48시간 이상 지속
- **강도 조정**
  10-20% 하향, 저충격 운동으로 전환
- **재평가**
  회복 확인 후 점진적 증량

운동 그만 !!!

즉시 운동 중단 및 정밀 평가 필요

- 안정 시 통증의 급격한 악화
- 진행성 신경학적 결손
- 설명되지 않는 발열·체중 감소
- 최근 저에너지 외상 후 악화

하지만 운동만으로 골다공증의 관리는 어렵다 !!!

- **호르몬 변화**
  폐경 후 급격한 변화
- **노화**
  자연스러운 골량 감소
- **영양 상태**
  칼슘·비타민 D 부족

과학적 스크리닝과 진단, 추적 평가가 모든 고령 운동참여자에게 필수적입니다.

3장. 검사·치료

"운동은 골밀도 유지 및 관리에 효과적이지만 충분조건은 아니다"

위험한 착각

"나는 운동을 꾸준히 하니까 골다공증은 없을 것이다"

노화에 따른 뼈의 미세구조 손상,
폐경등으로 인한 호르몬 변화,
기저 질환에 따른 영양·약물·동반질환의 복합적 영향
→ 운동만으로 해결되기는 어렵다 !!

무증상 골다공증의 위험

1 초기
증상 없이 골밀도 감소

2 진행
무증상 척추 압박골절 발생

3 발견
뒤늦게 진단, 이미 진행된 상태

임상 현장에서 드물지 않은 사례 !!!

골다공증 검사 보험 기준

일반 기준
- ✓ 여성: 65세 이상
- ✓ 남성: 70세 이상
- ✓ DXA 검사: 요추 및 대퇴골

조기 검사 대상
- ✓ 고위험 요소가 1개 이상 있는 65세 미만의 폐경 후 여성
  - 저체중(BMI < 18.5)
  - 비외상성 골절의 과거력이 있거나 가족력이 있는 경우
  - 외과적인 수술로 인한 폐경 또는 40세 이전의 자연 폐경
- ✓ 비정상적으로 1년 이상 무월경을 보이는 폐경 전 여성
- ✓ 비외상성(fragility) 골절
- ✓ 골다공증을 유발할 수 있는 질환이 있는 경우
- ✓ 골다공증을 유발할 수 있는 약물을 복용 중
- ✓ 기타 골다공증 검사가 반드시 필요한 경우

고령 스포츠인 맞춤 접근

65세 부터 골밀도검사
운동 여부와 무관하게 최소 1회 검사

1-2년 간격 추적
개인 위험도에 따라 조정

증상 발생 시 즉시 평가
키 감소, 등·요통, 자세 변화

기본 영양·생활습관 교정

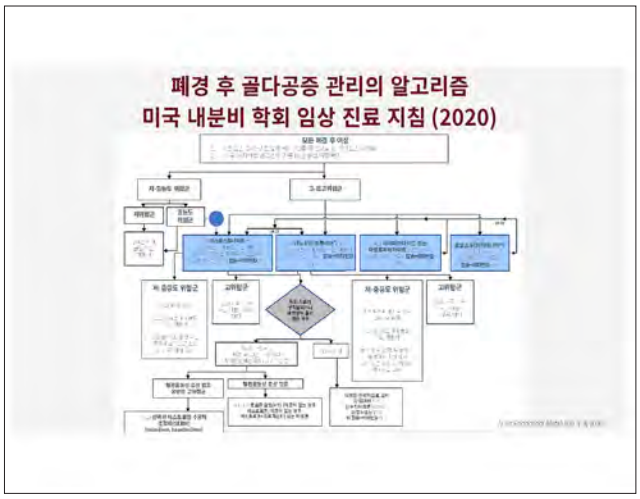
칼슘
800-1000 mg/일

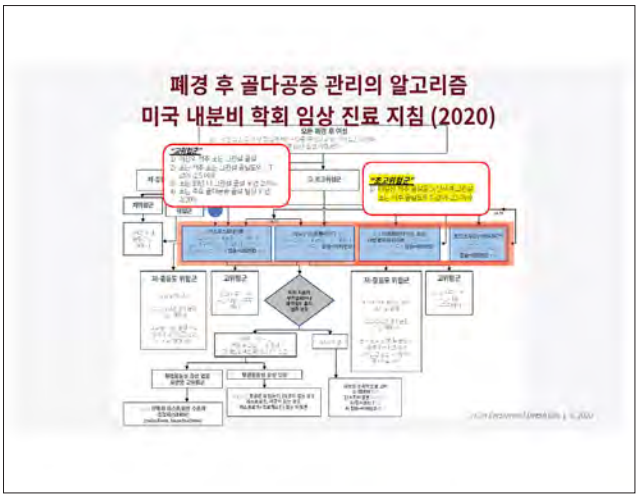
비타민 D
≥800 IU/일

단백질
1.0-1.2 g/kg/일

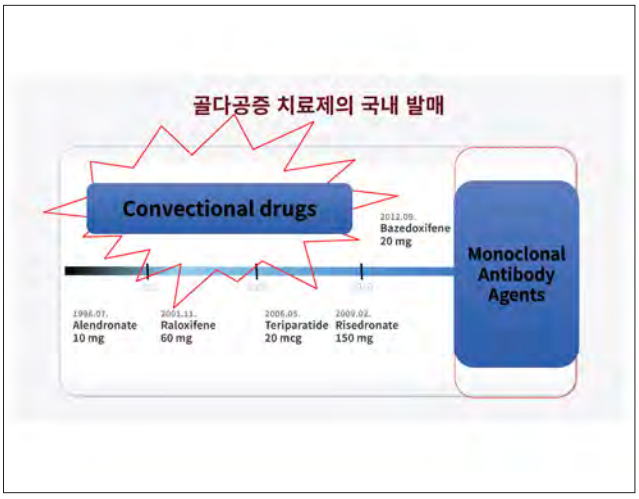
금연·절주·일광 노출·낙상 환경 개선 병행 필수


4장. 약물 치료


폐경 후 골다공증 관리의 알고리즘
미국 내분비 학회 임상 진료 지침 (2020)


폐경 후 골다공증 관리의 알고리즘
미국 내분비 학회 임상 진료 지침 (2020)

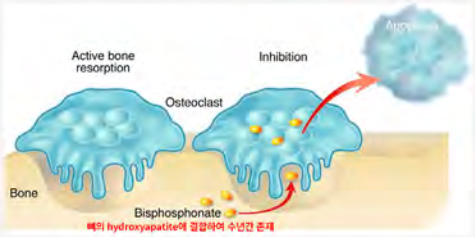

골다공증 약물 치료의 두 축
항흡수제 – Anti-resorptive agents
파골세포 활성 억제
· 비스포스포네이트 계열 약제
· 데노수맙
골형성제 - Anabolic agents
골형성 촉진
· 테리파라타이드
· 로모소주맙
Osteocyte


골다공증 치료제의 국내 발매
Convectional drugs
Monoclonal Antibody Agents
1996.07. Alendronate 10 mg
2001.11. Raloxifene 60 mg
2006.05. Teriparatide 20 mcg
2009.02. Risedronate 150 mg
2012.09. Bazedoxifene 20 mg


골다공증에 사용되는 약제
- 작용 기전에 따른 분류, Anti-resorptive agents -
Administration considerations
Treatment duration and follow-up
Bisphosphonates
Alendronate
Ibandronate
Zoledronate
Monoclonal antibody against RANKL
Denosumab

Bisphosphonate

- BPs bind with high affinity to hydroxyapatite in bone

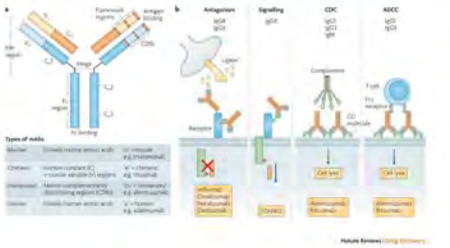


Bisphosphonate
- Well-known complications -

- 턱뼈괴사 (ONJ, osteonecrosis of the jaw)
  - ✓고용량의 비스포스포네이트 주사 : 1~10%
  - ✓골나공증 시료 목적의 용량 : 1~10명/10만명
- 비진형 대퇴골골절 (atypical femur fracture)
  - ✓대퇴부, 서혜부 통증
  - ✓X-ray: 비후된 피질골, 골막 반응
- 신독성
  - ✓중증 신부전 (Creatinine clearance < 30~35mL/min)
  - ✓투여X
  - ✓고용량, 짧은 주사 시간, 짧은 투약 간격

What is Monoclonal antibody agents ?

- To enhance effects and to minimize immunogenicity and side effects



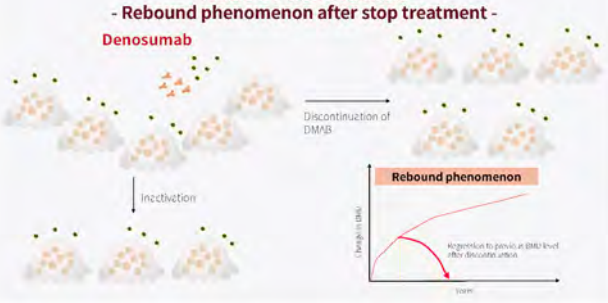
Osteoclast inhibition mechanism
- Anti-resorptive agents -

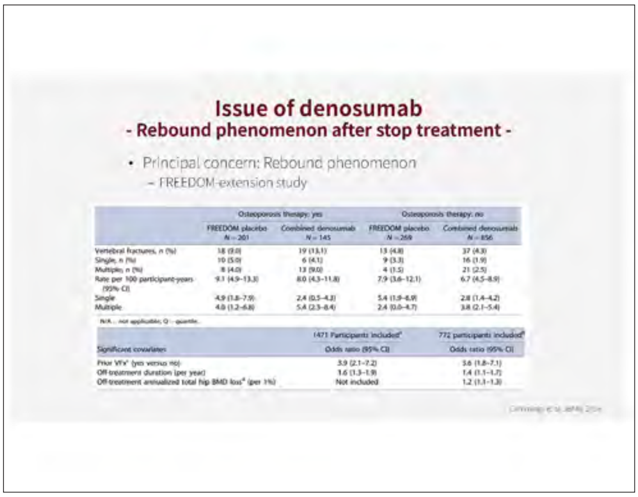
Denosumab vs. Bisphosphonates
Osteoclast bone resorption inhibition

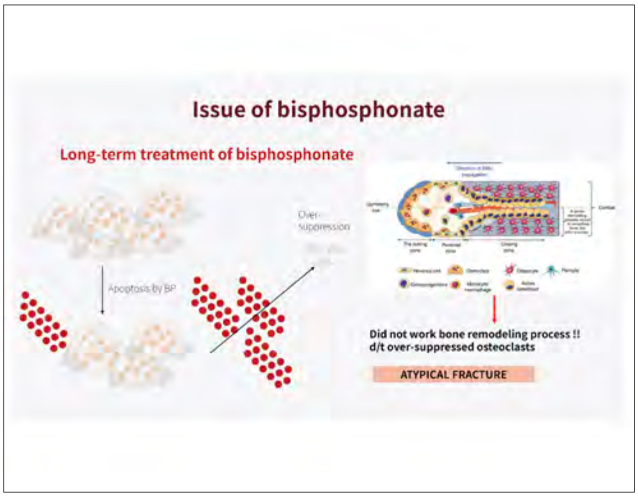
Feature	Bisphosphonates	Denosumab
Molecular target	Cellular metabolic enzymes; for the nitrogen-containing bisphosphonates, the key target is FPPS, an enzyme needed for modification (prenylation) of proteins.	Binds with high affinity and specificity to circulating RANKL
Structure	Small-molecule drugs	Monoclonal antibody
Site of action	Tightly bound to mineral in the bone matrix; internalized by osteoclasts	Extracellular mimic; does not associate with bone tissue
Specific effect on osteoclasts?	Yes; needs to be taken up into bone matrix into osteoclast cytoplasm during bone resorption	Yes; affects osteoclasts and their precursors, which express the RANK protein
Effect on osteoclast lineage	Induce apoptosis; bone-associated osteoclasts that survive may remain in the bone, but with reduced resorptive activity	Inhibits osteoclast formation, function, and survival
Onset of action and reversibility of effect	Depends on type of bisphosphonate and length of treatment; slow offset of action	Rapid onset of action; fully reversible and relatively rapid offset of action
Clearance	Release from bone matrix depends on bone turnover; may remain in bone over weeks to years. Released bisphosphonates are cleared by the kidney.	Cleared by the reticuloendothelial system with half-life of ~ 26 days

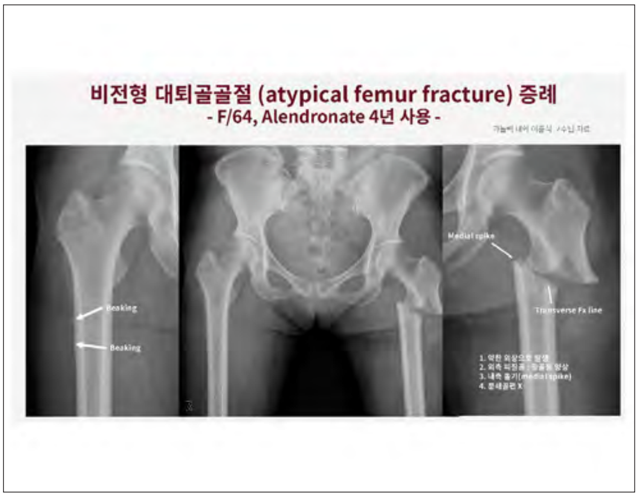
Hypocalcemia
Atypical fracture
Rebound phenomenon
Be careful for kidney dysfunction!!

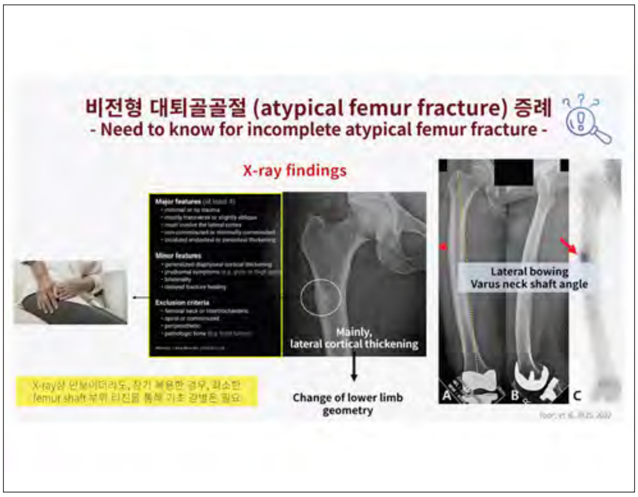
Issue of denosumab
- Rebound phenomenon after stop treatment -

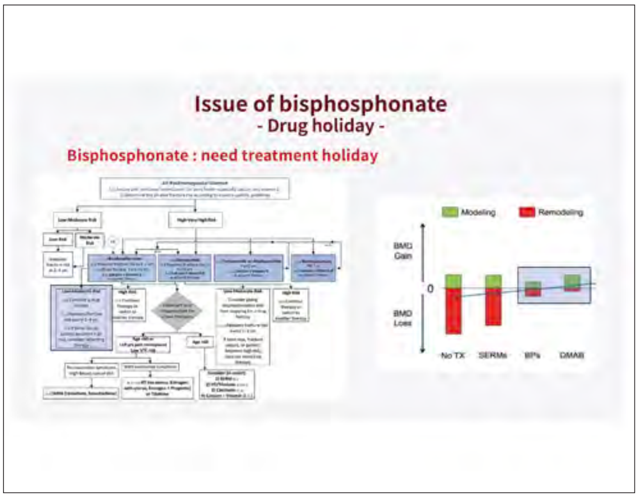



Issue of denosumab
- Rebound phenomenon after stop treatment -
• Principal concern: Rebound phenomenon
– FREEDOM-extension study
Osteoporosis therapy: yes
Osteoporosis therapy: no
FREEDOM placebo N = 201
Combined denosumab N = 145
FREEDOM placebo N = 269
Combined denosumab N = 856
Vertebral fractures, n (%) 18 (9.0) 19 (13.1) 13 (4.8) 37 (4.3)
Single, n (%) 10 (5.0) 6 (4.1) 9 (3.3) 16 (1.9)
Multiple, n (%) 8 (4.0) 13 (9.0) 4 (1.5) 21 (2.5)
Rate per 100 participant-years (95% CI) 9.1 (4.9–13.3) 8.0 (4.3–11.8) 7.9 (3.6–12.1) 6.7 (4.5–8.9)
Single 4.9 (1.8–7.9) 2.4 (0.5–4.3) 5.4 (1.9–8.9) 2.8 (1.4–4.2)
Multiple 4.0 (1.2–6.8) 5.4 (2.3–8.4) 2.4 (0.0–4.7) 3.8 (2.1–5.4)
1471 Participants included
772 participants included
Significant covariates
Odds ratio (95% CI)
Odds ratio (95% CI)
Prior VFx (yes versus no) 3.9 (2.1–7.2) 3.6 (1.8–7.1)
Off-treatment duration (per year) 1.6 (1.3–1.9) 1.4 (1.1–1.7)
Off-treatment annualized total hip BMD loss (per 1%) Not included 1.2 (1.1–1.3)


Issue of bisphosphonate
Long-term treatment of bisphosphonate
Over-suppression
Apoptosis by BP
Did not work bone remodeling process !!
d/t over-suppressed osteoclasts
ATYPICAL FRACTURE


비전형 대퇴골골절 (atypical femur fracture) 증례
- F/64, Alendronate 4년 사용 -
Beaking
Beaking
Medial spike
Transverse Fx line
1. 약한 외상으로 발생
2. 외측 피질골 : 횡골절 양상
3. 내측 돌기(medial spike)
4. 분쇄골편 X


비전형 대퇴골골절 (atypical femur fracture) 증례
- Need to know for incomplete atypical femur fracture -
X-ray findings
Major features
Minor features
Exclusion criteria
Mainly,
lateral cortical thickening
Change of lower limb geometry
Lateral bowing
Varus neck shaft angle
A
B
C


Issue of bisphosphonate
- Drug holiday -
Bisphosphonate : need treatment holiday
Modeling
Remodeling
BMD Gain
BMD Loss
0
No TX
SERMs
BPs
DMAB

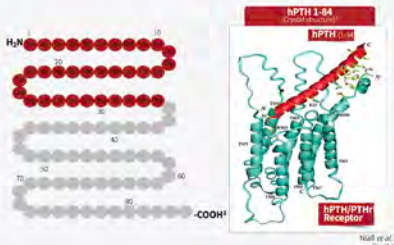

골형성제: 초고위험군의 선택
Teriparatide
최대 24개월 사용, 척추·비척추 골절 감소
종료 후 항흡수제로 전환 필수
Romosozumab
sclerostin 억제, 골형성 촉진+흡수 억제
12개월 내 빠른 BMD 상승

골다공증에 사용되는 약제
- 작용 기전에 따른 분류, Anabolic agents -

	Administration considerations	Treatment duration and follow-up
Parathyroid hormone analogue		
Teriparatide	✓ Treatment of postmenopausal women and glucocorticoid osteoporosis, and patients at high fracture risk	Usually treat for up to 2 years and follow with anti-resorptive agent
Monoclonal antibody against sclerostin		
Romosozumab	✓ Dose provided as two 105 mg s.c. injections ✓ Should not be initiated in patients who have had a myocardial infarction or stroke within the preceding year	Treat for 12 months and follow with anti-resorptive agent

Human Parathyroid Hormone 1-34 [Teriparatide]

- Synthetic peptide containing the first 34 amino acids of endogenous human PTH



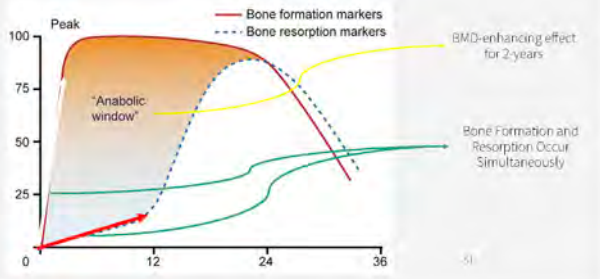
Niall et al. Proc Natl Acad Sci U.S.A. 1974
Jin et al. J Biol Chem 2000;275:27238

Teriparatide : Osteoanabolic Effect

	Callus Formation	Increase Callus Size	Improve Mechanical Strength	Callus Mineralization	Cellular Content of Callus	Implant Osseo-integration
Bisphosphonates	-	+	+	+	-	+
Denosumab	-	-	+	-	-	-
SERMs	+	-	-	-	-	-
Teriparatide	+	+	+	+	+	+
Strontium ranelate	-	+	+	-	-	+

'+' denotes favourable effect, while '-' denotes no effect.
1. Goldhahn et al. Calcif Tissue Int 2012;90(5):343-53.

Teriparatide

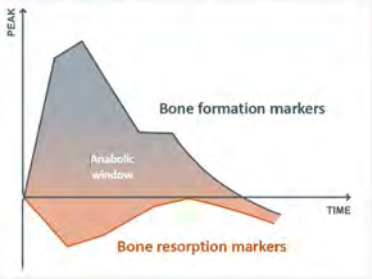


Romosozumab: Overview

- Humanized immunoglobulin G2 monoclonal antibody for sclerostin
- Bone formation by osteoblast differentiation & activity
- Bone resorption by altering expression of osteoclast regulators

Romosozumab
- Dual effect -

Anabolic window - Romosozumab



Critical issue of romosozumab
- Cardiovascular issue -

A ARCH: ROMO vs ALD

F FRAME: ROMO vs placebo

MACE RISK ↑

MACE RISK no significance

- FRAME이 ARCH보다는 더 큰 Trial로 얻어지 있는데, 상이한 결론이 어떻게 해석될 수 있는가?
- Alendronate가 Cardioprotective effect가 있는 것일까?
- 아니면, Romosozumab이 MACE risk를 증가 시키는 것일까?

치료 시퀀스 전략

고위험군
비스포스포네이트 또는 데노수맙 → 유지

초고위험군
골형성제 → 항흡수제 전환 (효과 고정)

시퀀스의 정교화가 누적 골절 예방 효과를 극대화합니다.

5장. 통합 관리 알고리즘

진료실과 현장에서의 실행

표준 경로: 초진부터 추적까지

초진 평가
DXA/FRAX, VFA-TBS, 실험실 검사

즉시 개입
교육·영양·보충요법 시작

운동 처방
삼축 맞춤 설계

약물 선택
위험도 기반 항흡수제/골형성제

정기 추적
6-12개월 간격 평가

반응 평가와 조정

12-24개월
DXA 반복으로 BMD 변화 확인

3-6개월
혈대사표지자로 조기 반응 평가

반응 불충분 시 약물 전환 또는 면역지료, 운동 재조정

안전 규칙 일관 교육

"데노수맙은 중단 계획 없는 중단 금지"

"척추 과굴곡·과회전·반복 고충격 회피"

모든 단계에서 일관되게 교육하는 것이 실무 성패를 가릅니다.

결론: 통합 전략의 힘

운동은 필수지만 충분조건은 아닙니다. 과학적 스크리닝과 표준 치료 경로에 편입될 때, 고령 스포츠인은 재골절과 기능저하 위험을 최소화하며 안전하고 의미 있는 활동을 지속할 수 있습니다.

The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

DCC 심포지엄 : 과학의 실천, 선수 보호와 공정한 경기 정신 수호

Science in action: Protecting athletes and preserving fair play

좌장: 건강보험심사평가원 노권재, 연세대학교 서상훈

최만호

학력

건국대학교 응용화학과 학사

건국대학교 생명과학대학원 응용화학과 석사

성균관대학교 약학대학원 약학과 박사

주요 경력

1996.9 ~ 2002.2: KIST 도핑콘트롤센터

2002.3 ~ 2004.8: MIT 생물공학부

2004.9 ~ 2007.2: KIST 도핑콘트롤센터

2007.3 ~ 2025.2: KIST 분자인식연구센터

2025.3 ~ 현재 : KIST 도핑콘트롤센터

현재 소속 및 직위

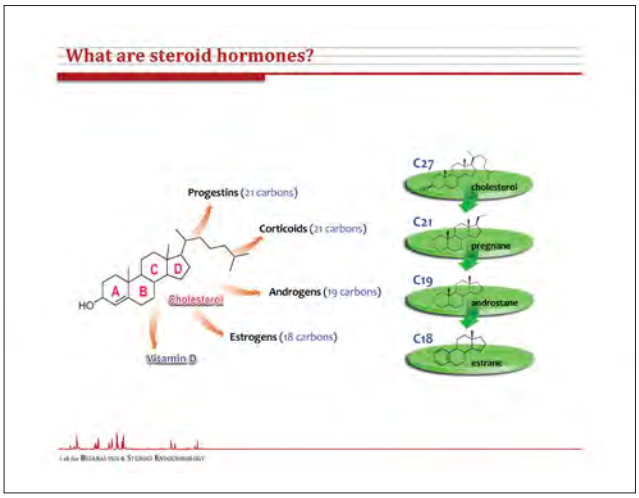
한국과학기술연구원(KIST) 도핑콘트롤센터 / 책임연구원(센터장)

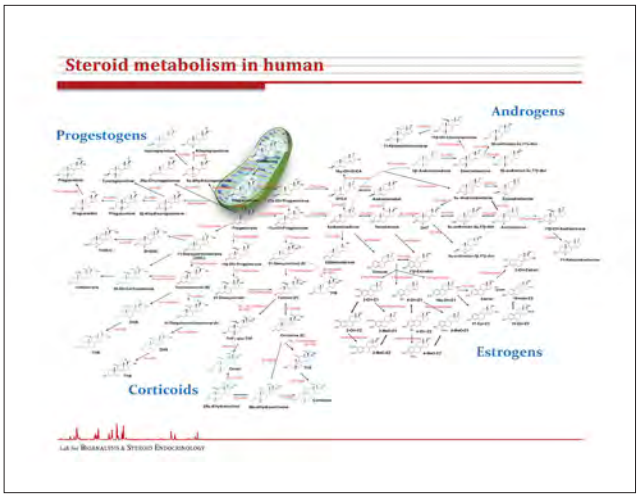
대표논문

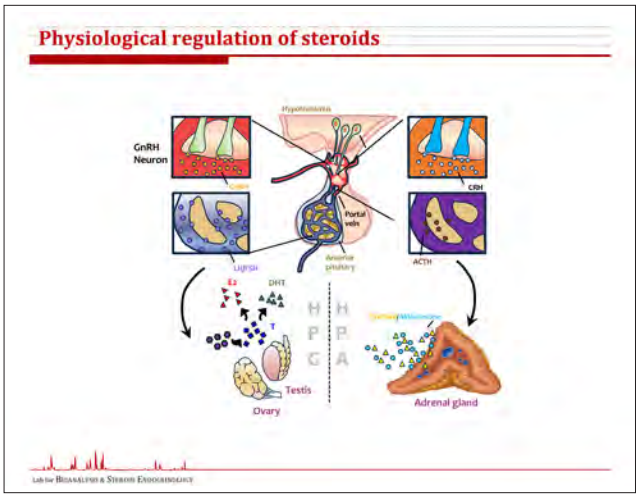
1. Clinical utility of salivary steroid profiling for the differential diagnosis of adrenal diseases.J. Clin. Endocrinol. Metab.,in press (2025)
2. Machine learning-based classification of adrenal tumors using clinical, hormonal, and body composition data.Eur. J. Endocrinol.,193, 204-215 (2025)
3. Intravenous dexamethasone transiently elevates blood glucose levels and reduces pain after TKA in patients with type-2 diabetes mellitus. J. Bone Joint Surg., 107, 1073-1081 (2025)

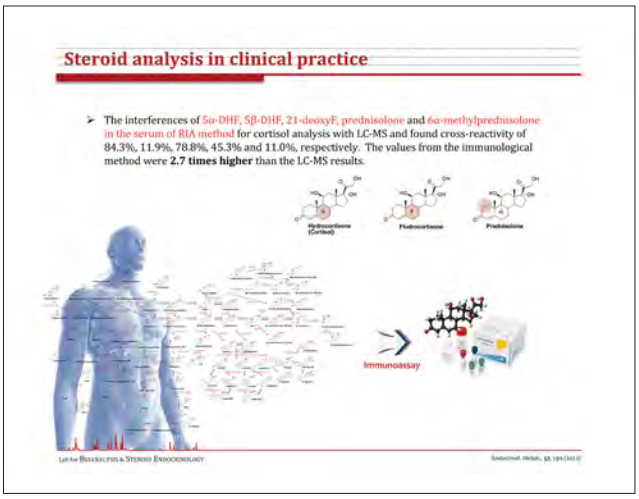
진단검사 및 반도핑 분석을 위한 질량분석법 기반 스테로이드 프로파일링
Mass Spectrometry-Based Steroid Profiling for Diagnostic Testing and Anti-Doping Analysis

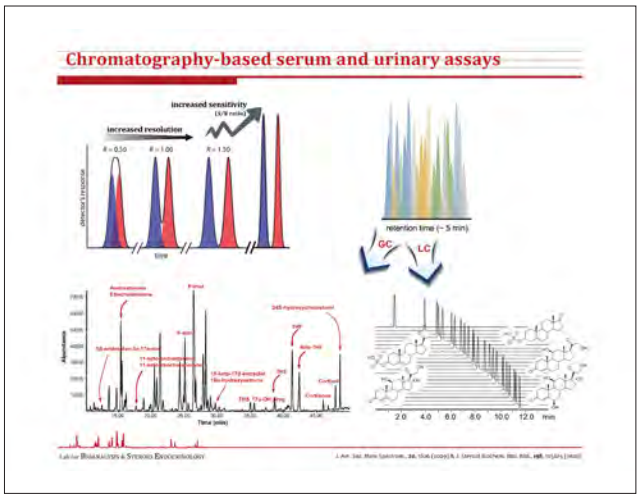
KIST/DCC
최만호

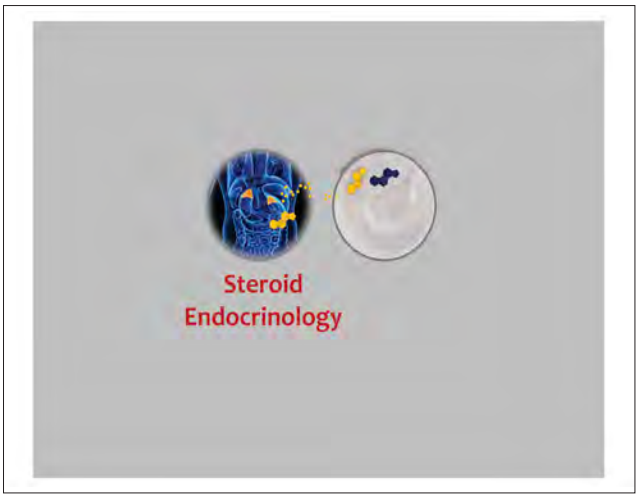


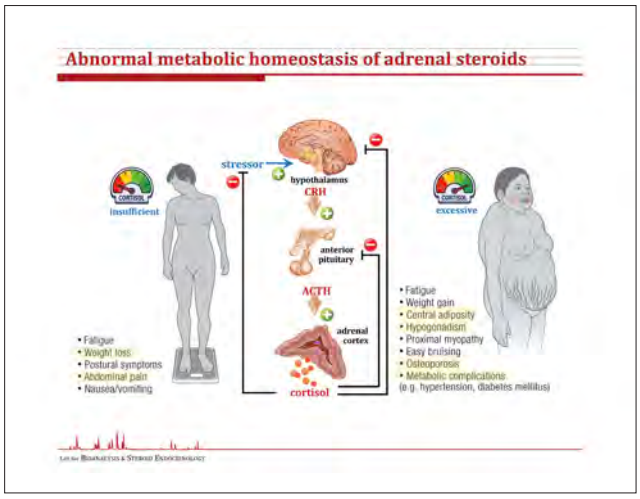


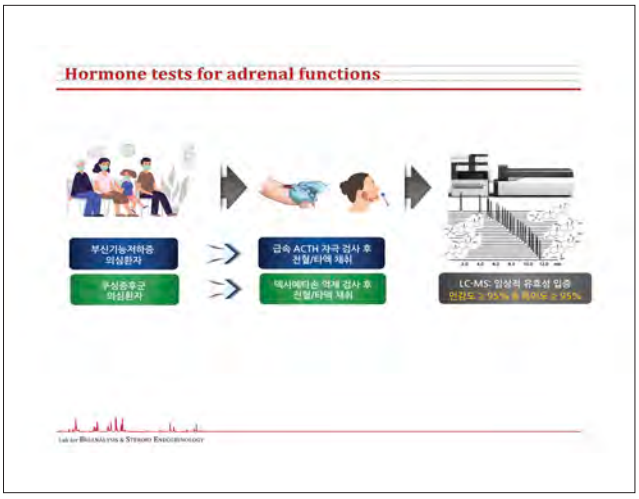


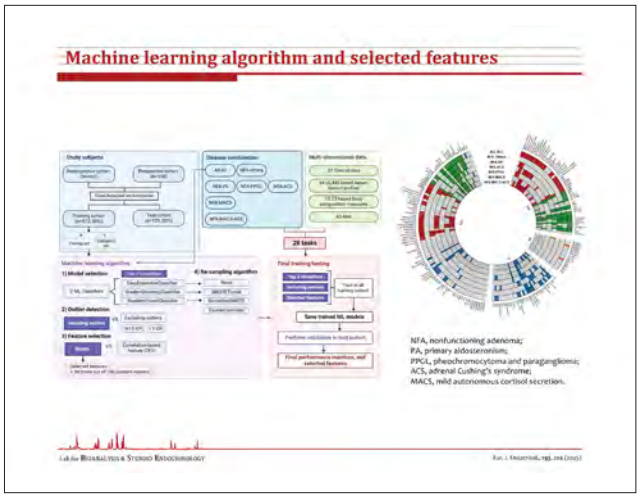

Steroid analysis in clinical practice
The interferences of 5α-DHF, 5β-DHF, 21-deoxyF, prednisolone and 6α-methylprednisolone in the serum of RIA method for cortisol analysis with LC-MS and found cross-reactivity of 84.3%, 11.9%, 78.8%, 45.3% and 11.0%, respectively. The values from the immunological method were 2.7 times higher than the LC-MS results.
Hydrocortisone (Cortisol)
Fludrocortisone
Prednisolone
Immunoassay

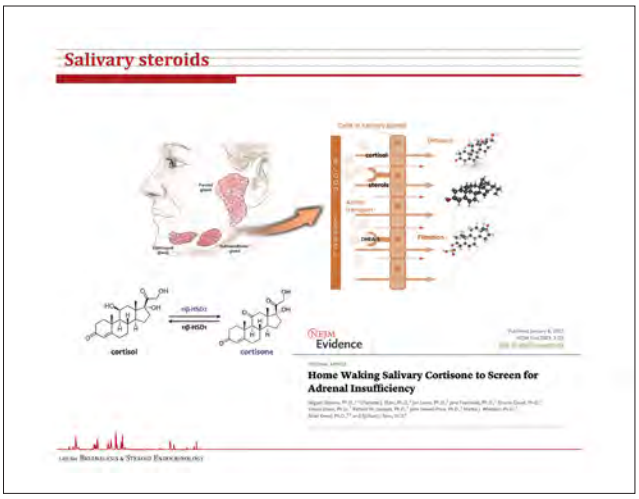

Chromatography-based serum and urinary assays
increased sensitivity
increased resolution
retention time (~ 5 min)
GC
LC
Time (min)
Abundance

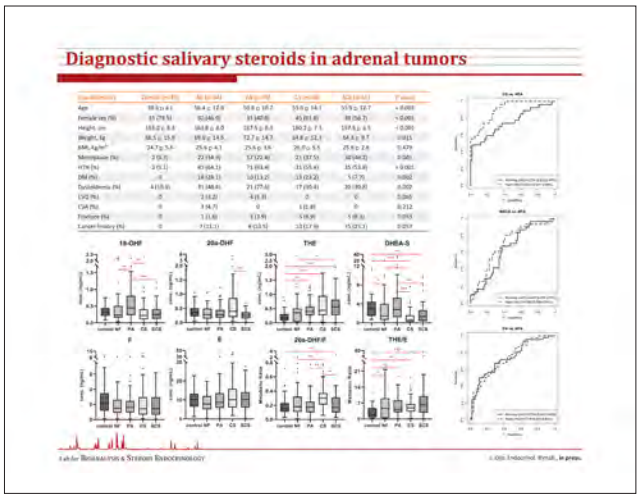

Steroid
Endocrinology

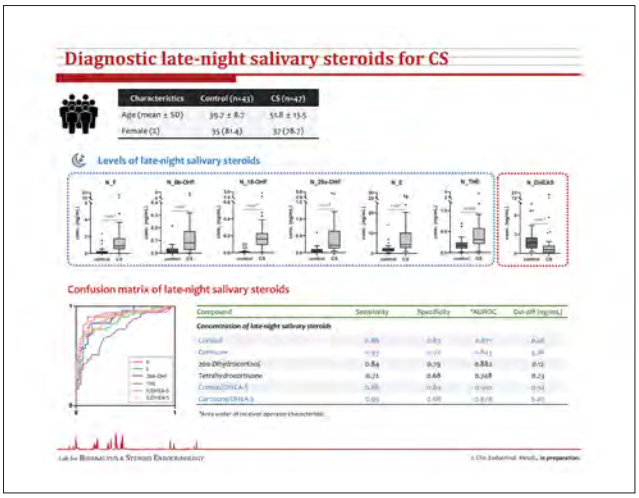

Abnormal metabolic homeostasis of adrenal steroids
stressor
hypothalamus
CRH
anterior pituitary
ACTH
adrenal cortex
cortisol
insufficient
excessive
• Fatigue
• Weight loss
• Postural symptoms
• Abdominal pain
• Nausea/vomiting
• Fatigue
• Weight gain
• Central adiposity
• Hypogonadism
• Proximal myopathy
• Easy bruising
• Osteoporosis
• Metabolic complications (e.g. hypertension, diabetes mellitus)

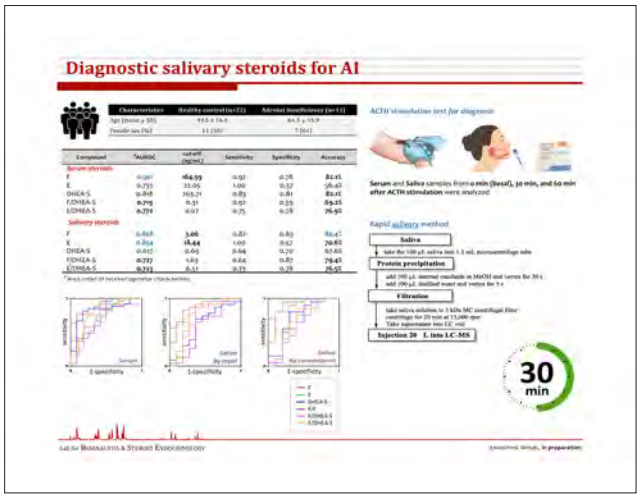

Hormone tests for adrenal functions
부신기능저하증 의심환자
쿠싱증후군 의심환자
급속 ACTH 자극 검사 후 전혈/타액 채취
덱사메타손 억제 검사 후 전혈/타액 채취
LC-MS: 임상적 유효성 입증

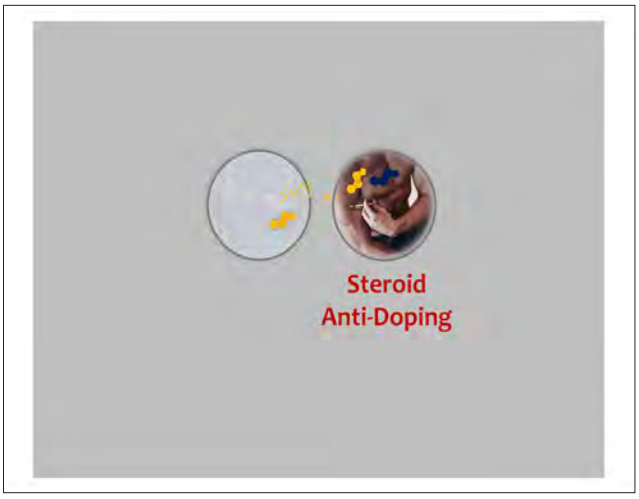

Machine learning algorithm and selected features
29 tasks
NFA, nonfunctioning adenoma;
PA, primary aldosteronism;
PPGL, pheochromocytoma and paraganglioma;
ACS, adrenal Cushing's syndrome;
MACS, mild autonomous cortisol secretion.

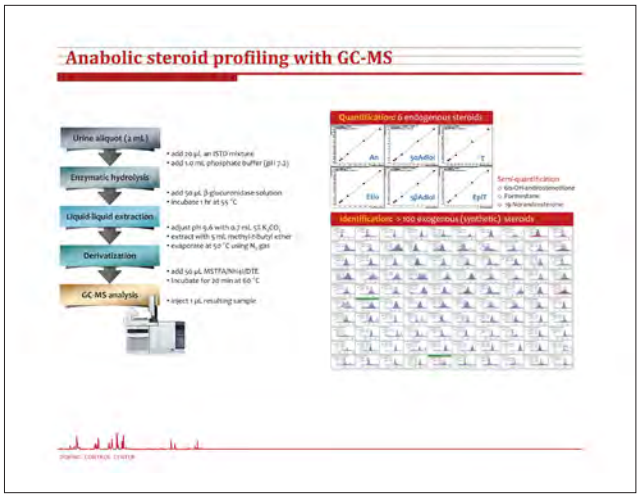

Salivary steroids
cortisol
cortisone
NEJM Evidence
Home Waking Salivary Cortisone to Screen for Adrenal Insufficiency


Diagnostic salivary steroids in adrenal tumors


Diagnostic late-night salivary steroids for CS
Levels of late-night salivary steroids
Confusion matrix of late-night salivary steroids


Diagnostic salivary steroids for AI
30 min


Steroid
Anti-Doping


Anabolic steroid profiling with GC-MS
Urine aliquot (2 mL)
Enzymatic hydrolysis
Liquid-liquid extraction
Derivatization
GC-MS analysis

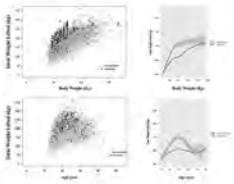
Athlete biological passport (ABP)

The ABP is a powerful anti-doping tool that monitors selected biological variables over time to reveal the effects of doping

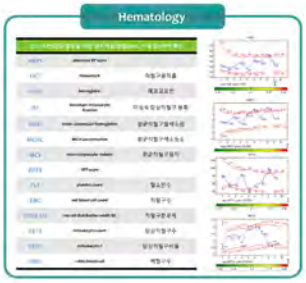
금지약물을 **직접적으로 검출**하는 기존 도핑검사는 소량 또는 간헐적으로 복용하는 경우에는 검출하기 어려울 수 있으므로, 1) 이전에 수집된 시료에 대한 표적검사, 시료 저장 및 추가 분석을 효과적으로 지시가 가능하며, 2) 전반적인 반도핑 전략을 더욱 정교화하고 강화하기 위한 절차로서 아래와 같은 항목으로 진행됨

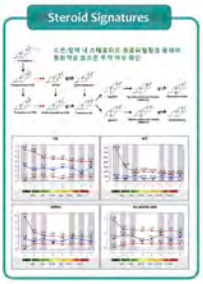
- Hematological module (혈액의 특성 고려)
- Steroidal module (호르몬 대사 및 분비 변화 평가)
- Endocrine module (내분비 조절 변화 고려)

Athlete's performance passport (APP)



Mixed modules for APP





Quantitative steroid profiling using chromatographic separation coupled to mass spectrometry provides **a cutting-edge analytical tool** and it has been recognized in clinical routine diagnostics. Because, **multiplexed assays** covering a multitude of analytes represent the gold standard in this regard.

Bringing **the artificial intelligence-powered analysis** into the anti-doping platform could be ideal to support both preventing the doping activity and maintaining athletes' health.

many thanks

박민구

학력

고려대학교 의학과 학사

고려대학교 의학과 석사

고려대학교 의학과 박사

주요 경력

대한남성과학회 총무이사 (전)

대한남성건강갱년기학회 학술이사 (전)

대한남성과학회 연구이사 (현)

대한남성건강갱년기학회 총무이사 (현)

World Journal of Men's Health 부편집인 (현)

현재 소속 및 직위

고려대학교 안암병원 비뇨의학과 교수

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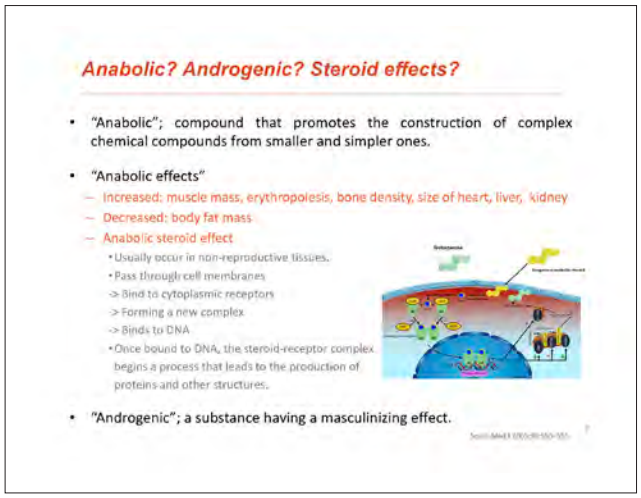
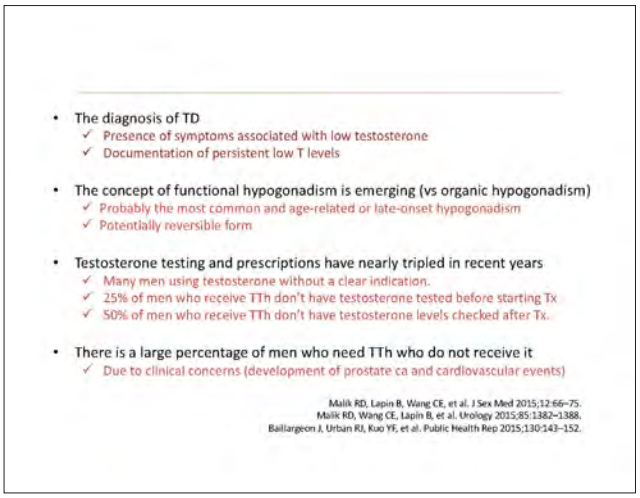
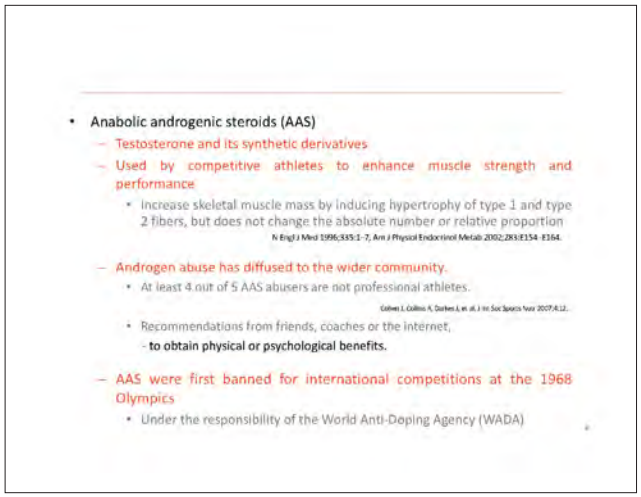
1. Yeo JK, Cho SI, Park SG, Jo S, Ha JK, Lee JW, Cho SY, Park MG.
   Which Exercise Is Better for Increasing Serum Testosterone Levels in Patients with Erectile Dysfunction?
   World J Mens Health. 2018 May;36(2):147-152.
2. Park TY, Choi MY, Kim DS, Yeo JK, Rajasekaran M, Park MG.
   Correlation Analysis between Hypogonadal Symptoms and Changes in Body Composition and Physical Fitness after Testosterone Treatment in Men with Testosterone Deficiency.
   World J Mens Health. 2024 Jan;42(1):178-187.
3. Park TY, Choi MY, Kong D, Yeo JK, Park MG.
   Do Strength and Anthropometric Size of the Lower Body Correlate with Serum Testosterone Levels?
   World J Mens Health. 2025 Jan;43(1):205-212.

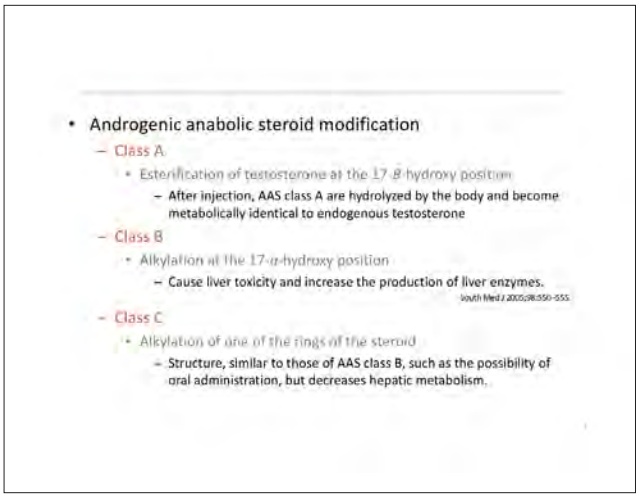
Anabolic steroid 오남용이 남성 생식능력에 미치는 영향
The Effects of Anabolic Steroid Abuse on Male Reproductive Function

고려대안암병원
박민구









Classification AAS

- "Testosterone-like" effect
  - Very potent effect
    - leading to large gains in muscle strength
  - Anabolic/androgenic ratio close to 1:1, similar to T
  - High aromatization rates are also comparable to T
    - Testosterone esters, methyl-testosterone, etc.
- "Dihydrotestosterone (DHT)-like" effect
  - Very potent, but highly androgenic
  - Inability to be aromatized to estrogen
  - Low salt, water retention
    - Stanozolol and oxandrolone.
- "Nandrolone-like" effect
  - Highest anabolic/androgenic ratio
  - Capable of reversing catabolic states
  - Most frequently used in AIDS-associated cachexia and severe burns
    - Nandrolone esters and trenbolone

Table 1. Biological properties of the commonly used anabolic androgenic steroids (AAS)

AAS	Substrate for aromatization	Substrate for 5-alpha reductase
Testosterone	+	+
Boldenone	+	+
Metadiene	+	+
Norterdosterone	+	+
Metandienone	+	+
Fluoxymesterone	+	-
Formebolone	+	-
Nadrolone	+	-
Bolandiol*	+	-
Oxymetholone	-	Already 5-alpha reduced
Stanazol	-	+
Oxandrolone	-	+
Trenbolone	-	+
Danazol	-	+
Dosttanolone	-	+
Meterolone	-	Already 5-alpha reduced
Clostebol	-	-
Gestrinone	-	-
Tetrahydrogestrinone	-	-

*Nadrolone precursors.

World J Mens Health. 2012 Apr; 30(1): 1-10

Prevalence of AAS Abuse and Starting Age

- Overall lifetime prevalence of AAS use
  - Men of 6.4% and 1.6% for women. Ann Epidemiol 2014;24:383–398.
- The use of AAS among men who attend the gym is estimated to be as high as 15–25% depending on the country and with an increasing prevalence.

Med Sci Sports Exerc 2009;38:644–651, Br J Sports Med 1997;31:54–58

- 2.9–4.0 million Americans have used an AAS at some point in their lives.

Br J Sports Med 1997;31:54–58.

  - Most AAS are obtained on the black market (85.2%), with physicians responsible for the illegal supply of 7.4–21% of users South Med J 2009;58:550–555.
  - AAS are generally manufactured by unregulated pharmacies
    - Unknown quality or content, easily obtainable with unregulated online purchases. Am J Ment Health 2018;12:1352–1357
- 32.5% of AAS users develop AAS dependence
- Vast majority of cases of AAS abuse actually begin after adolescence.
  - AAS use starts later than most drugs, with only 22% of users starting < age 20.
  - The median age of onset remained in the range of 22–24 years.

Endocr Rev 2014;35:341–375.
Med J Aust 2008;189:436–439.

Reasons for unnotice of AAS addiction

- Public attention remains focused on AAS in athletes
  - whereas the great majority of users are not competitive athletes. Am J Addict 2014;23:371–377.
- AAS users are rarely sincere with physicians.
  - 56% of users of AAS reported that they have never disclosed their use of androgens to any doctor they consulted. Am J Addict 2014;23:371–377.
- Physicians rarely investigate the use of AAS when obtaining a history
  - thus missing the opportunity to establish an association between the abuse of androgens and secondary pathology
    - such as cardiomyopathy, atherosclerotic disease, neuroendocrine abnormalities and psychiatric disorders. Addiction 2004;99:1189–1194.

Patterns of AAS Use

- Elite athletes
  - testosterone, stanozolol and nandrolone
- Nonathlete weightlifters
  - testosterone, boldenone, trenbolone, and nandrolone
  - boldenone is a veterinary steroid
- Complicated multidrug regimens (called "cycle")
  - combining oral, transdermal and intramuscular preparations,
  - progressively increase in dose until reaching 40–100 times

Patterns of AAS Use

- Stackers use supraphysiological doses of anabolic steroids for 4–18 weeks, followed by a drug-free period of 1–12 months.
  - Drug-free period for minimizing side effects, promoting the recovery of hormonal systems, avoiding detection during competition. Pediatr Clin North Am 2002;49:435–461.
- "Mass-building cycle"
  - Combination of T and nandrolone with the objective of maximizing muscle and strength gains
- "Cutting cycle"
  - Consists of combinations containing potent androgens, preferred for body definition, due to the lack of estrogenic activity (less water, salt and fat retention).
- "Postcycle therapy,"
  - Including antiestrogens or hCG
  - Restart the production of androgens by the testicles Basic Clin Androl 2016;26:2.

Table 2: Common terminologies used by the AAS user community.

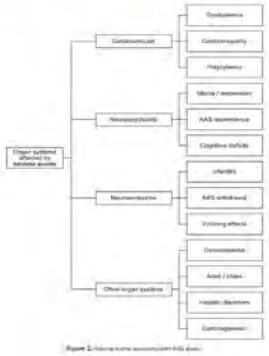
Terminology	Interpretation
Stacking/blending/ shotgunning	Combining more than one AAS or non-AAS drug into a single regimen to be taken concurrently. This could involve mixing oral and injectable types or taking compounds intended for veterinary use.
Tapering	Gradually weaning an AAS dose down.
Plateauing	When a drug becomes ineffective at its current dose. Suggestive of the need to increase calorie intake, increase the drug dose, or stop the drug.
Cycle	Using one or more AAS for a fixed period, ranging anywhere from 6 to 16 weeks, and then stopping for approximately a similar duration of time.
Pyramiding	Gradually maximizing the dosage of an AAS and then gradually minimizing the dosage of the same drug to zero over a predefined amount of time.
Blast and cruise/bridging [45]	Alternating between periods of high and low doses of AAS, but never completely ceasing drug use. Periods of high AAS dose are a 'blast' phase, whereas periods of lower AAS dose are a 'cruise' phase.

Other High-Risk Behaviors of AAS abuser

- The combined use of AAS and opioids allows the user to continue training, despite muscle and joint pain
  - Increasing the risk of musculoskeletal injuries
  - Some develop opiates addiction
- In particular, Nalbuphine Hydrochloride (Nubain) is very popular among weightlifters.
  - 29% of people who abuse both steroids and opioids started with steroids and were later introduced to opioids by the person who provided the AAS.

J Clin Psychiatry 2003;64:156–160.

Adverse Effects of AAS



Effects on the cardiovascular system

- Dyslipidemia — Circulation 2004;110:227–239.
  - Low serum concentrations of HDL cholesterol
  - High concentrations of LDL cholesterol
  - In a Swedish study, which recruited 56 users of AAS
    - lipid profile improved significantly 6 months after cessation of the steroid abuse, suggesting the reversibility of this alteration.

    J Steroid Biochem Mol Biol 2011;127:295–300.
- Hypertension — J Hypertens 2018;36:277–285.
  - A cross-sectional study, comparing current and former AAS abusers and controls,
    - current abusers exhibited increased 24-hour systolic blood pressure, while both former and current AAS abusers exhibited greater aortic stiffness.
- Thrombosis — Endocr Rev 2014;35:341–375.
  - Alterations in the lipid profile and erythrocytosis secondary to the use of AAS contribute to the increased risk of thrombosis

Effects on the cardiovascular system

- Increase in coronary atherosclerosis, and the severity of atherosclerotic disease was strongly associated with the cumulative duration of AAS use.
  - Long-term use of AAS is associated with cardiovascular toxicity characterized mainly by myocardial pathology and coronary artery disease. Circulation 2017;135:1991–2002.
- When clinicians encounter young or middle-aged men who present evidence of unexplained LV dysfunction or premature coronary artery disease
  - Cardiotoxicity due to AAS abuse should be considered in the differential diagnosis.

Neuroendocrine effects

- Suppression of the HPT axis, causes testicular atrophy, decreased endogenous testosterone production and reduced spermatogenesis.

  Curr Opin Endocrinol Diabetes Obes 2018;25:218–223.
  - HPT axis can be suppressed for months or years
  - Some individuals may never recuperate normal testosterone levels.
  - This condition is known as anabolic steroid-induced hypogonadism (ASIH).

  Fertil Steril 2014;101:1271–1279.
- In a cross-sectional study, comparing 24 former male long-term AAS users, who reported at least 2 years of supraphysiologic use of androgens and discontinued androgens at least 3 months before the time of evaluation, with 36 comparable weightlifters, but not androgen users.

  Addiction 2015;110:823–831.
  - Former AAS users exhibited significantly lower testicular volumes and lower serum testosterone levels, with some displaying testosterone levels below 200 ng/dL, despite abstinence for 3–26 months.
    - Untreated former users exhibited significantly lower scores on the IIEF sexual desire subscale.

Neuroendocrine effects

- Higher proportion of participants with depressive symptoms, fatigue, erectile dysfunction (ED) and decreased libido than the control group, even after 2 years of cessation of AAS abuse. PLoS One 2016;11:e0161208.
- The mechanisms of prolonged androgen-withdrawal hypogonadism remain incompletely understood. Curr Opin Endocrinol Diabetes Obes 2018;25:218–223.
  - Some cases can be attributed to the incomplete recovery of gonadotropin function and consequent hypogonadotropic hypogonadism.
  - Some individuals experience hypogonadism, despite normal or elevated levels of LH and FSH, suggesting that they may have suffered direct damage to Leydig cells.
  - Some may still exhibit normal pituitary hormones and testosterone levels, but still exhibit functional symptoms of hypogonadism.
    - Possible development of target organ resistance due to downregulation of androgen receptors.

Reproductive system and infertility

- Inhibition of pituitary secretion of LH and FSH by AAS suppresses the production of testosterone and spermatogenesis leading to male infertility.
- Oligozoospermia or azoospermia, associated with abnormalities in sperm motility and morphology. Clin J Sport Med 2010;20:475–481.
- According to most reports, sperm quality tends to recover spontaneously within 4–12 months after discontinuation.
  - Negative effect on semen quality may persist for longer periods.
- During the use of AAS, serum androgen concentrations may be supraphysiologic high,
  - Hypogonadotrophic state decreases the intratesticular testosterone concentrations, necessary to maintain normal spermatogenesis.

  BJU Int 2011;108:1860–1865.

Reproductive system and infertility

- XY and chromosome 1 and 9 disomies
  - Suggesting anomalies in the meiotic process and genetic damage among AAS users. J Assist Reprod Genet 2007;24:195–198.
- Serum inhibin B and AMH (Anti-Müllerian Hormone) decreased markedly among current AAS abusers
  - Cumulative duration of AAS abuse has been strongly associated with decreased levels of inhibin B and AMH
    - Extent of AAS abuse may be important with regard to recovery of spermatogenesis and that it may increase the risk of permanent impairment of fertility. PLoS One 2016;11:e0161208.
- Patients may be actively treated, hCG, hMG, or even recombinant FSH. Basic Clin Androl 2016;26:2., BJU Int 2011;108:1860–1865.
  - Restoration of fertility has been reported even in situations of persistent azoospermia up to 5 years after interruption of AAS.

Neuropsychiatric effects

- Association between long-term exposure to AAS and brain morphometry
  - 150 participants (82 current or previous users vs 68 nonuser controls), underwent MRI scans of the brain
    - AAS group had a thinner cortex in generalized regions and significantly smaller neuroanatomical volumes.
      - The frontal, parietal, temporal and occipital cortexes were thinner in long-term consumers than in short-term consumers Biol Psychiatry 2017;82:294–302.
- Reduction in orbitofrontal activity could explain the lack of inhibitory control, resulting in aggression and violent behavior, drug addiction, and obsessive-compulsive disorder as a consequence of androgen consumption. J Cogn Neurosci 2010;22:2357–2368.
- 10,259 high school participants investigated the impact of AAS abuse on mental health
  - Associated with problems of anger, anxiety, depression, and low self-esteem.
  - More likely to take medications for mental health problems than nonusers, with an 30% rate of suicide attempts in the AAS abuse group. Scand J Public Health 2021;49:555–562.

Effects on other organ systems

- Painful breast enlargement, or gynecomastia
  - Up to half of all abusers
  - Due to an imbalance in the testosterone/estradiol ratio
  - Symptoms may appear in the postcycle period
    - due to deep ASIH or administration of hCG and subsequent elevation of the serum estradiol level, secondary to aromatization. Fertil Steril 2014;101:1271–1279.
- Supraphysiologic levels of plasma androgens stimulate the production of erythropoietin and can lead to clinically significant polycythemia.
  - Increase in plasma viscosity may be a factor that contributes to adverse cardiovascular events
- Damage to liver tissue due to AAS abuse
  - Impaired function, liver cholestasis causing jaundice, peliosis hepatis, and increased risk of liver tumors. Endocr Rev 2014;35:341–375.. Am J Addict 2014;23:371–377.
  - Orally active 17a-alkylated androgens
- Acne and male pattern alopecia

How to Manage Androgen Abuse?

- A key question when caring for this kind of patient
  - Whether the patient really wants to quit using AAS
- All AAS users should be questioned about anxiety and depressive disorders and alcohol or illicit drug abuse
  - With appropriate referral for treatment, as these conditions are usually associated
- Baseline hormonal panel should be obtained and the patient should be advised to discontinue all AAS as well as any self-administered auxiliary drugs and supplements. Fertil Steril 2014;101:1271–1279.
- For very symptomatic patients, a 4-week tapered course of injectable or transdermal TTh
  - May be necessary to immediately improve withdrawal symptoms.
- A SERM such as clomiphene citrate (25 mg every other day), should be administered simultaneously with TTh
  - In an attempt to restart the HPT axis and ultimately increase intratesticular testosterone.

How to Manage Androgen Abuse?

- Serum hormone levels should be assessed again after 4 weeks of TTh and/or SERM.
- If a poor gonadotropin or T response is detected,
  - 4-week course of hCG (1,000–3,000 IU, 3 times per week) simultaneously with daily treatment with a SERM at the initial starting dose. Fertil Steril 2014;101:1271–1279.
- If gynecomastia appears during the use of hCG
  - Anastrozole or tamoxifen can be started.
- After 8 weeks of hCG and adjuvant treatment, hormone levels should be assessed again. Fertil Steril 2014;101:1271–1279.
- If adequate T and gonadotropin levels are achieved
  - SERM can be reduced to 50% of the starting dose in 10 weeks and continued through weeks 12–16 or until target T level is detected. Fertil Steril 2014;101:1271–1279.
- If total T remains low and the patient remains symptomatic
  - Primary testicular failure is likely and recovery may be limited.

Summary

- Most of AAS users are not elite athletes and these drugs are easily obtained online.
  - AAS abuse is a considerable public health issue
- There is no reliable test to diagnose AAS abuse.
- AAS misuse and abuse lead to adverse effects in all body tissues and organs.
  - Hypogonadism, infertility, cardiac impairment, neurodegeneration, coronary artery disease and sudden cardiac death
- Hypogonadism and infertility are frequent findings in AAS abusers and need to be taken into consideration when AAS use is suspected.
  - A standardized protocol is needed to improve the infertility and hypogonadism.
- More clinical research in this regard is urgently needed.
  - Korean situation (prevalence and cases of complication)

성창민

학력

전남대학교 생명과학기술학부 이학사

서울대학교 공과대학원 바이오엔지니어링 협동과정 공학박사

주요 경력

2016.06 ~ 2018.03	KIST 도핑콘트롤센터, 연구원
2018.02	평창 동계올림픽 도핑분석 전문가
2018.03 ~ 2025.02	KIST 도핑콘트롤센터, 선임연구원
2021.07	도쿄 하계올림픽/패럴림픽 국제 초빙 반도핑분석 전문가
2022.02	베이징 동계올림픽/패럴림픽 국제 초빙 반도핑분석 전문가

현재 소속 및 직위

KIST 도핑콘트롤센터, 책임연구원

대표논문

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2. Yi JY, Park S, Kim M, Jeong Y, Shin H, Cho Y, Jeon M, Oh MK, Sung C. Emerging wound-healing injectable polydeoxyribonucleotide: potential as a prohibited doping method and its simple detection via CRISPR/Cas12a system. Int J Biol Macromol. 2025 May.
3. Yi JY, Ryu J, Jeong Y, Cho Y, Kim M, Jeon M, Park HH, Hwang NS, Jeong HJ, Sung C. One-step detection of procollagen type III N-terminal peptide as a fibrosis biomarker using fluorescent immunosensor (quenchbody). Anal Chim Acta. 2024 Aug.

바이오도핑의 최신동향과 DCC 연구 기술
Latest Trends in Bio-Doping and DCC Research Techniques

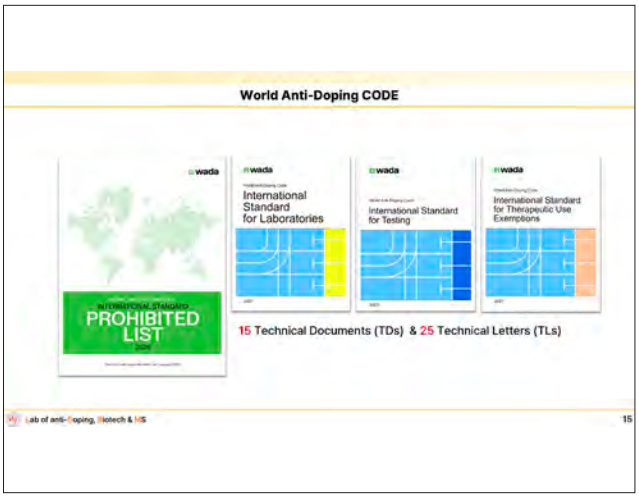
KIST/DCC
성창민

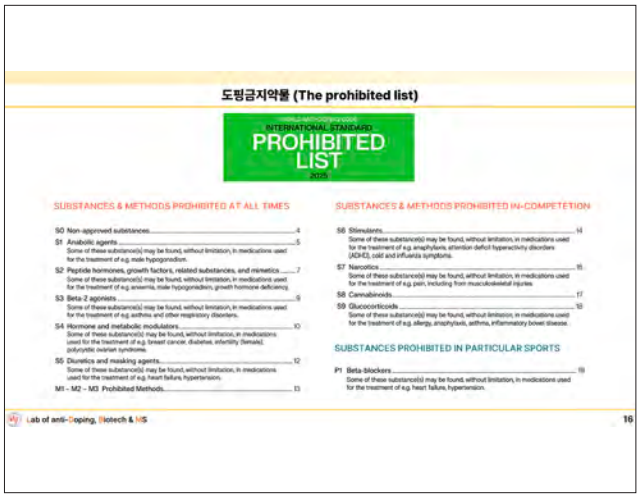

국제스포츠 이벤트 지원
Rio2016
TOKYO 2020
19th Asian Games Hangzhou 2022
PARIS 2024
Lab of anti-Doping, Biotech & MS
10


Tokyo 2020 + 1 Olympic and Paralympic
TOKYO 2020 Games Laboratory
Lab of anti-Doping, Biotech & MS
11


Beijing 2022 Olympic and Paralympic
Together for d
Together for d
Lab of anti-Doping, Biotech & MS
12

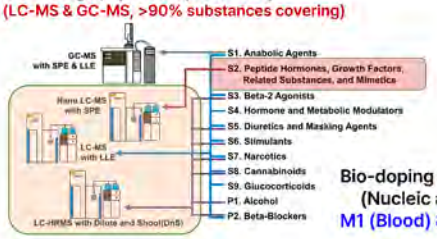

세계반도핑기구(WADA) 공인 도핑분석시험실
Anti-doping
ISL
EQAS
DB-EQAS
Lab of anti-Doping, Biotech & MS
13


World Anti-Doping CODE
INTERNATIONAL STANDARD
PROHIBITED LIST
International Standard for Laboratories
International Standard for Testing
International Standard for Therapeutic Use Exemptions
15 Technical Documents (TDs) & 25 Technical Letters (TLs)
Lab of anti-Doping, Biotech & MS
15


도핑금지약물 (The prohibited list)
INTERNATIONAL STANDARD
PROHIBITED LIST
2025
SUBSTANCES & METHODS PROHIBITED AT ALL TIMES
SUBSTANCES & METHODS PROHIBITED IN-COMPETITION
SUBSTANCES PROHIBITED IN PARTICULAR SPORTS
Lab of anti-Doping, Biotech & MS
16

Anti-Doping analysis : Initial Testing Procedure (ITP) & Confirmation Procedure (CP)

Chromatography-Mass spectrometry
(LC-MS & GC-MS, >90% substances covering)

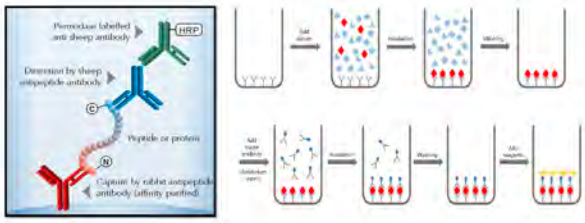


Bio-doping : <10% substances
(Nucleic acid, Amino acid)
M1 (Blood) & M3 (Gene & Cell)

Testosterone, Coreticosteroids, Erythropoietin (EPO), Human Growth hormone(hGH), Blood doping, etc

Lance Armstrong (USA)

ERAs, hGH, Biomarkers, hCG, LH – immunoassay based techniques



Dual-antibody, sandwich-type immunoassay system (ELISA)

Erythropoietin (EPO)-Receptor Agonists (ERAs) analysis

Erythropoietin (EPO)-Receptor Agonists (ERAs) analysis

Positive

Negative

- Western blotting-based technique
- Gel electrophoresis (protein separation), then immunoassay (detection)

Fully automated immunoassay instrument – hCG, hLH

Cobas e411
(Roche)

Immulite 1000
(Siemens)

Research fields of Bio-Engineer in anti-doping

WHAT?	HOW?	WHY?
Nucleic acid (DNA, RNA)	CRISPR	Platform
Amino acid (Peptide, Protein)	Antibody	SOP
Small molecule (Chemical, drug)	Mass spectrometry	Accreditation

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Research fields of Bio-Engineer in anti-doping

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M3. Gene and cell doping is strictly prohibited by the World Anti-Doping Agency (WADA)

Gene and cell doping: genetical approach to get a better athletic performance including viral/non-viral delivery of both mRNA and DNA gene manipulation and control

Potential doping genes: *EPO, GH, IGF1, etc*
> cDNA-based genes because of the package capacity
> exon-exon junction is a distinctive feature of doping genes

Erythropoietin → RBC level
Growth hormone → Muscle synthesis
Insulin-like growth factor-1 → Liver catabolism

The first drugs found in 2024
> cDNA-based plasmid genes
> Unknown clinical results and data

However, there is currently no standard detection method in anti-doping laboratories

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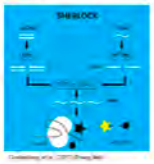
Analysis techniques for Gene and Cell doping

Sequencing-based methods -> require massive sample preparation
-Target-enrichment for specific sequences: qPCR, qRPA, ddPCR
-Long-read sequencing: WES, WGS

Multiplexed CRISPR-based methods -> crude samples can be applied, rapid and simple
-Targeted nucleic acid detection: SHERLOCK(Cas13), DETECTR(Cas12), HOLMES(Cas12)



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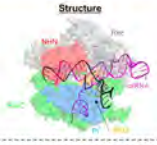
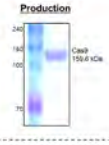
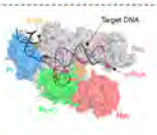
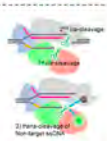
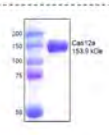
Class II CRISPR for DNA targeting diagnosis

	Structure	Action mechanism	Production
spdCas9 DNA binding protein Type II-A CRISPR NHN, RuvC nuclease dsDNA Target 5'NGG3' PAM			
asCas12a Trans-cleavage activity Type V-A CRISPR RuvC nuclease ss/dsDNA Target 5'TTV3' PAM			

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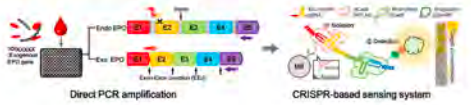
Result and discussion

Part 1

CRISPR/dCas9-based high-throughput gene doping analysis (HiGDA) for exogenous human erythropoietin gene doping detection

HiGDA uses two dCas9/sgRNA (RNP) that target different exon-exon junctions of EPO gene



Advantage of HiGDA

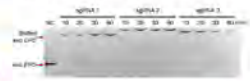
1. High throughput both on sample preparation and detection
-Direct PCR amplification without DNA extraction by whole blood templated PCR
-Magnetic bead-based rapid isolation and detection process
2. Colorimetric analysis using HRP
3. Dessise Confirmation of two exon-exon junction at the amplification and detection step
4. Versatile application using programmable sgRNAs and primers
5. Sensitive to detect 2.5 copies of the exogenous *EPO* gene

Yi JY et al. Talanta. 2023 Jun 1;258:124493. doi: 10.1016/j.talanta.2023.124455.

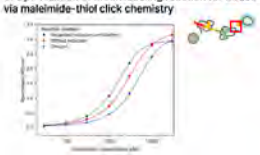
Optimization process of HiGDA

1. exogenous *EPO*-targeting sgRNA binding test: sgRNA1, sgRNA2, sgRNA3

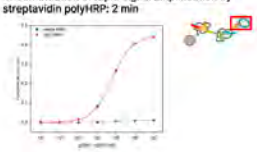
2. Target binding time optimization: 10 min



3. Optimization of biotin labeling reaction for dCas9 via maleimide-thiol click chemistry



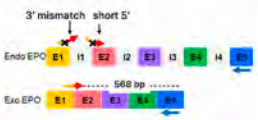
4. Confirmation of rapid signal amplification by streptavidin polyHRP: 2 min



Yi JY et al. Talanta. 2023 Jun 1;258:124455. doi: 10.1016/j.talanta.2023.124455.

Blood direct amplification enabled target amplification within 45 min using whole blood

Design of exogenous gene specific primers



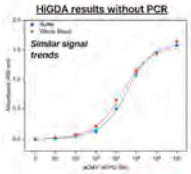
Results of blood direct amplification

- 5–10 copies of exogenous *EPO* were identified on an agarose gel
- TritonX-100 is the most important reagent for blood debris separation

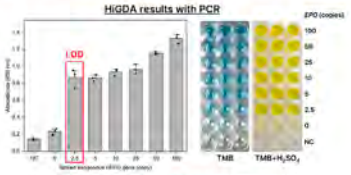
Yi JY et al. Talanta. 2023 Jun 1;258:124455. doi: 10.1016/j.talanta.2023.124455.

HiGDA detected 2.5 copies of the exogenous *EPO* gene within 90 minutes from whole blood

HiGDA results without PCR



HiGDA results with PCR



LOD w/o PCR: 12.3 fM (7.41 × 10^3 copies)

Limit of detection of HiGDA was 2.5 copies for exogenous *EPO*

The matrix effect was found to be minimal, regardless of the use of blood samples with gDNA

Yi JY et al. Talanta. 2023 Jun 1;258:124455. doi: 10.1016/j.talanta.2023.124455.

Conclusions of HiGDA

HiGDA		qPCR*
None	Sample treatment	DNA extraction
Colorimetric (HRP)	Detection method	Fluorescence (TaqMan)
2.5copies*	Sensitivity	20 copies*
90 min	Assay time	> 3 hr

- HiGDA's limit of detection is 2.5 copies, meeting the gene doping guidelines set (10 copies) by WADA.
- Blood samples without the need for preprocessing allows for significant reductions in analysis time
- Future challenges include validating its practical applicability using animal models and transitioning to a multiplexing assay for different genes.

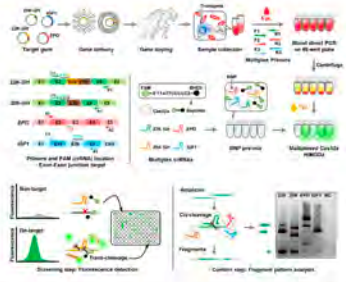
Yi JY et al. Talanta. 2023 Jun 1;258:124455. doi: 10.1016/j.talanta.2023.124455.

Result and discussion

Part 2

CRISPR/Cas12a-based high-throughput multiplexed gene and cell doping analysis (HiMDA) for simultaneous gene doping detection

HiMDA utilizes Cas12a harboring target-dependent fluorescence reporting system

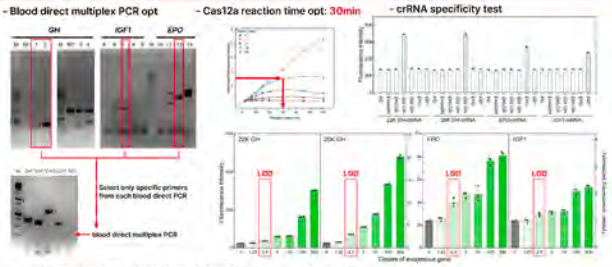


Features of HiMDA

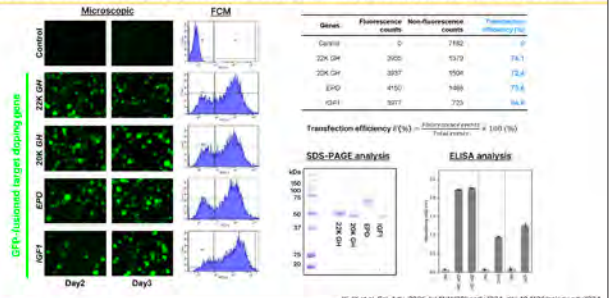
1. Multiplexing for both PCR and CRISPR
2. High-throughput sample preparation
   -Blood direct multiplex PCR
   -Cas12a reaction with crude PCR product
3. Versatile application with programmable crRNAs and multiplex primers
4. Accurate analysis platform divided into screening and confirmation process

HiMDA detected 2.5 copies of 4 exogenous doping genes spiked in whole blood within 2 hr

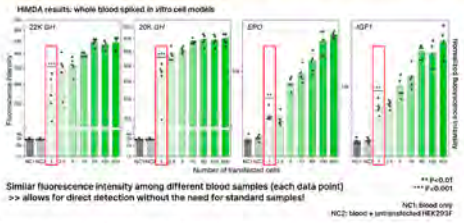
- Blood direct multiplex PCR opt
- Cas12a reaction time opt: 30min
- crRNA specificity test



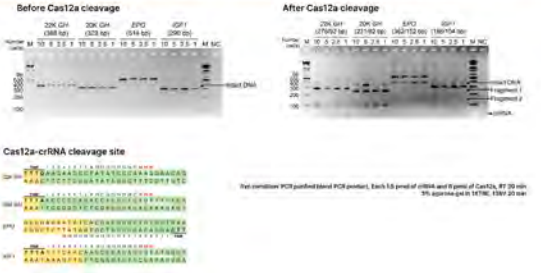
Cell models carrying doping genes were developed through transfection of HEK293F cell line



In the cell models, single cell with the transgene was detected by HiMDA



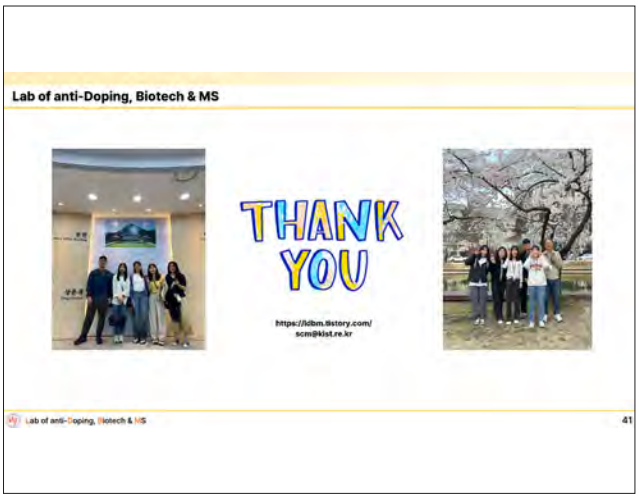
Fragment pattern analysis of HiMDA identified the single cell carrying the transgene



Conclusions of HiMDA

	Exogenous doping gene (confirm DNA)		Cell model
	min PCR (pM)	mf PCR (copies)	mf PCR (cells)
22K GH	27.0	2.5	1
20K GH	12.3	2.5	1
EPO	39.3	2.5	1
IGF1	27.8	2.5	1

1. HiMDA successfully detected single-cell models and as low as 2.5 copies of doping genes for four potential targets using 5 μL of whole blood, all within a 90 minutes of analysis time.
2. Both cell DNA and cell-free DNA could be amplified and detected in HiMDA due to the use of whole blood in the blood direct PCR process.
3. The versatile analysis design, high-throughput sample preparations, and multiplexed amplification and detection showed HiMDA's applicability in anti-doping laboratories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THANK YOU
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The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 14: 여성 선수를 위한 스포츠의학: 성별에 따른 맞춤형 접근

Gender-Specific Approaches in Sports Medicine for Female Athletes

좌장: 서울아산병원 진영수, 계명대학교 안나영

권지은

학력

서울대학교 의과대학 의학과 학사

서울대학교 의과대학 임상의과학과 석사

서울대학교 의과대학 정형외과학 박사 수료

주요 경력

대한스포츠의학회 SAT 인증관리위원회 간사

대한스포츠의학회 여성스포츠위원회 위원

한국도핑방지위원회 (KADA) 치료목적사용면책 (TUE) 위원

대한견주관절 국제위원회 위원

대한노년근골격의학회 학술위원회 위원

현재 소속 및 직위

이화여자대학교 의과대학 부속 의료원 목동병원 임상부교수

대표논문

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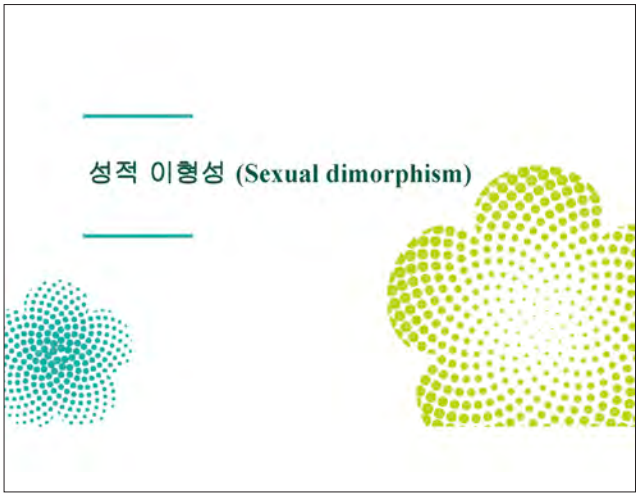
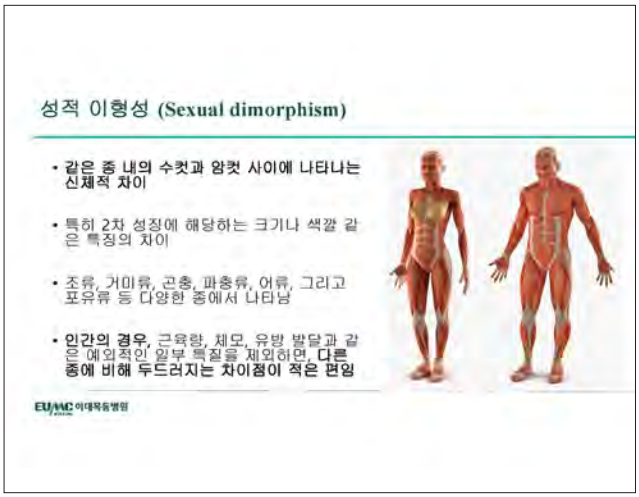
2. Kwon J, Lee YH, Kim SH, Ko JH, Park BK, Oh JH. Delamination Does Not Affect Outcomes After Arthroscopic Rotator Cuff Repair as Compared With Nondelaminated Rotator Cuff Tears: A Study of 1043 Consecutive Cases. Am J Sports Med. 2019 Mar;47(3):674-681.
3. Oh JH, Lee YH, Lee TH, Jang SI, Kwon J. The Natural History of High-Grade Partial Thickness Rotator Cuff Tears: The Conversion Rate to Full Thickness Tears and Affecting Factors. Clin Orthop Surg. 2020 Dec;12(4):514-520.

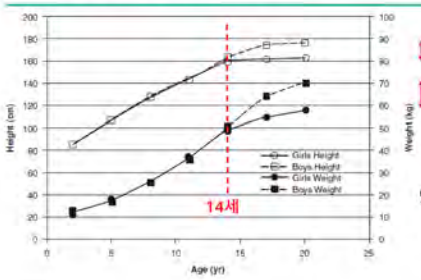
여성 선수의 생리학적, 해부학적 특징: 성별에 따른 차이
Understanding Sex Difference: Physiological and Anatomical Considerations

이대목동병원
권지은





성적 이형성 (Sexual dimorphism)



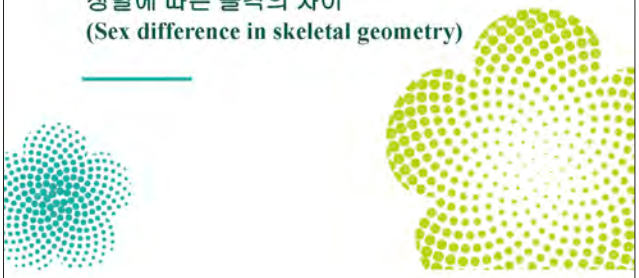
2세부터 20세까지
남자 아이와 여자아이의
평균 몸무게 및 키
(2000년 미국 CDC)

성적 이형성 (Sexual dimorphism)

- 일반적인 신체 특징 (general body characteristic) 외에도, **골격과 연조직 구성, 생리학적 성 차이가 존재함.**
- 이러한 차이는 **움직임의 패턴, 부상 위험, 근골격계 질환의 발병 및 진행에** 영향을 줄 수 있으므로, **성별에 따른 생리·해부학적 차이를 이해하는 것은 중요함.**

EUMC 이대목동병원

성별에 따른 골격의 차이
(Sex difference in skeletal geometry)



성별에 따른 골격의 차이
골 형태의 차이

- 골반골 (Pelvis)
  - 골반골은 성별에 따른 형태의 차이가 가장 두드러지는 골임
  - 여성의 골반골은 출산에 적합하도록 넓고 얕은 골반 내 공간 (wide and shallow pelvic cavity)을 가지고 있음

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성별에 따른 골격의 차이
골 형태의 차이

- 골반골 (Pelvis)

	남성	여성
골반 입구 (Pelvis inlet)	좁은 하트 모양 (small and heart-shaped)	넓고 둥근 모양 (wide and round-shaped)

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성별에 따른 골격의 차이
골 형태의 차이

- 골반골 (Pelvis)

	남성	여성
엉치뼈 (sacrum)	길고 좁음 (long and narrow)	짧고 넓음 (short and wide)
꼬리뼈 (coccyx)	덜 유연함 (less flexible)	더 유연함 (more flexible)

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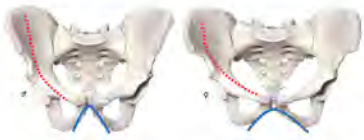
성별에 따른 골격의 차이
골 형태의 차이

• 골반골 (Pelvis)



	남성	여성
장골 (ilium)	높고 수직에 가까운 형태임 (high and vertical)	넓적하고 완만한 형태임 (wide and less vertical)
치골 간 각 (subpubic angle)	70-75°	90-100°

EUMC 이대목동병원

성별에 따른 골격의 차이
골 크기의 차이

• 장골 (Long bone)
- 대퇴골 (Femur)

대퇴골 계측값	남성	결정이 어려움 (undetermined)	여성
대퇴골두 직경 (Diameter of the femoral head)	≥ 46.5mm	43.5 – 46.5 mm	≤ 43.5mm
대퇴과 간 넓이 (Bicondylar width)	≥ 76mm	74 – 76mm	≤ 74mm
대퇴골의 길이 (Length of femur)	≥ 430mm	405 – 430 mm	≤ 405mm

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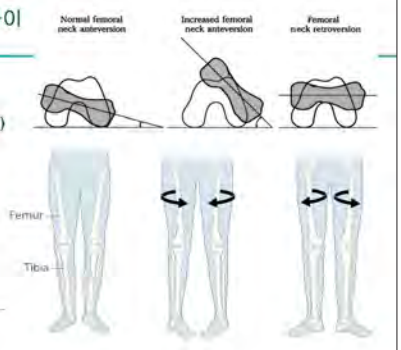
성별에 따른 골격의 차이
정렬의 차이

• 대퇴골 전경각 (femoral neck anteversion)

• 대퇴골 근위부와 원위부의 축이 이루는 각

• 대퇴골 전경각은 여성이 남성에 비해 평균 1 – 10 도 가량 증가되어 있음



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성별에 따른 골격의 차이
정렬의 차이

• 대퇴사두각 (Q-angle)

• 전상장골극 (anterior superior iliac spine, ASIS)에서 슬개골 중간 지점을 잇는 선과 슬개골의 중간 지점에서 경골 결절 (tibial tuberosity)을 잇는 선이 이루는 각

• 여성이 남성보다 평균적으로 4-5 도 가량 큰 값을 보임

EUMC 이대목동병원

성별에 따른 골격의 차이
정렬의 차이

• 운반각 (Carrying angle)

• 상완과 전완이 이루는 각도

• 남성에서 평균 5-10도, 여성에서 평균 10-15 가량의 값을 보임

• 여성이 남성에 비해 평균 5 도 가량 더 큰 값을 보임

EUMC 이대목동병원

성별에 따른 골격의 차이
정렬의 차이

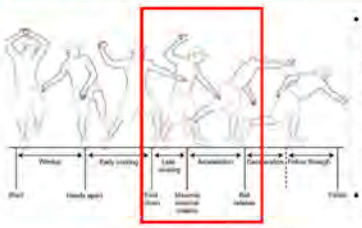
• 운반각이 큰 경우,

• 팔꿈치관절의 내측으로 지나가는 척골 신경이 쉽게 자극될 수 있어, 주관증후군 (cubital tunnel syndrome)이 발생하기 쉬움

• 손을 짚고 넘어졌을 때, 팔꿈치 관절의 탈구나 골절이 쉽게 발생함

EUMC 이대목동병원

성별에 따른 골격의 차이
정렬의 차이



팔꿈치 관절에 외반력
(valgus stress on elbow)

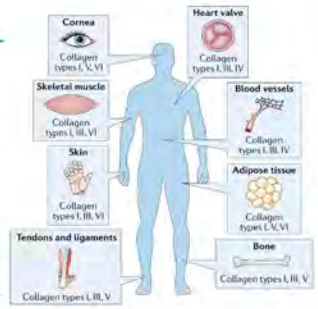
- 지속적인 던지기 동작으로 팔꿈치 관절에 반복적인 외반력(valgus force)이 가해질 경우, **척골 신경염 (ulnar neuritis), 굴곡건염 (flexor tendinitis), 내측측부인대 손상 (ulnar collateral ligament injury)** 이 발생할 수 있음
- 운반각이 클 경우, 이러한 손상의 위험이 높음

EUMC 이대목동병원

성별에 따른 조직학적 차이
(Sex difference in collagenous, cartilage, and bone tissue)

1. 콜라겐 (collagen)

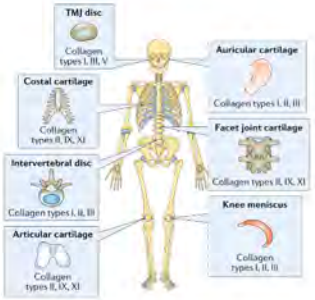
- 인체의 세포 외 기질 (extracellular matrix)을 구성하는 주요 구조 단백질 (structural protein)



EUMC 이대목동병원

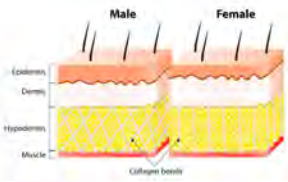
1. 콜라겐 (collagen)

- 연골, 골, 혈관, 피부를 비롯하여 여러 결합 조직을 구성하고 있음.
- 28 가지 아형 (subtype)이 있으나 I, II, III형이 전체 콜라겐의 80-90% 를 차지함



EUMC 이대목동병원

1. 콜라겐 (collagen)



- 성별에 따라, 조직의 두께와 콜라겐의 배열, 함량, 대사율에 차이를 보임
- 예를 들어, 피부 조직에서 콜라겐 함량은 나이가 들수록 감소하며, 동일 연령의 남성에 비해 여성에서 적은 것으로 알려져 있음

EUMC 이대목동병원

2. 연골 (Cartilage)

- 여성에서 **골관절염 (osteoarthritis)**의 발병 위험은 남성에 비해 1.5 – 4배 가량 높음
- 성별에 따른, 관절 연골의 구조적 차이가 존재하며, 연골의 생성과 분해와 같은 대사에도 차이가 있음

EUMC 이대목동병원

2. 연골 (Cartilage)

구조적 차이

- 성별에 따른 관절 연골 형태의 차이는 아동기 (9 – 18세) 에서부터 확인되며, 여성의 폐경기 이후 차이가 심화됨

연골의 부피 연골의 두께 연골의 표면적	남성	≥	여성

- 이러한 차이는 연령, 체질량지수, 신체 활동 등, 관련 요인을 보정한 이후에도 동일하게 확인됨

EUMC 이대목동병원

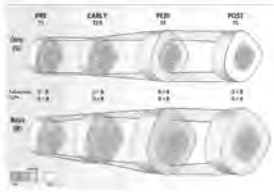
2. 연골 (Cartilage)

대사 (metabolism)의 차이

- 남아는 여아에 비해 연골 조직이 빠르게 생성됨
- 고령의 여성은 동일 연령 남성에 비해 연골 조직 소실 속도가 빠름
- 연골 조직에 있는 성 호르몬 수용체 (sex hormone receptor)를 통해 성 호르몬이 관여

EUMC 이대목동병원

3. 골 (Bone)

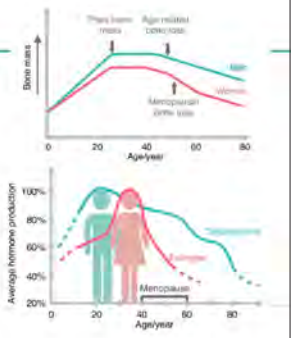


- 여성은 동일 연령 남성에 비해 골의 질량이 적고, 두께가 얇으며, 밀도와 강도가 떨어짐
- 골의 구조적 차이와 골의 생성 및 소실의 차이에 기인함

EUMC 이대목동병원

3. 골 (Bone)

- 남성과 여성은 모두, 아동기에서부터 청소년기를 거쳐 성인에 이르기까지 골 질량을 축적함.
- 평균적으로 30세 가량에 최대 골 질량을 기록하게 됨



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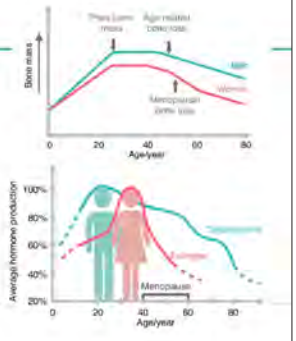
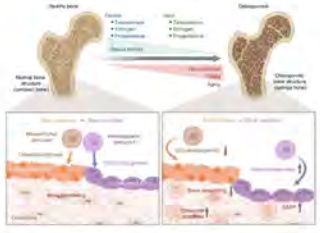
3. 골 (Bone)

- 나이가 들면서 성 호르몬의 분비가 감소하고, 골 질량이 함께 감소
- 여성의 경우, 폐경기에 급격한 여성 호르몬의 감소와 함께 골 질량과 밀도가 크게 감소



EUMC 이대목동병원

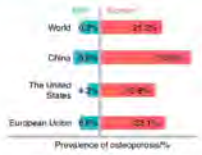
3. 골 (Bone)

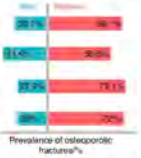


- 건강한 골은 생성과 흡수가 균형을 이루고 있음
- 생성에 비해 흡수가 늘어나면 골의 질량과 밀도가 감소하며 **골다공증 (osteoporosis)**이 발생함

EUMC 이대목동병원

3. 골 (Bone)



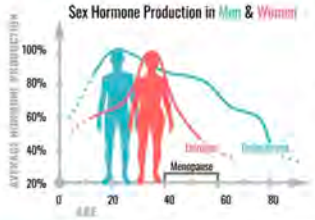


- 여성은 남성에 비해 골다공증이 발생할 위험이 약 3-4 배 가량 높음
- 여성은 남성에 비해 골다공증성 골절 발생 위험이 약 1.5 - 3 배 가량 높음

EUMC 이대목동병원

성별에 따른 생리학적 차이
(Sex difference in physiological mechanism)

1. 성 호르몬 (Sex hormone)

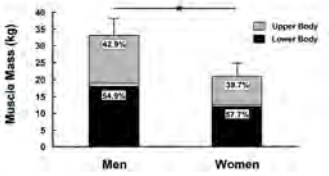


- 성인 남성은 성인 여성에 비해 내인성 테스토스테론 (endogenous testosterone) 이 약 15배 가량 높음
- 성인 여성은 남성이 비해 내인성 에스트로겐 (estrogen) 이 약 4배 가량 높음
- 테스토스테론은 골격근에 동화 효과 (anabolic effect) 가 있어, 사춘기 이후 성별에 따른 운동 수행 능력 차이를 만드는 주된 원인으로 작용함

EUMC 이대목동병원

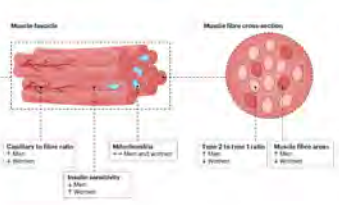
2. 근골격계 (Musculoskeletal system)

- 여성은 남성에 비해 절대적인 골격근량이 적음 (남성 33kg, 여성 21kg). 이러한 차이는 키를 보정해도 동일하게 확인됨.
- 골격근량의 차이는 하지에 비해 상지에서 더욱 두드러짐.
  - 상지 – 여성의 골격근량이 남성에 비해 40% 가량 적음
  - 하지 – 여성의 골격근량이 남성에 비해 33% 가량 적음



EUMC 이대목동병원

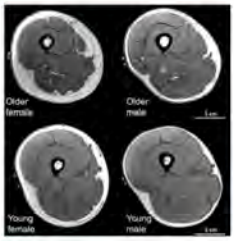
2. 근골격계 (Musculoskeletal system)



- 여성의 근섬유는 남성에 비해 단면적 (cross-sectional area, CSA) 이 작고, 제 1형 근섬유의 상대적 비중이 크며, 제 2형 근섬유의 비중이 작음
- 그러나, 근섬유의 절대적인 개수 (absolute number of fibres within a muscle), 근섬유 단위 면적 당 발생시키는 힘 (force per unit CSA of fibres) 에는 성별에 따른 차이가 없음

EUMC 이대목동병원

2. 근골격계 (Musculoskeletal system)

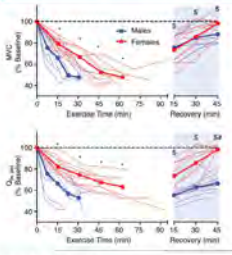


- 최대 근력 (maximal muscle strength)은 근육의 단면적과 관련이 있음
- 파워 (power)는 근력과 수축 속도 (contractile velocity)와 관련이 있음

근육량 (muscle mass)	남성	> 여성
근육의 단면적 (CSA of skeletal muscle)		
근력 (muscle strength)		
Type II (fast)/ Type I (slow)		
파워 (muscle power)		

EUMC 이대목동병원

2. 근골격계 (Musculoskeletal system)

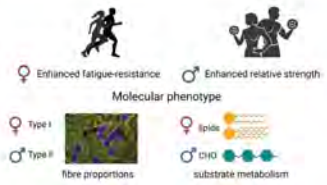


• 여성은 남성에 비해 근육의 피로 저항성 (fatigue resistance) 이 높은 것으로 알려져 있음

Type I (Oxidative)/ Type II (Non-oxidative)	남성 < 여성
대사물 제거 (metabolite) i.e. 젖산 (lacatate)	
유산소 능력 (Oxidative capacity)	
에스트로겐의 근육 회복 및 손상 보호	

EUMC 이대목동병원

2. 근골격계 (Musculoskeletal system)



• 그 결과, 여성은 지구력을 필요로 하는 운동에 유리하고 (fatigue-resistance exercise – type 1 muscle fiber), 상대적으로 남성은 고강도 운동 (high intensity exercise – type 2 muscle fiber)에 유리한 경향을 보임

EUMC 이대목동병원

3. 심혈관계 (Cardiovascular system)

• 최대 산소 섭취량 (VO2 mas)

- 신체가 운동 중 섭취할 수 있는 산소의 양 (산소량/ min/ kg)
- 심폐 지구력과 유산소 체력의 대표적인 지표
- 폐 기능 (pulmonary function), 심혈관 기능, 근육량의 영향을 받음

EUMC 이대목동병원

3. 심혈관계 (Cardiovascular system)

• 심박출량 (Cardiac output)은 심박수 (Heart rate) 와 1회 박동 시 펌프되는 혈액량 (Stroke volume)의 영향을 받음. 심박수에는 성별에 따른 차이가 없음.

심장의 크기 (Heart size)	남성 > 여성
1회 박동량 (Stroke volume)	
심박출량 (Cardiac output)	
혈액 내 헤모글로빈 비중 (Hb concentration)	
골격근량 (Skeletal muscle mass)	
최대 산소 섭취량 (VO2 mas)	

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4. 호흡기계 (Pulmonary system)

• 여성은 남성에 비해 폐의 크기가 적음. 이는 키에 따른 편차를 보정해도 유지됨.

• 여성은 남성에 비해 기도가 좁음. 이는폐의 크기에 따른 차이를 보정해도 유지됨

EUMC 이대목동병원

여성 선수의 스포츠 활동 특성
(Characteristics of female athletes in sports activity)

1. 근력 및 훈련 반응 (Muscle strength and Training response)

- 남성은, 여성에 비해 절대적으로 더 큰 근육량 (absolute muscles mass)을 가지고 있음. 장기간 훈련 시 절대적인 근육 성장 규모가 더 큼.
- 단기간 저항 훈련 (6-12주, resistance exercise) 에 대한 상대적 근력 향상률 (strength gain rate) 은 남성과 여성에서 유사하게 측정됨.

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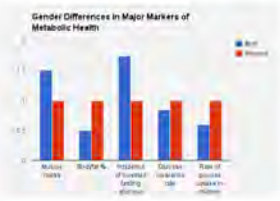
2. 대사 효율 및 에너지원 이용 (metabolic efficiency)



- 여성은 운동 중 에너지 공급을 위해 지방을 연료로 사용하는 경향이 강함 (fat metabolism).

→ 탄수화물 (글리코겐)을 절약하고 지구력 운동 시 피로를 지연시키는데 유리하게 작용함.

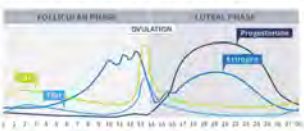
→ 남성에 비해 상대적으로 피로 저항성 (fatigue resistance)이 높고 운동 후 회복 속도가 빠름.

(제 2형 근섬유 비율↑, 혈관 확장에 유리. 근육 내 관류가 원활)

EUMC 이대목동병원

3. 생리 주기와 스포츠 활동 반응의 변화 (Menstrual cycle and sports performance)

- 여포기 (Follicular phase)
  - 생리 시작부터 배란까지의 기간
  - 에스트로겐 수준이 점진적으로 상승
  - 고강도 근력 훈련에 적합



- 황체기 (Luteal phase)
  - 배란 후부터 생리 전까지의 기간
  - 에스트로겐과 프로게스테론 모두 높은 수준
  - 체온 상승, 심박수 증가, 체액 저류
  - 호르몬 변동에 따른 인대 이완성과 강도 변화로 전방십자인대 손상 위험성이 높음

EUMC 이대목동병원

4. 영양학적 문제 (Nutritional issues)

- 낮은 에너지 가용성 (Low Energy Availability, LEA)
  - 섭취 칼로리가 운동으로 소모되는 에너지보다 지속적으로 부족한 상태
  - 여성 선수들이 체중 감량, 체지방률 감소에 대하여 더 큰 압박을 느끼는 사회, 문화, 심리적 요인과 관련이 있음
- 미세 영양소 결핍 (Micronutrient Deficiencies)
  - 낮은 에너지 가용성으로 인해 철분 (Iron), 칼슘 (Calcium), 비타민 D 등 필수 미세 영양소의 섭취가 부족해지기 쉬움
  - 특히, 철분 결핍은 여성의 월경 (menstruation) 으로 인한 혈액 손실과 결합하여 빈혈 및 지구력 성능 저하를 유발할 수 있음

EUMC 이대목동병원

5. RED-S (Relative Energy Deficiency in Sports)

- 낮은 에너지 가용성 (Low Energy Availability, LEA)으로 인해 발생하는 신진대사 기능 장애 증후군
- 단순한 식이 장애를 넘어, 성기능, 골격, 면역, 내분비 등 전신 시스템에 광범위하게 부정적인 영향을 미침

EUMC 이대목동병원

5. RED-S (Relative Energy Deficiency in Sports)

- 성기능 장애 – 무월경 (Amenorrhea) 또는 희발 월경 (Oligomenorrhea)
- 골격 건강 저하 – 골밀도 (Bone Mineral Density, BMD) 감소, 피로 골절 (stress fracture) 위험성
- 내분비계 교란 – 갑상선 호르몬, 인슐린, 성장 호르몬 등 다양한 호르몬 축의 교란

EUMC 이대목동병원

5. RED-S (Relative Energy Deficiency in Sports)

- 성장 저해 (impaired growth)
- 건강 악화 (adverse effect on health)
- 운동능력 저해 (adverse effect on sports performance)

- 16세 이상에서 월경이 없는 경우, 6개월 이상 무월경인 경우, 월경 주기가 심하게 불규칙한 경우, 염두에 두어야 함
- 피임약을 복용중인 경우, 이러한 이상 징후를 놓치기 쉬우므로 주의 요망

EUMC 이대목동병원

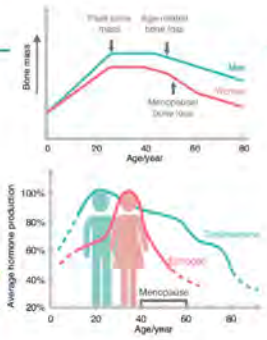
Summary

- 여성이 남성에 비해
  - 키 (Height) ↓
  - 체중(Wieght) ↓
  - 체지방 (Body fat) ↑
  - 근육량 (Muscle mass) ↓
  - 근력 (Strength) ↓
  - 파워 (Power) ↓

EUMC 이대목동병원

Summary

- 여성이 남성에 비해
  - 최대 골 질량 (Peak bone mass) ↓
  - 피질골 두께 (Cortical bone thickness) ↓
  - 골밀도 (Bone mineral density) ↓
  - 골 강도 (Bone strength) ↓
  - 골다공증 (osteoporosis)발생 위험 ↑



EUMC 이대목동병원

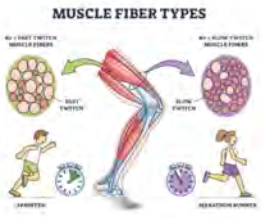
Summary

- 여성이 남성에 비해
  - 연골의 부피 ↓
  - 연골의 두께 ↓
  - 연골 표면적 ↓
  - 골관절염 (osteoarthritis)의 발생 위험 ↑

EUMC 이대목동병원

Summary

- 여성이 남성에 비해
  - 제 1 근섬유/제 2 근섬유 ↑
  - 에너지원으로 지방 사용 (fat metabolism)
  - 대사물 축적 ↓
  - 산성화 ↓
  - 유산소 능력 ↑
  - 에스트로겐의 근육 회복 및 손상 보호 효과
  - 피로 저항성 (Fatigue resistance) ↑
  - 피로 회복 속도 ↑



EUMC 이대목동병원

Summary

- 여성이 남성에 비해
  - 심장의 크기 ↓
  - 심박출량 (Cardiac output) ↓
  - 혈액내 헤모글로빈 (Hb concentration) ↓
  - 폐의 크기 ↓
  - 기도의 직경 ↓
  - 최대 산소 섭취량 (VO2 max) ↓

- 남성 – 고강도 운동/ 여성 – 지구력 운동

EUMC 이대목동병원

Summary

- 여성이 남성에 비해
  - 골반 너비 ⬆
  - 대퇴 전경각 (femoral anteversion) ⬆
  - 대퇴 사두각 (Q-angle) ⬆
  - **전방십자인대 손상 (ACL injury) 위험 ⬆**
  - **전방 무릎 통증 (anterior knee pain)발생 위험 ⬆**

EUMC 이대목동병원

Summary

- 여성이 남성에 비해
  - 낮은 에너지 가용성 (Low Energy Availability, LEA) 발생 가능성 ⬆
  - **상대적 에너지 결핍 증후군 (Relative Energy Deficiency in Sports, RED-S)** 발생 가능성 ⬆
    - 식이장애, 골다공증, 무월경

→ 성장 저해, 건강 악화, 운동 퍼포먼스 저해

EUMC 이대목동병원

Summary

- 성별에 따른 생리,해부학적인 차이는
  - 움직임의 패턴
  - 운동 반응
  - 부상 위험
  - 근골격계 질환의 발병 및 진행

에 영향을 줄 수 있음.

- 따라서, 성별에 따른 이러한 차이를 이해하는 것은 개인의 건강과 질병을 관리하는 건강 관리 전문가 (health care professionals)들은 물론, 공중 보건 (public health) 을 관리하는 학자나 정책 관리자에게도 중요함.

EUMC 이대목동병원

Thank you for your attention

이동원

학력

가톨릭대학교 의과대학 정형외과학 박사

주요 경력

대한체육회 스포츠의학위원회 위원

대구광역시 스포츠과학센터 의무위원

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현재 소속 및 직위

건국대학교병원 스포츠수술, 통증 클리닉장

건국대학교병원 반월연골판이식클리닉장

건국대학교 의과대학 정형외과학 교실 부교수

대표논문

1. 전방십자인대 재건술의 최근 경향 및 향후 발전 방향: 최신 지견 리뷰. 2023 (대한스포츠의학회지 교신 저자 이동원)
2. 무릎 손상 및 질환 환자에서 혈류 제한 운동의 적용: 최신 경향 분석. 2024 (대한스포츠의학회지 교신 저자 이동원)
3. 전방십자인대 재건술 전후의 기능 회복 치료: 최신 경향 분석. 2024 (대한스포츠의학회지 교신 저자 이동원)

여성 선수에서 흔한 무릎 질환: 전방십자인대 손상과 슬개대퇴통증증후군 중심으로
Common Knee Disorders in Female Athletes: Focus on ACL Injuries and Patellofemoral Pain Syndrome

건국대병원
이동원

Introduction

Knee injuries are a leading cause of time lost from sport in female athletes. Anterior cruciate ligament (ACL) injuries occur two- to eight-times more often in women than in men, and only about two-thirds of those injured return to their preinjury level of competition. Patellofemoral pain syndrome (PFPS) is also widespread among adolescent and young adult women who participate in running, jumping, or cutting sports. These differences reflect not only knee size but a combination of anatomical, hormonal, neuromuscular and training-related factors. Recognising these patterns early allows coaches and clinicians to act before injuries occur.

1. ACL Injuries in Female Athletes

1) Multiple Factors

Several features work together to raise the risk:

- Anatomy: narrower intercondylar notch, steeper lateral tibial slope, smaller ACL cross-section, higher Q-angle.
- Hormones: cyclical changes in estrogen may increase ligament laxity at certain phases of the menstrual cycle, though direct causation is still debated.
- Movement and muscle control: greater knee abduction (dynamic valgus), less knee flexion, and reduced hip rotation and abduction on landing or cutting; insufficient medial hamstring activation.
- Training load: high volumes with limited recovery and limited strength work may amplify the above risks.

These internal and external factors interact across adolescence and may partly explain why injury

rates rise after puberty.

2) Clinical Patterns

Female athletes more often present with ACL injuries combined with meniscal or cartilage damage rather than isolated injuries and show higher rates of both ipsilateral and contralateral reinjury. This not only delays return to play but may accelerate early degenerative changes in the knee if not addressed.

3) Injury Prevention and Functional Recovery Program

Effective prevention and functional recovery programs for female athletes focus on restoring normal joint mechanics and muscle balance while limiting stress on the knee during high-risk movements. Rather than relying on a single named protocol, the emphasis is on consistent application of proven training elements. Key components include:

- Progressive strengthening of the hip, hamstring and core muscles to improve proximal control and reduce dynamic valgus.
- Closed-kinetic-chain exercises such as mini-squats, step-ups or leg presses within safe angles to encourage quadriceps–hamstring co-contraction and lower anterior shear forces on the ACL.
- Selective open-chain exercises (short-arc knee extensions, straight-leg raises) introduced at low loads to address isolated weakness without overloading the joint.
- Proprioceptive and balance training to retrain joint position sense, landing mechanics and cutting movements.
- Gradual load progression with feedback so that correct movement patterns are reinforced as training intensity rises.

Combining these elements makes it possible to strengthen the quadriceps safely, protect grafts or healing tissue, and accelerate return to sport. In practice, well-structured and regularly supervised training with clear progression is more important than following any single named protocol.

2. Patellofemoral Pain Syndrome (PFPS) in Female Athletes

1) Background and Mechanisms

Patellofemoral pain syndrome — also called anterior knee pain — is one of the most common overuse conditions in active young women. A larger Q-angle, ligamentous laxity, weak hip abductors, and delayed activation of the inner part of the quadriceps muscle (vastus medialis oblique, VMO) contribute to abnormal patellar tracking and increased loading of the patellofemoral joint. Many of these factors overlap with those associated with ACL injury, which means a single preventive approach can benefit both conditions.

2) Clinical Characteristics

Sports with repetitive jumping and landing, such as handball, volleyball, and gymnastics, show high PFPS prevalence and recurrence rates approaching 40% at one year. Persistent pain can limit training volume, reduce performance, and may predispose athletes to patellofemoral osteoarthritis if not addressed early.

3) Exercise-Based Care

Most cases improve with a structured exercise approach rather than surgery. A typical plan includes:

- Starting with low-load, pain-free closed- and open-kinetic-chain exercises in angles that minimise joint stress.
- Progressively adding hip and quadriceps strengthening, proprioceptive and core training as symptoms allow.
- Using taping or foot orthoses when needed to improve patellar alignment and reduce irritation.

Both closed- and open-kinetic-chain exercises have roles when combined properly:

- Closed-chain activities such as step-ups, mini-squats and leg press encourage co-contraction of quadriceps and hamstrings, improving joint stability.
- Open-chain exercises such as short-arc knee extensions, straight-leg raises or quadriceps sets can selectively target weak muscles at low load.

In the chronic phase, emphasis should shift toward exercises that recruit the VMO more strongly (for example, squats with isometric hip adduction or lunges) while continuing hip and core strengthening to reduce dynamic valgus. Education on training load, recovery, and correct movement patterns is essential to prevent recurrence and support a safe return to sport.

3. Shared Clinical Implications

ACL injury and PFPS in female athletes share two main features: dynamic valgus movement patterns and proximal muscle deficits. These common findings suggest that clinicians can apply a single framework for prevention and rehabilitation rather than treating each condition in isolation. Practical steps include: Prevention: begin sport- and age-specific neuromuscular and strength training before the competitive season.

- Assessment: screen for movement faults, hip strength and recovery status using simple field tests, and use instrumented measures when available.
- Rehabilitation: combine open- and closed-kinetic-chain exercises, increase the load gradually, and adapt exercises to each athlete's condition as symptoms and function change.
- By addressing these factors across the training cycle, clinicians and coaches may not only reduce injury incidence but also improve movement efficiency and long-term knee health in female athletes.

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The 67th Autumn Conference of Korean Society of Sports Medicine

사단법인 대한스포츠의학회

제67차 추계학술대회

자유연제 구연 4

Free paper presentation 4

좌장: 순천향대학교 김철현, 아주대병원 정준영

Subcritical Glenoid Bone Loss 의 외상성 전방 견관절 불안정성에서 관절경 연부 조직 안정화술 후 운동선수와 비운동선수 간의 임상 결과 및 재발률 비교
Comparison of Clinical Outcomes and Recurrence Rates between Athlete and Non-Athlete Patients after Arthroscopic Soft Tissue Stabilization for Traumatic Anterior Shoulder Instability with Subcritical Glenoid Bone Loss

고려대안암병원
황교선, 이진혁, 유강훈, 정웅교

목적(Background)
외상성 전방 견관절 불안정성을 가진 환자 중 관절와 골 결손이 20% 미만인 subcritical glenoid bone loss를 동반한 경우에 있어 관절경 연부 조직 안정화술을 시행한 후, 환자의 운동 여부에 따른 임상 결과 및 재발률의 차이를 분석하고자 하였다.

대상 및 방법(Methods)
본 후향적 비교 연구는 최소 2년 이상의 추시가 가능하고 관절경적 연부조직 안정화술(관절경 Bankart 봉합술, Hill-Sachs 병변에 대한 remplissage 수술, 또는 골성 Bankart 봉합술)을 받은 환자를 대상으로 하였다. 총 54명의 환자가 포함되었으며, 이 중 15명은 운동선수, 39명은 비운동선수로 분류되었다. 환자 특성을 조사하였으며, 수술 2년 후 Korean Shoulder Score for Instability(KSSI), University of California Los Angeles(UCLA) 점수, Rowe 점수, 그리고 관절 가동범위(ROM), 재발률 및 재수술률를 비교하였다.

결 과(Results)
운동선수군은 비운동선수군에 비해 유의하게 젊은 연령(21.3세 vs. 27.2세, P=0.026)을 보였으며, 불안정성 중증도 지수(ISIS, 5.1 vs. 3.0, P=0.002), 관절와 골 결손률(11.45% vs. 6.39%, P=0.008), KSSI(Korean Shoulder Score for Instability, 98.00 vs. 94.64, P=0.012)에서 모두 유의하게 높은 수치를 나타냈다. 반면, UCLA 점수(34.33 vs. 33.87, P=0.370)와 Rowe 점수(96.67 vs. 96.67, P=0.460)는 두 군 간 유의한 차이를 보이지 않았다. 수술 후 관절 가동범위에서는 운동선수군이 전방거

상(flexion) 범위에서 더 높은 수치를 보였으며(178.0도 vs. 172.8도, P=0.023), 반면 내회전(internal rotation) 범위는 오히려 더 낮았다(7.73 vs. 8.36, P=0.033). 재발률은 운동선수군에서 1명(7%), 비운동선수군에서 5명(13%)으로 나타났으나 통계적으로 유의한 차이는 없었다(P=1.000). 또한 운동선수의 93%(14명)는 평균 5.4개월(범위 4-8개월)의 재활 후 완전한 스포츠 활동 복귀를 이루었다.

결 론(Conclusion)

관절경 연부 조직 안정화술은 경계 이하 관절와 골 결손을 동반한 외상성 전방 불안정성 환자에서 운동 여부와 관계없이 우수한 임상적 예후와 낮은 재발률을 보였다.

자가 골연골이식술의 우수한 임상결과 및 영상학적 결과 : 양적 MRI 평균 4년 추시 연구

Autologous osteochondral transfer demonstrates satisfactory clinical outcomes and durable cartilage properties: A mean 4-year follow-up using quantitative MRI

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이효열[1], 김종민[2], 이범식[2], 송주호[2]

목적(Background)

Autologous osteochondral transfer (AOT) is preferred because of its ability to replace defective cartilage with hyaline cartilage. However, longitudinal changes in hyaline cartilage after AOT and their correlation with clinical outcomes remain unclear. This study aimed to evaluate the short-to-midterm outcomes of AOT, and investigate the correlation between clinical outcomes, and the morphologic and qualitative findings of cartilage. We hypothesized that cartilage would remain stable over the follow-up period and clinical outcomes would correlate with cartilage status.

대상 및 방법(Methods)

Patients who underwent AOT between 2002 and 2021 and were followed for a minimum of 2 years were retrospectively reviewed. Clinical outcomes were assessed at postoperative early-term (1–2 years postoperatively), and at short-to-midterm period (2–6 years postoperatively) using the Lysholm score, International Knee Documentation Committee (IKDC) score, Tegner activity scale, and visual analog scale (VAS) for pain. Morphology of cartilage was evaluated using Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) 2.0 scores, and quality was assessed quantitative magnetic resonance imaging (MRI) T2 mapping. In those who were assessed with serial MRIs at early term and short-to-midterm intervals, correlation analysis was performed to assess the relationship between MRI and clinical outcomes

결 과(Results)

A total of 45 patients with a mean age of 36.6±14.0 years (range, 16-63 years) were included. The mean follow-up period was 4.3±1.2 years.. The mean MOCART score was 84.0±11.5 at early term and 78.1±21.0 at midterm, with no significant changes between follow-up intervals. T2 value also remained unchanged between postoperative follow-ups. Significant improvements in the Lysholm, IKDC, and VAS scores observed at the early-term improved further through the midterm period. The MOCART score at the postoperative early term was correlated with VAS improvement (P=.003); however, no significant correlation was found between other clinical and MRI outcomes

결 론(Conclusion)

Postoperative improvements in clinical and MRI outcomes following AOT at the early-term follow-up were maintained through a mean follow-up of 4 years. The further improvement in clinical outcomes, despite stable MRI findings, suggests a limited correlation between structural and clinical outcomes.

아쿠아백 도구 운동이 만성 요통을 가진 중년 여성의 통증, 기능장애, 균형 능력, 심리사회적 요인에 미치는 영향

The Effects of Aquabag-Based Dynamic Stabilization Exercise on Pain, Disability, Balance, and Psychosocial Factors in Middle-aged Women with Chronic Low Back Pain

리본필라테스

허진희

목적(Background)

만성요통 환자를 위한 운동 중재 중 도구를 활용한 다양한 연구가 존재한다. 하지만 아쿠아백을 이용한 운동을 통한 만성요통 환자에 대한 연구는 부족한 것이 현실이다. 따라서, 본 연구는 본 연구는 만성 요통을 가진 중년 여성을 대상으로 아쿠아백 도구를 활용한 동적 안정화 훈련이 통증, 기능 장애, 균형 능력, 통증 자기효능감, 공포 회피 반응, 운동 공포, 삶의 질 등 신체 및 심리 사회적 요인에 미치는 효과를 검증하고자 한다.

대상 및 방법(Methods)

본 연구 는 만성 요통을 가진 중년 여성 16명을 대상으로, 아쿠아백 훈련군(Aquabag Training Group, ATG)과 허리 안정화 훈련군(Lumbar Stabilization Training Group, LTG)의 2그룹으로 나누었다. 8주간 주 2회 1시간동안 중재를 실시하였다. 중재 전 후 통증 강도(VAS), 기능 장애지수(ODI), 동적균형 능력(YBT), 통증 자기효능감(PSEQ), 공포 회피 반응(FABQ),운동 공포(TAMPA), 삶의 질(SF-36)을 측정하여 그룹간 비교를 실시하였다.

결 과(Results)

아쿠아백 훈련군은 통증 강도(Δ71%, p=.002), 기능 장애지수(Δ68%, p=.001), 동적 균형 능력(Δ29%, p<.001), 통증 자기효능감(Δ16 p=.041), 공포 회피 반응 및 운동 공포(p=.012, p=.007)에서 안정화 훈련군보다 더 향상된 것으로 나타났다. 또한 삶의 질(SF-36)에서는 신체 건강(PCS, p=.025), 정신 건강(MCS, p<.001) 모두에서 ATG가 더 유의한 향상을 나타냈다.

결 론(Conclusion)

본 연구는 아쿠아백 운동이 만성 요통 중년 여성의 신체적 기능 향상은 물론, 심리사회적 건강 회복을 위한 효과적인 중재 전략이 될 수 있음을 시사하며, 향후 임상 및 재활 현장에서의 실용적 적용 가능성을 제시한다.

대한민국 스포츠 지도자 자격시험에서 GPT-4o, Claude Sonnet 4, Gemini 2.5 Flash의 성능 비교 분석
Comparative Performance Analysis of GPT-4o, Claude Sonnet 4, and Gemini 2.5 Flash on the Korean National Sports Instructor Licensing Examination

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주식회사 델토이드 디지털헬스케어 분과*
박선영[1], 조광현[2], 김요섭*

목적(Background)

While ChatGPT and other large language models (LLMs) have demonstrated passing-level performance on medical licensing exams such as the USMLE and JMLE, relatively little research has examined their capabilities on professional certification exams in sports education. To address this gap, this study evaluates the performance of three advanced LLMs—GPT-4o, Claude Sonnet 4, and Gemini 2.5 Flash—on the 2024 Korean Sports Instructor Licensing Examination (SILE), a nationally administered, domain-specific certification exam. The exam includes seven core subject areas, and candidates must meet both per-subject and average score thresholds to pass. This study aims to analyze the subject-wise accuracy and relative strengths and weaknesses of each model in a controlled and standardized setting.

대상 및 방법(Methods)

All models were evaluated using an identical set of 134 multiple-choice questions drawn from the 2024 SILE, covering Sports Sociology, Sports Education, Sports Psychology, Korean Sports History, Exercise Physiology, Sports Biomechanics, and Sports Ethics. All questions were text-based, and image-containing items were excluded to ensure consistency. Identical prompts were used across all models. Responses were recorded as Top-1 answer selections and scored against the official answer key. Accuracy was computed both per subject and overall. All models were evaluated in the same execution environment to control for variation.

결 과(Results)

GPT-4o achieved the highest overall accuracy, correctly answering 125 out of 134 questions (93.1%), followed closely by Claude Sonnet 4 with 124 correct answers (92.5%) and Gemini 2.5 Flash with 120 (89.6%). GPT-4o demonstrated perfect accuracy in Sports Sociology, Biomechanics, and Ethics, while Claude Sonnet 4 achieved 100% in Sports Sociology, Biomechanics, Ethics, and Sports Psychology. Gemini's performance was generally consistent but slightly lower, particularly in Sociology (90%) and Ethics (95%). All models showed equivalent performance in Biomechanics. The models' strong overall scores suggest potential for high-stakes exam applications, though differences in subject-specific accuracy indicate domain variation in reasoning capabilities.

결 론(Conclusion)

All three tested LLMs surpassed the passing threshold required for the Korean SILE, with GPT-4o exhibiting the strongest overall performance. These findings reinforce the growing potential of LLMs as educational tools and evaluative agents in the sports and physical education domain. However, subject-level disparities—especially in areas involving abstract reasoning such as ethics—highlight the need for further domain-specific fine-tuning. Future studies may explore model consistency, inference capabilities, and prompt refinement techniques to improve reliability in certification-level tasks.

The 67th Autumn Conference of Korean Society of Sports Medicine

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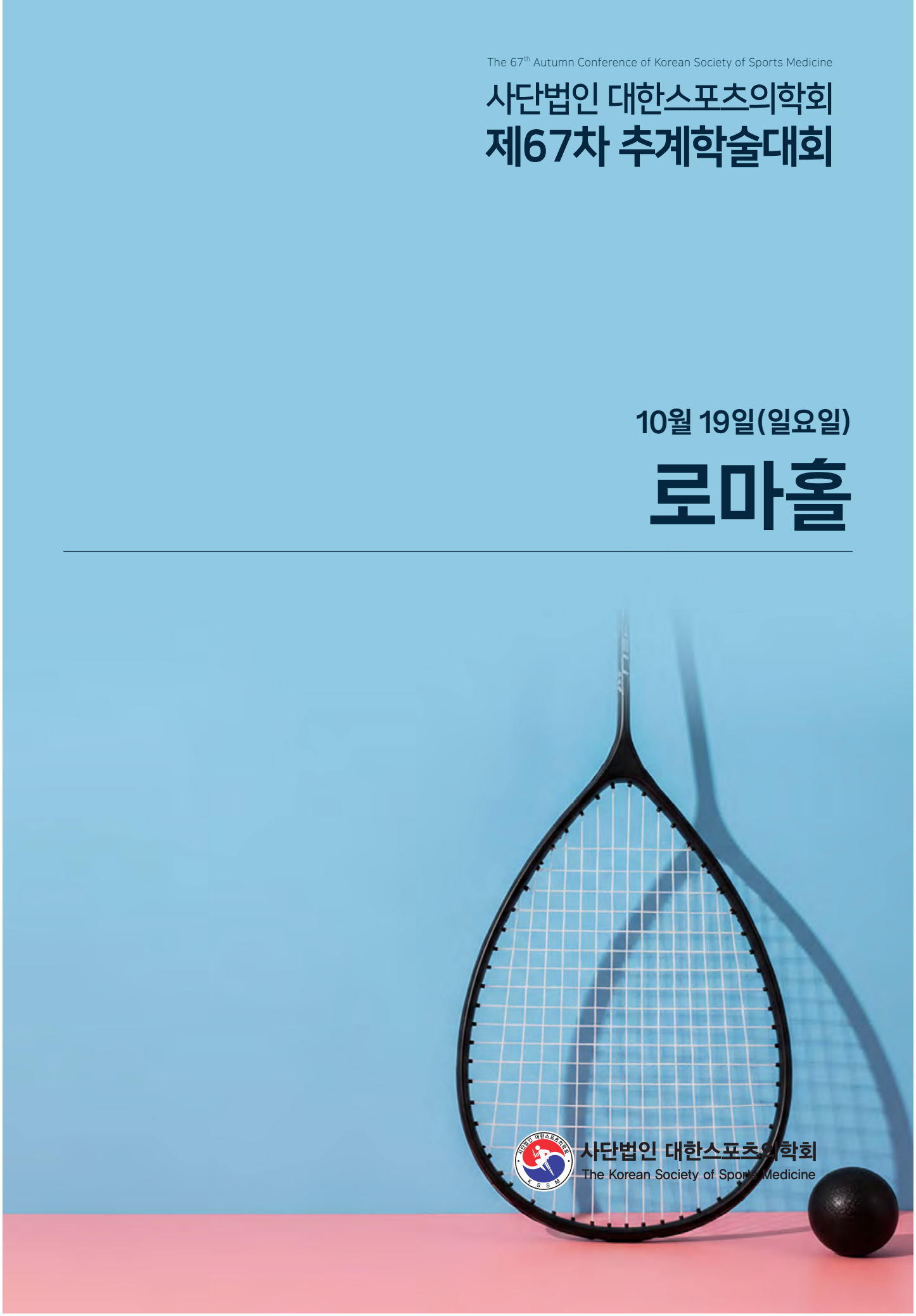
제67차 추계학술대회

10월 19일(일요일)

로마홀



사단법인 대한스포츠의학회
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사단법인 대한스포츠의학회

제67차 추계학술대회

심포지엄 9: 수술 후 기능 회복을 위한 시각적 피드백 운동의 임상적 적용

Clinical Application of Visual Feedback Exercise for Functional Recovery after Surgery

좌장: 동원대학교 양상진, 부경대학교 김태규

서용곤

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현) 문화체육진흥원 자문위원

현재 소속 및 직위

삼성서울병원 척추센터 건강운동관리사

대표논문

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2. Seo YG, Kim MK, Sung J, Jeong DS. Can exercise-based cardiac rehabilitation increase physical activity in patients who have undergone total thoracoscopic ablation?. Rev Cardiovasc Med. 2021;22:1595-1601.
3. Seo YG, Park WH, Oh S, Jeon ES, Choi JO, Kim HY, et al. The effects of pre-transplantation center-based cardiac rehabilitation on the postoperative quality of life and adherence to exercis

허리 수술 후 환자의 기능 개선을 위한 시각적 피드백 적용
Application of visual feedback for functional improvement in patients following spinal surgery

삼성서울병원
서용곤

건강보험심사심평원 자료에 따르면 국내 척추질환 환자는 전체 인구수 대비 22.0%로 전체 인구의 5명 중 1명은 척추질환으로 진료를 받았으며 평균 진단 연령은 매년 감소하여 2012년41.8에서 2021년 36.9세로 낮아졌으며 2021년도 평균 수술 연령은 60.5세로 2012년보다 5.4세 더 높아졌다고 보고하였다. 척추수술은 국내에서 4번째로 빈번하게 시행되는 수술이며 수술 후에도 통증이 완화되지 않거나 요통, 신경통 및 이상 감각과 같은 신체적 문제가 발생될 수 있으며 이러한 문제로 인해 정서적 불안감이나 우울 등 심리적 문제 또한 발생될 수 있다.

허리 수술 후 환자를 위한 운동 요법은 수술 후 환자의 통증을 완화하고 기능 개선을 통해 빠른 회복을 위한 중요한 중재(intervention) 중 하나이다. 허리 수술 환자를 위한 운동 요법에 대해 2025년도 발표된 review article에 따르면 운동은 다양한 형태가 적용 되고 있으며 대부분 관절가동범위 향상, 근 기능 개선, 균형감각 향상, 움직임 개선에 초점을 맞추어 진행되었으며 운동 요법을 적용할 때는 the patient's distinct presentation, surgical factors, expertise and experience of the clinician, available resources, and patient preferences을 적용해야 한다고 보고하였다.

바이오피드백(biofeedback)은 운동 요법을 적용할 때 이용되는 하나의 중재 방법으로 전자 기구나 센서를 통해 생리 활동에 대한 실시간 피드백을 제공함으로써 개인이 근육이완, 심박수, 호흡 패턴과 같은 신체의 반응을 인지하고 이를 이용하여 행동 변화를 일으키는 하나의 기술이다. Edmund Jacobson (1938)는 EMG를 이용하여 근육의 이완 여부를 판단한 최초의 의사이며 1966년도에 Joe Kamiya는 연구 성과 등을 통해 학계와 대중으로부터 biofeedback의 아버지라고 불리었다. 바이오피드백은 real-time feedback을 통해 시각(virtual), 청각(auditory), 그리고 시각과 청각을 함께 이용하는 형태로 진행되어 왔으며 그 중에서도 시각적(virtual) 바이오피드백은 가장 흔히 사용되는 방법으로 재활에서 surface EMG를 이용하여 근육의 활성도를 보여줌으로써 근육의 파워를 증가시키기 위한 방법으로 활용되는 EMG biofeedback는 가장 대표적인 방법이라고 볼 수 있다.

허리 환자에 대한 시각적 바이오피드백 적용은 환자에게 올바른 자세(posture)에 대해 인식을 시켜주는 것이며 이는 시각적 바이오피드백 적용을 통해 통증이 완화되고 움직임이 개선되면서 전반적인 신체 기능이 향상되는 효과를 기대 할 수 있다. 허리 환자

를 대상으로 진행된 이전의 대부분 연구에서는 abdominal hollowing과 같은 운동을 할 때 목표로 하는 근육의 활성도를 EMG나 초음파(Rehabilitative ultrasound imaging) 등을 이용하여 시각적 피드백을 주는 형태로 이루어졌다. 최근 한 연구에서는 digital platform을 이용해 환자에게 자세에 대한 posture awareness을 개선시키기 위해 posture biofeedback training을 실시한 결과 허리의 통증 감소와 더불어 올바른 자세에 대한 질적 향상이 나타났다고 보고하였다. 따라서, 허리 수술 환자에 대한 시각적 바이오피드백을 적용할 때는 해당 근육의 활성도에 대한 모니터링 뿐만 아니라 올바른 자세에 대한 인식을 개선 시켜주는 것이 매우 중요하다고 볼 수 있다.

현재 임상에서 허리 수술 환자를 대상으로 실시한 시각적 바이오피드백 방법 중 Biodex stability machine를 이용한 biomechanical factor를 활용한 방법과 MEDX machine을 이용한 시각과 청각을 동시에 활용하여 허리 근력을 향상시키는 방법에 대해서 공유하고자 한다.

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백민수

학력

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대구보건대학교 물리치료학 학사

주요 경력

울산과학대학교 스포츠재활학부 특강

코레일 인재개발원 사외강사

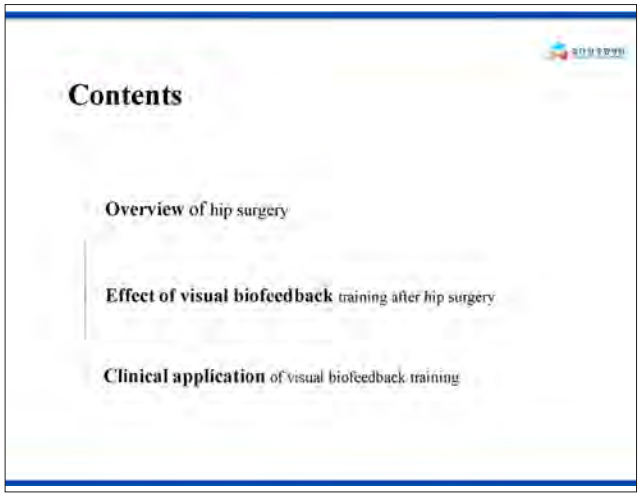
강 의료재단 강병원 운동치료실 물리치료사

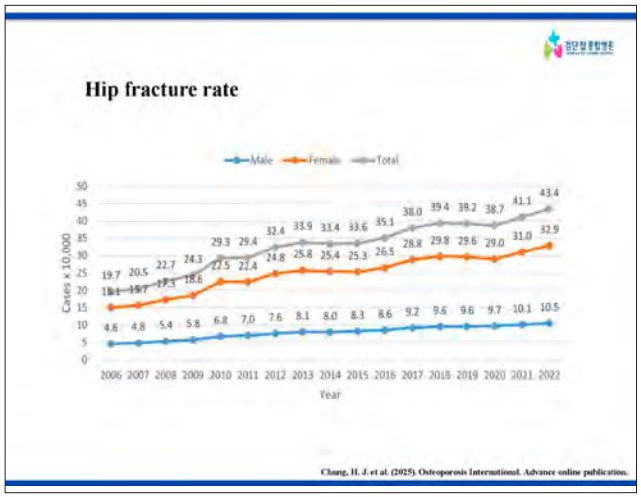
현재 소속 및 직위

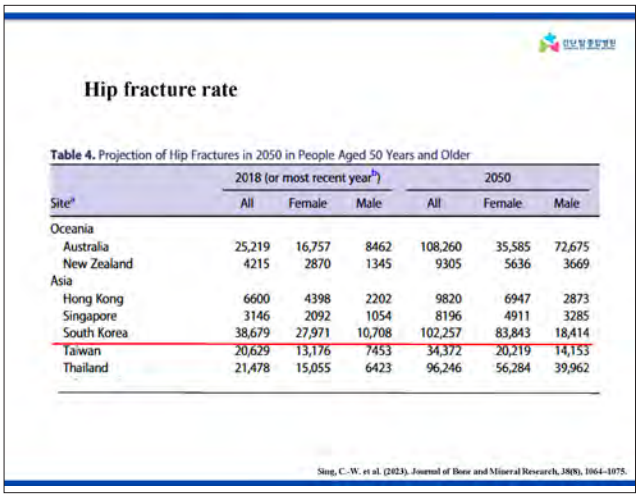
검단탑종합병원 물리치료실 실장

고관절 수술 후 환자의 기능 개선을 위한 시각적 피드백의 적용
Application of visual feedback for functional improvement in patients following hip surgery

검단탑병원
백민수







Site[a]	2018 (or most recent year[b]) All	Female	Male	2050 All	Female	Male
Oceania						
Australia	25,219	16,757	8462	108,260	35,585	72,675
New Zealand	4215	2870	1345	9305	5636	3669
Asia						
Hong Kong	6600	4398	2202	9820	6947	2873
Singapore	3146	2092	1054	8196	4911	3285
South Korea	38,679	27,971	10,708	102,257	83,843	18,414
Taiwan	20,629	13,176	7453	34,372	20,219	14,153
Thailand	21,478	15,055	6423	96,246	56,284	39,962

Complications in Hip Surgery

Intraoperative complications

Bleeding, Vascular/nerve injury, Fx

Postoperative complications

Infection, Dislocation, Neurological deficits, Persistent pain/Functional limitation

Hoody, W. L., et al. (2016). Clinical Orthopaedics and Related Research, 474(2), 359–366.

Approach of hip surgery

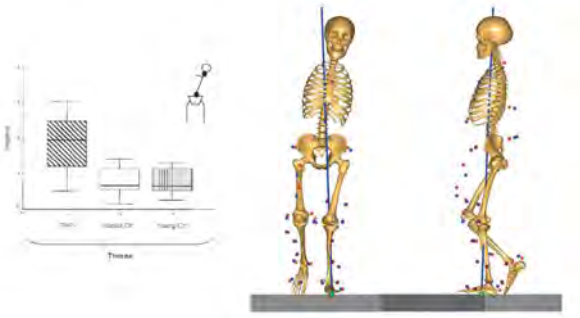
Surgical approach	Major muscles incised/manipulated	Potential complications
Posterior (posterolateral)	Gluteus maximus, piriformis, short external rotators	Increased risk of posterior dislocation, possible sciatic nerve injury
Lateral (direct lateral / anterolateral)	IT band, gluteus maximus/medius/minimus, vastus lateralis	Abductor or nerve injury can cause gluteus medius insufficiency
Anterior (direct anterior)	Intermuscular approach, minimal cutting, TFL/rectus femoris stretch	Narrow field increases difficulty, stretch may cause transient pain or sensory symptoms

Winther, S. B. et al. (2016). Acta Orthopaedica, 87(1), 22–28.

1. Abnormal gait pattern

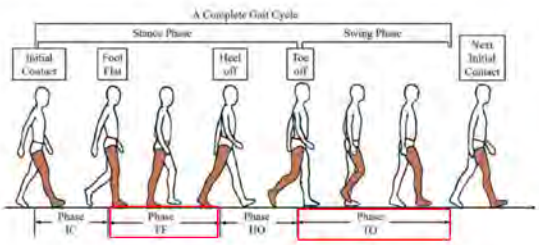
Period	Gait asymmetry	References
At **3–4 weeks** postoperatively	ranging from **9.9% to 42%**	(Kabaciński et al., 2024)
At **1 year** after surgery	gait function and asymmetry persist	(Bahl et al., 2018)
At **1 year** after surgery	gait recovery remains **less than half**	(Engdal et al., 2024)

Pattern 1. **lateral trunk lean pattern**



Leijendekkers, et al. (2018). PLOS ONE, 13(2), e0193487.
Vogt, L. et al. (2003). Disability and Rehabilitation, 25(7), 309–317.

Pattern 2. **antalgic gait**



abnormal gait pattern:
shorter stance phase and longer swing phase

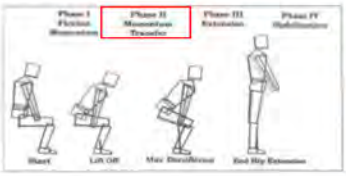
Wei, et al. (2023). Frontiers in Neuroscience, 15, 704226.

Show cases for gait pattern after hip surgery

Case 1

Case 2

2. Weight-Bearing Asymmetry, WBA and Sit-to-Stand, STS



WBA determines STS success or failure

Frykberg, G. E., & Häger, C. K. (2015). Physical Therapy Reviews, 20(3), 156–167

3. Change of quality of life (EQ-5D-5L)

Subject: patients with Hip sugery

N= 199(mean age: 75.45±9.0), male:103, female:96

Usual activities (84.4%), mobility (78.9%), self-care (76.9%)

Pain/discomfort (58.8%), anxiety/depression (40.2%)

4. Anxiety and depression in surgical patients (HADS)

Subject: patients with Hip sugery

N= 211(mean age: 70.65±8.9), male: 115, female: 96

Anxiety (67.3%), depression (60.7%)

Fear of Falling

- Within 1 month after surgery – **50 ~ 100%**
- At 3 months – **47 ~ 59%**
- Between 3–13 months – **23 ~ 50%**
- FoF impairs balance, gait, ADL, and worsens rehab outcomes

Effect of visual biofeedback

training after hip surgery

Conventional rehabilitation protocol

Phases	Objectives	Precautions
Phase 0 (Preoperative)	Patient education and preparation Surgery and recovery explanation Walking aid training Home environment preparation	Safe assistive devices setup (shower chair, bed rails, etc.)
Phase 1 (0-6 weeks)	Tissue healing protection Pain/edema control **DVT prevention** **Early ROM recovery** Muscle activation & independent mobility	Use of walking aids with WBAT Early exercise: Passive → Active ROM
Phase 2 (6–12 weeks)	Complete ROM & strength recovery normal gait **pain-free ADL**	Resistance exercise Aerobic exercise
Phase 3 (12–24 weeks)	High-intensity readiness: Strength, endurance, balance gradual return from low- to high-impact activities	Multi-joint/directional training Core strengthening Unilateral & bilateral WB

Sara, L. K., & Lewis, C. L. (2023). HSS Journal, 19(4), 494–500.
Borchers, K., & Depp, S. (2022). The Ohio State University Wexner Medical Center.

Conventional exercise approach

Recent Approach in Exercise

Immediate unrestricted weight bearing is not more harmful than partial weight bearing and may be advantageous in terms of functional recovery and patient compliance (Huang et al., 2023).

Elderly patients with femoral neck fractures demonstrated sufficient weight-bearing capacity in the early postoperative period after hip surgery (Grabmann et al., 2024)

Early full weight-bearing mobilization and gait training promote a gradual recovery of load-bearing symmetry over time (Alves et al., 2022)

Visual Feedback in Rehabilitation: Reconstructing Mental Representation of Gait

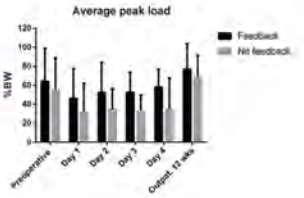
1 ground contact of right foot
2 ground contact of left foot
3 extension of right hip and knee
4 extension of left hip and knee
5 offtake of right foot
6 offtake of left foot
7 forward swing of right leg
8 forward swing of left leg
9 extension of knee and flexion of hip right
10 extension of knee and flexion of hip left
11 looking down
12 tilt of hip
13 tilt of torso

Schega, L., et al. (2014). Applied Psychophysiology and Biofeedback, 39(1), 37–43.

Early full weight-bearing promotes recovery

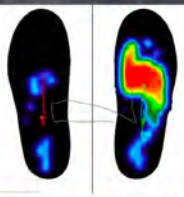
Low adherence in conventional care → additional guidance needed

(SensiStep system)



Rasbjen, M., Vögely, H. C., & Blokhuis, T. J. (2018). Gait & Posture, 61, 306–310

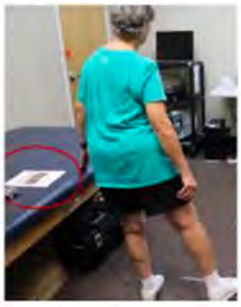
Insole-Based Visual Feedback on Weight-Bearing



Marin, L., et al. (2021). International Journal of Environmental Research and Public Health, 18(7), 3346.

Emerging trends

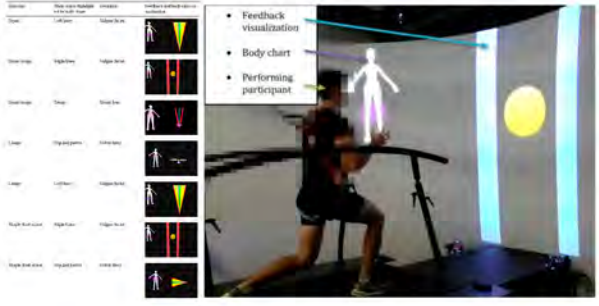
Integrated Telehealth and Extended Reality Approach



Conroy, C. L. et al. (2025). [Preprint]. arXiv. https://arxiv.org/abs/2502.14059

Emerging trends

Real-Time Digitized Visual Feedback in Home Exercise



Widhalm, K. et al. (2024). JMIR Serious Games, 12(1), e51771.

Clinical application of visual biofeedback training

Clinical application

Mirror visual biofeedback and auditory biofeedback (verbal cueing)

Take home messege

1. After hip surgery, not only physical but also psychological problems may occur, and these effects can persist for more than one year.

2. Early full weight-bearing is advantageous in terms of patient compliance and functional recovery.

3. Visual biofeedback provides real-time cues that enhance weight-bearing symmetry and functional recovery.

4. Rehabilitation should combine visual biofeedback with conventional protocols for optimal outcomes.

5. In clinical practice, low-cost and effective tools such as mirror feedback or smartphone applications can be applied.

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The Korean Society of Sports Medicine

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Thank you for your attention

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김희중

학력

가천대학교 운동재활복지학과 학사

고려대학교 융합과학대학원 스포츠의학과 석사 과정

주요 경력

노원삼성정형외과 AI 퍼포먼스센터 / 운동사

대찬병원 스포츠메디컬센터 / 운동사

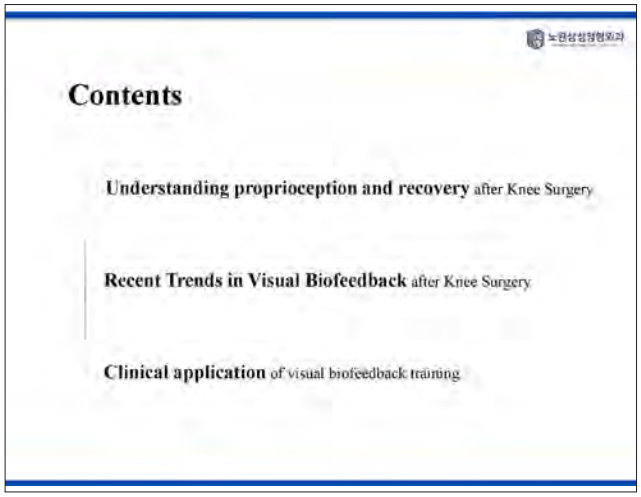
가천대학교 운동재활학과 / 운동손상 및 평가 특강

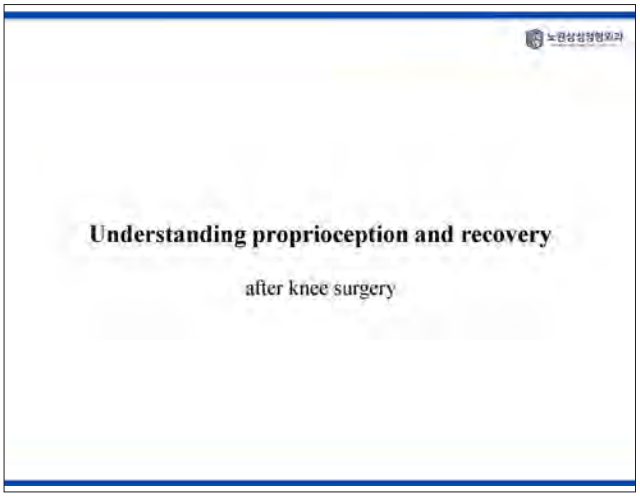
현재 소속 및 직위

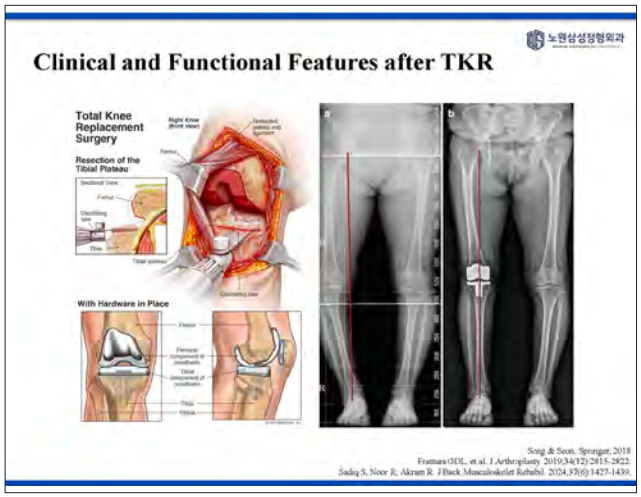
노원삼성정형외과 AI 퍼포먼스센터 / 사원

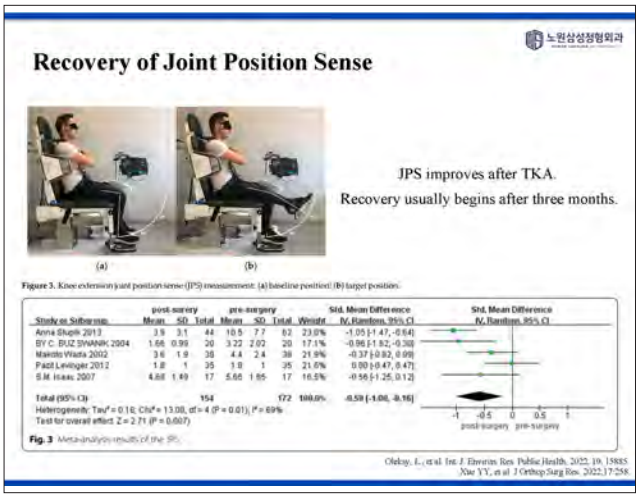
무릎 수술 후 환자의 기능 개선을 위한 시각적 피드백의 적용
Application of visual feedback for functional improvement in patients following knee surgery

노원삼성정형외과
김희중



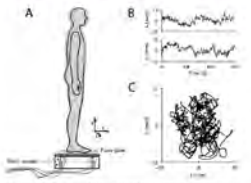






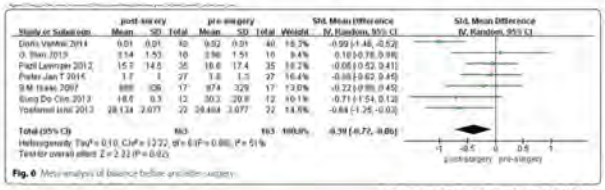
노원성심정형외과

Recovery of Balance Assessed



Balance improved significantly after TKA.

COP displacement was reduced postoperatively.

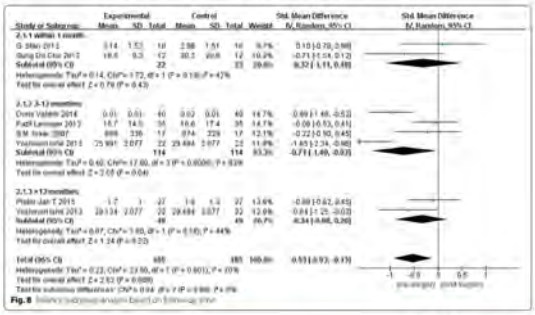


노원성심정형외과

Recovery of Balance Assessed

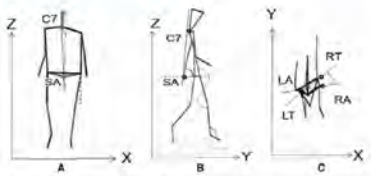
TKA patients improved balance within 3–12 months.

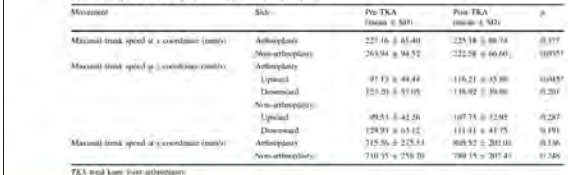
Significant recovery appears after three months.



노원성심정형외과

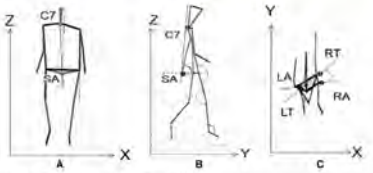
Gait Patterns and Postural Control





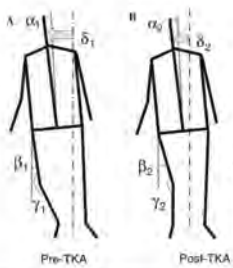
노원성심정형외과

Gait Patterns and Postural Control



노원성심정형외과

Gait Patterns and Postural Control



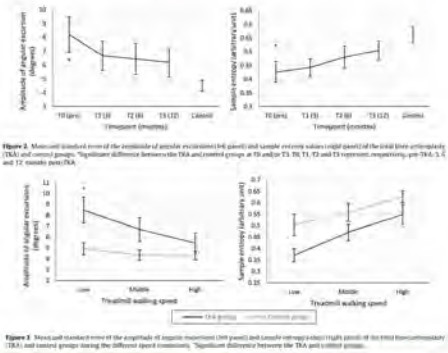
Reduced lateral trunk movement observed

Abnormal trunk movement persisted after TKA

Beneficial for balance and fall prevention after TKA

노원성심정형외과

Gait Patterns and Postural Control



노원성심정형외과

Recent Trends in Visual Biofeedback

after Knee Surgery

노원성심정형외과

General Rehabilitation Protocol after TKR

Phase 1 – Acute (0–2 weeks)

Goals	- Early ambulation & functional independence - Restore muscle strength and coordination
Intervention Points	- Early mobilization from day 1 - Ambulation with assistive devices (walker, crutches) - Cryotherapy, CPM (optional) - Isometric contractions, weight shifting
Exercise Examples	- Straight Leg Raise (SLR) - Quadriceps / Hamstring / Glute isometrics - Passive & Active assisted ROM - Transfer & gait training

Gheorghievici et al., Romanian Journal of Rheumatology, 2023

노원성심정형외과

General Rehabilitation Protocol after TKR

Phase 2 – Subacute (2–8 weeks)

Goals	- Transition to normal gait (without assistive devices) - Achieve 110° knee flexion & full extension
Intervention Points	- Progressive weight bearing - Edema management, NMES - Balance & proprioception training - Sit-to-Stand, aquatic therapy
Exercise Examples	- Sit-to-Stand, chair exercises - Active assisted open chain (knee, hip, ankle, core) - Cycle ergometer (≥110° flexion) - Balance & proprioception training - Stair training (10 cm)

Gheorghievici et al., Romanian Journal of Rheumatology, 2023

노원성심정형외과

General Rehabilitation Protocol after TKR

Phase 3 – Functional (9–16 weeks)

Goals	- Restore normal function - Achieve limb symmetry & return to leisure/sport
Intervention Points	- Strength, endurance, flexibility training - Unilateral balance, unstable surfaces - Cycling, treadmill - Return to sports (≥4 months)
Exercise Examples	- Strength training (resistance bands, machines) - Flexibility exercises (hamstrings, calves, quadriceps stretches) - Endurance training (cycling, treadmill) - Balance training (bilateral → unilateral, unstable surfaces) - Advanced functional & recreational activities

Gheorghievici et al., Romanian Journal of Rheumatology, 2023

노원성심정형외과

Recent Trends in Visual Biofeedback

Autonomic Nervous System / Electromyography

Since the 1991s

Figure 1. mTrigger device and disposable electrodes. This is a 2-channel system, but in this study, only 1 channel was used.

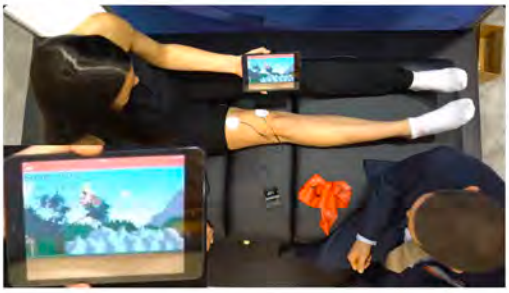
mTrigger LLC. (2025). *Getting started* mTrigger. https://mtrigger.com/pages/getting-started
Beckham JC, et al. Biofeedback Self Regul. 1991;16(3):23-35.
Kosler et al., *IJERPH*, 2023

노원성심정형외과

Recent Trends in Visual Biofeedback

Autonomic Nervous System / Electromyography

Since the 1991s



mTrigger LLC. (2025). *Getting started* mTrigger. https://mtrigger.com/pages/getting-started
Beckham JC, et al. Biofeedback Self Regul. 1991;16(3):23-35.
Kosler et al., *IJERPH*, 2023

노원삼성정형외과

Recent Trends in Visual Biofeedback

Biomechanical factor / Instrumented balance platform

Since the 2004s

Figure 3. Tecnobody system for knee rehabilitation.

Swanik et al., JBJS Am, 2004

Carozzo S, et al. J Clin Med. 2022;11(24):7355.

노원삼성정형외과

Recent Trends in Visual Biofeedback

Biomechanical factor / Pressure biofeedback & Camera based systems.

Figure 3. Tecnobody system for knee rehabilitation. Walker View 3.0 SCX tool (left side) and the ProKin 252 tool (right side).

Carozzo S, et al. J Clin Med. 2022;11(24):7355.

노원삼성정형외과

Recent Trends in Visual Biofeedback

Biomechanical factor Camera based systems & Instrumented treadmill

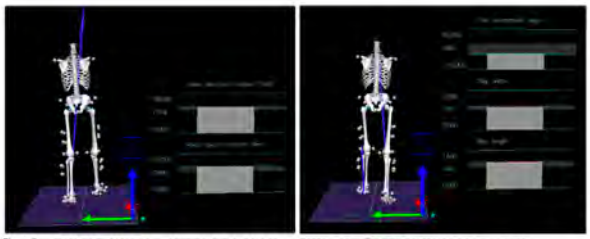


Fig. 3 Example of real-time knee moment feedback (left) and gait pattern feedback (right). The light grey shaded area in each graph is the customised target for each parameter

Wen Y, et al. BMC Musculoskelet Disord. 2023;24:984.

노원삼성정형외과

Immersive vs. Non-Immersive Biofeedback

Immersive VR

Non-Immersive VR

Virtual reality vestibular therapy, Memorial Healthcare System

Mirelman et al., The Lancet, 2016

Ventura S, et al. Front Psychol. 2019;10:2509.

Lo HHM, et al. J Med Internet Res. 2024;26:e48787.

노원삼성정형외과

Recent Trends in Visual Biofeedback

Immersive Virtual Reality

Figure 1. VR intervention (rowing boat) in OA patients after TKA.

Fig. 2. Head-mounted display.

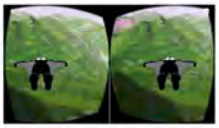


Fig. 3. "BASE/prop VR: Wingsuit" Application.

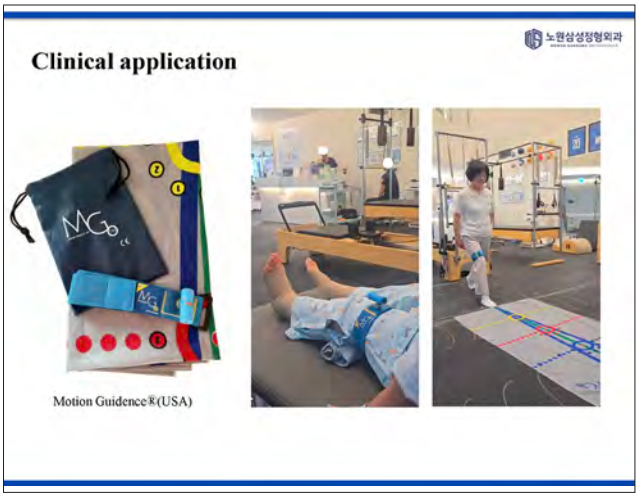
Jin et al., *International Journal of Clinical and Experimental Medicine*, 2018

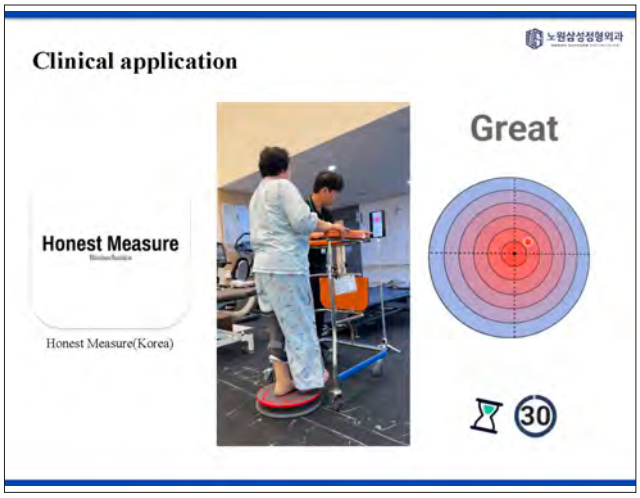
Jung et al., *Journal of Physical Therapy Science*, 2019

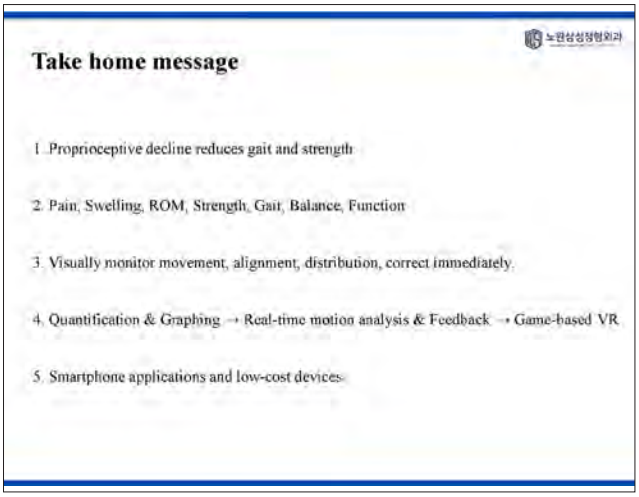
노원삼성정형외과

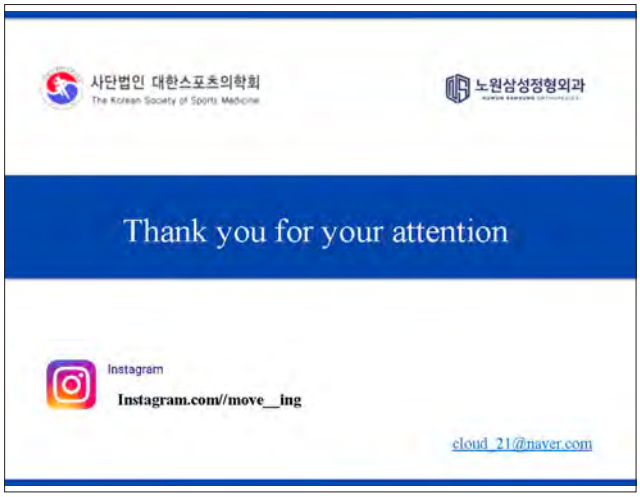
Clinical application

of visual biofeedback training


노원삼성정형외과
Clinical application
Motion Guidence®(USA)


노원삼성정형외과
Clinical application
Honest Measure
Honest Measure(Korea)
Great
30


노원삼성정형외과
Take home message
1. Proprioceptive decline reduces gait and strength
2. Pain, Swelling, ROM, Strength, Gait, Balance, Function
3. Visually monitor movement, alignment, distribution, correct immediately.
4. Quantification & Graphing → Real-time motion analysis & Feedback → Game-based VR
5. Smartphone applications and low-cost devices


사단법인 대한스포츠의학회
The Korean Society of Sports Medicine
노원삼성정형외과
Thank you for your attention
Instagram
Instagram.com//move__ing
cloud_21@naver.com

사단법인 대한스포츠의학회
제67차 추계학술대회

발행일. 2025년 10월 18일

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