Ultrasound Point of Care Tool for Evaluation and Intervention

Pierre d'Hemecourt, MD

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Ultrasound

High resolution for superficial structures

Multi-planar capabilities

Color Doppler

Dynamic Evaluation

Intervention

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HIP

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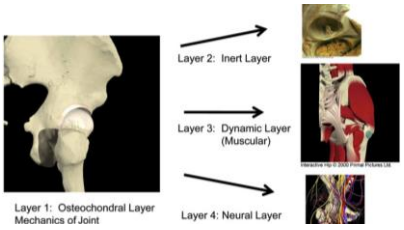
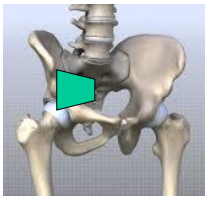
The Multi-layered causes of Pelvic Pain



Kelly B *Sports Health: A Multidisciplinary Approach* Feb 2014

Static Examination



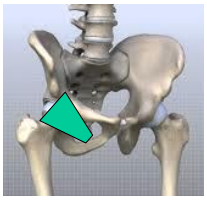
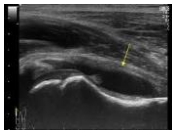
Start Anterolateral: Sagittal Direct

- AIIS (Subspine Impingement)
- Capsule
- Labrum
- Calcification: labrum, rectus,capsule

Static Examination

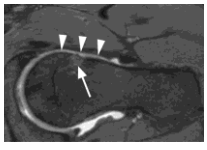
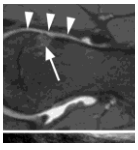
Static Examination

Now turn probe in sagittal oblique plane
- Look at cam as well as pincer
- Effusion and note the orbicular fibers

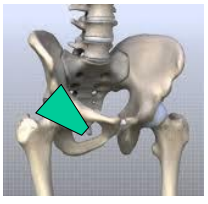
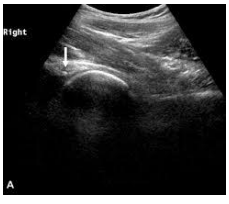

Static Exam

90% Sensitive
? Screening
Buck: Eur Radiol 2011

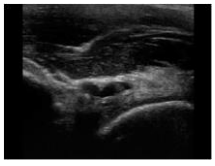

Static Examination

Now turn probe in sagittal oblique plane and view the anterior labrum to the psoas

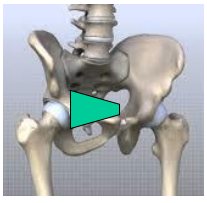
Static Examination

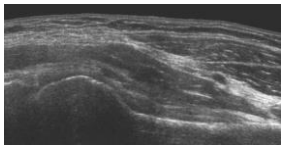
Labral Tears and Paralabral Cysts



Static Examination

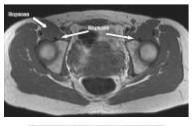
Psoas Bursa

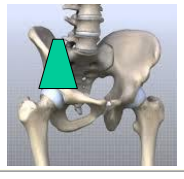




Static Examination

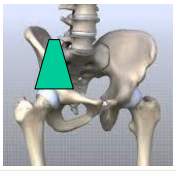
Short Axis
- Rectus
- Psoas
- Acetabulum





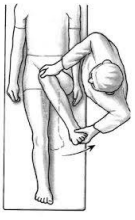
Dynamic Examination

Impingment at 90:90 with internal rotation
- Look at acetabulum and at Rectus F
- Snaps and clicks



Dynamic Examination

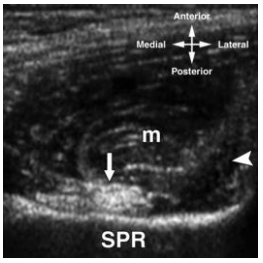
Impingment at 90:90 with internal rotation



Snapping Psoas

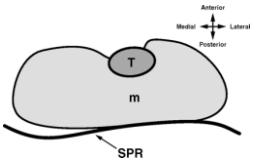
Left hip at rest with posterior psoas tendon

Deslandes et al, AJR 2008



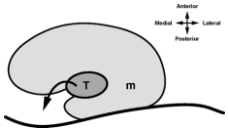
Psoas

Hip Flexion Abduction and ER



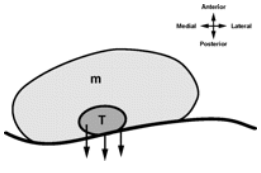
Entrapment as it is brought back to neutral

Psoas



Psoas

Sudden release

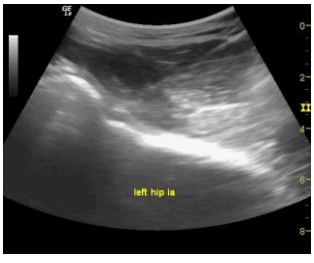


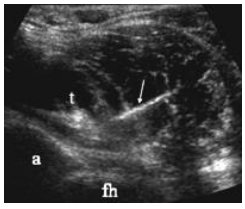
Diagnostic and Therapeutic Injections

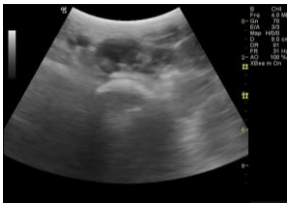
Differential Injections

Hip IA first:

- Povocative tests
- Ropivacaine 0.2% and triamcinalone
- Repeat Provocative tests
- Psoas







Lateral to Medial Psoas Injection

Ankle

Directed examination
Where are the symptoms?

Posterior Ankle

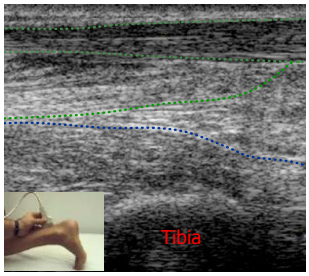
Achilles Tendon

Gastrocnemius and soleus tendons
No synovial sheath
Paratenon
Kager's fat pad
Retro- calcaneal bursa

Achilles

Soleus

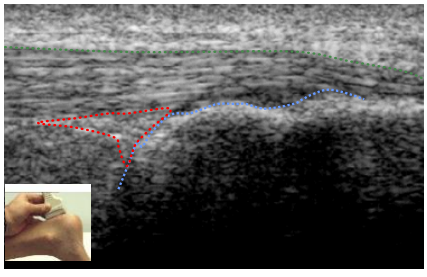
FHL



Achilles LAX

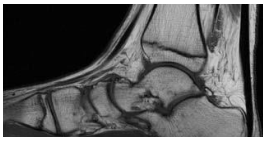
Achilles

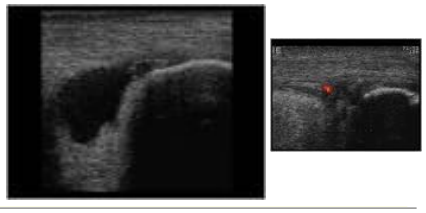
Retro-calcaneal Bursa



Achilles insertion LAX

Bursitis

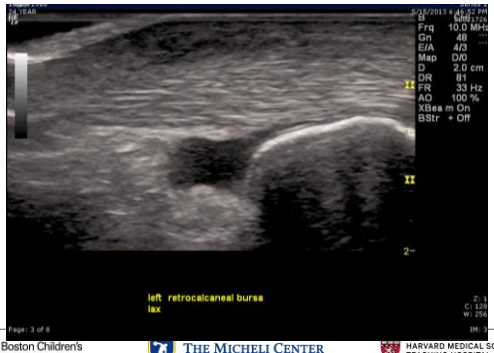




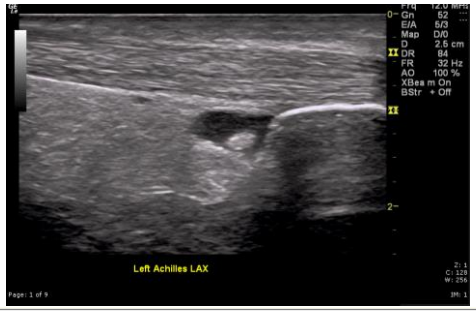
Case

24 Y.O.Dancer with posterior ankle pain

Tender at Achilles



MRI



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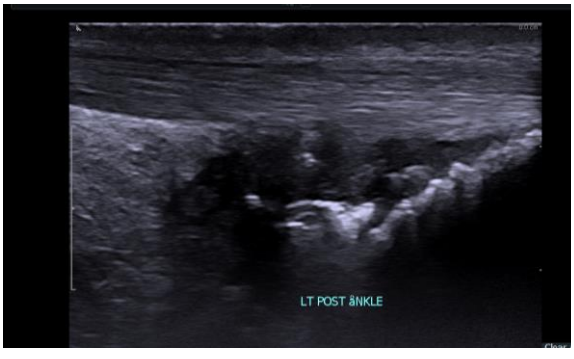

Recurrent Bursitis

Underwent PRP into Bursa

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THANK YOU

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Knee Injuries in the Young Athlete
Top 10 Facts

Pediatric and Adolescent Sports Medicine

Vu Medi Webinar

September 16, 2015

Theodore J. Ganley, MD
Director of Sports Medicine at
The Children's Hospital of Philadelphia

Sports Medicine *and* Performance Center *at*
The Children's Hospital *of* Philadelphia

Associate Professor, Department of Orthopaedic Surgery
The University of Pennsylvania School of Medicine

DISCLOSURES

I, Theodore Ganley, have relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation as follows:

- Volunteer: Reviewer/editor
  - The American Journal of Sports Medicine
  - Clinical Orthopedics and Related Research
  - The Journal of Bone and Joint Surgery
  - The Journal of Pediatric Orthopedics
  - The University of Pennsylvania Orthopedic Journal
- Volunteer - Advisory Board
  - IPOS – Int. Pediatric Orthopedic Symposium
  - ROCK – Research in OCD of the Knee
  - PRISM – Pediatric Research in Sports Medicine
- Paid Consultant
  - None

Pivot – Pop – Pain

Pivot – Pop – Pain

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PE

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Lachman

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Anterior Drawer

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Cruciate Ligaments and Menisci

10

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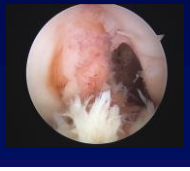
ACL Injury on the Rise

- Over 10 yrs
  - 914 ACL, 996 meniscal tears, 155 tibial spines
    - Tibial spine fractures (controls)

400% increase in ACL injuries ($p<0.001$)
Multivariate linear regression analysis



The Children's Hospital of Philadelphia
2011 AAP

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Girls - greater risk of injury!

Females > Males, Same Sports, Same Schools

Goldberg, Flynn, Ganley 2006

- Females - significantly greater risk/rate of these injuries relative to males

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ACL Injury

ACL tears can be prevented

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Ready Set Prevent

www.chop.edu/sportsmed

ACL tears can be prevented

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Pediatric ACL Prevention Programs can increase strength & performance

Theodore J. Ganley, MD
Jeffrey Albaugh, PT, MS, ATC

European Pediatric Orthopedic Society
Pediatric Orthopedic Society of North America
International Pediatric Orthopedic Symposium

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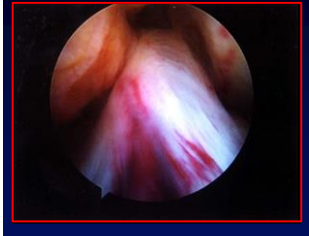
Kids Ligament injuries…
Some (partial) will heal



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Partial will heal…

Complete will not…

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Valgus and Varus Stress

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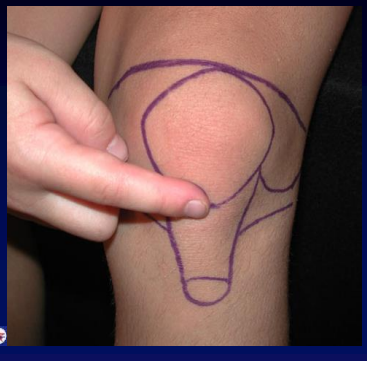
“My knee hurts after soccer”



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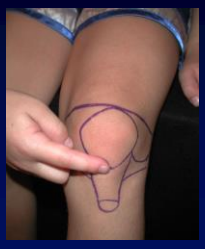
"My knee hurts after soccer"

- Exam Findings
  - Tenderness
  - Quad Contracture



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"My knee hurts after soccer"

- Management
  - Quad stretching
  - Ice after sports
  - Activity modification

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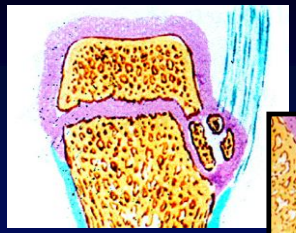
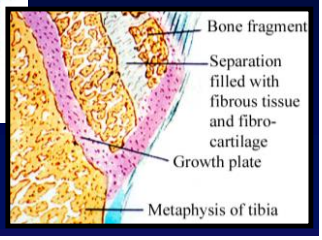
"My knee hurts after soccer"





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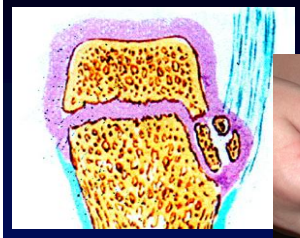

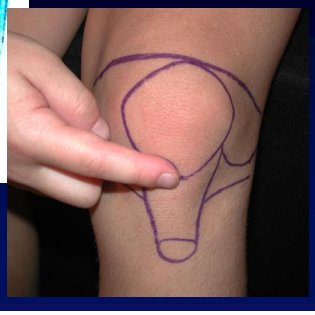

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TG's ABC's

- Activity Modification
  - OK to play sports
  - Pain/Limping
    - D/C activities for the day

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TG's ABC's

- Activity Modification
  - OK to play sports
  - Pain/Limping – D/C activities for the day
  - D/C activites 3 - 4 days in a row
    No sports 4 wks

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TG's ABC's

- Bracing

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TG's ABC's

- Continued Rehabilitation

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Osgood-Schlatters

- TG to dad "What did I say?"
- Dad's responce

"Not Dangerous"
"You really don't know what it is"
"Ok to go"

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Teaching Sheets


Osgood Schlatter Disease

What is Osgood Schlatter Disease?

What are the recommended treatments?


Figure A: Quadriceps Stretch

Figure B:

Hamstring Stretch

Figure B

On the Sports Website

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Osgood-Schlatters Fact

- Teaching Sheets are valuable
- Now I say (after a complete discussion)
  - "Not Dangerous"
  - "Hand these forms to your spouse"
  - "Ok to go"

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Tackle - Pop - Pain

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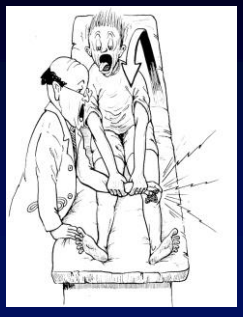

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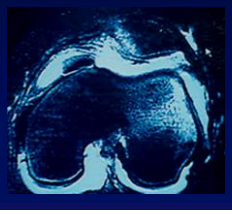
Patellar Dislocation

- "One-Time Dislocators"

Treatment:

- Evaluate for fractures (common)



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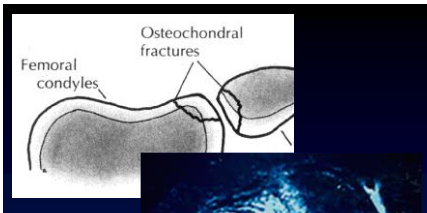

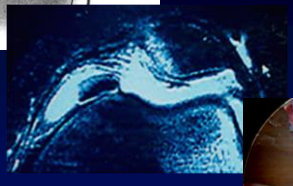

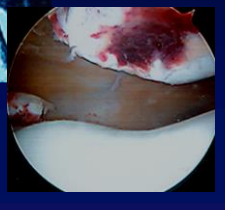

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Patellar Dislocation

- "One-Time Dislocators"

Treatment: "Amazing Fact"

-Brace/Cast & Rehab (ABC's) – If no fractures

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Pivot – Pop – Pain

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Clinical Evaluation

- History
  - Initially asymptomatic
  - Later – Snapping/clunking/giving way

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Imaging

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Imaging

- Plain Radiographs
  - Lateral joint widening, tibial cupping, femoral dysmorphia, tibial spine hypoplasia

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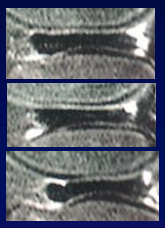
Imaging

- MRI diagnosis
  - 3 or more consecutive 5 mm thick sagittal slices
    - Continuity between anterior and posterior horns
  - Thickened bow-tie appearance



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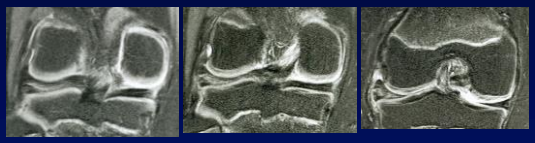
Imaging

- MRI diagnosis
  - Transverse meniscal diameter > or = 15 mm



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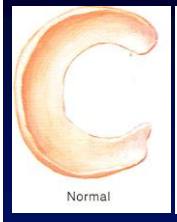
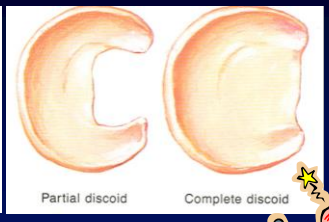
Discoid Lateral Meniscus

is primarily a pediatric finging





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Pain – Swelling – Gradual onset

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Wilson’s Test

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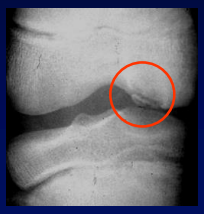
Knee ***

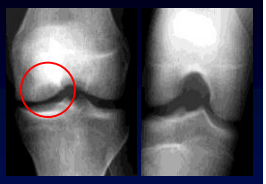
- Location
  - lateral aspect of MFC > 70%
  - Inferior-central lateral 15-20%
  - Patellar 5-10%
  - Trochlea <1%



T Ganley

***

- Imaging:
  - Plain Films
    - AP, Lat, tunnel views
    - Assess: Lucency, Size, Location, Loose Bodies



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Osteochondritis Dissecans

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Osteochondritis Dissecans (OCD)

- Etiology
  - Repetitive focal microtrauma
  - Ischemia
  - Abnormal ossification
  - Genetic/endocrine factors

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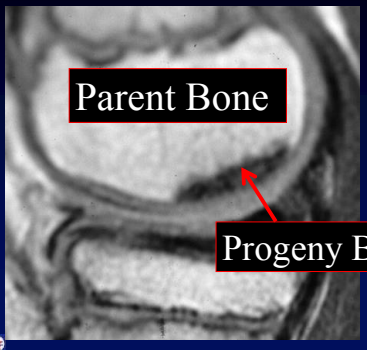

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ROCK
Research in OsteoChondritis of the Knee

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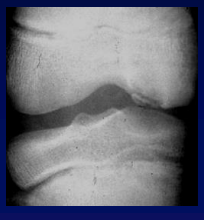
Osteochondritis Dissecans - Fact

ABC's

Smaller Lesions
Skeletally Immature → Immobilization
Younger Kids Age <12 Activity Restriction



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3

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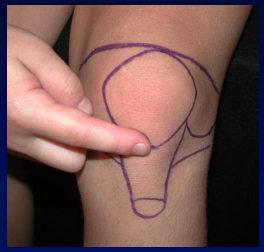
Kid's will point to the problem

- Physical Exam Findings:

  Where: Point maximal tenderness



T Ganley

2

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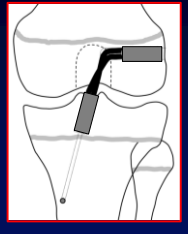
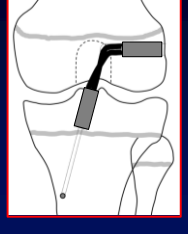
Good News: We can do amazing things to fix kids knee



T Ganley

Good News: We can do amazing things to fix kids knee



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All-Inside, All-epiphyseal, Autograft Quadrupled Semitndinosis ACL Reconstruction

Eric J. Sarkissian, B.S., Theodore J. Ganley, M.D.
Division of Pediatric Orthopaedic Surgery, The Children's Hospital of Philadelphia

ACL tears in skeletally immat
treatment remains controversi
• Non-operative mea
damage?
• Operative reconstr
consequent

We developed and previously
using a socket in the tibia to pl
equipment refinement allows t
less invasive and less disrupti

into femoral and

Graft Preparation

• Quadrupled semitendinosu
• Two ACL TightRope® RT
placed o
ends of graft
• Alternatively, TightRope®
Implant
may be used on

CL reconstruction:

documented by
, Shirley, NY)
. Sec. Prevent.

Socket Preparation

• Pilot tracks created by guide
confirmation of positioning w
arm 3-D CT scanner (Medtron
Minneapolis, MN)
• C-arm imaging acceptable

and using buttons to
detally immature
lescent patients.

reverse reamed creating sockets
in femur and tibia

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Bad News…
We can't control patient behavior

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1

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In Summary…

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1) ACL Rupture

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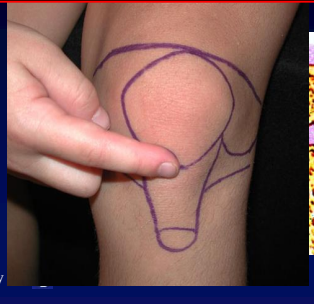
2) Osgood Schlatter's



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3) Patella Dislocation

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4) Discoid Meniscus

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5) Knee OCD

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Ready Set Prevent

www.chop.edu/sportsmed

Injury Prevention programs

T Ganley

Thank You

T Ganley

Sports Medicine *and* Performance Center *at* The Children's Hospital *of* Philadelphia

Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Acute Ankle Injuries of Young Athletes

Michael T. Busch, MD

Children's Orthopaedics of Atlanta

Children's Healthcare of Atlanta
Dedicated to All Better

Financial Disclosure

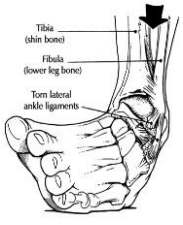
None pertinent

Consulting/Education
- Orthopediatrics
- Arthrex

Children's Healthcare of Atlanta

History

- 13 y/o boy playing tennis
- "Rolled his ankle"
- Felt a pop
- Swelled quickly
- Severe pain
- Could not play
- No prior problems
- R.I.C.E. by school trainer



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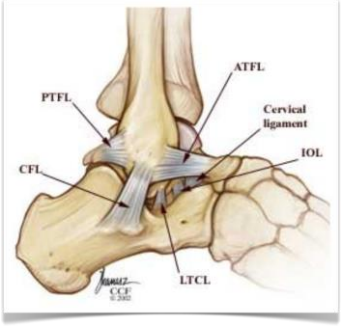
Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Physical Exam

- Swelling
- Discoloration
- ROM
- Crepitation
- Weight bearing
- Stability

Lateral Ankle Ligaments



Severity Grading

- Grade I - min. structural disruption
- Grade II - partial disruption/stretching
- Grade III - complete disruption

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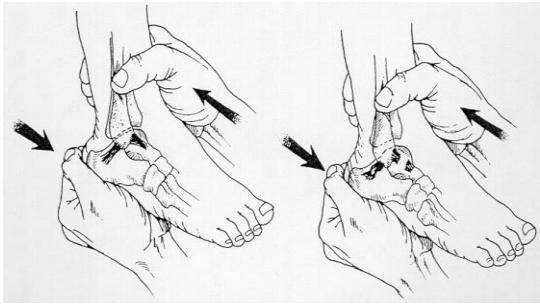
Michael T. Busch, MD
www.childrensortho.com

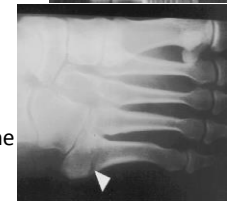
Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Physical Exam: Anterior Drawer



Differential Dx?

- Ankle Sprain
  - Garden Variety
  - Acute on Chronic instability
  - Underlying tarsal coalition
- "High Ankle Sprain"
- Fracture
  - Ankle (tibia, fibula, talus)
  - MT5 base, etc
- Ankle / subtalar dislocation
- Peroneal tendon dislocation
- ± Osteochondral injury of the talus



Static assessment vs. Injury

Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Radiographs

When to order: "Ottawa Criteria"

What to order: 3 Views

- AP
- Lateral
- Mortise
- Stress Views
  - Chronic
  - Syndesmosis injury

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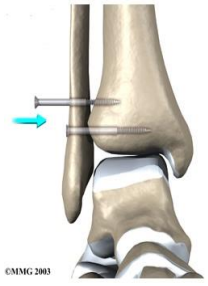
"High Ankle Sprain"

> 5 mm "clear space" is abnormal

Slow to heal ± surgery



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Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Physeal Fractures

- Sprain vs fracture
- Weak link in the chain
- Clinical diagnosis !
  - Refusal to WB
  - Focally tender over the physis
- Radiographs
  - Bony element
  - Displacement
  - ± Soft tissue swelling

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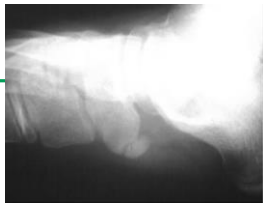
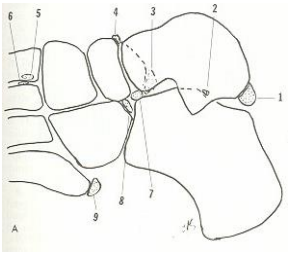
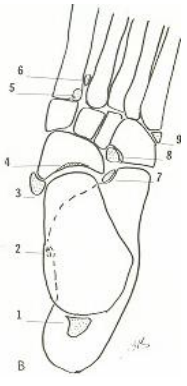
Foolers

- Accessory navicular
- Os subtibiale
- Os subfibulare



Accessory Ossicles





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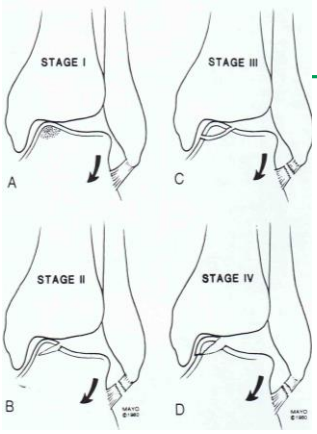
Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

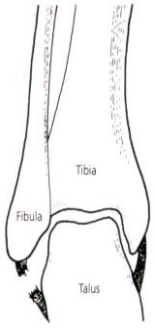


Concurrent

Berndt & Hardy JBJS '59

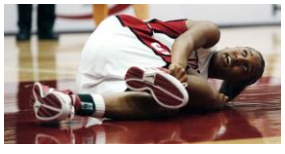
Ankle Sprains

- Most common sports injury
- 27,000/day in the US
- Peak incidence 15-19 y/o



Youth Sports

- Extremely common in most running/jumping sports
- Frequency in Basketball: 70%
- Severe Grade: 32%
- Recurrence: 80%
- Rehab = Prevention



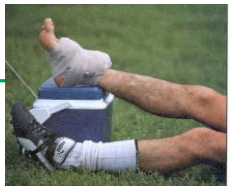
Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Treatment

- Acute management
- Range of motion
- Strength
- Proprioception
- Return to sport

Acute Mgmt.

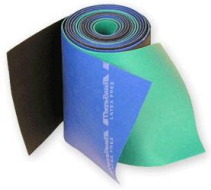
- RICE technique
  - Rest
  - Ice
  - Compression
  - Elevation
- Modalities
  - Ice
  - Electrical stimulation
  - Taping/bracing/cast?



Range of Motion

Active, Passive, Active Assisted

Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist



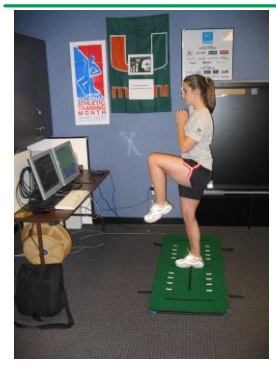
Strength

- Isometric
- Isotonic
  - Concentric
  - Eccentric
- Isokinetic

Proprioception

- Affected by injury
- Start in early phases
- Advanced throughout

Proprioception



Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Return to Sport

- More than exercises
- Sport specific skills
- Vary the challenges
- Protect
  - Taping
  - Bracing
- Prevent re-injury!

Who Needs How Much?

Ankle Sprain Treatment Plan

	Geek	Jock
Not so bad	Ace Ice Rest Return	R.I.C.E. Rehab Brace Early Return
Bad	R.I.C.E. Splint/cast Self-rehab	R.I.C.E. Splint Rehab Brace

Pitfalls of the Young Athlete: Ankle, Elbow, and Wrist

Primary Surgical Repair ?

Highlights

- Comprehensive meta analysis
- No advantage to early surgery
- Most do well
- Rehab > no rx.
- Good outcomes with reconstructions
- Beware of concurrent subtalar instability

Lynch SA, Renstrom PA Treatment of acute lateral ankle ligament rupture in the athlete. Conservative versus surgical treatment. Sports Med.1999 Jan;27(1):61-71.

Summary

- Common injuries
- Common sense evaluation
- Most are simple, but there are foolers and pitfalls
- Know your limits, but most are basic
- No single recipe for rx. selection
- Rehab = re-injury reduction

Michael Busch, MD
mtbusch@childrensortho.com
Admin Asst: 678-686-6820

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Evaluation of Hip Pathologies in Young Athletes

VuMedi – Pediatric and Adolescent Sports Medicine

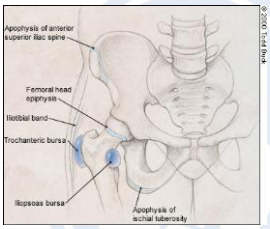
Yi-Meng Yen MD, PhD
Assistant Professor
Boston Children's Hospital
Harvard Medical School
Department of Orthopaedics
Division of Sports Medicine
Child and Adult Hip Unit

Disclosures

- Smith & Nephew (paid consultant); Orthopediatrics (paid consultant); AJSM Editorial Board

Anatomy

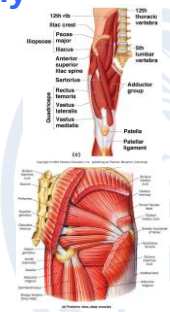
- Bony Anatomy
  - Pelvis – Ischium, Ilium and Pubis
  - Femur
  - Hip – femoral head and acetabulum
- Physis and apophysis
  - More prone to injury in the young



www.aafp.org

Anatomy

- Flexion
  - Iliopsoas
  - Quadriceps – Rectus femoris
  - Sartorius
- Extension
  - Gluteus Maximus
  - Hamstring
- Abduction
  - Gluteus Medius/Minimus
- Adduction
  - Adductors
- Internal/external rotation



Anatomy

Sensory Nerves

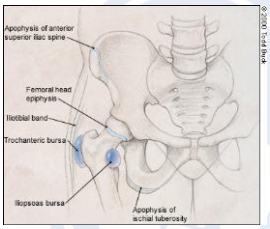
- Genitofemoral nerve (L1-L2) anteromedial thigh
- Obturator (L2-4) inferomedial thigh
- Lateral femoral cutaneous nerve (L2-3) anterolateral thigh
- Posterior femoral cutaneous nerve (S1-3) posterior thigh

Motor Nerves

- Obturator – adduction
- Superior gluteal – abduction
- Femoral – flexion
- Inferior gluteal – extension
- Sciatic – knee flexion

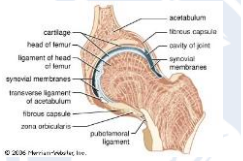
Anatomy

- Bursa
  - Prevent excessive friction of soft tissue over bony prominence
  - Tight tendons can cause inflammation with repetitive activity
  - Trochateric bursa
    - ITB
  - Iliopsoas



Anatomy

- **Intra-articular Anatomy**
  - Synovial lining
  - Capsule
  - Cartilage
  - Bone
  - Labrum
  - Ligamentum teres
- Histology of pain receptors (Nociceptin, Substance P, Neuropeptide Y) Haversath BJJ 2013
- Distribution of receptors on labrum, ligamentum teres and capsule
- Cartilage has no pain receptors
- Highest concentration at anterosuperior labrum and at chondrolabral junction



Anatomy

- Other causes of hip pain
  - Male and female sexual organs
  - Intestinal tract
  - Urinary tract
  - Vascular structures
  - Tumor
  - Referred pain from back/knee

EVALUATION OF HIP PAIN

History

- Age
  - Pre-pubescent – Transient synovitis, septic arthritis, Legg-Calve-Perthes
  - Adolescence – SCFE, FAI, Avulsion fractures
  - Young adult – Stress fracture, FAI
  - Older adult - OA
- Trauma – Fracture
- Constitutional symptoms – tumor, inflammatory arthropathy
- Mechanical symptoms – coxa saltans, labral pathology
- Activity related, sitting, walking, sports, exacerbating factors
- Relieving factors

Physical Examination

- Systematic – Standing, Sitting, Supine
- Always evaluate the hip if young patient complains of knee pain
- Always evaluate the contralateral hip

Standing examination

- Gait
  - Antalgic – decreased stance phase
  - Trendenlenberg
  - Foot progression angle
- Leg length – Symmetry of iliac crests
- Spine evaluation
- Popping of psoas or ITB
- Beighton score

Sitting Examination

- Sitting posture
- Neurologic examination
- Seated straight leg raise
- Ludloff exam for psoas

Supine Examination

- Bulk of examination
- Palpation of bony structures
- Range of motion
  - Impingement free range of motion
  - Pain or decreased internal rotation is red flag

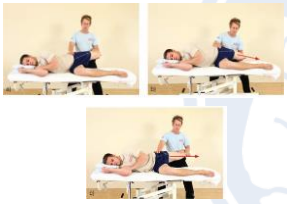
Provactive Tests

- Thomas
  - Test Iliopsoas

www.positivehealth.com

Provactive Tests

- Ober
  - Tests for TFL/ITB



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Radiology

- Order AP Pelvis NOT AP Hip
- Bilateral lateral radiographs (Frog-leg or Dunn lateral)
- MRI if suspect soft tissue injury, stress fracture or tumor

Pre-pubescent

- Transient synovitis
- Most common case of hip pain in children
- History
  - Recent trauma or viral infection
  - Acute onset of limp
- PE
  - Pain with internal rotation, logroll
- Labs to consider
  - CBC, CRP, ESR
- Prognosis
  - Self-limited, improvement with NS

Legg-Calve-Perthes

- Unknown Etiology
- Males > Females (5:1)
- Between age 4-8
- Hx
  - Insidious onset of limp with mild hip or knee pain
- PE
  - Plain with internal rotation, limited abduction
- X-ray
  - Flattened femoral head

Adolescent: SCFE

- Failure of epiphysis, femoral head slips posterior
- Hx
  - Acute – cannot weight bear
  - Chronic – limp with external rotation gait
- X-ray
  - Need AP and lateral

Adolescent – Avulsion Fracture

- Concentric or eccentric contraction with sudden "pop"
- Pain with stretch or active motion
- X-ray
  - X-ray usually definitive
  - May need CT or MRI
- Most treatment is non-operative

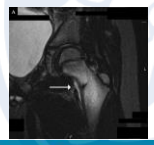
Adolescent/Young Adult - FAI

- Increasingly recognized as source of pain in adolescents
- Cam or pincer deformity or both
  - Likely develops during adolescence
- X-rays
  - AP pelvis, Dunn Lateral
  - MRI to diagnose labral pathology

Jones, Lancet 2015

Young Adult – Femoral Neck Stress Fracture

- Female athlete triad
- Hx
  - Groin pain with activity and weightbearing
- X-ray
  - Sclerosis in femoral neck
  - May need CT, MRI to diagnose
- Tension-side
- Compression-side



Evaluation and Indications for Operative Management of Clavicle Fractures

VuMedi Webinar Pediatric & Adolescent Sports Medicine: Current Concepts

September, 2015

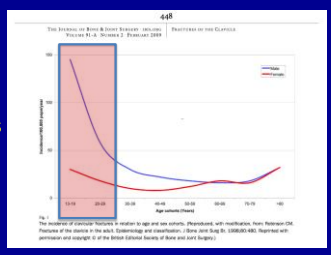
Kevin G Shea, MD
St. Lukes Sports Medicine
St Lukes Health System
Boise, Idaho

Disclosures

- None – Financial

Epidemiology -

- 10-15% of all pediatric fractures
- Most Common fracture under 10 years of age
- This is a significant pediatric, adolescent, young adult problem



Epidemiology: Location

- Mid-Shaft - 69 to 82%
  - Most are displaced

History of Treatment – 1950-1990s

- Non-unions were thought to be rare for mid-shaft
  - 0.1% to 0.8%
- Mal-unions not discussed
- Open Treatment most common cause of Non-Union
  - Neer - 4.6%
  - Rowe - 3.7%


NONUNION OF THE CLAVICLE

Charles S. Neer II, M.D., New York

J.A.M.A., March 5, 1960


An Atlas of Anatomy and Treatment of Midclavicular Fractures

Carter R. Rowe, M.D.*

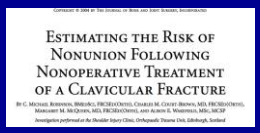
Clinical Orthopaedics and Related Research | Number 58 May-June, 1968

Clavicle Shortening and Poor Satisfaction – Adult Patients

- Worse Clinical Results with Fracture Shortening
  - Ledger et al JSES 2005
  - Lazaridez et al JSES 2006

Some Real Data – Prospective, Registry

- Robinson et al 2004
- Adults
- Risk Factors for Non-Union
  - Increasing Age
  - Female
  - Displacement
  - Comminution



ESTIMATING THE RISK OF NONUNION FOLLOWING NONOPERATIVE TREATMENT OF A CLAVICULAR FRACTURE

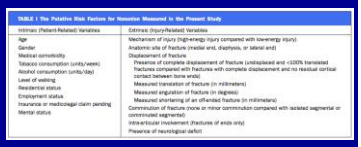
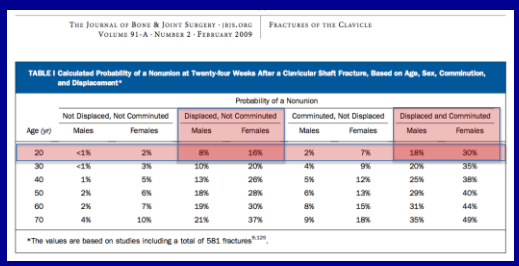


TABLE I The Putative Risk Factors for Nonunion Measured in the Present Study

Intrinsic (Patient-Related) Variables	Extrinsic (Injury-Related) Variables
Age	Mechanism of injury (high-energy injury compared with low-energy injury)
Gender	Anatomic site of fracture (medial end, diaphysis, or lateral end)
Medical comorbidity	Displacement of fracture
Tobacco consumption (units/week)	Presence of complete displacement of fracture (undisplaced and <100% translated fractures compared with fractures with complete displacement and no residual cortical contact between bone ends)
Alcohol consumption (units/day)	Measured translation of fracture (in millimeters)
Level of walking	Measured angulation of fracture (in degrees)
Residential status	Measured shortening of an offended fracture (in millimeters)
Employment status	Comminution of fracture (none or minor comminution compared with isolated segmental or comminuted segments)
Insurance or medicolegal claim pending	Intra-articular involvement (fractures of ends only)
Mental status	Presence of neurological deficit

Data – A critical tool for patient centered care



THE JOURNAL OF BONE & JOINT SURGERY · JBJS.ORG | FRACTURES OF THE CLAVICLE
VOLUME 91-A · NUMBER 2 · FEBRUARY 2009

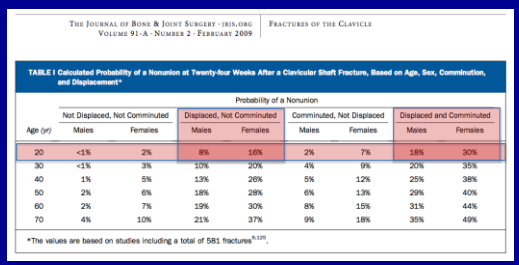
TABLE I Calculated Probability of a Nonunion at Twenty-four Weeks After a Clavicular Shaft Fracture, Based on Age, Sex, Comminution, and Displacement*

	Probability of a Nonunion							
	Not Displaced, Not Comminuted		Displaced, Not Comminuted		Comminuted, Not Displaced		Displaced and Comminuted	
Age (yr)	Males	Females	Males	Females	Males	Females	Males	Females
20	<1%	2%	8%	16%	2%	7%	18%	30%
30	<1%	3%	10%	20%	4%	9%	20%	35%
40	1%	5%	13%	26%	5%	12%	25%	38%
50	2%	6%	18%	28%	6%	13%	29%	40%
60	2%	7%	19%	30%	8%	15%	31%	44%
70	4%	10%	21%	37%	9%	18%	35%	49%

*The values are based on studies including a total of 581 fractures[9,125].

- Data Starts at age 20 –
- Displaced
  - non-union 8% and 18% male/female
- Displaced and Comminuted
  - non-union 18% and 30% male/female

Data – A critical tool for patient centered care



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70	4%	10%	21%	37%	9%	18%	35%	49%

*The values are based on studies including a total of 581 fractures[9,125].

- We don't have much prospective data on pediatric and adolescent patients

Higher Quality Data - RCT

- McKee 2007 JBJS
- Operative versus non-operative
- Displaced Midshaft
- RCT – 'Adult' males
  - Ages 16-45 years
- Operative Group
  - Improved functional Outcome
  - Lower rate of mal-union and nonunion


Nonoperative Treatment Compared with Plate Fixation of Displaced Midshaft Clavicular Fractures
A Multicenter, Randomized Clinical Trial
By the Canadian Orthopaedic Trauma Society

Adult Literature: 100% displaced mid-shaft clavicular fracture

- Obremsky, JBJS 2009
- 75% of all patients will do very well without surgery
- 25% of these clavicle fractures wont do well
  - Shortening, non-union, mal-union
- How do we determine which ones won't do well?

Systematic Review

- McKee et al 2012
- Meta-Analysis
- 6 Studies, 412 Patients
- Operative vs Non-operative
  - Non-union rate higher in non-operative group
  - 14.5 % vs 1.4 %
  - Symptomatic Mal-union rate higher in non-op
  - 8.5 % vs. 0.0%
- Earlier Functional Recovery in operative group
- No evidence to support better long term outcomes in operative group


Operative Versus Nonoperative Care of Displaced Midshaft Clavicular Fractures: A Meta-Analysis of Randomized Clinical Trials

Functional Limitations after Clavicle Fractures in Adolescents?

- Schulz et al 2013
- Adolescents
  - 10 to 18 years of age
  - 16 patients
  - Isolated, completely displaced, shortened, mid-shaft clavicle fracture sustained between 2009 and 2011


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Functional and Radiographic Outcomes of Nonoperative Treatment of Displaced Adolescent Clavicle Fractures

Jacob Schulz, MD, Molly Moor, MPH, Joanna Roocroft, MA, Tracey P. Bastrom, MA, Andrew T. Pennock, MD

J Bone Joint Surg Am. 2013 Jul 03;95(13):1169-1169. http://dx.doi.org/10.2106/JBJS.L.01390

Functional Limitations after Clavicle Fractures in Adolescents?

- Schulz et al 2013
- Regardless of patient age, sports participation, and final clavicle shortening
- For displaced , shortened, mid-shaft clavicle fracture
- Excellent outcomes for non-operative treatment


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Clavicle Complications/Reoperations

- Leroux et al JBJS 2014
  - Administrative Database
- 25% reoperation rate
- 19% hardware removal
- Complications
  - Infection 2.6%
  - Non-union 2.6%
  - Mal-union 1.1%
  - Pneumothorax 1.6%


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Rate of and Risk Factors for Reoperations After Open Reduction and Internal Fixation of Midshaft Clavicle Fractures

A Population-Based Study in Ontario, Canada

Timothy Leroux, MD, MSc, David Wasserstein, MD, MSc, FRCSC, Patrick Henry, MD, FRCSC, Amir Khoshbin, MD, MSc, Tim Dwyer, MBBS, FRCSC, Darrell Ogilvie-Harris, MBBS, FRCSC, Nizar Mahomed, MD, ScD, FRCSC, Christian Veillette, MD, MSc, FRCSC

J Bone Joint Surg Am. 2014 Jul 02;96(13):1119-1125. http://dx.doi.org/10.2106/JBJS.M.00807

Large Series of Pediatric and Adolescent Patients

- Heyworth et al, AOSSM 2014
- 641 case, retrospective
- Findings
  - 82% non-surgical, 18% surgical
  - Non-union
    - 1/526 non-op
    - 1/115 operative
  - 0% infections
  - 13 % symptomatic implants
  - 2% symptomatic mal-unions


Study Finds Low Complication Rates for Adolescent Clavicle Fractures

Authors call for additional studies to identify optimal treatment strategies

Terry Stanton

Large Series of Pediatric and Adolescent Patients

- Conclusions
  - The surgical approach more common now, especially in older patients
  - Complication rates were low for both operative and non-operative treatment
  - Patient Centered Decision Making is important


Study Finds Low Complication Rates for Adolescent Clavicle Fractures

Authors call for additional studies to identify optimal treatment strategies

Terry Stanton

Displaced, comminuted fractures Where are we now?

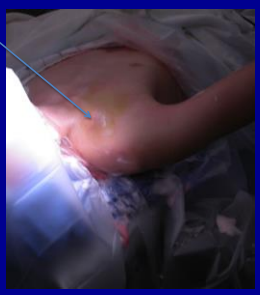
- We have much better evidence for decision making in 'adults'
- Active adults may do better with surgery for first 6-12 months
- Long term benefits?
- Shortening – association with poor satisfaction?

Displaced, comminuted fractures Where are we now?

- Operative treatment of clavicle fractures in young patients is safe - low rates of complications
  - Vanderhave et al JPO 2010
  - Mehlman et al, JPO, 2009
- Healing Rates in the skeletally immature is still not well known – but probably much better than adults

Surgical Indications

- Significant Skin Tenting
- Open fractures
- Soft-tissue interposition
- Neurovascular compromise
- Multiple trauma
- Floating shoulder
- Repeat Fractures



Relative Surgical Indications

Patient Centered Decision Making is Key

- Younger, active patients with greater than 1.5- 2 cm of shortening?
- Severe displacement or comminution
- Sports
  - Cyclists
  - Throwing athletes?
- Hand dominance
- Female?

Future/Research Questions

- How many patients do we operate on to prevent one symptomatic non-union or mal-union?
- Prospective Cohorts
  - EMR
- RCT's?
- Identify patient factors and preferences that direct patients into appropriate treatment path – adolescents and adults
- Data on outcomes and complication rates
  - Improved Patient Communication Tools
- POSNA/AOSSM – Ben Heyworth, Michelle Caird

Acknowledgments

- Ben Heyworth
- John Polousky
- Ted Ganley
- Don Bae

- Why treat something non-operatively when you can get the same result from surgery?
  - Steve Frick

Case Study: Radiographs

13 Year old Male
Closed fracture
Soccer
Non skin compromise

How would you treat this?

Now 17 Years Old – Chronic Shoulder Pain, and weakness

ORIF with Local Bone Graft

Non-Surgical versus Surgical Treatment

Factors To consider	Non-Surgical Treatment	Surgical Treatment
Time for Healing	Longer – average 28 weeks	Shorter – average 16 weeks
Impact on shoulder function	Displaced fractures may heal with clavicle shortening, which may have an impact on shoulder position and function	Fracture fixation restores the clavicle to its normal length
Non-union risk (fracture does not heal)	Higher	Lower
Cosmetic Issues	May have large lump or deformity in clavicle	Surgical Scar. In lean cyclists, the hardware may be slightly prominent
Skin Sensation	No significant changes in sensation	Numbness below the incision
Infection Risk	None	Most implant surgeries have an infection risk of approximately 1%, even with appropriate preoperative antibiotic use.
Nerve/blood vessel/lung injury risk	Very Rare	Rare
Impact on Training	Riding a bike places significant loads upon the arm and shoulder, and the discomfort from the fracture may delay return to training	Usually allows earlier return to training. Resumption of training on a trainer or exercise bike can resume in a few weeks or shorter, after surgery.
Future Treatment	If the fracture does not heal, surgery may be required to get the fracture to heal.	Future hardware removal may be necessary if the implants bother the patient.

Figure 1

Middle Shaft Clavicle fracture, with 3 separate fracture pieces

Fixation with plate and screws

Case 2

Clavicle Fracture in 19 Year Old Cyclist – simple fracture pattern, with 2 fracture pieces.

Treatment with intramedullary pin

Non-Surgical versus Surgical Treatment

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Reference on Clavicle Fracture

- Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures. Surgical technique.
- Altamimi SA, McKee MD; Canadian Orthopaedic Trauma Society.
- J Bone Joint Surg Am. 2008 Mar;90 Suppl 2 Pt 1:1-8.