The Orthopaedic Institute at St. Elizabeth: A partnership between OrthoCincy Orthopaedics & Sports Medicine, St. Elizabeth Physicians and St. Elizabeth Healthcare.

2021 SPORTS MEDICINE CONFERENCE

The Webinar will begin shortly

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2021 SPORTS MEDICINE CONFERENCE

ACL INJURY PREVENTION PROGRAM OVERVIEW & RESEARCH UPDATE

Kathy Boehmer PT, ATC

OrthoCincy Orthopaedics & Sports Medicine | St. Elizabeth PHYSICIANS | St. Elizabeth HEALTHCARE

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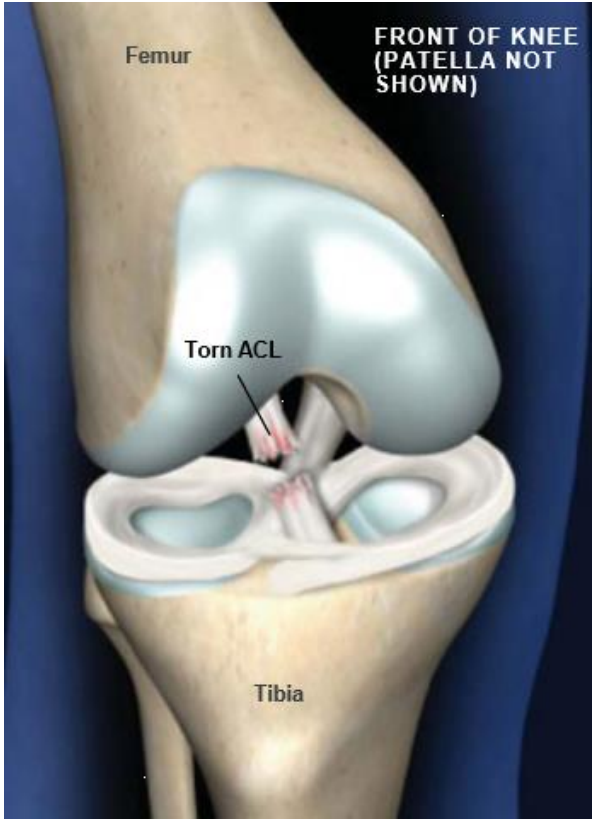
ACL INJURIES

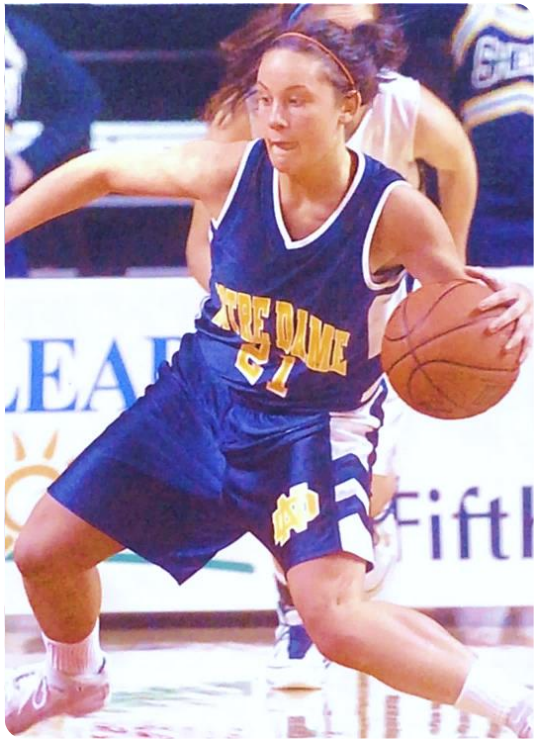
Statistics

- Approximately **250,000** ACL reconstructions are performed each year in the US
- 50% of ACL injuries are in the 15 to 25-year-old age group
- 75-80% of ACL injuries are non-contact related
- Female athletes are **~5-7 times more likely** to experience a serious knee injury or ACL tear than male athletes



ACL INJURIES

Statistics



- High school female athletes have a **1 in 100** chance of tearing their ACL
- Female college athletes have a **1 in 10** chance of tearing their ACL during their collegiate career
- Patients who have a primary ACL injury **are twice as likely** to tear the contralateral ACL
- Highest incidence of ACL tears occurs in soccer, volleyball, football and basketball, but is evident in all sports

RESEARCH UPDATE

Systematic Review with Meta-Analysis

- Petushek et al reviewed 18 studies, with a total of 27,231 participants, 347 sustaining an ACL injury[1]

Findings:

- ACL Injury Prevention Programs (IPP) reduced the risk for ACL injury from 1 in 54 to 1 in 111

Recommendations:

- Target younger athletes
- Incorporate neuromuscular control exercises
- Use trained personnel who incorporate lower body strength exercises (i.e. Nordic hamstrings, lunges, calf raises)
- Focus on landing stabilization (jump/hop and hold)

RESEARCH UPDATE

Meta-Analysis of Meta-Analyses

- Attar and Alshehri performed a systematic review to meta-analyze the existing meta-analyses the effectiveness of the FIFA 11 injury prevention programs[2]
- Five databases for the period of January 1990 through July 2018

Findings:

- Evidence supporting a 34% reduction for all injuries and a 29% reduction for injuries to the lower limbs
- Evidence that the risk of injuries while playing **soccer** is reduced as a result of FIFA's injury prevention programs

RESEARCH UPDATE

Systematic Review with Meta-Analysis

- Huang et al reviewed 5 electronic scientific databases to identify studies testing the efficacy of ACL injury prevention programs[3]

Findings:

- Significant reduction in ACL injury rates (53%) when athletes participated in IPPs

Recommendations:

- ACL IPPs may be designed within an overarching best-practice framework
- Plyometric, strengthening, agility, proper landing technique

ACL INJURY PREVENTION PROGRAM

What is an ACL Injury Prevention Program?

- ACL injury prevention programs work to **improve how an athlete moves** in order to help prevent injury
- Focus is on the **technique and skill**
- Training can take place year round
  - ✓ Pre-season program
  - ✓ In-season “maintenance” program

ACL INJURY PREVENTION PROGRAM

When Should You Start?

- Training is most beneficial if athletes begin at a younger age[4]
- “Younger athletes will have greater improvements in body mechanics than the teenagers”
- Continue the program yearly until the athlete is skeletally and muscularly mature

ACL INJURY PREVENTION PROGRAM

Five Components

1. Dynamic/Functional Warm Up
2. Neuromuscular Balance
3. Jump Training/Landing Specialization
4. Plyometrics
5. Strengthening

ACL INJURY PREVENTION PROGRAM

Dynamic/Functional Warm-Up

- A **series of movements** that involve dynamic activities and sport-specific movements
  - ✓ Maximize active ranges of motion
  - ✓ Prepare the body for the demands of sports training and competition

- If completed properly the functional warm-up may enhance athletic performance and decrease the risk of injury.

ACL INJURY PREVENTION PROGRAM

Dynamic/Functional Warm-Up

ACL INJURY PREVENTION PROGRAM

Neuromuscular Balance

- Poor balance and control has been linked to increased lower extremity injury[1]
- Neuromuscular balance exercises involve **multiple joints and muscle groups** performed in functional weight-bearing positions
- Activate the **nervous system** to challenge your body
- Emphasize on the **quality and efficiency** of movement, as well as the **alignment** of the trunk and lower limb joints

ACL INJURY PREVENTION PROGRAM OVERVIEW

Neuromuscular Balance

Beginner

- Single leg balance
- Single leg balance “clock”
- Single leg balance with ball toss

SINGLE LEG BALANCE CLOCK

ACL INJURY PREVENTION PROGRAM OVERVIEW

Neuromuscular Balance

Intermediate

- Single leg balance on an unstable surface
- Single leg balance “clock” on an unstable surface
- Single leg squat

SINGLE LEG BALANCE ON UNSTABLE SURFACE

ACL INJURY PREVENTION PROGRAM OVERVIEW

Neuromuscular Balance

Advanced

- Single leg balance on unstable surface with ball toss
- Single leg squat on unstable surface
- Lateral bound

SINGLE LEG SQUAT ON UNSTABLE SURFACE

ACL INJURY PREVENTION PROGRAM

Jump Training/Landing Stabilization

- Singh et al reported that faulty mechanics during dynamic movement that cause excessive valgus force at the knee increases the risk of ACL injury[5]
- Faulty mechanics may be a result of lateral displacement of the trunk, unequal limb loading, and lack of control to avoid the valgus knee position
- Altered movements that place the ACL at risk are best identified in a fatigued state
- The faulty movement patterns are modifiable and should be addressed in an injury prevention program

ACL INJURY PREVENTION PROGRAM

Jump Training/Landing Stabilization

OPTIMAL POSITION

- Kneecaps facing forward and in line with your hips and feet
- Knees and hips flexed to allow your muscles to “**absorb”** the forces of jumping and landing
- Land “**softly**”

ACL INJURY PREVENTION PROGRAM

Jump Training/Landing Stabilization

Beginner

- Double leg box drop
- Single leg box drop
- Double leg side to side hop

ACL INJURY PREVENTION PROGRAM

Jump Training/Landing Stabilization

Intermediate

- Double leg box drop - jump
- Single leg box drop–lateral hop (opposite side)
- Single leg side to side hop

ACL INJURY PREVENTION PROGRAM

Jump Training/Landing Stabilization

Advanced

- 90º single leg hops
- Single leg drop-jump-single leg hop
- Skaters

SKATERS

ACL INJURY PREVENTION PROGRAM

Plyometrics

- Plyometric exercises are powerful aerobic exercises used to increase your speed, endurance, and strength
- They require you to exert your muscles to their maximum potential in short periods of time
- Challenge your nervous system

ACL INJURY PREVENTION PROGRAM

Plyometrics

Beginner

- Alternating step/box taps
- Broad jump
- Single leg forward and backward line hop

ACL INJURY PREVENTION PROGRAM

Plyometrics

Intermediate

- Jumping lunges
- Repeated tuck jumps
- Single leg hops

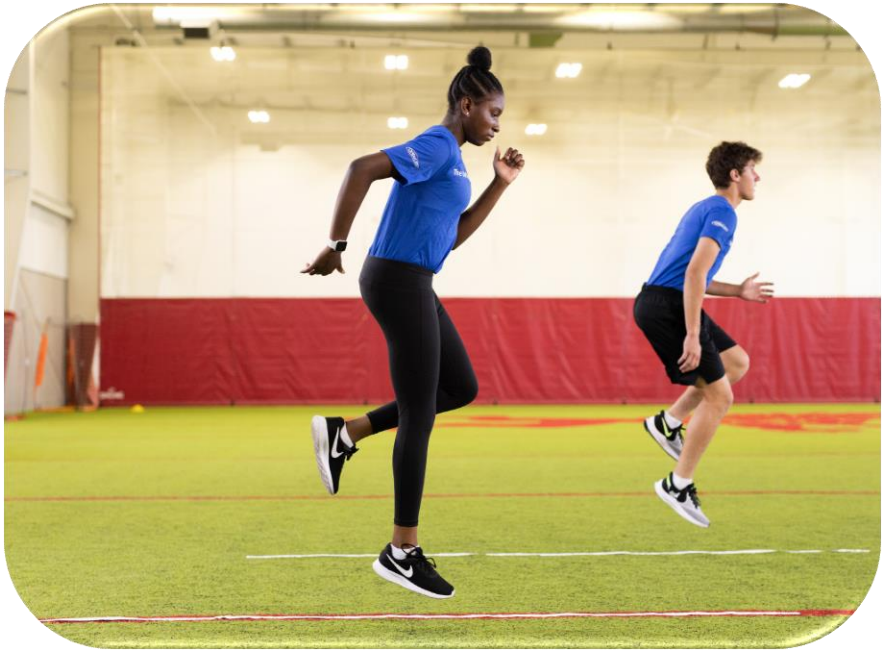
TUCK JUMPS

ACL INJURY PREVENTION PROGRAM

Plyometrics

Advanced

- Single leg vertical hop
- Single leg zig zag bounding
- 180° jump lunges



Strengthening

Why is it important?

Strength – Muscle weakness is a **modifiable risk factor**, specifically weak gluteus medius, gluteus minimus, quadriceps, hamstrings and hip abductor muscles[6]

- ✓ Weakened quadriceps may decrease knee flexion control
- ✓ Weak hamstrings and hip abductors may lead to an increased valgus load on the knee
- ✓ Weak core musculature will lead to decreased trunk stability and/or lateral pelvic movement

ACL INJURY PREVENTION PROGRAM

Strengthening

Squat

Single Leg Heel Raise

Nordic Hamstring

ACL INJURY PREVENTION PROGRAM

Strengthening

Forward Lunge

Lateral Lunge

ACL INJURY PREVENTION PROGRAM

Strengthening

Push up

Side Plank

Modified Side Plank w/ Hip Abduction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ACL INJURY PREVENTION PROGRAM

A → **Accentuate Balanced Body Motion**

C → **Control Limb Rotation**

L → **Land With Bent Hip and Knee**

Singh and Verma DPT

COVID-19 ILLNESS AND RETURN TO EXERCISE

Dr. Mike Miller

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COVID-19 PANDEMIC TIMELINE

- **December 2019**: First case confirmed in Wuhan, China
- **January 20, 2020**: First reported US case (Washington State)
- **February 6, 2020**: First reported American death

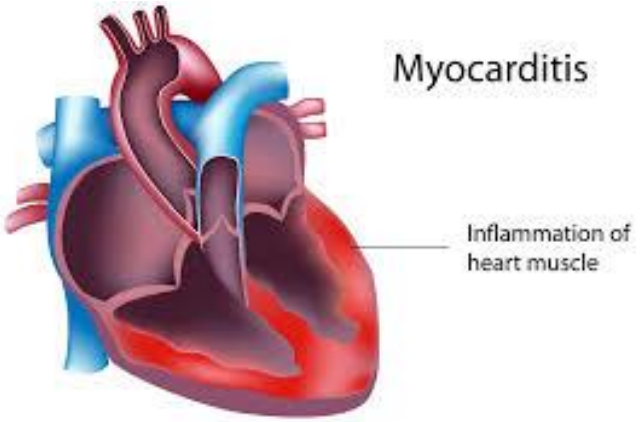
COVID-19 PANDEMIC

The Journey Back to Sports

- The most significant disruption to the worldwide sporting calendar since World War II
- The 2020 Summer Olympics in Tokyo were rescheduled to 2021
- March 12, 2020: NCAA cancelled “March Madness”
- April 21, 2020: KHSAA cancelled spring sports
- August 24, 2020: KHSAA approves Fall sports to begin practice

RETURNING TO SPORTS

- Early in the COVID-19 pandemic, there was a growing concern for possible COVID-19 induced myocarditis
- Myocarditis is the 3rd leading cause of sudden cardiac death (SCD) among high school and college athletes
- Prior to the COVID-19 pandemic, myocarditis accounted for 7-20% of SCD in young athletes



COVID-19 AND MYOCARDITIS

416 patients hospitalized in the initial outbreak in Wuhan, China:

- 84 (19.7%) had “myocardial involvement”, suggesting that cardiac injury is a common condition in COVID-19
- Hospitalized patients (very ill)
- Older patients (median age 74)
- More comorbidities

COVID-19 AND MYOCARDITIS IN ATHLETES

A cardiac MRI study of 26 Ohio State athletes found:

- Four (4) athletes (15%) had cardiac MRI findings “suggestive of myocarditis”
- Eight (8) athletes (30%) had late gadolinium enhancement (LGE) “suggestive of prior myocardial injury”

Study concerns:

- No control population
- We don’t have good normative cardiac MRI data in young athletes
- Difficult to differentiate scarring from artifact on LGE imaging

COVID-19 AND MYOCARDITIS IN ATHLETES

- A recent study out of the University of Wisconsin reviewed cardiac MRIs on 145 student athletes after COVID-19 infection:
  - Only 2 (1.4%) had findings consistent with myocarditis

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

The following guidelines are intended for:

- Patients ≤ 18 years of age
- Previously tested positive for COVID-19

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

Mild Illness:

- < 4 days of fever (> 100.4˚F)
- Mild, self limiting fatigue
- Mild cough with no shortness of breath or chest pain
- Mild URI (sore throat, congestion), or GI (nausea, vomiting or diarrhea) symptoms
- Headache
- Loss of taste or smell

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

Moderate Illness:

- ≥ 4 days of fever (> 100.4˚ F)
- Significant fatigue and myalgias
- Significant cough with shortness of breath and chest pain
- Non-ICU inpatient stay
- No evidence of Multisystem Inflammatory Syndrome in Children (MIS-C)

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

Severe Illness:

- Lethargy
- Pneumonia with hypoxia
- ICU stay and/or intubation
- MIS-C diagnosis in children

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

Asymptomatic/mild illness:

1. Ten (10) day isolation and rest from exercise (Symptom free/afebrile 24 hours off meds)
2. Physician H&P with emphasis on cardiopulmonary system
3. IF H&P normal, no cardiac testing recommended
4. Written clearance to begin a gradual return to play

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

KMA Committee on Sports Medicine: **Return to Activity (RTA) Protocol After COVID-19 Infection**
Any return to play should be preceded by a gradual and progressive return to physical exertion. Athletes should complete the progression below without the development of cardiopulmonary symptoms (chest pain, chest tightness, palpitations, shortness of breath, excessive fatigue, lightheadedness, pre-syncope, or syncope). Monitor the student-athlete closely for the development of any symptoms during this active progression. If any symptoms develop, the athlete should stop exertion immediately and be referred back to the evaluating physician for consideration of additional evaluation, including cardiology consultation, before resuming activity.
• **Step 1: (2-Days Minimum)** Light activity (walking, jogging, stationary bike) for 15 minutes or less at intensity no greater than 70% of maximum heart rate. NO resistance training
• **Step 2: (1-day minimum)** Add simple movement activities (For example, running drills) for 30 minutes or less at intensity no greater than 80% of maximum heart rate
• **Step 3: (1-day minimum)** Progress to more complex training for 45 minutes or less at intensity no greater than 80% maximum heart rate. May add light resistance training.
• **Step 4: (2-days minimum)** Normal training activity for 60 minutes or less at intensity no greater than 80% maximum heart rate
• **Step 5: Return to full activity**
**RTA Protocol adapted from Elliott N, et al. Infographic. British Journal of Sports Medicine, 2020.*

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

Moderate illness:

1. Ten (10) day isolation (Symptom free/afebrile 24 hours off meds)
2. Physician H&P with cardiopulmonary emphasis
3. American Academy of Pediatrics recommends referral to a pediatric cardiologist for additional work-up as indicated (HS-Troponin, ECG, Echocardiogram, Holter, Exercise stress test, or cardiac MRI)
4. If cardiac work-up is negative, written clearance for gradual return to play is required. The student athlete must be symptom free for ten (10) days before beginning their gradual return.
5. If cardiac work-up is positive, the athlete must be cleared by a pediatric cardiologist before their gradual return to play.

RETURN TO ACTIVITY AFTER COVID-19 GUIDELINES

Severe illness:

1. Will typically already be working with pediatric cardiologist
2. Will likely involve extensive testing and rest up to 3-6 months
3. Must have written clearance by pediatric cardiologist
4. Gradual return to play will be extended

COVID-19 ILLNESS AND ATHLETICS RETURN TO PLAY

Summary:

- Education of athletes, parents, and coaches is critical
- Most young athletes will recover uneventfully
- Most will not require cardiac testing
- Gradual return to play is key, monitoring for exercise intolerance

COVID-19 ILLNESS AND ATHLETICS RETURN TO PLAY

AED availability/accessibility & Review emergency action plan (EAP)

WHAT IS YOUR PLAN?

CARTILAGE REPAIR AND TRANSPLANTATION

Dr. Adam Metzler

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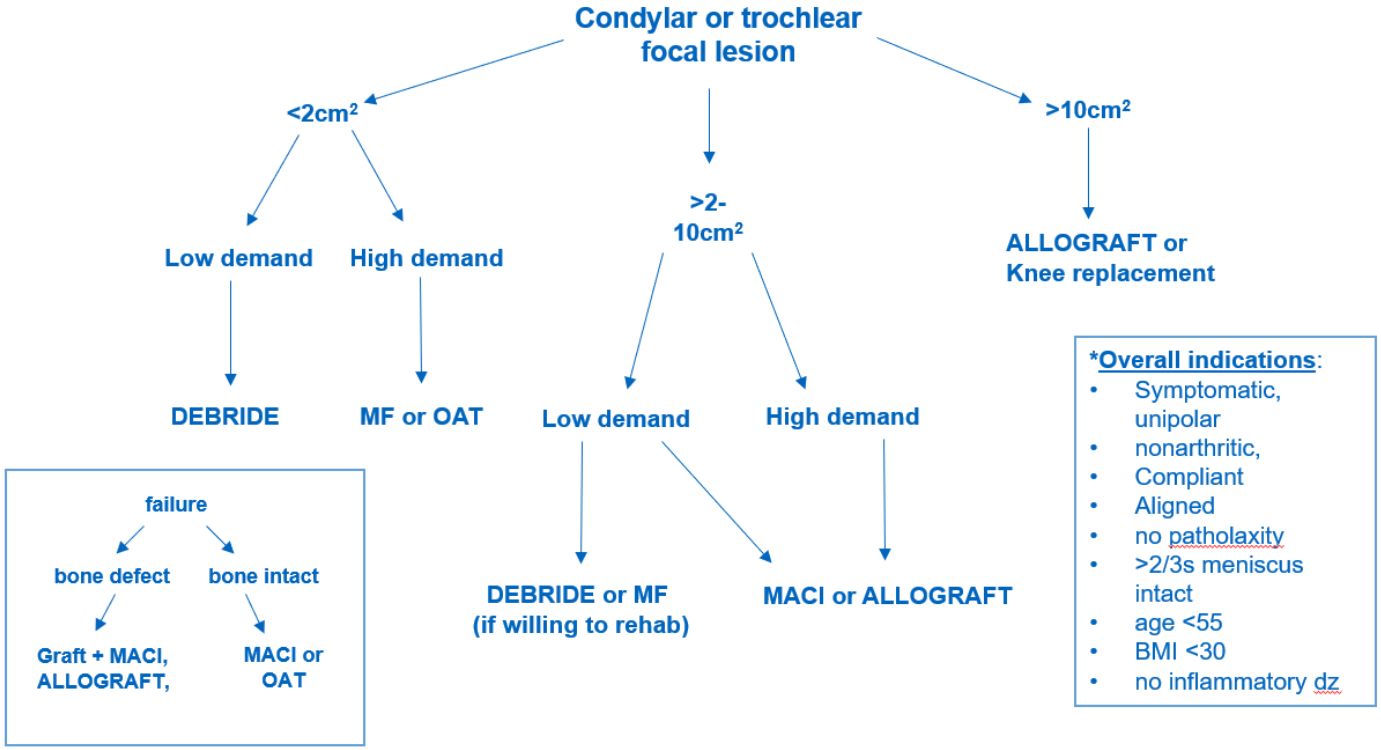
QUESTIONS TO ANSWER

- Should I treat this lesion, in this patient?
- Is the lesion symptomatic?
- How large of a defect should I address?
- How should I address it?
- Will my technique provide a durable repair?

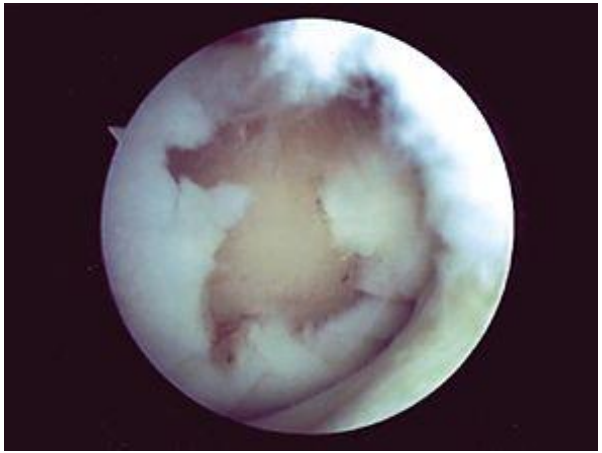
CARTILAGE REPAIR AND TRANSPLANTATION



CARTILAGE REPAIR AND TRANSPLANTATION

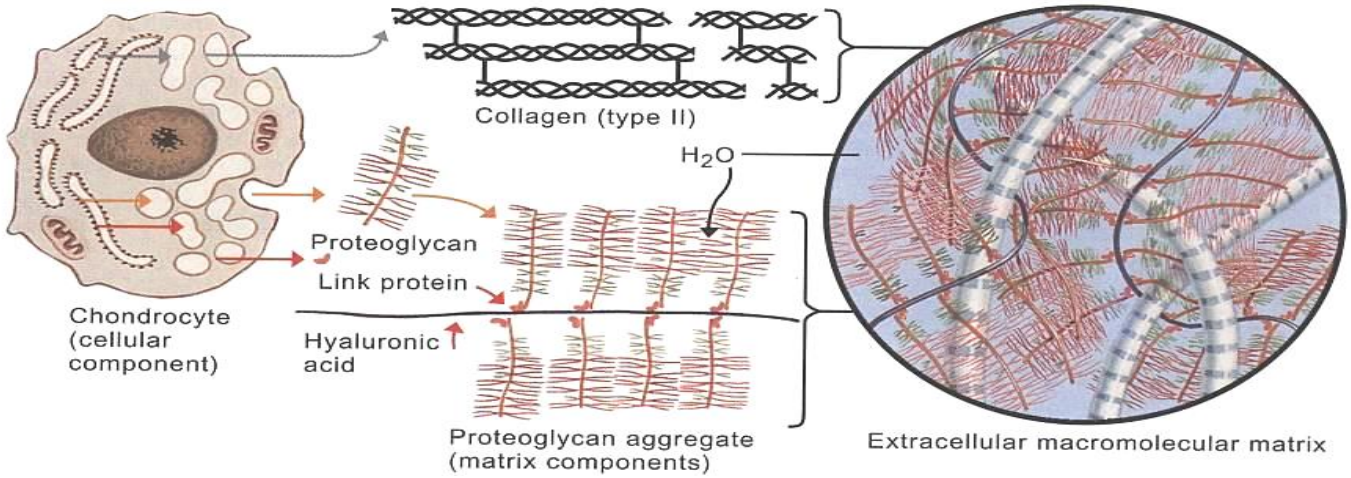
William Hunter 1743

"From Hippocrates to present age, it is universally allowed that ulcerated cartilage is a troublesome thing and that once destroyed, is not repaired."

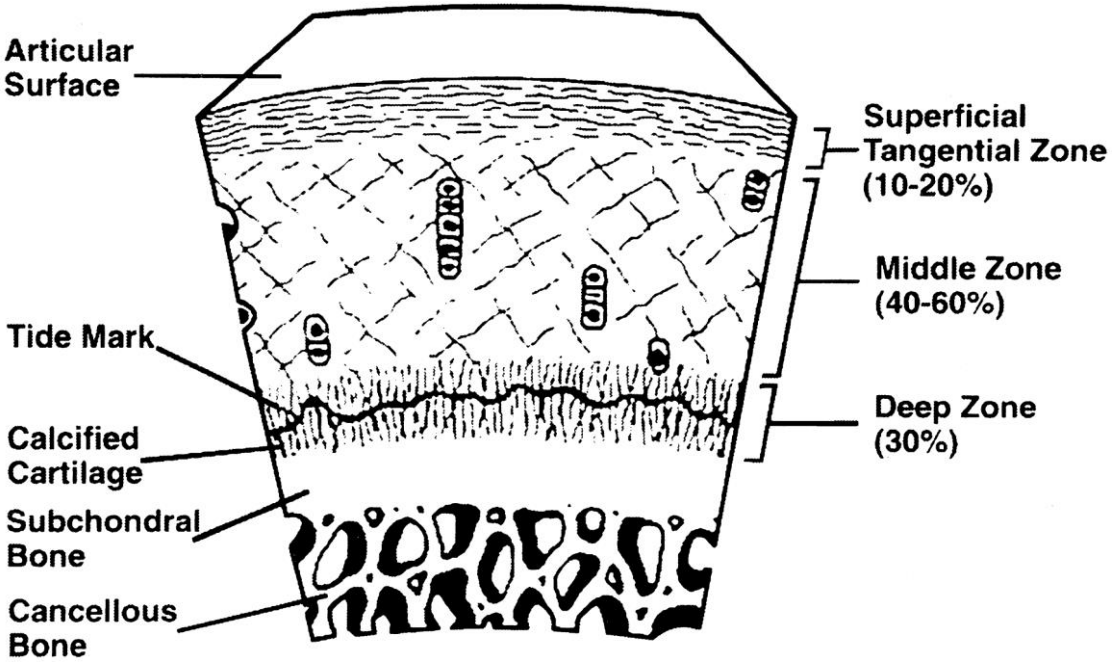


HYALINE CARTILAGE

- **Water**: 80% of total weight
- **Type 2 Collagen**: 90% of total collagen, tensile strength
- **Proteoglycans**: account for 10% weight, compressive strength



HYALINE CARTILAGE



CARTILAGE REPAIR AND TRANSPLANTATION

Causes of Cartilage Injury

- Sports
- Trauma – MVC, etc.
- OCD – juvenile form
- Iatrogenic – “resident factor”

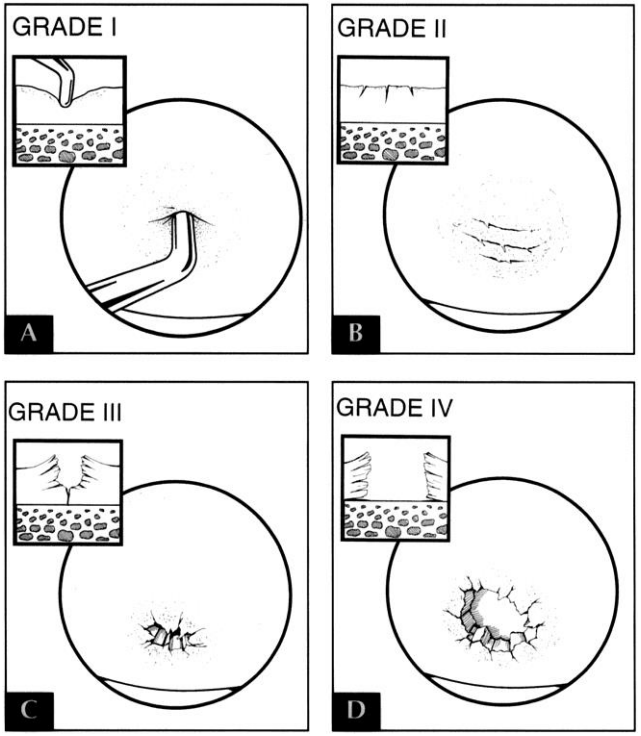
Prevalence

- Cartilage injuries occur frequently
- 20 – 60% of knee arthroscopies reveal focal chondral or osteochondral defects

CARTILAGE REPAIR AND TRANSPLANTATION

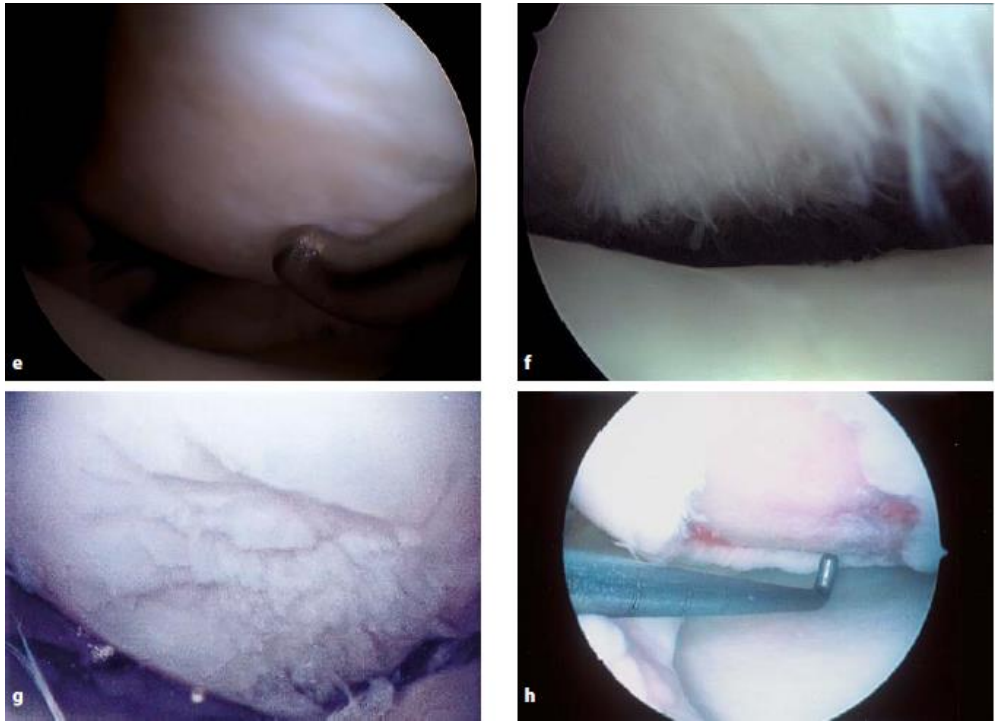
Outer bridge Classification

1. Softening, blistering (A)
2. Partial surface fissuring (B)
3. Full thickness fissuring (C)
4. Full thickness lesion with exposed subchondral bone (D)



CARTILAGE REPAIR AND TRANSPLANTATION

Outer bridge Classification



CARTILAGE REPAIR AND TRANSPLANTATION

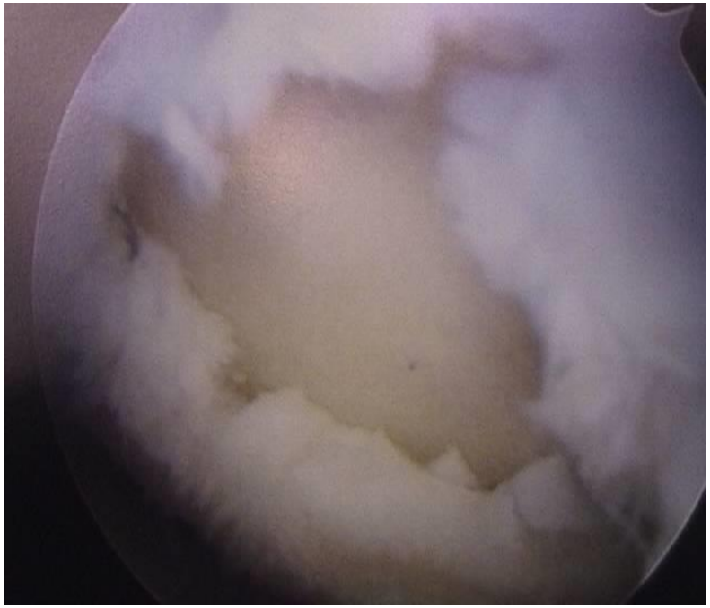
Symptoms of Articular Cartilage Injury

- Swelling
- Catching / Clicking / Locking
- Instability
- Pain
  - Can cause significant disability in relatively young patients.
  - Limit employment, sports participation, and activities of daily living.

ARTICULAR CARTILAGE INJURY

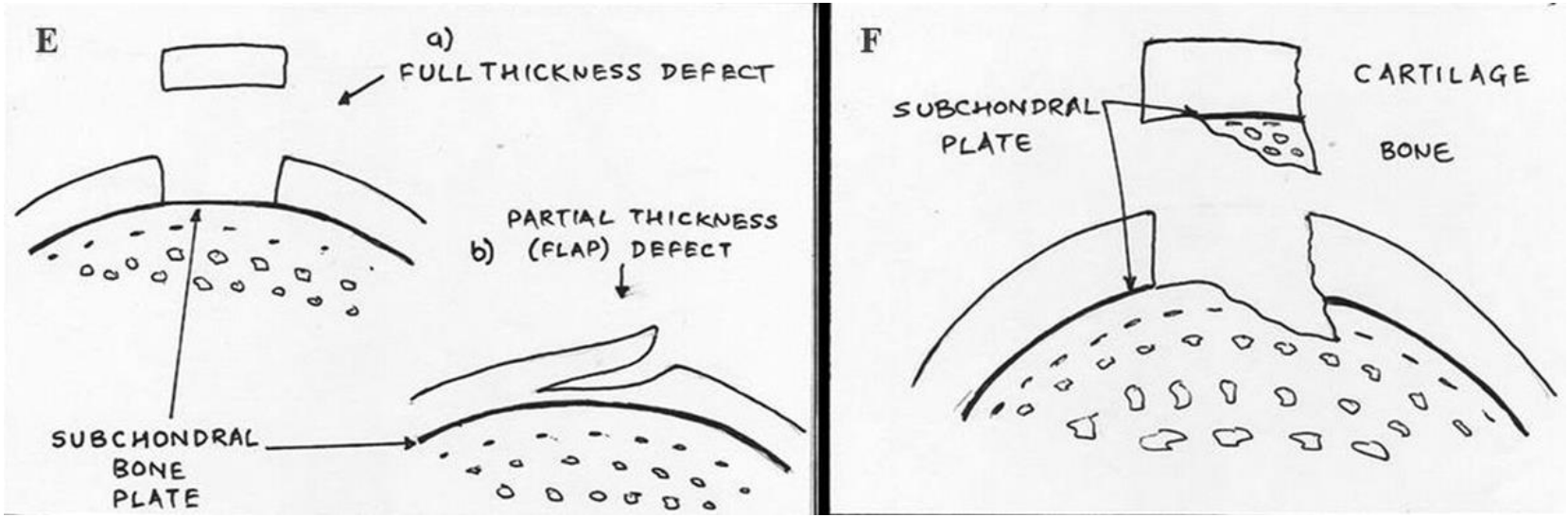
What's the Problem?

- Poor vascularity – minimal healing potential
- Nutrients delivered via diffusion from synovial fluid
- Adult chondrocytes do not migrate or replicate to fill defects after about age 12 – 14



ARTICULAR CARTILAGE INJURY

Subchondral plate must be penetrated to allow for stimulation of cartilage repair.



ARTICULAR CARTILAGE INJURY

- Repair cartilage is mostly fibrocartilage (type 1)
- Fibrocartilage cannot restore the ultrastructural anatomy or biochemical properties of hyaline cartilage
  - Poor wear characteristics
  - Lacks longevity

CARTILAGE REPAIR AND TRANSPLANTATION

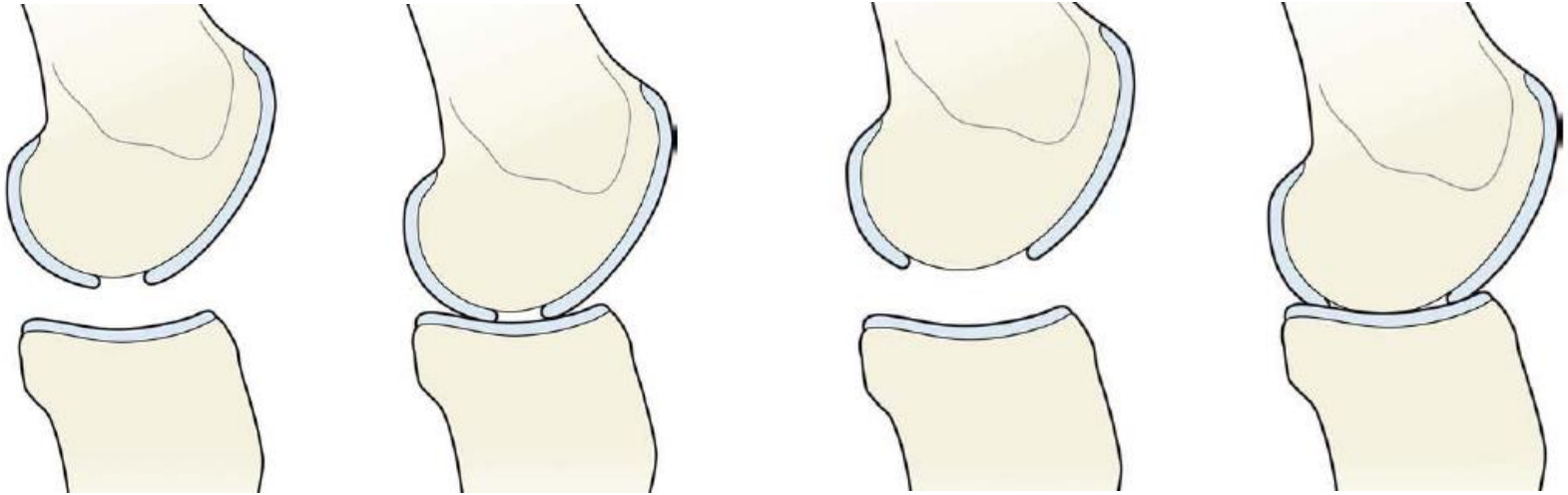
Considerations

- Age
- BMI
- Location
- Size (cm^2)
- Previous surgery
- Depth
- Limb alignment
- Joint stability
- Associated injuries
- Patient demands
- Future surgeries

CARTILAGE REPAIR AND TRANSPLANTATION

Size Matters

Defects <1 cm in diameter are less likely to affect stress distribution on the subchondral bone, and probably will not progress.



CARTILAGE REPAIR AND TRANSPLANTATION

Aims of Cartilage Surgery

- Restore joint function
- Pain relief
- Maintain or return to higher level activities

Ultimate Goal:

- Restoration of hyaline or hyaline like cartilage
- If not possible, fibrocartilage repair

CARTILAGE REPAIR AND TRANSPLANTATION

Treatment Options for Cartilage Defects

Palliation

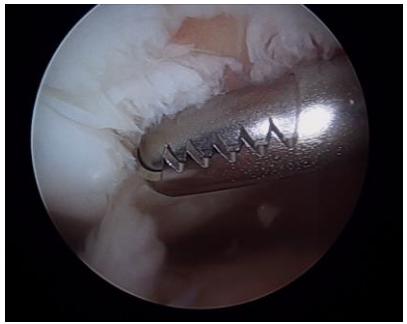
- Chondroplasty Debridement

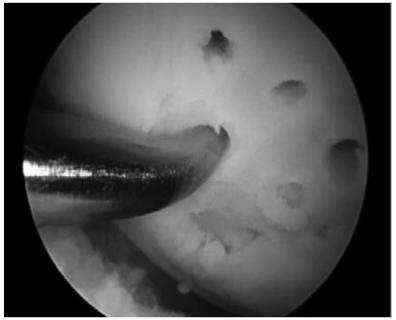
Repair

- Drilling
- Microfracture
- Microfracture Augmentation

Restoration

- Autologous chondrocyte implantation (ACI)
- Osteochondral autograft transfer (OAT)
- Osteochondral allograft (OCA)
- Particulated juvenile articular cartilage (PJAC)





CARTILAGE REPAIR AND TRANSPLANTATION

Microfracture

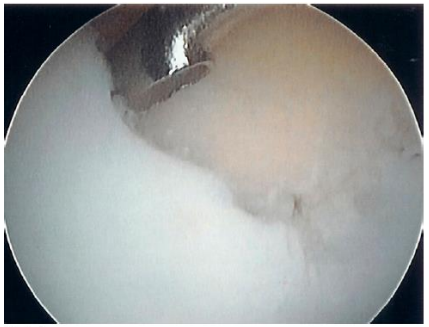


Fig. 1-A

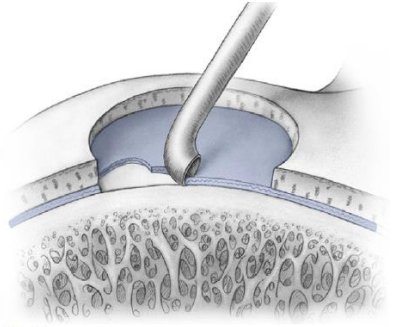
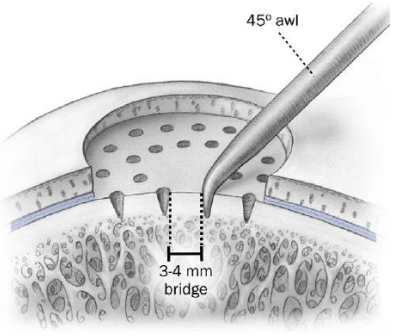
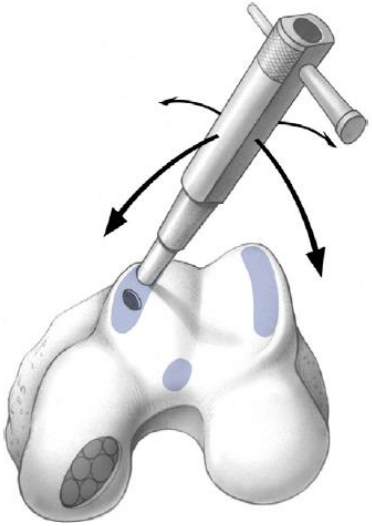


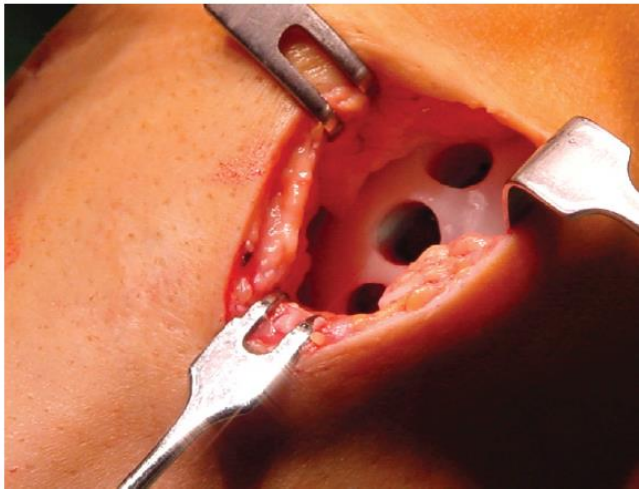
Fig. 1-B

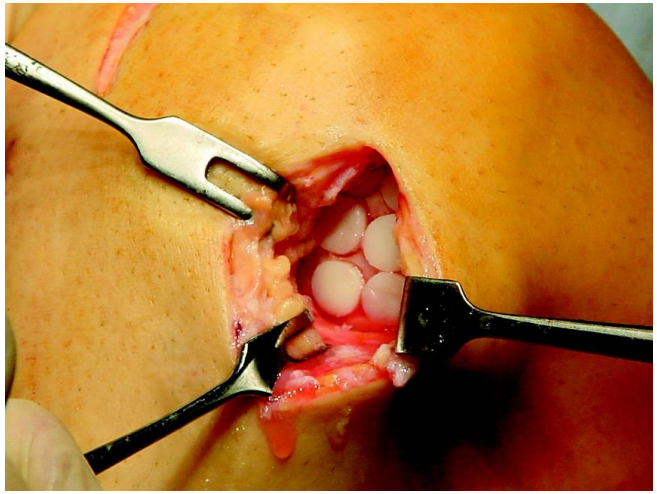


CARTILAGE REPAIR AND TRANSPLANTATION

OATS





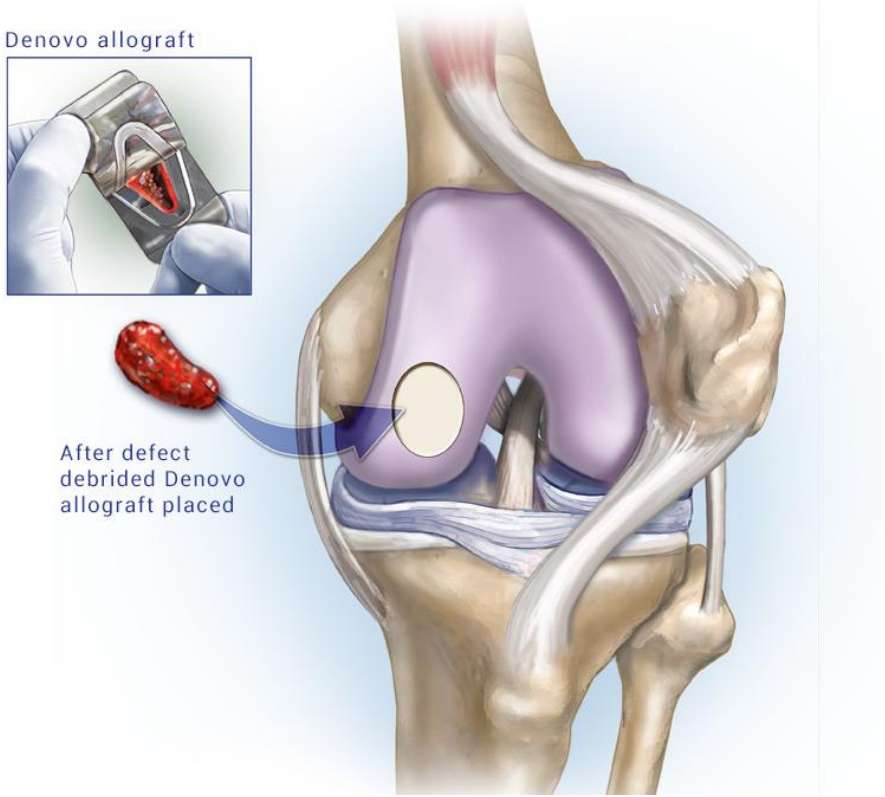


CARTILAGE REPAIR AND TRANSPLANTATION

Osteochondral Allograft

Transplantation of cadaveric osteoarticular graft to host defect.

CARTILAGE REPAIR AND TRANSPLANTATION



INTRODUCTION TO MACI

What is MACI?

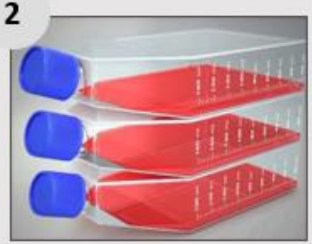
- Characterized autologous cultured chondrocytes on a resorbable porcine Type I/III collagen membrane.
- At a density of 500,000 – 1,000,000 cells per cm^2
- Customized by the surgeon for an exact fit to the size and shape of the defect(s)

Key Steps[2]

1

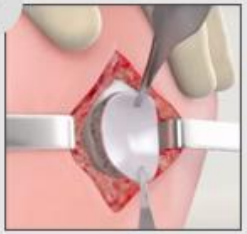
Defect assessment and biopsy collection

2



Chondrocyte propagation and membrane seeding

3



MACI implantation

KEY FEATURES OF MACI

Simplified ACI[1,2]

- Can be implanted via mini-arthrotomy
- Ability to be secured with fibrin sealant alone
- Less invasive with fewer steps than prior generations of ACI, reducing operative time

Versatility and flexibility[1,3]

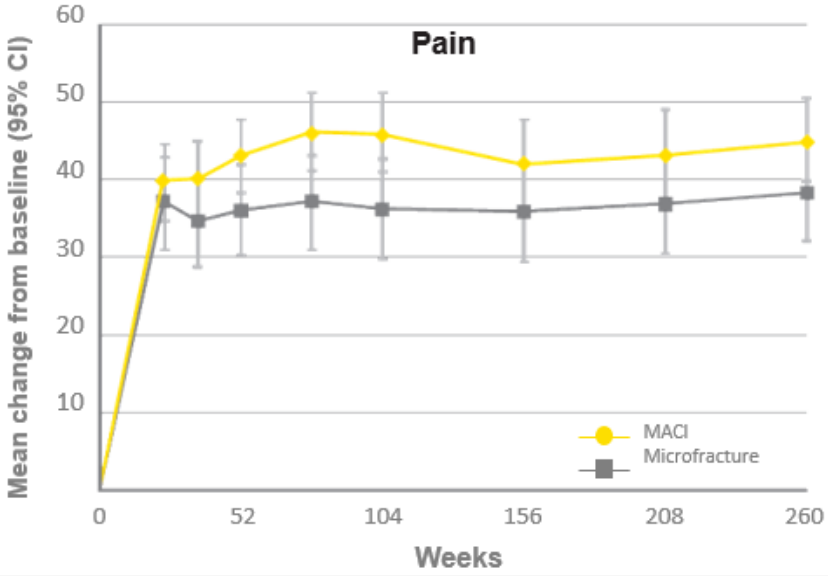
- Conforms to most defects
- Controlled, uniform dose of cells, regardless of defect size
- Permits the use of suture or suture anchor fixation when needed

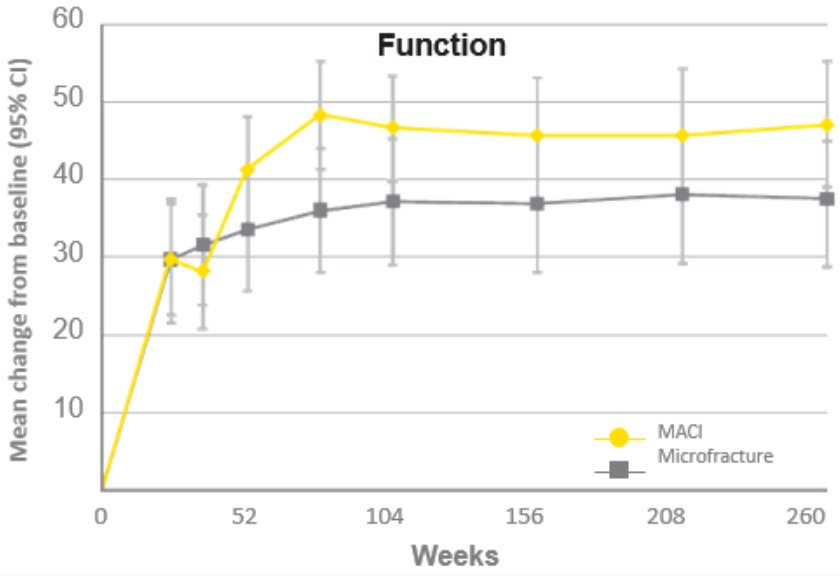
Proven results[4,5]

- Over 17 years of clinical experience outside the US
- FDA approved based on results from the rigorous phase 3 SUMMIT clinical study

Improvements in KOOS Pain and Function Were Maintained to Year 5 (Voluntary Extension of the SUMMIT Study)

KOOS pain and function mean change from baseline to Year 5 (Week 260)





WHICH PATIENTS ARE GOOD CANDIDATES FOR MACI?

Patient Characteristics

- Moderate-to-large (≥ 2 cm^2), full thickness defect(s) associated with pain and impaired function
- 18 – 55 years of age
- Able to perform rehabilitation protocol
- Realistic expectations
- Personal considerations (ex. Job expectations)

DEFECT ASSESSMENT AND CARTILAGE BIOPSY

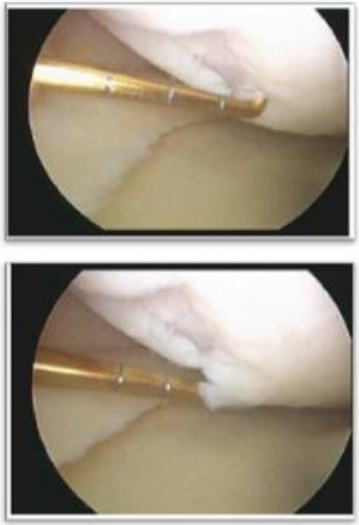
1. Examine the defect

- ✓ Contained vs uncontained
- ✓ Unstable or undermining cartilage
- ✓ Bone loss and quality of subchondral bone

2. Evaluate dimensions and bony involvement

- ✓ Surface area ≥2 cm^2
- ✓ Not osteoarthritic
- ✓ Bony involvement >6 mm may require bone graft

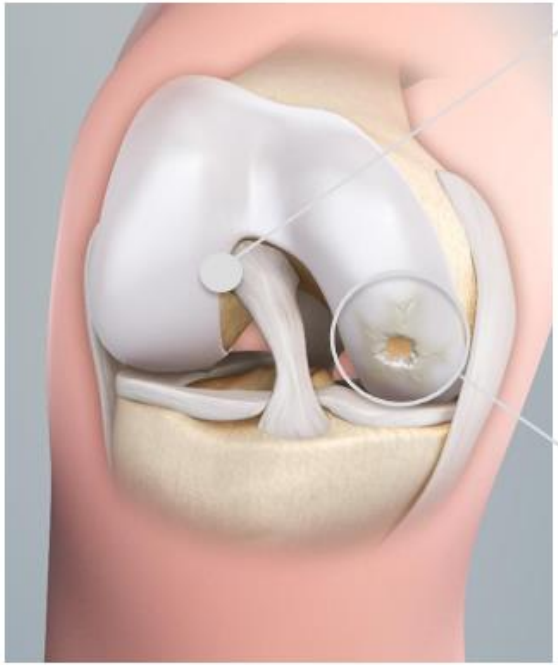
Optional: Assess bone marginal viability (AVN) and bone marrow lesions via MRI



Using probe to assess chondropenia

Note:
If total size of all (n= >1) defects is >10 cm^2, 2 MACI implants should be ordered

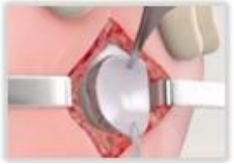
MACI OVERVIEW



1 Defect assessment and cartilage biopsy

2 Chondrocyte propagation and membrane seeding

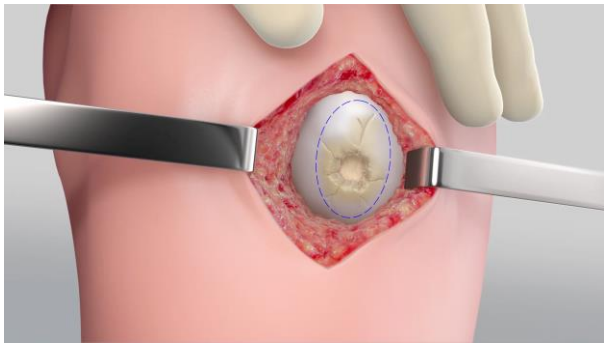
3 MACI implantation



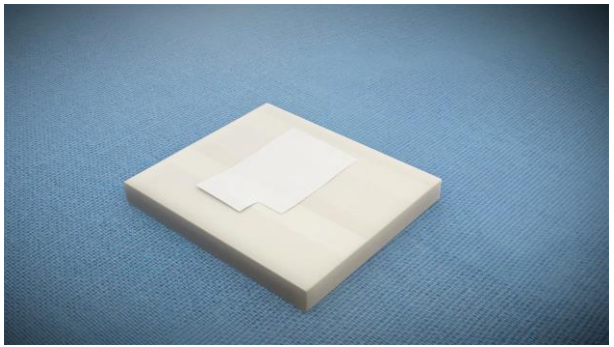
MACI SURGICAL TECHNIQUE

Overview:

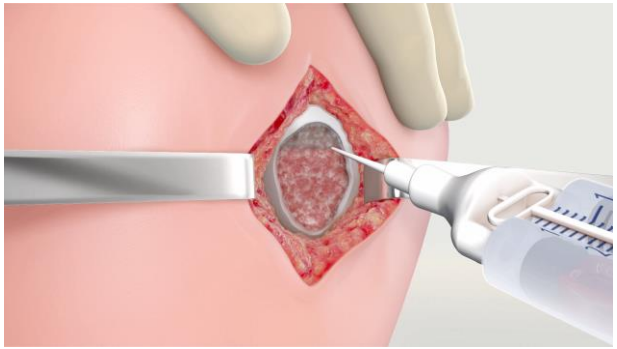
Defect Preparation



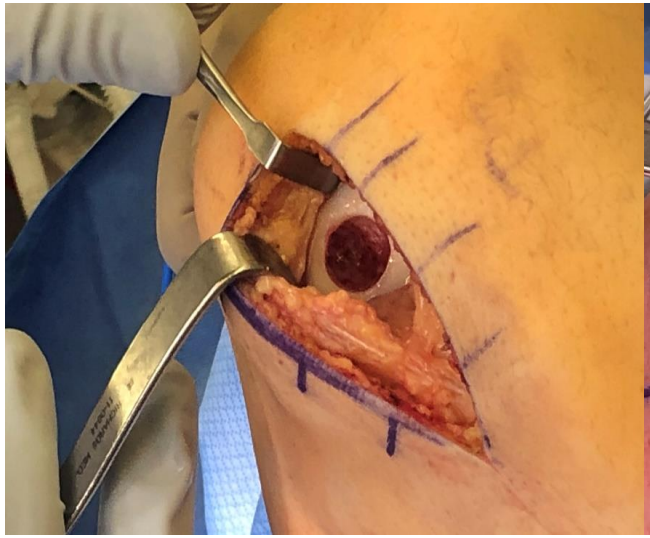
Templating the Defect



Implantation



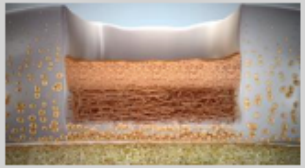
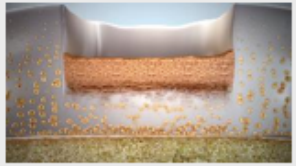
CARTILAGE REPAIR AND TRANSPLANTATION



CARTILAGE REPAIR AND TRANSPLANTATION

MACI REHABILITATION MATURATION PHASES

Timelines are based on biology and serve as a guide. Clinical observation provides insight into the development/remodeling of the regenerating cartilage.

	Rehabilitation Phase	Following Surgery	Stage of Tissue Development	Cartilage Maturation
1	**Achieve Routine**	0-3 months	**Implantation and Protection** Cells adhere to bone and begin to proliferate throughout the defect	
2	**Build Strength**	3-6 months	**Transition and Proliferation** Continued proliferation forms a defect-spanning matrix	
3	**Be Active**	6-9 months	**Remodeling & Maturation** Expansion of the cell matrix into putty-like consistency. Progressive hardening until a durable repair tissue is formed	

TISSUE PHASES DURING MACI REHABILITATION

FUNCTIONAL GOALS

- Limited weight bearing and pain-free, full knee extension by 2-3 weeks
- Full weight bearing and full knee range of motion by 8-12 weeks post-surgery
- Free from knee brace by 8-12 weeks post-surgery

FUNCTIONAL GOALS

- Full and pain-free weight bearing and range of motion
- Continue progression of strengthening exercises without pain or swelling
- Transition to gym/home based rehab

FUNCTIONAL GOALS

- Increase distance, time, and difficulty of exercises
- Ability to tolerate lengthy walking distances
- Return to a pre-operative level of activity

WHY MACI?

Chondroplasty

- Chondroplasty may offer temporary relief but does not repair the cartilage lesion.

Microfracture

- Marrow stimulation forms tissue resembling fibrocartilage rather than hyaline cartilage.
- Biocartilage (PRP + Dried Cartilage) has shown some promise in early studies.

Osteochondral Autograft (OATS)

- Cartilage implants are limited by the ability to procure donor tissue and have donor site pain.

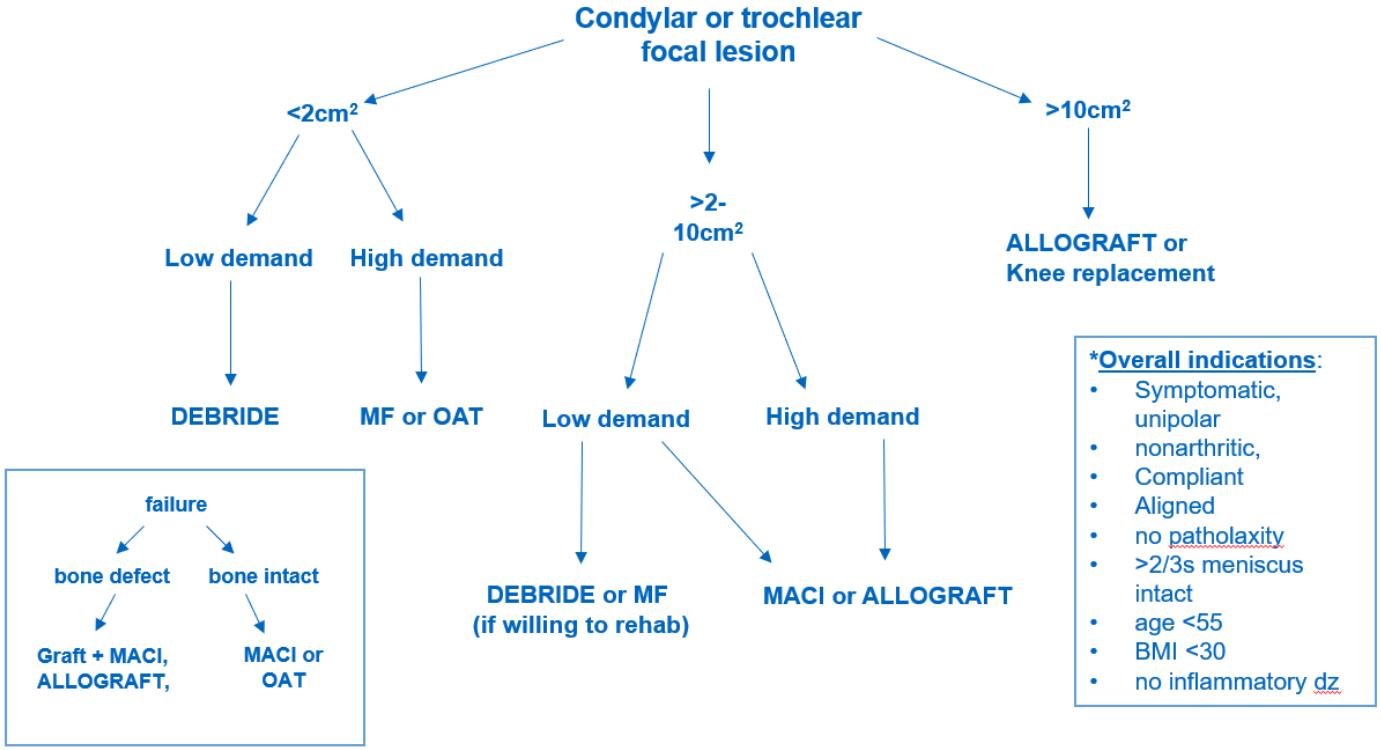
Osteochondral Allograft

- Uses cadaver tissue
- Cartilage implants are limited by the ability to procure donor tissue
- Excellent choice to salvage a failed MACI

WHY MACI?

- Used for more than 20 years, MACI has been proven to provide long-lasting pain relief and help patients regain knee function.
- MACI is a third-generation ACI, offering a safer way to deliver cells.
- Chosen in the right patient; 5-year data clearly supports MACI as the leader for true cartilage restoration.
- Approved by most insurance plans.*

CARTILAGE REPAIR AND TRANSPLANTATION



ADHD AND THE PEDIATRIC ATHLETE

Dr. James Hahn

OrthoCincy Orthopaedics & Sports Medicine | St. Elizabeth PHYSICIANS | St. Elizabeth HEALTHCARE

The Orthopaedic Institute at St. Elizabeth: A partnership between OrthoCincy Orthopaedics & Sports Medicine, St. Elizabeth Physicians and St. Elizabeth Healthcare.

ADHD AND THE PEDIATRIC ATHLETE

ADHD Overview

- Definition
- Epidemiology
- Diagnosis and difficulties
  - Medical and mental health mimics and co-morbidities
- Treatment Options
  - Side effects
  - Co-morbidities considerations
- Special considerations for athletes

ADHD DEFINITION

Attention Deficit Hyperactivity Disorder

Common childhood neurobehavioral disorder characterized by symptoms in 2 major domains:

1. Inattention
2. Hyperactivity and Impulsivity

- Must be present by age 12 (increased from 7 y.o. with DSM-5)
- Symptom duration > 6 months
- Cause impairment in multiple settings (ie both school and home)
- Excessive for developmental level of child
- Sx not caused by other identifiable disorder

ADHD AND THE PEDIATRIC ATHLETE

ADHD

- Symptoms may affect functioning in multiple areas:
  - Cognition
  - Academic performance
  - Emotional well-being
  - Behavior
  - Social functioning/peer relationships
  - Athletic performance

ADHD AND THE PEDIATRIC ATHLETE

ADHD Pathogenesis

- Thought to be related to genetic imbalance of catecholamine metabolism in cerebral cortex.
- Structural changes and decreased activation seen on advanced imaging
- Prefrontal cortex → Executive functioning
  - Planning/Anticipating
  - Impulse control/emotional regulation
  - Reasoning
- Environmental factors?

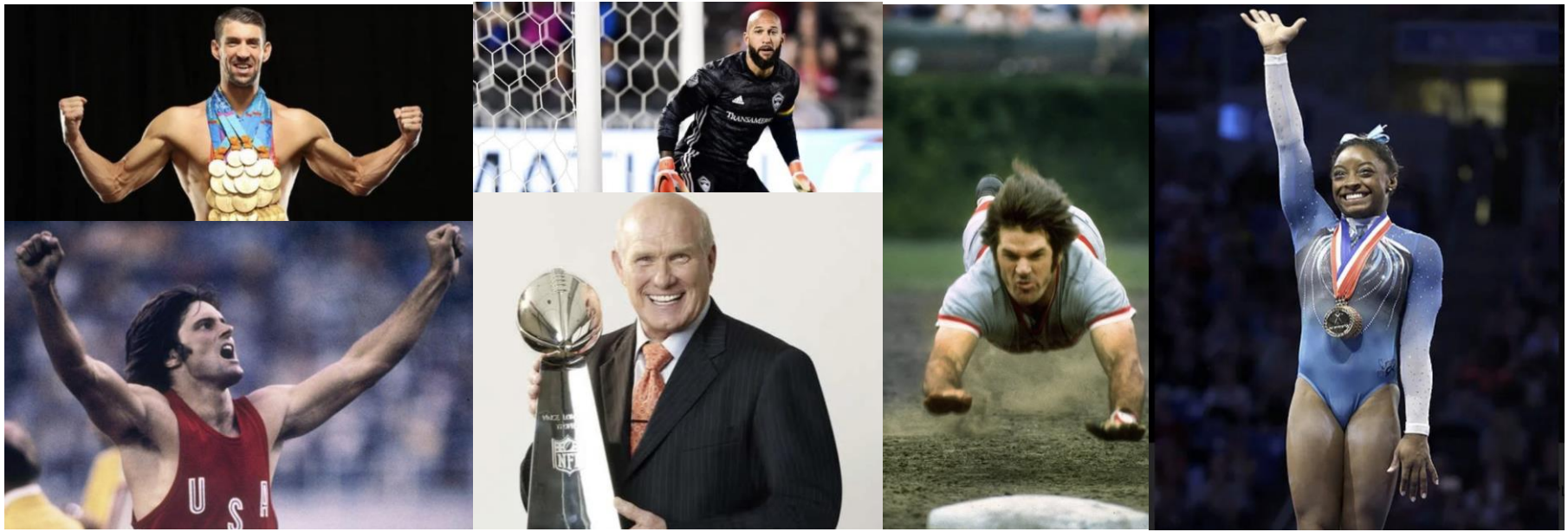
ADHD AND THE PEDIATRIC ATHLETE

ADHD Epidemiology

- Prevalence varies based on population, criteria and assessments used:
  - Estimated 4-15% of children affected
  - Male > Female ~ 4:1 hyperactivity/impulsivity, ~2:1 inattention
  - Symptoms may diminish with maturation, but > 50% continue in adulthood
  - Most don’t “lose” dx, meet criteria for ADHD in adulthood

ADHD AND THE PEDIATRIC ATHLETE

ADHD Common in Athletes



STEPS TO DIAGNOSING ADHD

- NOT simple or easy
- Clinical diagnosis - No diagnostic objective labs or imaging; motivation/gain?
- Process starts with detailed medical and developmental history
  - Prenatal/perinatal complications and exposures
  - Prematurity, LBW, tob exposure associated w increased ADHD incidence
  - Family Hx ADHD (strong familial association)
  - Diet/nutrition
  - Temporal relationship with stressor or life event
  - Sleep quantity/quality

STEPS TO DIAGNOSING ADHD

Assess core symptoms of ADHD, inattention predominant (parent and teacher reports)

	Symptoms	Never	Occasionally	Often	Very Often
1.	Does not pay attention to details or makes careless mistakes with, for example, homework	0	1	2	3
2.	Has difficulty keeping attention to what needs to be done	0	1	2	3
3.	Does not seem to listen when spoken to directly	0	1	2	3
4.	Does not follow through when given directions and fails to finish activities (not due to refusal or failure to understand)	0	1	2	3
5.	Has difficulty organizing tasks and activities	0	1	2	3
6.	Avoids, dislikes, or does not want to start tasks that require ongoing mental effort	0	1	2	3
7.	Loses things necessary for tasks or activities (toys, assignments, pencils, or books)	0	1	2	3
8.	Is easily distracted by noises or other stimuli	0	1	2	3
9.	Is forgetful in daily activities	0	1	2	3

STEPS TO DIAGNOSING ADHD

Assess core symptoms of ADHD, hyperactivity predominant (parent and teacher reports)

10.	Fidgets with hands or feet or squirms in seat	0	1	2	3
11.	Leaves seat when remaining seated is expected	0	1	2	3
12.	Runs about or climbs too much when remaining seated is expected	0	1	2	3
13.	Has difficulty playing or beginning quiet play activities	0	1	2	3
14.	Is "on the go" or often acts as if "driven by a motor"	0	1	2	3
15.	Talks too much	0	1	2	3
16.	Blurts out answers before questions have been completed	0	1	2	3
17.	Has difficulty waiting his or her turn	0	1	2	3
18.	Interrupts or intrudes in on others' conversations and/or activities	0	1	2	3

STEPS TO DIAGNOSING ADHD

Other mental health problems that can cause attention/behavior problems or co-exist with ADHD

19.	Argues with adults	0	1	2	3
20.	Loses temper	0	1	2	3
21.	Actively defies or refuses to go along with adults' requests or rules	0	1	2	3
22.	Deliberately annoys people	0	1	2	3
23.	Blames others for his or her mistakes or misbehaviors	0	1	2	3
24.	Is touchy or easily annoyed by others	0	1	2	3
25.	Is angry or resentful	0	1	2	3
26.	Is spiteful and wants to get even	0	1	2	3
27.	Bullies, threatens, or intimidates others	0	1	2	3
28.	Starts physical fights	0	1	2	3
29.	Lies to get out of trouble or to avoid obligations (i.e. "cons" others)	0	1	2	3
30.	Is truant from school (skips school) without permission	0	1	2	3
31.	Is physically cruel to people	0	1	2	3
32.	Has stolen things that have value	0	1	2	3
33.	Deliberately destroys others' property	0	1	2	3
34.	Has used a weapon that can cause serious harm (bat, knife, brick, gun)	0	1	2	3
35.	Is physically cruel to animals	0	1	2	3
36.	Has deliberately set fires to cause damage	0	1	2	3

STEPS TO DIAGNOSING ADHD

- Carefully consider medication seeking behavior

Performance improvement:

- Academic
- Athletic
- Body image (weight loss, appetite suppression)

Med diversion:

- Parent or patient/athlete

- Patient/parent contract

TREATMENT OPTIONS

- Behavior Therapy
- Exercise as Medicine
- Medication

Stimulant

- Methylphenidates
- Amphetamines

Non-stimulants

- Atomoxetine
- Clonidine
- Guanfacine

TREATMENT OPTIONS – BEHAVIOR TX

- Psychosocial treatment can help improve behavior, emotional regulation
- Develop skills to reduce distractibility
  - Minimize distractions
- Cognitive Behavior Therapy
- Maintain daily schedule/routine
- Assistance with organization skills/planning- charts, checklists
- Target goals - setting small, achievable goals
- ID unintentional reinforcement of negative behaviors, reward positive behaviors
- School-based modifications/accommodations: IEP/504
- Social skills training

TREATMENT OPTIONS - EXERCISE

- Sports can provide inherent structure, outlet for kids
- Long-term can reduce severity of ADHD sx and improve executive functioning
- Exercise shown to improve response time, impulsivity and attention
- Better peer/social relationships
- Improved school performance

TREATMENT OPTIONS - STIMULANT

Mainstay first treatment of ADHD

- Helpful in >75% of patients with ADHD
- Methylphenidates and Amphetamines

Block reuptake of catecholamines norepinephrine and dopamine

- Increased availability in the synapse
- Effect mainly seen in prefrontal cortex

STIMULANT BENEFIT

- Consistent efficacy in improving hyperactivity-impulsivity and inattention, executive fxn

Benefits in athletes:

- Increased attention helpful for on-field tasks
- Improved fine motor coordination, balance
- Better off-field instruction (“coachable”)
- Decreased fatigue/sustained energy
- Improved pain tolerance?

STIMULANT SIDE EFFECT

- GI - Decreased appetite/weight loss, abdominal pain, nausea
- Sleep difficulties - detrimental to skill execution/decision making, alertness/reaction time, max strength effort, time to exhaustion
- CNS - Nervousness, irritability, affect change, psychosis
- CV - hypertension/tachycardia
- Thermoregulation
- Bone health - decreased BMD/fracture risk

STIMULANT CONTRADICTIONS

- CV - hypertension, structural heart disease, symptomatic CV disease
- Hyperthyroidism
- Psychosis
- Illicit drug abuse/dependence
- Stimulant hypersensitivity
- MAOI drug use

TREATMENT OPTIONS NON-STIMULANT

- Less effective than stimulant medication, but different side effect profile

Atomoxetine

- Selective NE reuptake inh.
- SE: GI upset, sleepiness/fatigue, dry mouth, BP/HTN; rare hepatotoxicity/suicidality

Clonidine/Guanfacine

- Alpha-2 adrenergic agonist
- Monotherapy vs adjunct to stimulant therapy
- SE: sleepiness/fatigue, HypoTN, bradycardia

ADHD AND THE PEDIATRIC ATHLETE

Considerations in Athletes

Personalized treatment approach

- Stimulant use - Episodic vs Daily
- Initiation consideration - trial low stress (ie Captain’s practice) vs game
- Med response - aggression vs flat affect
- Untreated symptoms harmful or helpful to performance

SPECIAL CONSIDERATION - CARDIAC

- Screen for underlying CV disease
- Personal history of CV disease, family history, baseline HR, BP, CV exam

EKG screening?

- AHA: EKG prior to ADHD med initiation
- AAP: no routine EKG prior to ADHD med initiation
- Cite no increased rate of SCD in patients taking ADHD meds
- EKG if on TCA med or + history

- Periodic monitoring of VS and CV/exertional symptoms with med use

SPECIAL CONSIDERATION - CARDIAC

Stimulant CV effects

- Increase SBP 3-5 mmHg, DBP 2-14 mmHg, HR 3-10 bpm from baseline

Case reports of SCD related to stimulant med use

- Recent meta-analysis: NO relationship of ADHD med and MI/stroke, all-cause death
- + association with arrythmia/ED visits (greatest in rec use/higher doses than rx)

SPECIAL CONSIDERATION – HEAT ILLNESS

- Increased risk of heat injury in athletes taking ADHD meds when exercising in hot environments

Stimulant medication:

- Mask symptoms of fatigue (time to exhaustion increased in methylphenidate use)
- Decreased perception of increasing heat
- Less responsive to elevated core temp during exercise

Risk greatest in athletes with other underlying risk factors for heat illness

- Higher BMI
- Poor conditioning

- Athletes need education: hydration, off-season conditioning, etc.

SPECIAL CONSIDERATION – CONCUSSION

Athletes with ADHD have higher prevalence of prior concussion

- Greater likelihood of 3+ lifetime concussions

Independent risk factor for:

- Prolonged symptoms after concussion
- Increased symptom score after concussion

ImPACT considerations:

- Increased invalid testing
- Both baseline and post-injury testing should be consistent (ie after med admin)

SPECIAL CONSIDERATION – GOV BODIES

NCAA: stimulants banned, but athletes taking stimulants can get medical exemption

- Specific NCAA documentation/forms must be kept current on annual basis
- Consider non-stimulants first, but not necessary

WADA/IOC stimulants banned, TUE with annual review

- Stimulants 3rd most common TUE (bronchodilators, glucocorticoids)
- Rare TUE (<1% athletes in last 5 Olympic games had TUE)

Q&A PANEL

BREAK

NEXT SESSION WILL BEGIN AT 11:00 A.M.

The Orthopaedic Institute at St. Elizabeth: A partnership between OrthoCincy Orthopaedics & Sports Medicine, St. Elizabeth Physicians and St. Elizabeth Healthcare.

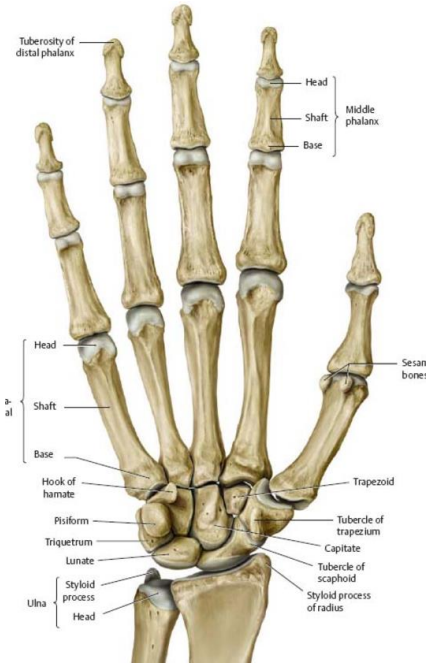
COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES

Dr. Jonathan Slaughter

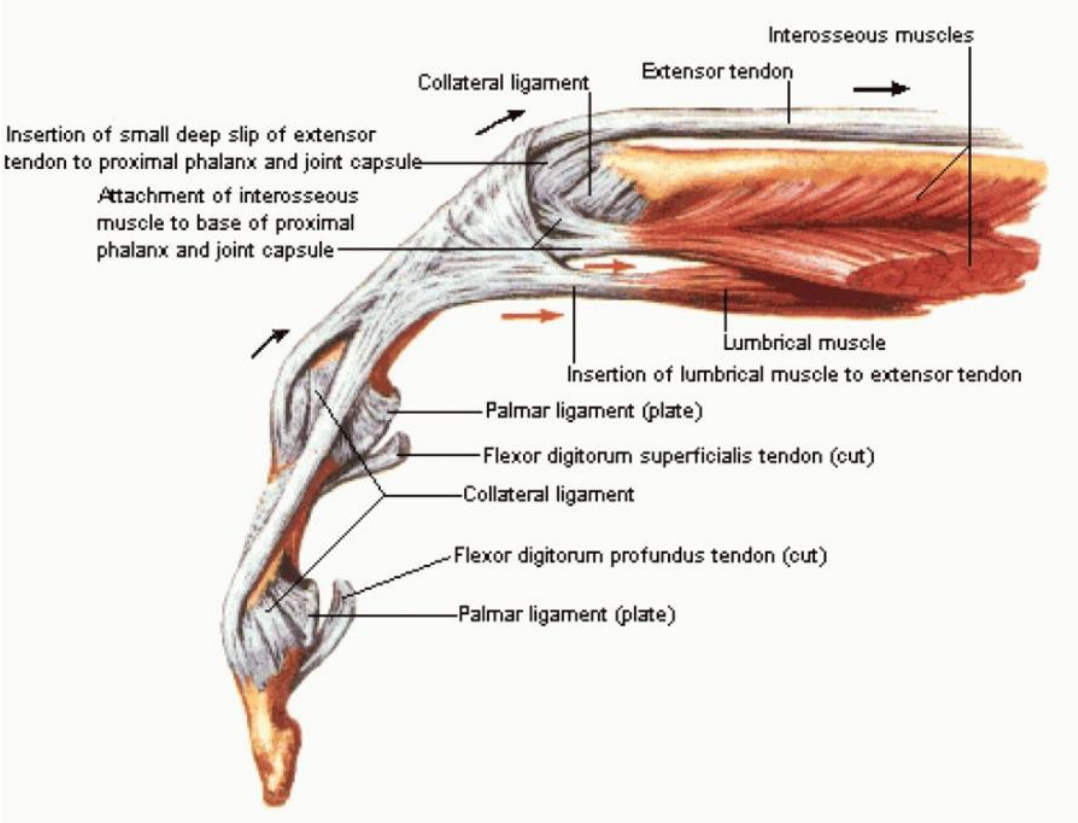
The Orthopaedic Institute at St. Elizabeth: A partnership between OrthoCincy Orthopaedics & Sports Medicine, St. Elizabeth Physicians and St. Elizabeth Healthcare.

HAND AND FINGER ANATOMY

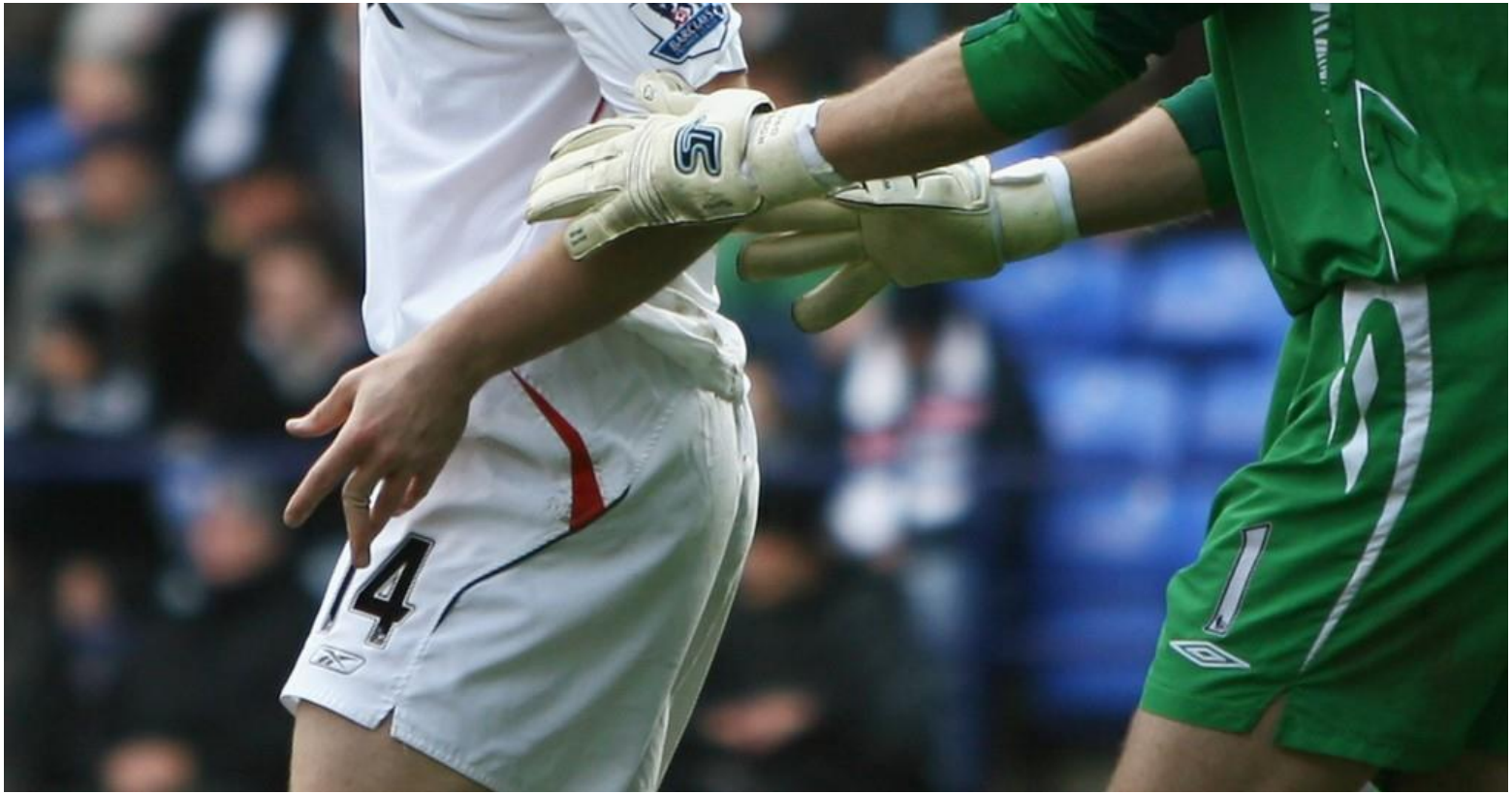
HAND AND FINGER ANATOMY



FINGER ANATOMY



COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES



COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES

Hand and Wrist Injuries

Very common in sports

- Often in baseball, softball, basketball, and football

Large variety of injuries

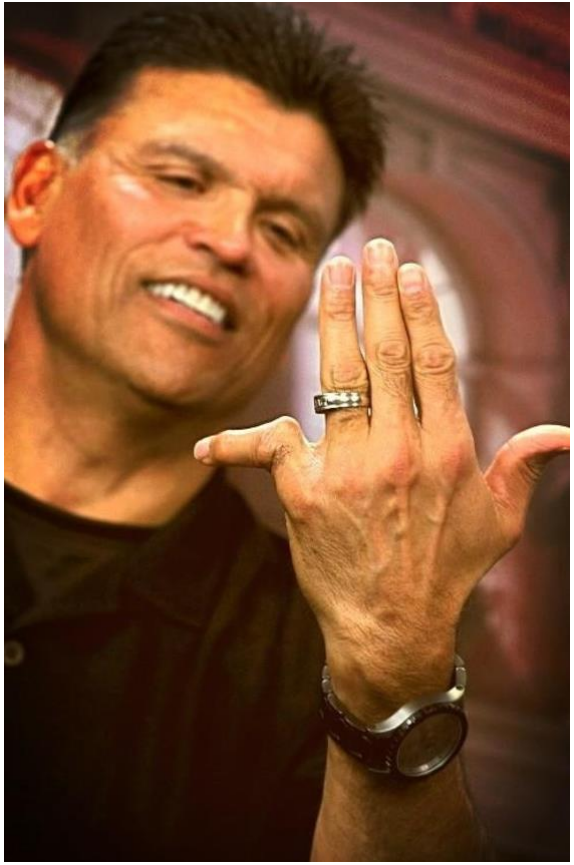
- Fractures
- Sprains/Dislocations
- Tendon Strains and Ruptures
- Ligament Strains and Ruptures

COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES

How will I approach each problem?

- What is it?
- Does it need any special imaging?
- How do I treat it?
- Should I send it to a hand surgeon?

COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES



DISLOCATIONS

PIP DISLOCATIONS

PIP DISLOCATIONS

Reduction:

- Reduce with minimal longitudinal traction and pressure on middle phalanx
- If initially unsuccessful, hyperextended joint to try and pull volar plate out of joint

Often can continue playing:

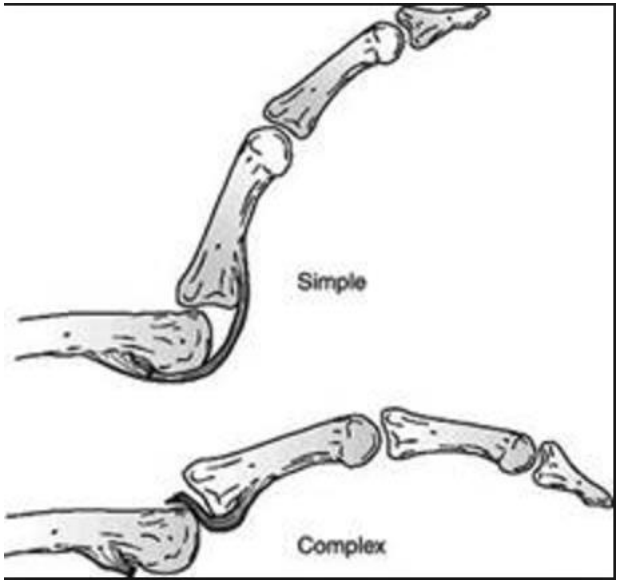
- Buddy Straps / Tape
- Splint

MCP DISLOCATIONS

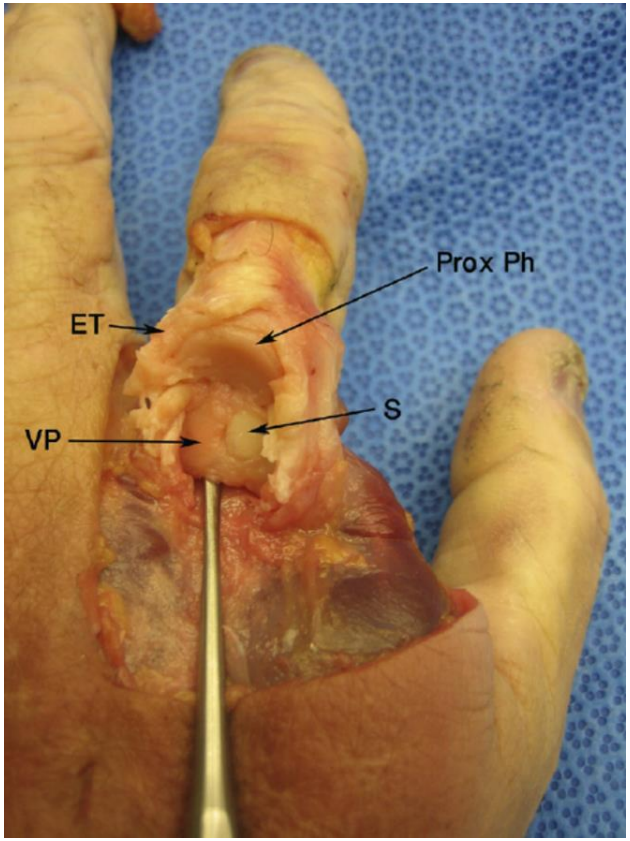
Reduction:

- Don’t pull longitudinal traction or hyperflex
- Pulls volar plate in joint blocking reduction

- Flex wrist and apply pressure on base of proximal phalanx



MCP DISLOCATIONS



COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES

“I jammed my finger.”

COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES





MALLET FINGER

MALLET FINGER

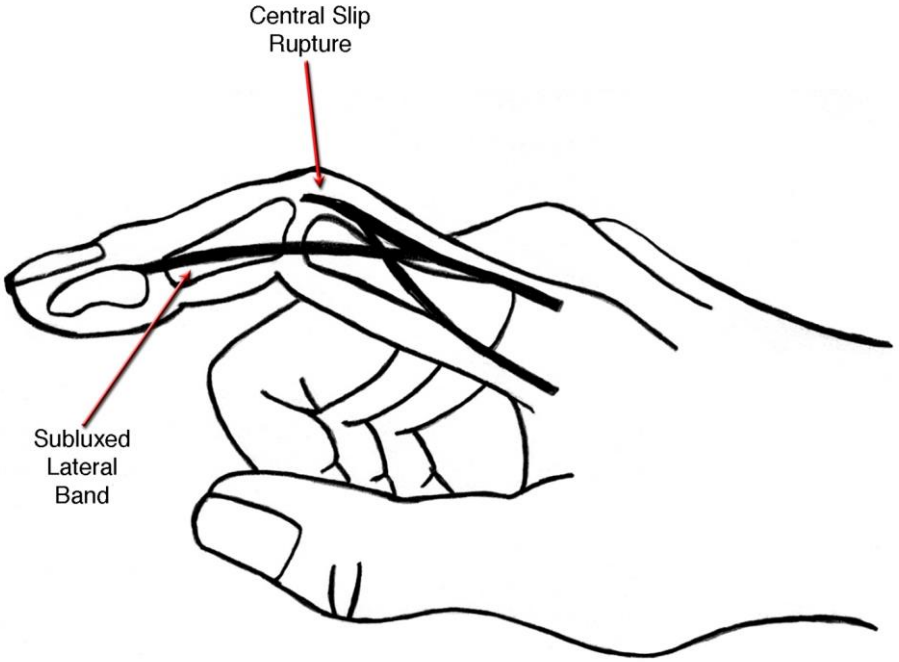
- Forced flexion of extended finger
- Dorsal avulsion of extensor tendon
- Can sometimes involve a fracture
- Majority don’t need surgery

MALLET FINGER

Presentation:

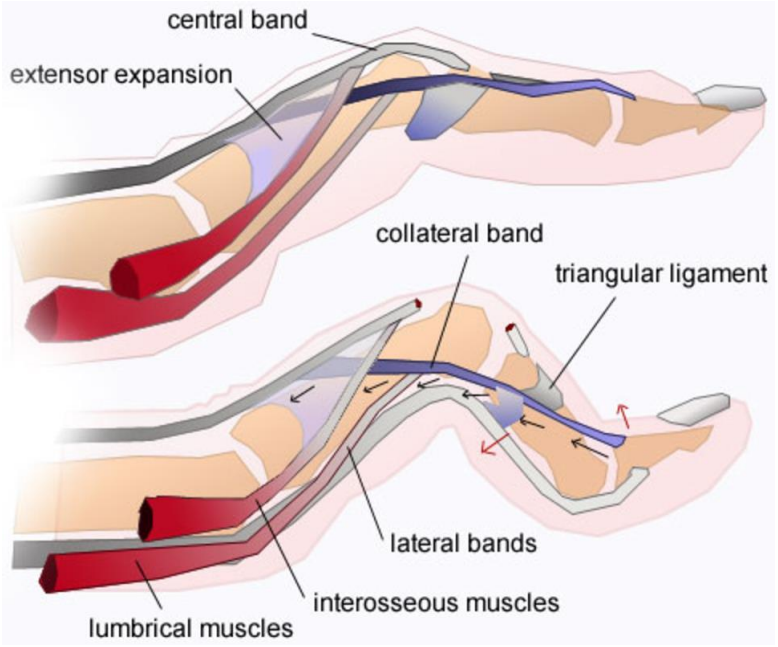
- Pain at DIP
- Can’t actively extend DIP
- Flexion deformity
- All need X-rays
- Splint in full to hyper-extension full time

CENTRAL SLIP INJURY

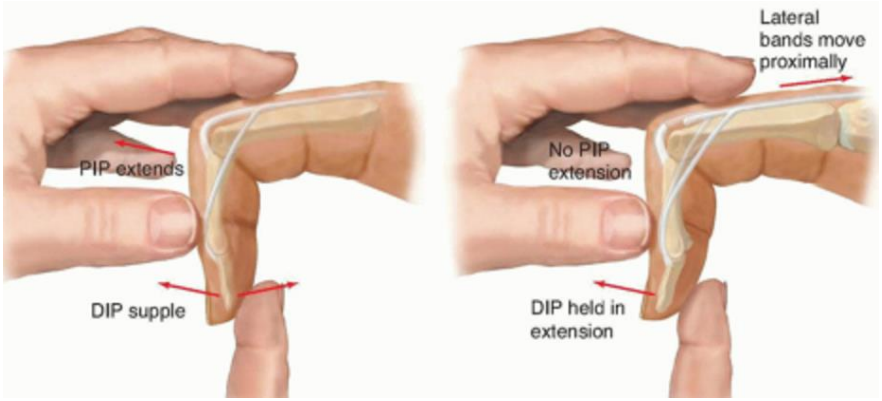


CENTRAL SLIP INJURY

- Forced flexion of PIP while actively extending
- Often occurs with volar dislocation of the PIP
- Athlete is unable to extend PIP when flexed 15-30 degrees
- Can lead to Boutonniere deformity

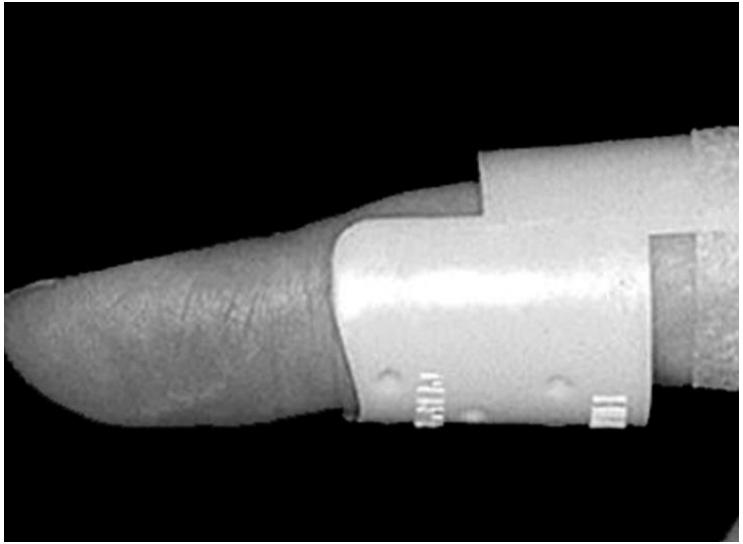


CENTRAL SLIP INJURY

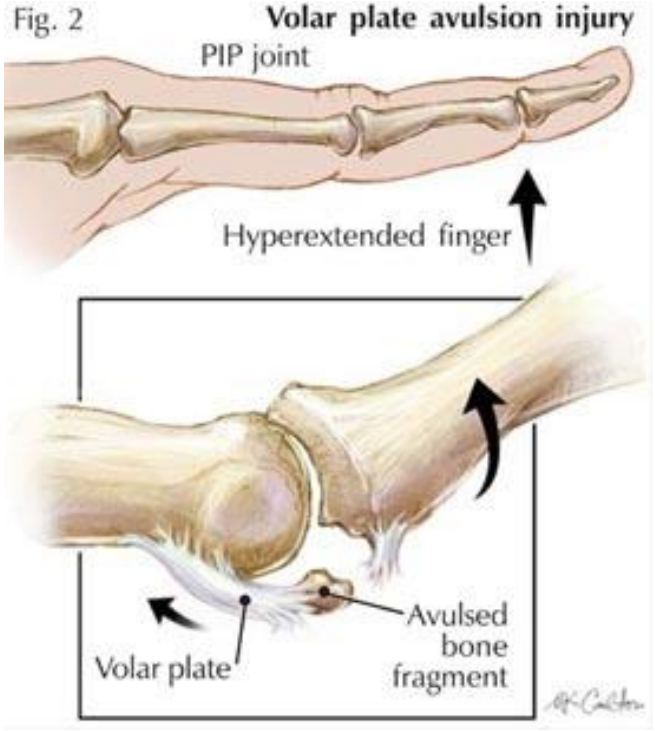


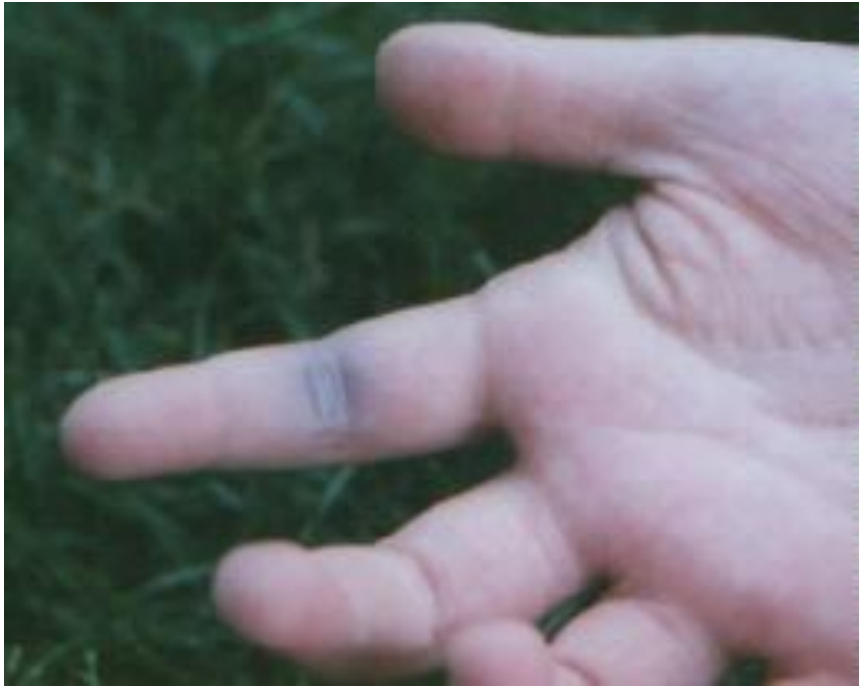
CENTRAL SLIP INJURY

- Full time extension splint six to eight weeks
- Can play sports in splint
- All should be followed by a hand surgeon



VOLAR PLATE RUPTURE



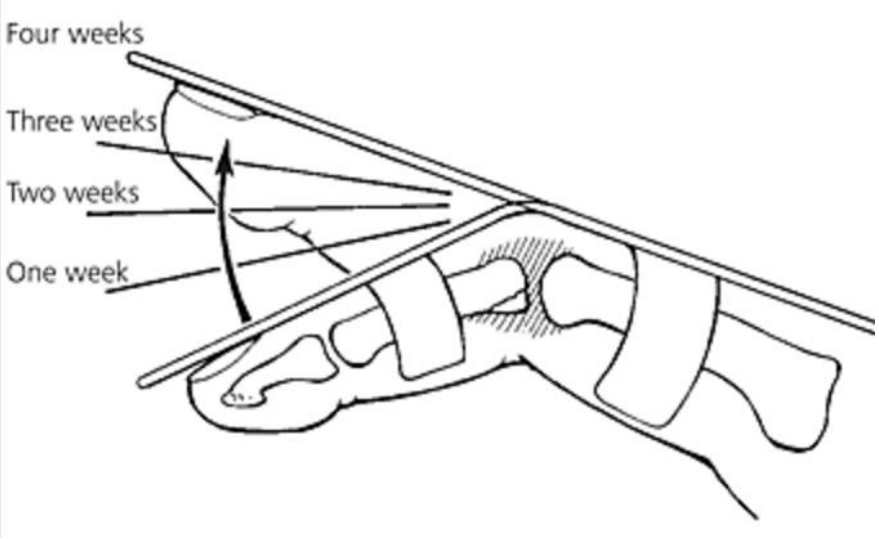


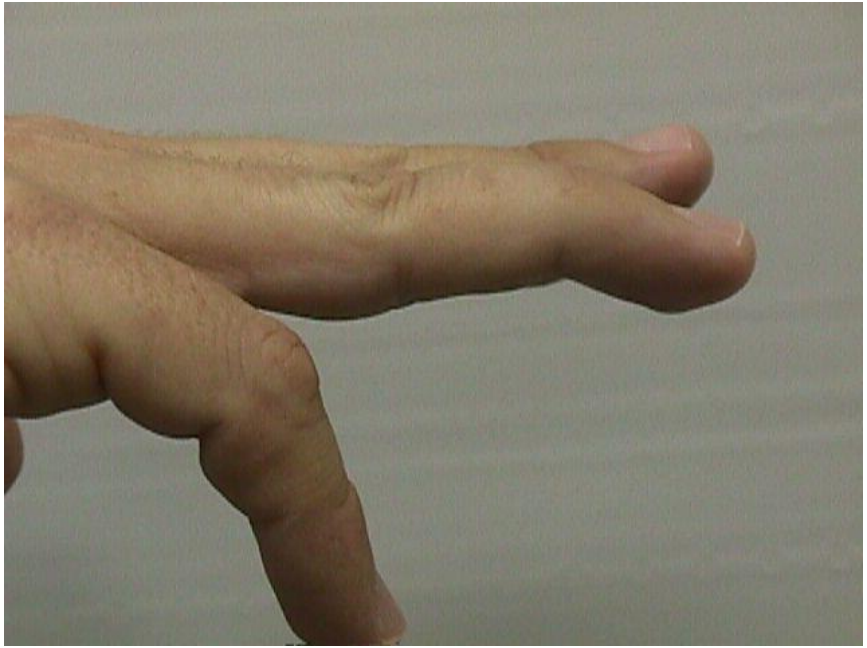
VOLAR PLATE RUPTURE

- Hyperextension injury
- PIP most common
- Often associated with dorsal PIP dislocation

VOLAR PLATE RUPTURE

VOLAR PLATE RUPTURE



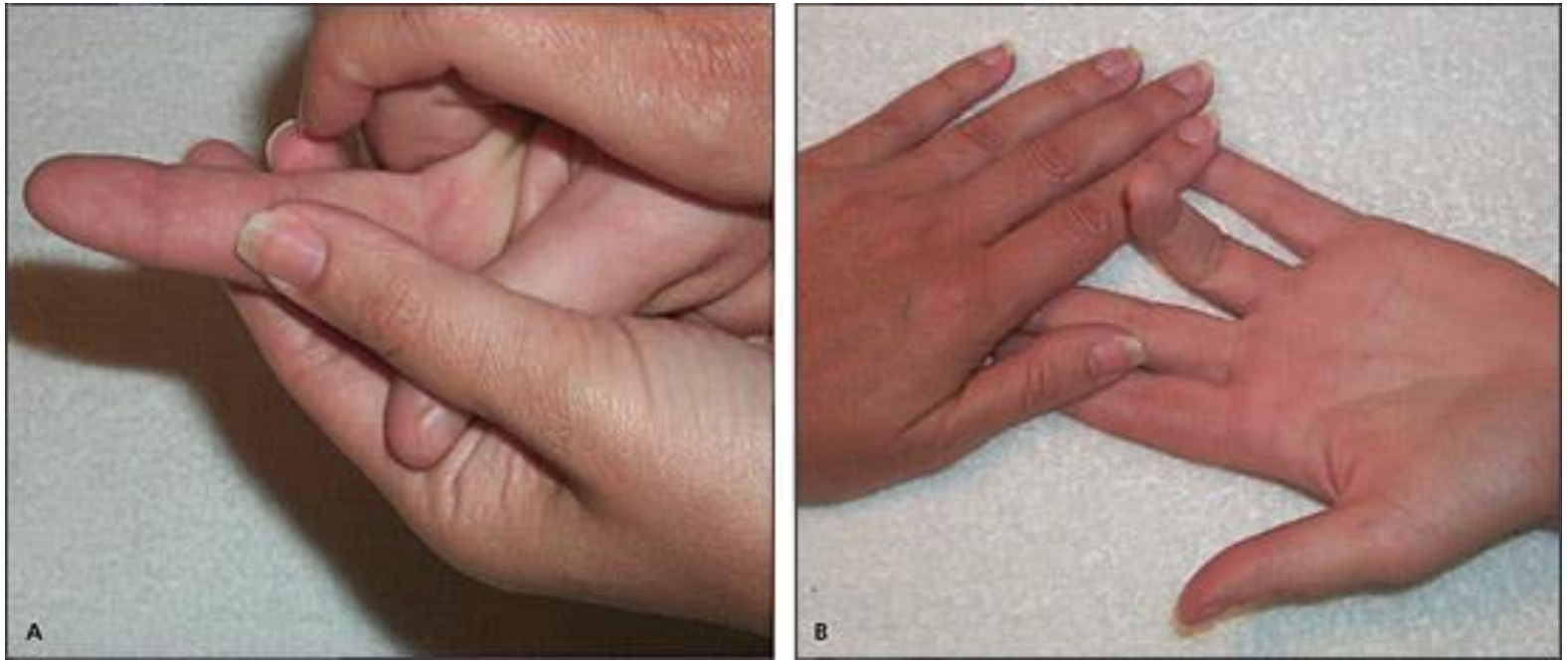


JERSEY FINGER

JERSEY FINGER

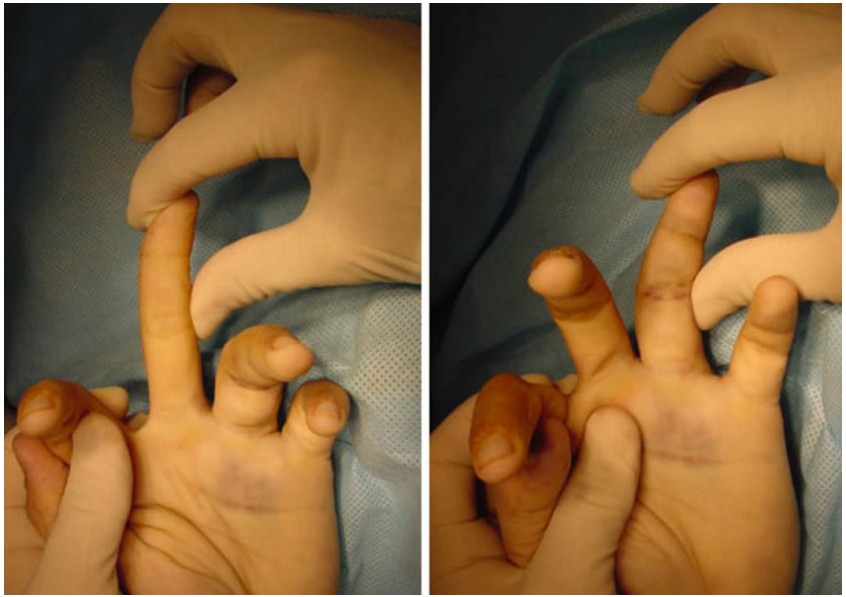
- Forced extension of DIP during active flexion
- Avulsion of Flexor tendon from distal phalanx
- 75% occur in ring finger
- All need referred to hand surgeon for surgery

JERSEY FINGER

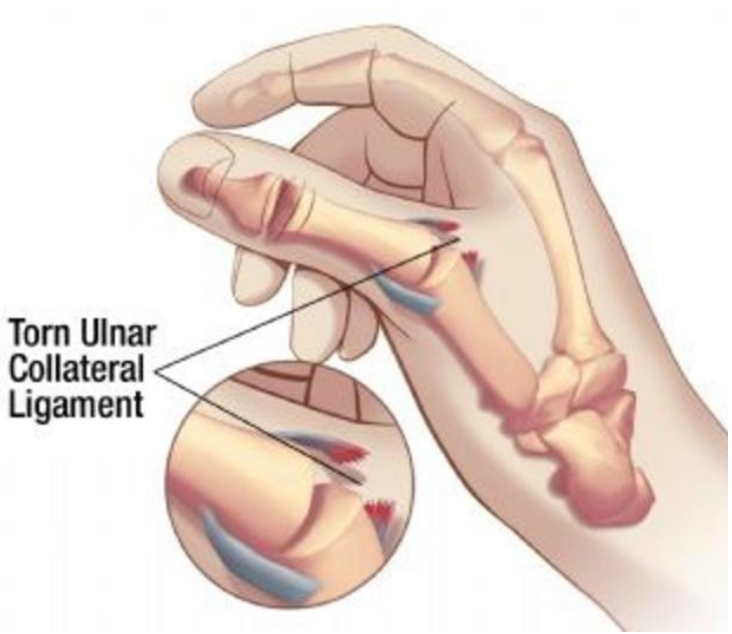


COLLATERAL LIGAMENT INJURIES

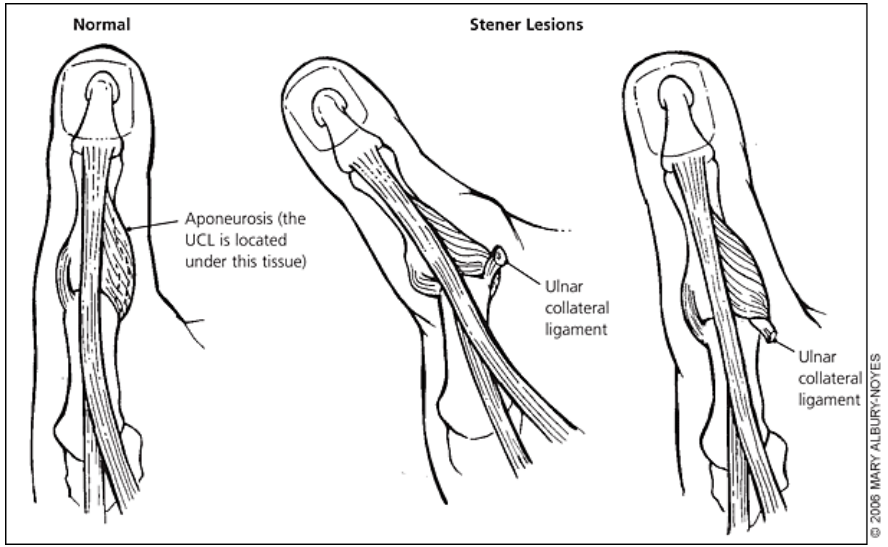
- Forced ulnar or radial deviation
- PIP most common
- Instability and pain
- Buddy tape 3 - 6 weeks
- Can continue to play



GAMEKEEPERS/SKIERS THUMB



STENNER LESION



FRACTURES

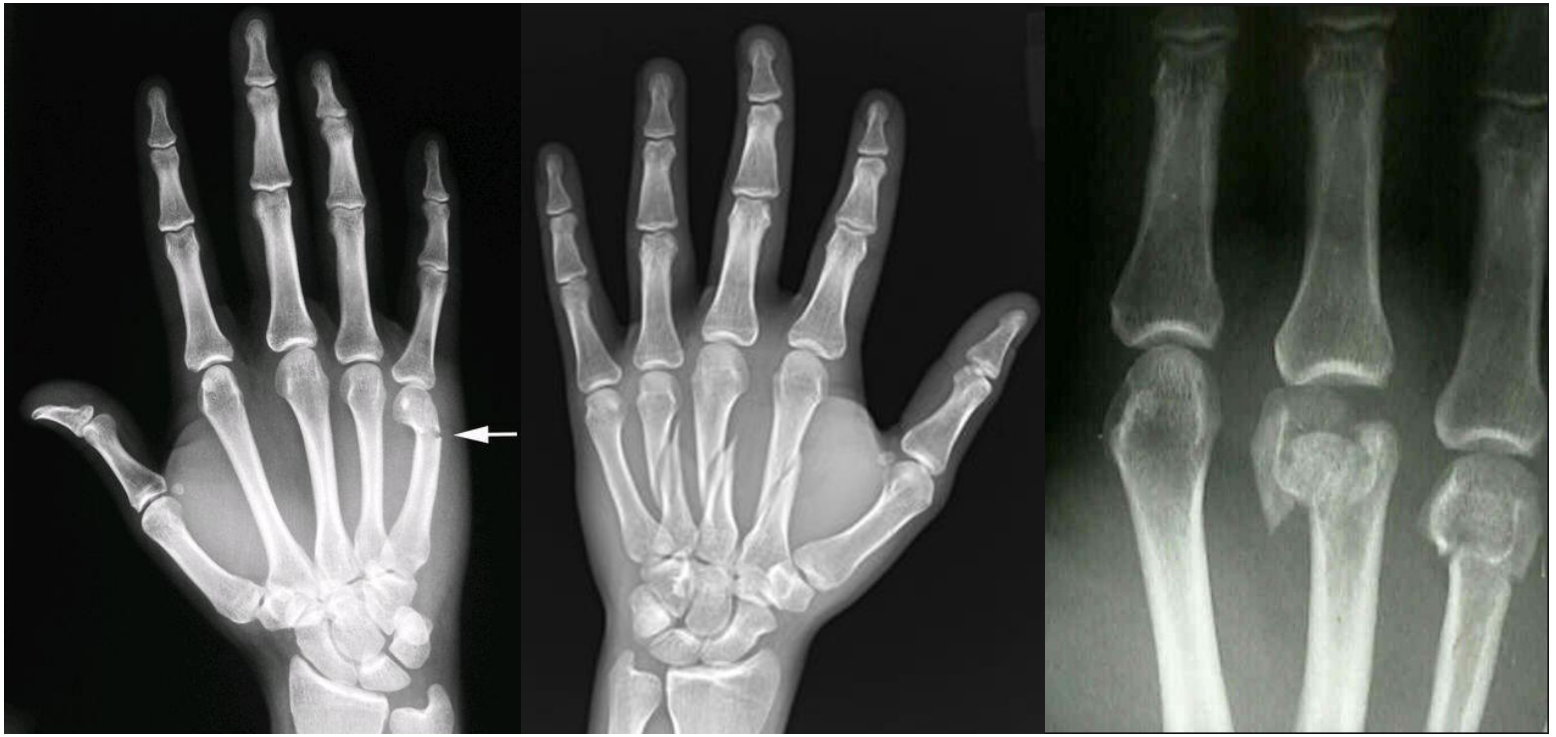
- **43% occurs in the hand and wrist**

Hand

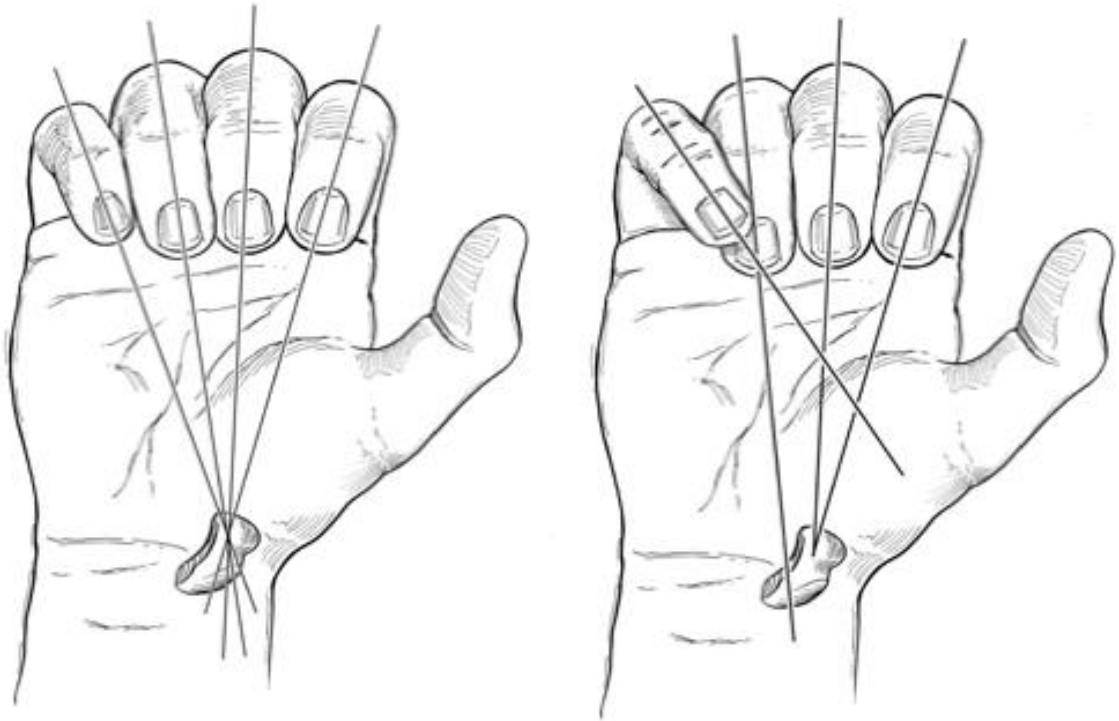
- Distal radius most common (26%)
- Small finger metacarpal
- Small finger proximal phalanx
- Thumb proximal phalanx

FINGER FRACTURES

METACARPAL FRACTURES



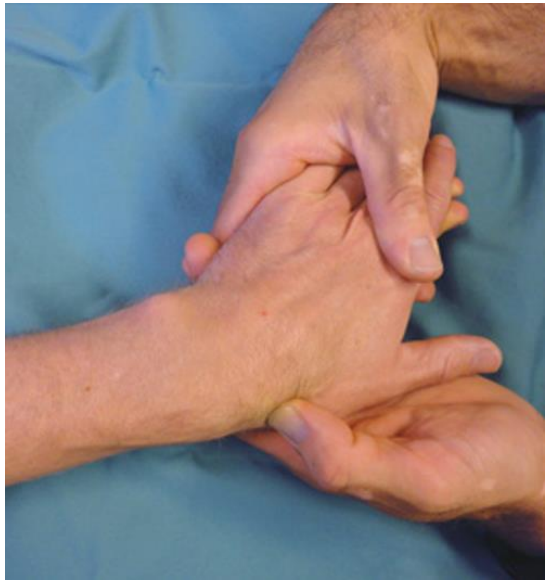
HAND FRACTURES



THUMB FRACTURES

WRIST SPRAIN

WRIST SPRAIN



SCAPHOID FRACTURE

SCAPHOID FRACTURE

SCAPHOID FRACTURE

X-rays Negative

- Immobilize two weeks
- If still tender
  - Repeat X-ray
  - MRI if X-ray negative

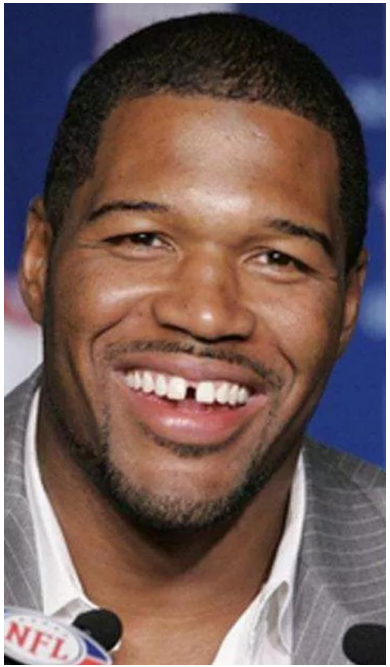
X-rays Positive

- Distal 1/3 – approx. 6 to 8 weeks
- Middle 1/3 – 8 to 12 weeks
- Proximal 1/3 – 12 to 23 weeks

SCAPHOID FRACTURE

WRIST SPRAIN

SCAPHOLUNATE DISSOCIATION



COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES

How will I approach each problem?

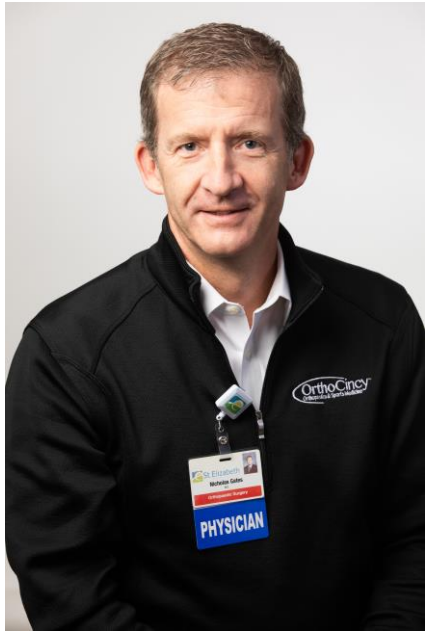
- What is it?
- Does it need any special imaging?
- How do I treat it?
- Should I send it to a hand surgeon?

COMMON PEDIATRIC SPORTS HAND & WRIST INJURIES

Finger Injury Pearls

- Treatment should restrict motion of the injured structures while allowing motion in the uninjured joints
- It is not unusual for an injured digit/finger to remain swollen for some time and that permanent deformity is possible even after treatment
- Have low threshold to obtain X-ray and/or be evaluated by hand surgeon for “sprains and jams”

ANKLE TIGHTROPE PROCEDURE



Dr. Nicholas Gates

The Orthopaedic Institute at St. Elizabeth: A partnership between OrthoCincy Orthopaedics & Sports Medicine, St. Elizabeth Physicians and St. Elizabeth Healthcare.

HIGH ANKLE SPRAIN = SYNDESMOSIS SPRAIN

Syndesmosis Ligament Injury

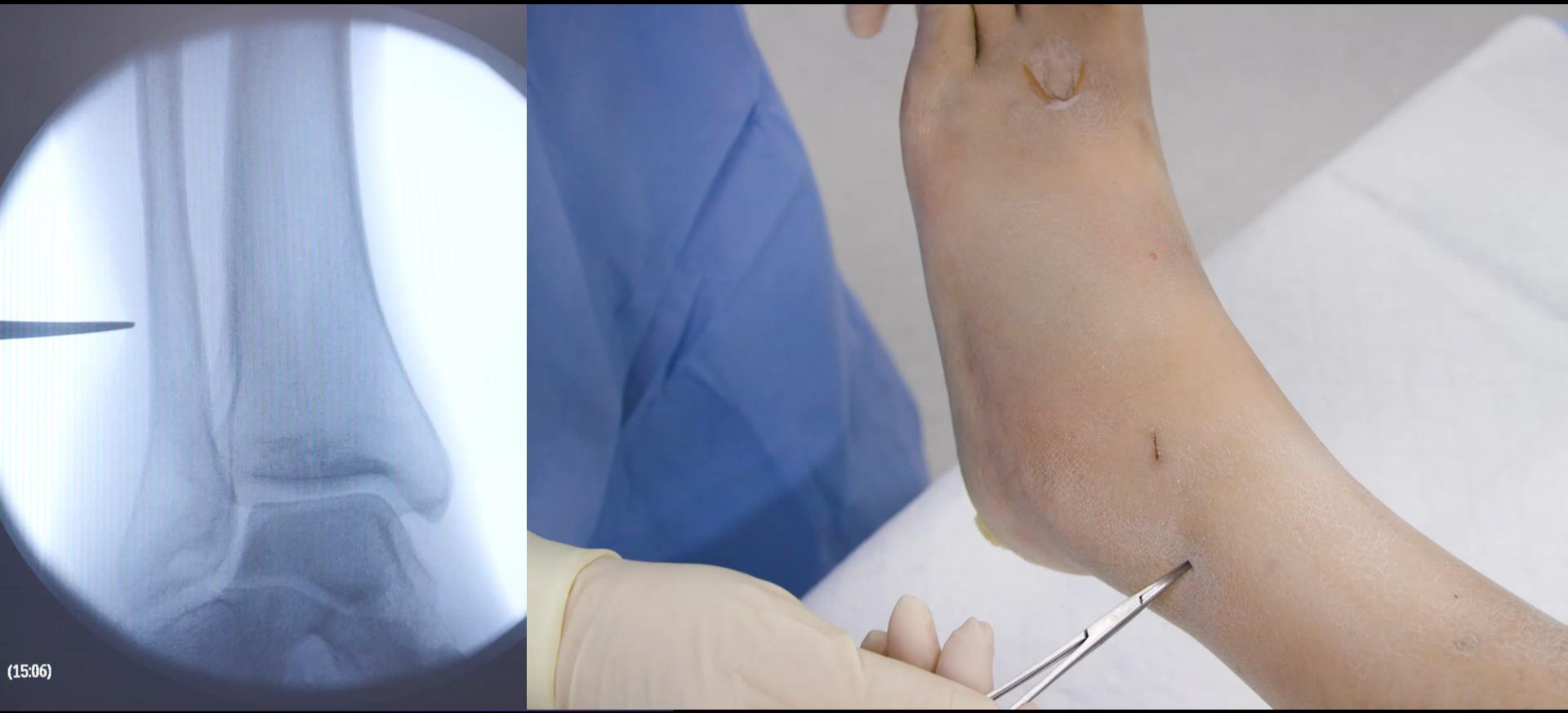
- Grade 1: sprain
- Grade 2: tear, no displacement
- Grade 3: tear, displaced

SYNDESMOSIS TREATMENT

- **Grade 1: boot, early PT**
- **Grade 2: boot, delayed WB, delayed PT**
- **Grade 3: surgical repair, PT**

SYNDESMOSIS TREATMENT

- **Grade 1: boot, early PT**
- **Grade 2: boot, delayed WB, delayed PT**
  (??? Surgical Repair, PT ???)
- **Grade 3: surgical repair, PT**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FUNDAMENTALS OF ANKLE REHABILITATION

Jake Jones PT, DPT

The Orthopaedic Institute at St. Elizabeth: A partnership between OrthoCincy Orthopaedics & Sports Medicine, St. Elizabeth Physicians and St. Elizabeth Healthcare.

FUNDAMENTALS OF ANKLE REHABILITATION

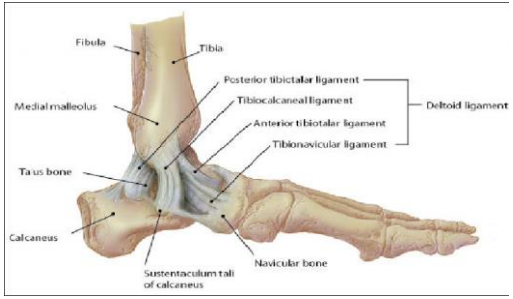
Ligaments Around the Ankle

Medial

Deltoid Ligament:

- **Anterior Tibiotalar Ligament**
- **Posterior Tibiotalar Ligament**
- **Tibiocalcaneal Ligament**
- **Tibionavicular Ligament**

• Resists excessive eversion, dorsiflexion, and external rotation



Lateral

Anterior Talofibular Ligament

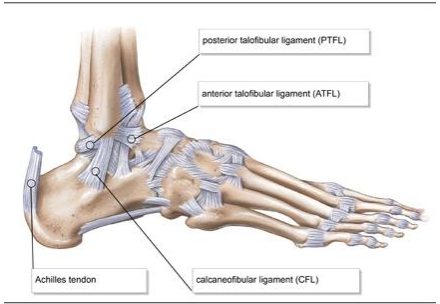
• Resists excessive plantar flexion, inversion, and anterior translation of talus

Calcaneofibular Ligament

• Resists torsion and inversion of a plantar flexed foot

Posterior Talofibular Ligament

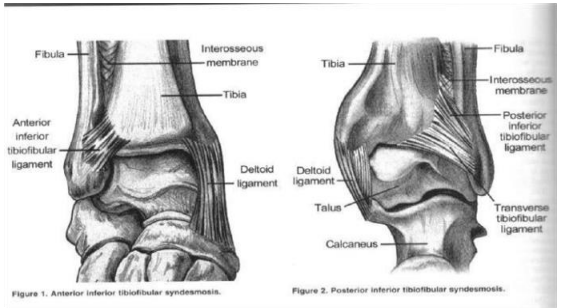
• Resists posterior translation of talus



Syndesmotic

- **Anterior Inferior Tibiofibular Ligament**
- **Posterior Inferior Tibiofibular Ligament**
- **Transverse Tibiofibular ligament**
- **Interosseous Ligament**

• Resists axial, translational, and rotational forces that attempt to separate the tibia and fibula



FUNDAMENTALS OF ANKLE REHABILITATION

Grades of Ankle Sprains

Grade 1

- Microscopic injury with minimal stretching[2]
- Little swelling and tenderness
- Feels stable with minimal impact on function/weight bearing

Grade 2

- Macroscopic injury with mild stretching; ligament still intact[2]
- Mild swelling and tenderness
- Reduced proprioception, ROM, and stability

Grade 3

- Complete rupture of ligament[2]
- Severe swelling and tenderness
- Significant instability and loss of function

Musculature Around the Ankle

Plantar Flexion

- Gastrocnemius, Soleus, Plantaris, Flexor Hallucis Longus, Flexor Digitorum Longus, Tibialis Posterior, Peroneus Longus, Peroneus Brevis

Dorsiflexion

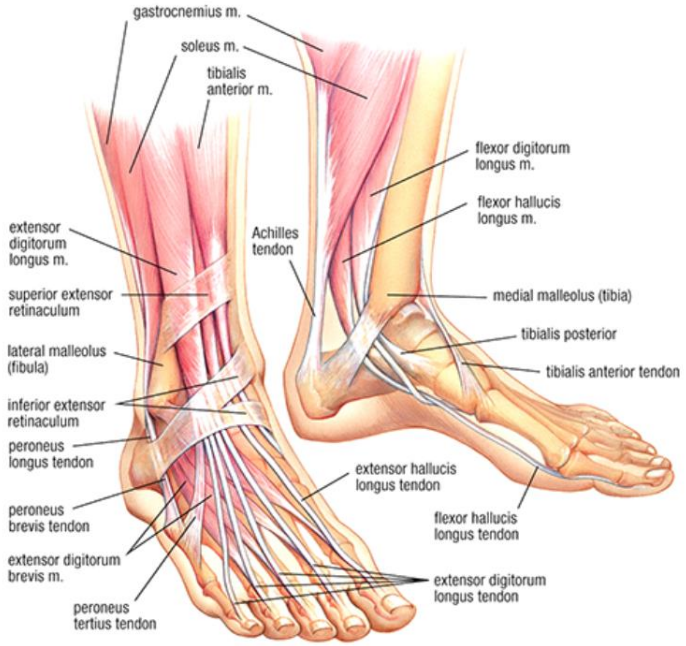
- Tibialis Anterior, Extensor Hallucis Longus, Extensor Digitorum Longus, Peroneus Tertius,

Inversion/Adduction

- Flexor Hallucis Longus, Flexor Digitorum Longus, Tibialis Posterior, Tibialis Anterior

Eversion/Abduction

- Extensor Digitorum Longus, Peroneus Tertius, Peroneus Longus, Peroneus Brevis



FUNDAMENTALS OF ANKLE REHABILITATION

Nerves Around the Ankle

1.) Common Peroneal

- Provides motor and sensory information
- Bifurcates to form the superficial peroneal and deep peroneal nerves

2.) Tibial

- Motor and sensory information
- Bifurcates to become the medial and lateral plantar nerves

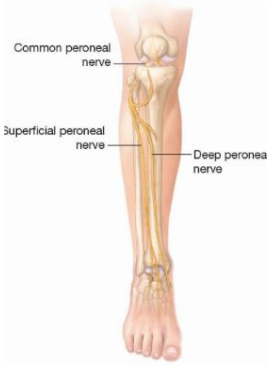
3.) Saphenous

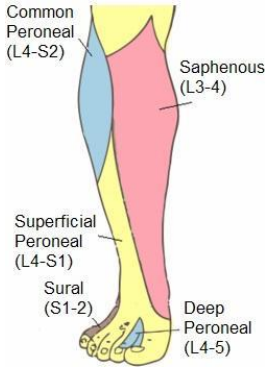
- Sensory information to the anteromedial aspect of the lower limb

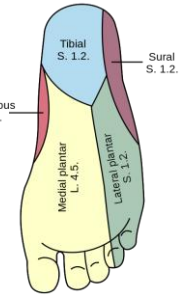
4.) Sural

- Sensory information for posterior calf region
- Medial cutaneous branch from tibial nerve and lateral cutaneous branch from the common peroneal nerve

Nitz and others found that grade II ankle sprains resulted in damage to peroneal nerve 17% of the time and tibial nerve 10% of the time. In grade III sprains these rates increased to 86% for peroneal and 83% for tibial.







FUNDAMENTALS OF ANKLE REHABILITATION

What does the research say about treatment regarding…

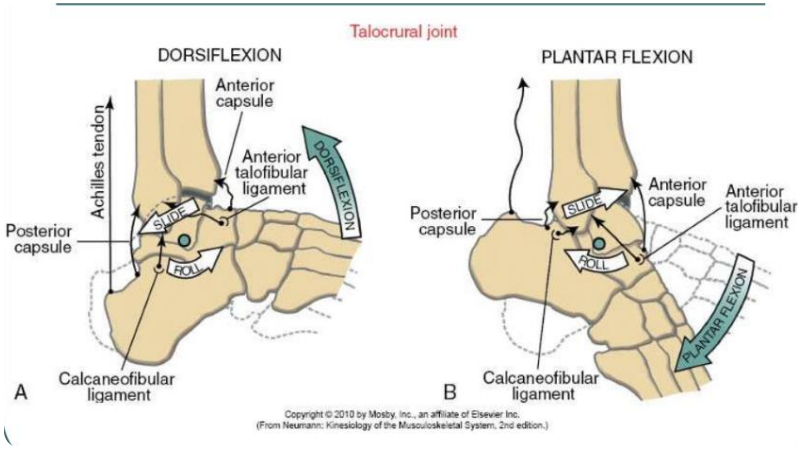
- Joint Mobilizations
- Strength Exercises
- Stretching
- Balance
- Gait Training
- Modalities
- Bracing & Tape

FUNDAMENTALS OF ANKLE REHABILITATION

Joint Mobility

Proper arthrokinematic motion is necessary for normal ROM

- Normal: convex talus glides posterior, rolls upward, rotates externally on concave mortise and the fibula glides superior and lateral away from tibia[8]
- ATFL Damage: posterior glide is restricted d/t laxity allowing talus to sublux anteriorly and internally rotate under the mortise and also causes anterior and inferior displacement of the fibula[8]
- Research has shown that normal ankle-dorsiflexion ROM was restored with fewer treatment sessions in patients who receive passive joint-mobilization interventions in combination with RICE
  - Passive mobilization can correct positional fault of the talus to improve arthrokinematic motion



Normal Active ROM

- Plantar flexion: 50 degrees
- Dorsiflexion: 20 degrees
- Inversion: 35 degrees
- Eversion: 25 degrees

FUNDAMENTALS OF ANKLE REHABILITATION

Joint Mobility

- A systematic review with meta-analysis by Doherty and others found that all 5 studies evaluating the effects of ankle mobilization demonstrated an initial positive effect on dorsiflexion ROM[17]

Mobilization with acute ankle sprain population:

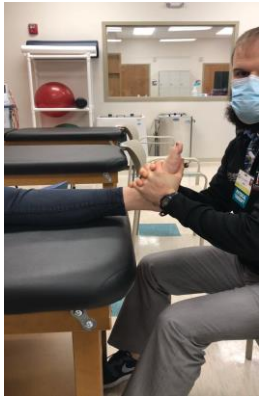
- Talocrural joint mobs every other day for 2 weeks lead to increased stride speed and DF ROM[9]
- One treatment of grade III TC joint mobs lead to significant decrease in pain[9]

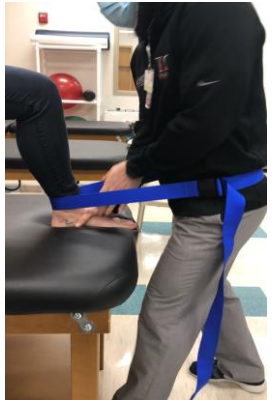
Mobilization with sub-acute/chronic sprain population:

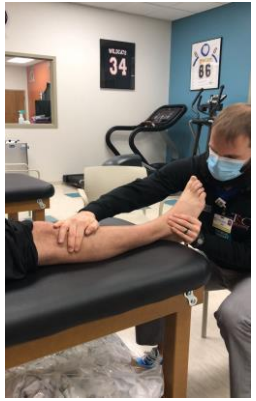
- TC joint mobs lead to immediate improvement in sagittal plane ROM, pressure pain threshold, and weight bearing load distribution[9]
- WB and NWB mobilizations with movement improved posterior talar glide and talocrural dorsiflexion immediately following application[10]

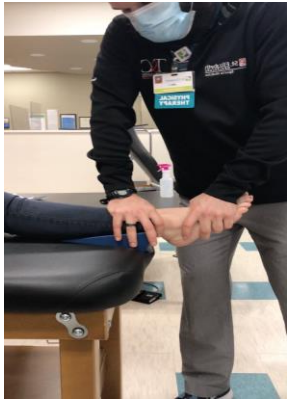
FUNDAMENTALS OF ANKLE REHABILITATION

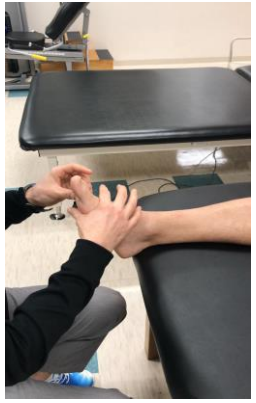
Joint Mobility











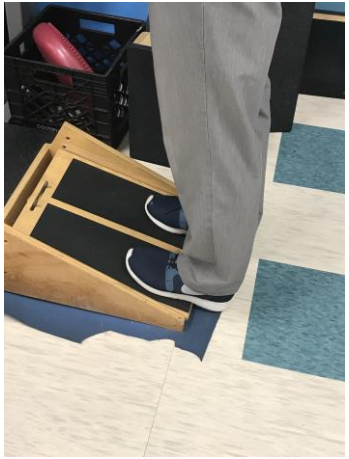
FUNDAMENTALS OF ANKLE REHABILITATION

Stretching

Static stretching programs have been shown to have the strongest effects on ankle dorsiflexion ROM after acute ankle sprains.[8]

- Masafumi and others performed a study examining the effects of stretching on dorsiflexion ROM after sprain
- 3 groups: 30 sec, 60 sec, and 120 sec static stretch groups performing the stretch 3x/day 5 days a week
- Researchers assessed ROM at 2, 4, and 6 weeks post sprain in all groups and found all groups had significant improvements when compared to baseline but there was no significant difference between groups
- Duration of hold not as important as doing the stretch regularly

Gastroc tightness is not caused from sprain itself, it is likely developed secondary to poor mobility or adaptive tightening.



FUNDAMENTALS OF ANKLE REHABILITATION

Strength

- After trauma to ligamentous structures there is notable laxity. When this happens, muscles become more dominant for stability however, they are slower to supply force d/t reaction time and the electrochemical delay to build force[12]

- Fatigue decreases proprioceptive accuracy thus training muscle strength and endurance to increase the fatigue threshold can reduce risk for injury[13]

- Study by Ismail et al. looked at 2 groups with grade I or II sprains. They were placed in either a traditional strength group (4-way ankle strength, towel curls, marble pick ups, heel raise) or plyometric group which included hopping and jumping activities. They had 2 sessions a week for 6 weeks. In the end they found that plyometric training was more effective in increasing functional performance in athletes than traditional strengthening exercises[15]

FUNDAMENTALS OF ANKLE REHABILITATION

Strength

- Training with an explosive pre-stretch of the muscle can improve the neural efficiency, thereby increasing neuromuscular performance and decreasing the time needed to produce force leading to more power output and better athletic performance.[15]
- Because strength and muscle performance are important to compensate for ligamentous laxity, we can infer that plyometric training would be a more superior way to train in order to improve dynamic stability necessary for sport

FUNDAMENTALS OF ANKLE REHABILITATION

Balance & Proprioception

Balance is believed to be mediated by the same peripheral afferent mechanism that mediates joint proprioception[7]

- Balance exercises are strongly indicated following soft tissue injury and should be initiated early if weight bearing is tolerated

- Every surgical intervention within the foot/ankle and its immobilization leads to the occurrence of proprioceptive disorders, related both to kinesthetic sensation and unconscious neuromuscular control[11]

- Every ligament and/or capsule injury within the foot and the talocrural joint leads to the occurrence of proprioceptive deficits and in consequence, to reduced neuromuscular control and functional instability[11]

Decreased proprioception due to:

- Tissue Damage
- Swelling
- Competing nociceptive inputs

FUNDAMENTALS OF ANKLE REHABILITATION

Balance & Proprioception

- **Proprioception is the ability to sense where our limbs and joints are in relation to our body and to the surrounding environment (position as well as movement) in the absence of visual feedback.[3]**

Joint position sense

- Ability to reproduce an angle after active or passive positioning[4]

Kinesthesia

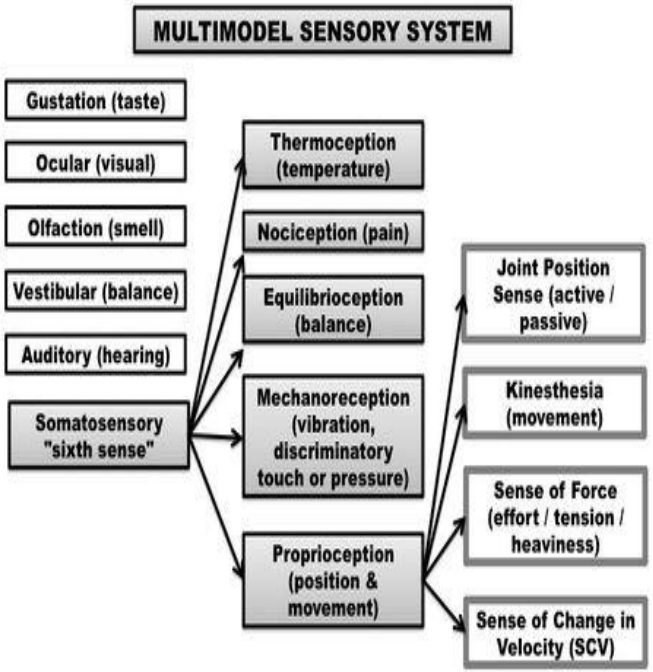
- Ability to appreciate duration, direction, amplitude, speed, acceleration, and timing of movement of a joint[4]
- Ability to detect active or passive motion[3]

Sense of force

- Ability to reproduce force of a movement one or more times (GTO and muscle spindles)[4]
- Ability to appreciate and interpret force being applied to or generated about a joint, as well as the ability to consistently reproduce a desired level of force[3]

Sense of change in velocity

- Awareness of the rate of displacement (velocity) of a limb[3]



FUNDAMENTALS OF ANKLE REHABILITATION

Balance & Proprioception

- Neural input provided by peripheral mechanoreceptors as well as visual and vestibular receptors are integrated by the CNS to create appropriate motor responses[1]

Proprioceptive mediated neuromuscular control comes from 3 distinct levels within the CNS:

- **Spinal Level**: reflex joint stabilization during conditions of abnormal stress i.e dynamic joint stabilization[6]
- **Brainstem**: integration of mechanoreceptor info, visual, and vestibular info to maintain body position[6]
- **Motor Cortex/Basal Ganglia/Cerebellum**: cognitive awareness of position and movement in which motor commands are initiated for voluntary movement; repetition leads to stored central commands that requires less and less conscious reproduction[6]

FUNDAMENTALS OF ANKLE REHABILITATION

Balance & Proprioception

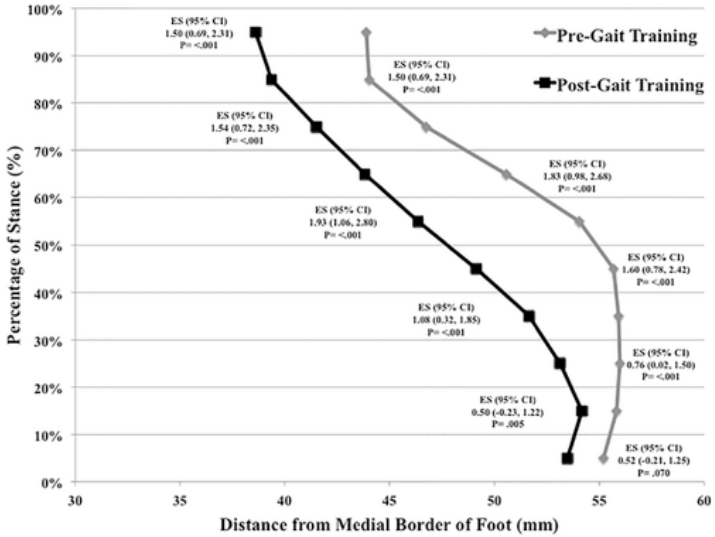
- **Proprioception is necessary for**:
  - Learning new skills
  - Dynamic joint stability
  - Injury prevention
    - **Reflex arc generated by mechanoreceptors and muscle spindles are 70-100x faster than nociceptive signals.**
    - **Joints and muscles can detect and respond to abnormal stresses much more quickly when functioning appropriately than a reflex that is initiated secondary to a stimulus that is perceived as painful**
- Programs with the addition of proprioceptive training demonstrated a significant reduction in subjective instability and functional outcomes[17]
- Meta analysis revealed a significant reduction of ankle sprain incidence when proprioceptive training was performed[17]
- Proprioceptive/neuromuscular exercise was effective at increasing functionality as well as at decreasing the incidence of recurrent injuries and “giving way” episodes after ankle sprains[17]




FUNDAMENTALS OF ANKLE REHABILITATION

Gait

- Within 2 weeks of sustaining an initial ankle sprain, patients exhibit altered gait patterns with increased ankle joint inversion during toe-off. In chronic ankle instability patients, there is a similar increase in ankle joint inversion prior to and following heel strike.[14]
- Feger and others found that ankle instability leads to a lateral deviation in center of pressure during stance phase of gait[14]
  - They collected EMG and force plate data from 14 patients with CAI while walking using a within subject design
  - The intervention was 5 sessions within 5-10 days of 7-10, one-minute bouts of walking with a band pulling the lower leg medially
  - Pretest showed increased glute med activation and decreased peroneus longus activation with COP measures located lateral
  - Post test showed decreased glute med activation and increased peroneus longus activation with COP measures moving medial



FUNDAMENTALS OF ANKLE REHABILITATION

Modalities

- Ankle ROM is typically restricted by pain, spasm, and swelling. Modalities controlling pain and swelling may improve ROM.
- Cryotherapy and electrotherapy are incorporated to minimize pain, spasm, and neural inhibition to allow for earlier and more aggressive interventions to restore motion.[8]
- Cochrane Review 1966-2010 comparing sham US to US[16]:
  - Zero reports showed significant difference in pain, swelling, weight bearing status, functional ability, or changes in ROM

FUNDAMENTALS OF ANKLE REHABILITATION

Tape and Bracing

- Tropp et al undertook a study in soccer players; subjects in the brace group experienced a significant decrease in the incidence of ankle sprains when compared to no intervention[2]
- Dizon et al found the reduction of ankle sprain by 69% with the use of ankle brace and reduction of ankle sprain by 71% with the use of ankle tape among previously injured athletes[17]
- Persistent swelling at short-term follow-up was less with lace-up ankle support than with semi-rigid ankle support, an elastic bandage, and tape[17]

FUNDAMENTALS OF ANKLE REHABILITATION

In Conclusion…

1. Assess for dermatomal and myotomal deficits that could indicate nerve damage
2. Perform joint mobilizations to talocrural joint, proximal tib/fib joint, and 1st ray to improve arthrokinematic motion necessary for normal motion
3. Perform traditional strength exercise for stability but make sure you incorporate plyometric work when tolerated especially for athletes
4. Make sure you perform some sort of plantar flexor stretch
5. Initiate balance and proprioceptive exercises early to enhance neuromuscular control and reduce recurrent injury
6. Assess gait mechanics and treat deficits especially activation of peroneus longus to reduce lateral deviation in center of pressure
7. Use modalities for pain control in order to initiate higher level activities earlier in the rehab process
8. Use tape or brace when returning to sport for added proprioceptive feedback and external support

Q&A PANEL

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