

Welcome

Dr. Carlos Prietto



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Keynote Presenter:

Kerry Peterson
Disability Advocate

Retired ATC, LAT, NBC-HWC



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Chris Meinhold, PT



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Optimizing Performance in Para Snowboard: Lessons from an Interdisciplinary High-Performance Team

CHRISTOPHER MEINHOLD PT DPT CSCS OCS SCS FAAOMPT

Doctor of Physical Therapy

Board-Certified Orthopedic & Sports Clinical Specialist

Strength & Conditioning Specialist

Fellow of the American Academy of Manual Physical Therapy





Classifications & Disciplines

First Introduced in 2014 Sochi Paralympics

- > Boardercross (SBX)
- > Banked Slalom (BS)
- > SB-LL1: Lower limb impairment (e.g., above-knee amputation)
- > SB-LL2: Lower limb impairment (e.g., below-knee amputation).
- > SB-UL: Upper limb impairments

Adaptive Equipment Rules: Strict FIS standards regulate the use of prosthetics and equipment configurations.



Performance Director /
Performance Staff

Coaching Staff /
Ski Technicians

Sport Dietitian



Team Physician

Medical Director

Physios & Athletic Trainers

Sport Psychologist

Interdisciplinary Team Dynamics

Interdisciplinary vs. Multidisciplinary

How we make medical and performance decisions:

- **Multidisciplinary Model:** Specialists work in vertical silos, passing the athlete along without collective communication.
- **Interdisciplinary Model:** Collaborative, horizontal decision-making where clinical team co-design treatment strategies.

Interdisciplinary Communication

01

Central Medical & Performance Portal

Translation: Fragmented information into a unified, cloud-based dashboard

02

International Emergency Action Plans (EAP)

Translation: Clear, consistently updated KPIs shared across the entire care team

03

Structured Communication Channels

Translation: A central platform designed to accelerate information sharing and drive immediate action

Key Evidence: Teams utilizing highly structured medical-to-performance communication strategies show significantly lower injury burdens and higher match availability.

Physiotherapy Insights:

Biomechanical Loading

- Asymmetrical tissue stresses during riding and training.

Stump & Limb Integrity:

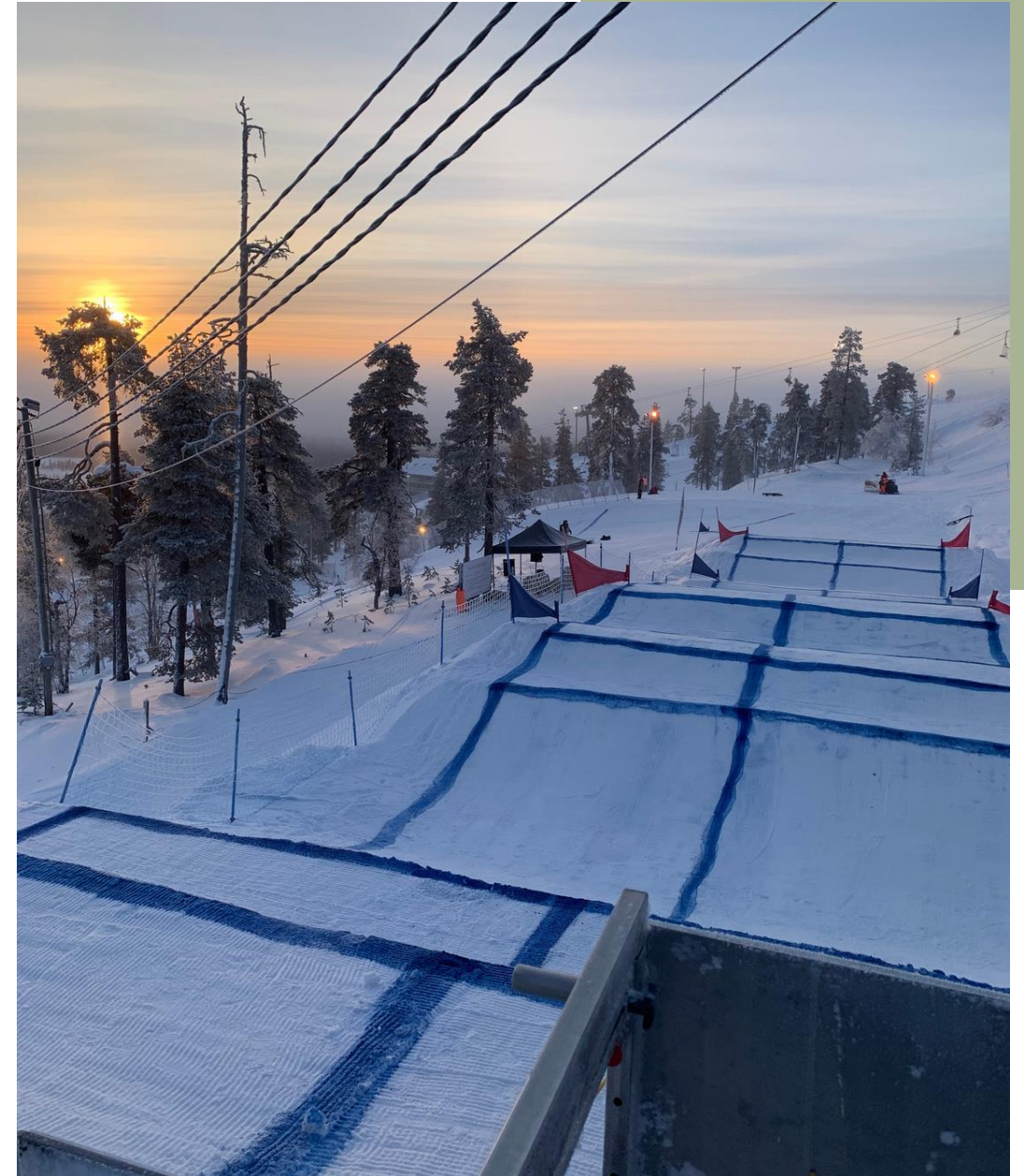
- Continual skin integrity check-ins. Monitoring distal residual limbs (specifically tibial crest and condyles) to prevent friction-induced cellulitis or breakdown.

Specialized Med Bag:

- Medical kits must look different, loaded with specialized silicones, custom paddings, and advanced wound-care dressings.

Modified Concussion Screening:

- Modifying standard assessment to fit athletes pre-existing impairments.



Strength & Conditioning Insights:

An Adaptive Athlete =

- An athlete that is able to solve problems, regardless of their environment.
- **Goal** = Build confidence to allow the athlete to be a problem solver, not just build physical qualities.



Sports Dietitian Insights:

In-Field Education

Hydration Monitoring

- International travel

Body Composition

- Fluctuations in residual limb volume, alter prosthetic fit → skin breakdown.





Further Insights:

- **Understanding athletes external financial/dual-career stress.**
- **Athletes with less than 5 years of elite training have a significantly higher risk of injury.**
- **Overuse injuries dominate training camps (41.2%), while acute traumatic injuries peak during competitions (31.8%).**

(Alexander et al., 2024)



“

Sometimes we need to place ourselves in different and unique environments to learn lessons that can be integrated into our everyday clinical practice.

”

RESOURCES & REFERENCES

My Email: chris@meinholdphysio.com

Checkout: US Ski & Snowboard Medical Pool

Alexander, D., Bloom, G. A., Bentzen, M., & Kenttä, G. (2024). Exploring the experiences and perceptions of coaches, athletes, and integrated support teams towards the management of three national Paralympic teams. *Psychology of Sport & Exercise*, 71, Article 102588.

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Coach Russ Turner



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Russell Turner

UC Irvine Men's Basketball Head Coach

Coaching Career

1992-1993	Darlington School (High School)	Varsity Ast. Coach
1993-1994	Hampden-Sydney (D3)	Assistant Coach
1994-2000	Wake Forest (D1)	Assistant Coach
2000	San Francisco WBB (D1)	Assistant Coach
2000-2004	Stanford (D1)	Assistant Coach
2004-2010	Golden State Warriors (NBA)	Assistant Coach
2010-Present	UC Irvine (D1)	Head Coach

- Entering 17th year as the head coach of UC Irvine
- Married to Liz Turner - Doctor of Internal Medicine & Critical Care



Dr. Carlos Prietto
Team Physician
Emeritus



Jaime Potter
Associate Athletic
Director for Sports
Performance



Kim Christensen
Athletic Trainer,
Men's Basketball



Mike Burns
Athletic Trainer,
Men's Basketball

Program success results from trust and belief in core values

Purpose

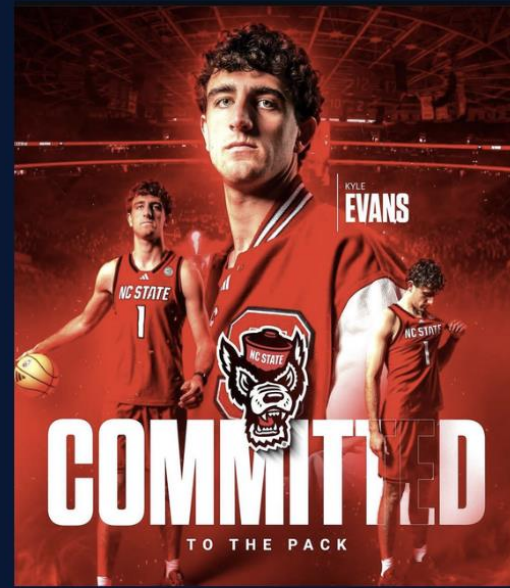
1. Share perspective
2. Think Critically
3. Engage with you. Improve.



Myles Che
UC Irvine → UNLV



Devin Tillis
UC Irvine → Virginia



Kyle Evans
UC Irvine → NC State



Jurian Dixon
UC Irvine → Virginia

Money = Pressure

Youth Sports

- Resilience Training
- Great Teammates
- Improvement and Perspective

Lower levels (D2, D3, JUCO)

- Possibilities and Perspectives change

Olympic Sports

- Dynamics
- Internal and vs high-revenue sports



ATHLETICS

Conclusion

- Medical Professionals, athletes, and coaches should be teammates.
- Openness and honesty leads to trust
- Expertise → Character → Judgment → Feel

Questions? Feel free to reach out
rturner@uci.edu

Morning Break 10:45 – 10:55am

CME Activity ID Code : **27594**

Text only “27594” to **1-833-645-1002** to record your attendance. This number can be saved as “Hoag CloudCME attendance” in your phone.

Your mobile number **must be paired to CloudCME** for texting the Activity Code to work.

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Dr. David Gazzaniga



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THE CHANGING PARADIGM OF YOUTH SPORTS

Early Specialization, Overuse Injury & the Crisis Facing Young Athletes

David S. Gazzaniga, MD

Sports Medicine · Hoag Orthopedic Institute

LEARNING OBJECTIVES

- Understand the scope of single-sport specialization in American youth
- Review the current evidence linking early specialization to overuse injury, growth plate damage, and burnout
- Identify specific injury patterns elevated by specialization: UCL/Tommy John, ACL, stress fractures, apophysitis
- Appraise 2024–2025 literature updates and HOI's own published findings
- Counsel athletes, families, and coaches on evidence-based risk reduction
- Recognize the physician's role in reshaping the youth sports culture

SECTION 1

The Landscape: Youth Sports Today

Scale · Costs · Specialization Trends · Parental Drivers

THE SCOPE: YOUTH SPORTS IN AMERICA

60M+

children in organized sports
annually (US)

8.3M

high school athletes in 2024–25
(record high, NFHS)

1.5M

ER visits for youth sports injuries
in 2024 (NSC)

~11.8

average age of single-sport
specialization (years)

60%

specialize before age 12;
club teams now dominant

~50%

of all youth sports medical visits
are overuse injuries

DEFINING SPORT SPECIALIZATION

Consensus Definition (Bell et al., J Athl Train 2021)

Intensive participation in a single sport to the exclusion of other sports, typically year-round (>8 months/year), beginning before puberty.

3-Point Specialization Scale

LOW

Plays multiple sports year-round

MOD

Has quit other sports to focus on one; year-round

HIGH

Trains >8 months/year in one sport, private coaching, camps, club team

WHO IS DRIVING SPECIALIZATION?

~80%

of parents believe
SSS increases child's ability

~60%

believe SSS raises
college team chances

~40%

think college scholarship
is somewhat/very likely

Only 31%

are very concerned
about overuse injury risk

83%

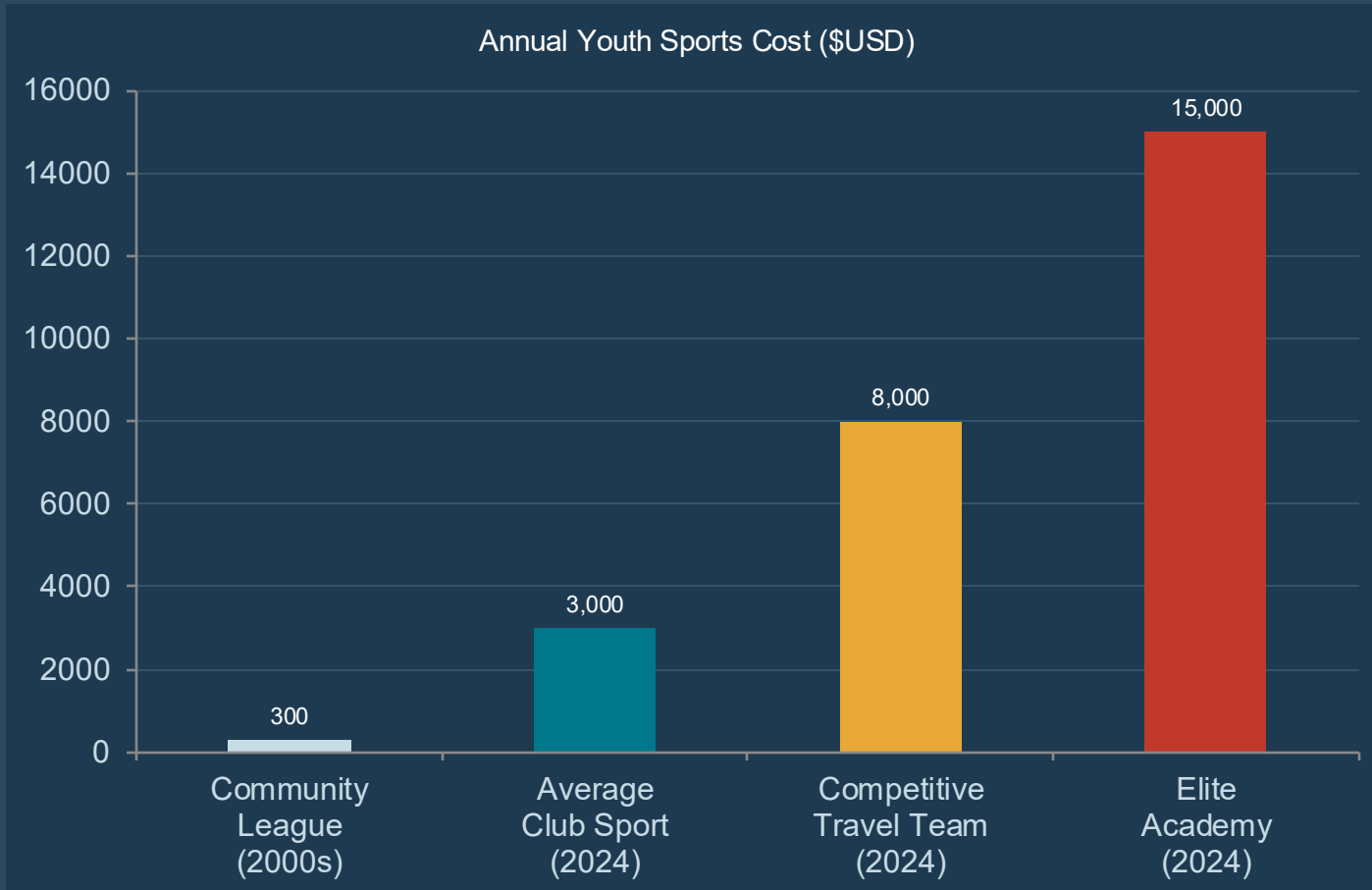
believe their child has
collegiate athletic potential

75%

believe their child has
professional athletic potential

Reality: <2% of specialized youth earn a Division I scholarship

THE COST EPIDEMIC



The Financial Pressure

- Avg \$3,000/yr per child in primary sport (NYL 2025)
- 64% of families report costs increased year-over-year
- 38% cut other household spending for sports
- 25% pull from savings; 29% fundraise
- Low-income children 6× more likely to quit due to cost
- Families spending 40–50% more than 5 years ago
- Only 22% use financial planning for sports spending

SECTION 2

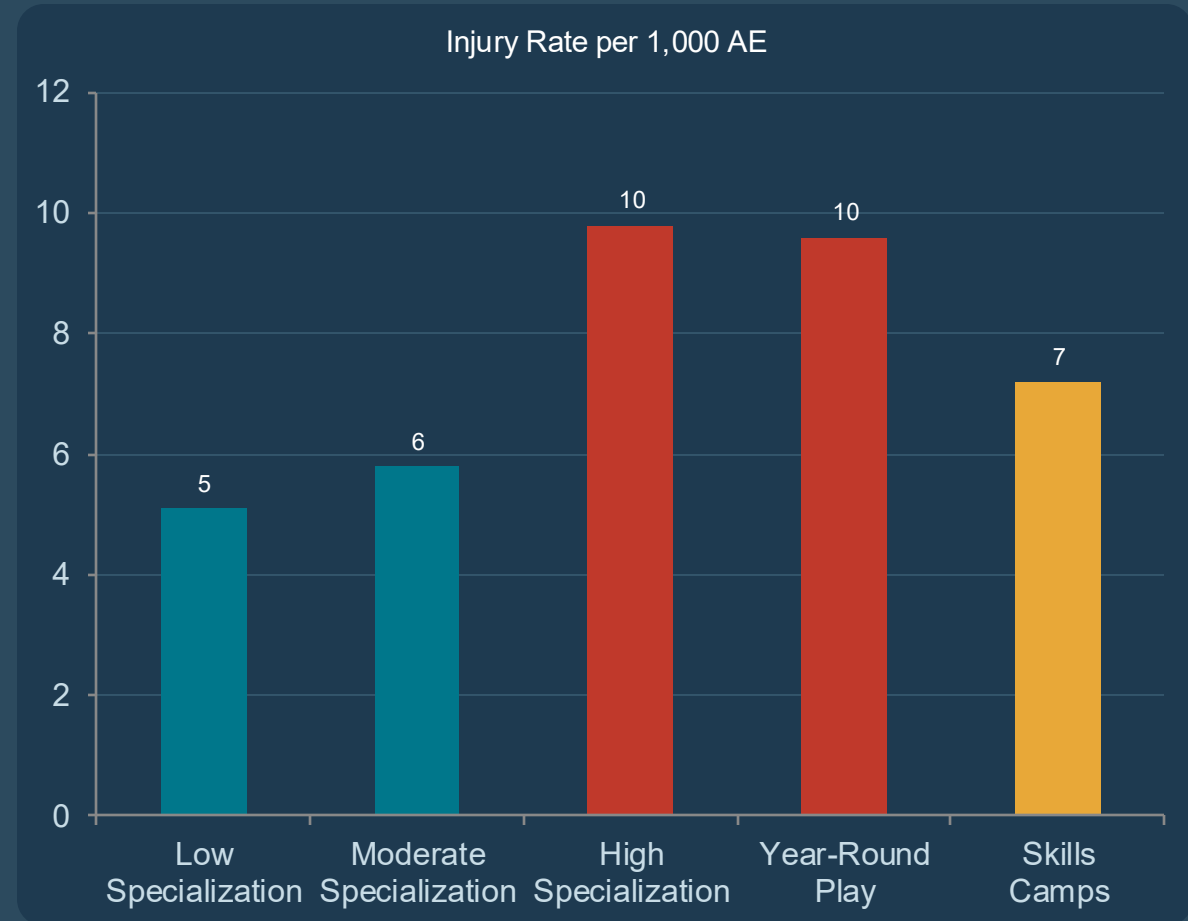
The Injury Crisis

Overuse · Tommy John · ACL · Stress Fractures · Growth Plates

OVERUSE INJURIES: THE EVIDENCE BASE

Key Meta-Analytic Findings

- High specialization = 2× overuse injury risk vs low specialization (Bell DR et al., Pediatrics 2018; meta-analysis)
- Year-round single-sport play: IRR 2.1 (95% CI 1.1–3.6) for injury (Post EG et al., J Athl Train 2024)
- Attending skills camps: IRR 2.5 (95% CI 1.2–5.7) for in-season injury
- Overuse injuries account for ~50% of all youth sports medical visits
- Stress fracture · tendinopathy · chondromalacia · OCD lesions all elevated
- Teen overuse injuries up 500% in the past decade (2025 review)



2025 RAPID REVIEW: ESS ACROSS ALL OUTCOMES

Luo EJ et al. Clin Pract. 2025 Apr;15(5):88 · Duke & UNC Orthopaedics · PubMed/MEDLINE Rapid Review

INJURY

ESS associated with higher overuse injury rates across all reviewed studies; stress fractures, tendinopathies, and UCL injuries most consistent findings

PERFORMANCE

Early multisport participation predicts better long-term elite outcomes than early specialization; ESS athletes plateau or drop out earlier

FUNCTION

No functional or biomechanical advantage demonstrated from ESS; movement pattern deficiencies noted in highly specialized youth

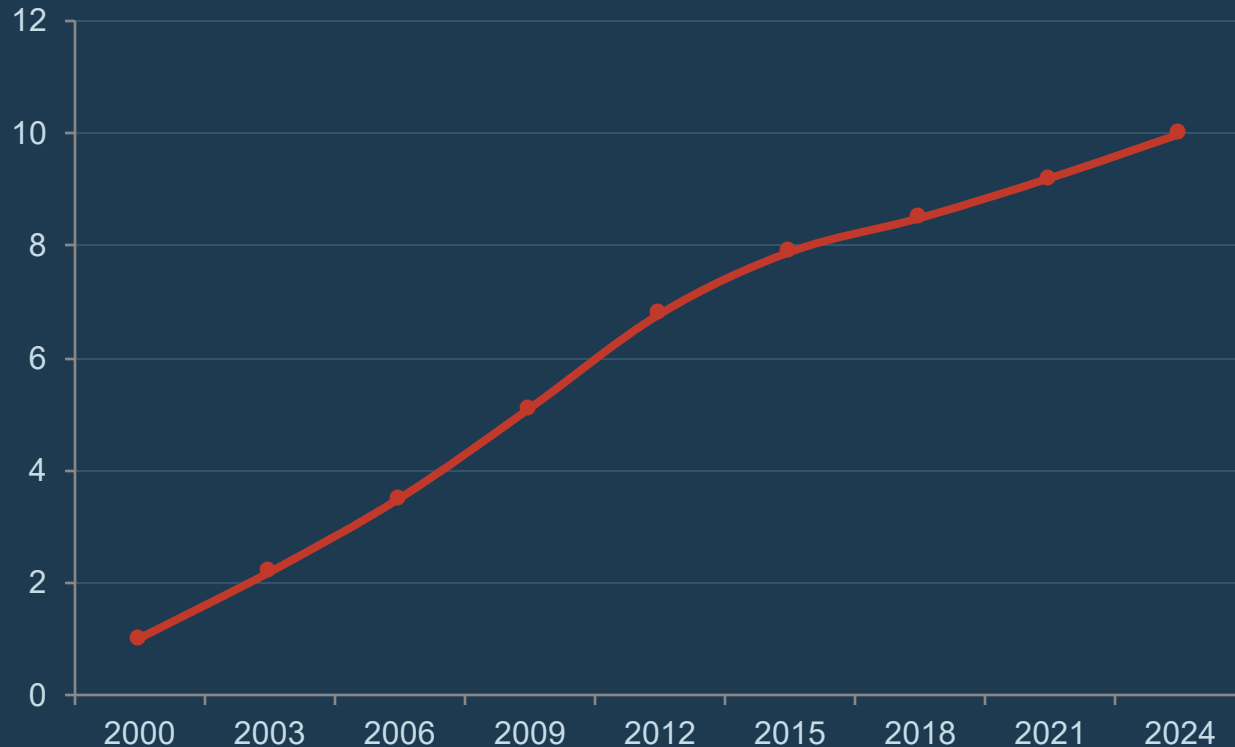
PSYCHOLOGY

ESS associated with higher burnout rates (19–23%), identity foreclosure, anxiety, and reduced intrinsic motivation over time

Bottom Line: No evidence supports ESS for improving long-term athletic outcomes. Evidence consistently shows harm.

THE TOMMY JOHN EPIDEMIC IN YOUTH BASEBALL

Youth UCL Surgery Trend (2000–2024)



Alarming Milestones

- UCL injury rate 10× higher in youth than in 2000
- Ages 15–19 now the LARGEST surgical cohort nationally
- Incidence rising 9.12% per year in adolescents
- Athletes under 18 = nearly 1/3 of all Tommy John surgeries at major centers (2025)
- 67.4% of UCL reconstructions performed on athletes ages 16–20 (AMA data)
- UCL matures at age 26 — year-round throwing demands adult performance from immature tissue
- Pitching while fatigued: 36× higher surgical risk in adolescents

HOI PUBLISHED DATA (JBJS Reviews 2025)

ASMI · Rush Univ. Med. Center · Kassam HF et al. HOI/JBJS Reviews 2025 · Columbia Univ. CUMC 2016 · Blaze Radio 2025

ACL INJURIES IN YOUNG ATHLETES: AN ACCELERATING CRISIS

↑ Rates

ACL injuries in 13–17 yo athletes are increasing, as are ACLRs performed

8×

Girls more likely than boys to tear ACL in soccer/volleyball

493K

Girls in HS volleyball 2024–25 (+3% YOY) — driving ACL exposure

Clinical Pearls: What the 2024 AAOS Data Tell Us

- Younger age at primary ACLR significantly increases secondary ACL injury risk (AAOS 2024)
- Earlier return-to-sport compounded risk — maturation matters
- Specialization + year-round load removes recovery windows needed for physeal protection
- Growth plate physeal arrest remains a concern with tunnel placement in skeletally immature athletes
- ACL injury increases radiographic osteoarthritis risk by 105× — lifetime consequence of a youth injury
- Female athletes: hormonal, neuromuscular, and anatomical factors + sport volume = compounding risk

STRESS FRACTURES, APOPHYSITIS & GROWTH PLATE INJURY

Stress Fractures

- Repetitive loading on bone undergoing active growth
- Pars interarticularis (spondylolysis) in gymnasts/swimmers/linemen
- Tibial stress fractures in runners and soccer players
- Metatarsal stress fx common in year-round dance/gymnastics

Apophysitis

- Osgood-Schlatter (tibial tuberosity) — peak age 10–15
- Sever's disease (calcaneal apophysis) — most common heel pain 8–13
- Little Leaguer's shoulder (proximal humeral physis)
- Little Leaguer's elbow (medial epicondyle apophysis)

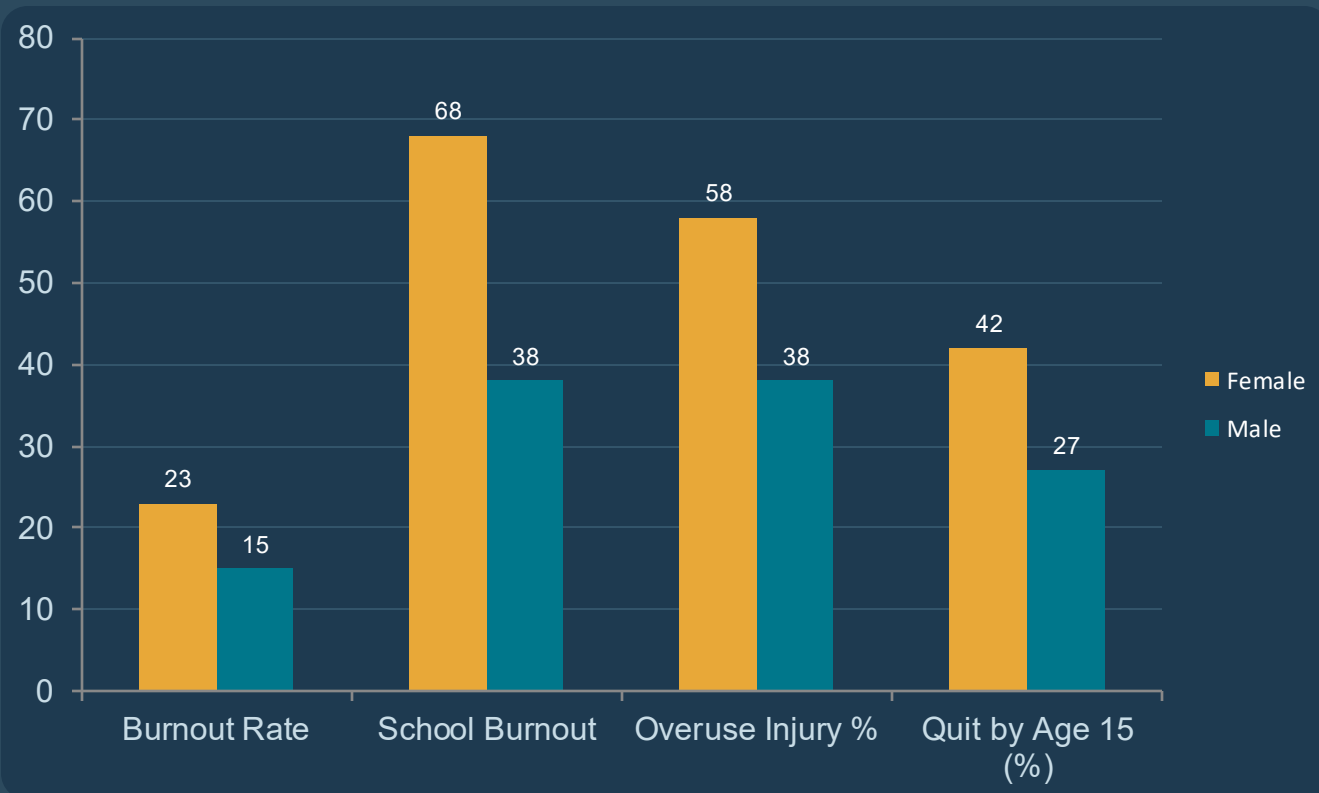
Growth Plate / OCD

- Physes are 2–5× weaker than surrounding ligament in adolescents
- OCD — osteochondral lesion from repetitive microtrauma
- Tri-plane ankle fractures (adolescent growth-plate variants)
- Femoral physis at risk from early pivoting sports

Key Principle: Adolescent physes are the weakest link — not the ligaments. The ligament tears in adults. The growth plate fails in children.

SEX DIFFERENCES IN SPECIALIZATION & INJURY (2025 DATA)

Buser A et al. *Sports Health*. 2025 Jan–Feb;17(1):190–201 · Harvard Medical School / Emory / Wu Tsai Female Athlete Program



Clinical Takeaways

- Female athletes bear disproportionate burden of specialization consequences
- Female burnout rate 23% vs male 15% (not stat. significant but clinically relevant)
- Female school burnout 68% vs 38% — academic costs often unaddressed
- ACL injury risk for females up to 8× higher in pivot sports
- Iron deficiency, RED-S, and bone stress interact with specialization load
- Two pathways to high specialization (exclusive vs evolved) show different injury profiles

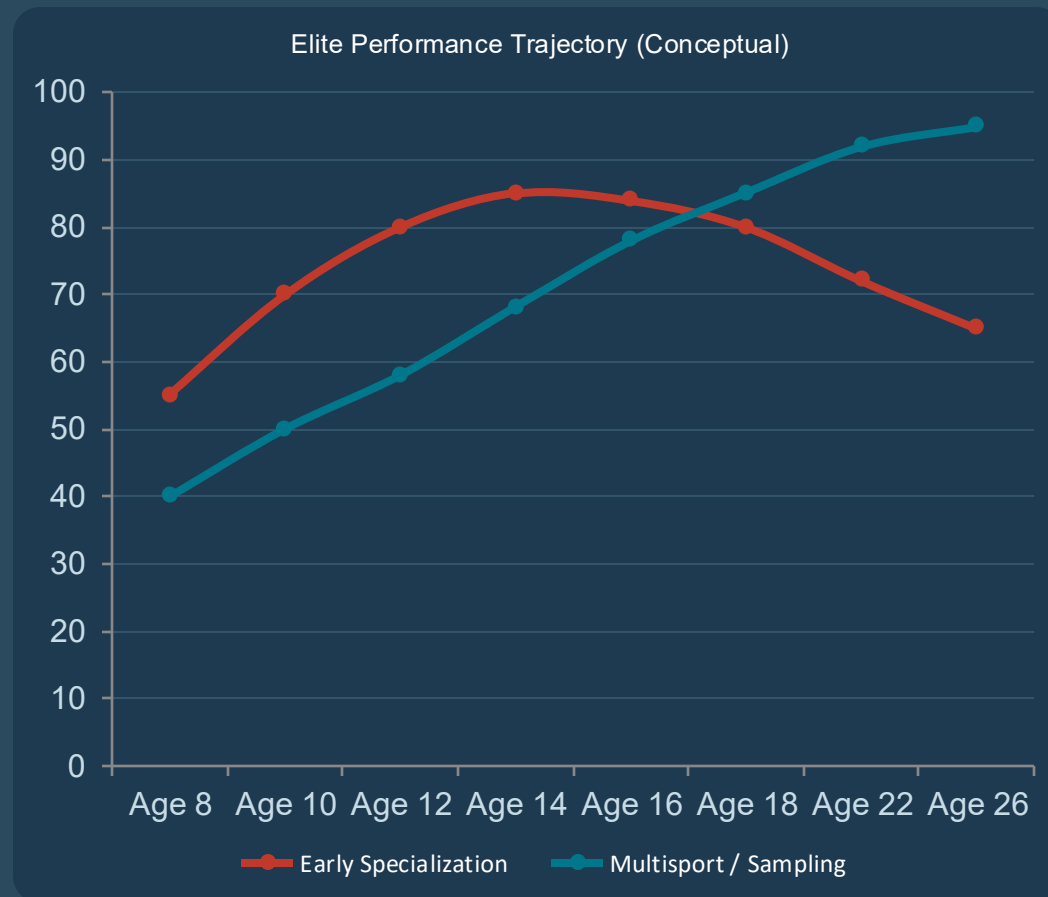
SECTION 3

Does It Even Work?

Talent Development · The 10,000-Hour Myth · What Actually Predicts Elite Performance

MULTISPORT vs SPECIALIST: WHAT THE EVIDENCE SHOWS

- Early variable, multisport practice = greater sustainability of long-term elite development (Sports Act. Living 2023)
- Early specialization = rapid early progress, BUT compromised long-term trajectory
- Most world-class athletes were multisport until mid-to-late adolescence
- Multisport athletes have fewer injuries AND lower burnout rates
- Sampling years (ages 6–12) develop broader motor literacy that fuels later specialization
- Specializing athletes often plateau by age 16–18; multisport athletes develop through age 22+



"Early specialization wrongly assumes early talent predicts elite outcomes." — Epstein, The Sports Gene

WHY WE CANNOT PREDICT ELITE ATHLETES IN CHILDHOOD

NOT Predictive

- Early club tournament success
- Early intense specialized training
- Youth rankings and showcase performance
- Being the biggest/strongest at age 10–12

More Predictive

- Biological maturation timing
- Intrinsic motivation without external pressure
- Adaptability and coaching responsiveness
- Physiological match to specific sport demands

"Relative Age Effect"

- Children born early in the selection year are consistently over-selected
- They appear 'elite' at age 10 because they are biologically 12 months older
- This creates false signals that drive parents toward early specialization
- 60–70% of 'elite' youth athletes at age 12 are simply early maturers
- Late bloomers are systematically cut — and they are often the future elites
- There is no reliable biomarker of elite athletic destiny in childhood

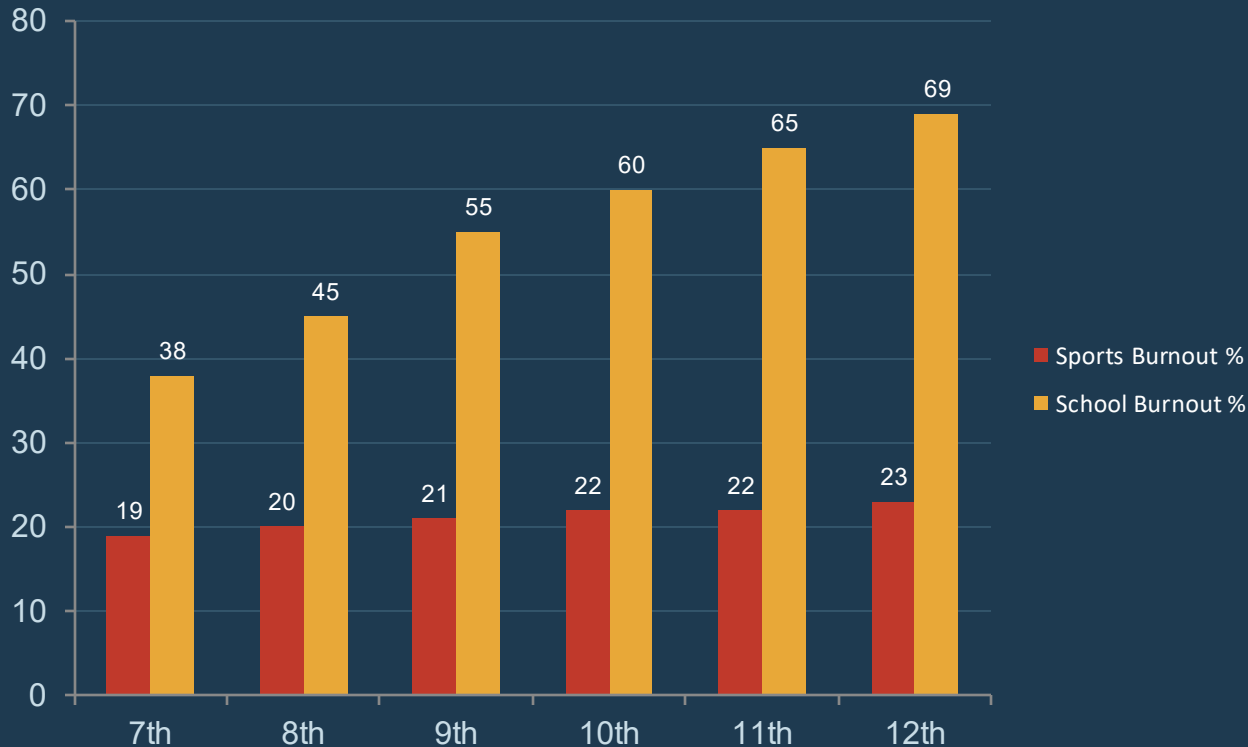
SECTION 4

Burnout, Mental Health & Identity

The Hidden Costs We Don't Talk About Enough

BURNOUT: PREVALENCE, PATTERNS & CLINICAL RECOGNITION

Burnout Rate by Grade (7th–12th)



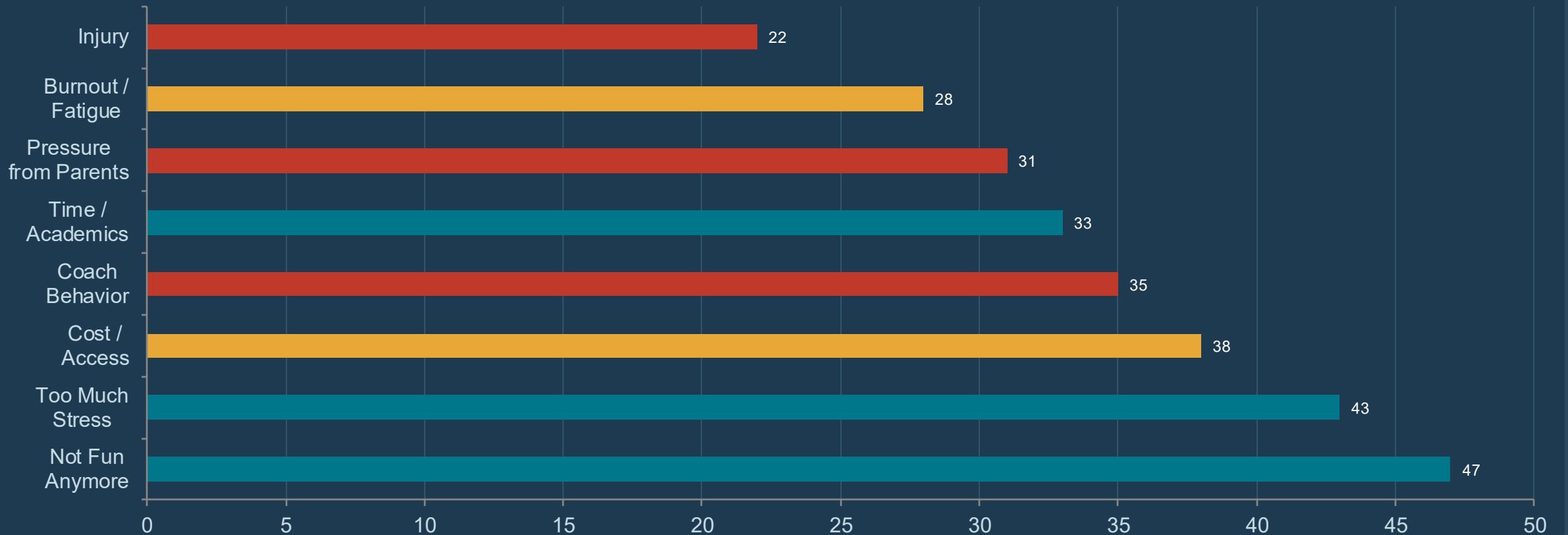
Clinical Burnout Symptoms

- Fatigue and chronic tiredness despite rest
- Decreased enjoyment; apathy toward competition
- Withdrawal from teammates and social activities
- Mood changes, irritability, anxiety
- Academic decline; concentration difficulty
- Physical complaints: aches, poor recovery
- Increased injury rate or missed practices

Sports burnout 19–23% across all grades · Female athletes disproportionately affected · Burnout precedes dropout

WHY YOUNG ATHLETES QUIT

Top Reasons Youth Athletes Drop Out of Sports (%)



Lost enjoyment is the #1 driver — and enjoyment is the #1 predictor of long-term athletic development.

SECTION 5

The Medical Staff Role

Counseling Families · Evidence-Based Guidelines · Having Difficult Conversations

MEDICAL GUIDELINES: WHAT THE EVIDENCE SUPPORTS

AAP

American Academy of Pediatrics: Delay single-sport specialization until age 15; advocate for multisport participation; limit sport-specific training to ≤ 1 day/year of age per week

AMSSM

American Medical Society for Sports Medicine: Published consensus statement favoring sampling through mid-adolescence; systematic review of all major health organizations converges on same recommendation (2025)

AOSSM

American Orthopaedic Society for Sports Medicine: recommendation against early specialization; insufficient evidence to support early single-sport training for improving elite outcomes

NATA/AAOS

National Athletic Trainers' Assoc. & AAOS: Screen for specialization level at every athlete visit; use 3-point scale; counsel on year-round play risks; recommend ≥ 3 months off primary sport annually

Consensus: Delay specialization · Take 3+ months off primary sport annually · Prioritize enjoyment · Multisport through age 15

COUNSELING ATHLETES & FAMILIES: WHAT TO SAY

With PARENTS

- "Only 2% of specialized youth earn a D1 scholarship — is the ROI worth the risk and cost?"
- Explain parental influence on specialization vs athlete self-motivation
- Discuss realistic timelines for sport selection
- Address financial burden and family stress
- Reframe success: lifelong fitness, not professional contract

With ATHLETES

- Screen for burnout at every visit (3 questions)
- Ask about enjoyment, not just performance
- Discuss relative age effect and late-bloomer reality
- Validate desire to try other sports
- Identify identity foreclosure — sport is not their whole self

With COACHES

- Share injury data: year-round play doubles injury risk
- Recommend adherence to pitch count guidelines (USA Baseball)
- Advocate for mandated rest periods between seasons
- Remind that athletic potential is not visible at age 10–12
- Coach development > coach winning

30 YEARS AT THE SIDELINE: WHAT I'VE SEEN

The best athletes I have seen at the professional level almost universally played multiple sports as children.

The parents investing the most money are often the most resistant to evidence. The financial sunk cost creates emotional barriers to hearing the truth.

Tommy John surgery used to be a rarity in teenagers now there are parents who are looking for it as a way to improve the elbow.

The athletes who sustain careers are almost always the ones who had organized rest, multisport backgrounds, and intrinsic — not parental — motivation.

Our job as physicians is not just to repair what breaks. It's to prevent a culture that breaks children before they reach their potential.

SECTION 6

Restoring Common Sense

Evidence-Based Recommendations · Policy · Culture Change

EVIDENCE-BASED RECOMMENDATIONS

CHILD

- Participate in multiple sports through age 14–15
- Take at least 3 months off primary sport each year
- Sport hours/week \leq age in years (AAP guideline)
- No showcase tournaments before age 14
- Communicate honestly with physicians about pain

FAMILY

- Prioritize enjoyment and health over scholarship chasing
- Recognize 98% realistic scholarship odds
- Model healthy attitudes toward loss, rest, and sport
- Audit costs annually — financial stress harms outcomes
- Create off-sport family activities and identity

SYSTEM

- Mandate rest: no >8 months/year per sport for youth
- Enforce USA Baseball pitch count and rest rules
- Eliminate year-round single-sport academies under age 12
- Require sports medicine pre-participation ESS screening
- Reform NCSA and recruiting industry transparency

OUR CALL TO ACTION AS SPORTS MEDICINE CLINICIANS

SCREEN

Ask specialization level at every pre-participation exam; use 3-point scale; document year-round play; calculate monthly sport hours

COUNSEL

Proactively discuss scholarship realities, injury risks, burnout signs, and multisport benefits before injury occurs — not after

ADVOCATE

Speak at schools, club meetings, and parent nights; publish in community channels; support legislative mandates for sport rest windows

RESEARCH

Contribute to multicenter registries; report injury patterns in specialized vs multisport youth; track HOI data longitudinally

TREAT THE SYSTEM

Use HOI as a resource...There is no reason not to reach out for help from your team doctor or from us. Be intentional about change.

We built our careers treating elite athletes. Our next obligation is protecting the children who might become them.

2024–2025 LITERATURE UPDATE: KEY STUDIES

Luo EJ et al. | Clin Pract. 2025;15(5):88

Rapid review: ESS consistently associated with injury, burnout, and worse long-term performance vs multisport. First comprehensive pediatric outcomes review.

Buser A et al. | Sports Health. 2025;17(1):190–201

Sex differences in ESS training patterns: females bear disproportionate burden of injury and burnout from early specialization.

Post EG et al. | J Athl Train. 2024;59(12):1213–1218

Year-round HS basketball: IRR 2.1 for year-round play; IRR 2.5 for skill camps. Prospective, NATION-SP data.

Kassam HF et al. | JBJS Reviews 2025 (HOI)

Adolescent UCL reconstruction rates rising at HOI. Year-round throwing in immature elbow = primary driver.

Sugimoto D et al. | Sports Med. 2024;20(3):416–423

Current concepts review: ESS definition updated; mental health, QOL, growth/maturation now recognized outcomes of concern.

AAOS 2024 Annual Mtg | San Francisco Feb 2024

Younger age at primary ACLR + earlier RTS = significantly higher secondary ACL injury rate in adolescents.

Adlou B et al. | Int J Sports Sci Coach. 2024

ESS meta-analysis: no protective effect at collegiate/professional level; ESS athletes not more durable or higher-performing.

MY GREATEST CONCERNS

After 30 years in practice — and thousands of young athletes — here is what keeps me up at night:

Team Concept Eroding

When youth sports become individual showcase events, we lose the foundational team dynamic that defines sport. We are raising individual brand managers, not teammates.

Exploitation of Families

The NCSA model, the showcase tournament industry, and the travel team ecosystem are built on monetizing parental fear. Families are being preyed upon.

The Next Generation of Patients

I am watching the future of orthopedic surgery. We are pre-loading a cohort of 25-year-olds with cumulative joint damage that will present in our clinics for the next 40 years.

Physician Silence

We have the evidence. We have the platform. If we don't speak up as sports medicine physicians, who will? Parents want to trust us.

THANK YOU

Questions & Discussion

David S. Gazzaniga, MD
Hoag Orthopedic Institute · Sports Medicine

*"The goal of youth sports is not to produce professional athletes.
The goal is to produce healthy, capable, joyful adults."*

— **D.S. Gazzaniga, MD**

THANK YOU

Questions & Discussion

Cell: 949-945-8441

David S. Gazzaniga, MD
Hoag Orthopedic Institute · Sports Medicine

*"The goal of youth sports is not to produce professional athletes.
The goal is to produce healthy, capable, joyful adults."*

— **D.S. Gazzaniga, MD**

Dr. Andrew Horn



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Adolescent Overuse Injuries
The Drivers, Tolls, and Roadmap for Young Athletes
Andrew Horn, MD

January 2026





Learning Objectives



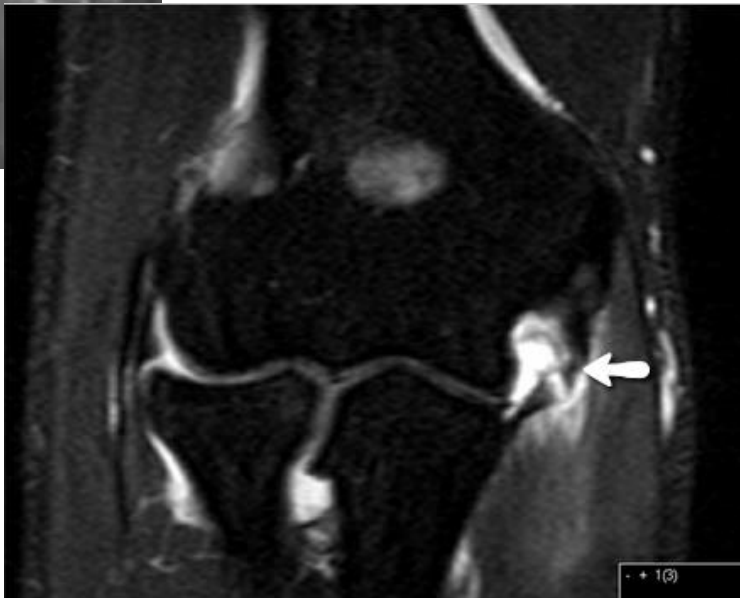
- **Define** overuse injuries and the musculoskeletal risk factors in adolescent athletes
- **Describe** current trends in the rise of Tommy John Reconstruction in young athletes
- **Recognize** psychological consequences of overuse injuries
- **Apply** evidence-based prevention strategies for athletic trainers, PTs, and Orthopaedic Surgeons
- **Collaborate** amongst sports specialists to reduce the burden of overuse injuries in youth sports

Youth Sports Participation and Overuse Injuries



- Approximately 35 million children (ages 5-18) participate in organized youth sports annually
- More than 3.5 million children under age 14 receive medical treatment for sports injuries
- Greater than half of overuse injuries may be prevented with early intervention and prevention techniques
- Difficulty with repetitive stresses and overuse due to single sport specialization

Defining Overuse Injuries



- Injury due to **excessive loading, insufficient recovery, and under-preparedness** without a **single, identifiable traumatic cause**.
- Rest and recovery are insufficient to allow adequate tissue repair and remodeling.
- Adolescents pose an at risk population due to a myriad of both intrinsic and extrinsic risk factors

Common Overuse Injuries in Adolescent Athletes



- UCL Injury/Medial Epicondylitis
- Little Leaguers Shoulder
- Osgood-Schlater's Disease
- Sever's Apophysitis
- Tibial Stress Fractures
- Lumbar Spondylolysis/Spondylolisthesis

Vulnerable Adolescent Athletes



- **Open physes:** repetitive stresses to open physes can lead to delayed physeal closure and stress injuries
- **Rapid skeletal growth:** growing athlete causes muscle/tendon imbalances due to increased bone growth
- **Inability to self-regulate injuries:** growing adolescents may lack insight as to what may be warning signs for overuse injuries
- **Parental pressures and “Keeping Up with the Jones’s”**



Risk Factors for Overuse Injuries

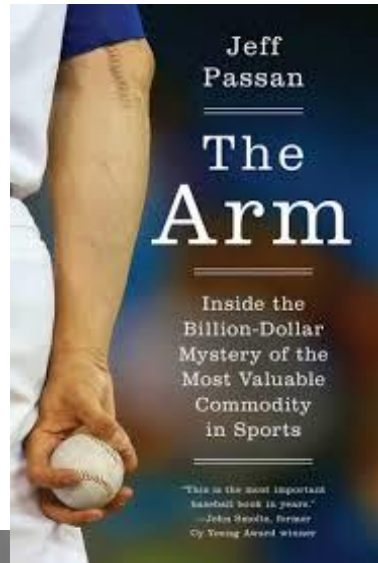
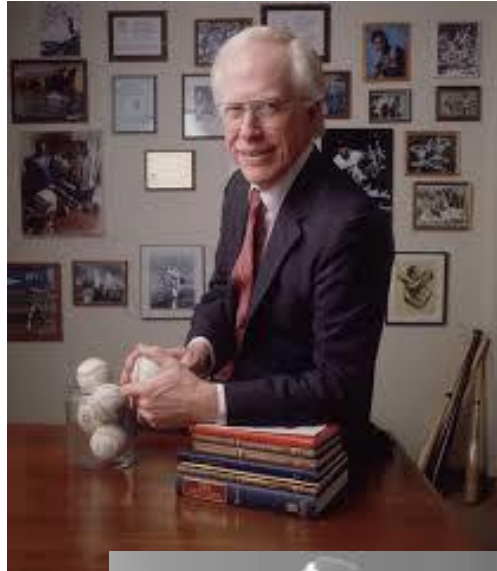
Intrinsic Risk Factors

- Prior Injury History
- Anatomic malalignment
- Muscle imbalance
- Decreased flexibility
- Hormonal Imbalances (female > male)
- Decreased physical fitness

Extrinsic Risk Factors

- Single sport specialization
- Year round participation
- Poor techniques and mechanics
- Inadequate rest
- Coaching and parental pressures

Tommy John Surgery



- First performed in 1974 by Dr. Frank Jobe on Dodgers Pitcher Tommy John
- Originally performed by harvesting palmaris longus tendon and reconstruction the Ulnar Collateral Ligament of the Elbow
- Once considered a career-ending injury, Tommy John reconstruction has allowed for return to high level of pitching
- Nearly 80% return to MLB level after pitchers undergoing Tommy John Reconstruction
- Recovery generally 12-18 months prior to return to pitching at same level

Table 8: Total salary dollars paid to MLB pitchers who underwent UCL reconstruction surgery by April 23.

Year	Total Salary in US Dollars
2021	\$22,984,908.00
2022	\$6,567,000.00
2023	\$9,176,700.00
2024	\$36,365,700.00

The Rise of Adolescent Tommy John Surgery

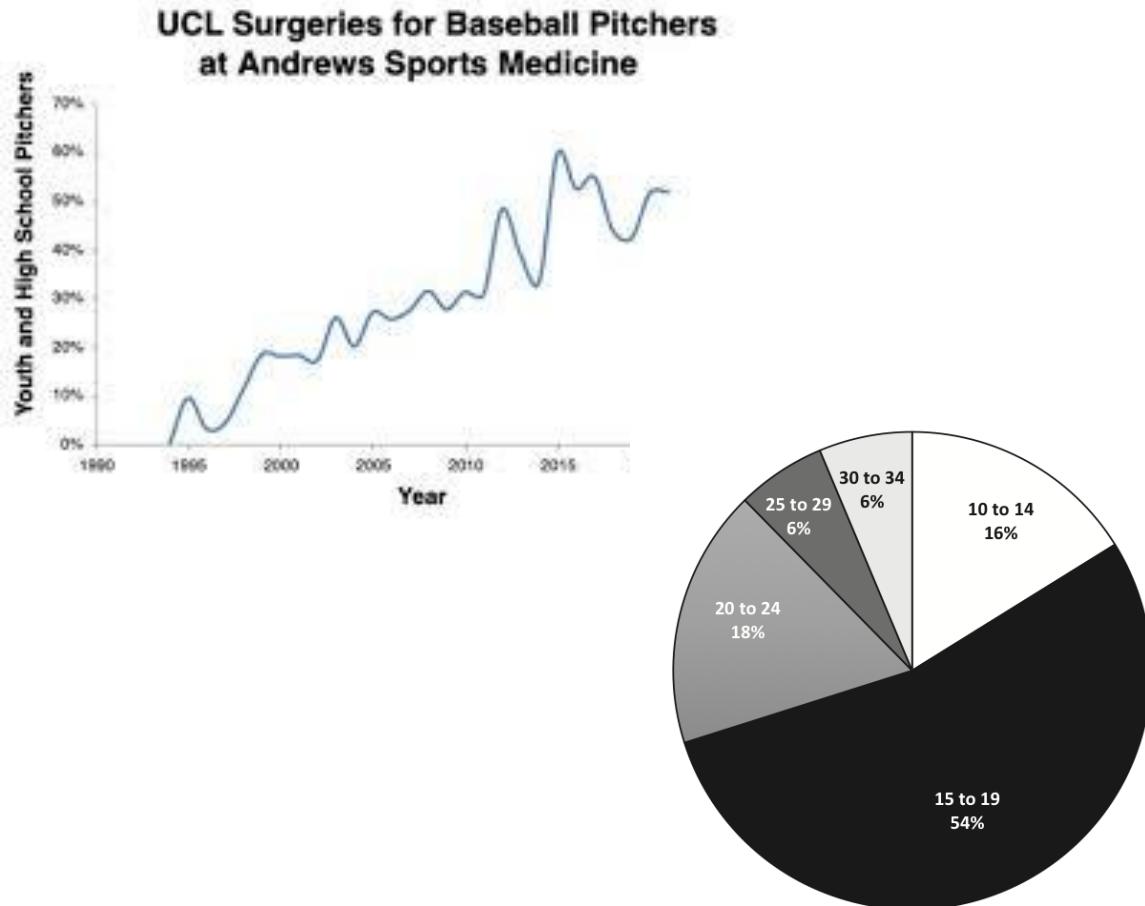


Figure 2. Ulnar collateral ligament (UCL) injury rates by age group.

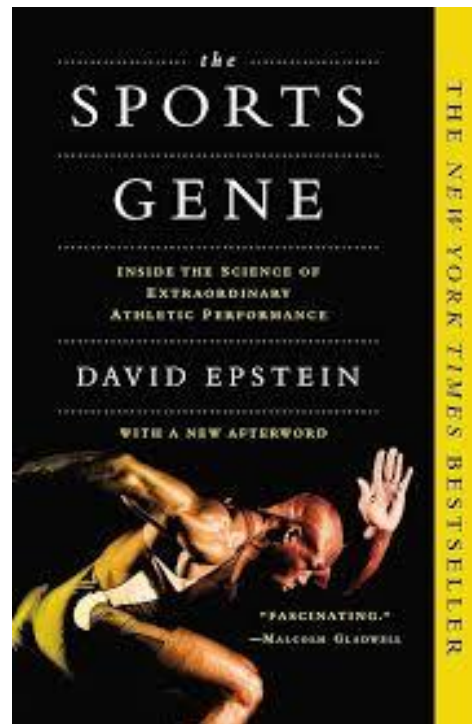
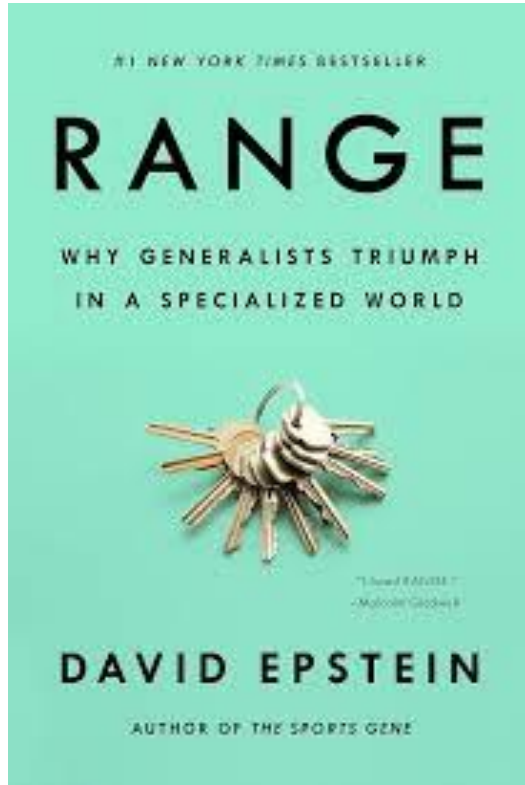
- 343% increase in UCL reconstruction in New York from 2003-2014 with 88.5% of all procedures in athletes aged 15-24
- 2025: 33.3% of all Tommy John surgeries performed in athletes **under age of 18**
- According to Yalozis et al. 54% of all UCL injuries occurred in the **15-19-year group**
- 10-14 year old age group sustained UCL injuries at very similarly percentages as those in the 20-24 year old age group

Why are UCL Injuries Becoming an Epidemic in Youth Sports?



1. Early sports specialization – no offseason
2. Overuse and Pitch Volume – 58% of high-school baseball player report elbow pain
3. Inadequate Rest: playing through the pain and improper recovery
4. Multi-team Participation: playing school, travel, and club team simultaneously
5. Financial Drive: from 2020-2025 MLB free agent pitcher contracts exceeded \$3.8 billion.

Psychological Consequences of Overuse Injuries



- Sports injured lead to some of the most psychologically impactful experiences for developing adolescents leading to
 - *Anxiety*
 - *Depression*
 - *Burnout*
 - *Loss of Identity*
- Early single sport specialization is independently associated with increased risk of *depression, anxiety, and maladaptive perfectionism*
- Tiger Woods versus Roger Federer debate (David Epstein)

Role of Athletic Trainer in Prevention of Overuse Injury



AGE	DAILY MAX PITCHES	REQUIRED REST (PITCHES)				
		0 Days	1 Day	2 Days	3 Days	4 Days
7-8	50	1-20	21-35	36-50	N/A	N/A
9-10	75	1-20	21-35	36-50	51-65	66+
11-12	85	1-20	21-35	36-50	51-65	66+
13-14	95	1-20	21-35	36-50	51-65	66+
15-16	95	1-20	31-45	46-60	61-75	76+
17-18	105	1-20	31-45	46-60	61-75	

- First line of defense and daily interaction with young athletes
- Key Roles for Athletic Trainers to Prevent Overuse Injury
 - **Injury Surveillance:** keep systematic log of pain complaints, pitch counts, velocity stats (Bell et. Al)
 - **Pitch Count Monitoring and Enforcement**
 - **Education:** educating athletes, coaches, and parents on dangers of overuse injury
 - **Advocacy:** athletes can be their own worst enemies; ATCs must know when and how to intervene

Role of the Physical Therapists in Prevention

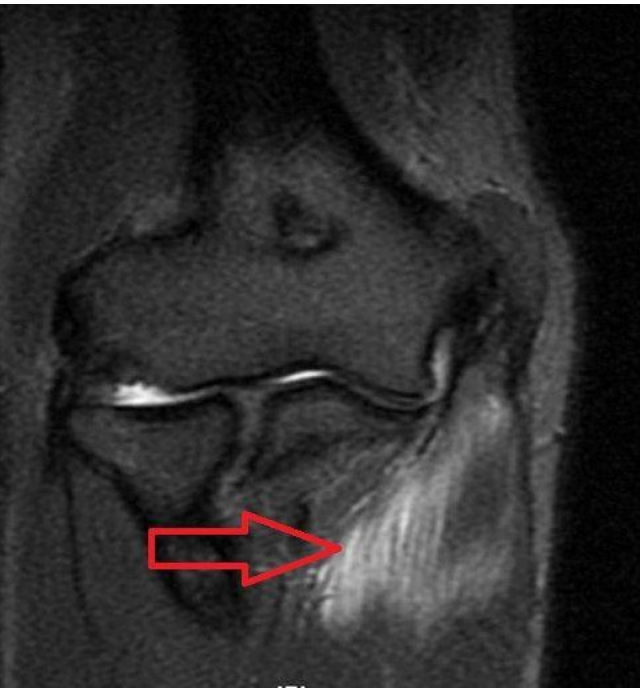
Little League Interval Throwing Program

<p>30' Phase</p> <p>Step 1: A) Warm-up Throwing B) 30' (25 Throws) C) Rest 15 min. D) Warm-up Throwing E) 30' (25 Throws)</p> <p>Step 2: A) Warm-up Throwing B) 30' (25 Throws) C) Rest 10 min. D) Warm-up Throwing E) 30' (25 Throws) F) Rest 10 min. G) Warm-up Throwing H) 30' (25 Throws)</p>	<p>45' Phase</p> <p>Step 3: A) Warm-up Throwing B) 45' (25 Throws) C) Rest 15 min. D) Warm-up Throwing E) 45' (25 Throws)</p> <p>Step 4: A) Warm-up Throwing B) 45' (25 Throws) C) Rest 10 min. D) Warm-up Throwing E) 45' (25 Throws) F) Rest 10 min. G) Warm-up Throwing H) 45' (25 Throws)</p>
<p>60' Phase</p> <p>Step 5: A) Warm-up Throwing B) 60' (25 Throws) C) Rest 15 min. D) Warm-up Throwing E) 60' (25 Throws)</p> <p>Step 6: A) Warm-up Throwing B) 60' (25 Throws) C) Rest 10 min. D) Warm-up Throwing E) 60' (25 Throws) F) Rest 10 min. G) Warm-up Throwing H) 60' (25 Throws)</p>	<p>90' Phase</p> <p>Step 7: A) Warm-up Throwing B) 90' (25 Throws) C) Rest 15 min. D) Warm-up Throwing E) 90' (25 Throws)</p> <p>Step 8: A) Warm-up Throwing B) 90' (20 Throws) C) Rest 10 min. D) Warm-up Throwing E) 60' (20 Throws) F) Rest 10 min. G) Warm-up Throwing H) 45' (20 Throws) I) Rest 10 min. J) Warm-up Throwing K) 45' (15 Throws)</p>

Physical therapists are key contributors to both **primary prevention and rehabilitation** from overuse injuries through

- **Movement screening and biomechanical analysis**
- **Strengthening programs** (core, periscapular stabilizers, rotator cuff, forearm and flexor-pronator mass)
- **Flexibility and mobility work**
- **Return-to-throw protocols**
- **Constant communication**

Role of The Orthopaedic Sports Surgeon



- Orthopaedic sports surgeons play a critical role in prevention, education, and management
 - **Accurate Diagnosis:** distinguishing UCL injury from medial epicondylitis, stress fracture, or flexor-pronator strain
 - Promote a graduate treatment plan
 - Transparency regarding surgical outcomes
 - Understanding and implementing new surgical technique
 - Leading within the community

Key Takeaways

Youth Sport Specialization: How to Keep Your Athletes Safe from Overuse Injuries



- Overuse injuries represent ~50% of all pediatric sports injuries and most are preventable
- UCL Injuries occur most frequently in the 15-19 year old age group and nearly 1/3 of Tommy John Reconstructions are performed on athletes under 18 years of age
- There is a true psychological burden associated with overuse injury
 - Depression, anxiety, burnout
- Early specialization, excessive pitch volume, and inadequate rest drive overuse injury and are a key contributor to the Tommy John Epidemic

What We Need to Do

- **Enforce Accepted Guidelines (Pitch Count/Rest Days)**
- **Advocate** for multi-sport participation
- **Address psychological burden**
- **Educate Coaches, Players, Communities**
- **Protect athletes from themselves**



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ACL “Prevention”

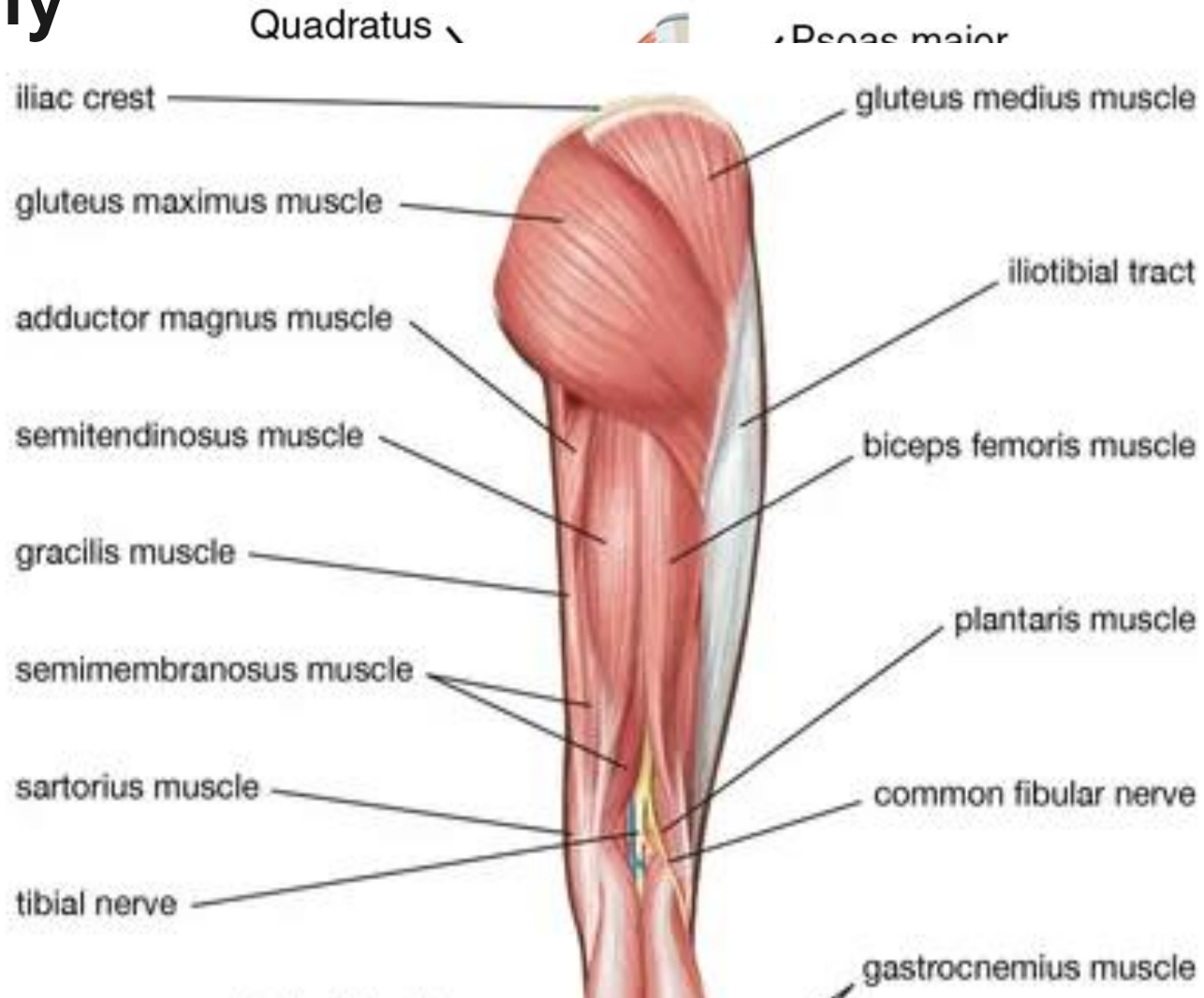
Gabrielle Leveratto MS, ATC
2026 HOI Sports Medicine Symposium
6/12/2026



Learning objectives

1. **Identify** common risk factors and movement patterns associated with non-contact ACL injuries.
2. **Demonstrate** proper landing, deceleration, and cutting mechanics used in ACL injury prevention.
3. **Apply** evidence-based ACL prevention exercises within warm-up and strength-training programs.

Anatomy



“Fun” Facts

Approximately 70% of ACL injuries are non-contact. 1,2,3

Female athletes sustain ACL injuries at higher rates than males in comparable sports. 1,3

Increased risk of future knee osteoarthritis. 1,4,5

Prevention programs reduce risk ~67% 1



But Why?

- Dynamic knee valgus 2,3,4,5
- Poor trunk control 4,5
- Quad-dominant movement patterns 2,3
- Weak hamstrings and gluteal muscles 3
- Neuromuscular deficits 1,2,3,5



How Can I Help?

Time to make a program! Lets think about a couple of things first

- What time do we have available?
 - General workout v warm up
- Most beneficial for the setting we are in?
 - Individual v team





What do programs need?

Effective Prevention Programs Include: 2-6

- ✓ Plyometrics
- ✓ Strength training
- ✓ Balance training
- ✓ Agility/change-of-direction drills
- ✓ Movement technique feedback

- Injury reduction rates of approximately 40–70% have been reported with comprehensive neuromuscular programs. 2,4
- Programs are most effective when performed consistently 2–3 times per week.5

High-Risk Movements 1-6

- Landing from a jump
- Sudden deceleration
- Cutting or changing direction
- Single-leg planting

Strength Training

- Quad v Hamstring strength 2,3
 - Overactive quad could cause increased ACL stress
- Hip Abductors 2
- Hip ER 2
- Non-dominant side weakness can increase injury risk 2
- Strengthen through multiple planes 4



Screenshot from *The Prehab Guys*, "Nordic Hamstring Curl Tutorial," 2025.

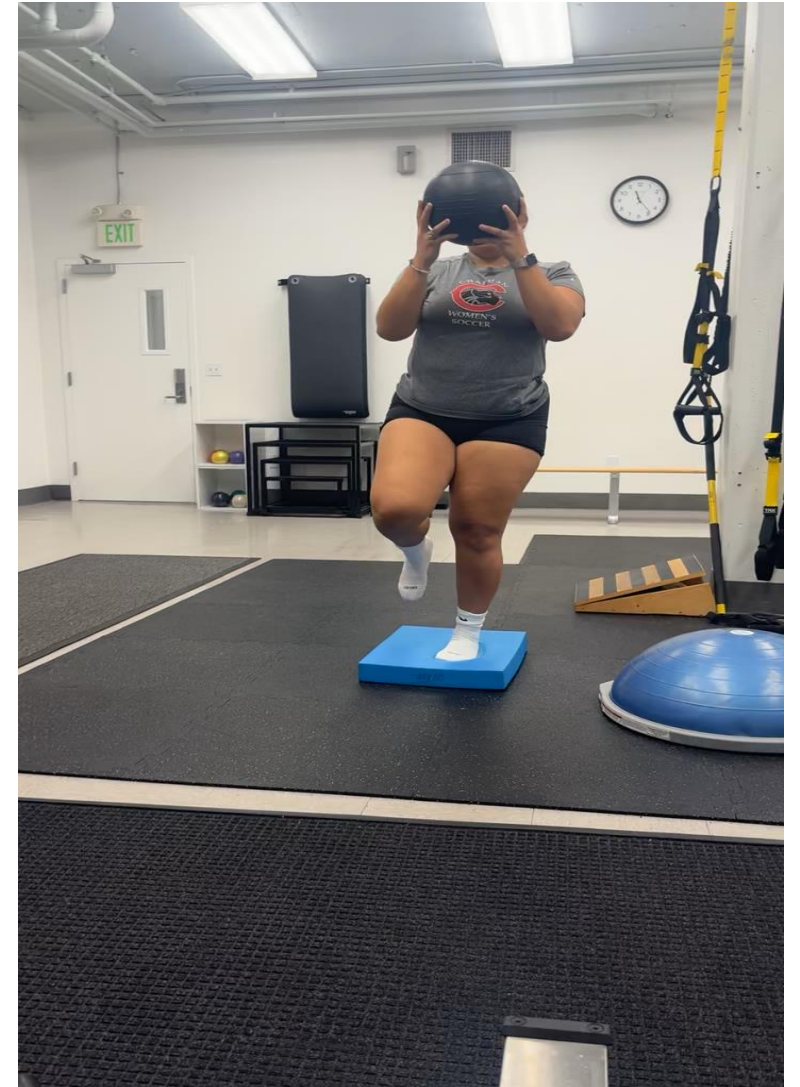
Exercises: Nordic curls*, Hamstring bridges, standing clams, side-lying hip CARs

Balance Training

- Core stability is an important factor 5
 - Positive contribution of proximal hamstrings and hip/trunk muscle activation
- Ipsilateral trunk tilt and contralateral rotation are risk factors 4

Exercises:

SL balance variations, SL RDLs, bosu ball variations



Plyometrics ^{2,3,4}

- Assess hip and knee flexion during landing
- What does foot contact look like
- Trunk control
- Try to avoid “stiff” landings

Exercises:

Bounds, Depth drops, Jump squats, jump lunges



Change of Direction

- Need to practice movements they will be performing!
- Help develop neuromuscular training 3,1
- Think about multiplanar movements

Exercises:

Cone drills, reaction drills, timed drills






TikTok
@marissssssssa17



Things to consider

- Accessibility
 - Time
 - Resources
 - Coach/Player Education
- Augmented Feedback
- Sport specific
 - Not every program will be the same for all sports
- Individual specific
- Popular programs
 - FIFA 11+ ~20 min
 - PEP (Prevent Injury, Enhance Performance) ~15 min

TLTDL

- Can decrease chances but can not fully prevent ACL injuries
- Proper warm-ups should include: plyometrics, balance and deceleration
 - Important to develop strength outside of just warm-ups
- Consistency with movements
 - 10-15 minutes can be helpful
 - At least 3x a week
- Deficits will vary athlete to athlete- consider personalized plan if possible





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Lunch Break 12:30 – 1:10pm

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ACL RECONSTRUCTION IN 2026

Graft Selection, Reinjury Risk & Return-to-Play Decision Making

David S. Gazzaniga, MD

Sports Medicine · Hoag Orthopedic Institute

Why ACL Reconstruction Matters

The modern challenge is not “does ACLR work?” — it is durable return to sport.



The decision is now a risk-management problem:

- stabilize the knee
- preserve the meniscus
- choose the graft for the patient
- reduce second injury risk
- return to performance, not just participation

15–25%

second ACL injury risk in young athletes after return to high-risk sport

87%

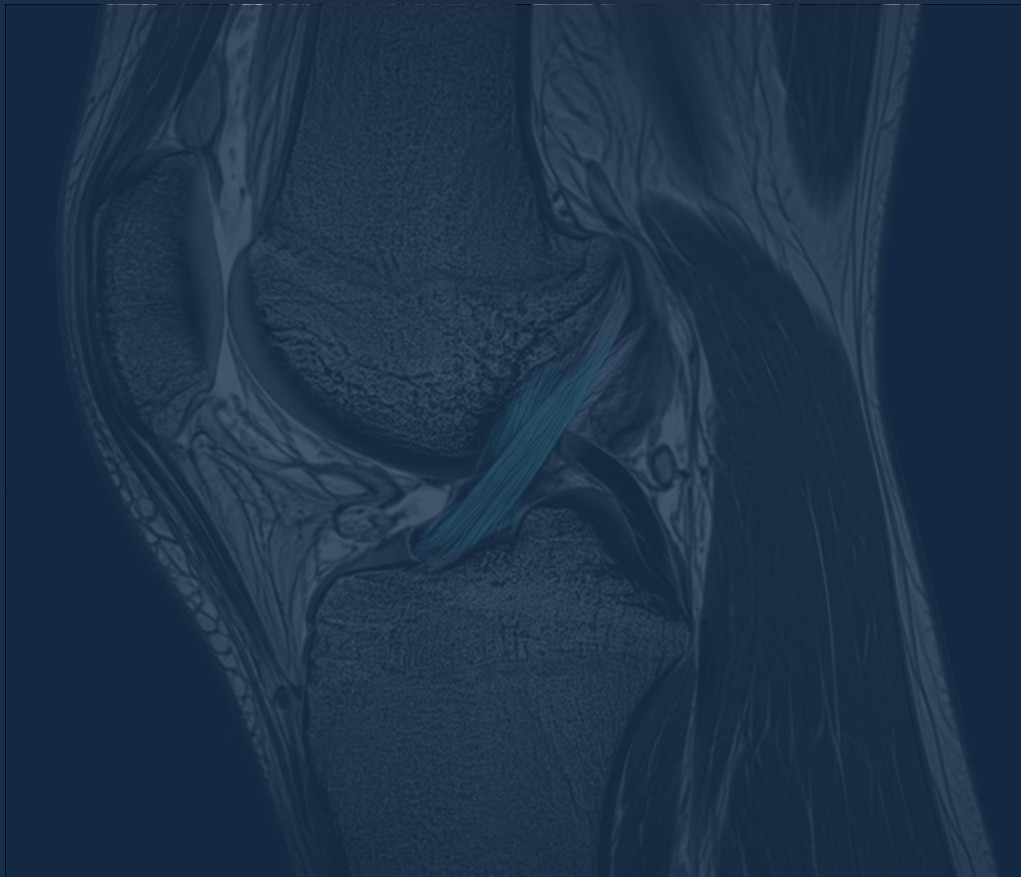
returned to sport in young high-risk cohorts

80%

returned to high-risk activity

When Should We Operate? The Quiet Knee

Surgery when the knee is ready — not when the calendar, coach, or parent demands it.



Quiet Knee = Safer Knee

- ✓ Full extension
- ✓ Minimal effusion
- ✓ Quad activation
- ✓ Normal gait
- ✓ Flexion >120°

Operate when the knee is ready — not when the calendar demands it.

Preoperative goals:

- restore full extension
- quiet the effusion
- recover quadriceps activation
- normalize gait
- respect concomitant injuries

A stiff and swollen knee is a setup for disaster. Optimally it would look like it was never injured.

Operative vs Nonoperative Decision Making

Match the treatment to instability risk, sport, age, and concomitant pathology.



The Four Major Graft Choices

Autograft is not one operation — each graft has a different biologic and morbidity profile.



BPTB

Bone–tendon–bone
fast bone-to-bone
healing

Hamstring

Semitendinosus ±
gracilis
less anterior knee pain

Quadriceps

Large cross-sectional
area
low donor-site
symptoms

Allograft

No harvest morbidity
but slower biologic
incorporation

**The right question is not “Which graft do I like?”
It is “Which graft does this patient need?”**

Graft Selection Matrix

AOSSM-level graft selection is a matrix, not a habit.

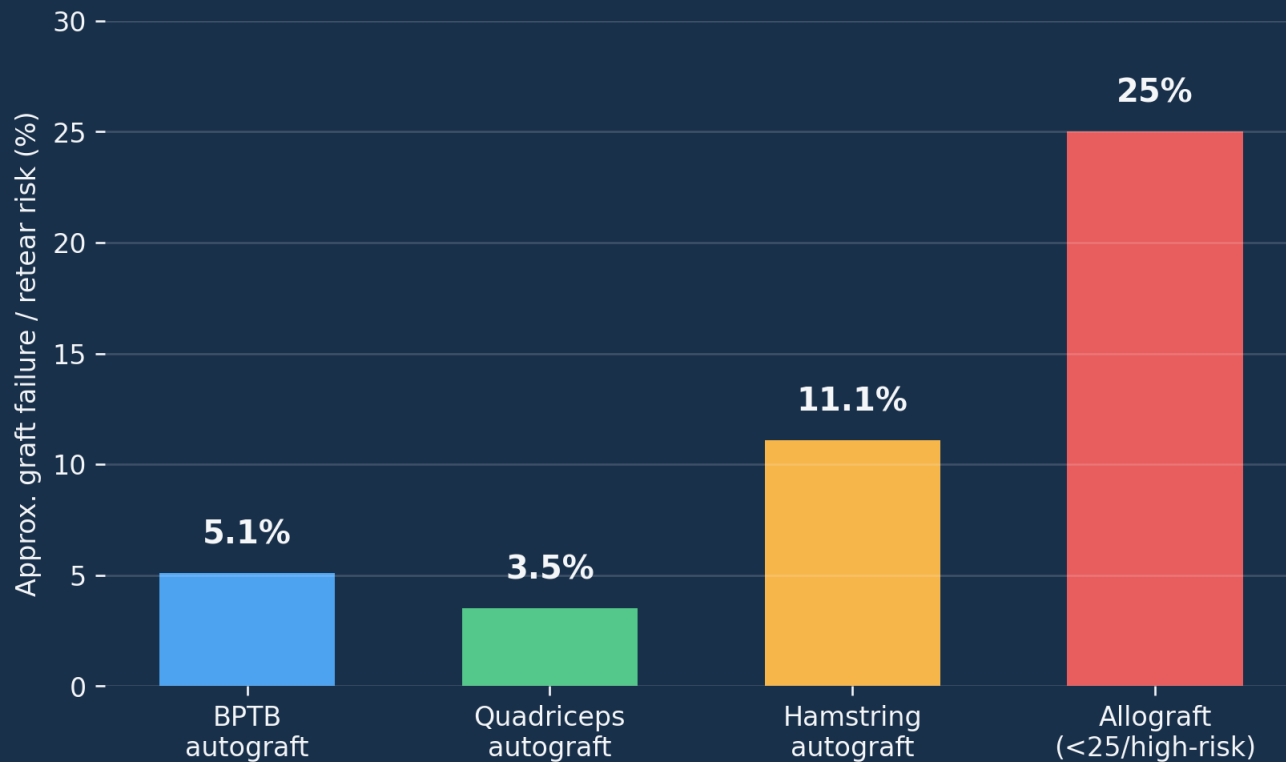
Factor	BPTB	Hamstring	Quadriceps	Allograft
Failure risk	Low	Moderate	Low	Highest in young
RTS	High	High	High	Variable
Anterior knee / kneeling	Highest	Low	Low-mod	None
Strength deficit	Extensor / kneeling	Flexion / IR	Early quad	None
Young pivoting athlete	Excellent	Selective	Excellent	Avoid
Revision flexibility	Good	Variable	Excellent	Selective
Best clinical fit	collision / cutting	kneeling concern	high-demand + avoid kneeling pain	older / lower demand

Use patient phenotype: age, sport, laxity, kneeling demands, revision status, and concomitant procedures.

Graft Failure Risk: The Data Should Change the Conversation

Allograft failure remains the key caution in young active patients.

Failure risk is not equal across grafts



Evidence pattern:

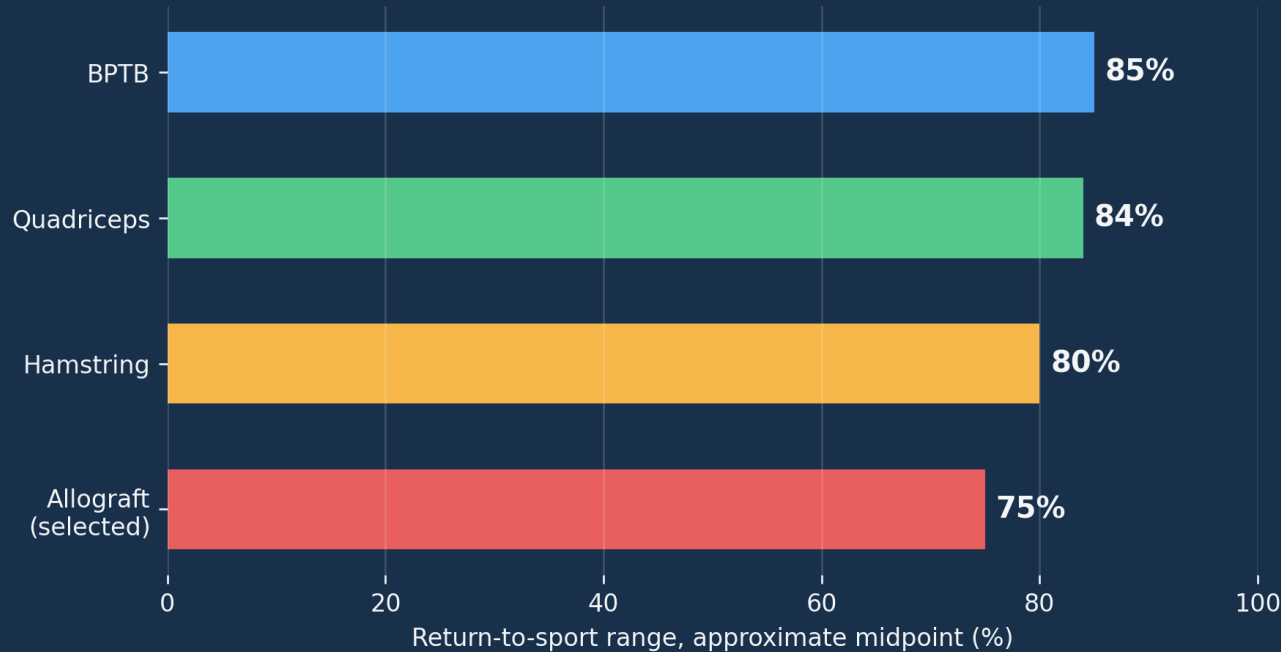
- younger age increases failure risk
- higher activity increases graft and contralateral risk
- allograft has markedly higher failure in young/high-demand patients
- QT and BPTB generally show low failure in high-risk cohorts

MOON: allograft rupture odds $\approx 4\times$ autograft; each 10-year decrease in age $\approx 2.3\times$ higher odds.

Return-to-Play: Similar Percentages, Different Tradeoffs

Return-to-sport is not the same as return-to-performance or durable survival.

RTS rates are high—but durable RTS is the goal



Key interpretation:

- RTS varies more by sport, age, criteria, and psychology than graft alone
- autografts all support high RTS in appropriate patients
- durability and donor-site morbidity drive the graft decision
- testing quality matters more than a calendar date

9–12 mo

typical competitive
pivoting-sport decision
window

>90%

strength / hop symmetry threshold
is a minimum, not enough alone

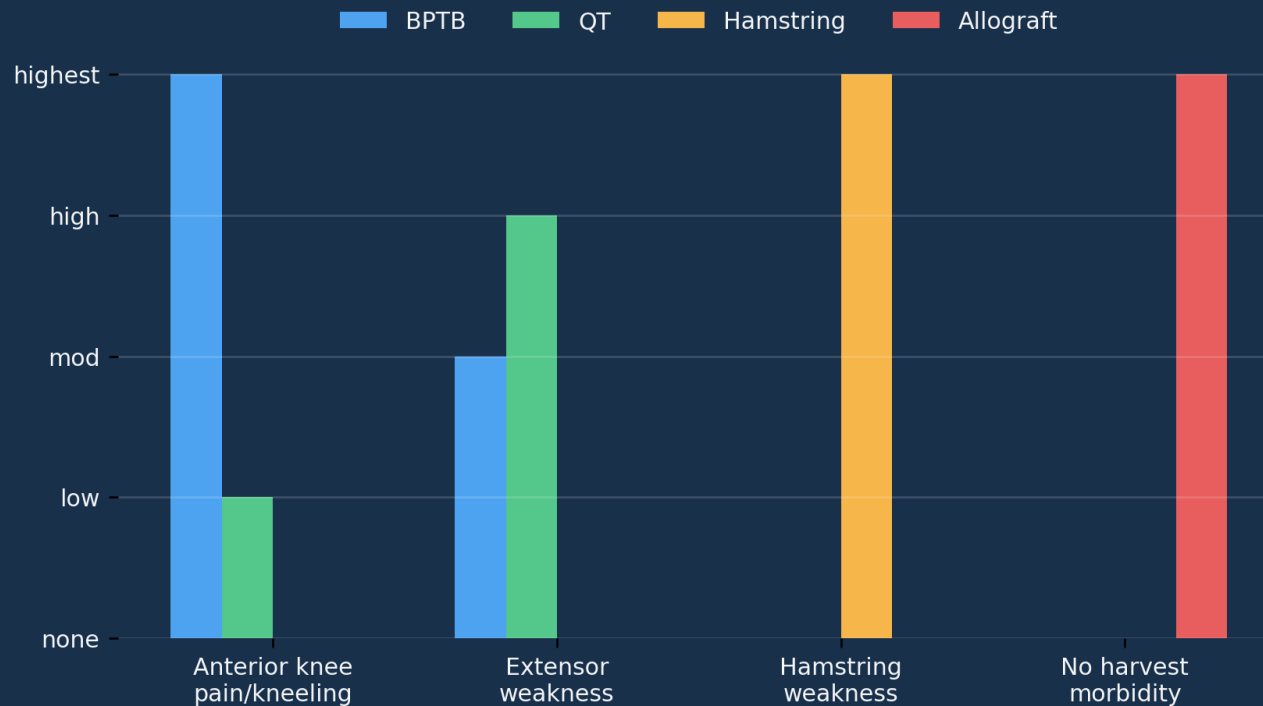
**RTS ≠
RTP**

participation
is not
performance

Donor-Site Morbidity & Harvest Deficits

The graft harvest creates its own rehabilitation problem. Own it early.

Harvest morbidity is graft-specific



Practical deficits:

BPTB: anterior knee pain, kneeling pain, patellar tendon symptoms, rare fracture

Hamstring: knee flexion/internal rotation weakness, variable graft size

QT: early extensor inhibition/weakness, usually lower kneeling morbidity

Allograft: no harvest morbidity, but biologic and failure concerns in young athletes

Therapists should know the graft before they prescribe the loading strategy.

Why Quadriceps Tendon Has Gained Momentum

QT often functions as the “middle path”: large graft, low failure, less anterior knee morbidity.

Why QT is compelling:

- large cross-sectional area
- robust collagen volume
- lower anterior knee / kneeling symptoms than BPTB
- avoids hamstring harvest deficit
- useful in primary and revision settings
- works well for high-demand athletes when technique and rehab are precise

Caveat: early quadriceps weakness is real — so rehab must be intentional, not gentle.

3.5%

QT rupture in one systematic review vs 12.4% HT

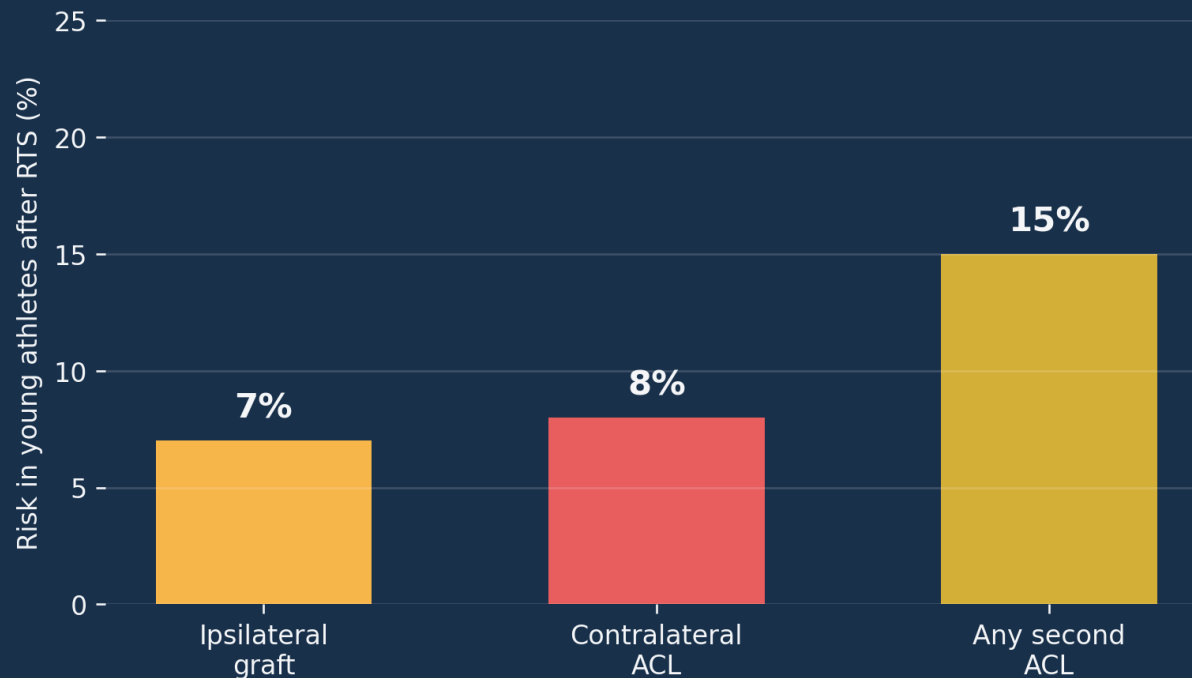
↓ pain

less donor-site morbidity vs BPTB in multiple reviews

The Second ACL Injury Problem

The greatest risk factor for ACL injury is a previous ACL injury.

The second ACL injury is the real adversary



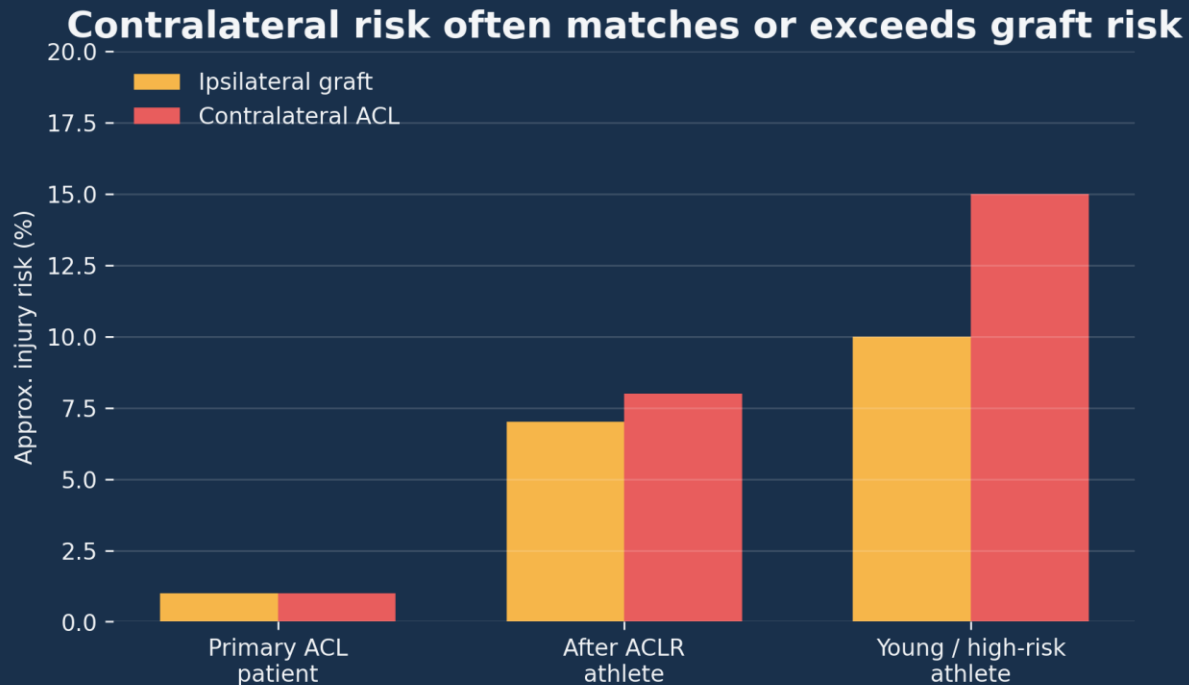
After ACLR, the risk is not one injury:

- ipsilateral graft rupture
- contralateral native ACL tear
- meniscal tear progression
- chondral injury
- psychological under-readiness or overconfidence

High-risk young athletes can return successfully — but recurrence prevention must be built into the plan from day 1.

Contralateral Risk & Concomitant Injury

The reconstructed side is not the only knee at risk.



Clinical implications:

- train both limbs, not just the surgical knee
- include deceleration, trunk control, perturbation, and fatigue testing
- evaluate risk before returning the athlete to chaotic sport
- protect meniscus and cartilage during the instability window

Contralateral ACL injury can match or exceed graft rupture risk — especially in young female athletes.

Meniscus Preservation: Repair Every Repairable Tear

The meniscus is not a secondary detail — it is the long-term joint preservation strategy.



Principles:

- repair every repairable meniscus tear
- avoid meniscectomy unless tissue is truly non-repairable
- stabilize the ACL to protect the repair biology
- address ramp/root/complex patterns deliberately
- counsel athletes that meniscus dictates rehab limits

Meniscus pathology is reported in 21–64% of operative ACL injuries.

Repair strategy may slow early rehab — but it protects the athlete's future knee.

Rehabilitation Philosophy: Motion, Load, Control

Gentle does not mean gentle. Early motion and controlled loading prevent avoidable problems.



1 ROM first

Get full extension and early flexion within surge on-set limits.

2 Weight bear early

Full weight bearing if isolated ACL and no other restriction.

3 No brace dependence

Brace rarely changes outcomes in isolated ACLR.

4 Reflex + balance early

Make the muscle work in reaction, not just isolation.

5 Push controlled pace

Jog and progress when able— often sooner than allowed.

6 Own the timeline

No 1-on-1 competition until readiness is demonstrated.

The treatment team must lead with objective criteria — not athlete pressure, parent anxiety, coach timelines, or social media.

Bracing + Return-to-Play Timeline

Brace less. Test more. Return when ready — usually around 9 months for 1v1 pivoting sport.

Criteria-based progression: pace early—but earn competition



Isolated ACLR bracing:

- no consistent improvement in ROM, strength, stability, function, or RTS
- use a brace only when there is a reason — not as tradition
- no brace / early discontinuation is evidence-supported in isolated ACLR

Competition decision:

- jog when **able**
- controlled cutting before chaos
- no 1v1 until objective readiness
- usually ~9 months for pivoting athletes
- strength, movement quality, fatigue, confidence

Final algorithm:

Young pivoting athlete: BPTB or QT
Kneeling/anterior knee concern: QT / HT
Hypertax/high-risk: consider LET + autograft
Older lower-demand: selective allograft possible

Samantha Baumler, PT, ATC



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ACL RECONSTRUCTION **REHABILITATION**

From Post op to Return to Sport

Samantha Baumler, PT, DPT, ATC, TPI2

ProSport Costa Mesa

FINANCIAL DISCLOSURES



No Financial Disclosures

There are no financial disclosures for this presentation.

No Product Affiliations

Any product shown in this presentation has no relationship of financial gain for myself or ProSport Physical Therapy.

GOALS OF PRESENTATION

Understand the phases of ACL reconstruction and key red flags along the way for an optimal team approach to recovery

Learn criteria-based progression principles and key benchmarks that guide individualized rehabilitation.

Review the return-to-sport testing battery and objective strength criteria for safe clearance.

Recognize the role of psychological readiness and a multifactorial approach in return-to-sport decisions.

REHABILITATION PHILOSOPHY

TIME-BASED

- Fixed timelines for progression
- Calendar-driven clearance
- One-size-fits-all protocols
- Higher reinjury rates

CRITERIA-BASED

- Functional milestones drive progression
- Objective strength & hop testing
- Individualized biopsychosocial model
- Reduced reinjury risk

KEY FINDING: Each month of delayed return (up to 9 months) reduces reinjury risk by ~51%. Returning before 9 months increases second ACL injury risk up to 7x

PHASE I IMMEDIATE POST-OP | 0–2 WEEKS

GOALS

- Protect graft integrity
- Minimize pain and swelling
- Restore patellar mobility
- Achieve full extension (0°)
- Re-establish quadriceps control
- DC brace/Crutches when appropriate and pending MD preference

INTERVENTIONS

- Ice, compression, elevation, 2-3x/day each
- Early quad intervention: Quad sets, straight leg raises
- Ankle pumps, heel slides
- Patellar mobilization
- Weight bearing precautions if any: Brace donning, meniscal injury to consider (alters timeline), crutch use/removal, safety
- Integrate NMES in clinic and at home for optimal quad recruitment – increased time spent firing quad, better rehab outcome

EARLY INTERVENTION YELLOW / RED FLAGS

Infection

Cyclops Lesions (10%)

Anterior knee pain with passive extension/overpressure, sudden loss of extension at wk 6, temporary gains of extension then loss returning each visit. Often requires PT wait and see approach, followed by MD consult and MRI if PT does not push knee forward.

Arthrofibrosis (2%)

Scar tissue causing loss of ROM, causing stiffness/pain

Screw Pain

Pain at proximal medial tibia, pain with activity

Arthrogenic Muscle Inhibition (AMI) : Main issue we see post operatively

Deficits in quad activation secondary to neural inhibition

PHASE II EARLY REHABILITATION | 2–6 WEEKS

GOALS

- Restore normal gait pattern without brace/crutches pending MD clearance
- Achieve full extension, progress flexion to 120°+
- Active Quad firing in full extension and hyperextension avoid AMI
- Improve hip and core strength
- Begin proprioceptive training

INTERVENTIONS

- Ongoing push of NMES for quad firing: Isos at 60 degrees (start prepping for testing positions and optimal quad strength), SLR, SAQ, LAQ
- Stationary bike (progress time/resistance)
- Closed kinetic chain: wall sits, leg press
- Step-ups, partial lunges
- Optimal stretches to maintain flexibility elsewhere
- Balance, single-leg stance uneven surfaces

RED FLAG ZONE: excessive/ongoing swelling, Avoid extension ROM limitations/quad inhibition (AMI): perform NMES 40/50mins/day to help fight poor firing, lack of hyperextension/heel prop during active firing will lead to struggling control when progressed to closed chain environments

PHASE III

PROGRESSIVE STRENGTHENING | 6–3 Months

GOALS

- Full pain-free range of motion
- Strength $\geq 70\%$ of uninvolved limb, testing at 3 mos
- Normalize closed chain strength mechanics
- Improve endurance and proprioception

INTERVENTIONS

- Squat strategy, SL strength, eccentric loading
- Cont Isometrics for optimal loading of patellar tendon, quad hypertrophy and knee over toe principles to regain functional strength
- Ongoing NMES for quad prep in 60 degrees and 90 degrees tolerance for LSI testing
- Assault bike, elliptical for endurance
- Progressive proprioceptive challenges
- Begin jump prep/SL acceptance exercises in preparation for running clearance

RED FLAG ZONE: quad strength $\geq 70\%$ LSI, patellar tendon pain = reassess exercise program/progressive loading principles/functional mechanics, hamstring/glute strength progressions in conjunction with trunk, progression to dynamic loading will only make red flag zone worse, must complete proper strength DL > SL > DL dynamic loading > SL dynamic loading

PHASE IV

ADVANCED STRENGTHENING | 3–6 MONTHS

GOALS

- Build strength: Quad strength \geq 80% LSI
- Introduce sport-specific movement patterns
- Develop neuromuscular control
- Progress to running program per MD clearance
 - Quadriceps strength to body weight ratio indicator of return to running clearance not just LSI
 - Be able to load for shock absorption to 30 degrees knee flexion in loaded position with minimal symptoms.

INTERVENTIONS

- Plyometrics: box jumps, depth jumps
- Agility: ladder drills, cone drills
- Progressive running: intervals, tempo
 - University of Delaware return to running
 - Run/walk- on/off to start
 - Do not increase frequency and intensity at the same time
- Single-leg plyometric progressions
- Sport-specific movement introduction

RED FLAG ZONE: Patellar tendon pain (QT or BPTB), hamstring cramping/pain (HS graft), Progress to sport-specific training when strength LSI \geq 80%, pain-free plyometrics, and minimal symptom complaints following training. Strength program matters in this phase, should ultimately be increasing weight/decreasing reps, deload when recovery is needed

PHASE V RETURN TO SPORT PREP | 6–9+ MONTHS

GOALS

- Quad & hamstring strength $\geq 90\%$ LSI
- Pass full return-to-sport test battery
- Psychological readiness (ACL-RSI ≥ 56)
- Unrestricted sport participation

INTERVENTIONS

- Full sport-specific drills & scrimmaging
- Cutting, pivoting, deceleration training in clinic (start/stop of surgical leg)
- Unrestricted plyometrics & agility
- Graduated return to team practice – Contact clearance per MD and graduated progressions with PT (9+-12mos)
- Maintenance strength program

RED FLAG ZONE: Minimum 9 months post-op before clearance. All RTS criteria must be met — no single test grants clearance.

RETURN TO SPORT TESTING BATTERY



Single Hop

Max distance on one leg
LSI \geq 90%



Triple Hop

3 consecutive single-leg hops
equivalent to non injured limb
LSI \geq 90%



Crossover Hop

3 hops crossing center line
LSI \geq 90%



6m Timed Hop

Speed over 6 meters
LSI \geq 90%



Quad Strength

Isokinetic dynamometry
LSI \geq 90%



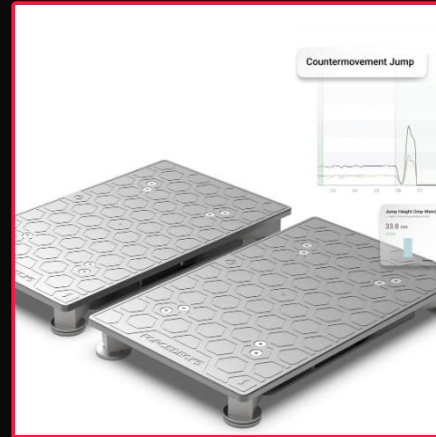
ACL-RSI Score

Psychological readiness
Score \geq 56/100

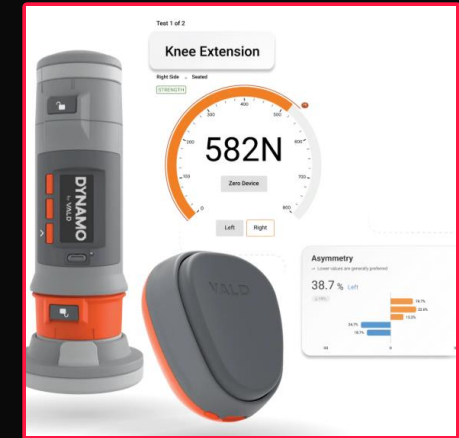
TECHNOLOGY IN ACTION



Crane Dynamometer



VALD Force Plates



VALD Dynamo



Kinvent K-Force Plates



Kinvent K-Pull

MOVEMENT QUALITY CRITERIA

Beyond numbers — observe quality during all functional tests



No Knee Valgus

Knee does not collapse inward on landing or during single-leg tasks



Controlled Landing

Stick the landing without excessive wobble or compensatory trunk shift

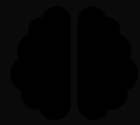


Equal Effort

Similar confidence and effort on both legs — no visible hesitation

LSI FORMULA: $(\text{Surgical Limb} \div \text{Non-Surgical Limb}) \times 100$ | Target: $\geq 90\%$ | 1% LSI improvement
→ ~3% reinjury risk reduction

PSYCHOLOGICAL READINESS



ACL-RSI QUESTIONNAIRE

- 12-item validated questionnaire
- Measures confidence, fear of reinjury, and risk appraisal
- Score range: 0–100
- Passing threshold: $\geq 56/100$
- Higher score = greater psychological readiness

BIOPSYCHOSOCIAL FACTORS

Fear of Reinjury

Most common barrier to return

Self-Efficacy

Confidence in knee during sport

Social Support

Team, coaching, family network

Motivation

Intrinsic drive to compete

2020 Panther Symposium consensus: RTS decisions must integrate biological healing, functional recovery, AND psychological readiness.

KEY OUTCOMES & EVIDENCE

84%

Lower reinjury risk
with RTS testing

51%

Risk reduction per
month delayed (to 9mo)

7×

Higher reinjury risk
if return < 9 months

ADDITIONAL EVIDENCE

- 1% improvement in quad LSI → 3% reduction in reinjury risk
- Exercise is the mainstay of ACLR rehabilitation (Aspetar CPG)
- Modalities helpful as adjunct in early phase for pain/swelling
- Neuromuscular training improves proprioception & dynamic stability

KEY TAKEAWAYS

Criteria-based progression replaces rigid time-based protocols — individualize every patient.

Quadriceps strength restoration (LSI \geq 90%) is the single most important and most challenging criterion.

Minimum 9 months before RTS clearance — each additional month reduces reinjury risk by ~51%.

The hop test battery (4 tests) plus isokinetic dynamometry form the core of objective RTS assessment.

Psychological readiness (ACL-RSI \geq 56) must be assessed alongside physical recovery.

No single test clears an athlete — use a comprehensive, multifactorial approach.

Thank You!

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Holmgren D, Noory S, Moström E, et al. Am J Sports Med. 2024;52(1):69-76. doi:10.1177/03635465231209442

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Iwame T, Matsuura T, Okahisa T, et al. Knee. 2021;28:240-246. doi:10.1016/j.knee.2020.12.010

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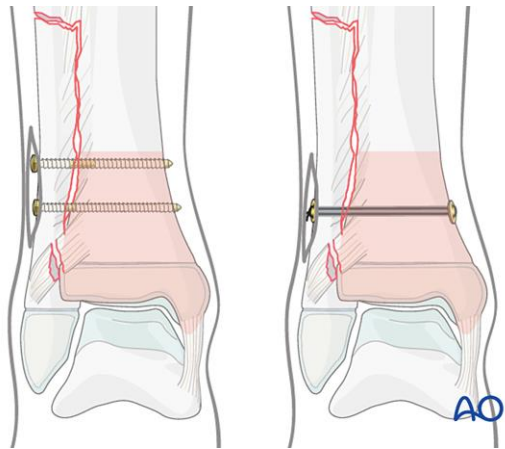
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“When It’s Not Just a Sprain: Differentiating & Treating High Ankle Sprains”

Brandon Haghverdian, MD

Orthopedic Foot and Ankle Surgeon

Orthopaedic Specialty Institute

Orange, CA



Disclosures

- TriMed, Inc
 - Consultant, lab instructor

Learning Objectives

- Differentiate syndesmotic injuries from lateral ankle sprains
- Review syndesmotic anatomy and biomechanical principles
- Interpret contemporary diagnostic strategies
- Understand operative and nonoperative treatment algorithms
- Apply evidence-based rehabilitation and RTP principles

Why Syndesmotic Injuries Matter

- Represent 1–15% of ankle sprains depending on cohort
 - 2011 NFL season: 81 syndesmotic injuries
- Increasing recognition has significantly raised reported incidence
- Higher incidence in collision and cutting sports
 - Risk factors: males, higher level of sports
 - “Higher risk” sport: Football, basketball, soccer, volleyball
 - Player contact most common mechanism
- Greater disability and prolonged RTP versus lateral ankle sprains
- Missed injuries contribute to chronic pain, instability, and arthritis

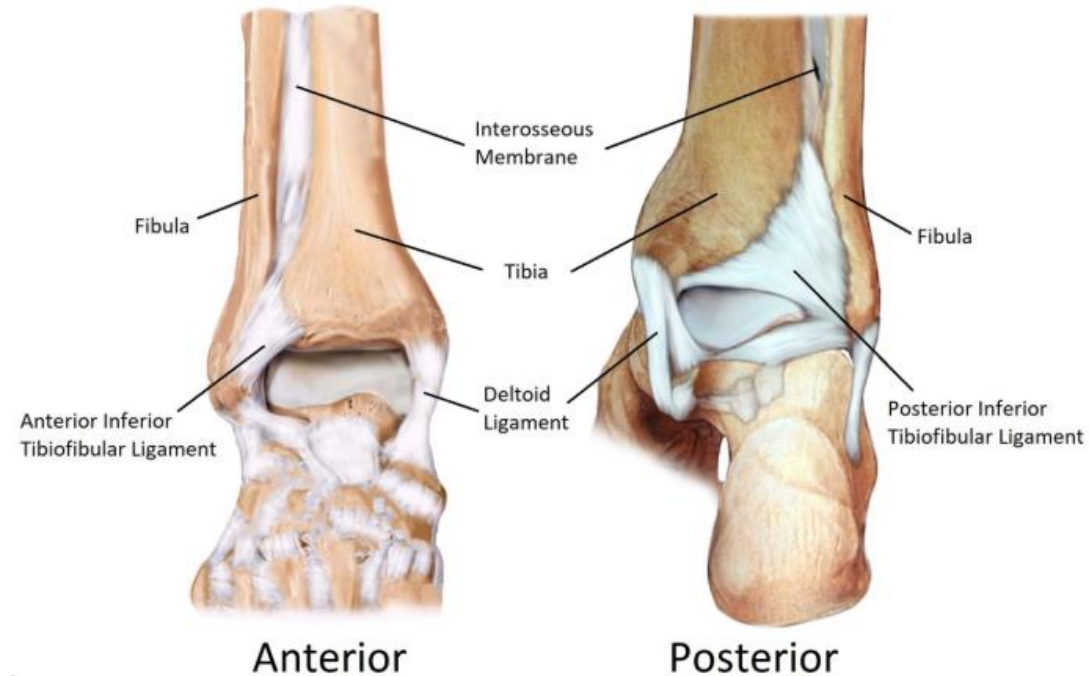




Functional Anatomy

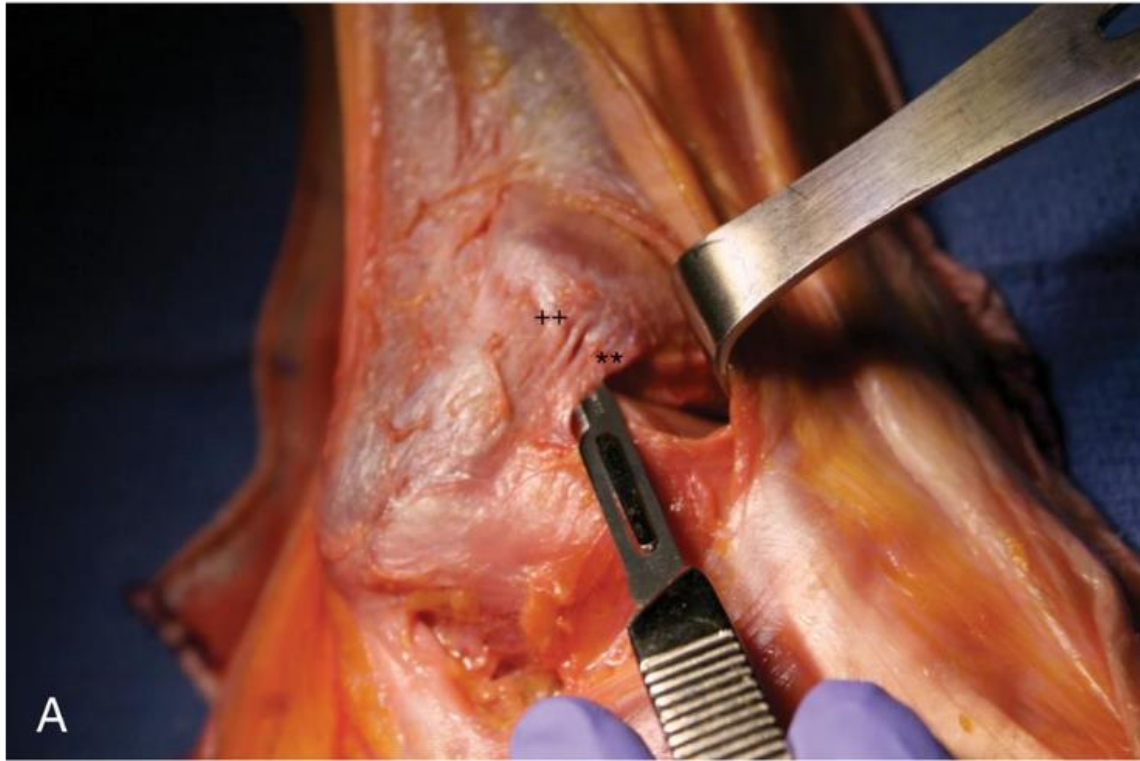
- Syndesmosis = inferior tibiofibular articulation
 - In majority of ankles, this is a true joint with articular cartilage
 - Extends proximally up to 3 cm from tibiotalar joint line

- Stability of joint rendered primarily by ligaments
- Primary components:
 - AITFL
 - PITFL (strongest, more likely to avulse than tear)
 - IO
 - ITL (distal continuation of IO)

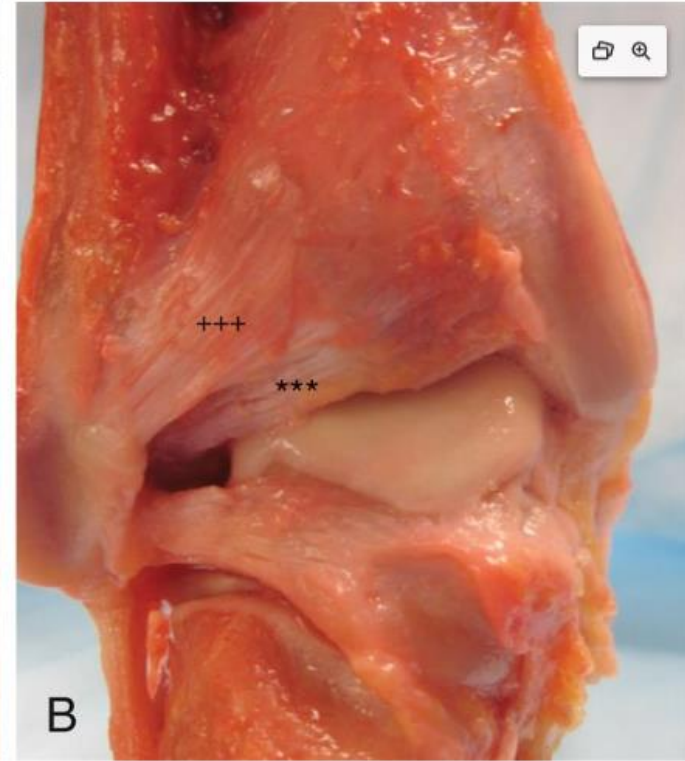


<https://www.sportsmedreview.com/blog/syndesmotic-ankle-sprain/>

Functional Anatomy

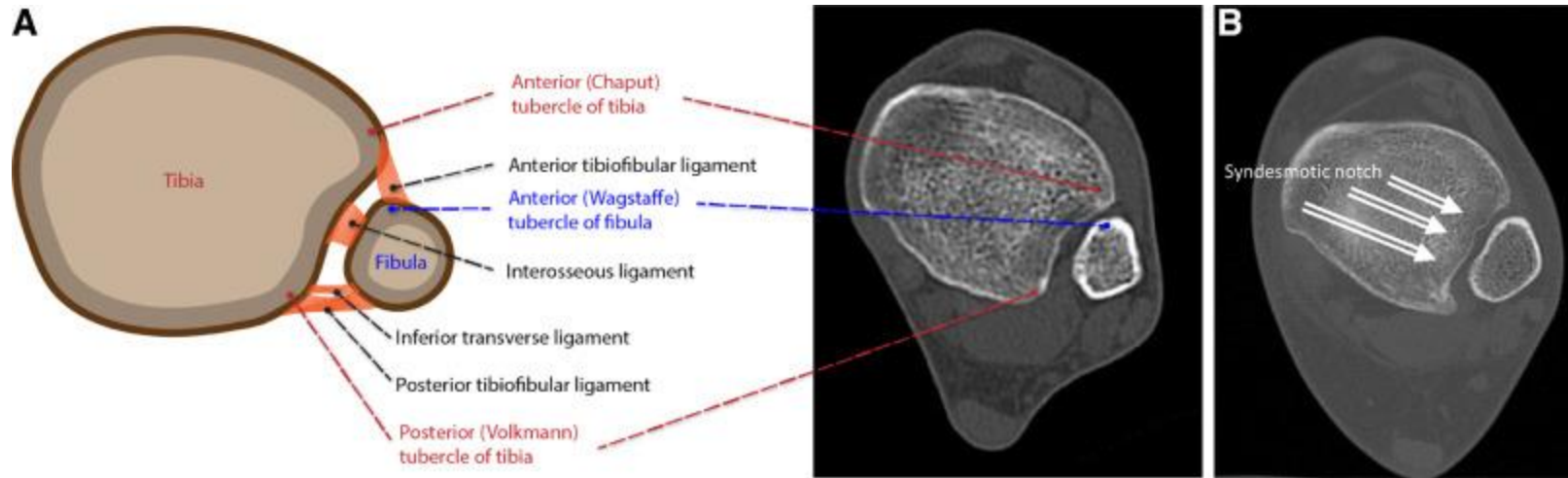


++AITFL
**AITFL accessory



++PITFL
**Deep transverse
ligament (component of
PITFL)

Functional Anatomy

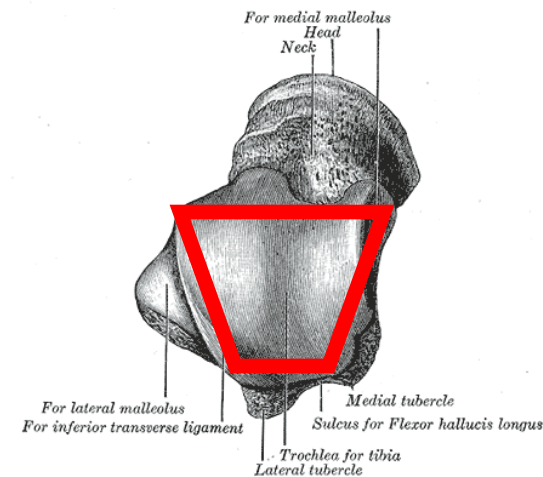
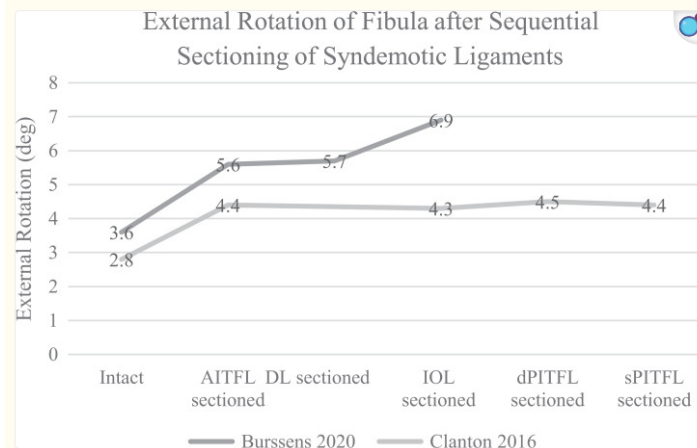


- Inferior tibiofibular articulation: articulation between distal fibula and incisura fibularis (component of tibia)
 - Concave 75%; convex 16%
 - Bounded anteriorly and posteriorly by tubercles of various sizes
 - Creates difficulty with radiographic interpretation
 - Shallower articulation may be risk factor for injury

Biomechanics

- Dorsiflexion widens mortise ~1.5 mm
- Fibular rotational and translational motion are physiologic
- AITFL contributes ~35% of stability
 - Injury to 2 of the 3 main ligaments = significant instability
 - Complete disruption substantially increases rotational instability
- Malreduction alters tibiotalar contact mechanics
- Syndesmosis injuries are a *continuum* from minor sprain to frank diastasis and instability.

Figure 4.



Mechanism of Injury

- External rotation of planted foot is classic mechanism
- Dorsiflexion drives wider talar dome into mortise
- Common in football, rugby, basketball, skiing
- Assess for concomitant deltoid injury
 - Injured if there is an abduction component of injury
- Maisonneuve injury represents proximal propagation

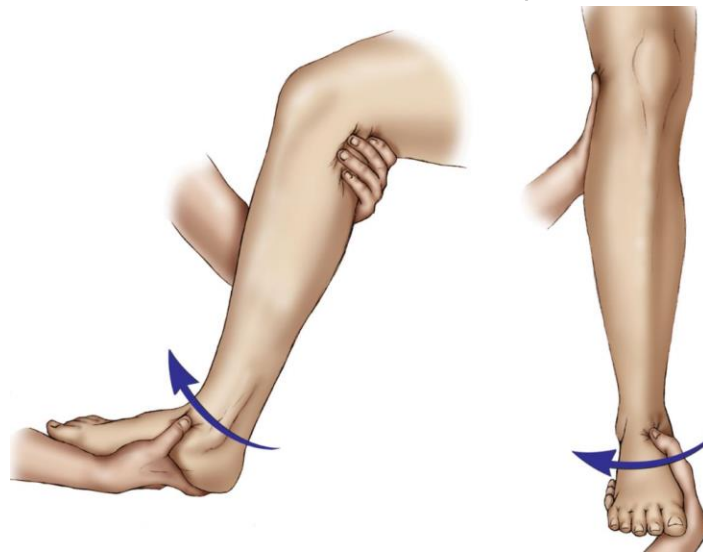


Clinical Presentation

- Pain proximal to anterolateral ankle joint line
- Difficulty with push-off, cutting, pivoting
- Less swelling over lateral ligaments compared to inversion sprains
- Ecchymosis proximal to anchor joint
- Critical to palpate entire length of fibula

Physical Examination

- External rotation stress test most reliable
- Squeeze test may reproduce syndesmotic pain
- Cotton/shuck test evaluates instability
 - Shuck heel medially/laterally
- Anterior drawer/talar tilt may remain negative



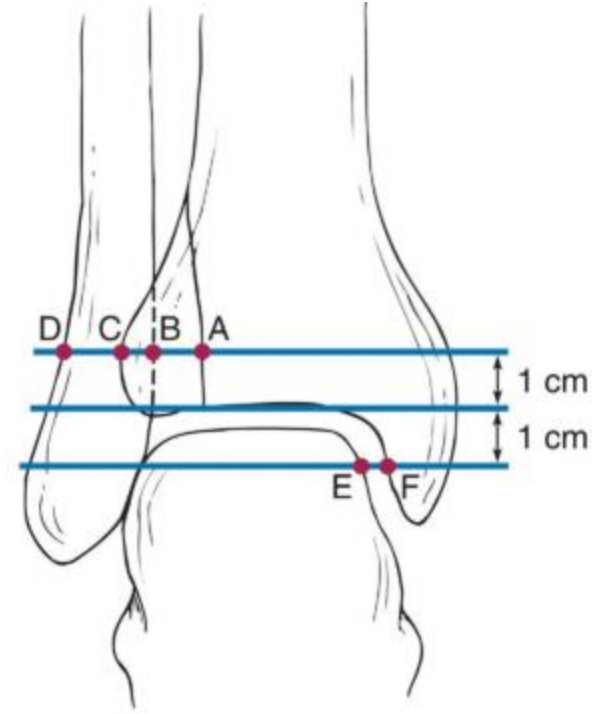
External rotation stress



Calf squeeze

Imaging Strategy

- Weight-bearing AP, mortise, and lateral radiographs
- Assess tibiofibular clear space and overlap
 - Absolute numbers unreliable
 - Can compare to contralateral
- Stress radiographs may reveal latent instability
- CT improves reduction assessment
- MRI preferred for acute ligament evaluation



A = Lateral border of posterior tibial malleolus
B = Medial border of fibula
C = Lateral border of anterior tibial prominence
D = Lateral border of fibula
E = Medial border of talus
F = Lateral border of medial malleolus
AB = Tibiofibular clear space
BC = Tibiofibular overlap
EF = Medial clear space

Imaging Strategy

- Weight-bearing AP, mortise, and lateral radiographs
- Assess tibiofibular clear space and overlap
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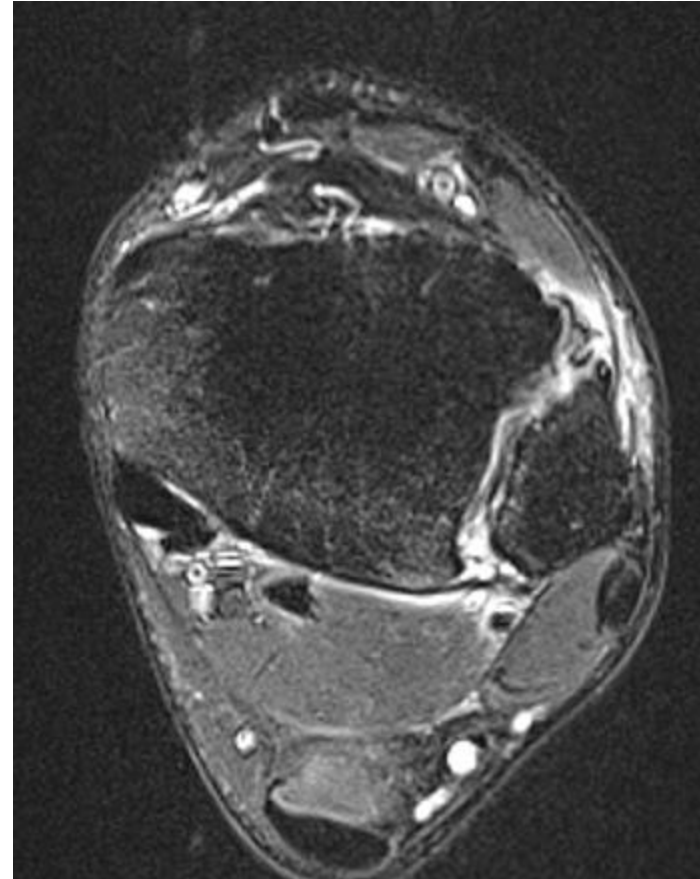


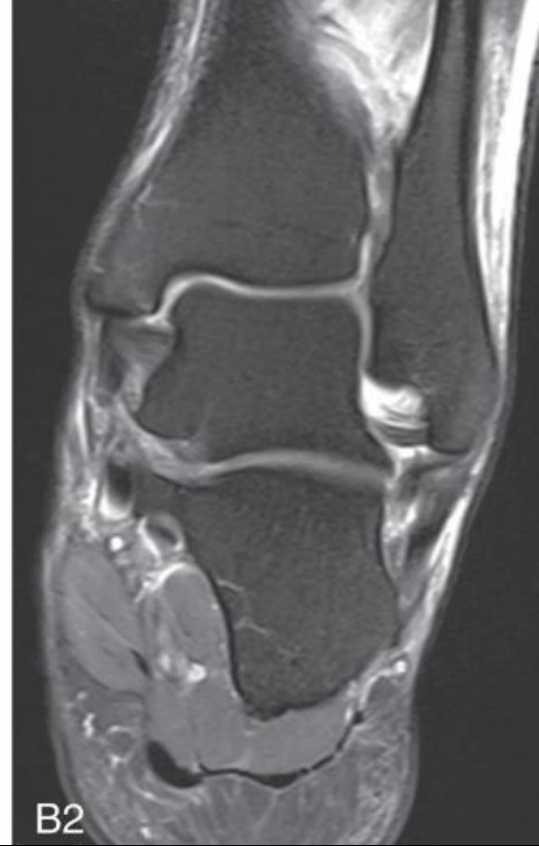
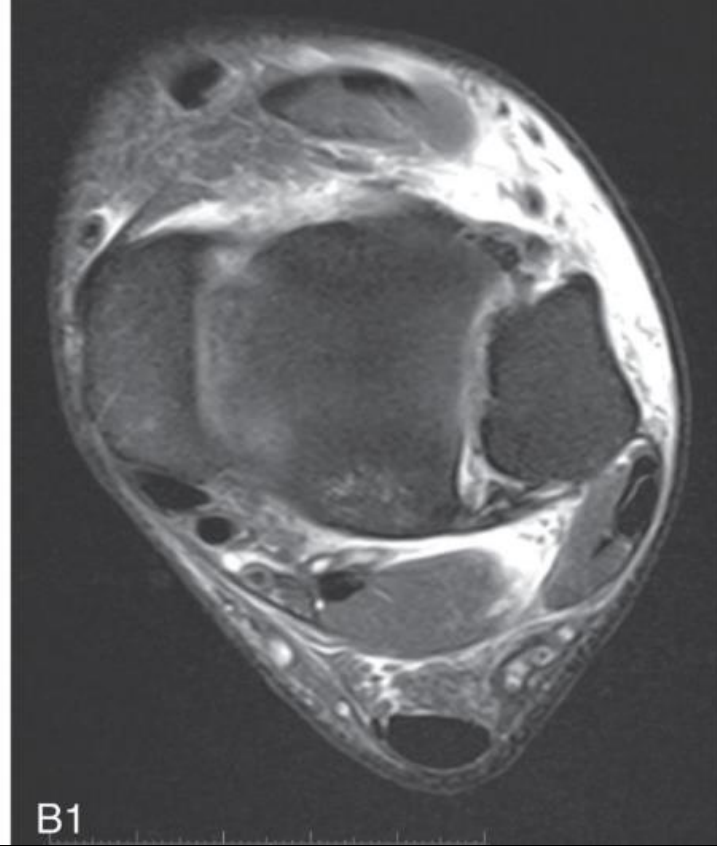
Radiographic Parameters

- Tibiofibular clear space <6 mm
- Tibiofibular overlap >6 mm on AP view
- Medial clear space should remain symmetric
- Subtle malreduction may be radiographically occult
- Compare with contralateral side if uncertain

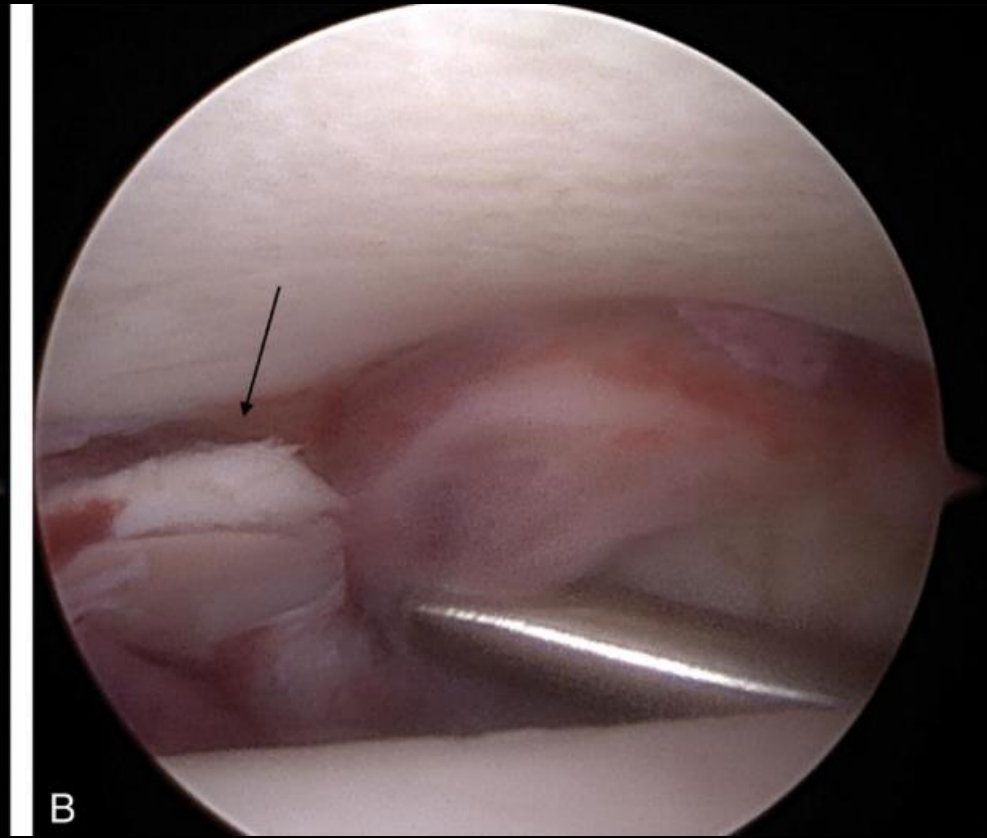
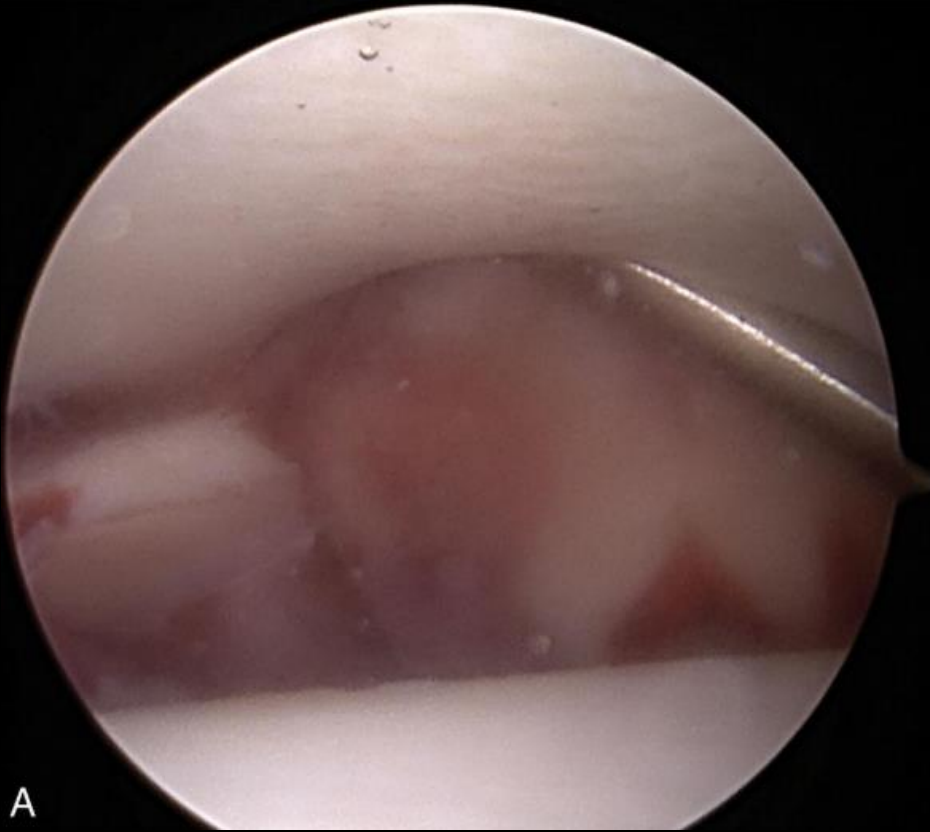
MRI Findings

- AITFL discontinuity or waviness
- Fluid tracking within syndesmosis
- Associated bone edema/chondral injury
- Evaluate deltoid and lateral ligament complex
- MRI sensitivity approaches 100% in acute injury





Arthroscopy

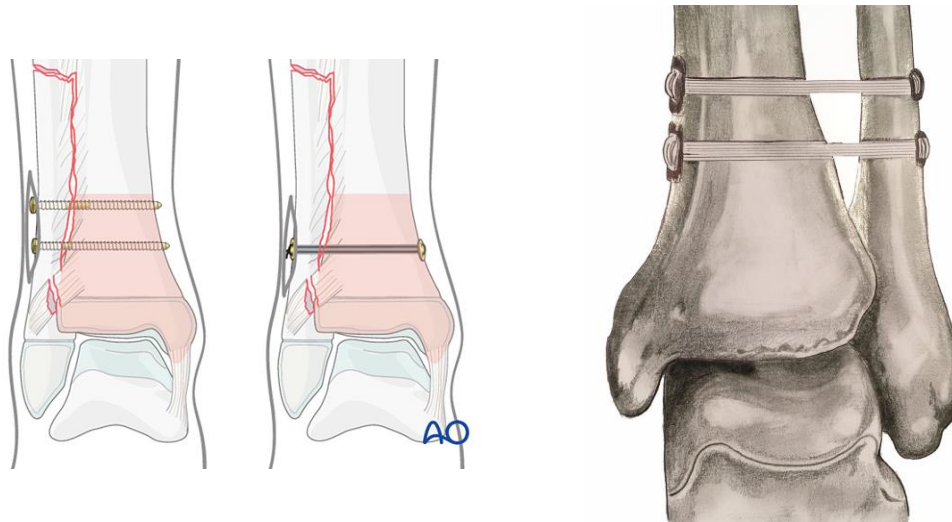


Classification

- Type I: stable sprain
- Type II: latent instability
- Type III: frank diastasis
- Subacute: 3 weeks–3 months
- Chronic injuries may develop arthritis or synostosis

Treatment Principles

- Restore anatomic fibular position in incisura
- Stable injuries treated nonoperatively
- Instability generally warrants fixation
- Arthroscopy increasingly used for subtle instability
- Reduction quality strongly predicts outcomes



Nonoperative Management

- Protected immobilization and edema control
- Early ROM restoration
- Progressive strengthening and proprioception
- Criterion-based loading progression
- Recovery commonly 4–8+ weeks



Hopkinson et al; NCAA studies

Operative Stabilization

- Syndesmotic screws remain effective
- Suture-button fixation allows physiologic micromotion
- Arthroscopy improves reduction accuracy
- Associated injuries often require treatment
- Reduction quality more important than implant choice

10th
EDITION

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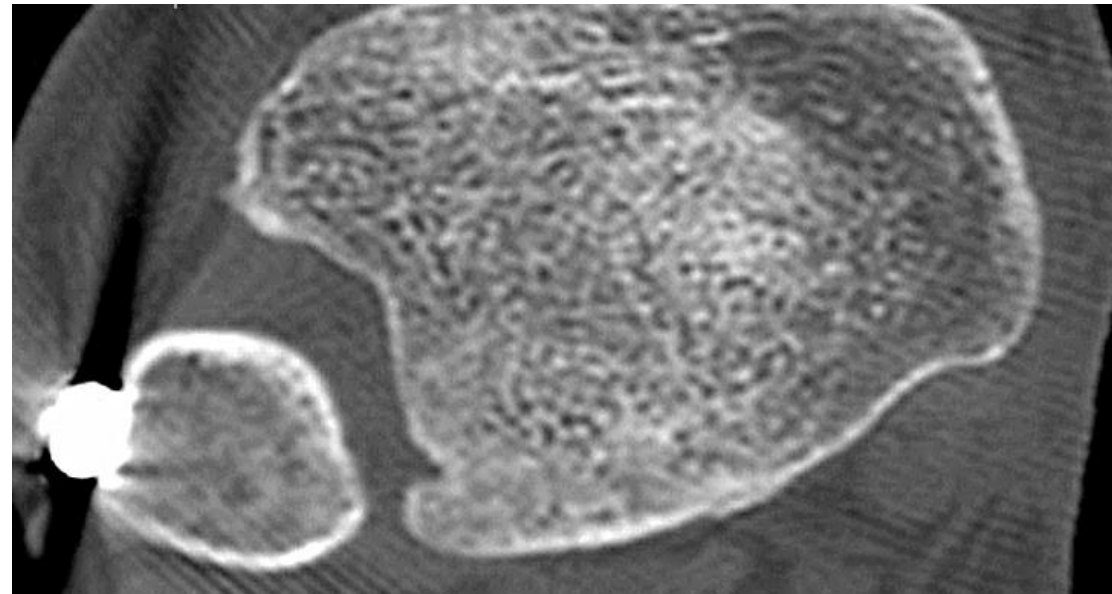
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Why Reduction Quality Matters

- 1 mm talar shift substantially decreases contact area
 - May lead to abnormal mechanics.
- Malreduction associated with persistent pain and arthritis
- CT identifies frequent occult malreductions
- Modern fixation seeks restoration of native kinematics



Gardner et al.; Marmor et al.

Postoperative Rehabilitation

- Initial immobilization and edema control
- Progressive weight-bearing after 2 weeks in CAM boot
 - Restore mobility before aggressive loading
- Transition to lace-up ankle brace or stirrup with return to play at 6-12 weeks
- Objective testing should guide RTP

Return-to-Play Considerations

- Pain-free hopping/cutting required
- Near-symmetric strength and balance
- No syndesmotic tenderness with stress
- Sport-specific confidence restored
- Recovery longer than lateral ankle sprains



Table 1. Criterion for Progression Through Rehabilitation Protocol.

Phase I: Range of Motion

Clinical finding or test

Little to no edema, recommend figure-of-8.³⁹
Symmetrical active range of motion (AROM) and passive range of motion (PROM) within postoperative precautions.
Weightbearing lunge test, achieve at least 50% as compared to uninvolved side.²¹
Demonstrate proper open-chain muscle recruitment for all lower extremity musculature through full available range of motion.
Patient can resist increasingly difficult resistance bands × 15 reps through full ROM without pain. Inversion isometrics at neutral is recommended when inversion is limited to neutral.
Demonstrate competency in foot core and intrinsic flexion exercises.²⁹
Patient can ambulate with safe and appropriate gait pattern in boot without crutches.

Phase II: Endurance

Patient-reported outcome measure recommended and reviewed every 4-6 weeks.
Normal gait pattern demonstrated at varied cadence on flat surface.
Foot lift test: demonstrate <5 errors during testing period²⁴
Weightbearing lunge test: within 75% of uninvolved leg.
Standing double leg heel raise: can demonstrate symmetrical heel height and weight distribution.
Double leg squat: demonstrate proper technique.
Isotonic single leg press: Achieve 50%-60% of body weight 3 × 15 reps
Demonstrate ability to perform seated towel curls with added weight, pulling weight equal to capability of uninvolved side.
Demonstrate ability to perform arch doming exercises.

Phase III: Strength

Patient-reported outcome measure reassessed.
Patient can demonstrate ability to maintain proper arch posture in single leg tasks.

Test	Passing Criteria
Weightbearing lunge test	Symmetry to uninvolved side, within 5 degrees or 1.5 cm ²¹
Heel raise endurance test	Within 90% of uninvolved side recorded in successful repetitions ³⁶
Single leg squat endurance test	Within 90% of uninvolved side, recorded in repetitions ¹⁴
Y balance test	Composite score >90% ^{17,30,35} Anterior reach within 4cm of uninvolved side
Isotonic leg press	Within 90% of uninvolved, 3 × 5 reps at RPE 8/10.

Phase IV: Power and Agility

Patient-reported outcome measure reassessed. Progress suggests return to sport readiness. Recommend SANE score >90%.
Pick appropriate test(s) from each category related to patient's desired activity or sport. Not all tests need to be performed.

Test	Passing Criteria
Single hop for distance	Within 90% of uninvolved side ^{20,24}
Triple hop for distance	
Box hop	Within 90% of uninvolved side, measured in seconds. ³
Figure-of-8 hop	Side hop > 12.88 s
Side hop	Figure-of-8 hop 17.36 s
Cross-over hop	
MAT test	
Modified t test	Within 90% of uninvolved side, measured in seconds ¹⁷

Comfort SM, Marchetti DC, Duncan PP, Dornan GJ, Haytmanek CT, Clanton TO. Broström Repair With and Without Augmentation: Comparison of Outcomes at Median Follow-up of 5 Years. *Foot & Ankle International*. 2023;44(8):691-701. doi:[10.1177/10711007231176806](https://doi.org/10.1177/10711007231176806)

Complications

- Chronic instability
- Heterotopic ossification or synostosis
- Persistent pain/stiffness
- Hardware irritation or screw breakage
- Post-traumatic ankle arthritis



Clinical Pearls for ATCs & PTs

- Persistent pain above ankle joint is not a routine sprain
- Delayed recovery should trigger reassessment
- Monitor rotational symptoms carefully
- Protect against premature RTP
- Interdisciplinary communication improves outcomes

Key Takeaways

- Mechanism and exam remain critical
- MRI improves detection of subtle injuries
- Anatomic reduction drives long-term outcomes
- Recovery slower than lateral ankle sprains
- Rehabilitation should be criterion-based

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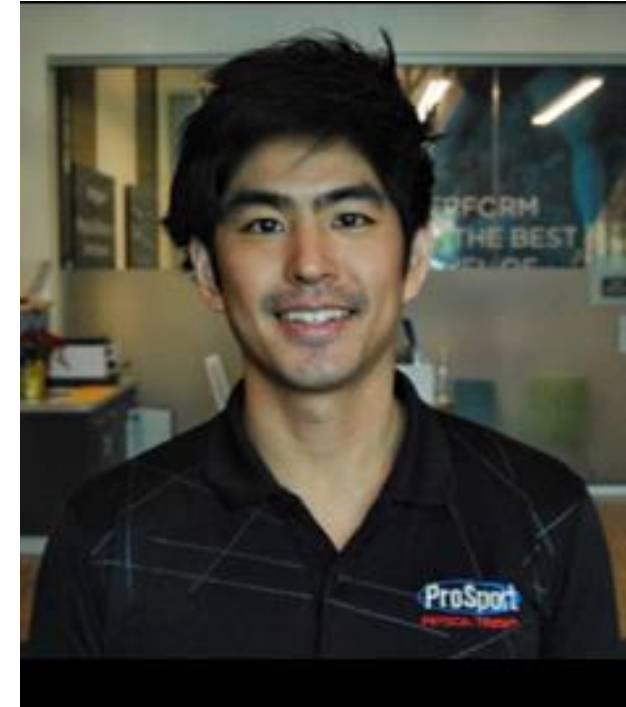
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HIGH ANKLE SPRAIN REHABILITATION

Hiroki Yokoyama, PT, DPT, OCS



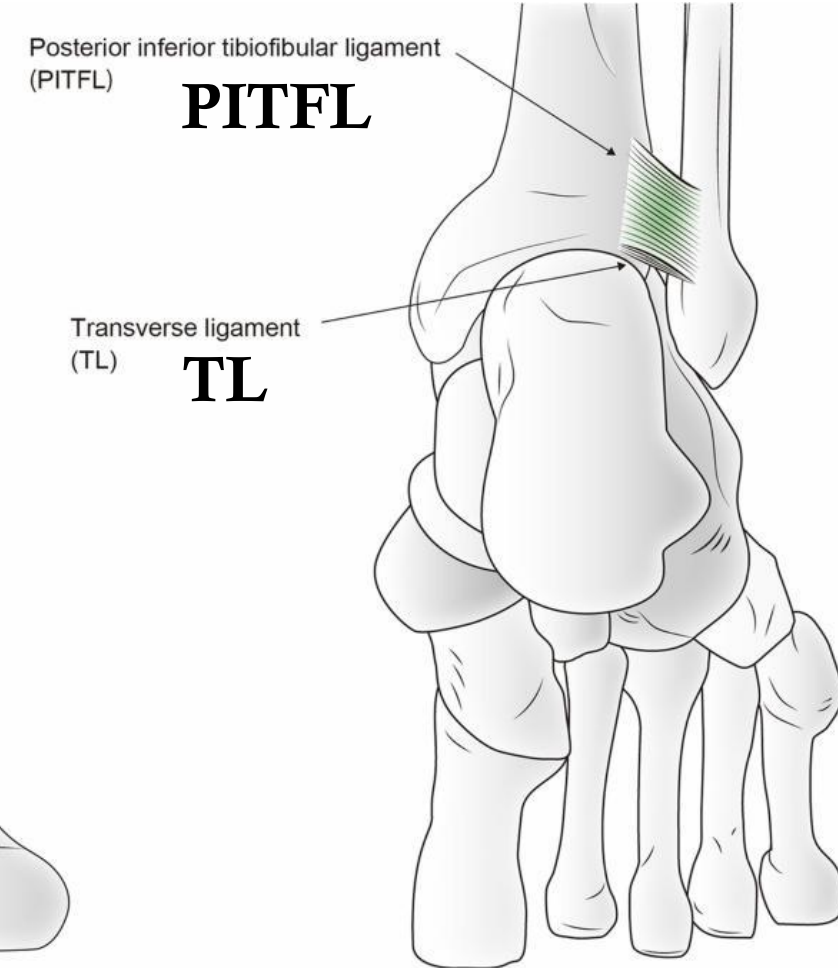
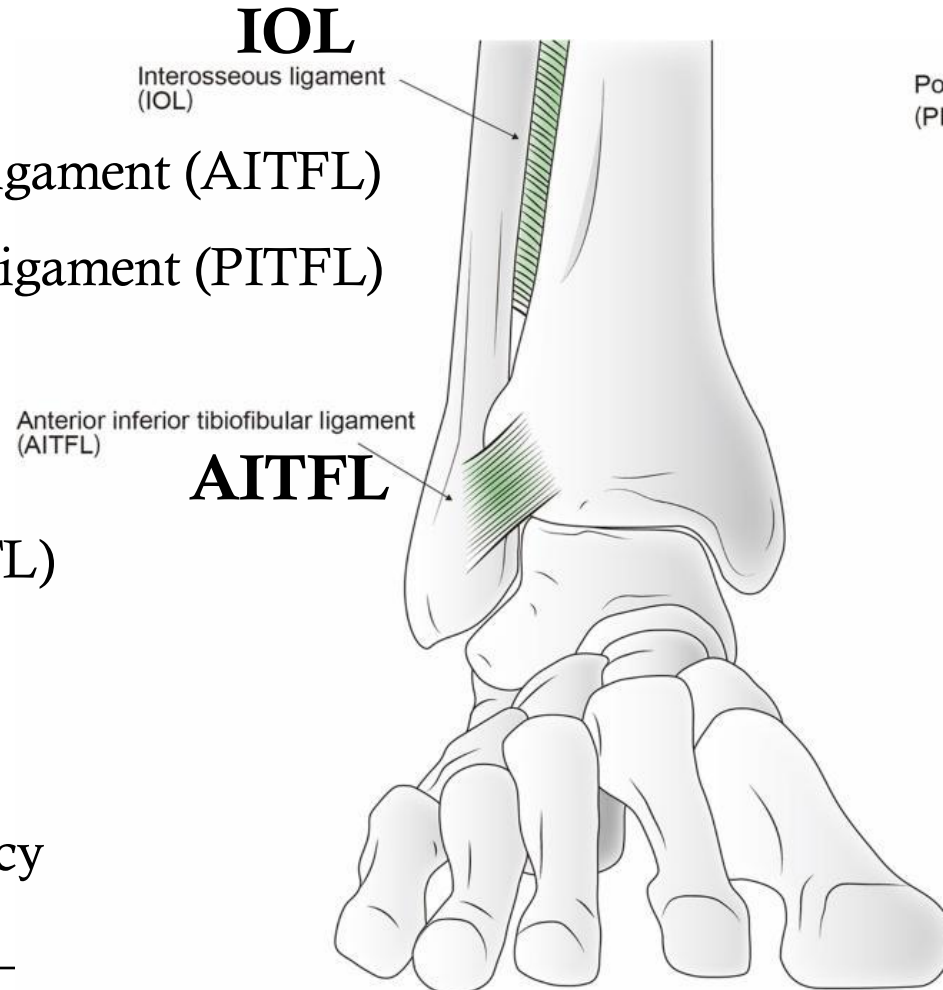
RELEVANT ANATOMY AND FUNCTION

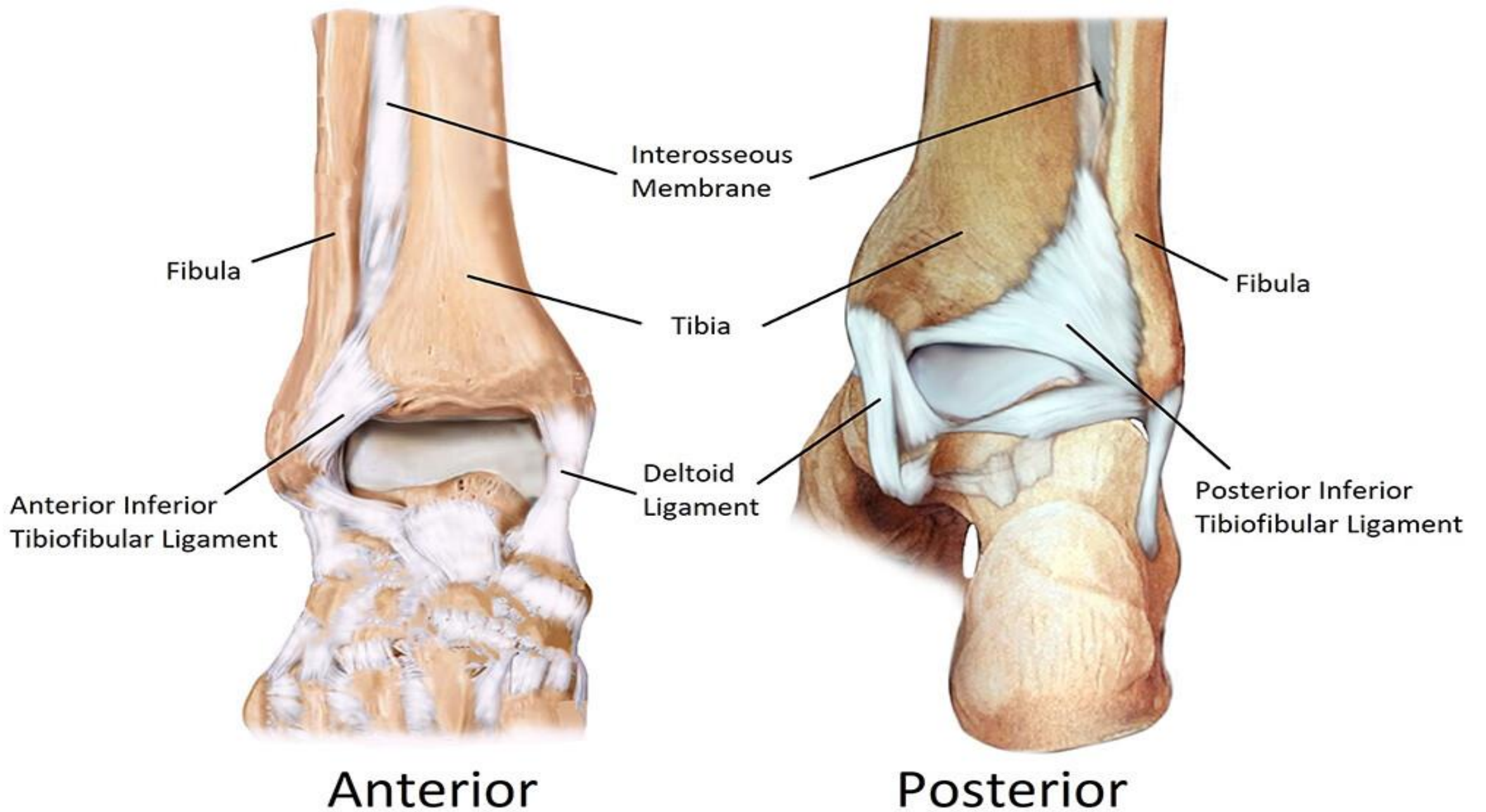
- **Primary Stabilizers**

- Anterior Inferior Tibiofibular Ligament (AITFL)
- Posterior Inferior Tibiofibular Ligament (PITFL)
- Interosseous Ligament (IOL)
- Interosseous Membrane
- Inferior Transverse Ligament (TL)

- **Function**

- Maintains tibia-fibula congruency
- Provides ankle mortise stability
- Resists external rotation and talar translation





ANTERIOR AND POSTERIOR VIEWS

MECHANISM OF INJURY

- Foot planted and fixed to the ground
 - Ankle in dorsiflexion
 - Forced external rotation of the foot relative to the tibia
 - Majority involve contact — e.g., being tackled in football, foot getting caught under in basketball
-

EXAMINATION FINDINGS AND IMAGING

- **Examination Findings**
 - Tenderness over AITFL
 - Pain with external rotation stress test
 - Positive squeeze test
 - Pain with weight-bearing
 - **Imaging**
 - X-ray
 - Weight-bearing radiographs
 - MRI (gold standard for ligament injury)
-

High Ankle Sprain vs. Lateral Ankle Sprain

Feature	High Ankle Sprain	Lateral Ankle Sprain
Structures	Syndesmosis	ATFL (primary), CFL, PTFL
Mechanism	Dorsiflexion + external rotation; While foot planted	Inversion ("rolling" the ankle); foot turns inward
Pain Location	Above the ankle joint, between tibia and fibula	Outer ankle, Lateral malleolus
Weight-Bearing	Often significantly limited; pain with every step	Often able to bear weight early
Special Tests	Squeeze test, external rotation stress test, Cotton test	Anterior drawer, talar tilt test
Recovery	6-12+ weeks; often significantly longer	2-8 weeks depending on severity
Key Difference	Syndesmosis stressed with ALL weight-bearing — slower healing	Lateral ligaments not stressed as directly during gait

West Point Classification System

Grading severity guides treatment decisions and recovery expectations.

Grade I

Stable

Mild Sprain or tear of the AITFL. Normal radiographs.

Management

Conservative — functional brace, early weight-bearing as tolerated.

Avg. Return to Play

< 35 days

Grade II

Variable

Complete AITFL tear + partial IOL tear.
May be **stable**(IIa) or **unstable**(IIb).

Management

IIa: boot/brace.

IIb: may require surgical fixation.

Avg. Return to Play

45 days (range: 23-63)

Grade III

Unstable

Complete disruption of AITFL, IOL, and often PITFL with instability

Management

Surgical stabilization indicated (screw or suture-button fixation).

Avg. Return to Play

3-6+ months

DE'AARON FOX INJURY (SAN ANTONIO SPURS)

- Game 4 of 2026 NBA Round 2 Playoffs (May 10th, 2026)



DE'AARON FOX INJURY

Picture 1

Foot Fixed / External Force Applied

- Fox's right foot is planted.
- The forefoot appears fixed against the floor.
- Opposing player's body weight is beginning to load the lower leg.

• Important Note

➔ *Foot fixed to court*



DE'AARON FOX INJURY

Picture 2

Syndesmotic Stress Begins

- Weight transfer increases.
- Tibia begins rotating internally relative to a fixed foot.
- Ankle appears near dorsiflexion.
- **Important Note**
 - *Axial load*
 - *External rotation mechanism*



DE'AARON FOX

INJURY

Picture 3

Peak Injury Mechanism

- Foot remains trapped.
- Body mass and momentum continue over the ankle.
- Maximum syndesmotic stress likely occurs here.
- AITFL is the first structure typically stressed.

Important Notes

- ➔ *Peak syndesmotic loading*
- ➔ *AITFL stress*
- ➔ *Distal tib-fib separation force*



DE'AARON FOX INJURY

Picture 4

Teaching Point: Immediate Aftermath

- Athlete begins unloading the extremity.
- Useful transition into examination findings.

Important Notes

- *Protective unloading*
- *Pain superior to ankle mortise*



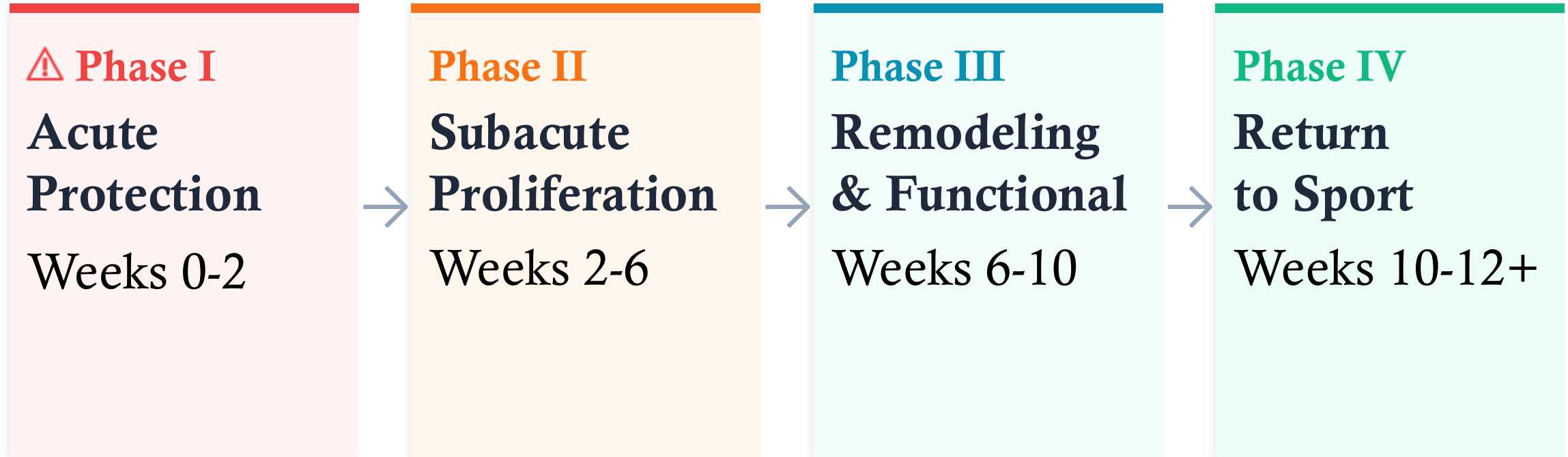
DE'AARON FOX INJURY (SAN ANTONIO SPURS)

- Game 4 of 2026 NBA Round 2 Playoffs (May 10th, 2026)



Rehabilitation Timeline Overview

Average 45-55 days for non-operative cases | Criterion-based progression, not calendar-driven



⚠ Key Precautions: Avoid forceful dorsiflexion | Avoid external rotation / eversion at ankle

Phase I: Protection/Symptom Management Weeks 0-2

Goals & Weight-Bearing

- MAIN GOAL: Protect syndesmosis
- Reduce Pain and swelling
- NWB to WBAT depending on severity
- Crutches until gait is essentially normal
- Severe: splint, cast, or boot immobilizer
- Mild: lace-up brace, stirrup, or taping
- Preserve strength and ROM elsewhere

Modalities: Edema control (ice, compression), e-stim for muscle activation.

*****Avoid ER and end-range DF throughout this phase.**

Interventions

ROM

Ankle pumps, arch raises, NWB → WB calf stretch, stationary bike, seated BAPS

Manual Tx

Tibiofibular, talocrural, subtalar mobilizations (Gr. I/II as tolerated)

Strength

Hip/knee strength training, ankle isometrics
PF/DF → band exercises, seated calf raise

Neuro

Weight shifting in standing, single-leg balance (eyes open)

Phase II: Mobility/ Strength

Weeks 2-6

MAIN GOALS : Pain-free ambulation without assistive device | Restore Full AROM |
Begin Strengthening | Pain < 3/10 with ADLs

ROM & Manual Therapy

- Progress joint mobilizations (Gr. III/IV)
- Ankle AROM all planes
- Standing calf stretches (gastrocnemius & soleus)
- Soft tissue mobilization as needed
- Stationary bike for ROM

Strengthening

- 4-way ankle resistance bands
- Standing calf raises (bilateral → unilateral)
- Heel walks and toe walks
- Leg press, squats, step-ups
- Progressive loading per tolerance

Proprioception & Balance

- Single-leg balance (eyes open → closed)
- BAPS board standing
- Tandem stance and walking
- Perturbation training
- Pool/aquatic exercises if available

MAIN GOAL: Improve calf strength and endurance | Increase load tolerance and force production | Restore Dynamic Stability | Prepare for running

Strengthening

- Eccentric loading program for gastroc-soleus complex
- Single-leg calf raises (full height, controlled)
- Farmer carries on toes, isometric calf holds
- Heavy seated calf raises (soleus)
- Airex/Bosu progressions
- Single leg squats, lunges, split squats, RDL, deadlift, palloff-press, cable chops

Running & Plyometric Progression

- Progressive running program (walk-jog intervals → continues jogging → sprint progression)
- Double leg jump → box jumps → single leg hopping → multidirectional hops
- Agility ladder and cone drills
- Change-of-direction training (cutting)
- Reactive agility and perturbation drills

Clinical Note: Continue to monitor for any return of syndesmosis pain during activity, 24 hours later, swelling response — regression in exercise tolerance may indicate inadequate healing.

Phase IV: Return to Sport

Weeks 10-12+ | Criterion-Based

MAIN GOAL: Pain free running | 5/5 strength all planes | Full sport-specific drills pain-free | Physician clearance

Sport-Specific Training

Full-speed cutting, pivoting, and deceleration drills. Agility ladders. Positional practice and scrimmage participation. Progressive volume and intensity over 1-2 weeks.

Conditioning

Sport-specific endurance conditioning. Interval training matching game demands. Full training session tolerance without compensatory patterns.

Psychological Readiness

Confidence in ankle during sport-specific tasks. No apprehension with contact or uneven surfaces. Self-reported readiness and commitment to ongoing prevention.

Return-to-Sport Criteria

Objective, measurable benchmarks — not timelines — should drive clearance decisions.

≥ 90%

Limb Symmetry Index

On single-leg hop test, side-hop test, and calf raise endurance

5/5

MMT All Planes

Full strength PF, DF, inversion, eversion — no pain

Full ROM

Pain-Free Range

Equal bilateral DF and PF; no pain at end range

Pass

Y-Balance Test

Composite score within 4 cm of uninvolved limb

100%

Sport-Specific Tasks

Full-speed cutting, pivoting, jumping — zero compensation

Ready

Psychological

No apprehension; athlete self-reports confidence and readiness

De'Aaron Fox - 2026 Playoffs

San Antonio Spurs | Right High Ankle Sprain

Date	Day	Event
May 10***	Day 0	Injured right ankle in Game 4 vs. Minnesota — Ayo Dosunmu landed on ankle
May 12	Day 2	Played Game 5 vs. Minnesota despite injury
May 14	Day 4	Played Game 6 vs. Minnesota — helped close out series (reaggravated ankle)
May 19-20	Day 9-10	Missed WCF Games 1 and 2 vs. OKC Thunder
May 22***	Day 12	Returned for Game 3 — re-aggravated ankle during game but finished
May 24	Day 14	Played Game 4 despite ongoing symptoms
May 26-30	Day 16-20	Played remainder of OKC series while limited by ankle
June 3	Day 24	NBA Finals Game 1 vs. Knicks. Plays but appears limited; scores 7 points.
June 5	Day 26	NBA Finals Game 2 vs. Knicks. Scores 20 points; appears improved but still managing ankle symptoms.
June 8	Day 29	NBA Finals Game 3 vs. Knicks. Continues to play through the injury as Spurs attempt to cut into series deficit.
<hr/>		
Stats while injured (vs. OKC): 11.2 PPG 36.5% FG 6.2 AST 5.2 REB		
(vs. NYK): 13.0 PPG 35.8% FG 6.0 AST 3.3 REB — Clearly not himself		

DE'AARON RE-INJURY (SAN ANTONIO SPURS)

- Game 3 of 2026 NBA Western Conference Finals Playoffs (May 22nd, 2026)



Clinical Discussion

"If De'Aaron Fox were not in the Western Conference Finals, would we have returned him to competition at Day 12 following a high ankle sprain?"

Why This Case Illustrates Key Principles

- Able to play initially (Games 5-6) — symptoms worsened after acute phase
- Required ~10 days before being shut down for recovery
- Returned at Day 12 — relatively aggressive for syndesmotic injury
- Re-aggravation occurred immediately upon return — classic pattern
- Continued play reflected playoff stakes, not ideal tissue healing

Would Objective Testing Clear Him?

External Rotation Stress	Likely positive
Single-Leg Hop Test	Likely painful
Change-of-Direction	Compensated
High-Speed Deceleration	Limited

Key Takeaway: Athletes often regain the ability to play before the syndesmosis has fully healed. RTS decisions balance tissue healing, functional capacity, symptom tolerance, and competitive demands.

Research Evidence: Return to Play

- Overall return-to-play rate in athletes is ~99%, with mean RTP around 52 days (systematic review & meta-analysis)
- Nonsurgical cases average ~39 days; surgical cases average ~71 days back to sport
- 2025 elite-athlete review reports pooled RTS ~96%, with many returning within ~2 months
- Best-supported approach: criteria-based, phased rehab — protect early, then load progressively
- Severity and treatment choice — not the calendar — are the strongest drivers of return timeline

Does a Torn AITFL Heal?

- Yes — but outcome depends on the grade and whether the syndesmosis stays stable
- Grade I (sprain / partial tear): heals non-operatively via scar remodeling — RTP typically 2–6 weeks
- Grade II (complete tear, stable syndesmosis): usually managed non-operatively — RTP 6–12+ weeks
- Grade III (tear with instability): often requires fixation (screw or suture-button) to protect healing
- MRI may show residual thickening or scar formation long after symptoms resolve

Clinical Pearl: Stability Over Imaging

- Unlike the ATFL (resists inversion), the AITFL's job is maintaining the tibiofibular mortise
- Success is defined less by MRI appearance and more by restoration of syndesmotic stability and function
- NBA players have returned at high performance with MRIs still showing AITFL disruption — once the syndesmosis is functionally stable
- De' Aaron Fox illustrates this: returned before complete biological ligament healing — relying on restored stability, strength, and function
- Bottom line: rehab decisions and clearance should be driven by stability and function — not solely by the MRI

Key Takeaways

- High ankle sprains involve the syndesmosis — distinct anatomy, mechanism, and timeline compared to lateral sprains
- The syndesmosis is stressed with ALL weight-bearing, making recovery inherently slower and more complex
- Rehabilitation should be criterion-based, not calendar-driven — use objective measures to guide progression
- Avoid external rotation and forceful DF early; progress through phased loading with clear milestones
- Return-to-sport requires $\geq 90\%$ LSI(limb symmetry index), 5/5 strength, full ROM, and sport-specific task completion

THANK YOU!!



Dr. Aditi Majumdar

Jim Herkimer, PT, ATC



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2026 HOI Sports Medicine Symposium :

Managing the Unstable Shoulder: Surgical Interventions and Post-Operative Rehabilitation in the Collision Athlete

Case Presentation

Aditi Majumdar, MD
Jim Herkimer, DPT

June 12, 2026



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Objectives

1. Analyze the biomechanical, structural, and athlete-specific factors underlying recurrent glenohumeral instability, multidirectional instability, and generalized ligamentous laxity and evaluate how these variables, in the context of elite collision-sport demands, drive surgical decision-making and shape the foundational goals of each phase of post-operative rehabilitation.

2. Evaluate the evidence base for surgical intervention including Bankart repair with capsulorrhaphy and Remplissage critically weighing the functional outcomes data, risks of in-season management, and limitations of current literature to formulate individualized treatment decisions for the competitive athlete.

3. Synthesize a criterion-based, sport-specific continuum of care that integrates tissue healing timelines, phase-appropriate therapeutic interventions, and progression criteria from surgical repair through advanced rehabilitation applying these principles to protect structural integrity while advancing mobility, strength, and functional performance.

4. Appraise late-stage rehabilitation outcomes and evidence-informed return-to-play frameworks following glenohumeral stabilization procedures, identifying current evidence gaps and determining athlete readiness for safe return to sport.

Demographics / Injury

17 year old female

Elite ice hockey, forward | Tier 1 (AAA/AA)

National roster

D1 collegiate scholarship committed

Dominant goal scorer : 76 goals / 105 games

Index injury ~ 1 month prior to districts (September 2025)
ie. Significant competitive stakes at time of presentation

Index mechanism : Holding stick out, felt LEFT shoulder slip out / subluxate

2nd shoulder event: Secondary to collision contact

Minimum 8 lifetime instability episodes, all spontaneous reduced



Demographics / Injury

Initial Course :

Mechanism + clinical context consistent with "subluxation" events (not necessarily frank dislocation)

Deferred immediate orthopaedic evaluation

Symptoms of diffuse pain, paresthesias throughout shoulder with associated instability events

+ subjective instability

+ intermittent clicking

Managed conservatively with PT (independent regimen + formal guided)

Taping / stabilizer bracing with partial symptomatic benefit

Demographics / Injury

Athlete specific considerations :

Affected side → *LEFT*

STICK & HAND dominance → *LEFT* (top / control hand)

IN SEASON athlete (competitive) / year round athlete

Laxity profile → Generalized ligamentous laxity (GLL)

PSH : B knee MPFL/extensor realignment surgery (2022, 2023)

Physical Exam

GENERAL

Beighton Score 8/9

MUSCULOSKELETAL | LEFT SHOULDER

Large sulcus sign

Active ROM FF 180, ER 70, IR upper thoracic spine

No significant scapular dyskinesia

Focal tenderness anterior GH joint

5/5 strength rotator cuff

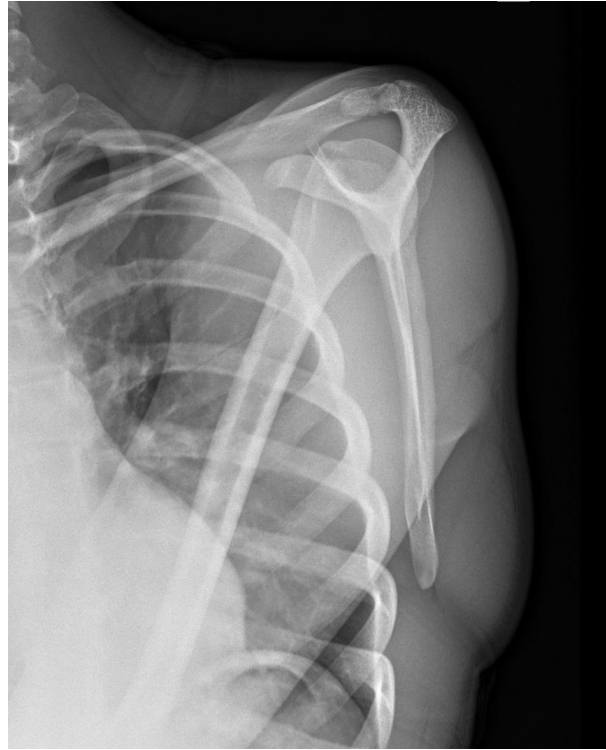
Positive O'Brien's

Positive apprehension, positive relocation

Positive Kim test, negative Jerk test

2+ anterior and posterior load-and-shift tests

Imaging - Radiographs



Congruent GH / AC joints
Mild Hill Sachs lesion

Diagnosis / Differential Diagnosis

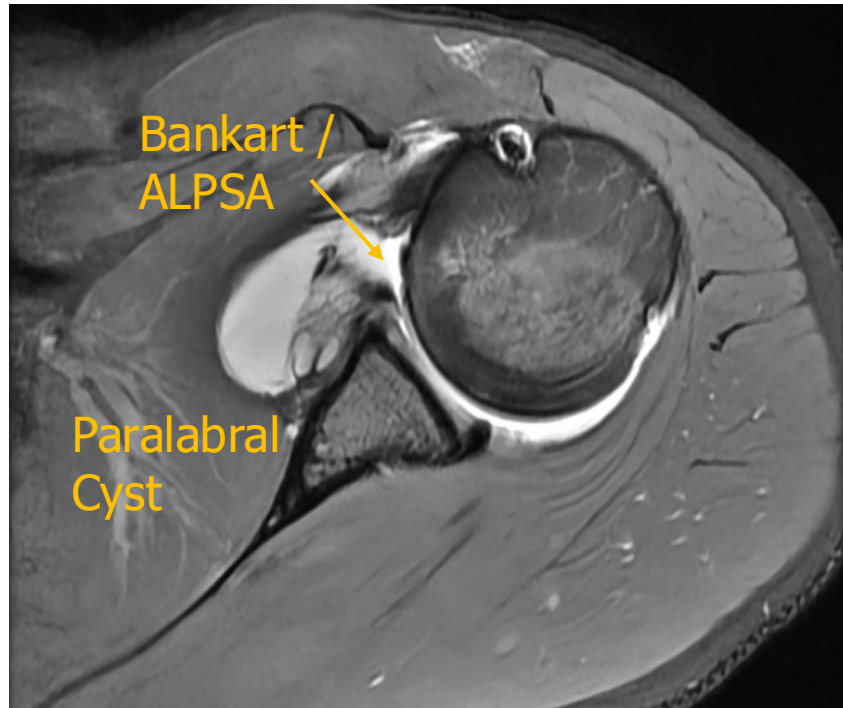
Left shoulder recurrent glenohumeral instability, MDI, GLL

DDx Labral / labroligamentous disruption
Capsular insufficiency
Rotator cuff abnormality
Glenohumeral osseous deficiency

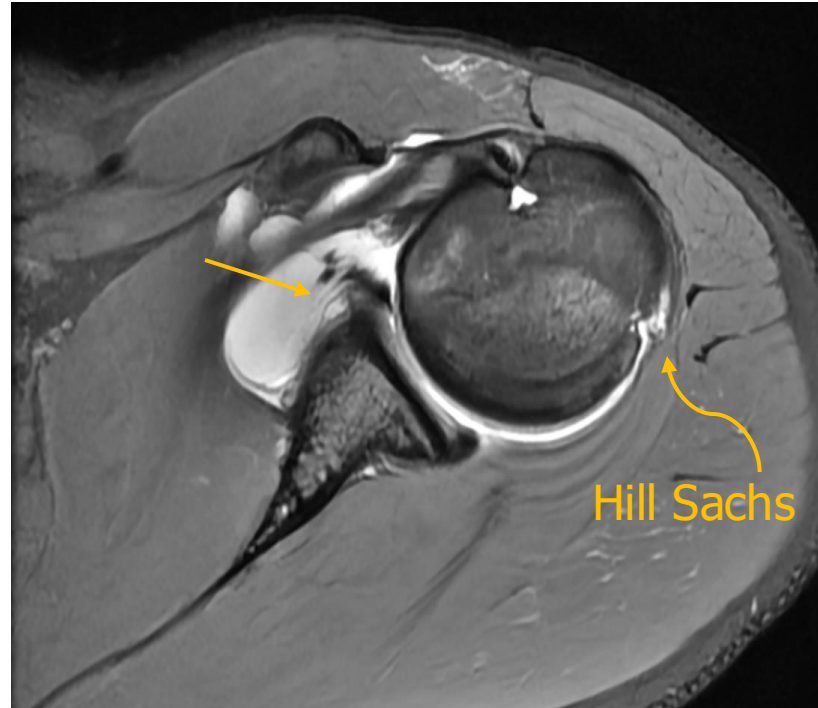
Considerations...

High level collision athlete
Concurrent generalized ligamentous laxity
Prognosis / risks / benefits
Acuity + magnitude of instability events

Imaging – MRI



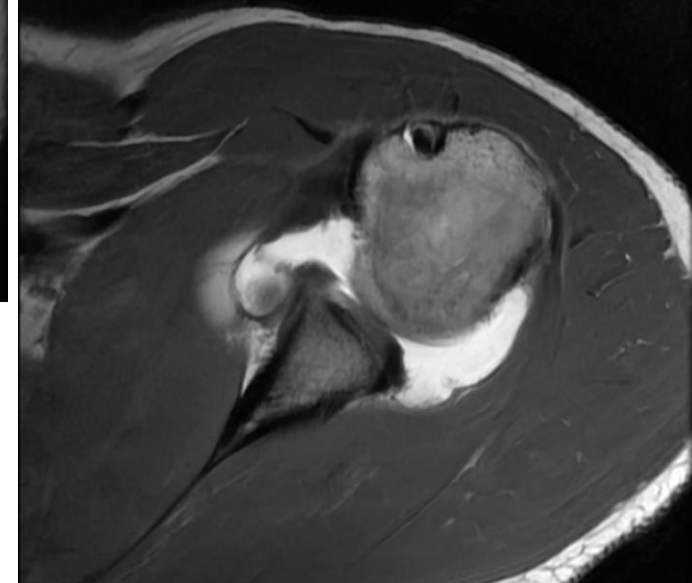
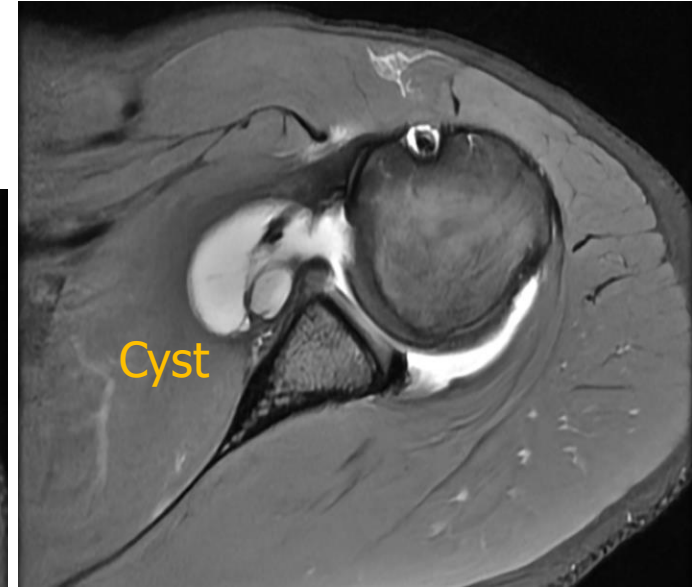
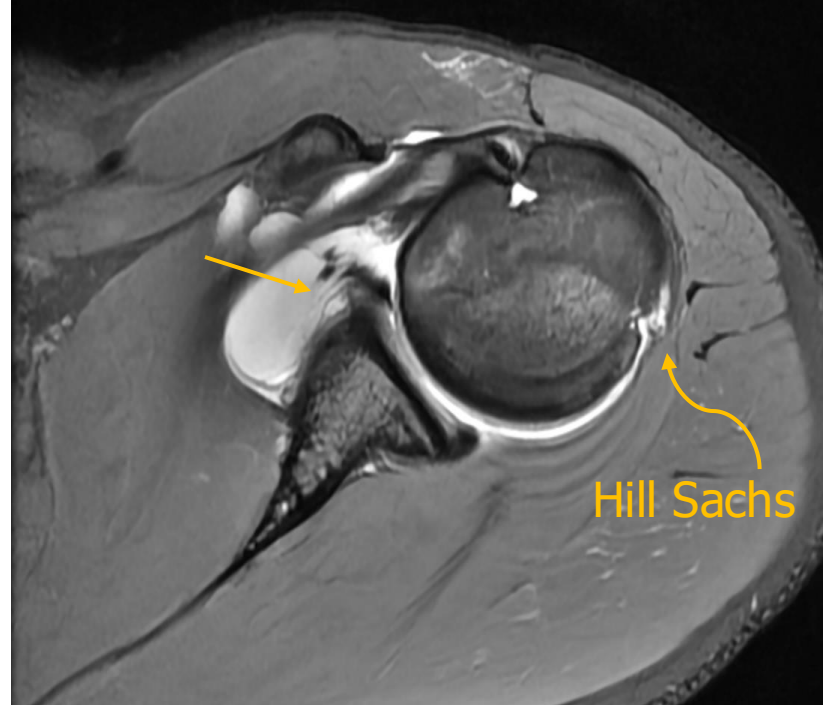
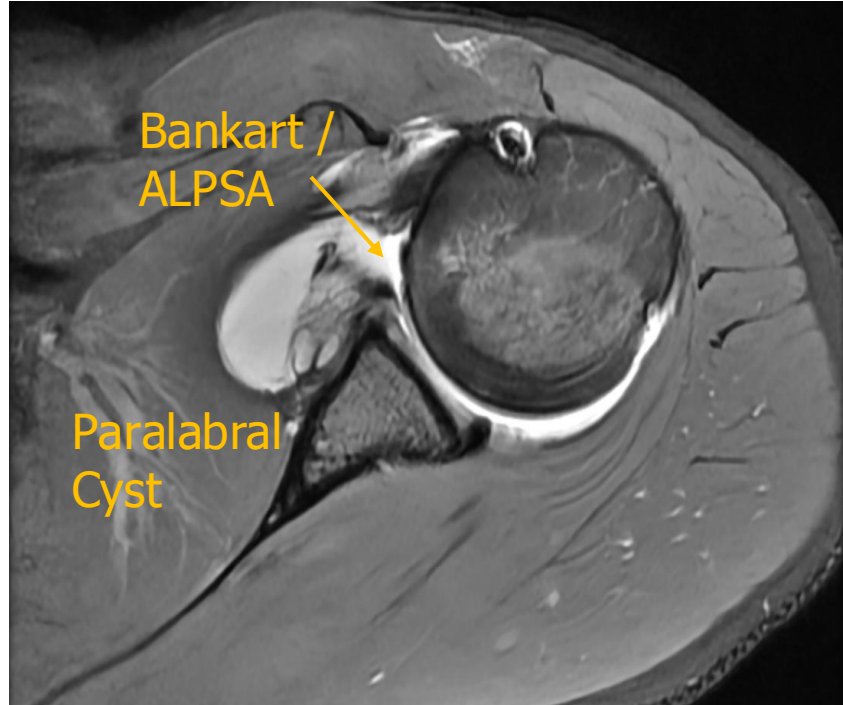
- Significant Bankart lesion with superior extension
- ALPSA pattern, medial displacement
- Paralabral cysts



- Patulous / attenuated capsule (A+P)
- Rotator interval laxity (SGHL / MGHL insufficiency)



Imaging – MRI



- Significant Bankart lesion with superior extension
- ALPSA pattern, medial displacement
- Paralabral cysts

- Patulous / attenuated capsule (A+P)
- Rotator interval laxity (SGHL / MGHL insufficiency)

Nonoperative / Index Conservative Management

Rehabilitation Goals

Acute protection phase + subacute phase

Pain free AROM, avoidance provocation

Postural education

RTC activation, scapular stabilization

RTP / RTS

Sling immobilization

Taping / Functional Bracing

Concepts...

Clinical Update

Return to contact / collision, sports / full training (never stopped)

(January 2026)...minimum 2 new instability events during games
EXCELLENT adherence to rehabilitation effort, taping / bracing

Failure of conservative approach in this athlete...

- Significant Bankart / ALPSA lesion (structural deficiency)
- MDI + GLL (inherently unstable capsuloligamentous substrate)
- Perpetuation of pathology (Hill Sachs, capsule, Bankart extension) with each successive instability event
- Elite athletics : Load demand exceeding rehab potential
- In season timeline constraints limiting full rehab window

Decision for Surgery

"Should we stop?"

Specific functional instability complaints

Unable to trust shoulder, joint preservation issue

Failure to improve despite "adequate" & appropriate rehabilitation, conservative measures

Timing in consideration of...

Club nationals (short term goals)

Collegiate / elite career (long term and beyond)



Operative Strategy

1. *Arthroscopic Bankart / ALPSA repair*

- Restore anterior/anteroinferior labral anatomy, AIGHL complex, anterior restraint

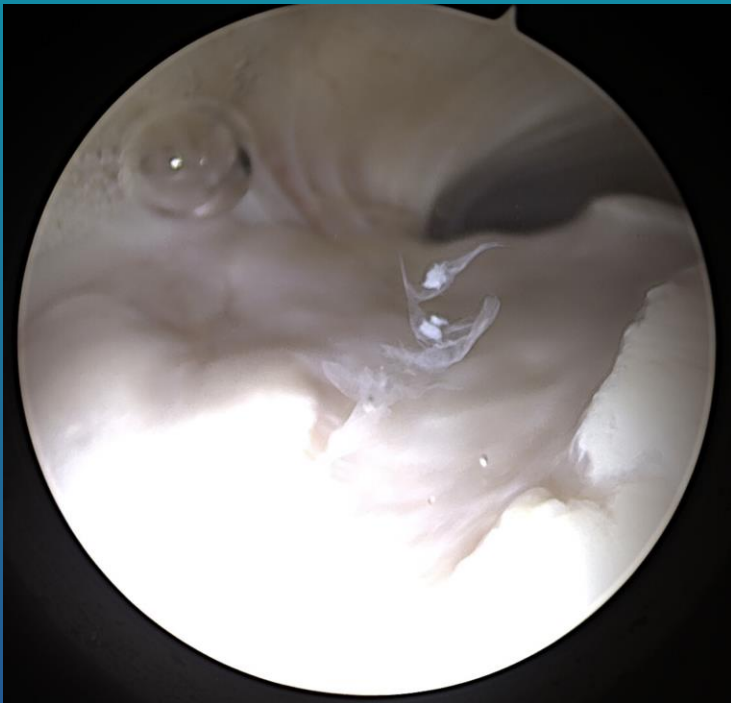
2. *Capsulorrhaphy (Anterior + Posterior)*

- MDI pattern warranting capsular volume reduction
- Address capsular insufficiency (MDI / posttraumatic) + GLL substrate
- Humeral head centralization within glenoid

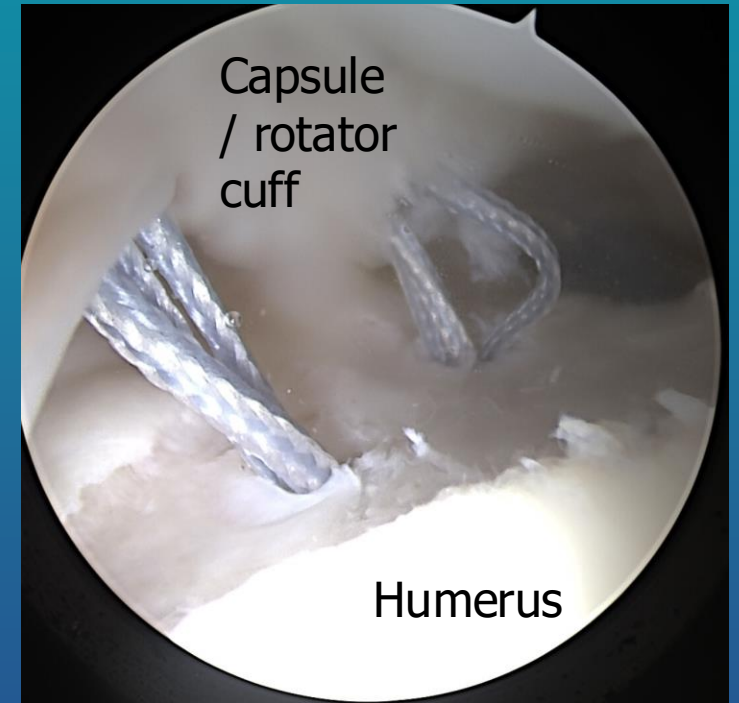
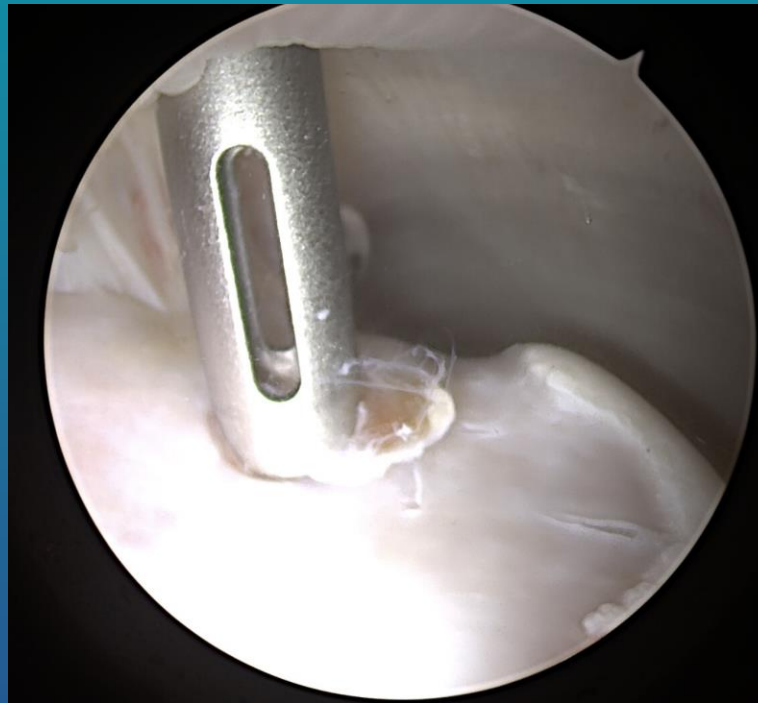
3. *Remlissage (IS tenodesis / posterior capsulodesis into Hill Sachs defect)*

- Reduce recurrence of instability, particularly in contact/collision
- Optimize glenoid track (off-track/engaging to on-track)

Intraoperative Images : Remplissage



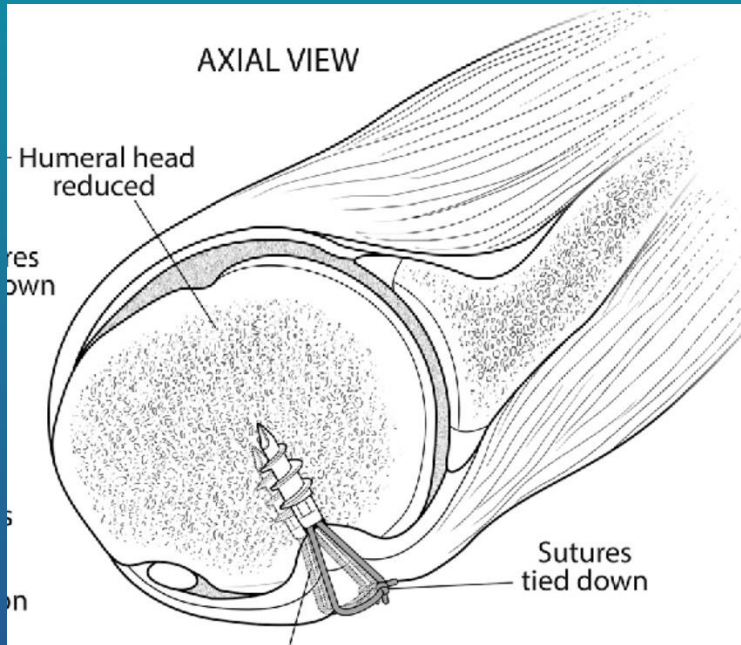
Hill Sachs lesion



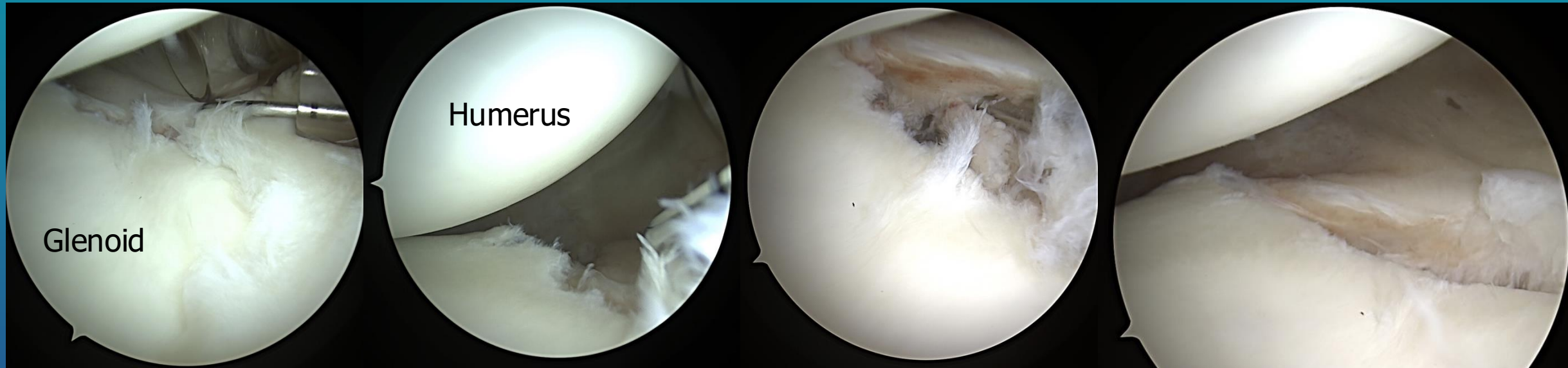
Pretensioning of suture anchors

Final tensioning after labral repair /
capsulorrhaphy

Intraoperative Images : Remplissage



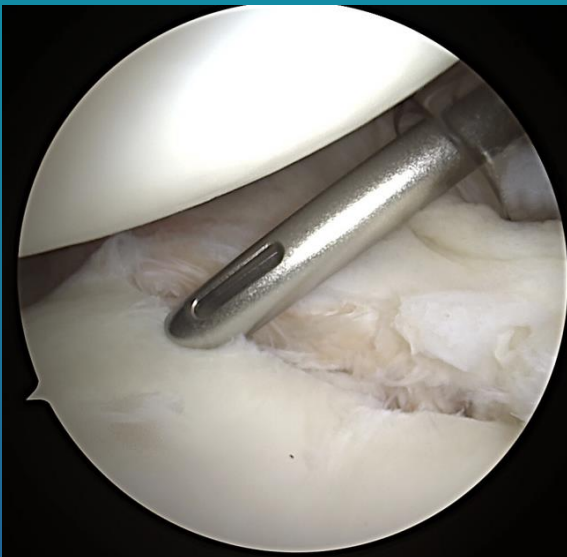
Intraoperative Images



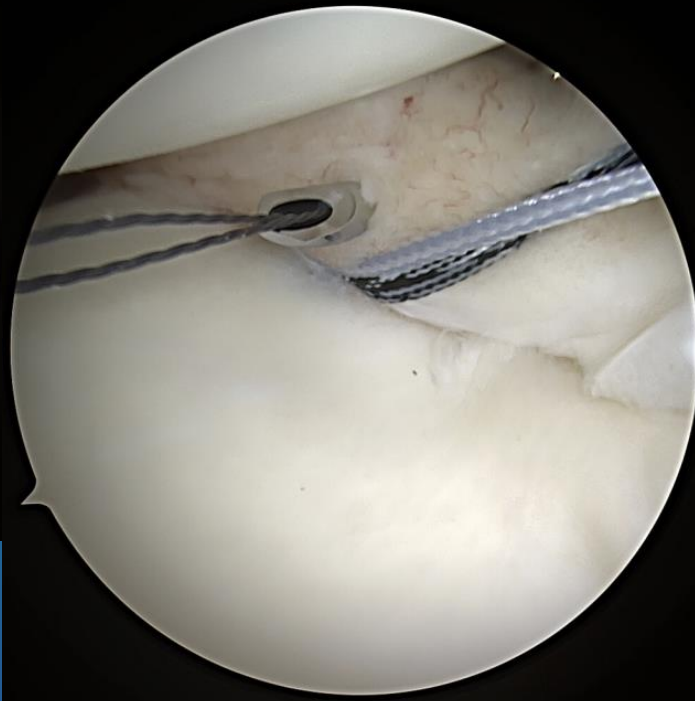
Significant Bankart / ALPSA lesion
Capsular attenuation
Anterior chondral irregularity, blunting of glenoid

Following preparation
labrum / glenoid

Intraoperative Images : Anterior



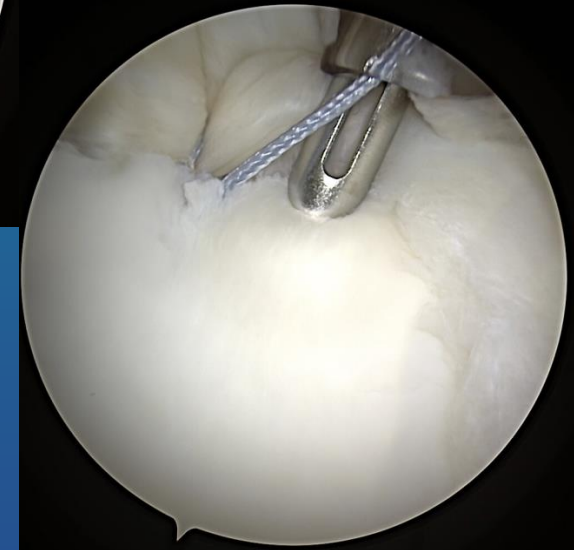
Anchor placement



Capsular shift
- Inferior most anchor, initial capsular bite

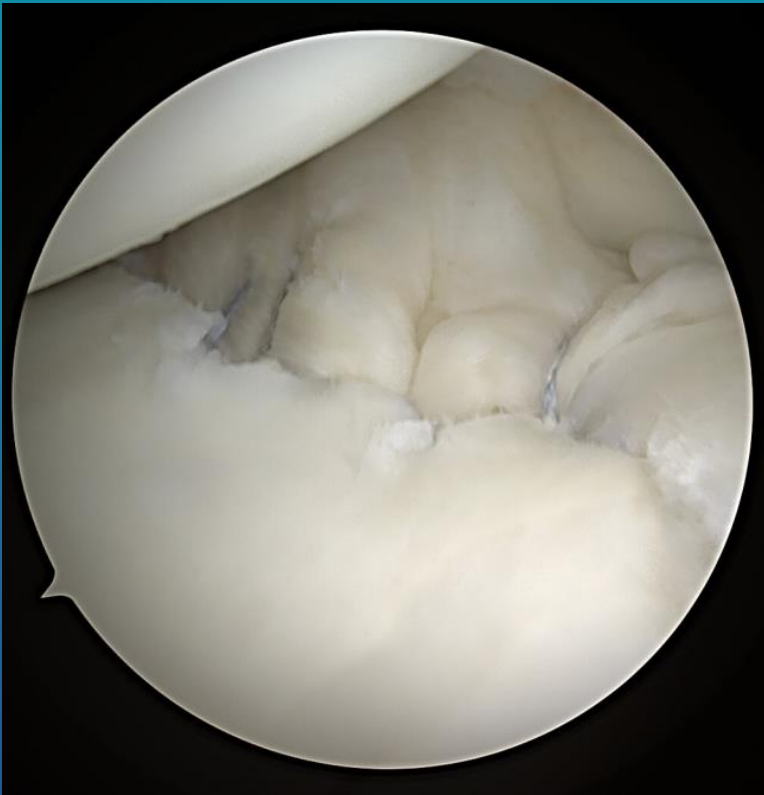


- Second pass including labrum + capsule

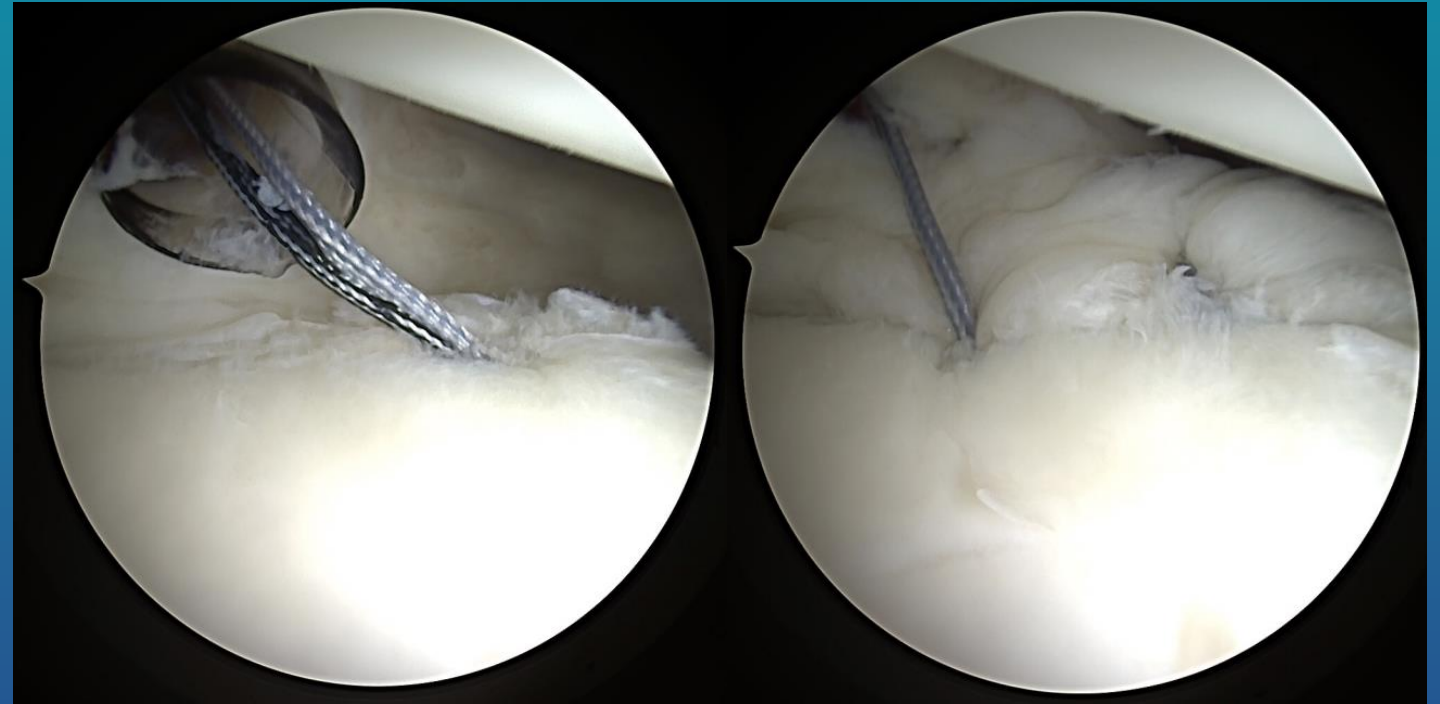


Bankart repair + capsulorrhaphy

Intraoperative Images

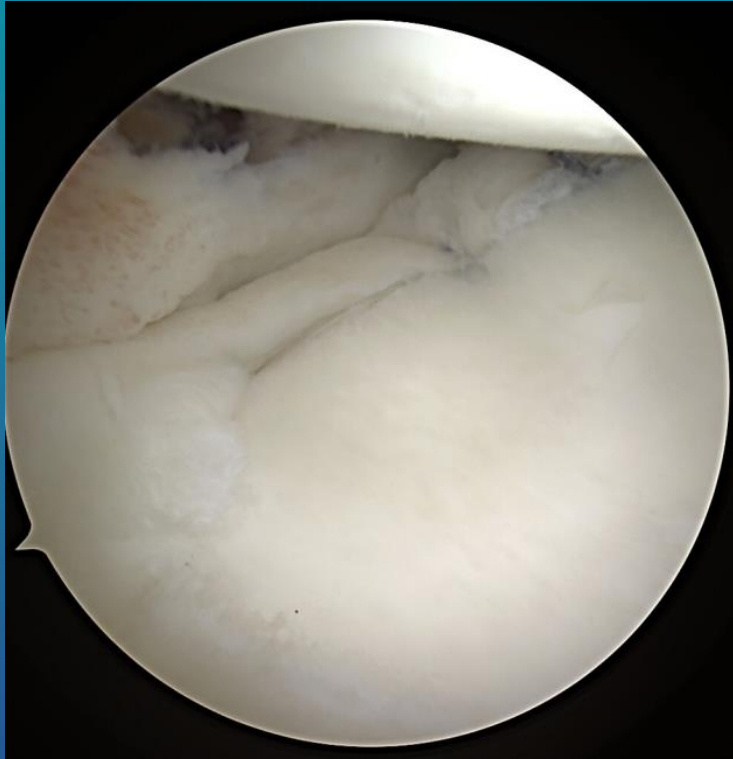


Anterior stabilization

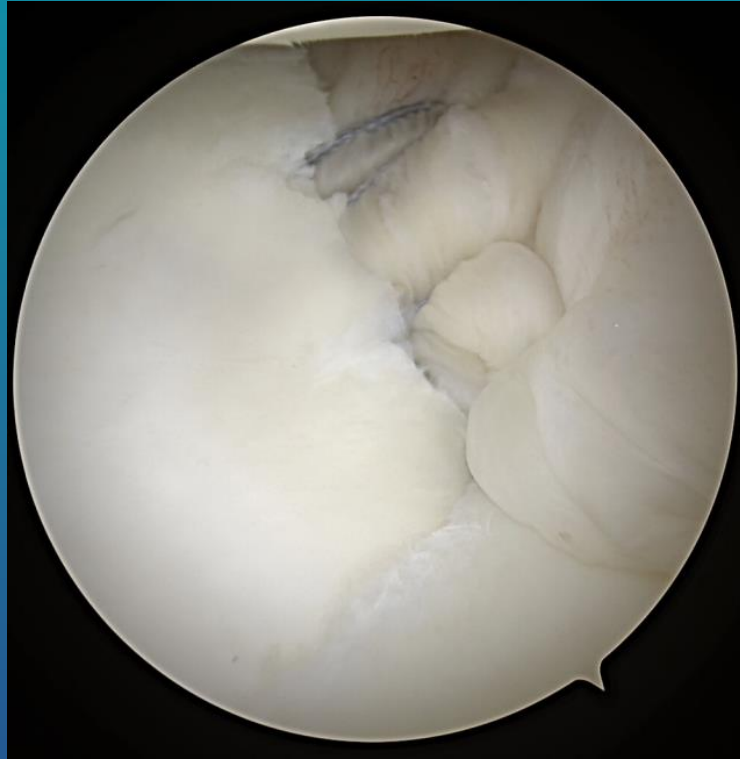


Posterior capsulorrhaphy

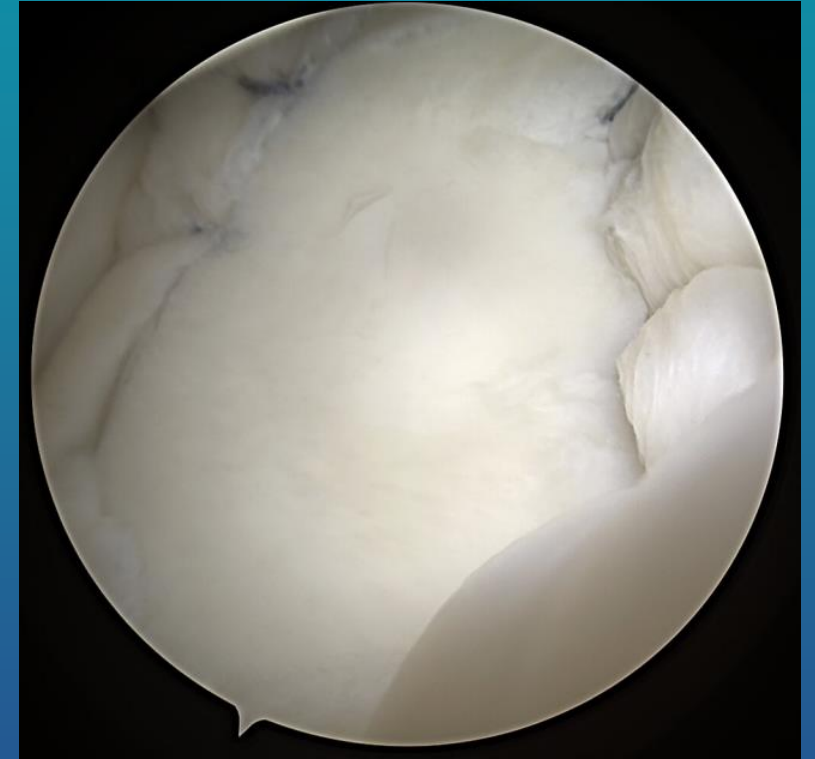
Intraoperative Images



Posterior
capsulorrhaphy



Bankart repair + anterior
capsulorrhaphy / capsular shift



"Bird's eye" view from
perspective of biceps

Initial Physical Therapy

Value and the Problem with Protocols

- The value of following protocols is biology, allow the tissues time to heal.
- However, criterion based is critical

Protect the Anterior/Posterior Capsule

- Supine PROM in the scapular plane to 90°, ER to 30°

Sling for Protection

- Maintain with abduction pillow all the time other than showering

Begin Deltoid and Cuff Isometrics

- Pain free, neutral position

Reinforce Posture and Scapular Position



4-8 weeks- Moderate Protection

PROTECT THE REPAIR!!

Scapular Position

- Setting and neutral position

Humeral Head Position

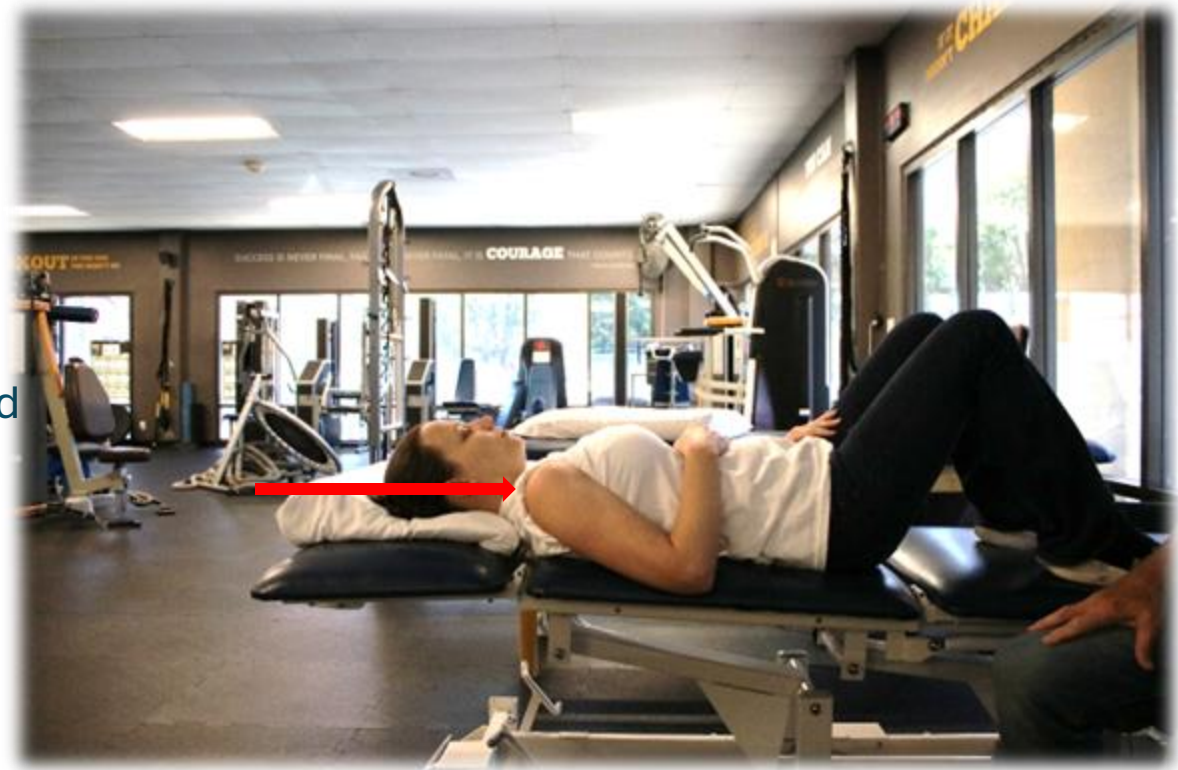
- Central position within the glenoid fossa

Sling

- Discontinue at 4-6 weeks

Range of Motion

- Scaption to 140°
- ER to 40°



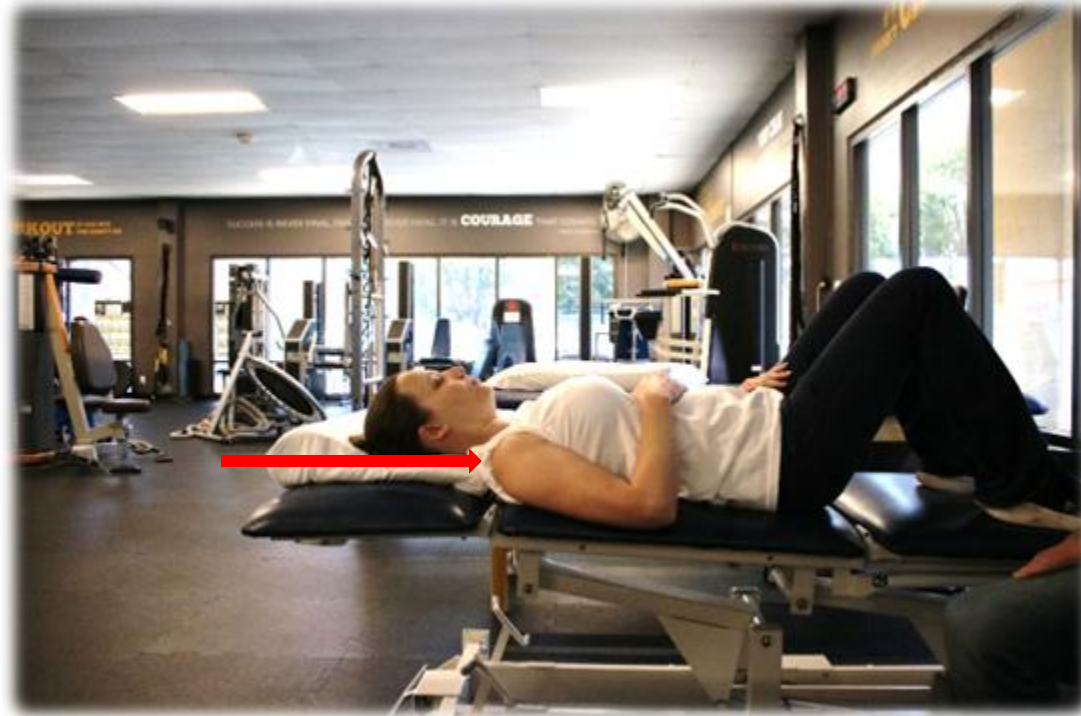
4-8 weeks- Moderate Protection

Scapular Position

- Setting and neutral position

Humeral Head Position

- Central position within the glenoid fossa



4-8 weeks- Moderate Protection

Scapular Position

- Setting and neutral position

Humeral Head Position

- Central position within the glenoid fossa



4-8 weeks- Moderate Protection

Scapular Position

- Stabilization

Total Body Integration



4-8 weeks- Moderate Protection

Scapular Position

- Stabilization

Total Body Integration

- Central position within the glenoid fossa

Closed Chain Options

- Neuromuscular activation



8-12 weeks- Minimal Protection

Advance to full, pain free ROM

- Continue to limit ER above 45 degrees of abduction

Active ROM

- Initiate Full AROM Below horizontal

Initiate Dynamic Strengthening

- Light Resistance
- Below the Horizontal



12+ weeks- Strengthening

Begin When AROM is Pain Free and Symmetrical

Confirm Scapulohumeral Rhythm

Increase Eccentric Intensity

- Point of Transformation

Advance Dynamic Strengthening

- Increase Resistance as Tolerated
- Dynamic Stabilization in WB and NWB
- Sport Specific and Return to Sport Activities.



12+ weeks- Strengthening

Return to Sport Functional Testing
Value???



Single Arm Shot Put



Upper Quarter Y-Balance



CKC Upper Extremity Stability Test

Key Takeaways and Questions



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Afternoon Break 3:30 – 3:40pm

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Dr. David Kruse



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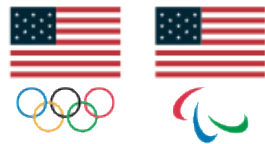
Adaptive & Para Sports Medicine Principles

Hoag Orthopedic Institute
Sports Medicine Symposium
June 12, 2026

David W. Kruse, MD, FAMSSM

Senior Medical Advisor to LA28 Olympic & Paralympic Games
Assistant Professor, Cedars Sinai Department of Orthopaedics & Sports Medicine
Faculty, Cedars Sinai Primary Care Sports Medicine Fellowship

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Cedars-Sinai, Team USA and the LA28 Games

Cedars-Sinai is the Official Medical Provider for the LA28 Olympic and Paralympic Games and is caring for Team USA athletes as a proud member of the U.S. Olympic & Paralympic Medical Network. Cedars-Sinai will serve as an adviser for medical services and clinics for the LA28 Games, providing the highest-quality care for athletes, coaches, team personnel and visitors who travel across the world for the competitions in Los Angeles.

This partnership has two components:

- LA28 Games: Cedars-Sinai is the *exclusive medical provider* for the LA28 Olympic and Paralympic Games. Our focus will be advising on the operational planning and delivery of medical services for the Games.
- Team USA: Cedars-Sinai is one of eight medical institutions in the U.S. Olympic & Paralympic Medical Network and has already begun providing care for Team USA athletes as they prepare to compete in national and international competitions leading up to the LA28 Games. Cedars-Sinai is the *exclusive provider in Los Angeles and surrounding areas of Southern California*.

These partnerships highlight Cedars-Sinai's commitment to the health and wellbeing of Angelenos and the athletes and visitors globally who will benefit from world-class care at one of the premier academic medical centers in the U.S.

Disclosures

- UpToDate author royalties – not relevant to this talk
- Consultant for Temp IQ – not relevant to this talk



Lecture Objectives

- Adaptive & Para Sport
 - Terminology
 - Overview & Access
 - Impairments, Classification, & Medical Complexity
 - Sports Medicine Considerations
 - Injury & Illness Profiles
 - Concussion



Why Adaptive Sport?

- National Center for Health Statistics:
 - 15% of adults with disability affecting physical activity
 - 4% of children with disability
 - Only 45% of individuals with physical disability engage in activity
- Southern California:
 - 3.5 million individuals with physical disability
 - 1.9 million who are not active
- For Individuals with Disabilities (Congenital or Acquired) – Physical Activity:
 - Promotes inclusivity
 - Improves quality of life
 - Lower rates of obesity
 - Lower rates of unemployment
 - Improves mental health
 - Lower rates of chronic disease
- Access remains challenging



Why Adaptive Sports Medicine?

- Provide trusted resource to facilitate participation in physical activity for individuals with disability
- Support unique medical and rehabilitation needs
- Safely facilitate performance for recreational to elite athletes
- Facilitate translational research and contribute to knowledge gaps
- Promote lifelong wellness
- Opportunity to engage in multidisciplinary care
- Promote access to physical activity
- Collaborate with community adaptive sports resources



Terminology & Definitions

Athlete with a Disability

The preferred term for a person participating in sport who has an underlying disability. Avoid using the phrase “disabled athlete,” which places emphasis on the disability rather than the athlete.

Athletic Impairment

An activity limitation caused by an athlete’s underlying disability that affects sport performance. Eligible impairments are defined by the International Paralympic Committee (IPC) and can result from disabilities such as limb deficiency, spinal cord injury, visual impairment, cerebral palsy and certain neuromuscular conditions, among others.



Terminology & Definitions

Adaptive Sports

A broad category of sports that are modified to facilitate the participation of individuals with physical, visual, and intellectual disabilities. Adaptive sports exist at all levels—from recreational participation to elite international competition.

Para Sports

Adaptive sports performed by athletes with disabilities that are included in the Paralympic Games. Most Paralympic sports can be considered adaptive sports, but not all adaptive sports are part of the Paralympics.









♡ Para Alpine Skiing



♡ Para Biathlon



♡ Para Cross-Country Skiing



♡ Para Ice Hockey



♡ Para Snowboard



♡ Wheelchair Curling

2028 PARALYMPIC GAMES COMPETITION SCHEDULE



Blind Football (Soccer)

Para Canoe

Para Powerlifting

Shooting Para Sport

Boccia

Para Climbing

Para Rowing

Sitting Volleyball

Goalball

Para Cycling Road

Para Swimming

Wheelchair Basketball

Para Archery

Para Cycling Track

Para Table Tennis

Wheelchair Fencing

Para Athletics

Para Equestrian

Para Taekwondo

Wheelchair Rugby

Para Badminton

Para Judo

Para Triathlon

Wheelchair Tennis

2028 PARALYMPIC GAMES COMPETITION SCHEDULE



Blind Football (Soccer)

Para Canoe

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Boccia

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Goalball

Para Cycling Road

Para Swimming

Wheelchair Basketball

Para Archery

Para Cycling Track

Para Table Tennis

Wheelchair Fencing

Para Athletics

Para Equestrian

Para Taekwondo

Wheelchair Rugby

Para Badminton

Para Judo

Para Triathlon

Wheelchair Tennis

Table 33.6 List of sports that are currently or have previously been included in the Paralympics (P) [54], Special Olympics (S) [55], Deaflympics (D) [56], and International Blind Sports Federation (B) [57] and eligible impairments for competition in each sport

	Physical Impairment								Intellectual impairment	Visual impairment	Hearing impairment
	Ataxia	Athetosis	Hypertonia	Impaired muscle Power	Impaired passive range of movement	Limb deficiency	Leg length difference	Short stature			
Alpine Skiing	P	P	P	P	P	P	P		S	P	D
Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

Table 33.6 List of sports that are currently or have previously been included in the Paralympics (P) [54], Special Olympics (S) [55], Deaflympics (D) [56], and International Blind Sports Federation (B) [57] and eligible impairments for competition in each sport

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Alpine Skiing	P	P	P	P	P	P	P		S	P	D
Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

Table 33.6 List of sports that are currently or have previously been included in the Paralympics (P) [54], Special Olympics (S) [55], Deaflympics (D) [56], and International Blind Sports Federation (B) [57] and eligible impairments for competition in each sport

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Alpine Skiing	P	P	P	P	P	P	P		S	P	D
Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

Table 33.6 List of sports that are currently or have previously been included in the Paralympics (P) [54], Special Olympics (S) [55], Deaflympics (D) [56], and International Blind Sports Federation (B) [57] and eligible impairments for competition in each sport

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Alpine Skiing	P	P	P	P	P	P	P		S	P	D
Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

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Alpine Skiing	P	P	P	P	P	P	P		S	P	D
Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

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Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

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Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

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Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

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	Ataxia	Athetosis	Hypertonia	Impaired muscle Power	Impaired passive range of movement	Limb deficiency	Leg length difference	Short stature			
Alpine Skiing	P	P	P	P	P	P	P		S	P	D
Archery	P	P	P	P	P	P	P				
Athletics (Track and Field)	P	P	P	P	P	P	P	P	P, S	P	D
Badminton	P	P	P	P	P	P	P	P	S		D
Basketball									S		D
Beach Volleyball											D
Biathlon (Nordic Skiing)	P	P	P	P	P	P	P			P	
Boccia	P	P	P	P	P	P	P		S		
Bowling									S	B	D
Canoe				P	P	P					
Cheer									S		
Chess										B	D
Cricket									S		
Cross-Country Skiing (Nordic Skiing)	P	P	P	P	P	P	P		S	P	D
Curling											D
Cycling	P	P	P	P	P	P	P		S	P	D
DanceSport									S		
Diving											D
Equestrian	P	P	P	P	P	P	P	P	S	P	
Figure Skating									S		
Floorball									S		
Floor Hockey									S		
Football									S	P, B	D
Futsal											D
Goalball (Torball)										P, B	

(continued)

	Physical Impairment								Intellectual impairment	Visual impairment	Hearing impairment
	Ataxia	Athetosis	Hypertonia	Impaired muscle Power	Impaired passive range of movement	Limb deficiency	Leg length difference	Short stature			
Golf									S		D
Gymnastics									S		D
Handball									S		D
Ice Hockey											D
Judo									S	P, B	D
Karate											D
Kayaking									S		
Mountain Biking											D
Netball									S		
Orienteering											D
Paracanoe				P	P	P	P				
Paratriathlon	P	P	P	P	P	P	P			P	
Powerlifting	P	P	P	P	P	P	P	P	S	B	
Roller Skating									S		
Rowing	P	P	P	P	P	P	P			P	
Sailing									S		
Shooting	P	P	P	P	P	P	P				D
Short Track Speed Skating									S		
Showdown										B	
Sitting Volleyball	P	P	P	P	P	P	P				
Sled Hockey	P	P	P	P	P	P	P				
Snowboarding	P	P	P	P	P	P	P		S		D
Snowshoeing									S		
Soccer	P	P	P							P	
Softball									S		
Swimming	P	P	P	P	P	P	P	P	P, S	P	D
Table Tennis	P	P	P	P	P	P	P	P	P, S		D
Taekwondo						P	P				D
Tennis									S		D
Triathlon	P	P	P	P	P	P			S	P	

	Physical Impairment								Intellectual impairment	Visual impairment	Hearing impairment
	Ataxia	Athetosis	Hypertonia	Impaired muscle Power	Impaired passive range of movement	Limb deficiency	Leg length difference	Short stature			
Golf									S		D
Gymnastics									S		D
Handball									S		D
Ice Hockey											D
Judo									S	P, B	D
Karate											D
Kayaking									S		
Mountain Biking											D
Netball									S		
Orienteering											D
Paracanoe				P	P	P	P				
Paratriathlon	P	P	P	P	P	P	P			P	
Powerlifting	P	P	P	P	P	P	P	P	S	B	
Roller Skating									S		
Rowing	P	P	P	P	P	P	P			P	
Sailing									S		
Shooting	P	P	P	P	P	P	P				D
Short Track Speed Skating									S		
Showdown										B	
Sitting Volleyball	P	P	P	P	P	P	P				
Sled Hockey	P	P	P	P	P	P	P				
Snowboarding	P	P	P	P	P	P	P		S		D
Snowshoeing									S		
Soccer	P	P	P							P	
Softball									S		
Swimming	P	P	P	P	P	P	P	P	P, S	P	D
Table Tennis	P	P	P	P	P	P	P	P	P, S		D
Taekwondo						P	P				D
Tennis									S		D
Triathlon	P	P	P	P	P	P			S	P	

	Physical Impairment								Intellectual impairment	Visual impairment	Hearing impairment
	Ataxia	Athetosis	Hypertonia	Impaired muscle Power	Impaired passive range of movement	Limb deficiency	Leg length difference	Short stature			
Golf									S		D
Gymnastics									S		D
Handball									S		D
Ice Hockey											D
Judo									S	P, B	D
Karate											D
Kayaking									S		
Mountain Biking											D
Netball									S		
Orienteering											D
Paracanoe				P	P	P	P				
Paratriathlon	P	P	P	P	P	P	P			P	
Powerlifting	P	P	P	P	P	P	P	P	S	B	
Roller Skating									S		
Rowing	P	P	P	P	P	P	P			P	
Sailing									S		
Shooting	P	P	P	P	P	P	P				D
Short Track Speed Skating									S		
Showdown										B	
Sitting Volleyball	P	P	P	P	P	P	P				
Sled Hockey	P	P	P	P	P	P	P				
Snowboarding	P	P	P	P	P	P	P		S		D
Snowshoeing									S		
Soccer	P	P	P							P	
Softball									S		
Swimming	P	P	P	P	P	P	P	P	P, S	P	D
Table Tennis	P	P	P	P	P	P	P	P	P, S		D
Taekwondo						P	P				D
Tennis									S		D
Triathlon	P	P	P	P	P	P			S	P	

	Physical Impairment								Intellectual impairment	Visual impairment	Hearing impairment
	Ataxia	Athetosis	Hypertonia	Impaired muscle Power	Impaired passive range of movement	Limb deficiency	Leg length difference	Short stature			
Volleyball									S		D
Water Polo											D
Wheelchair Basketball	P	P	P	P	P	P	P				
Wheelchair Curling	P	P	P	P	P	P	P				
Wheelchair Fencing	P	P	P	P	P	P	P				
Wheelchair Rugby	P	P	P	P	P	P	P				
Wheelchair Tennis	P	P	P	P	P	P	P				
Wrestling											D



ANGEL CITY GAMES

Brought to you by



2025 SCHEDULE OF EVENTS

THE HARTFORD EXPERIENCE ZONE IS OPEN 9AM-4:30PM EACH DAY WITH VENDOR VILLAGE BOOTHS AND RECREATIONAL SPORTS. EVENTS LISTED IN **YELLOW** ARE MOVE UNITED SANCTIONED TOURNAMENTS

Friday, June 27
9 am - 11:30 am

- ARCHERY CLINIC
- GOLF CLINIC
- OTTOBOCK FULL CIRCLE MOVEMENT CLINIC
- PICKLEBALL CLINIC
- TABLE TENNIS CLINIC
- TRACK & FIELD CLINICS
- ADAPTIVE FITNESS CLINIC
- WHEELCHAIR RUGBY CLINIC

- LUNCH
- OPENING CEREMONIES & THE HARTFORD GIFTING MOMENT

2pm - 4:30pm

- ARCHERY COMPETITION
- GOALBALL CLINIC
- GOLF COMPETITION
- OTTOBOCK FULL CIRCLE MOVEMENT CLINIC
- PICKLEBALL CLINIC
- TRACK & FIELD CLINICS
- ADAPTIVE FITNESS CLINIC
- WHEELCHAIR RUGBY COMPETITION

SHARE YOUR EXPERIENCE ON SOCIAL
#ACG25

@angelcitysports

Saturday, June 28
9 am - 11:30 am

- BLIND TENNIS CLINIC
- SITTING VOLLEYBALL CLINIC
- SWIMMING CLINIC
- TABLE TENNIS COMPETITION
- TRACK & FIELD - COMPETITION (JUMPS & THROWS)
- WHEELCHAIR BASKETBALL CLINIC
- WHEELCHAIR FENCING CLINIC
- WHEELCHAIR FOOTBALL CLINIC
- WHEELCHAIR TENNIS CLINIC
- YOGA/STRETCHING CLINIC

11:30am - 2pm

- LUNCH
- OLYMPIC & PARALYMPIC DAY CELEBRATION
- ALL-STAR/CELEBRITY WHEELCHAIR BASKETBALL GAME
- "THE ROLLETES" HALFTIME SHOW

2pm - 4:30pm

- BOCCIA CLINIC
- BLIND SOCCER CLINIC
- PICKLEBALL COMPETITION
- SITTING VOLLEYBALL COMPETITION
- SWIMMING CLINIC
- TRACK & FIELD - COMPETITION (JUMPS & THROWS)
- WCMX/SKATING CLINIC
- WHEELCHAIR BASKETBALL CLINIC
- WHEELCHAIR DANCE CLINIC
- WHEELCHAIR FOOTBALL TRYOUTS
- WHEELCHAIR TENNIS CLINIC

Sunday, June 29
9 am - 11:30 am

- AMPUTEE SOCCER CLINIC
- SWIMMING CLINIC/COMPETITION
- TRACK & FIELD - COMPETITION (RACING)
- WHEELCHAIR BASKETBALL COMPETITION
- WHEELCHAIR LACROSSE CLINIC
- WHEELCHAIR TENNIS COMPETITION

11:30am

- LUNCH
- CLOSING CEREMONY
- TODDLER GAMES

2pm - 4:30pm

- CLIMBING COMPETITION
- ROWING CLINIC
- SWIMMING COMPETITION
- TRACK & FIELD COMPETITION (RACING)
- WHEELCHAIR BASKETBALL COMPETITION
- WHEELCHAIR TENNIS COMPETITION

ADAPTIVE GOLF CLINIC

MAR 5

Adaptive Golf Clinic

10:30 AM – 12:00 PM
Westchester Golf Course (map)

[VIEW EVENT →](#)

WHEELCHAIR TENNIS

MAR 14

Wheelchair Tennis

12:30 PM – 2:00 PM
Burbank Tennis Center (map)

[VIEW EVENT →](#)

ADAPTIVE SWIMMING

MAR 15

Adaptive Swimming

3:00 PM – 4:30 PM
Harvard Westlake Upper School (map)

[VIEW EVENT →](#)

ADAPTIVE TRACK & FIELD

MAR 15

Adaptive Track & Field

1:00 PM – 2:30 PM
Harvard Westlake Upper School (map)

[VIEW EVENT →](#)



2026 Youth Weekend

[VIEW EVENT →](#)



Terminology & Definitions

Paralympic Games

The world's premier international competition for elite athletes with disabilities, held every two years in conjunction with the Olympic Games. The Paralympic Games are governed by the International Paralympic Committee and are distinct from the Special Olympics.

Para Sport Classification

A system used to evaluate athletes with disabilities to determine eligibility and organize competitors based on how their impairment impacts performance in a specific sport—helping ensure fair and meaningful competition.



International Paralympic Committee: Impairments

- Physical Impairment (PI)
- Visual Impairment (VI)
- Intellectual Impairment (II)

- Many disabilities/impairments not included:
 - Hearing
 - Chronic Pain
 - Hypermobility
 - Endocrine



**IMPAIRED
MUSCLE
POWER**

**LIMB
DEFICIENCY**

**LEG LENGTH
DIFFERENCE**

PARALYMPICS: ELIGIBLE PHYSICAL IMPAIRMENTS

**SHORT
STATURE**



HYPERTONIA

Must have at least 1 eligible impairment, which is permanent, and a direct result of an underlying health condition

ATAXIA

ATHETOSIS

**IMPAIRED
PASSIVE
RANGE OF
MOTION**

PARALYMPIC SPORTS BY IMPAIRMENT GROUP

Eligibility criteria for each sport by impairment group

Classification process further determines if the athlete meets the minimum criteria based on their impairment evaluation

Paralympic Sports by Impairment Group

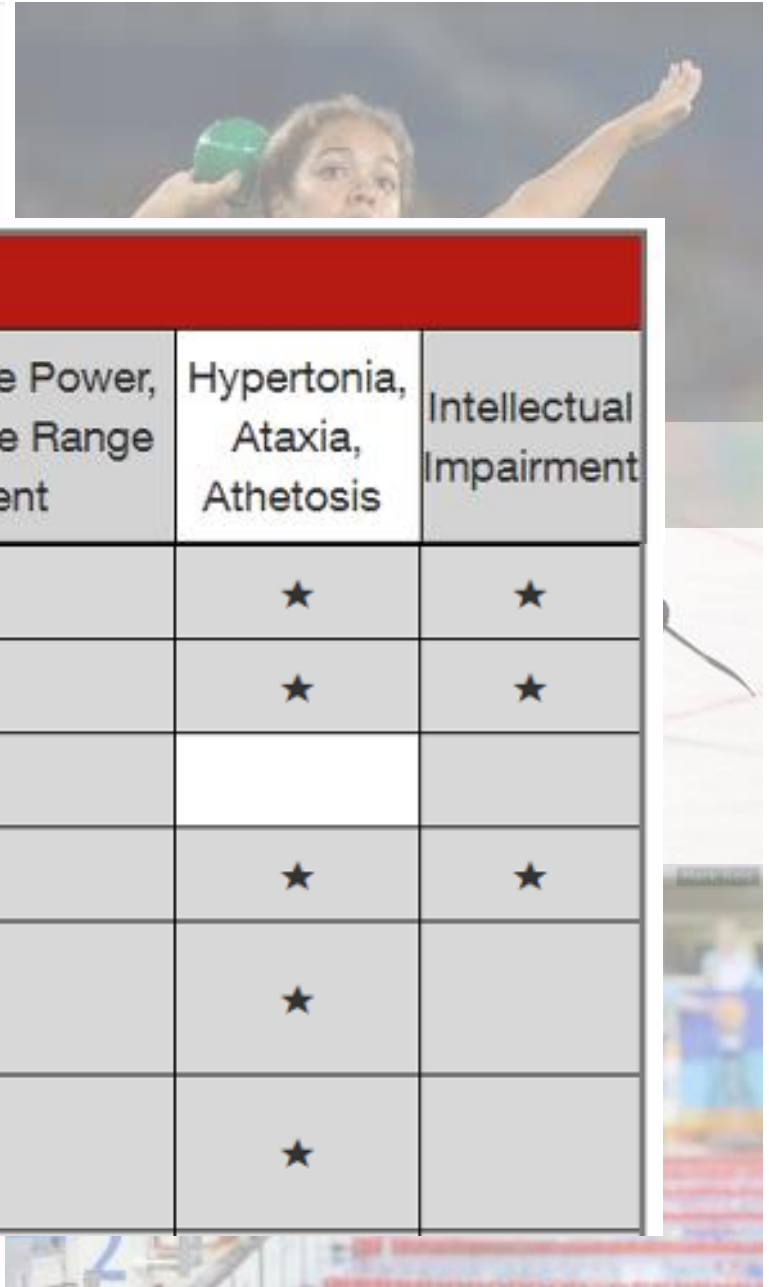
Summer Sports						
	Limb Deficiency, Leg Length Difference	Short Stature	Visual Impairment	Impaired Muscle Power, Impaired Passive Range of Movement	Hypertonia, Ataxia, Athetosis	Intellectual Impairment
Archery	★			★	★	
Badminton	★	★		★	★	
Boccia	★			★	★	
Cycling	★		★	★	★	
Equestrian	★	★	★	★	★	
Goalball			★			
Judo			★			
Paracanoe	★			★		
Paratriathlon	★		★	★	★	
Powerlifting	★	★		★	★	
Rowing	★		★	★	★	
Shooting	★			★	★	
Sitting Volleyball	★			★	★	
Soccer			★			
Swimming	★	★	★	★	★	★
Table Tennis	★	★		★	★	★
Taekwondo	★					
Track and Field	★	★	★	★	★	★
Wheelchair Basketball	★			★	★	
Wheelchair Fencing	★			★	★	
Wheelchair Rugby	★			★	★	
Wheelchair Tennis	★			★	★	
Winter Sports						
Alpine Skiing	★		★	★	★	
Nordic Skiing (biathlon and cross-country)	★		★	★	★	
Sled Hockey	★			★	★	
Snowboarding	★			★	★	
Wheelchair Curling	★			★	★	



PARALYMPIC SPORTS BY

Paralympic Sports by Impairment Group

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Swimming	★	★	★	★	★	★
Table Tennis	★	★		★	★	★
Taekwondo	★					
Track and Field	★	★	★	★	★	★
Wheelchair Basketball	★			★	★	
Wheelchair Fencing	★			★	★	
Wheelchair Curling	★			★	★	



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Track and Field	★	★	★	★	★	★
Wheelchair Basketball	★			★	★	
Wheelchair Fencing	★			★	★	

Wheelchair Curling	★			★	★	
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PARALYMPIC CLASSIFICATION PANELS

Each classification panel has at least 1 medical classifier and 1 technical classifier

MEDICAL CLASSIFIERS

Physical impairments:
Physician or physiotherapist who is a health professional in a field relevant to the eligible impairments evaluated

Visual impairments:
Ophthalmologist or optometrist

Intellectual impairments:
Psychologist

TECHNICAL CLASSIFIERS

Extensive coaching or other relevant background in specific Para sport

Or

Recognized and reputable academic qualification encompassing requisite level of anatomical, biomechanical, and sport-specific expertise

Paralympic Classification – 2025 Update

1. More sport-specific testing
2. More research-based classification systems
3. Further integration of Intellectual Impairment (II)
4. Stricter penalties for misrepresentation
5. Clearer non-eligible list
6. Consolidation of physical impairments

Continued goal of improved objectivity and fairness



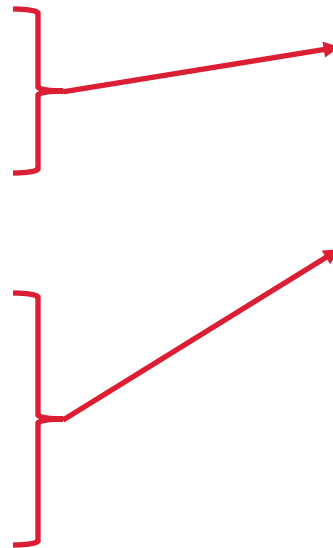
Consolidation of Physical Impairments

Pre-2025

1. Impaired muscle power
2. Impaired passive ROM
3. Limb deficiency
4. Limb length difference
5. Short Stature
6. Athetosis/dyskinesia
7. Hypertonia
8. Ataxia

2025-Current

1. Impaired muscle power
2. Impaired passive ROM
3. Limb deficiency & leg length difference
4. Short stature
5. Coordination impairment



Paralympics

- Athletes with eligible diagnosis and impairment
 - Need to qualify under certain standards
- Focused on elite performance sport
- Run by the International Paralympic Committee (IPC)

What's the difference?

- Athletes with intellectual impairments
- Anyone over the age of 8 years old with any ability level
- 7 regions of the world, over 170 countries, more than 220 programs operating in 32 Olympic-type sports

Special Olympics

Injury & Illness Patterns

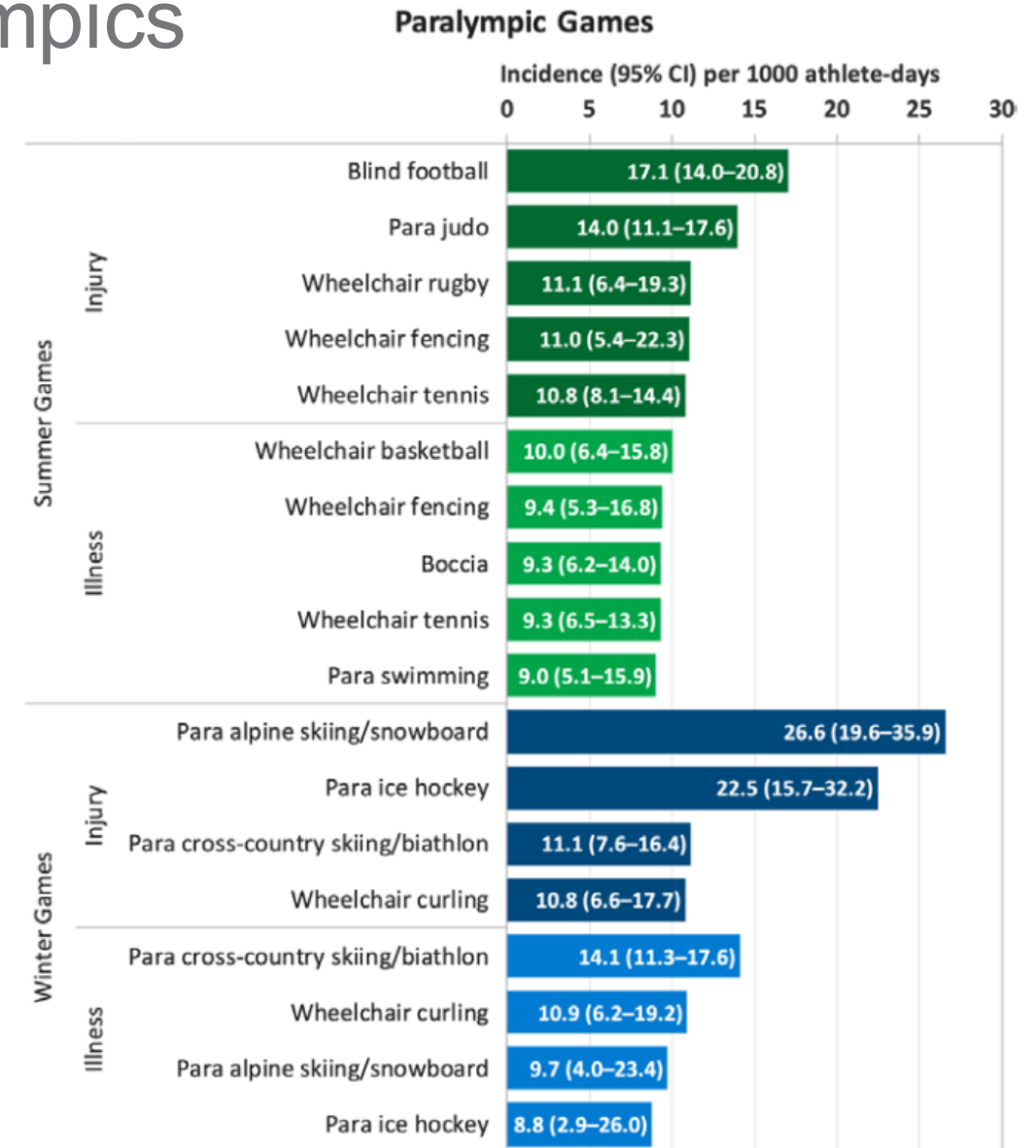


- Athletes first – common injury and illness types similar to athletes without disabilities and sport-specific
- Reality – all athletes in adaptive or para sport have an underlying medical condition related to their impairment
- Incidence of injury and illness in Paralympic athletes can be higher than Olympic athletes, but variable per:
 - Summer vs winter
 - Impairment type
 - Injury vs illness
 - Female vs male



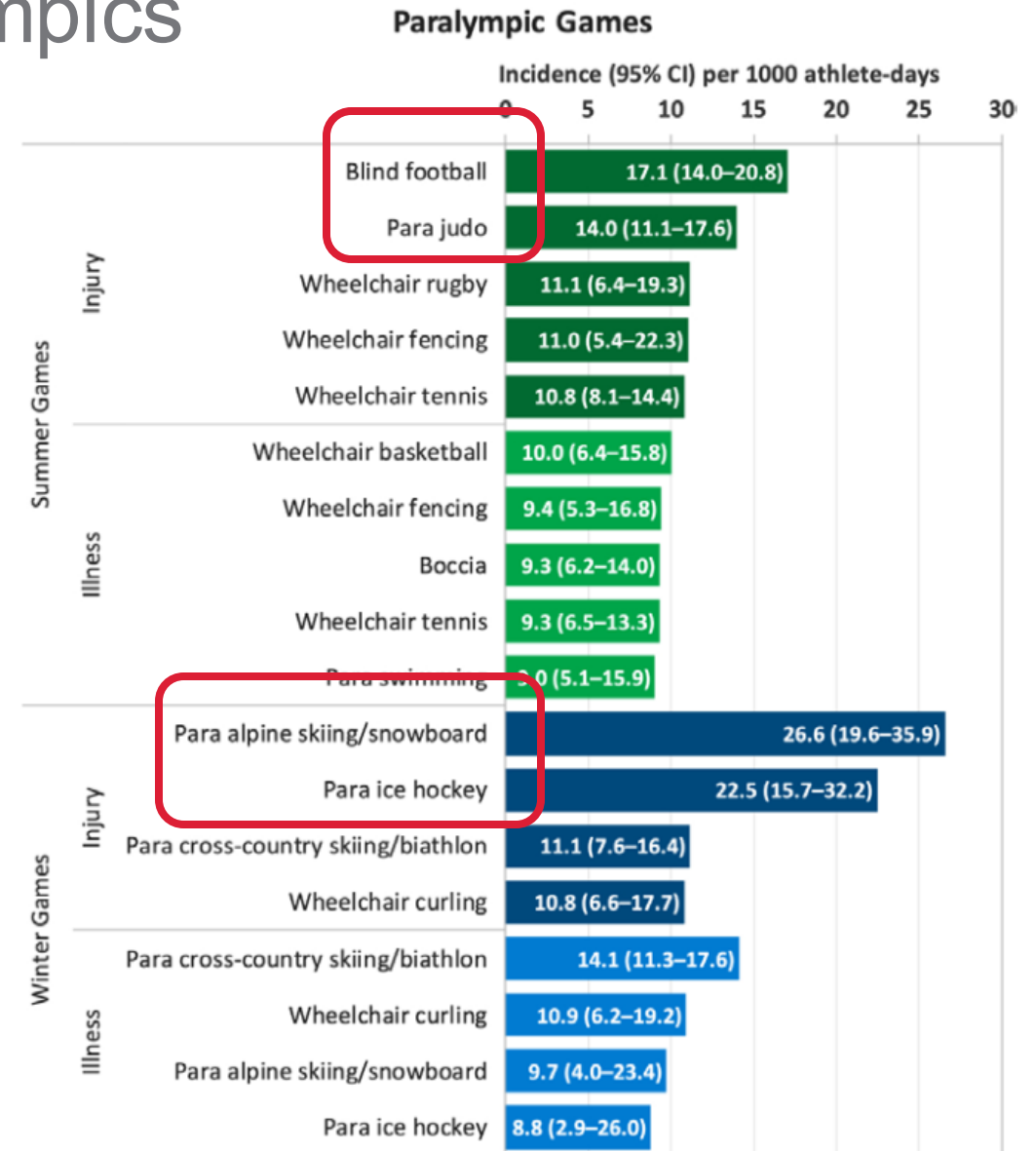
Injury & Illness Incidence: Paralympics

- Injury incidence can vary per impairment type:
 - Highest – VI & Neuromuscular d/o
 - Lowest – Brain disorder
- Meta-analysis across 10 Oly/4 Youth Oly/13 Paralympic: [Torvaldsson 2025]
 - Incidence of injury and illness highest in Paralympics
 - Upper limb injuries most common in Paralympics
 - Injury incidence male = female
 - Illness incidence:
 - Respiratory most common
 - GI and dermatologic illness rates much higher compared to Olympic



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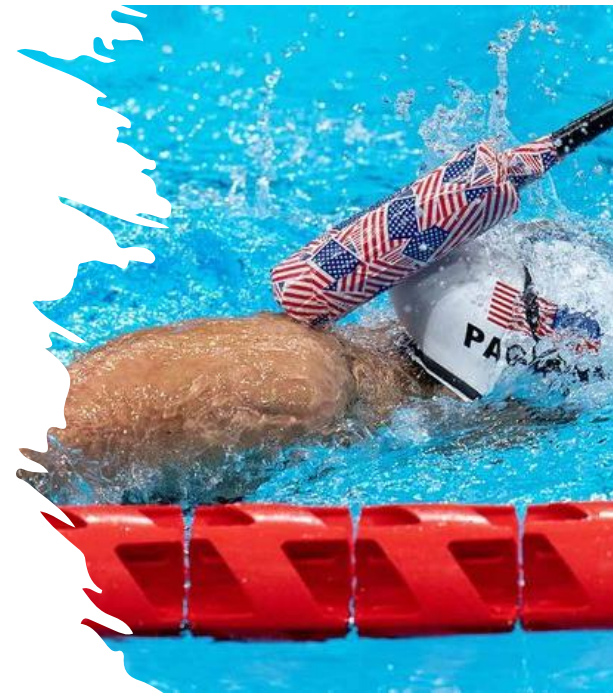
Comparative Analysis – Team USA Athletes

- Post et al. Team USA Comparative Analysis, Orthop J Sports Med, Jan 2025
 - Team USA data from Tokyo 2020 Olympic and Paralympic Games
 - Olympics – 701 athletes, 34 sports / Paralympics – 245 athletes, 20 sports
 - No differences in injury or illness (Female>Male Para illness)
- Post et al. Team USA Patterns, BMJ Open Sp Ex Med, Sept 2025.
 - Team USA data from Paris 2024 Olympic and Paralympic Games
 - Injury and Illness rates higher among Paralympic Athletes
 - Injury – 20.5/1000AD vs. 14.6
 - Illness – 15.7/1000AD vs. 8.3 (Respiratory highest)
 - 38% of Paralympic injuries were in non-sports setting (accessibility risk)



Injury & Illness – Knowledge Gaps

- Current Para Sport Injury and Illness Rates
 - Mostly centered in Elite Athlete
 - Based on Games data
 - Significant gaps in knowledge
 - Limited research involving athletes with disabilities
 - Disability or impairment specific
 - Return to sport profiles
 - Cardiology considerations
 - Sports-related Concussion – patterns, evaluation, tools, RTS
 - Overuse and periodization
 - Mental health



Systematic Review: Sports-Related Health Problems Para-Sport

Luijten, et al. *Sports Health*, Aug 2024

- 64 Studies – 30 with high quality
- 84% elite-level athletes
- Injury and illness data varied widely dependent on sport and impairment
- Sparse data on risk factors, severity and prevention
- Significant heterogeneity in definitions, low numbers



Adaptive & Para Sport Injury Risk Factors

- Improper equipment
 - Poor fit, improperly maintained, mismatched use
- Seated equipment setup (wheelchair, sled, sit-ski, etc.)
 - Seat too wide/narrow
 - Wheels too far back or forward
 - Inadequate support of core instability
 - Inappropriate cushioning
- Improper training
- Overuse – Sport training + ADL



CASE 1



Athlete: 31 yo female Paralympic cyclist

Disability: T4 complete spinal cord injury

Other Medical History: None

Environment: Hot summer day, first Para cycling competition of the year and she is trying a new handcycle

Presentation: Shortly after her first event, athlete complains of a pounding headache and nasal congestion. She also has noticed worsened spasticity in her bilateral lower extremities.

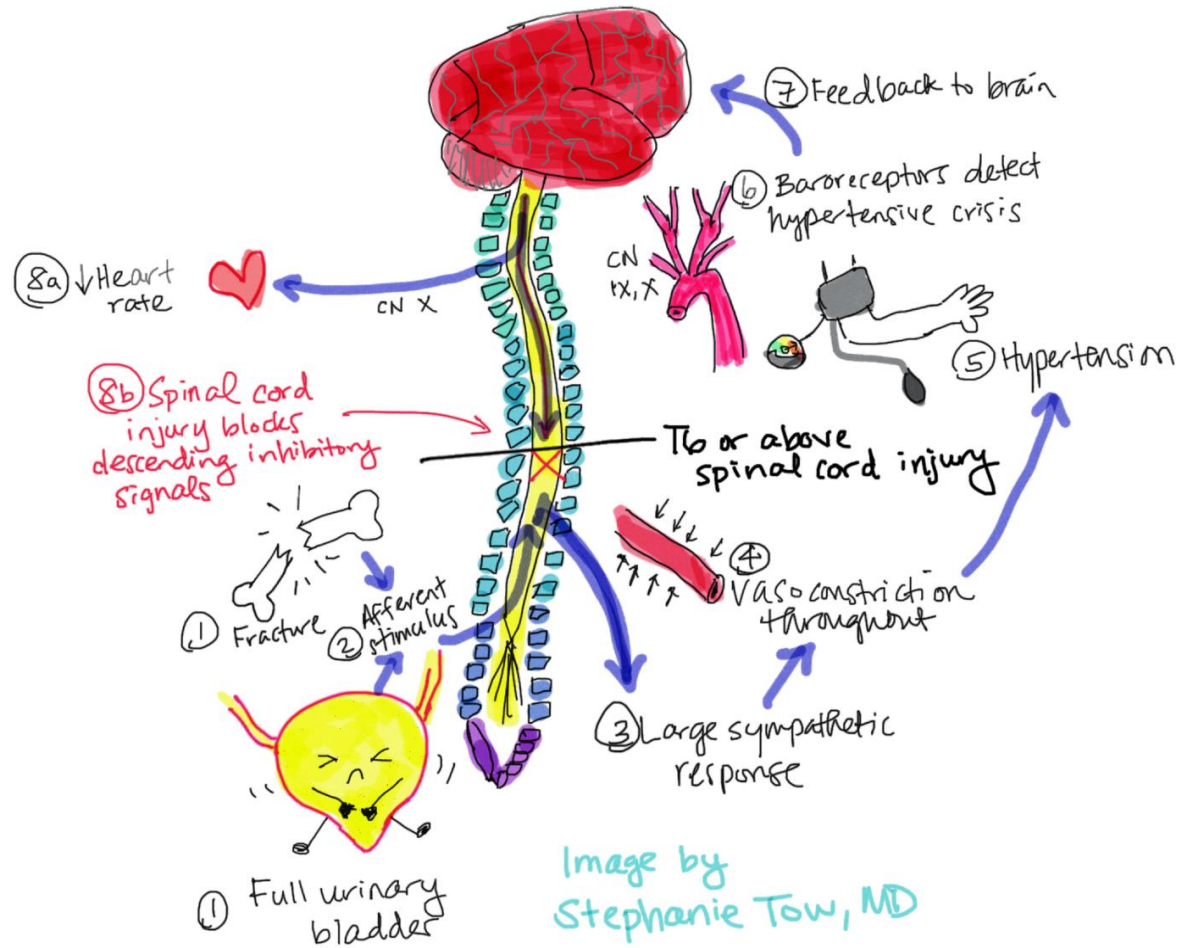
Autonomic Dysreflexia (AD)

- Medical Emergency
- Occurs in SCI at T6 or above
- Uncoordinated sympathetic response to a stimulus below the level of injury
- Common causes:
 - Visceral stimulus (full bladder, UTI, bowel impaction)
 - Tight equipment
 - Occult lower body injury
 - Occult skin lesion
- Presentation:
 - Sudden spike in blood pressure (>150 or >30-40 over baseline)
 - Common symptoms: headache, flushing, congestion, anxiety (sense of impending doom), diaphoresis, blurry vision, piloerection, nausea

CASE 1



Autonomic Dysreflexia (AD)



Normal:

- Noxious stimulus
- Sympathetic response
- Brain senses and sends inhibitory parasympathetic response -creating homeostasis

T6 – Location of Splanchnic nerves

SCI at T6:

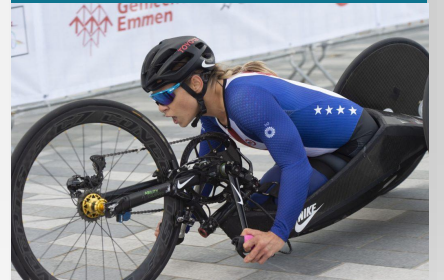
- Noxious stimulus and sympathetic response
- Vasoconstriction – HTN
- Brain response blocked prior to arrival at splanchnic control
- Sympathetic response continues unchecked

Autonomic Dysreflexia (AD)

MANAGEMENT:

- Check vital signs – severe hypertension, bradycardia/tachycardia
- Sit athlete upright (reduce ICP)
- Loosen clothing
- Scan head to toe while also asking athlete pertinent questions: When did she last catheterize? Have a bowel movement? Has she had AD previously? What medications do she take? Any recent injuries or crashes?
- Check equipment fit - loosen
- Rapid-acting hypertensive (nitroglycerin oint) if remains hypertensive
- Check vital signs frequently
- Remove nitroglycerin oint once SBP down to 130
- Emergency department if remains hypertensive
- **In this case:** Athlete's handcycle strapping system was too tight and caused a noxious stimulus. Symptoms and BP normalized once this noxious stimulus was removed.

CASE 1



Other Cardiovascular Conditions



- Dysautonomia
- **Orthostatic hypotension**
- Deep venous thrombosis
- Loss of blood flow regulation by nervous system
- Associations with cardiac disease (**cardiomyopathy, arrhythmias**)
- **Decreased cardiorespiratory endurance**
- Aortic dilatation (osteogenesis imperfecta)

Bone Conditions

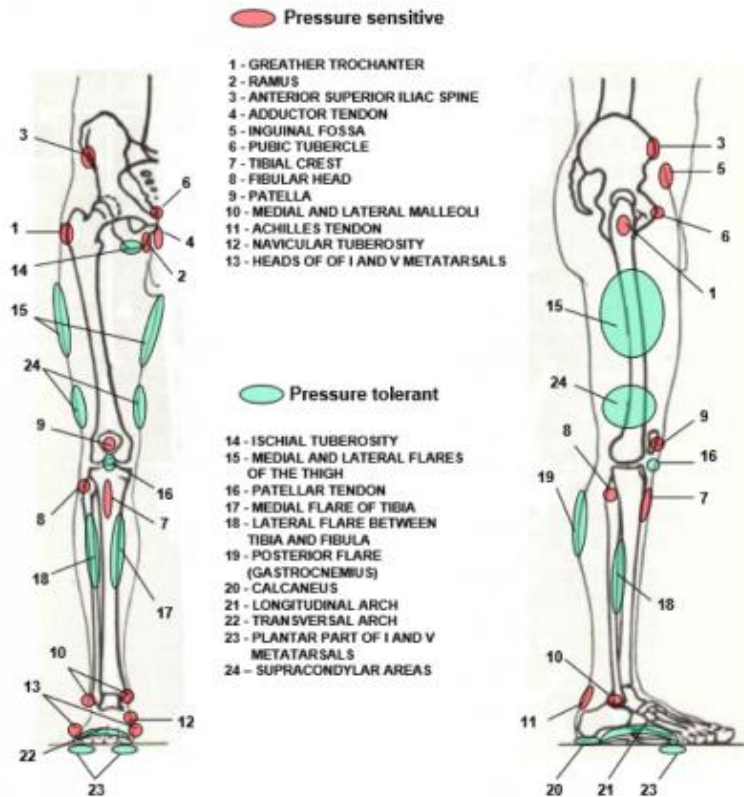
- **Fractures** / low bone mineral density
- Hypermobility or hypomobility in joints
- Contractures
- **Acetabular dysplasia** and hip subluxation
- **Terminal osseous overgrowth** – skeletally immature amputees
- **Osteomyelitis**
- Scoliosis (idiopathic vs neuromuscular)
- Atlantoaxial instability
- Skeletal anomalies



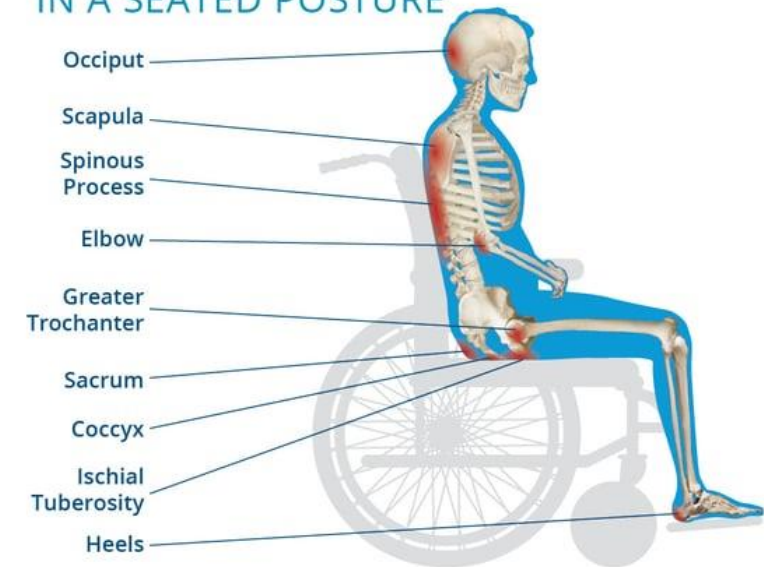
Skin Conditions

- Risks:
 - Impaired sensation and vascularization
 - SCI
 - Amputees with prostheses
 - Orthoses
 - Equipment
- Complications
 - **Pressure ulcers**
 - **Skin breakdown**
 - **Abscesses**
 - **In-grown hairs**
 - **Hyperhidrosis**
 - **Infection**
 - **Skin rashes**
 - **Friction injuries**

Pressure sensitive and pressure tolerant areas of the entire leg



COMMON AREAS OF PRESSURE IN A SEATED POSTURE



CASE 2



Athlete: 37 yo male Para Ice Hockey player

Disability: Traumatic Bilateral AKA

Recent Medical History:

- Phantom Limb Pain – managed with daily Methadone, Oxycontin, Neurontin, Lyrica, and Celebrex
- Chronic stump skin sore
- History of Right olecranon infectious bursitis 10yrs prior
- Left proximal medial thigh abscess – 3 weeks before travel, I&D, Linezolid transitioned to Amoxicillin (Strep A)

Presentation:

- Day 3 after arrival to Paralympic Games, while finishing Amoxicillin, developed right olecranon bursa swelling, erythema, and concern for infectious etiology. Abx switched to Keflex.



- 1 Day of Keflex, erythema and swelling improved but athlete developed significant elbow ROM restriction, limited from 90° flex to 120° extension
- Pain only mild at end range restriction, otherwise able to self propel manual wheelchair. No fever/chills/constitutional symptoms.
- POC ultrasound demonstrated both bursal swelling and presence of joint effusion
- Given improved infectious signs and minimal pain, presumed reactive synovitis, decision to: monitor, complete Keflex course
- Following day: no improvements and mild increase in discomfort, still benign exam besides ROM restriction. Still no local signs of infection or systemic symptoms.
- Due to persistence: pursued further workup - X-ray no acute findings; MRI confirming joint effusion.



- Escalated care for joint aspiration & fluid analysis – showed copious purulent fluid.
- Started on Daptomycin and Ceftriaxone.
- Washout procedure performed
- Discharged Post-op Day 1 with return of FROM and no pain
- Recommended course of Levofloxacin and Doxy
- Chose to continue Keflex with addition of Doxy
- Post-op Day 7 cleared for skating
- Post-op Day 8 played in Semi-final game
- Post-op Day 10 played in Gold Medal game





Neurologic Conditions

- Spina bifida and Chiari malformation
- **Hydrocephalus** with shunt
- **Impaired sensation and motor control**
- Hypertonia (e.g. spasticity, dystonia, athetosis)
- Ataxia
- Neurogenic bowel and bladder
- Peripheral neuropathies
- Neuromas
- **Seizures**
- Tethered cord syndrome
- Spinal stenosis
- Spinal cord syrinx
- **Impaired thermoregulation**
- Concussion



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Table 1 Examples of medical condition specific to Paralympic athletes in relation to thermoregulation

Diagnosis	Thermoregulation considerations for in-competition performance	Para sport	Reporting of heat-related illness/symptoms
Spinal cord-related disorders	<ul style="list-style-type: none"> ▶ Impairments in skin blood flow and sweat responses below the lesion level,^{24,25} reduced venous return,²⁶ and higher body fat will all contribute to increased heat storage for a given workload.²⁷ ▶ T_c typically increases continuously throughout competition, as well as passive heating²⁸ (without cooling aids), highlighting the level of thermoregulatory disruption. 	Wheelchair Rugby Para Athletics Para Archery Paratriathlon	Heat-related disorientation ²⁹ Convulsion ⁵ Heat-related fatigue ²² Heat-related illness ³⁰
Non-spinal cord-related neurological disorders	<ul style="list-style-type: none"> ▶ Greater metabolic heat production of locomotion, for a given workload, when compared with Olympic athletes.³¹ ▶ High muscular tone impairs venous return, increasing the cardiovascular strain and relative intensity of exercise.³² ▶ Impaired pace awareness may increase their risk of thermoregulatory strain.³³ ▶ Increases in body and/or environmental temperature (without cooling) can exacerbate neurological symptoms, including fatigue, in those with multiple sclerosis,³⁴ where the sudomotor response to heating is already impaired.³⁵ 	Para Athletics Paratriathlon	Heat exhaustion ⁵ Heat-related illness ⁵ Heat-related illness ³⁰
Limb deficiency	<ul style="list-style-type: none"> ▶ Display limited body surface area for evaporative and convective heat loss, increasing heat storage.³⁶ ▶ Closer coupling of T_c and T_{sk} which is further exacerbated by socket liners and prostheses limiting heat dissipation.³⁷ ▶ Skin grafts remove a portion of the skin capable of sweating and cutaneous vasodilation, augmenting the impairment in thermoregulatory capacity.³⁸ ▶ Significant gait asymmetries, elevating metabolic heat production for a given workload.³⁹ 	Para Athletics Paratriathlon	Cramps and collapse ⁵ Heat exhaustion ⁵ Heat-related illness ⁵ Heat-related illness ³⁰
Visual impairment	<ul style="list-style-type: none"> ▶ Impaired pace awareness (depending on level of visual feedback) may increase their risk of thermoregulatory strain.⁴⁰ ▶ Difficulties in self-monitoring hydration through urine colour or volume may cause issues during competition.⁴¹ ▶ Athletes with albinism are prone to sunburn in situations of high radiant load. This exacerbates thermal sensation and limits thermoregulation during exercise through a locally mediated effect on sweat gland responsiveness and capacity.⁴² 	Para Athletics Paratriathlon	Dermatological burn ⁵ Heat exhaustion ⁵ Heat-related illness ⁵ Heat-related illness ³⁰

Grobler *et al*⁵ competitive athletics taking place in wet-globe temperatures 24.6–36.0°C; Griggs *et al*²⁹ wheelchair rugby match play at 18.4–20.9°C and 31.1%–45.1% relative humidity; Handrakis *et al*²² competitive archery outdoors for 10 hours (conditions not reported); Stephenson *et al*³⁰ competitive paratriathlon in 33°C relative humidity 35%–41%. The reader is guided to Westaway *et al*⁴³ for lists of medications that can interfere with thermoregulation, dehydration and heat-related illness.

Adapted from Stephenson and Goosey-Tolfrey⁴⁴ and evidence of heat-related illness reported in Paralympic sports.^{3,16–18}

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Heat Illness - Tokyo

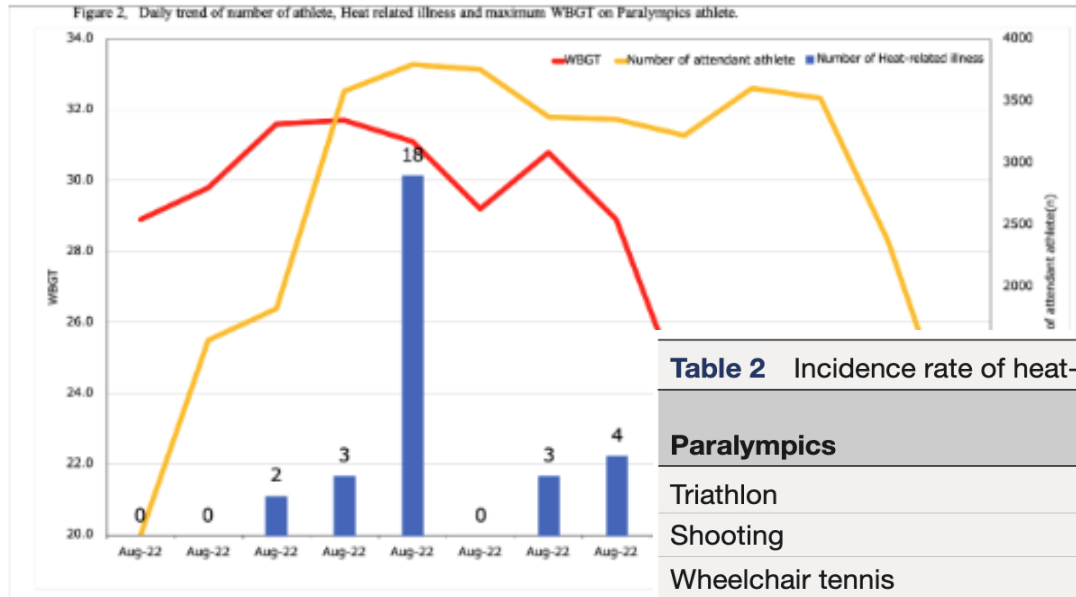


Table 2 Incidence rate of heat-related illness by sports on Paralympic Games

Paralympics	Number of heat stroke (n)	Number of persons in games	Incidence rate (%)	Incidence of 1000 athletes	OR (95% CI)
Triathlon	3	102	1.47	29.4	
Shooting	4	154	0.32	26.0	
Wheelchair tennis	2	104	0.21	19.2	
Rowing	2	108	0.62	18.5	
Athletics (track and field/marathon)	19	1144	0.17	16.6	1.81 (0.94 to 3.49)
Football 5-a-side	1	78	0.26	12.8	
Cycling	2	233	0.21	8.6	
Sitting volleyball	1	187	0.05	5.3	
Table tennis	1	278	0.04	3.6	
Swimming	1	605	0.02	1.7	
Total	36	2993	81.14	12.0	

ORs are calculated for Paralympics for athletics (track and field/marathon) versus other sports.

Figure 2 Daily trend of number of athletes, heat-related illness and maximum globe temperature.

Table 4 Patient background and risk factor of heat-related illness on Paralympics athlete

Paralympics		Total n=36 (%)	Minor degree		Moderate degree		Severe degree		P value	
			n=15 (%)		n=21 (%)		n=0 (%)			
Environment factor										
Venue zone†	Tokyo bay zone‡	10	(27.8)	4	(11.1)	6	(16.7)	0	(0.0)	0.48
	Heritage zone§	20	(55.6)	7	(19.4)	13	(36.1)	0	(0.0)	
	Other venue	6	(16.7)	4	(11.1)	2	(5.6)	0	(0.0)	
Location*	Outdoors venue	31	(86.1)	14	(38.9)	17	(47.2)	0	(0.0)	0.38
	Indoors venue	5	(13.9)	1	(2.8)	4	(11.1)	0	(0.0)	
Occurrence time†	Morning game (7:00 to 12:00)	21	(58.3)	8	(22.2)	13	(36.1)	0	(0.0)	0.90
	Afternoon game (12:00 to 18:00)	11	(30.6)	5	(13.9)	6	(16.7)	0	(0.0)	
	Evening game (18:00 to 22:00)	4	(11.1)	2	(5.6)	2	(5.6)	0	(0.0)	
WBGT (°C)*	21°C~28°C	16	(44.4)	15	(41.7)	1	(2.8)	0	(0.0)	0.0004
	28°C~	20	(55.6)	5	(13.9)	12	(33.3)	3	(8.3)	
Non-endurance sports	Shooting	4	(11.1)	2	(5.6)	2	(5.6)	0	(0.0)	
	Sitting volleyball	1	(2.8)	1	(2.8)	0	(0.0)	0	(0.0)	
	Table tennis	1	(2.8)	0	(0.0)	1	(2.8)	0	(0.0)	
Treatment factor										
	CWI	3	(8.3)	0	(0.0)	0	(0.0)	3	(8.3)	
	Intravenous injection	1	(2.8)	0	(0.0)	4	(11.1)	1	(2.8)	
	Ice towel	35	(97.2)	15	(41.7)	18	(50.0)	2	(5.6)	
	Ambulance transportation	3	(8.3)	1	(2.8)	2	(5.6)	0	(0.0)	
	Hospitalisation (<2 days)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	



Bowel & Bladder Conditions

Complications:

- Urinary tract infections
- Constipation
- Incontinence
- Increased risk of infection
 - Catheterization
 - Travel (new pathogens)

Urinary Tract Infection:

- May not be typical symptoms
- Fatigue, increased spasticity, not feeling well
- Bacteriuria common (colonization)
- WBC > 10, +leukocyte esterase
- Treatment based on prior sensitivities

Mental Health

- Increased risk of mental health issues
- Disability related to past trauma – PTSD
- Impact of injuries/illnesses on:
 - Sports participation
 - ADL's
 - Autonomy
 - Isolation/Social network
- Classification
- Athlete identity
- Special considerations for athletes with intellectual disability
- Sleep impairments (e.g. visual impairment, conditions with high risk for OSA)



Sports Concussion – Standard of Care

International Consensus Statements:

Vienna 2001

Prague 2004

Zurich 2008

Zurich 2012

Berlin 2016

Amsterdam 2022



Athlete Name: _____ ID Number: _____
 Date of Birth: _____ Date of Examination: _____ Date of Injury: _____
 Time of Injury: _____ Sex: Male Female Prefer Not To Say Other _____
 Dominant Hand: Left Right Ambidextrous Sport/Team/School: _____
 Current Year in School (if applicable): _____ Years of Education Completed (Total): _____
 First Language: _____ Preferred Language: _____
 Examiner: _____

Concussion History

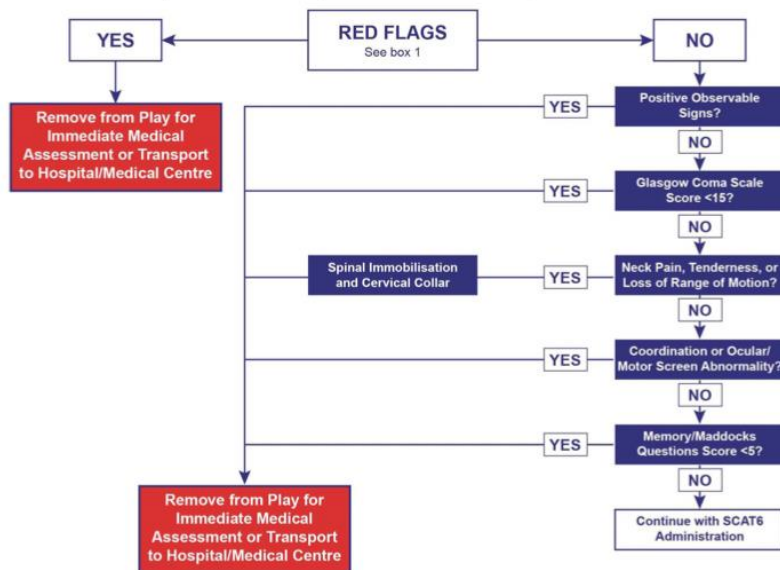
How many diagnosed concussions has the athlete had in the past?: _____
 When was the most recent concussion?: _____
 Primary Symptoms: _____
 How long was the recovery (time to being cleared to play) from the most recent concussion?: _____ (Days)

Immediate Assessment/Neuro Screen (Not Required at Baseline)

The following elements should be used in the evaluation of all athletes who are suspected of having a concussion prior to proceeding to the cognitive assessment, and ideally should be completed "on-field" after the first aid/emergency care priorities are completed.

If any of the observable signs of concussion are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by an HCP.

The Glasgow Coma Scale is important as a standard measure for all patients and can be repeated over time to monitor deterioration of consciousness. The Maddocks questions and cervical spine exam are also critical steps of the immediate assessment.



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 (M)			
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
Localized to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma Score (E + V + M)			

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

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

Step 5: Memory Assessment Maddocks Questions¹

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



Step 2: Symptom Evaluation

Baseline: Suspected/Post-injury: Time elapsed since suspected injury: mins/hours/days

The athlete will complete the symptom scale (below) after you provide instructions. Please note that the instructions are different for baseline versus suspected/post-injury evaluations.

Baseline: Say "Please rate your symptoms below based on how you typically feel with "1" representing a very mild symptom and "6" representing a severe symptom."

Suspected/Post-injury: Say "Please rate your symptoms below based on how you feel now with "1" representing a very mild symptom and "6" representing a severe symptom."

PLEASE HAND THE FORM TO THE ATHLETE

Symptom	Rating
Headaches	0 1 2 3 4 5 6
Pressure in head	0 1 2 3 4 5 6
Neck pain	0 1 2 3 4 5 6
Nausea or vomiting	0 1 2 3 4 5 6
Dizziness	0 1 2 3 4 5 6
Blurred vision	0 1 2 3 4 5 6
Balance problems	0 1 2 3 4 5 6
Sensitivity to light	0 1 2 3 4 5 6
Sensitivity to noise	0 1 2 3 4 5 6
Feeling slowed down	0 1 2 3 4 5 6
Feeling like "in a fog"	0 1 2 3 4 5 6
"Don't feel right"	0 1 2 3 4 5 6
Difficulty concentrating	0 1 2 3 4 5 6
Difficulty remembering	0 1 2 3 4 5 6
Fatigue or low energy	0 1 2 3 4 5 6
Confusion	0 1 2 3 4 5 6
Drowsiness	0 1 2 3 4 5 6
More emotional	0 1 2 3 4 5 6
Irritability	0 1 2 3 4 5 6
Sadness	0 1 2 3 4 5 6
Nervous or anxious	0 1 2 3 4 5 6
Trouble falling asleep (if applicable)	0 1 2 3 4 5 6

Do your symptoms get worse with physical activity? Y N

Do your symptoms get worse with mental activity? Y N

If 100% is feeling perfectly normal, what percent of normal do you feel?

If not 100%, why?

PLEASE HAND THE FORM BACK TO THE EXAMINER

Once the athlete has completed answering all symptom items, it may be useful for the clinician to revisit items that were endorsed positively to gather more detail about each symptom.

Total number of symptoms: of 22

Symptom severity score: of 132

Step 4: Coordination and Balance Examination (Continued)

Modified BESS (20 seconds each)

Double Leg Stance: of 10

Tandem Stance: of 10

Single Leg Stance: of 10

Total Errors: of 30

On Foam (Optional)

Double Leg Stance: of 10

Tandem Stance: of 10

Single Leg Stance: of 10

Total Errors: of 30

Note: If the mBESS yields normal findings then proceed to the Tandem Gait/Dual Task Tandem Gait.

If the mBESS reveals abnormal findings or clinically significant difficulties, Tandem Gait is not necessary at this time.

Both the Tandem Gait and optional Dual Task component may be administered later in the office setting as needed (see SCOAT6).

Timed Tandem Gait

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed. Please complete all 3 trials.

Say "Please walk heel-to-toe quickly to the end of the tape, turn around and come back as fast as you can without separating your feet or stepping off the line."

Single Task:

Time to Complete Tandem Gait Walking (seconds)				
Trial 1	Trial 2	Trial 3	Average 3 Trials	Fastest Trial
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Dual Task Gait (Optional. Timed Tandem Gait must be completed first)

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed.

Say "Now, while you are walking heel-to-toe, I will ask you to count backwards out loud by 7s. For example, if we started at 100, you would say 100, 93, 86, 79. Let's practise counting. Starting with 93, count backward by sevens until I say "stop". Note that this practice only involves counting backwards.

Dual Task Practice: Circle correct responses; record number of subtraction counting errors.

Task									Errors	Time
Practice	93	86	79	72	65	58	51	44	<input type="text"/>	<input type="text"/>

Say "Good. Now I will ask you to walk heel-to-toe and count backwards out loud at the same time. Are you ready? The number to start with is 88. Go!"

Dual Task Cognitive Performance: Circle correct responses; record number of subtraction counting errors.

Task													Errors	Time (circle fastest)	
Trial 1	88	81	74	67	60	53	46	39	32	25	18	11	4	<input type="text"/>	<input type="text"/>
Trial 2	90	83	76	69	62	55	48	41	34	27	20	13	6	<input type="text"/>	<input type="text"/>
Trial 3	98	91	84	77	70	63	56	49	42	35	28	21	14	<input type="text"/>	<input type="text"/>

Alternate double number starting integers may be used and recorded below.

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Starting Integer: Errors: Time:

Concussion in Para Sport 2021

Consensus statement



Concussion in para sport: the first position statement of the Concussion in Para Sport (CIPS) Group

Richard Weiler^{1,2,3} Cheri Blauwet^{4,5} David Clarke,⁶ Kristine Dalton⁷,
 Wayne Derman^{8,9} Kristina Fagher¹⁰ Vincent Goutteborge^{1,11}
 James Kissick^{12,13} Kenneth Lee¹⁴ Jan Lexell¹⁰ Peter Van de Vliet¹⁵,
 Evert Verhagen¹ Nick Webborn¹⁶ Osman Hassan Ahmed^{3,17,18}

KEY SCAT5 ADAPTATIONS:

- Impairment/Disability-specific SCAT5 adaptations
- Baseline testing recommended: variable nature of disability and the potential for atypical presenting signs/symptoms of concussion
- Central nervous system injury (CP, stroke) may require an extended period of initial rest
- Exertional symptom testing during recovery may require modification for PI (arm ergometry vs. treadmill/stationary bike)
- RTS protocols must be tailored and include the use of the individual's personal adaptive equipment or VI guide

STEP 1 ATHLETE BACKGROUND		
Hospitalization for a head injury?		Increased risk
Headache disorder or migraines?		Increased risk
Learning disability / dyslexia?		Increased risk
ADD / ADHD?		Increased risk
Depression, anxiety or other psychiatric disorder?		Increased risk
STEP 2 SYMPTOM EVALUATION	The athlete should be given the symptom form and asked to read this instruction paragraph out loud, and then complete the symptom scale	
Symptom form with instructions		Consider if accompanying person required/modify descriptive words
Headache		Increased risk
"Pressure in head"		Increased risk
Neck pain		Consider baseline
Nausea or vomiting		Increased risk
Dizziness		Increased risk
Blurred vision		Increased risk
Balance problems		Increased risk
Sensitivity to light		Increased risk
Sensitivity to noise		Increased risk
Feeling slowed down		Increased risk
Feeling like "in a fog"		Increased risk
"Don't feel right"		Increased risk
Difficulty concentrating		Reflect on values over time
Difficulty remembering		Reflect on values over time
Fatigue or low energy		Increased risk
Confusion		Increased risk
Drowsiness		Increased risk
More emotional		Increased risk
Irritability		Increased risk
Sadness		Increased risk
Nervous or anxious		Increased risk
Trouble falling asleep		Increased risk
Symptoms get worse with physical activity?		Increased risk
Symptoms get worse with mental activity?		Increased risk
If 100% is feeling perfectly normal, what percent of normal do you feel?		Increased risk
STEP 3 COGNITIVE SCREENING		
ORIENTATION	Month	Increased risk
Today's date	Increased risk	
Weekday	Increased risk	
Current year	Increased risk	
Current time (within 1 hour)	Increased risk	
IMMEDIATE MEMORY	Repeat as many words as possible from a read list	Can tester interpret/LD association
CONCENTRATION – Digits backwards	Repeat a string of numbers	Can tester interpret/LD association
Repeat a string of numbers in reverse order	Can tester interpret/LD association	
MONTHS IN REVERSE ORDER	Tell the months of the year in reverse order	Can tester interpret/LD association
STEP 4 NEUROLOGICAL SCREEN	Read out loud and follow instructions without difficulty	Increased risk
Full range of pain-free PASSIVE cervical spine movement	Comparative to baseline	
(fixed head) Look side-to-side and up-and-down	Increased risk	
Performs finger nose coordination test normally	Hand function may be affected	
Performs tandem gait normally	Leg function may be affected	
BALANCE EXAMINATION	Double leg stance	Increased risk
Modified Balance Error Scoring System (mBESS) testing	Single leg stance (non-dominant foot)	Increased risk
Tandem stance (non-dominant foot at back)	Increased risk	
STEP 5 DELAYED RECALL	Repeat as many words as possible from the previously read list (step 3)	Consider association with learning disability



Post EG, et al. Advancing concussion assessment for para sport athletes through the Para SCAT6 initiative. *Br J Sports Med*. Published Online First: 10 February 2026.

- SCAT6 neither adapted nor validated for Para sport
- Some components can be either not applicable or possible for some Para athletes
 - Example: mBESS for athlete with lower body impairment who uses a WC as primary mobility
- CIPS highlighted the need and identified components that shouldn't be used or need modifications, but no recommendations on adaptations
- Para SCAT6-WC Initiative:
 - Develop modified SCAT6 for WC users through collaborative process with subsequent validation and reliability assessments
 - Provide framework for further development of Para concussion assessment tools
 - Priorities – VI, limb deficiencies, II, pediatrics

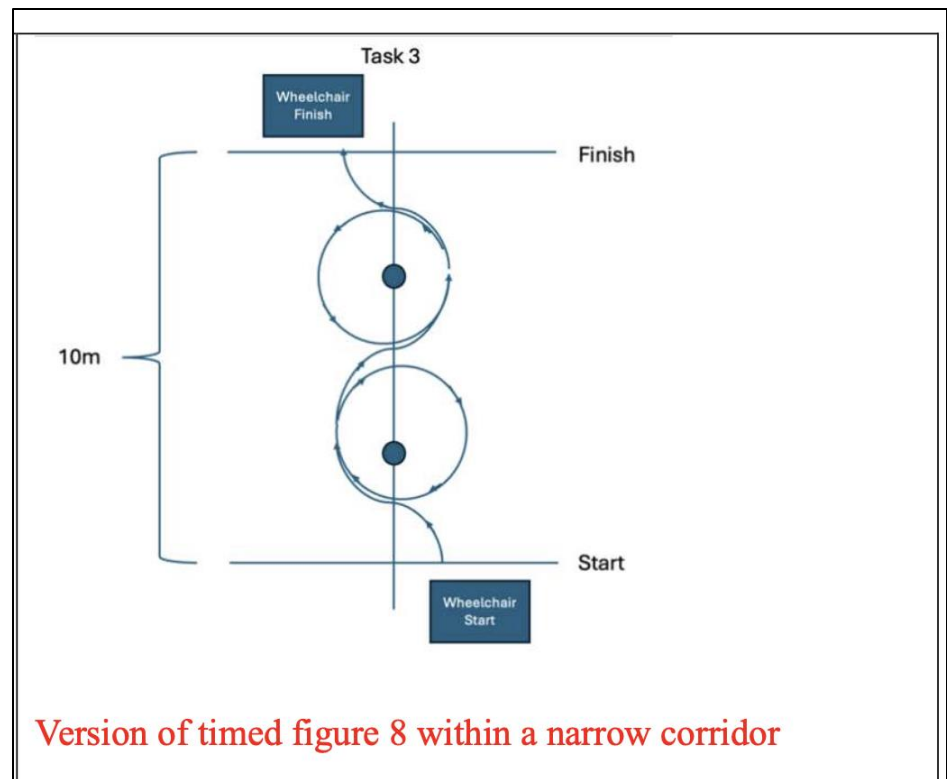
Para SCAT6-WC Suggested Modifications Table

Step/Item – SCAT6 Version	Suggested Modification – Para SCAT6-WC
On Field Assessment	
Box 1: Red Flags	
Neck pain or tenderness	<i>Atypical and new onset of neck pain or tenderness</i>
Seizure or convulsion	
Double vision	<i>Atypical and new onset of double vision</i>
Loss of consciousness	
Weakness or tingling/burning in more than 1 arm or in the legs	<i>Atypical and new onset of weakness or tingling/burning in more than 1 arm or in the legs</i>
Deteriorating conscious state	

Step 5: Coordination and Balance Exam	
mBESS: Double-leg stance	<i>WESS seated firm condition-eyes open</i>
mBESS: Tandem stance	<i>WESS seated firm condition-eyes closed</i>
mBESS: Single leg stance	<i>WESS seated balance disc condition-eyes open</i>
mBESS: Double-leg stance on foam (optional)	<i>WESS seated balance disc condition-eyes closed</i>
mBESS: Tandem stance on foam (optional)	<i>WESS wheelie condition – eyes open</i>
mBESS: Single leg stance on foam (optional)	<i>WESS wheelie condition – eyes closed</i>

Step 1: Observable signs	
Lying motionless on playing surface	<i>Sitting motionless or unresponsive in or out of chair</i>
Falling unprotected to the surface	<i>Slumping in chair or otherwise unable to protect themselves from contact with playing surface/equipment</i>
Balance/gait difficulties, motor incoordination, ataxia: stumbling, slow/laboured movements	<i>Atypical and new onset of visible motor incoordination, including slow/laboured movements</i>

Balance problems	<i>Atypical and new onset of instability or unsteadiness</i>
Sensitivity to light	<i>Atypical and new onset of “</i>
Sensitivity to noise	<i>Atypical and new onset of “</i>
Feeling slowed down	<i>Atypical and new onset of “</i>
Feeling like “in a fog”	<i>Atypical and new onset of “</i>
“Don’t feel right”	<i>“I don’t feel like myself”</i>
Difficulty concentrating	<i>Atypical and new onset of “</i>
Difficulty remembering	<i>Atypical and new onset of “</i>



Adaptive & Para Athletes - Final Important Points

- Overall, majority of Paralympic athlete injury and illness type is similar to Olympic athletes but with increased incidence
- Don't forget about medical conditions athletes may have that are not Paralympic sport eligible
 - Chronic pain, rheumatologic, endocrine, hypermobility, cardiac
- Medical risks can be increased and disability/impairment-specific, or unique to sport
- Many athletes have more than one eligible impairment
- Shoulder health in wheelchair athletes
 - Complicates care and has increased implications outside of sport
- Knowing an athlete's medical history and baseline is critical



Thank You

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Resources

- BJSM Live: Para + Adaptive Sports Medicine Webinar: <https://bjsmlive.bmj.com/para-and-adaptive-sports-medicine/>
- Adaptive Sports Medicine Textbook (DeLuigi, 2nd ed): <https://link.springer.com/book/10.1007/978-3-031-44285-8>
- Concussion in Para Sport: First Position Statement of the Concussion in Para Sport (CIPS) Group: <https://pubmed.ncbi.nlm.nih.gov/33837003/>
- Concussion Management for Wheelchair Athletes Textbook: <https://link.springer.com/book/10.1007/978-3-030-83004-5>
- Become a Classifier for Para Sports: <https://www.teamusa.org/Team-USA-Athlete-Services/Paralympic-Sport-Development/Eligibility-Information/Become-a-classifier>
- Move United: <https://www.moveunitedsport.org/>
- Challenged Athletes Foundation: <https://www.challengedathletes.org/>

Resources

- Abilities Expo: <https://www.abilities.com/>
- US Paralympics / Team USA: <https://www.teamusa.org/team-usa-athlete-services/paralympic-sport-development>
- International Paralympic Committee: <https://www.paralympic.org/>
- American Academy for Cerebral Palsy and Developmental Medicine Adapted Sports Journal Article Digest: <https://www.aacpdm.org/resources/adapted-sports-journal-digest>
- “Rising Phoenix” (Netflix Documentary)
- “Murderball” (Movie)
- Stella Young: I'm not your inspiration, thank you very much (TED Talk)

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Ask Me Anything.....



Dr. David Kruse



Gabby Leveratto, ATC



Chris Meinhold, PT



Jim Herkimer, PT, ATC

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Questions

- Share with us the one tip, trick, shortcut, nugget that you think we should know.
- How big is the risk if we push an ACLR patient too soon too hard?
- How do we engage local physicians to participate in mass sports physical at the secondary school level? More and more physicians are opting out due to liability concerns
- Can you discuss the role of PRP to accelerate healing in a return to sport strategy?

2025 Sports Medicine Symposium

CME Activity ID Code : **27310**

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