Spectrum of Elbow Injuries in the Throwing Athlete

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March 24, 2011

Presentation Outline

- The story of Tommy John
- Study of pitching motion
- Elbow anatomy relevant to throwing injuries
- Lateral elbow injuries
- Medial elbow injuries
- Posterior elbow injuries

TOMMY JOHN

From the internet

The Injury

From the internet

- July 3, 1974
- Last game before All-Star break
- 13-3 record (career 123-106 at age 31)
- Snubbed from the All-Star game roster

The Injury

- Dodgers 4, Expos 0, top of the 4th inning, 2 runners on
- Delivered a sinker, felt arm flailing with no pain
- Delivered sinker again, felt a pop, flailing sensation worse, no pain

From the internet

The Aftermath

- Team orthopedic surgeon Dr. Frank Jobe
- PEX revealed a tear to the UCL
- Attempted rest and conservative rehab to no avail
- Surgical reconstruction recommended

From the internet

UCL Reconstruction

- At the time, reconstructive surgery of the UCL had been performed on non-athletes, but never attempted in a professional athlete before
- Dr. Jobe told Tommy to consider alternate career, very little chance he would ever pitch again

September 25, 1974

- Intraoperatively, UCL found to be completely torn
- 3 hour surgery utilizing innovative surgical technique
- Harvested palmaris longus tendon from non-pitching arm
- Palmaris longs tendon looped through holes in medial epicondyle and sublime tubercle in figure of 8 configuration

From the internet

Outlook Following Surgery

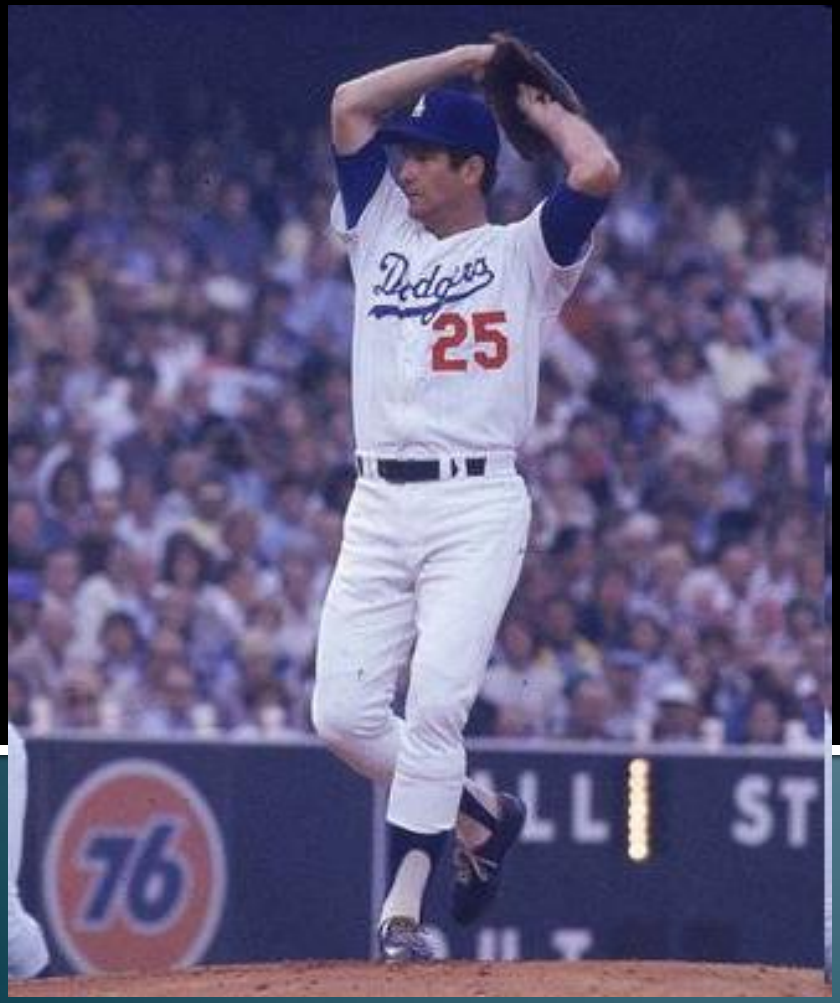
- Dr. Jobe gave Tommy 1 in 100 chance of ever pitching again
- Additional surgeries to correct nerve damage

From the internet

Rehabilitation

- Spent offseason recovering from surgery
- Spring of 1975, attempted to throw, but too much pain
- July 1975, had feeling back in his left arm
- September 1975, pitched in the instructional league

Return To Baseball



From the internet

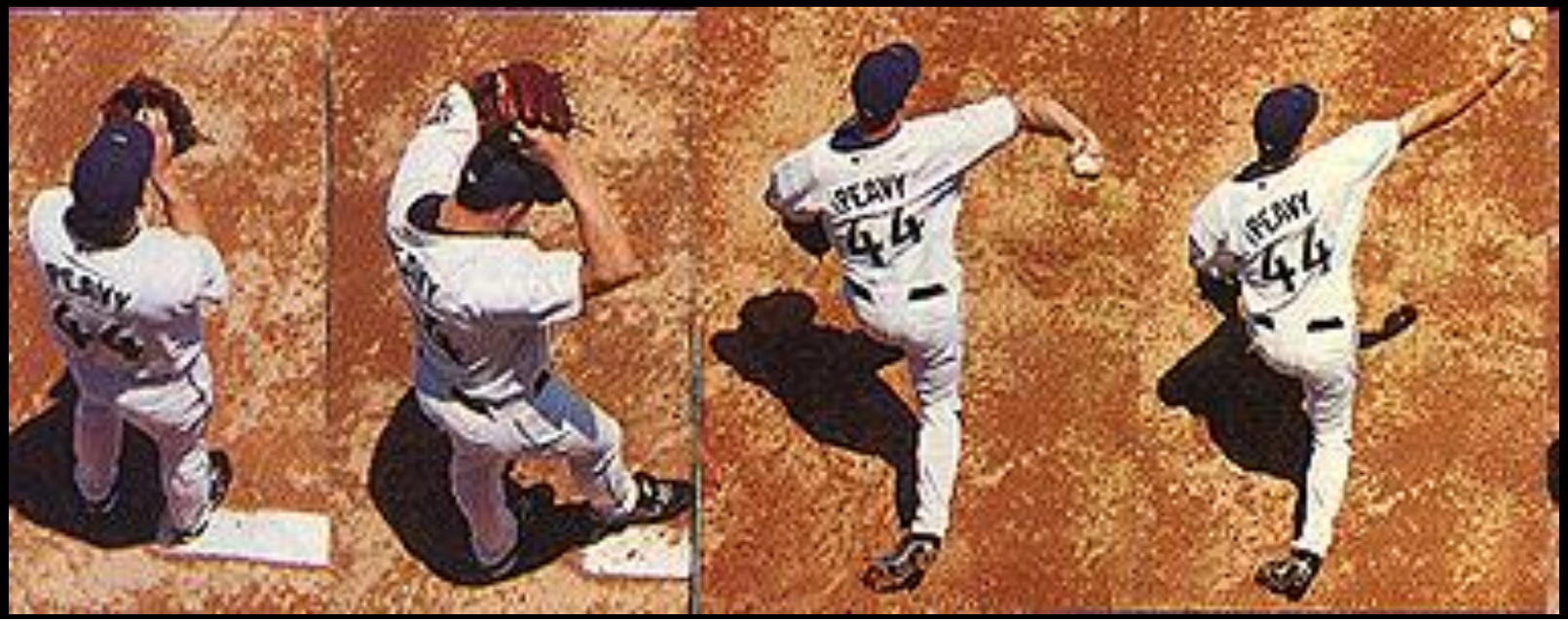
- Changed style of delivery to decrease injury risk, utilized more off speed pitches
- Returned to the Dodgers in the 1976 season
  - 10-10 record

Remarkable Success After Surgery

- 1977: 20-7
- 1978: 17-10
- 1979: 21-9
- 1980: 22-9
- Pitched until 1989 at age 46 without missing a single start due to injury
- 288 career wins

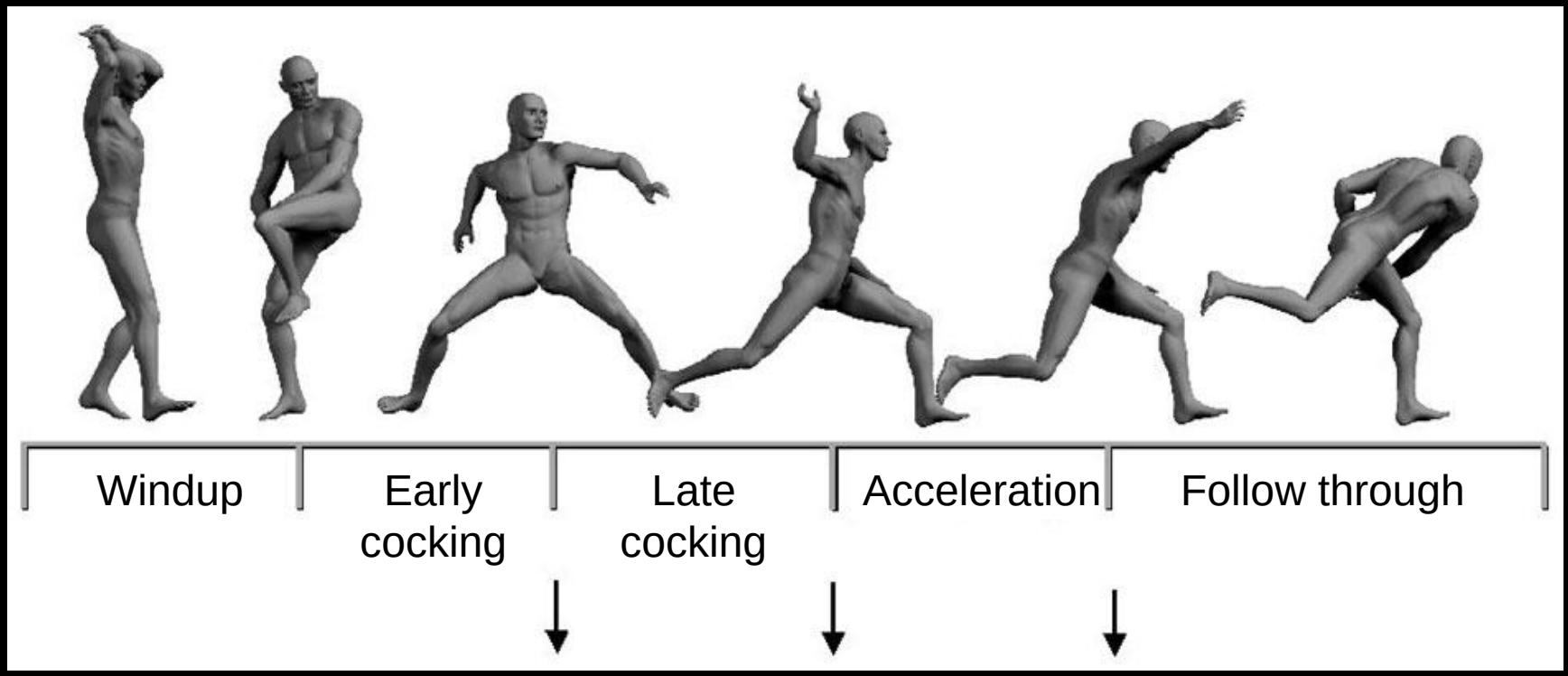
From the internet

STUDY OF PITCHING MOTION



From the internet

Pitching Sequence



J Chin Inst Eng, 2003; 26:861-868.

Elbow Injuries in the Pitching Sequence

- Most elbow injuries occur during acceleration phase
- Combination of high valgus load and rapid extension
  - Tensile stress of the medial stabilizers
    - UCL, flexor/pronator group, medial epicondyle, ulnar nerve
  - Compression stress of lateral compartment
    - Radiocapitellar articulation
  - Shear stress of the posterior compartment
    - Posteromedial tip of olecranon, trochlea/olecranon fossa

Valgus & Extension Forces During Late Cocking/Early Acceleration

- Biomechanical study of the elbow moving from 110° to 20° flexion
  - Valgus forces up to 290 N, torque up to 64 N-m
  - Compressive forces up to 500 N at lateral radiocapitellar articulation
  - Elbow peak angular velocities as high as 4500°/sec

Am J Sports Med 1995; 23:233-239

Evidence of Subclinical Medial Collateral Ligament Injury and Posteromedial Impingement in Professional Baseball Players

Cynthia L. Kooima, Kyle Anderson, Joseph V. Craig, Douglas M. Teeter and Marnix van Holsbeeck

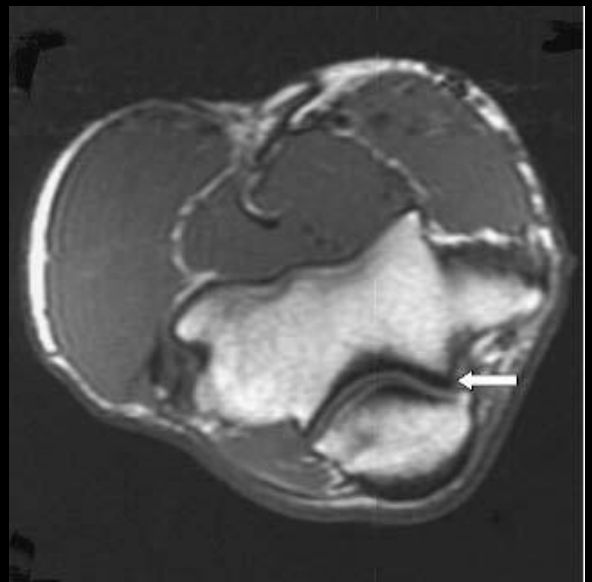
Am J Sports Med 2004 32: 1602

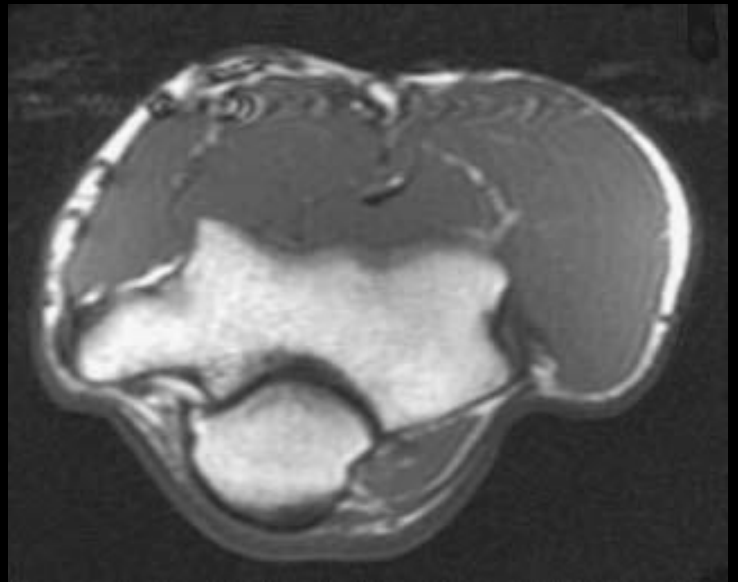
- 16 asymptomatic professional baseball players with no history of injury
- MRI bilateral elbows, readers blinded to handedness of player
- 12/16 pitchers, 4/16 position players

Am J Sports Med 2004; 32:1602-1606

13/16 had MCL thickening/edema in dominant arm

13/16 had PM spurs/sclerosis in dominant arm





Am J Sports Med 2004; 32:1602-1606

Elbow Injuries in Other Sports

- Similar elbow injuries in other sports with overhead motion
  - Softball
  - Football
  - Tennis
  - Track and field sports - Javelin
- Physis particularly susceptible in skeletally immature athletes

From the internet





Effect of Pitch Type, Pitch Count, and Pitching Mechanics on Risk of Elbow and Shoulder Pain in Youth Baseball Pitchers

Stephen Lyman,* PhD, Glenn S. Fleisig,*† PhD, James R. Andrews,* MD, and E. David Osinski,‡ MA

- 476 pitchers aged 9-14 in Alabama were followed for 1 season in 1999
- Elbow and shoulder pain was the designated outcome of interest in relation to pitch count, pitch type, and pitching mechanics

Am J Sports Med 2002; 30: 463-468

Effect of Pitch Count on Elbow Pain

- Conclusions:
  - Elbow pain associated with increased number of pitches in a game
  - Elbow pain associated with increased number of pitches in a season
    - Highest at the 601-800 pitch range

Am J Sports Med 2002; 30: 463-468

Pitch Count Regulations in Little League Baseball

Age	Maximum Pitches Per Day
7-8	50
9-10	75
11-12	85
13-16	95
17-18	105

The Little League Pitch Count Regulation Guide, 2010

Rest Requirements in Little League Baseball

Up to age 14

# of pitches	Days of rest required
>65	4
51-65	3
36-50	2
21-35	1
1-20	0

Ages 15-18

# of pitches	Days of rest required
>75	4
61-75	3
46-60	2
31-45	1
1-30	0

The Little League Pitch Count Regulation Guide, 2010

Effect of Pitch Type on Elbow Pain

- Sliders associated with elbow pain
  - 86% increased risk of elbow pain
- Changeup associated with 12% reduction of risk of elbow pain

Am J Sports Med 2002; 30: 463-468

Recommendations on Pitch Type

TABLE 3
Age to Learn Types of Pitches[a]

Pitch	Age, y
Fastball	8
Change-up	10
Curveball	14
Knuckleball	15
Slider	16[b]
Forkball	16[b]
Splitter	16[b]
Screwball	17[b]

[a]Reprinted with permission from the USA Baseball Medical & Safety Advisory Committee.[1]

[b]These ages reflect results from a survey by the USA Baseball Medical & Safety Advisory Committee. The authors of the current study believe that these pitches should not be thrown before the player is 18 years old.

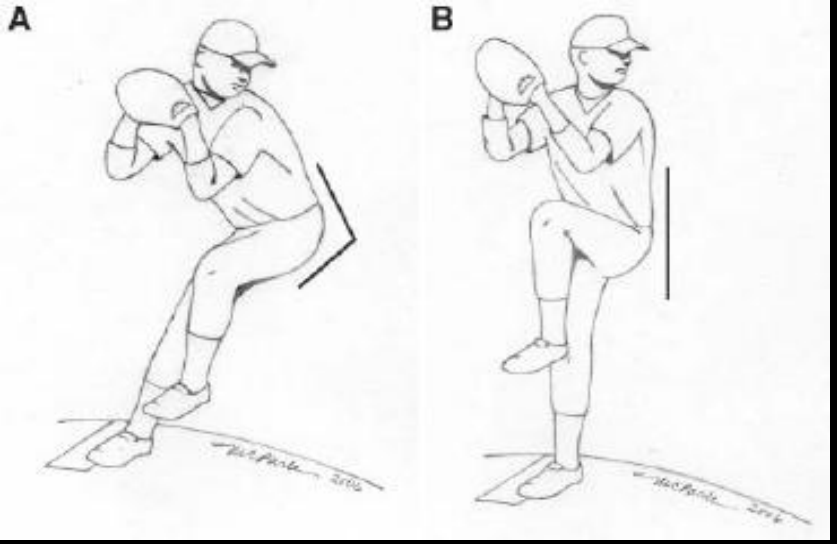
The Effect of Pitching Biomechanics on the Upper Extremity in Youth and Adolescent Baseball Pitchers

J. T. Davis, Orr Limpisvasti, Derrick Fluhme, Karen J. Mohr, Lewis A. Yocum, Neal S. ElAttrache and Frank W. Jobe

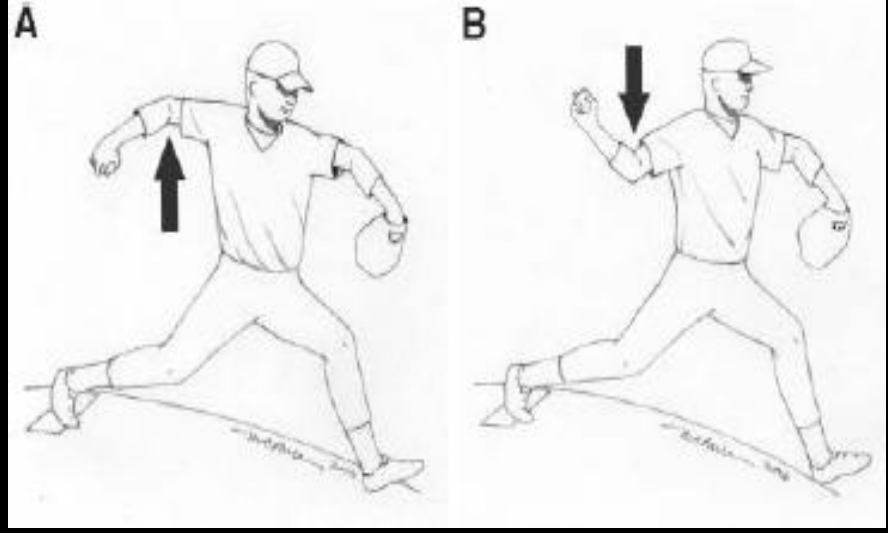
Am J Sports Med 2009 37: 1484
DOI: 10.1177/0363546509340226

- 5 mechanical pitching parameters evaluated
  - Simple errors generally considered poor mechanics common in youth pitchers
- 169 participants undergoing video and motion analysis
  - 86 youth, 83 adolescent
  - Evaluated elbow valgus load, pitching efficiency (EVL/pitch velocity)

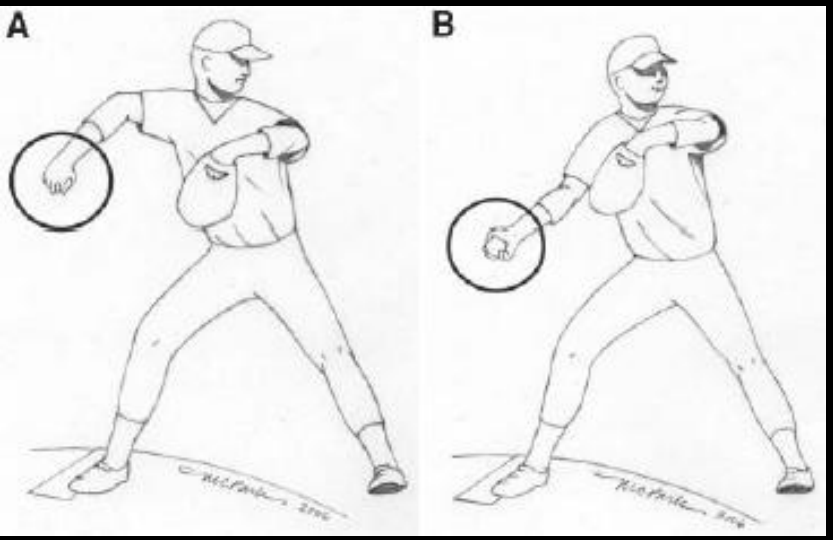
Am J Sports Med 2009; 37:1484-1491



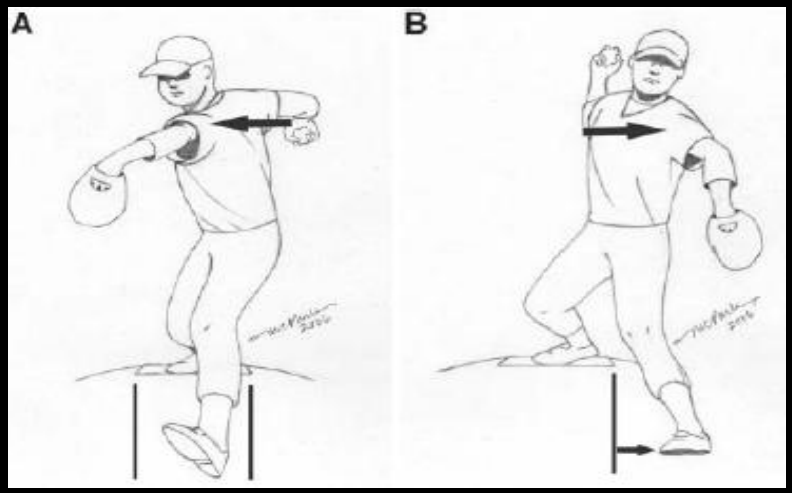
Leading with the hips



Arm in throwing position



Hand on top position



Closed shoulder position &
stride foot toward home plate

Am J Sports Med 2009; 37:1484-1491

Effect of Pitching Biomechanics on Elbow Pain

- Conclusions:
  - Better pitching mechanics generates lower EVL and better pitching efficiency
    - Therefore may help prevent elbow injuries
  - Of the 5 parameters, hand on top position & closed shoulder position are the 2 most important
    - Confer biomechanical benefit when performed correctly, regardless of how the other 3 are performed

Am J Sports Med 2009; 37:1484-1491

Little Leaguer's Elbow

- Nonspecific, sometimes confusing terminology
- Refers to valgus overload injuries of the elbow in skeletally immature youth due to repetitive throwing motions
- Term has been used for variety of disorders:
  - Injury to the capitellum including Panner's disease (osteochondrosis)
  - Injury to the medial epicondyle including medial epicondyle apophysitis, medial epicondylar avulsion/stress fracture

Little Leaguer's Elbow

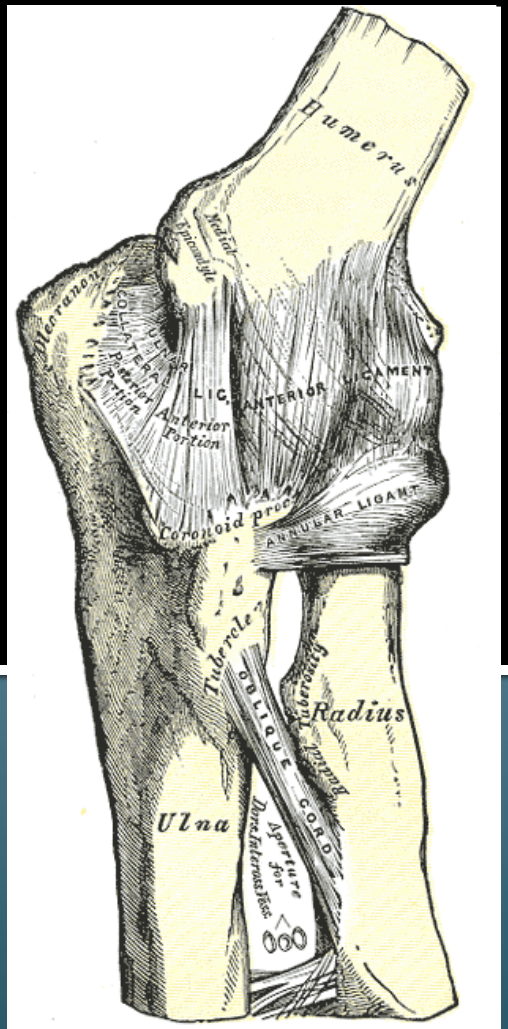
- Increasing incidence due to:
  - Increased participation
  - Increased competition and intensity in youth organized sports
  - Increased training, year round throwing regimen
  - Longer seasons

Recommendations for Young Pitchers

- Recommendations put forth by DH Petty, JR Andrews, GS Fleisig, EL Cain
  - Follow published guidelines for pitch count, minimum rest
  - 2-3 month rest during the off-season
  - Avoid overthrowing during crucial points of the season, during back-to-back games
  - Avoid throwing curveball before age 14 and other breaking pitches before recommended ages
  - Adequate warm up

Am J Sports Med 2004; 32:1158-1164

ELBOW ANATOMY RELEVANT TO THROWING INJURIES



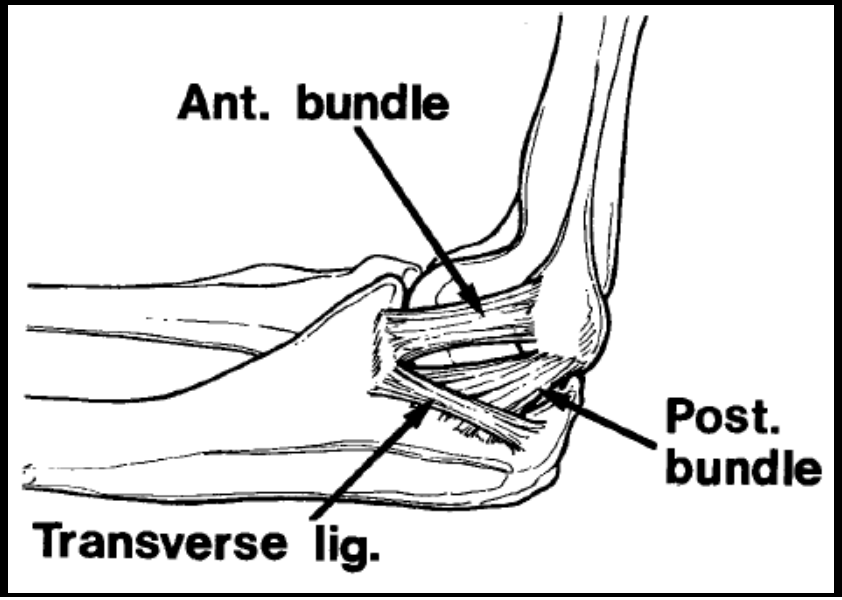
Gray's Anatomy

Elbow Stabilizers

- Elbow stability provided by olecranon and olecranon fossa at <20° degrees and >120° of flexion
- Soft tissue structures provides static and dynamic elbow stability between 20° and 120° of flexion
  - Arc of overhand throwing motion occurs in this range

Anatomy of UCL

- Anterior bundle
  - Origin: anterior inferior aspect medial epicondyle
  - Insertion: sublime tubercle, medial aspect coronoid process
  - Primary restraint to valgus force at 30-120° flexion
  - Subject to near-failure tensile stresses during acceleration phase (up to 290 N, anterior band can tolerate 260 N)



J Bone Joint Surg 1992; 74A: 67-83

Anterior Bundle of UCL

RadioGraphics 2010; 30:167-184

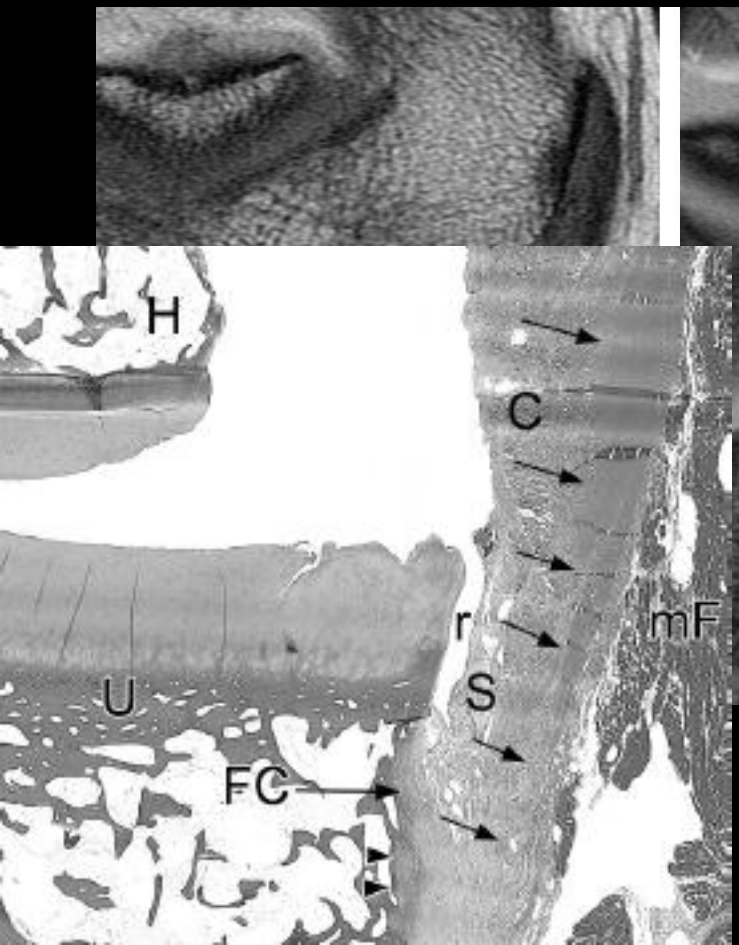
Anterior Bundle Insertion

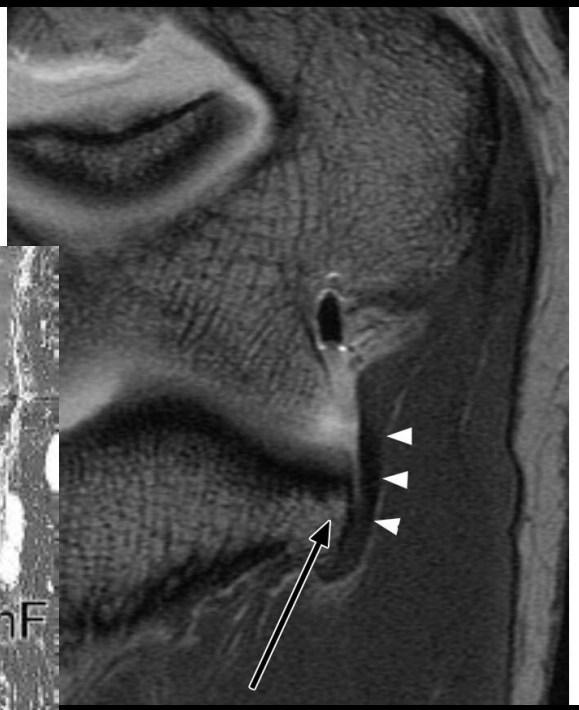
Insertion flush with sublime tubercle

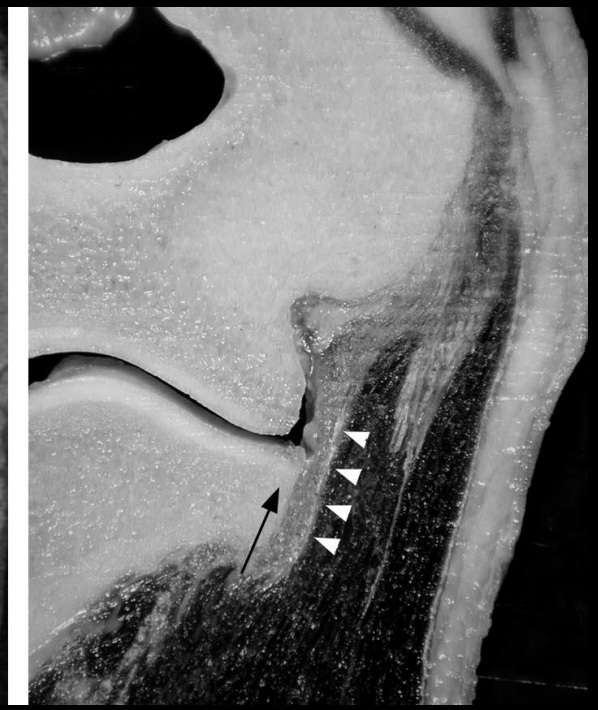
Radiology 2004; 231:797-803

Anterior Bundle Insertion

Insertion within 3-4 mm distal to joint margin



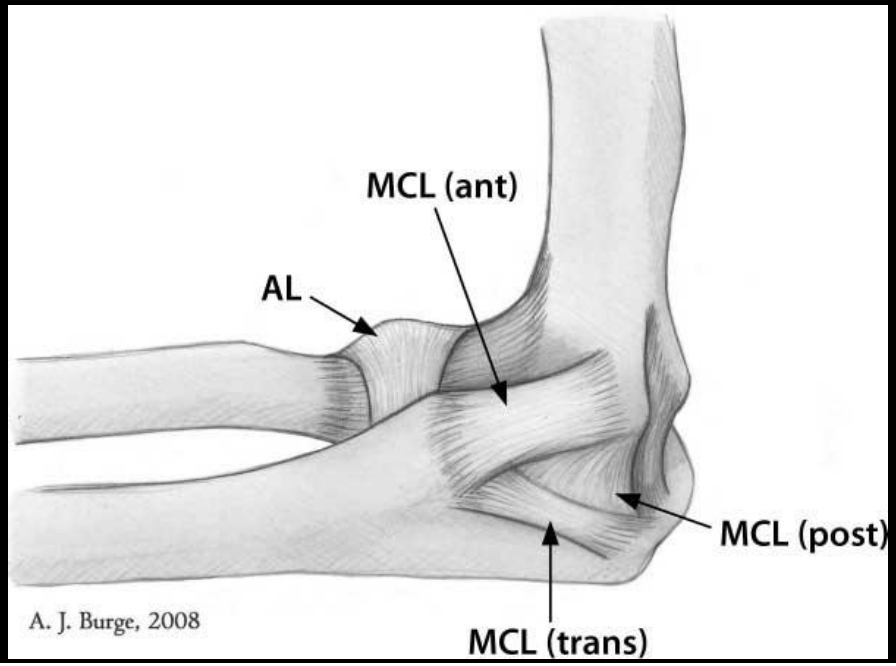




Radiology 2004; 231:797-803

Normal variant or ligament degeneration

Anatomy of UCL

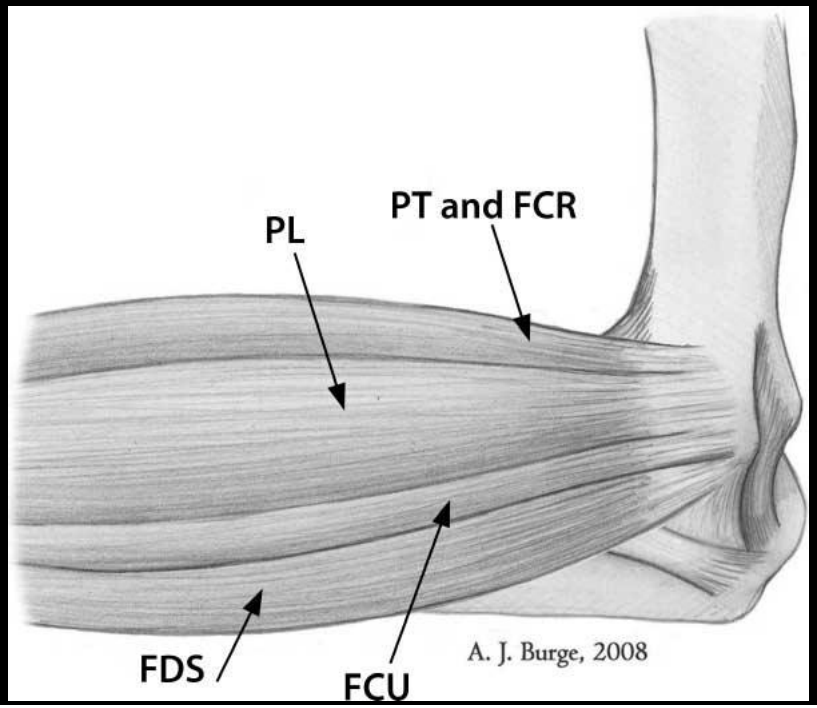


- Much less important
  - Posterior band
  - Transverse oblique band

RadioGraphics 2010; 30:167-184

Anatomy of Flexor-Pronator Muscle Group

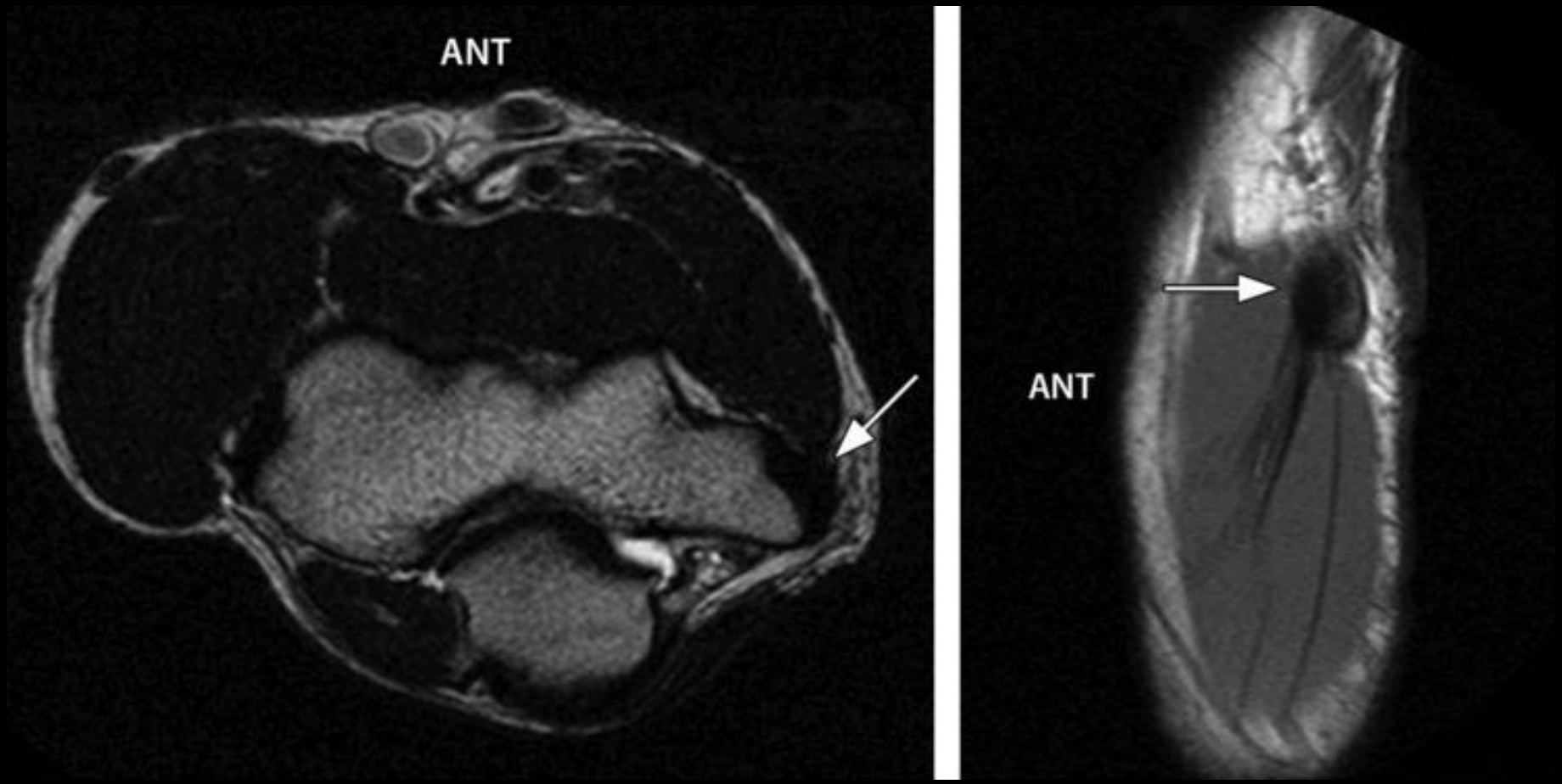
- FCR, PL, FCU = common flexor tendons
- PT & FCR = flexor-pronator mass
  - Attach at anterior aspect of medial epicondyle, most commonly injured
- Humeral attachment of UCL deep to F-P mass



RadioGraphics 2010; 30:167-184

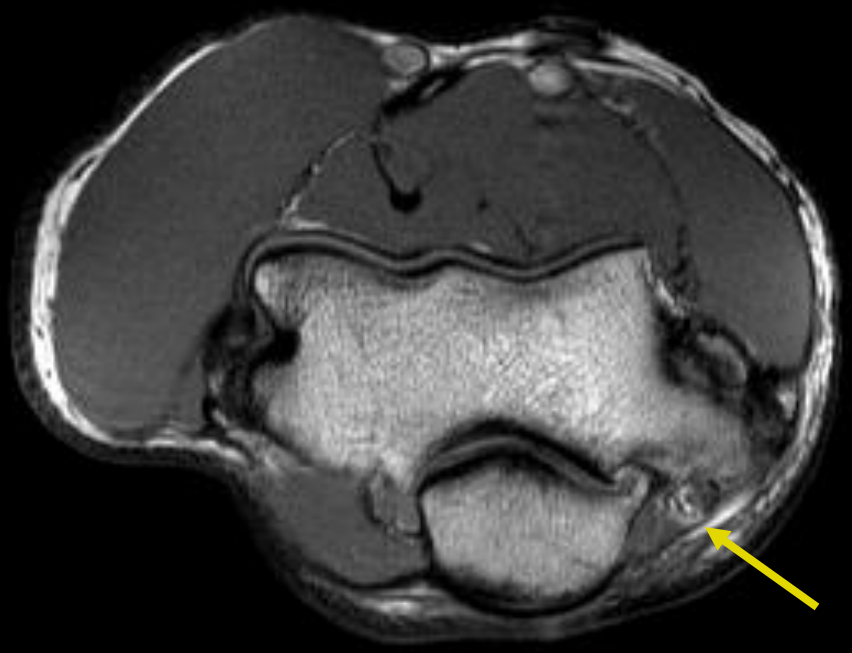
- PT = pronator teres
- FCR = flexor carpi radialis
- PL = palmaris longus
- FCU = flexor carpi ulnaris
- FDS = flexor digitorum superficialis

Flexor-Pronator Muscle Group



RadioGraphics 2010; 30:167-184

Ulnar Nerve, Cubital Tunnel



- Ulnar nerve within cubital tunnel bordered by
  - Medial epicondyle anteriorly
  - Cubital retinaculum laterally
  - Flexor carpi ulnaris posteromedially

Courtesy of Brady Huang, MD

LATERAL ELBOW INJURIES

From the internet

Panner's Disease

- AKA osteochondrosis of capitellum, Little Leaguer's elbow
- Epidemiology: boys ages 5-12 (prior to capitellar fusion)
- Affects little league pitchers and gymnasts

Panner's Disease - Presentation

- Clinical course:
  - Acute onset of mild symptoms of pain, stiffness, decreased ROM
  - Unilateral, rarely bilateral
  - Frequently lasts several months with complete recovery
- PEX: focal tenderness over capitellum, limited extension, supination, pronation

Panner's Disease - Pathophysiology

- Failure of blood supply to growing epiphysis of capitellum from chronic repetitive lateral impaction
  - Capitellum only supplied by posterior end arteries prior to age 20, vulnerable to traumatic disruption
  - Capitellum fuses at age 12-13
- AVN/ischemia of growing capitellar epiphysis
- Usually revascularize and heal

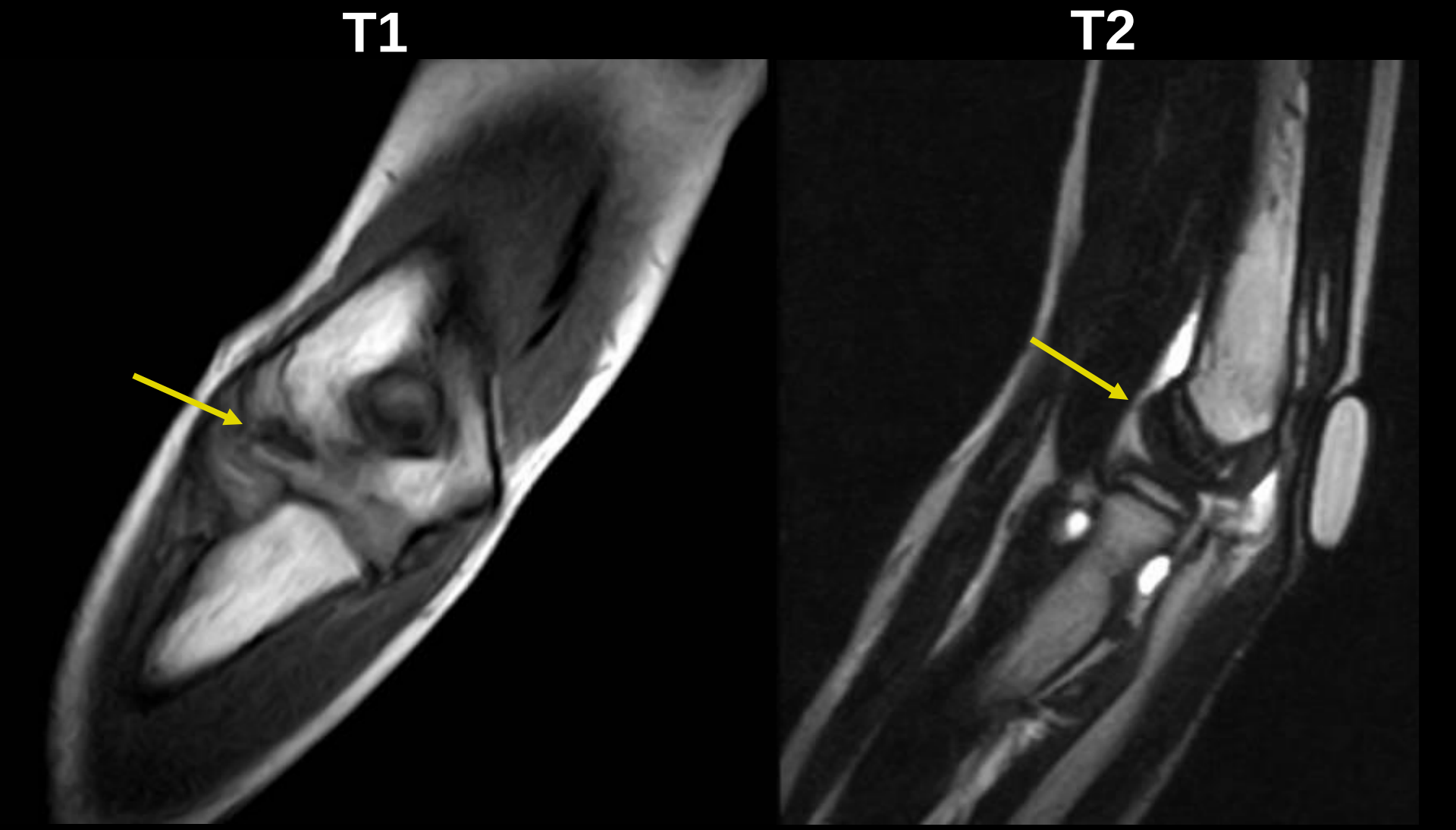
Panner's Disease – XR Findings

- Initial radiographs – irregularity, lucency along articulating surface, fissuring, sclerosis
- Subsequent radiographs – progressive lucency, sclerosis, fragmentation, decreased size and increased radiohumeral space
- After several months - reconstitution and regeneration of capitellum
- After 1-2 years: return to normal radiographic appearance of the capitellum, with no residual deformity or flattening
- Early maturation of radial head compared to contralateral elbow in 50% of cases, due to hyperemia

9 y/o pitcher with elbow pain and popping

Courtesy of Brady Huang, MD

9 y/o M pitcher with elbow pain and popping



Courtesy of Brady Huang, MD

Panner's Disease - Treatment

- Conservative symptomatic treatment
  - Elbow rest
  - Splint or cast for 3-4 weeks as necessary to immobilize elbow and relieve symptoms

Capitellar Osteochondritis/OCD

- Epidemiology: Boys ages 13-16 (after capitellar fusion)
- Adolescent pitching athlete and gymnasts
- Clinical presentation: insidious onset lateral elbow pain, locking
- 20% bilateral

Capitellar OCD - Pathophysiology

- Chronic valgus stress with lateral impaction
  - Compressive and shearing forces during acceleration & deceleration phases results in osteochondral injury
- Results in osteochondral fragmentation & intra-articular body formation
- Poor healing due to poor vascular supply
- *OCD may also occur in the radial head*

Capitellar OCD – XR Findings

- Flattening of capitellum
- Enlarging lucencies
- Sclerosis and fragmentation
- Intra-articular body formation
- Secondary radiocapitellar joint degeneration
- Residual deformity after healing

Courtesy of Brady Huang, MD

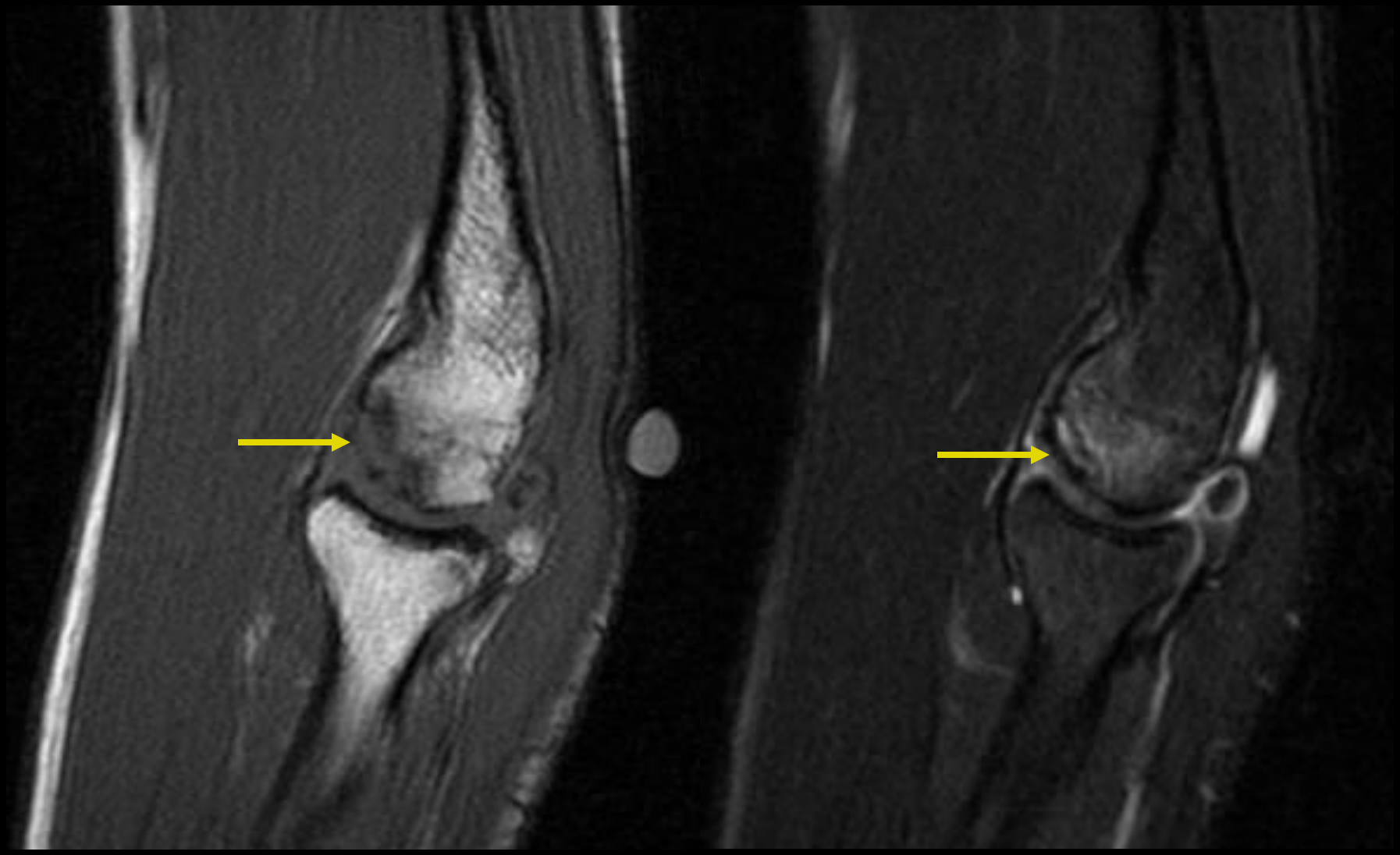
Capitellar OCD – MR Findings

- BME anterior capitellum
- Low T1 and variable T2 signal within the osteocartilagenous fragment
- T2 hyperintense rim surrounding fragment indicates loose fragment and instability

PD FS

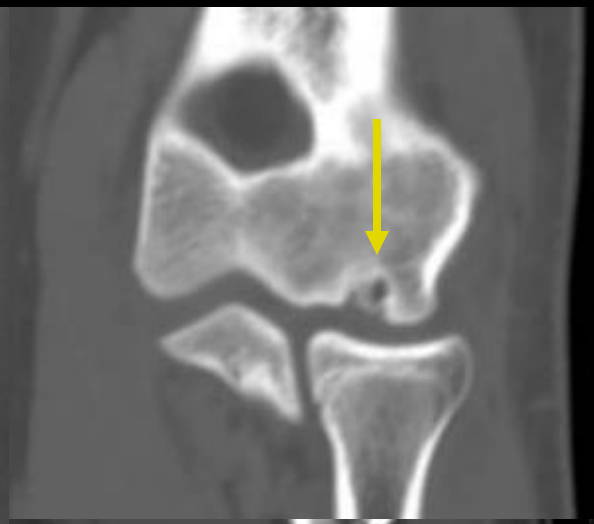
Courtesy of Brady Huang, MD

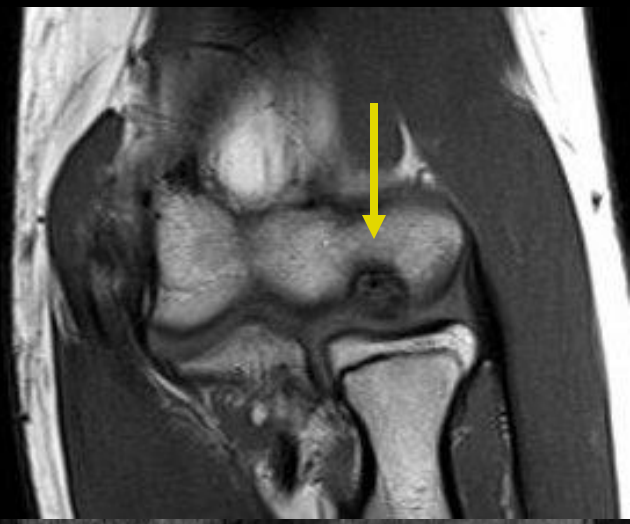
17 y/o high school baseball player

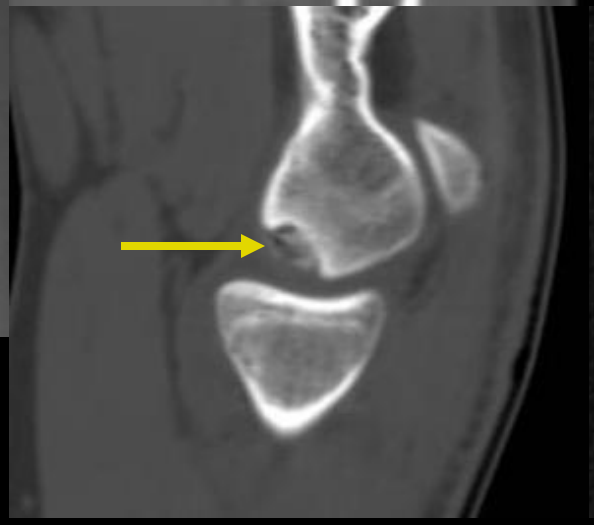


Courtesy of Brady Huang, MD

14 y/o baseball player







Courtesy of Tudor Hughes, MD & Mini Pathria, MD

Capitellar OCD - Stability

Stable lesion

- Small size (<1 cm)
- No thin rim of fluid signal b/w humerus and fragment

Unstable lesion

- Large size (> 1 cm)
- Thin rim of fluid b/w humerus and fragment
- Intra-articular body
- Cyst-like lesion subjacent to OCD fragment

Capitellar OCD - Treatment

- Stable lesion: rest, splinting
- Unstable lesion: surgical
  - Arthroscopic debridement & loose body removal
  - Abrasion chondroplasty & microfracture surgery
  - Autologous chondrocyte transplantation
  - Wedge osteotomy
  - Wiring and bone grafting
- Poor prognosis with large fragment, secondary OA

Panner's Disease vs. OCD

	Panner's Disease	Capitellar OCD
Presentation	Acute pain	Insidious onset
Age	5-12	13-16
Frequency	Rare	Common
Outcome	Good, no residual deformity	Poor, residual deformity and 2° OA

MEDIAL ELBOW INJURIES

From the internet

Medial Epicondyle Apophysitis

- AKA Little Leaguer's elbow, medial epicondylitis
- Epidemiology: childhood and young adolescents (prior to fusion of medial epicondyle at age 16)
- Chronic stress injury

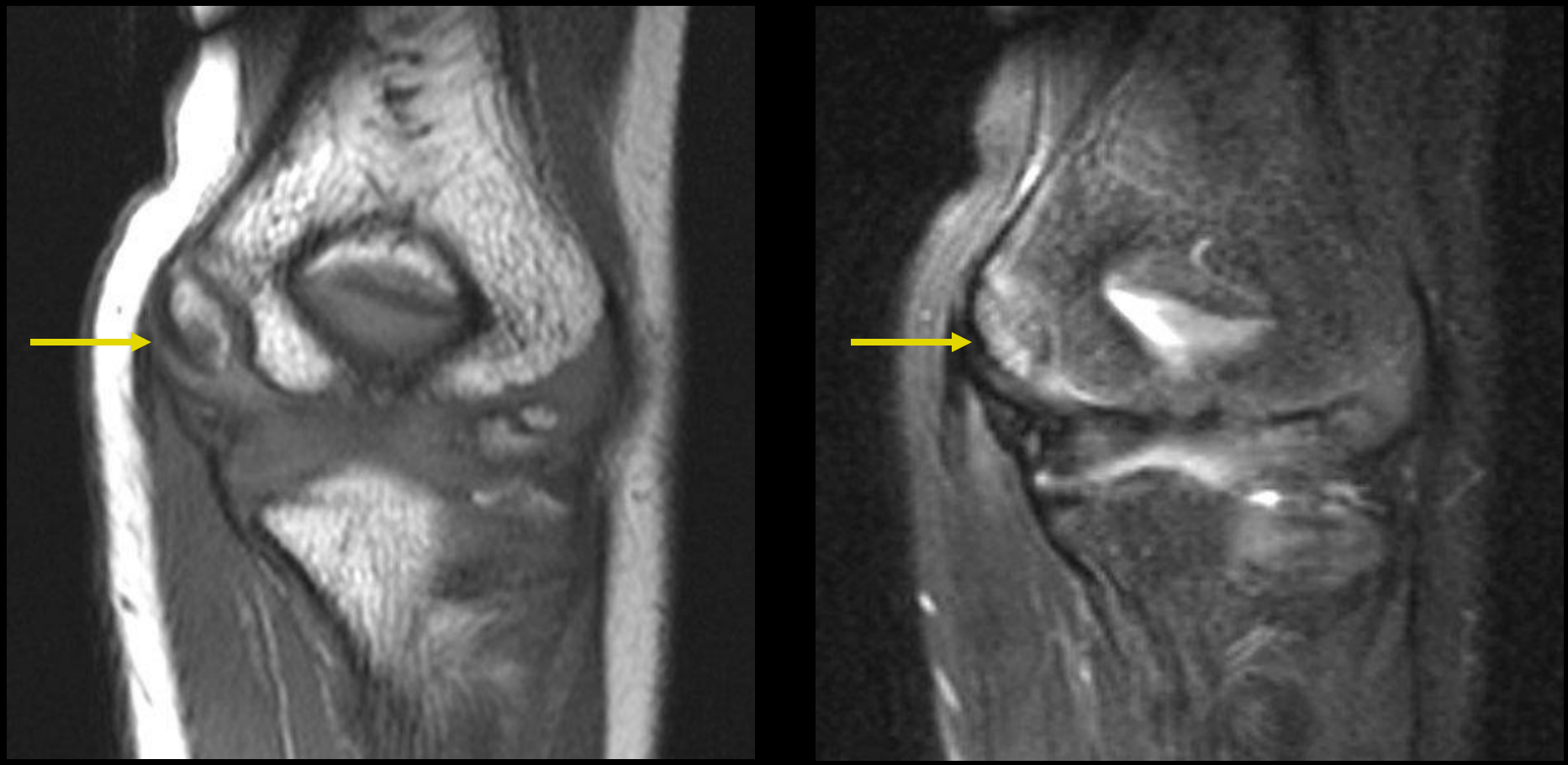
Medial Epicondyle Apophysitis - Pathophysiology

- Chronic repetitive valgus stress from recurrent contraction of flexor-pronator muscle group
  - In children, main stabilizer to valgus stress is flexor-pronator muscle group
  - Failure at the weakest link - unfused apophyseal plate
- Apophysitis may progress to avulsion of apophysis into the joint

Medial Epicondyle Apophysitis – Findings

- Conventional radiography
  - Fragmentation of the unfused apophysis
- MR Findings
  - BME of medial epicondylar apophysis
  - In more severe cases, entire apophysis avulsed

Medial Epicondyle Apophysitis



Courtesy of Mini Pathria, MD

Medial Epicondyle Apophysitis - Treatment

- Conservative
  - Rest, ice, activity modification
  - Occasionally needs splinting
- Surgical (rare)
  - Usually in the presence of instability & avulsion fx

Medial Epicondylitis

- AKA pitcher's elbow, golfer's elbow, medial tennis elbow
- Epidemiology: after fusion, dominant hand
- Refers primarily to stress related injury to the flexor pronator group, secondarily to medial epicondyle
  - Spectrum of injuries include tendinosis, tear, or muscle strain, bone marrow edema

Medial Epicondylitis

- Injury during late cocking and early acceleration phases
- Result of tendon degeneration from chronic valgus stress

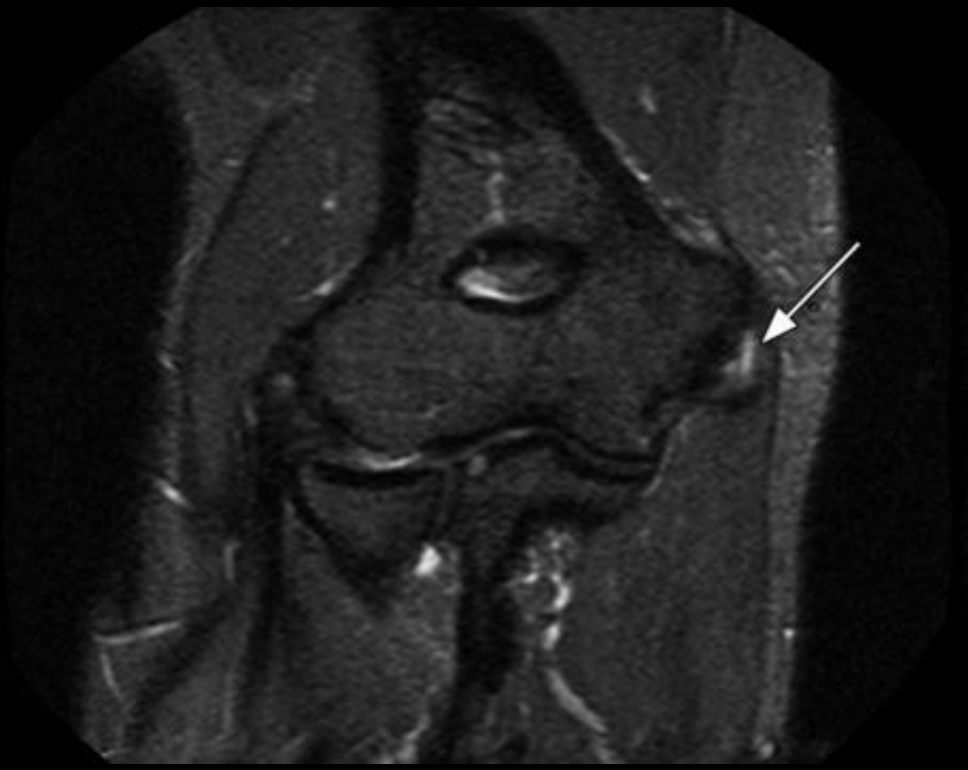
AJR 1996; 167:325-331

Medial Epicondylitis - Findings

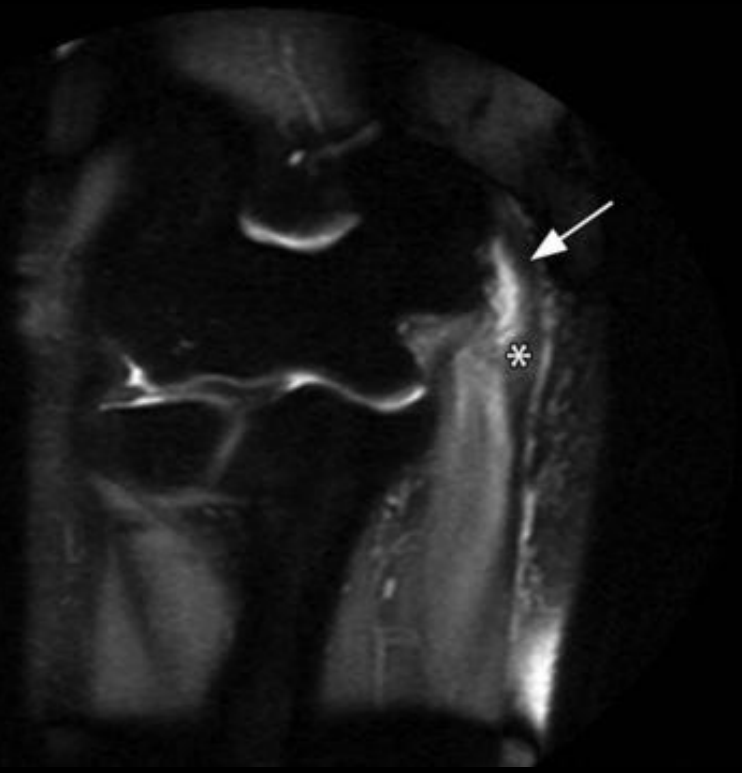
- Tendinosis or tearing of the common flexor/pronator group, with or without medial epicondyle bone marrow edema
- Associated findings
  - Partial UCL tear
  - Signs of lateral impaction injury (subchondral cysts, sclerosis, intraarticular bodies)
  - Ulnar neuritis (high association)
  - Synovitis

Medial Epicondylitis

Moderate

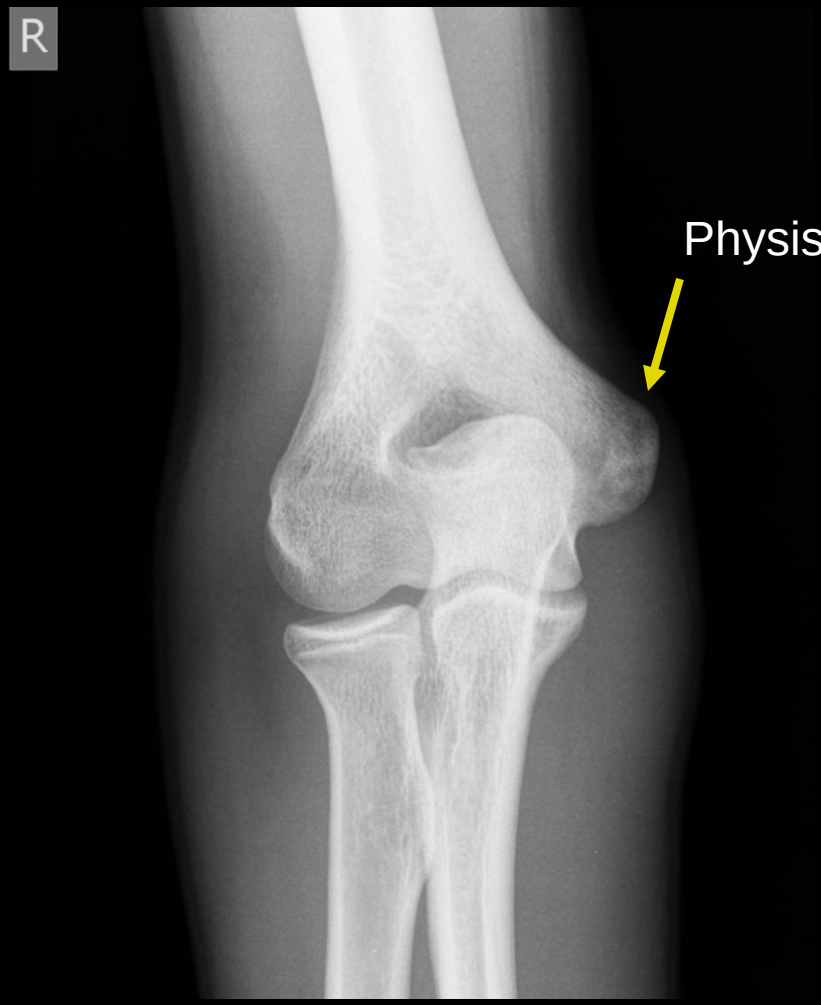


Severe



RadioGraphics 2010; 30:167-184

15 y/o R handed pitcher with medial elbow pain not improving after 6 months



Courtesy of Brady Huang, MD

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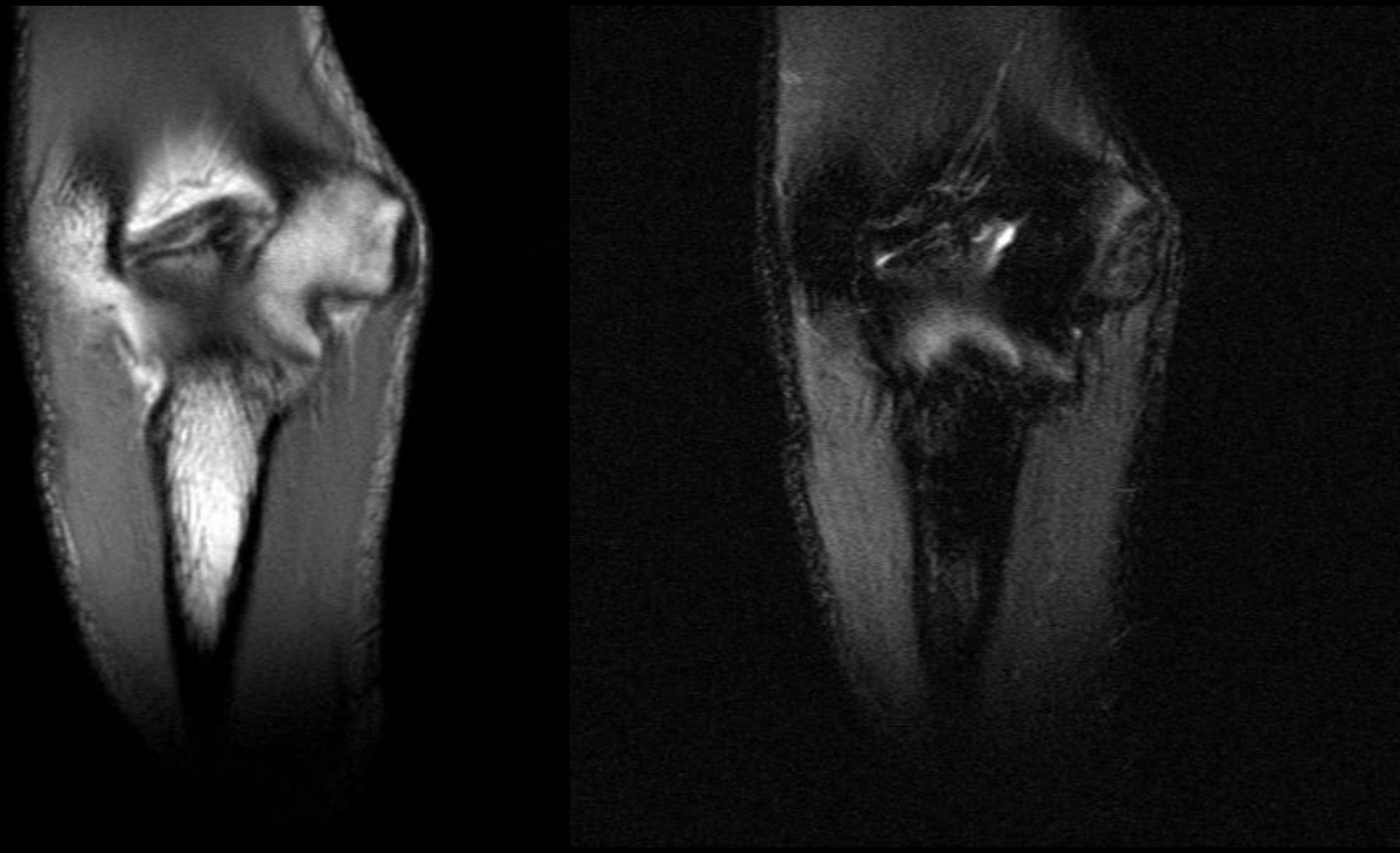

Courtesy of Brady Huang, MD

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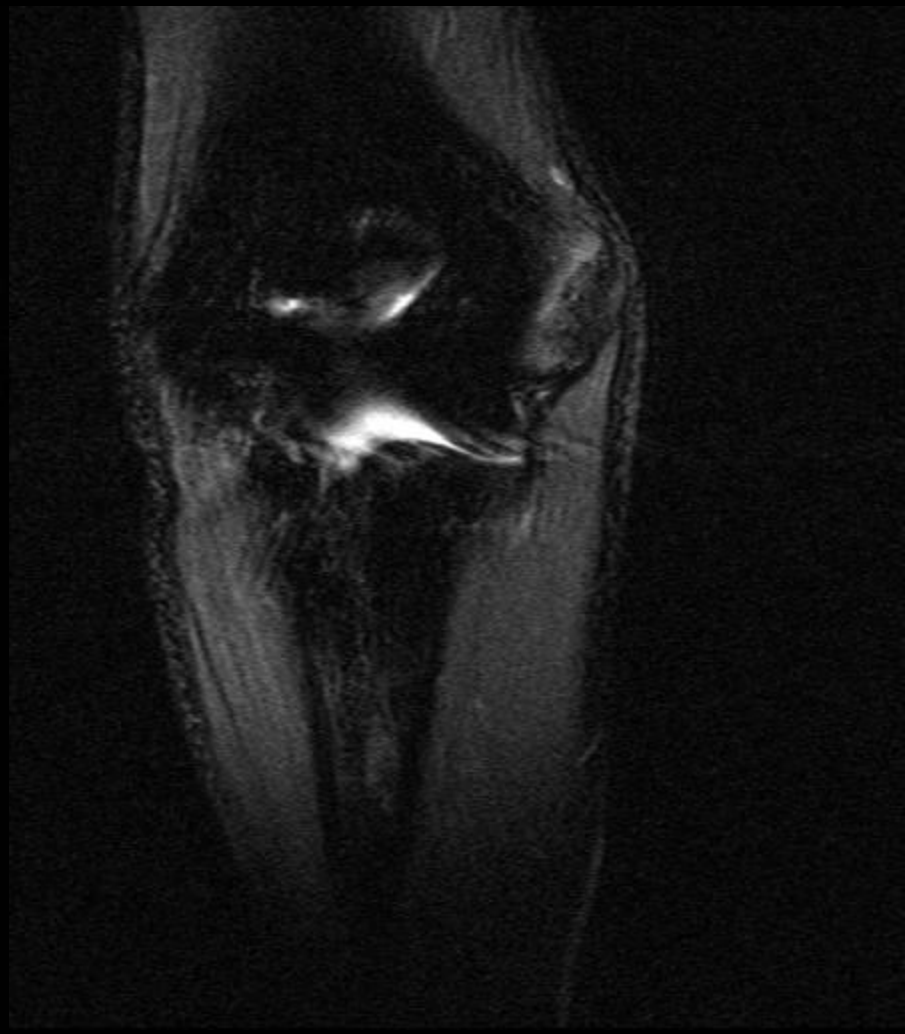
T2 FS



Courtesy of Brady Huang, MD

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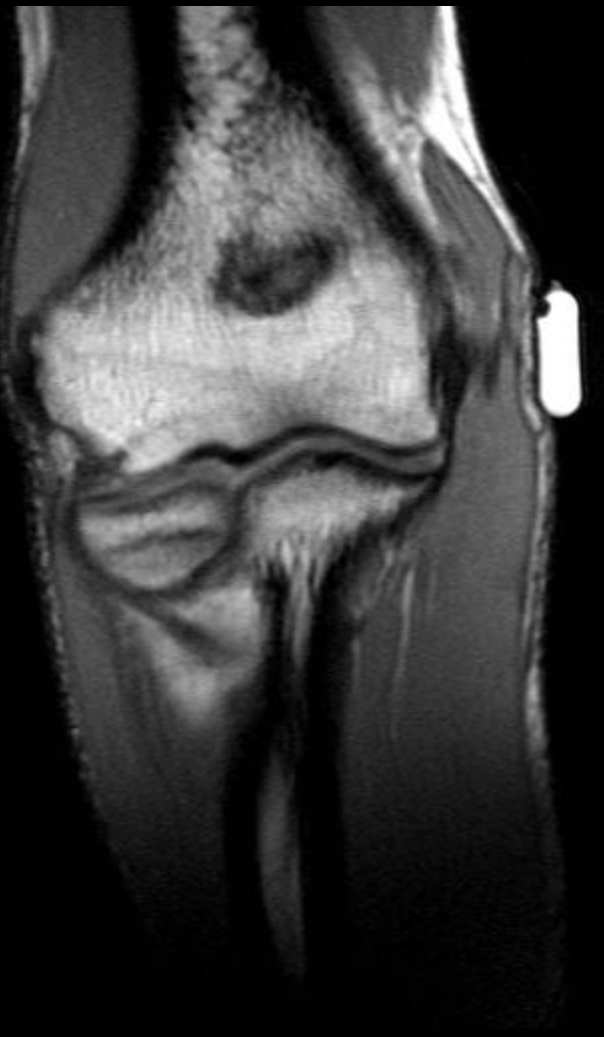

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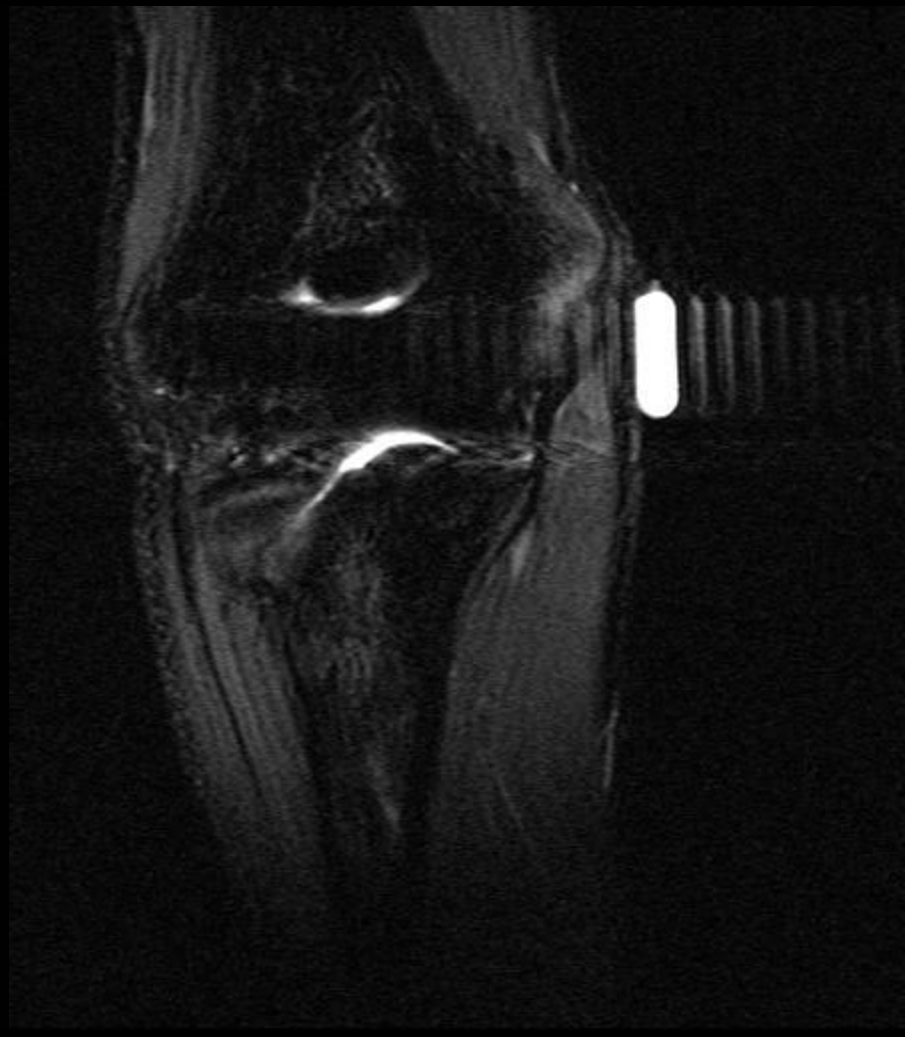

Courtesy of Brady Huang, MD

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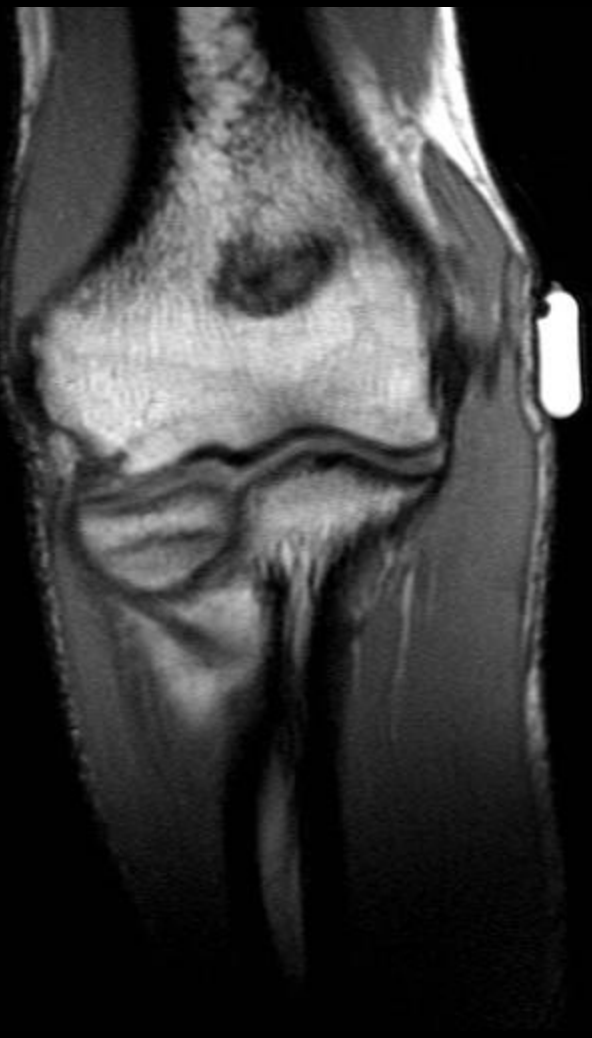

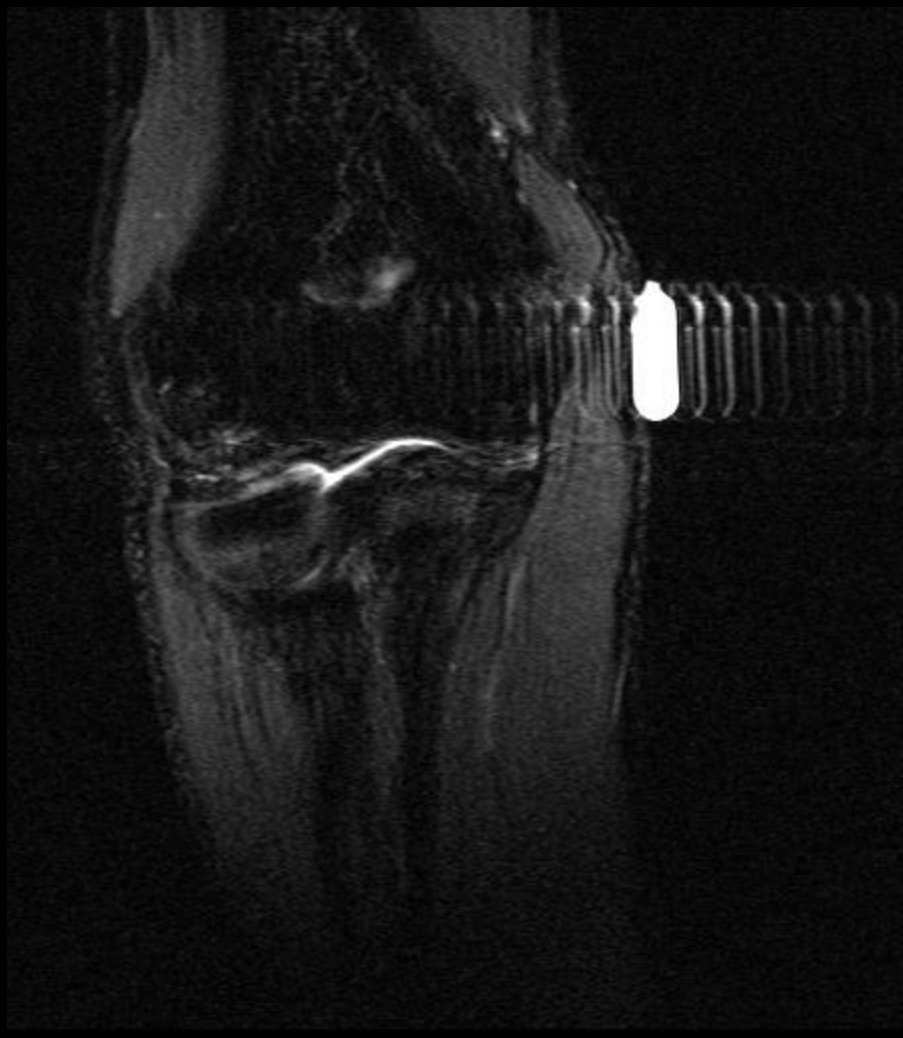

Courtesy of Brady Huang, MD

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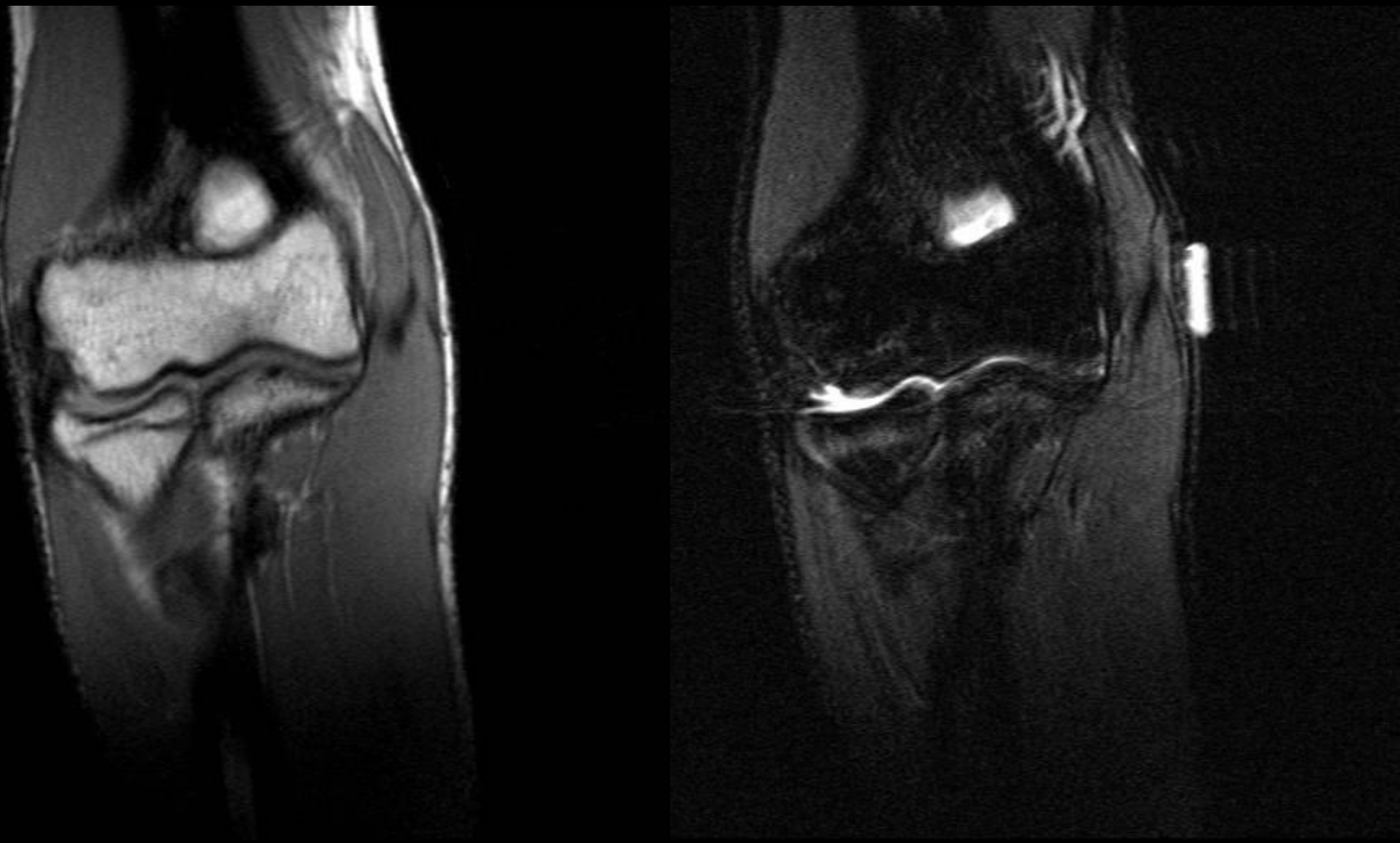


Courtesy of Brady Huang, MD

Medial Epicondylitis - Treatment

- Conservative
- Surgical (rare)
  - Common flexor origin release & extirpation of affected tissue
  - Tendon repair
  - Ulnar nerve transposition or decompression if ulnar neuritis present

Medial Epicondyle Avulsion

- AKA Little Leaguer's elbow
- Presentation: "pop" followed by acute pain, locking
- Epidemiology: commonly occur during adolescence when apophysis starts to fuse
  - Avulsion of unfused apophysis associated with larger fragment size than avulsion of fused apophysis
- Acute or chronic injury from repetitive valgus stress

Medial Epicondyle Avulsion

Radiographics 1987; 7:945-974

Am J Sports Med 2004; 32:1158-1164

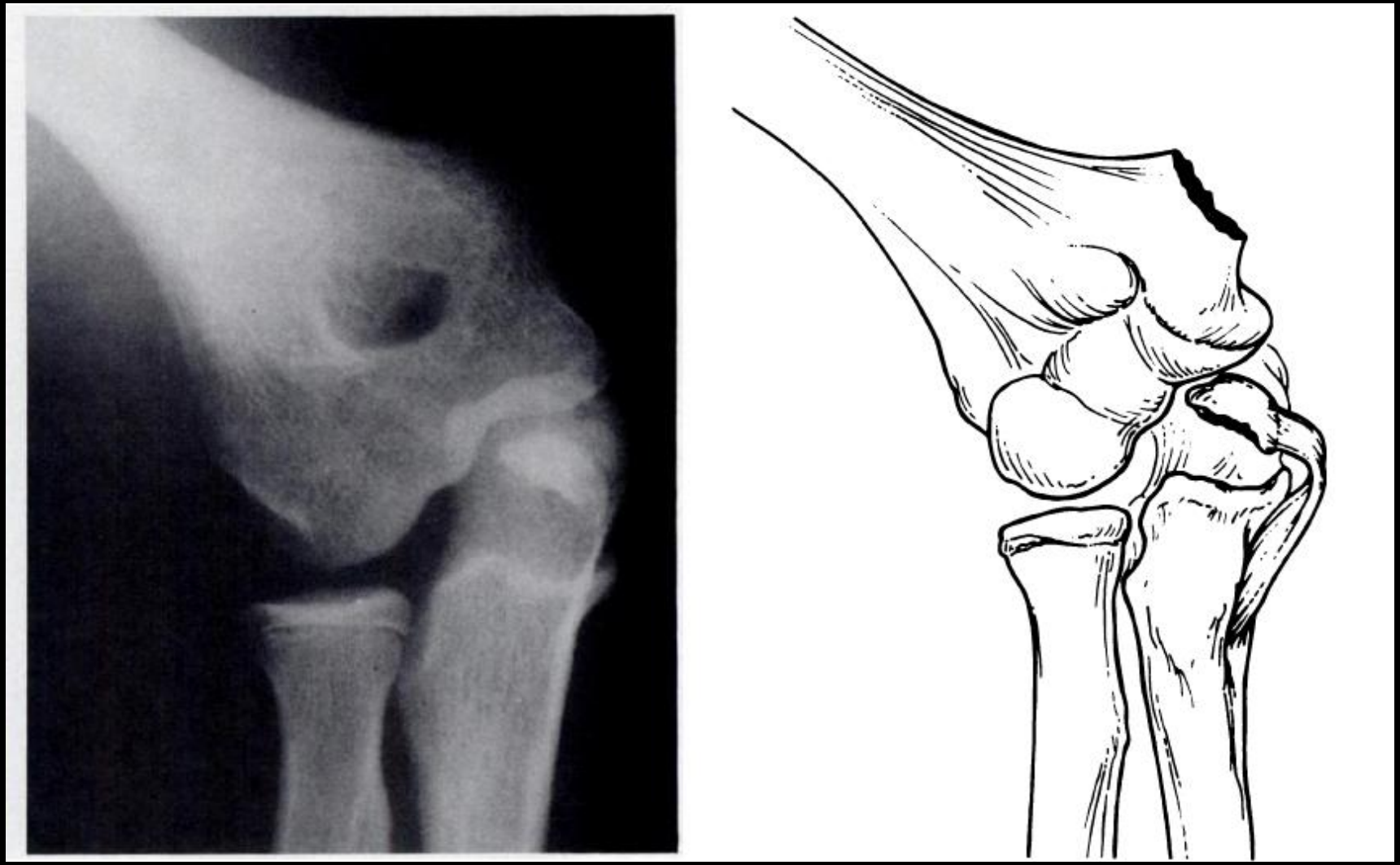
- Avulsion of entire unfused apophysis
- Avulsion fracture through apophysis
- Cresentic flake of bone avulsed from fused medial epicondyle

Medial Epicondyle Avulsion Entrapment

- 8 y/o M with valgus stress injury
- Avulsed medial epicondylar apophysis may become trapped in the joint space

Radiographics 1999; 19:655-672.

May be mistaken for normal trochlear apophysis



Radiographics 1987; 7:945-974

Medial Epicondyle Avulsion - Treatment

- Indications for surgical treatment controversial
- Fx fragment displaced <5mm, without instability
  - Splinting for 5-7 days, early motion
  - Some advocate early surgical reduction
- Displaced fx >5mm, instability, or incarcerated fx fragment
  - ORIF

15 y/o L handed pitcher with elbow pain

Courtesy of Brady Huang, MD

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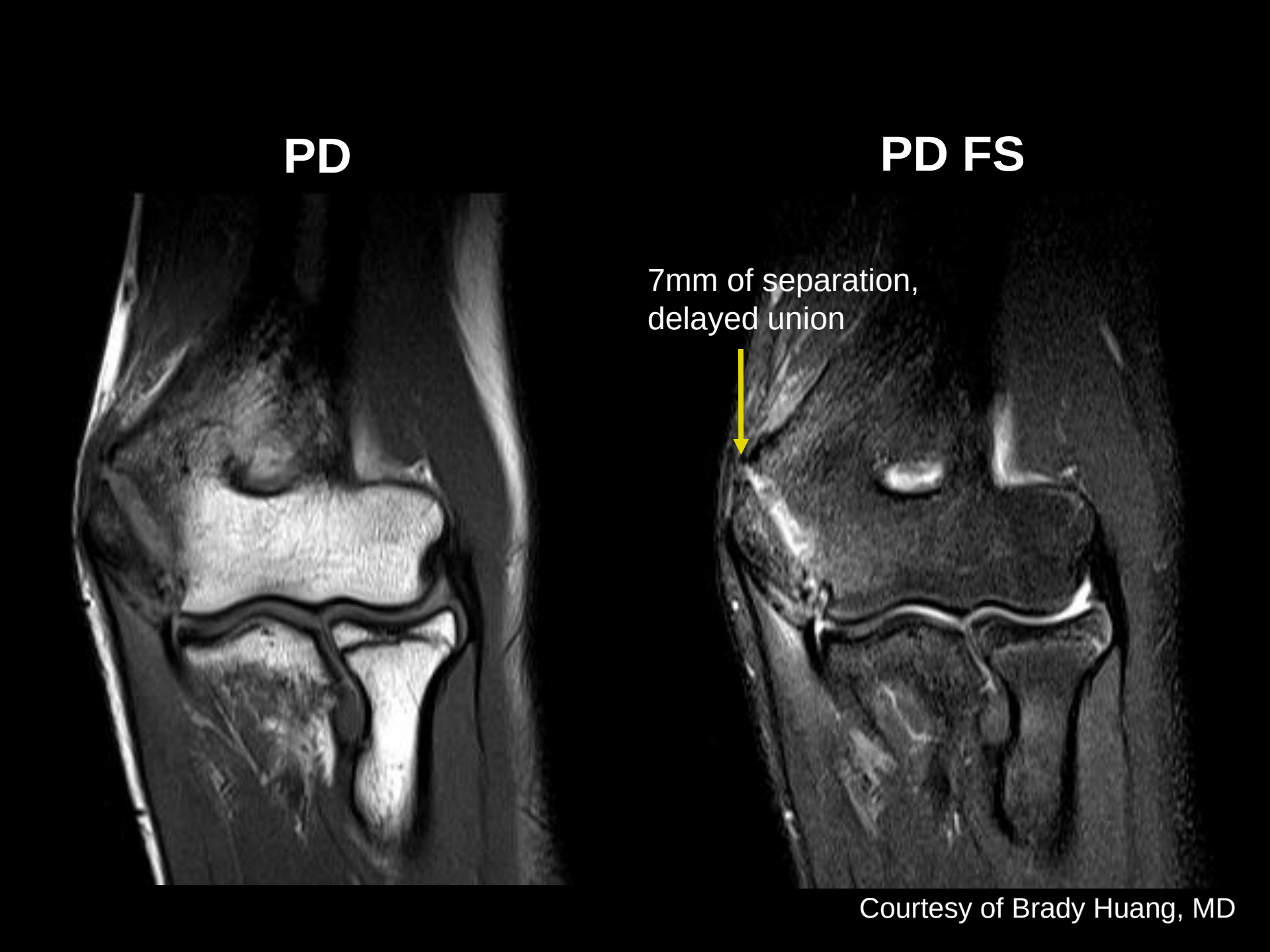
PD FS

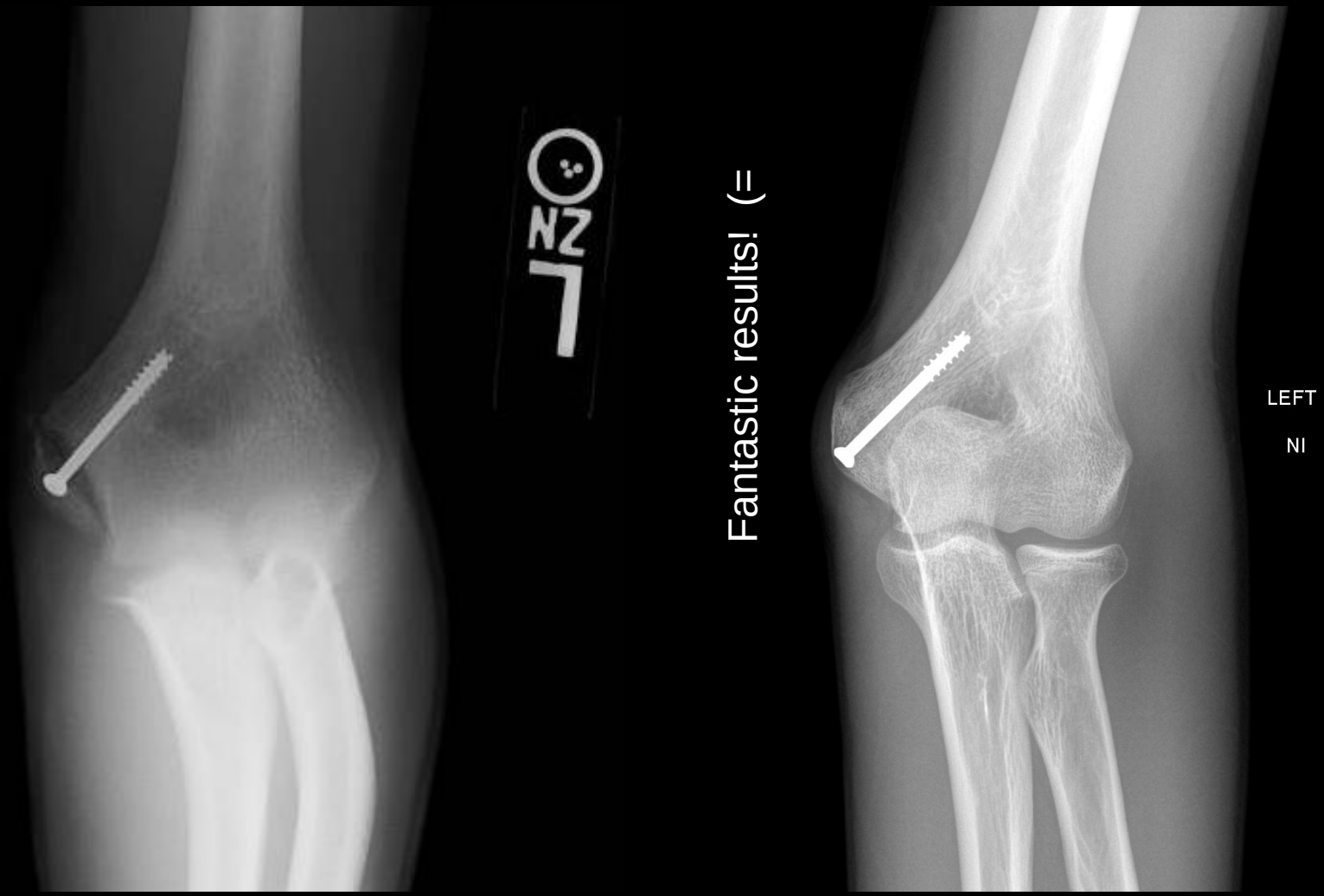
Courtesy of Brady Huang, MD



Courtesy of Brady Huang, MD

Immediate post-op

Post-op follow-up



Fantastic results! (=

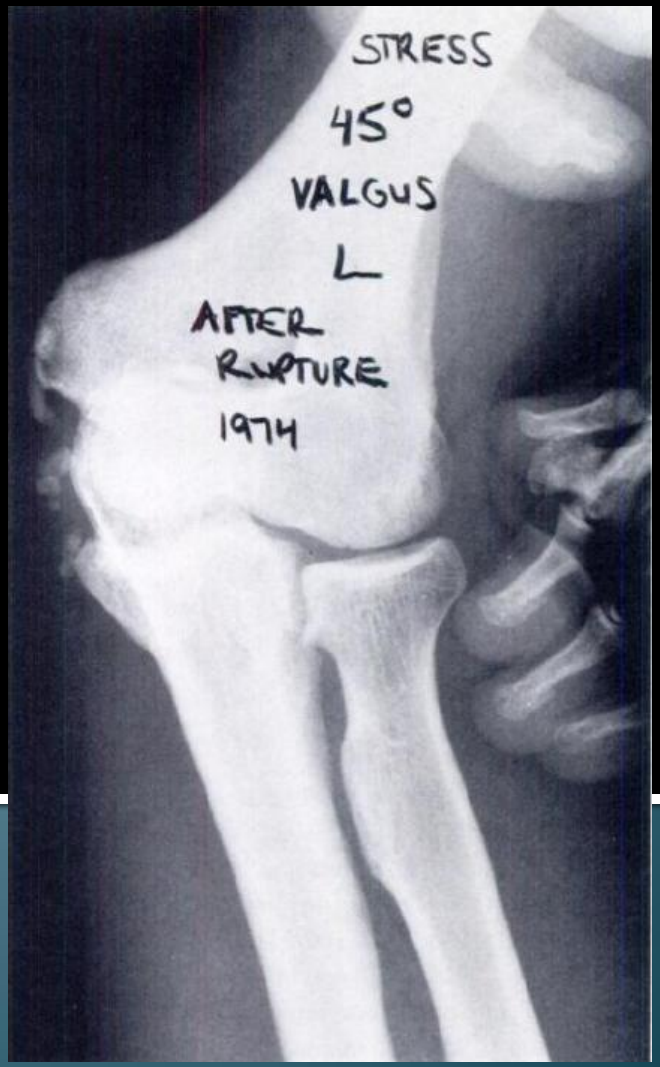
Courtesy of Brady Huang, MD

Ulnar Collateral Ligament Injury

- Valgus stress injury during acceleration phase
  - In adults, anterior band of UCL is most frequently injured - primary stabilizer of medial elbow
  - In children, primary stabilizer of medial elbow = flexor/pronator group
- Partial/complete tear, usually result of chronic injury from repetitive microtrauma

Ulnar Collateral Ligament Injury

- Pitchers usually notice decrease in velocity and control
- Initial injury may not be symptomatic
  - If activity continued, injury exacerbated by singular event – usually hear a "pop" and immediate pain



JBJS 1986; 68A:1158-1163

Am J Sports Med 2004; 32:1158-1164

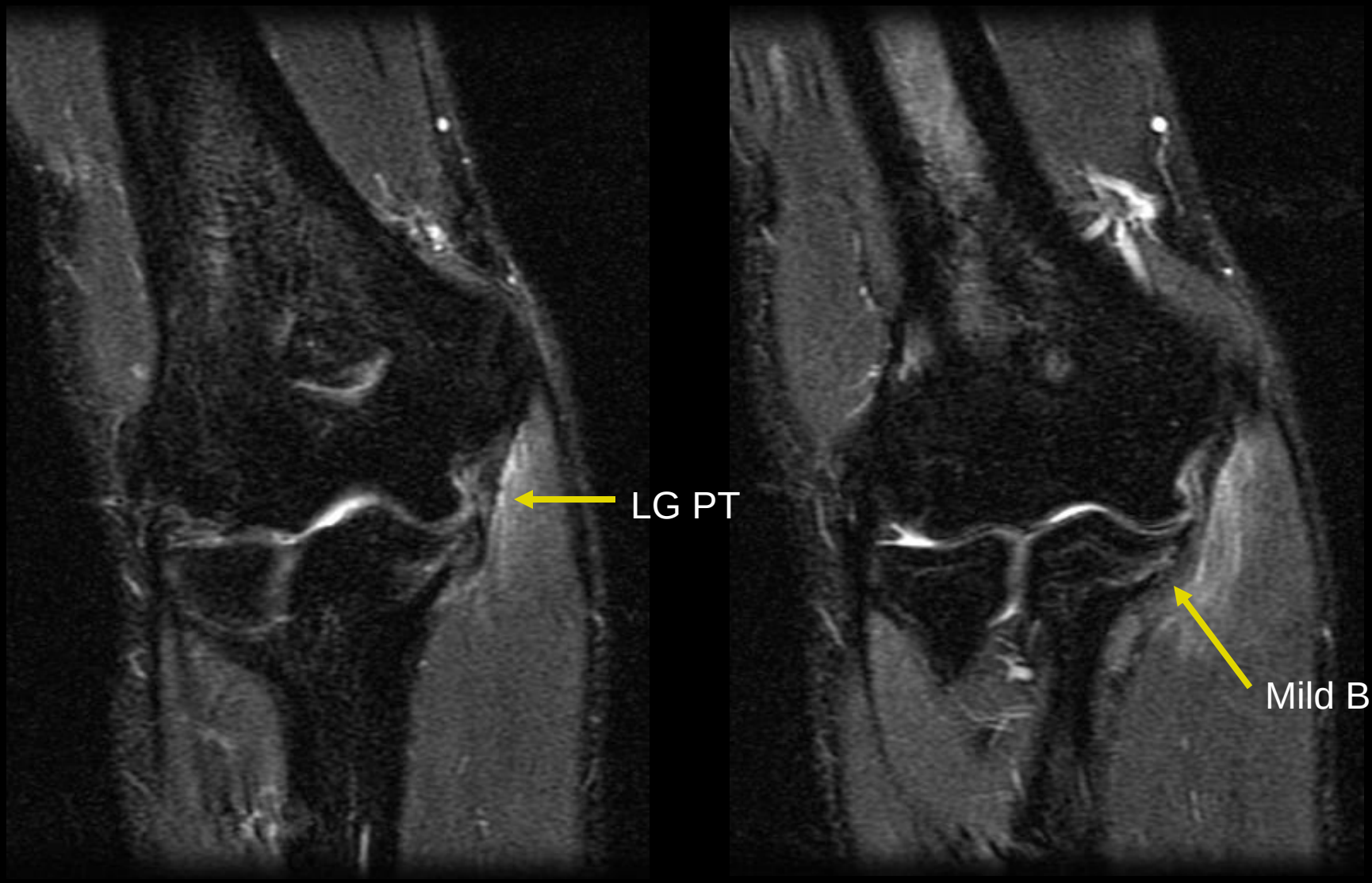
Ulnar Collateral Ligament Injury

RadioGraphics 1996; 16:1323-1336

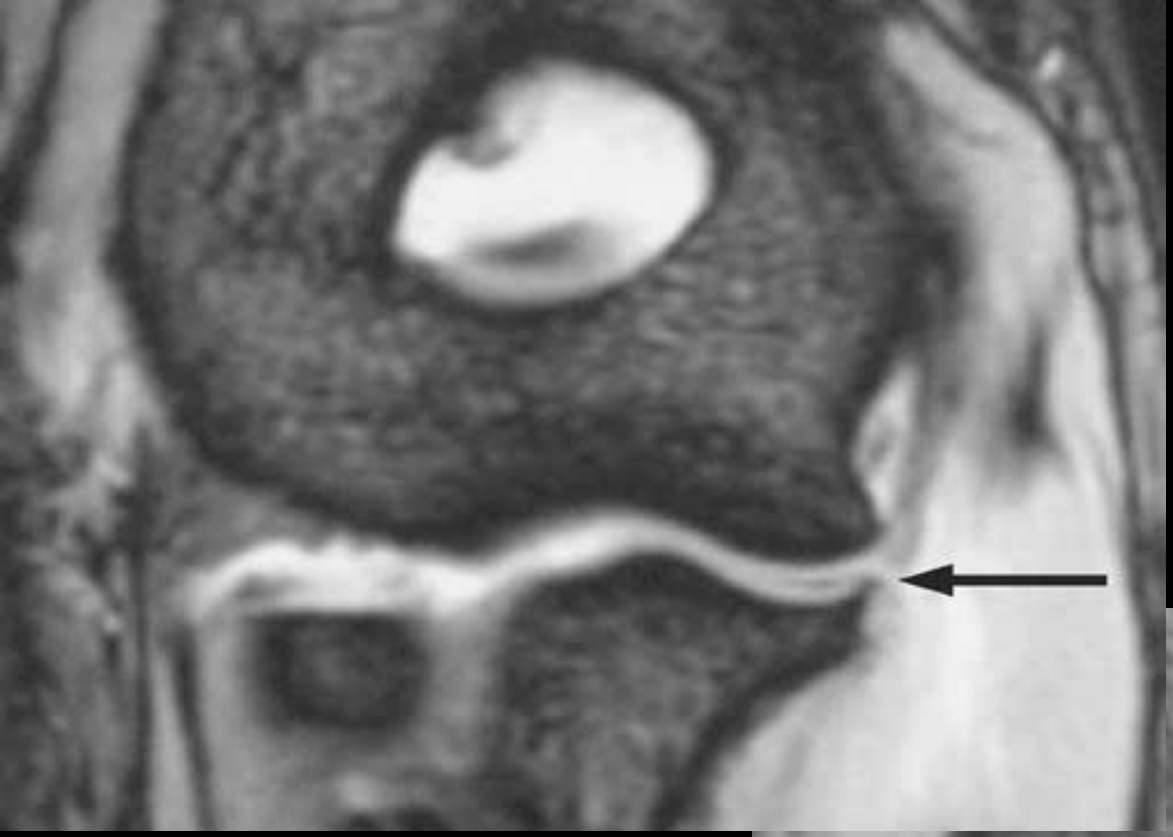
- Site of failure
  - Midsubstance – 87%
  - Distal – 10%
  - Proximal – 3%

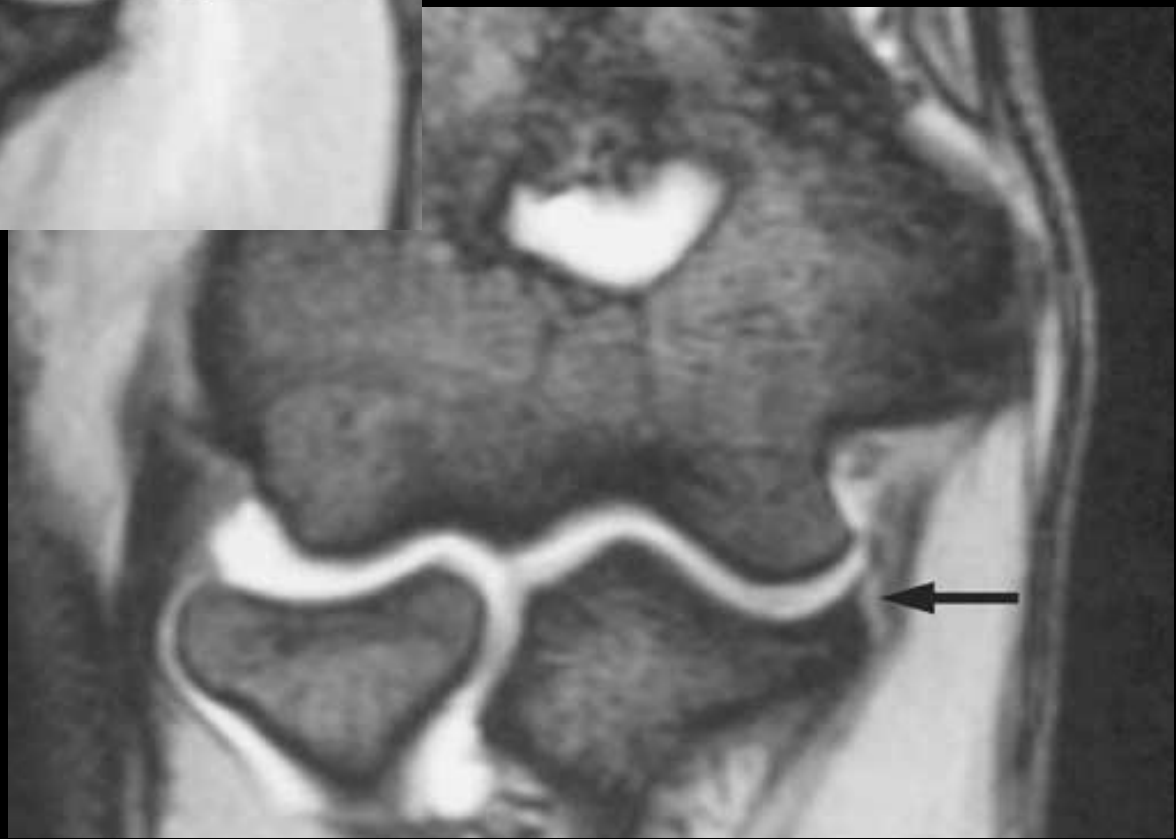
JBJS 1992;74A:67-83

19 y/o R handed pitcher with valgus instability



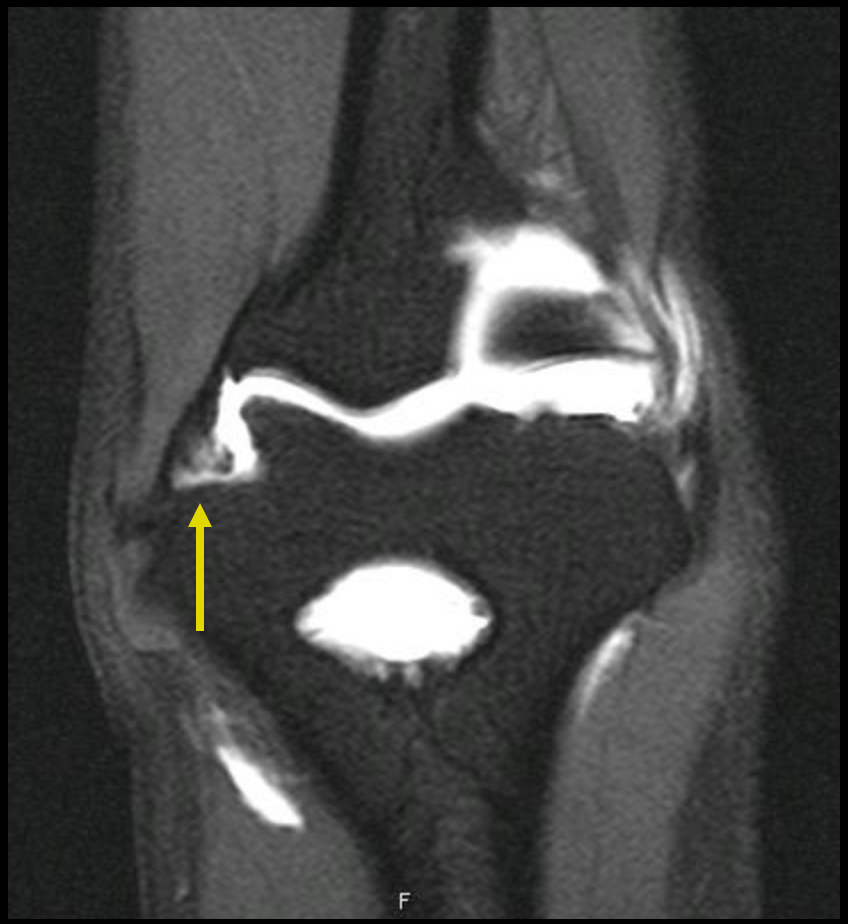
Courtesy of Tudor Hughes, MD





Am J Sports Med 2004; 32:1158-1164

MR Elbow Arthrogram



Courtesy of Tudor Hughes, MD

UCL Injury – Associated Findings

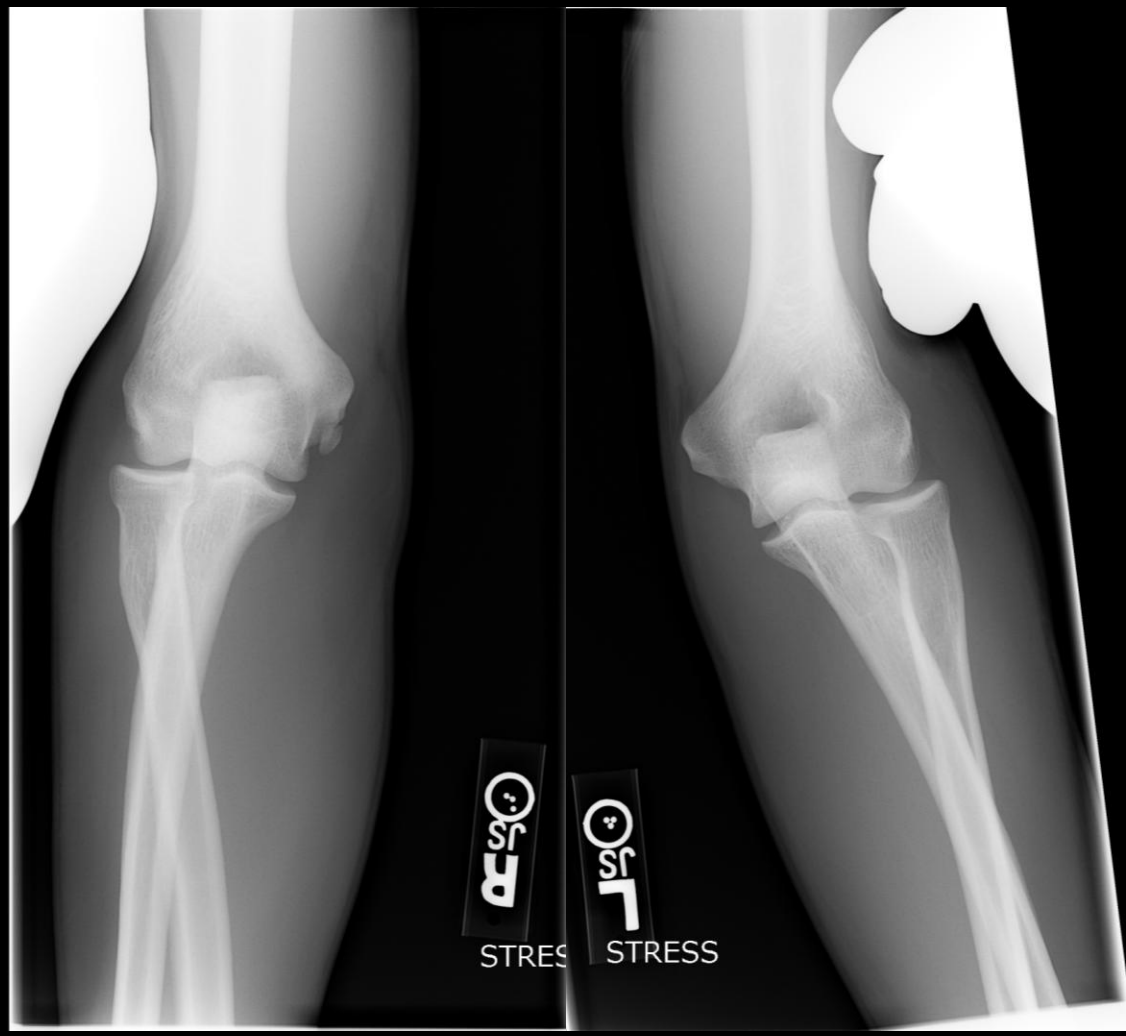
- Associated strain injuries to flexor digitorum superficialis
  - FDS muscle fibers blend with anterior bundle of UCL
- Ulnar traction spurs at insertion of UCL on coronoid process
  - 75% of profession baseball pitchers (AJR 1980; 134(5):971-977)
- Calcification/heterotopic bone along UCL from chronic degeneration

UCL Injury – Heterotopic Calcification/Ossification

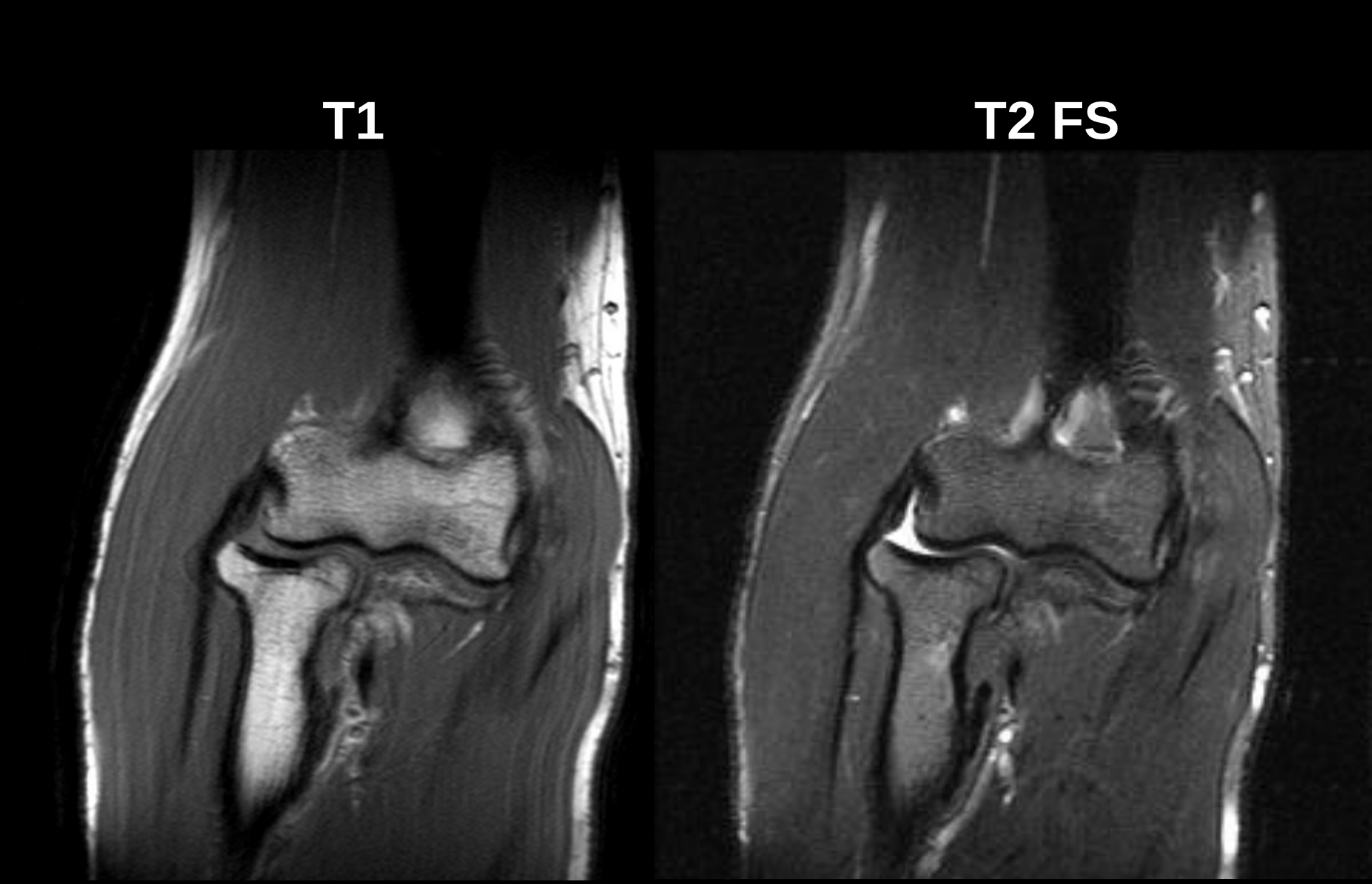
- Analogous to Pelligrini-Stieda phenomenon of the proximal MCL in the knee
- With chronic stress, progressive ligamentous changes
  - Inflammation/edema -> scarring -> calcification -> ossification

AJR 2000; 175:1099-1102

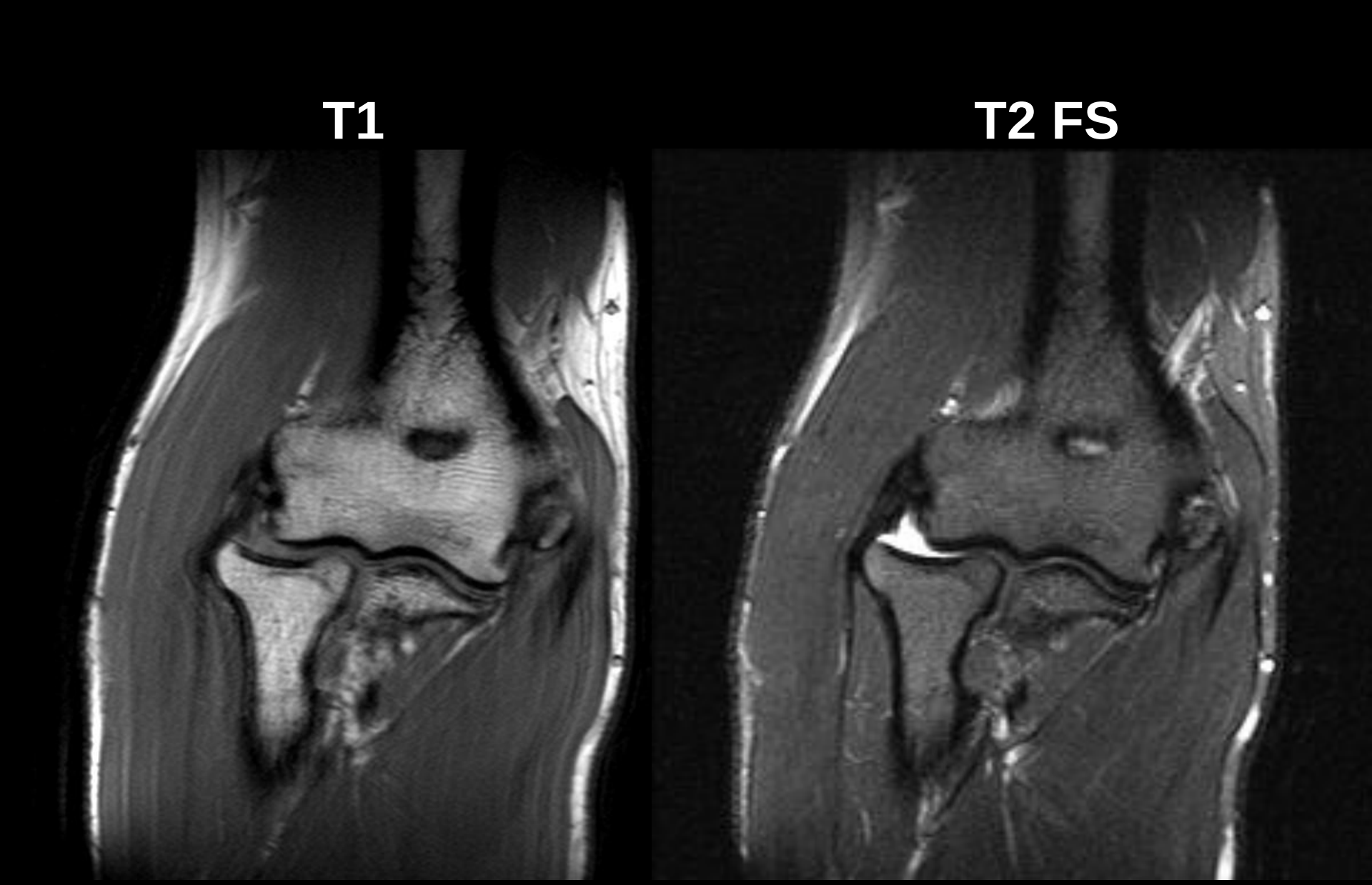
19 y/o R handed pitcher with elbow pain



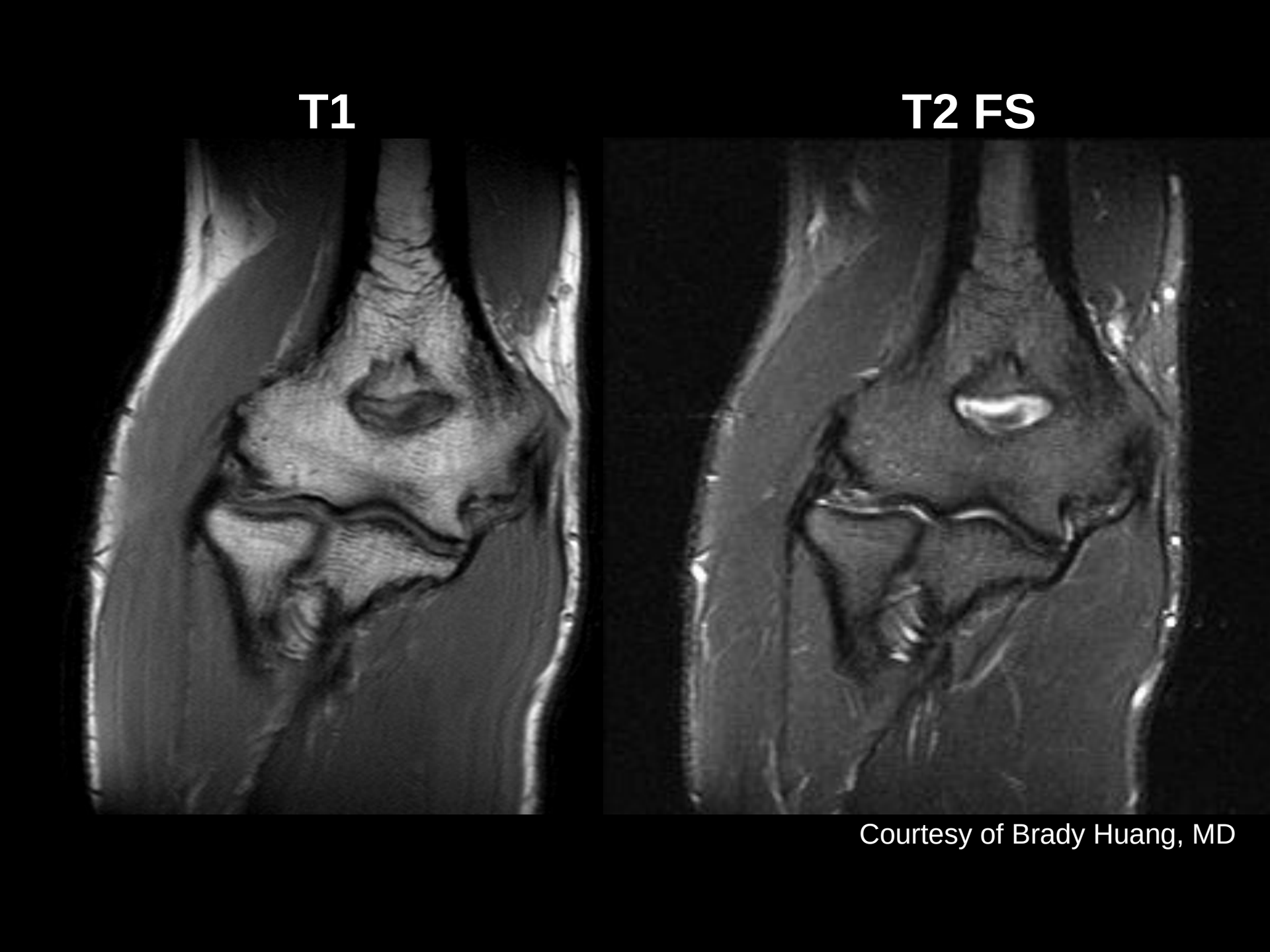
Courtesy of Brady Huang, MD



Courtesy of Brady Huang, MD

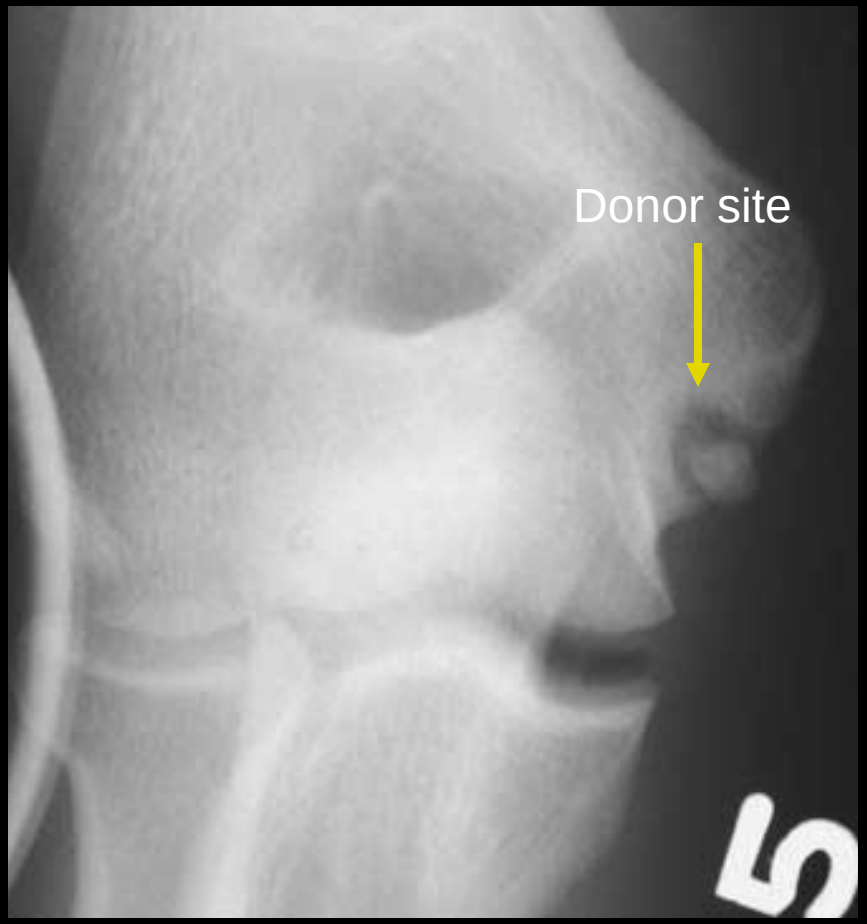


Courtesy of Brady Huang, MD



Courtesy of Brady Huang, MD

Heterotopic Ossification of UCL vs. Medial Epicondyle Avulsion



Am J Sports Med 2004; 32:1158-1164

Confluent Ossification of UCL

AJR 2000; 175:1099-1102

Treatment of UCL Injury - Conservative

- Acceptable results in non-throwing athletes and low demand population
- Regimen of rest, anti-inflammatory medications, and specific functional exercises
- Avoid corticosteroid injection
  - May cause weakening of UCL

Conservative Treatment in Professional Football Quarterbacks

- UCL injuries in football quarterbacks relatively uncommon
- Differences in biomechanics b/w football & baseball players
  - Lower forces & torque, lower angular velocity, slower acceleration phase required to throw a football
  - Lack of dramatic cocking phase
- Majority of football elbow injuries from direct contact (acute injury) vs. baseball players (chronic repetitive microtrauma)

From the internet

J Shoulder Elbow Surg 2010; 19:1276-1280

Treatment of UCL Injury – Surgical Repair vs. Reconstruction

- Inferior results with repair compared to reconstruction
- Returned to same or higher level of performance
  - 50% in repair group, 68% in reconstruction group (Conway et al. JBJS 1992; 74A:67-83)
  - 63% in repair group, 81% in reconstruction group (Azar et al. Am J Sports Med 2000; 28:16-23)
- Good or excellent results
  - 71% in repair group, 80% in reconstruction group (Conway et al. JBJS 1992; 74A:67-83)

History of UCL Reconstruction

- First published in 1986 by Jobe et al
  - Tendon autograft (palmaris longus, plantaris, Achilles, gracillis)
  - Tendon graft tunneled through sublime tubercle & medial epicondyle
    - Figure of 8 technique
    - Flexor-pronator mass detached at origin to access UCL
    - Submuscular ulnar nerve transposition
  - 10 of 16 athletes (63%) returned to same level of sports
  - High incidence of ulnar nerve dysfunction in 5 of 16 athletes (31%)

JBJS 1986; 68A:1158-1163

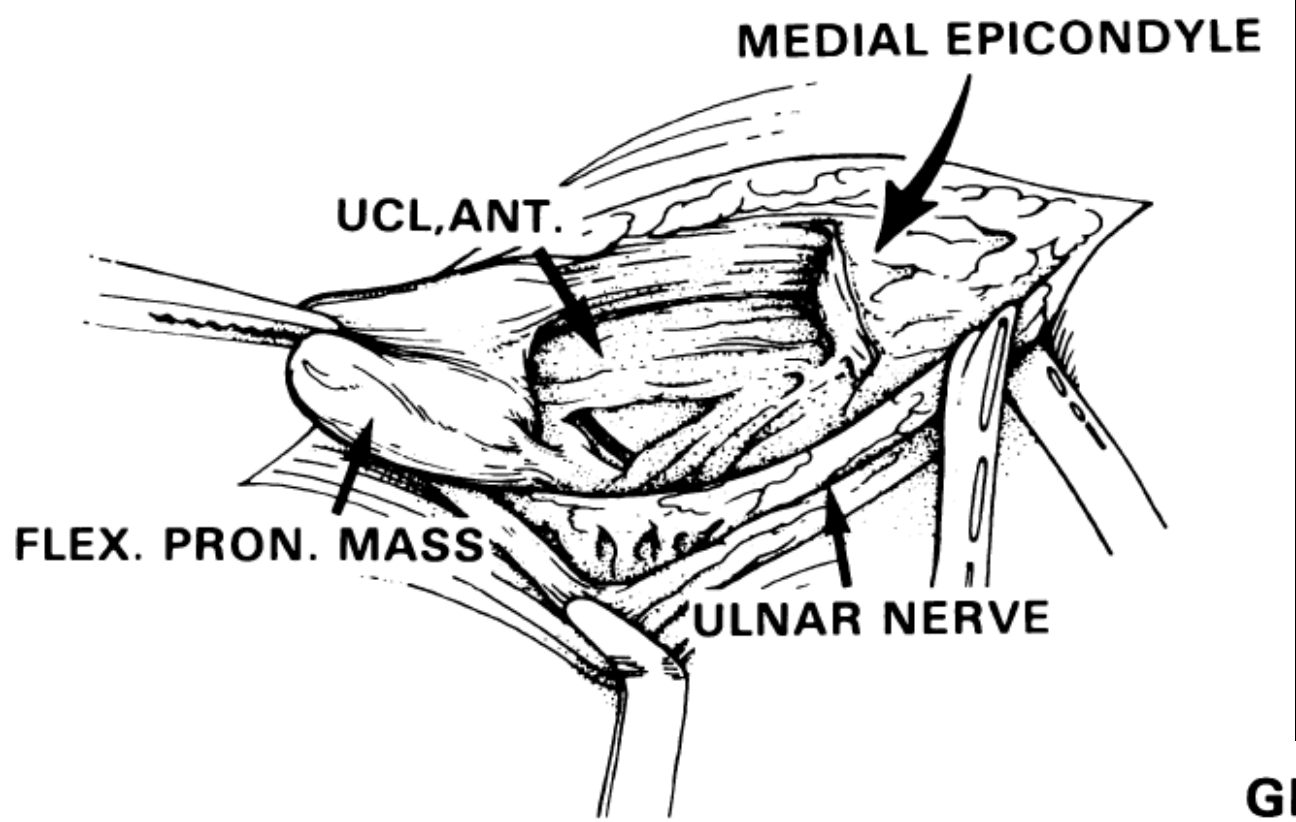


FIG. 5

JBJS 1986; 68A:1158-1163

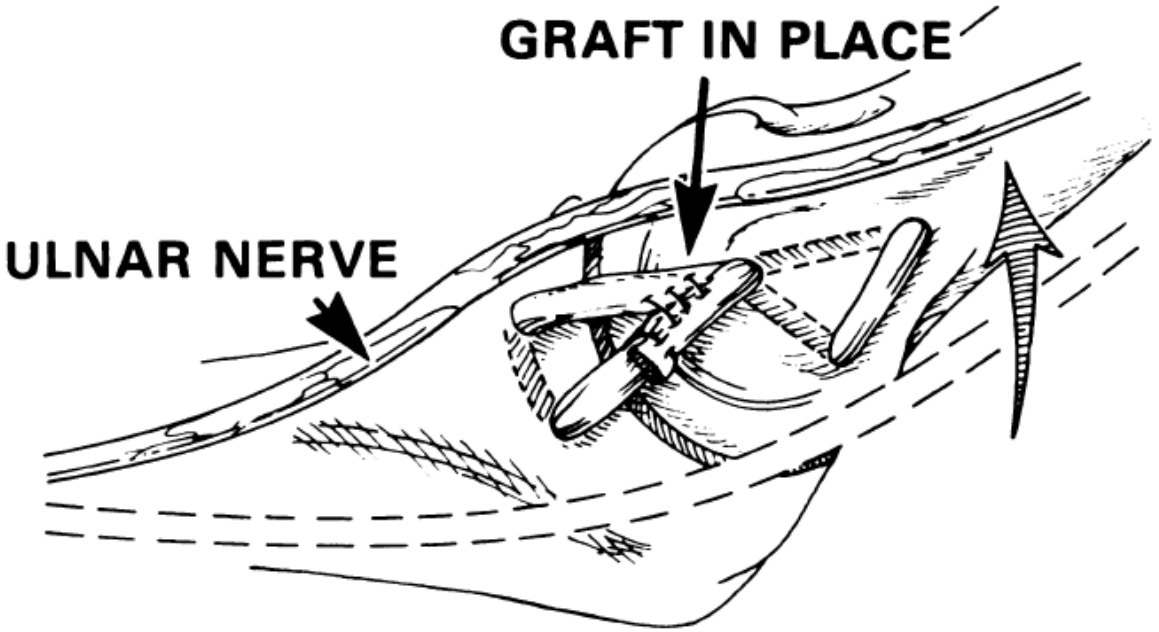


FIG. 6-B

Evolution of UCL Reconstruction

- Dr. James R Andrews modified the procedure (article by Azar et al in 2000)
  - Elevated flexor-pronator mass
  - Subcutaneous rather than submuscular ulnar nerve transposition
    - Fewer ulnar nerve complications than submuscular transposition

Am J Sports Med 2000; 28:16-23

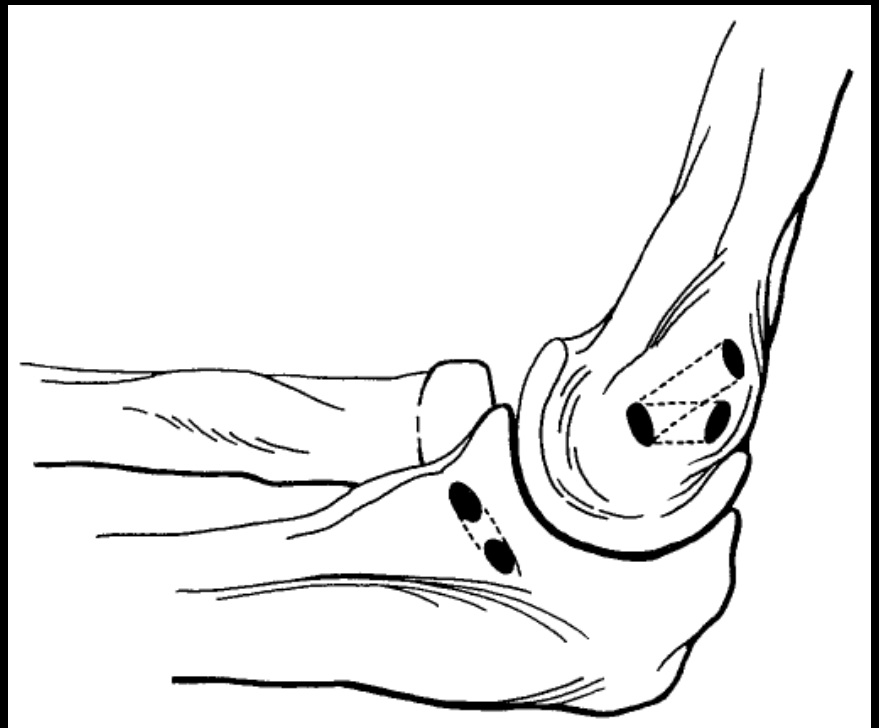


Figure 4. Placement of bone tunnels for ulnar collateral ligament reconstruction.

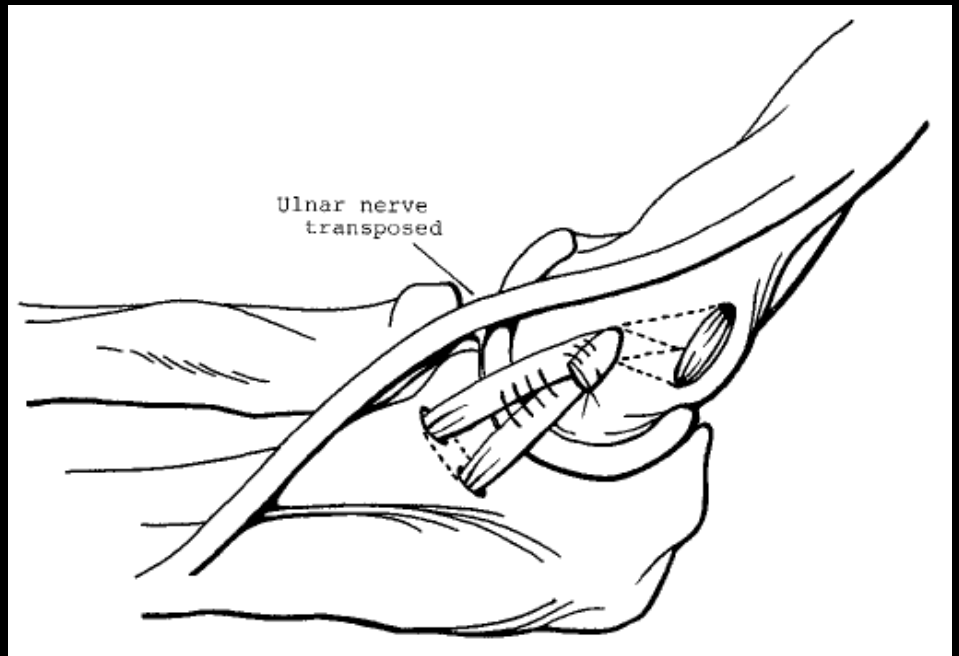


Figure 5. Graft placement for ulnar collateral ligament reconstruction.

Am J Sports Med 2000; 28:16-23

Evolution of UCL Reconstruction

- Dr. Lewis Yocum modified procedure with muscle splitting technique
  (article by Thompson et al in 2001)
  - Muscle splitting technique through flexor-pronator mass to access UCL
  - No ulnar nerve transposition
    - All ulnar neuritis symptoms resolved post-operatively

J Shoulder Elbow Surg 2001; 10:152-157

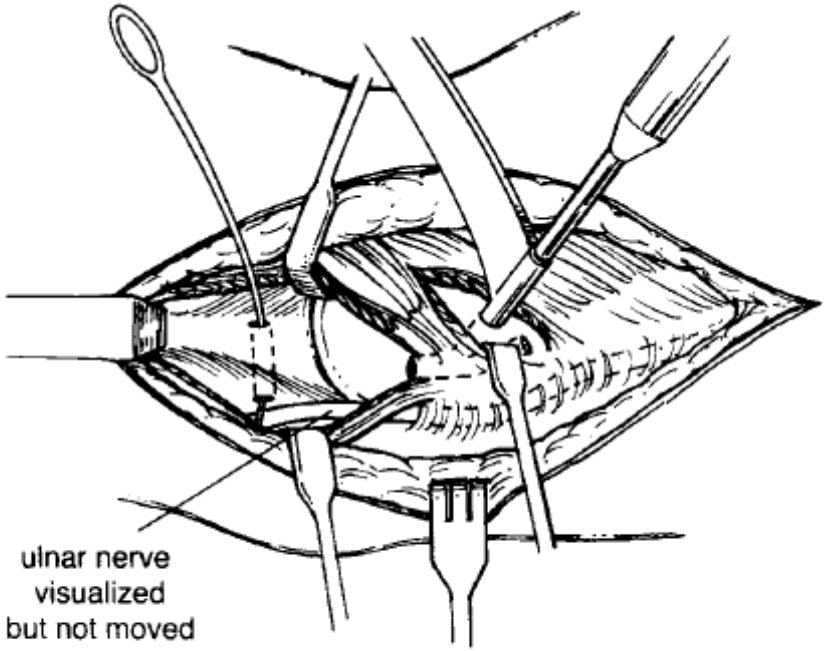


Figure 2 Surgical procedure. A longitudinal split was made in the muscle. The ulnar collateral ligament was neither dissected nor transposed. The humeral tunnels are directed toward the anterior cortex.

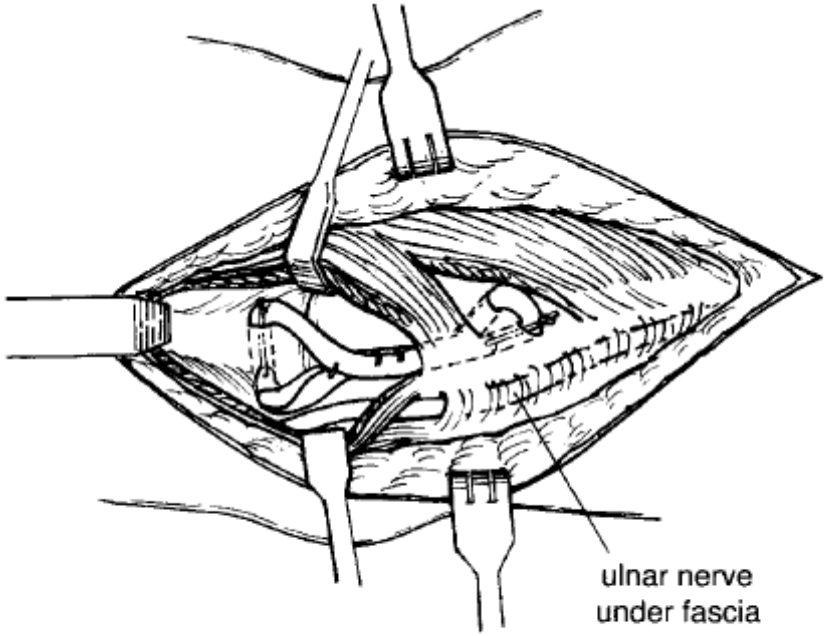


Figure 3 Surgical procedure. Figure-8 configuration of autogenous tendon graft with suture fixation.

J Shoulder Elbow Surg 2001; 10:152-157

Evolution of UCL Reconstruction

- Dr. David Altchek modified procedure utilizing docking technique
  (article by Rohrbough et al in 2002)
  - Docked 2 ends of tendon graft within 1 humeral tunnel
  - Muscle splitting technique
  - No ulnar nerve transposition

Am J Sports Med 2002; 30:541-548

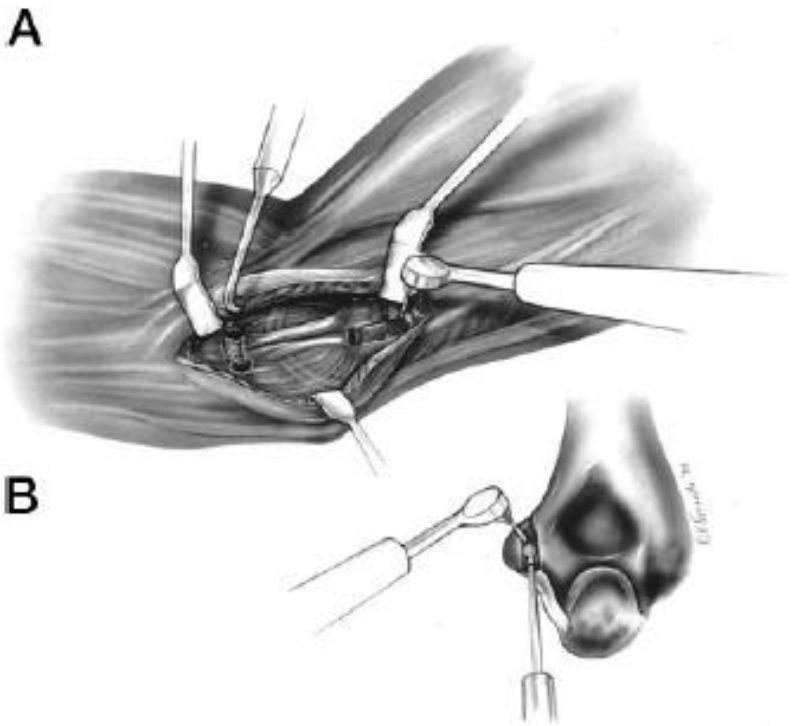


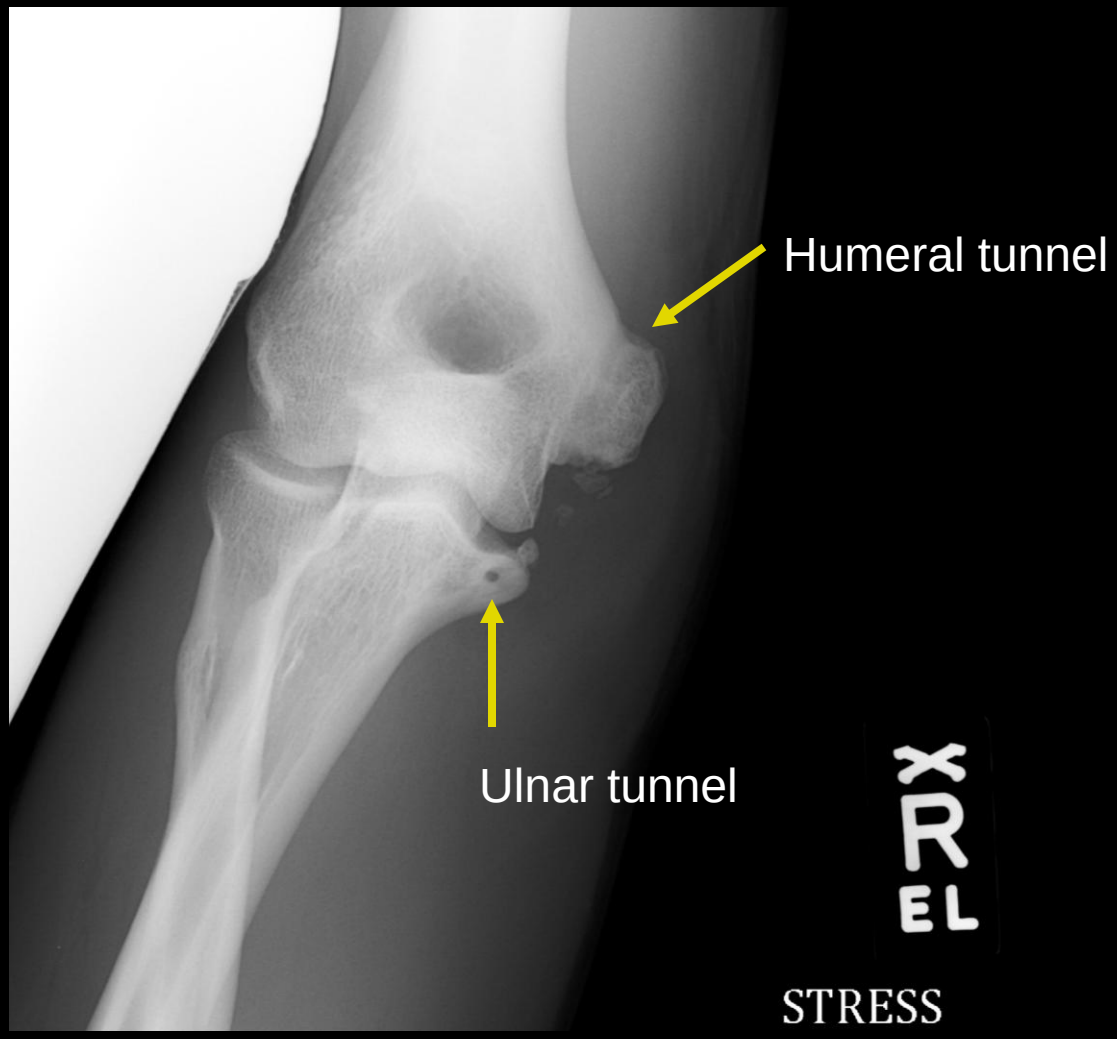
Figure 6. A, creation of the ulnar tunnel using a curved curette to connect the ulnar holes. B, creation of the single humeral tunnel and the exit punctures for the two suture bundles using the dental bur. (Reprinted with permission of Hospital for Special Surgery, New York, New York.)

Am J Sports Med 2002; 30:541-548

UCL Reconstruction in Notable Major League Pitchers

- Tommy John
- AJ Burnett
- Eric Gagne
- John Franco
- Kenny Rogers
- John Smoltz
- Billy Wagner
- Kerry Wood
- Cris Carpenter
- Tim Hudson
- Jamie Moyer
- Stephen Strasburg
- Adam Wainwright

25 y/o R handed pitcher with h/o UCL reconstruction with mild elbow pain



Courtesy of Brady Huang, MD


T1 FS
Courtesy of Brady Huang, MD


T1 FS
Courtesy of Brady Huang, MD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Courtesy of Brady Huang, MD

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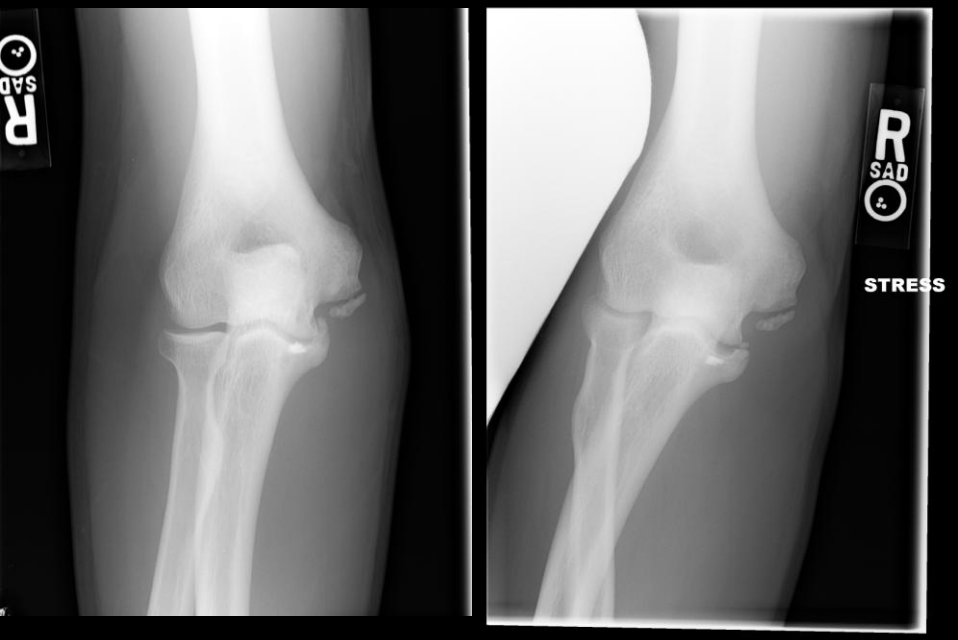
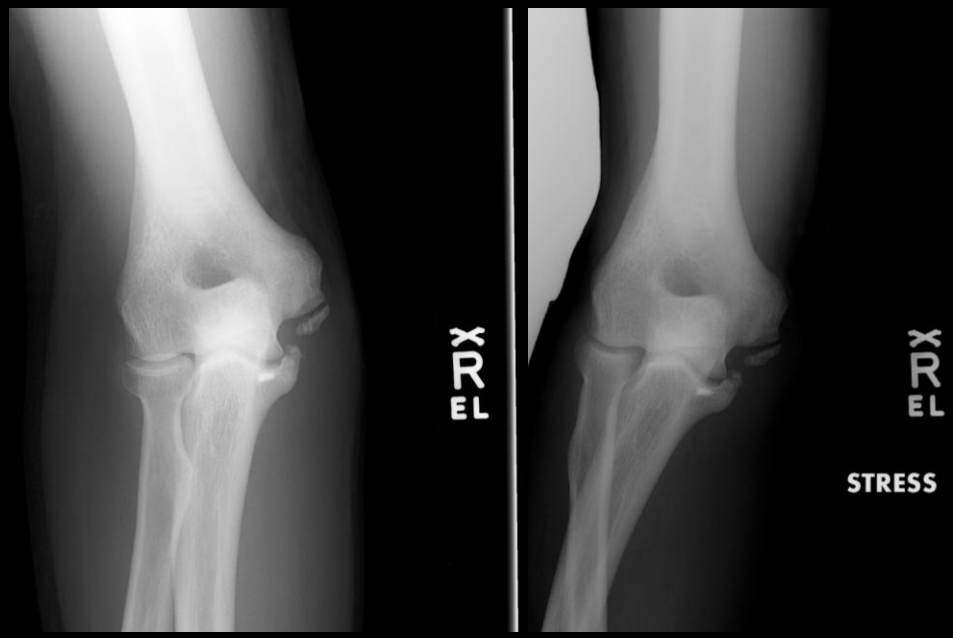
Courtesy of Brady Huang, MD

25 y/o minor league pitcher with h/o UCL reconstruction, felt elbow pop while pitching

10 months ago



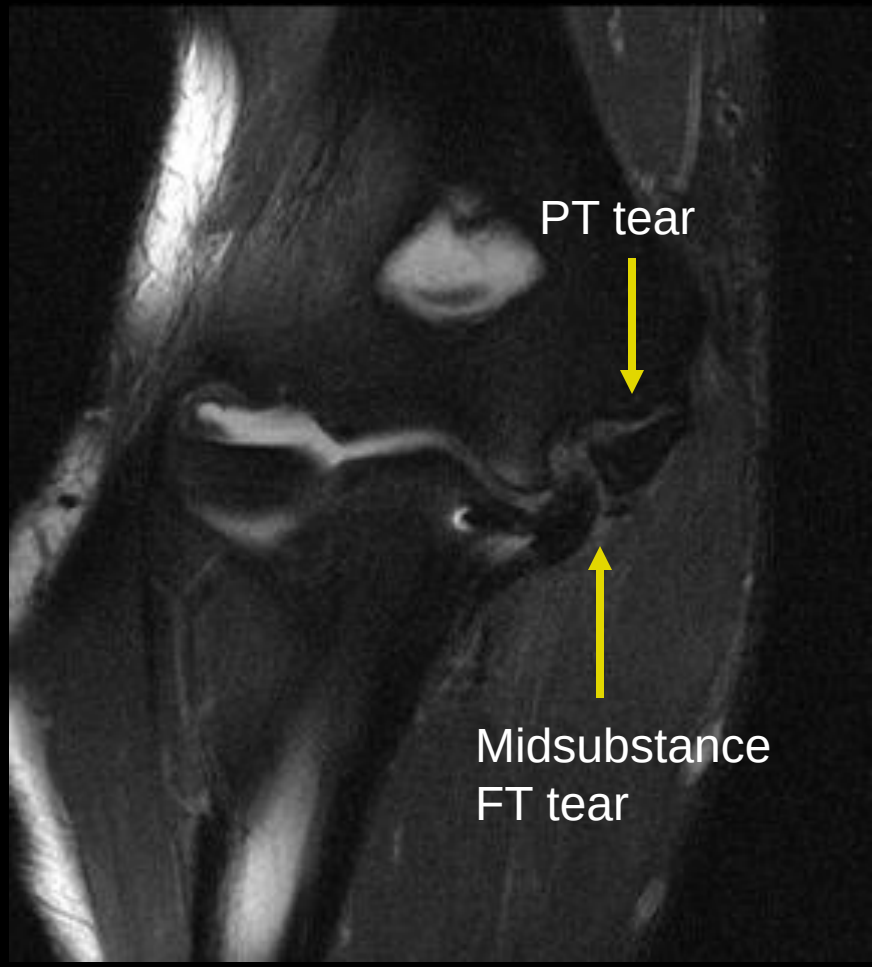
At time of visit



Courtesy of Brady Huang, MD

10 months ago

At time of visit



Courtesy of Brady Huang, MD

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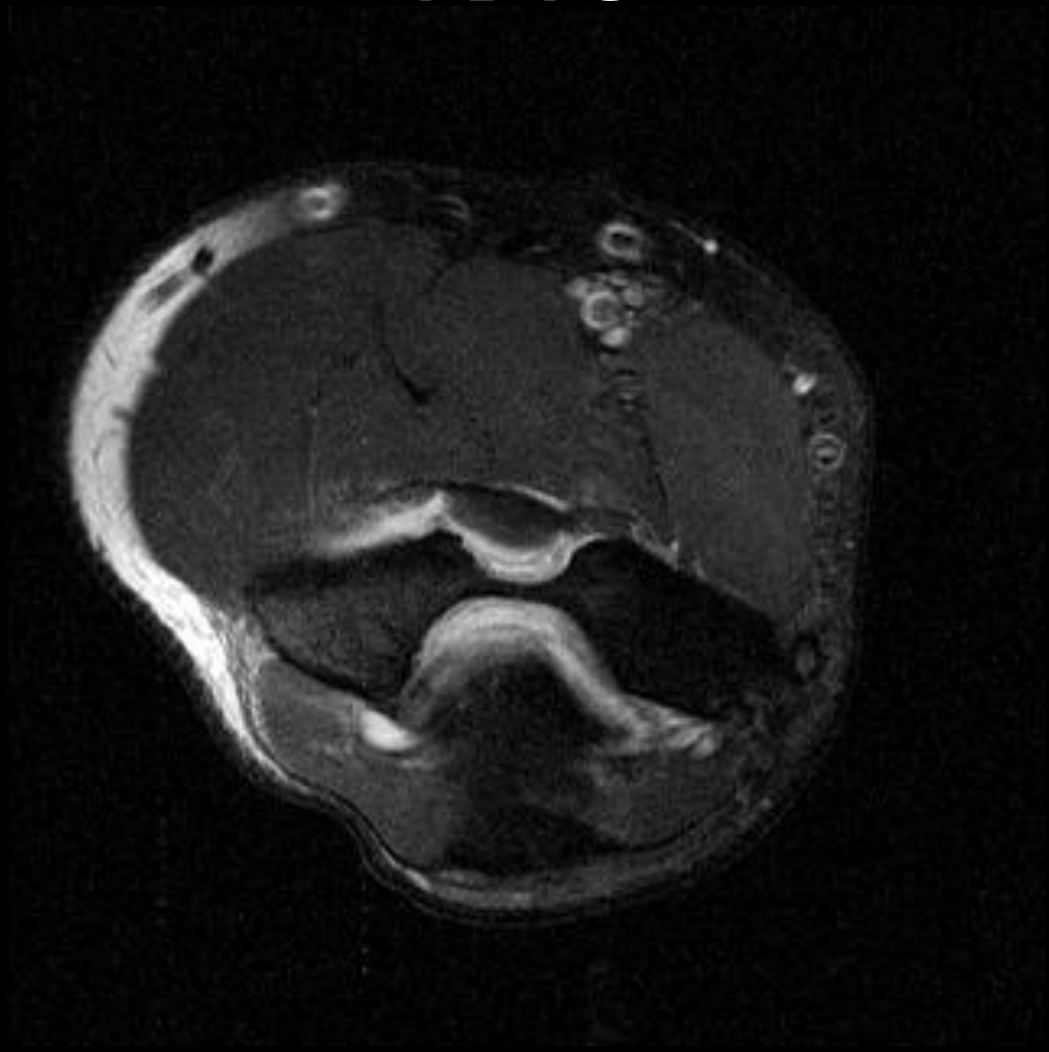

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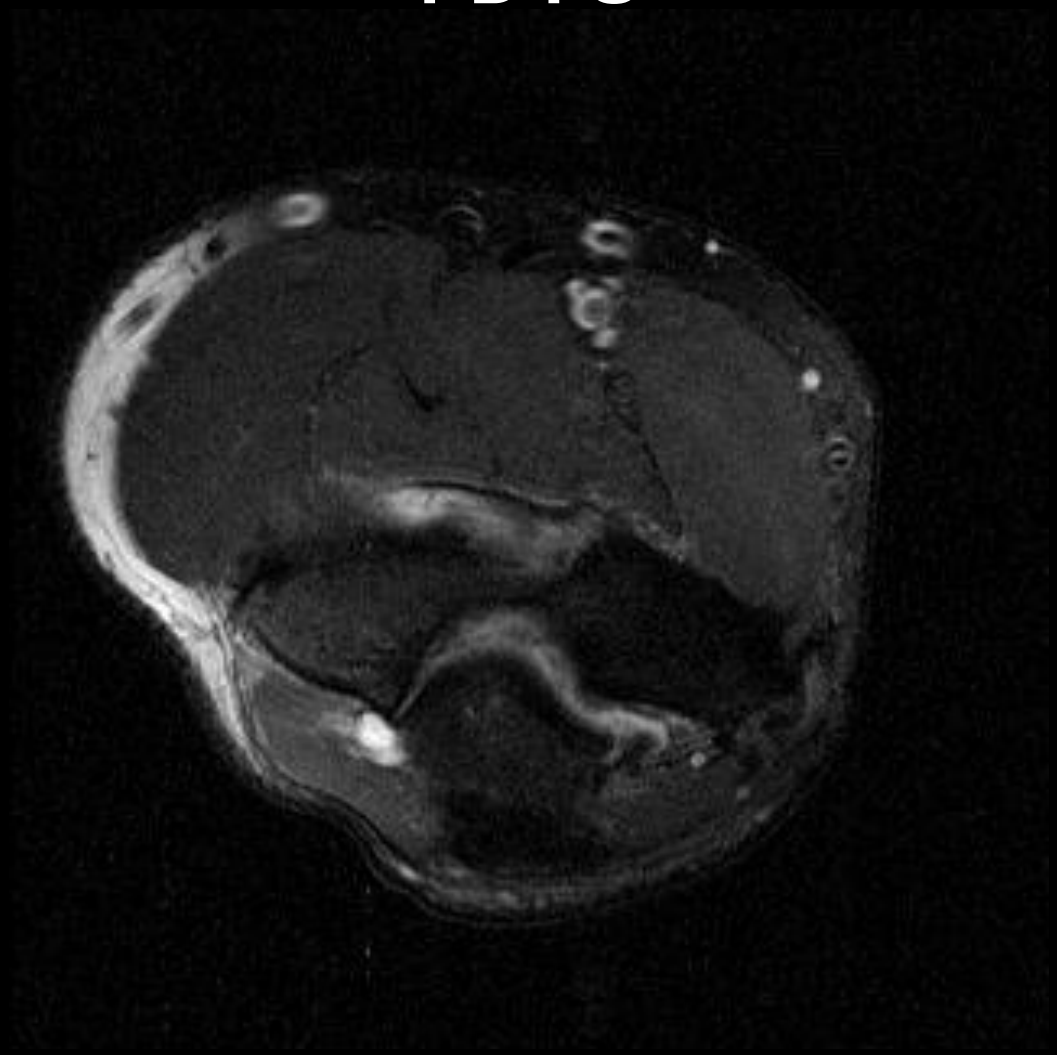

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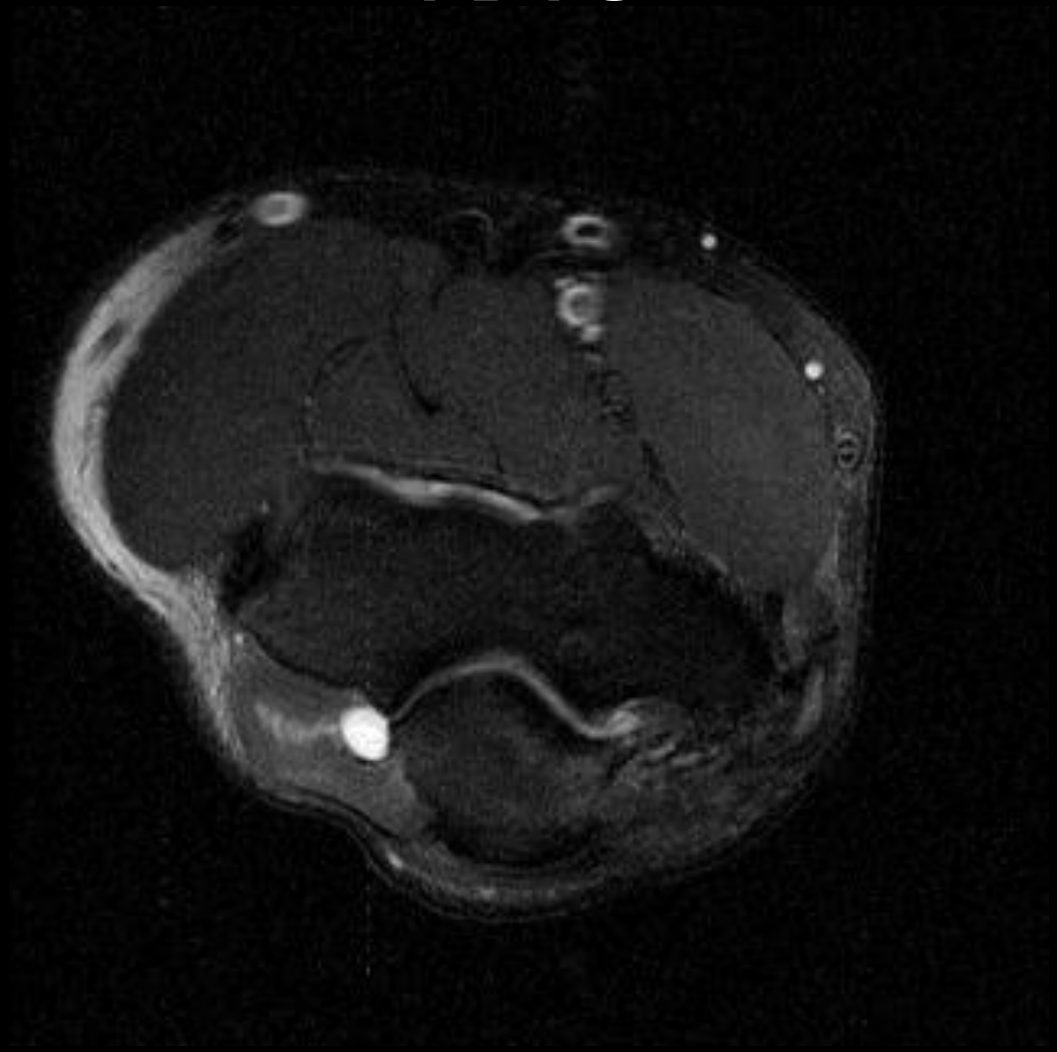

Courtesy of Brady Huang, MD

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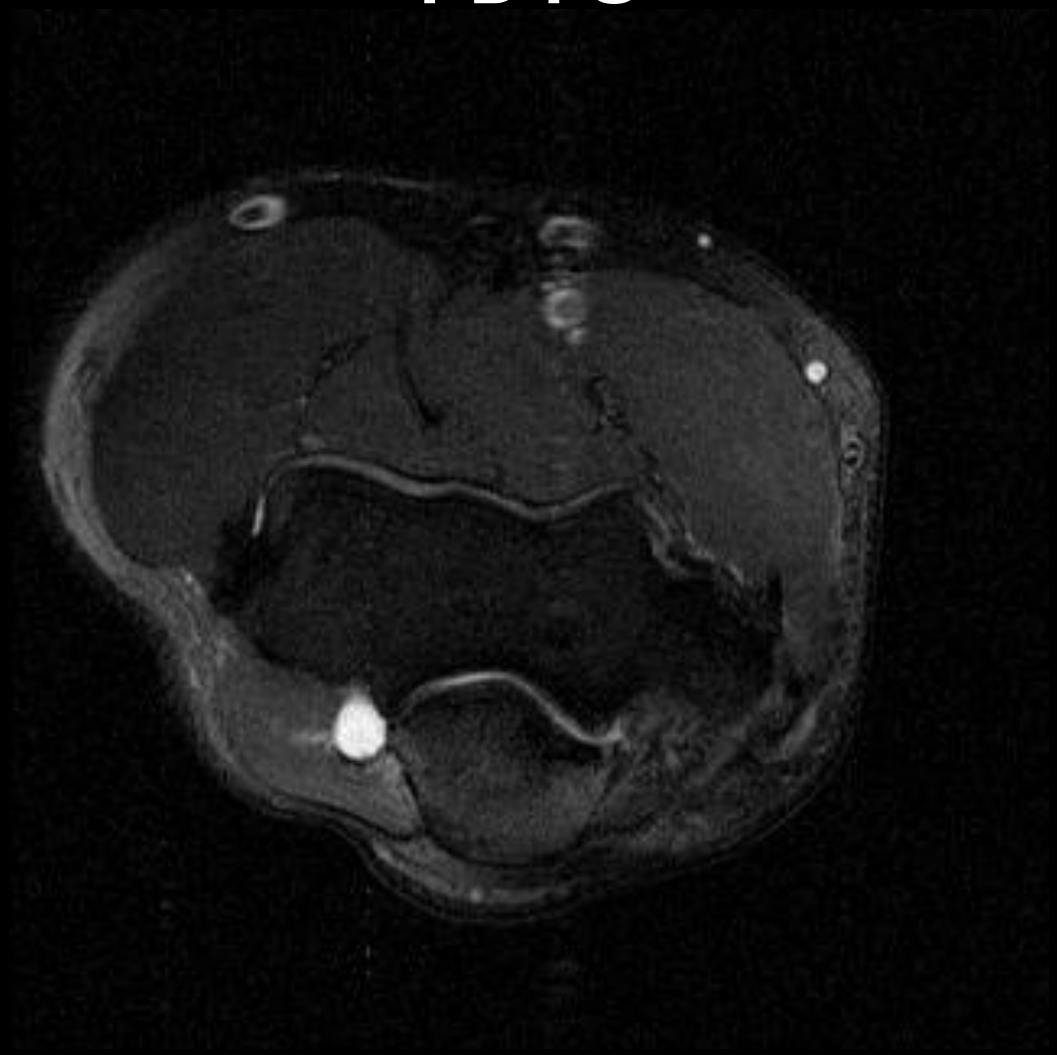

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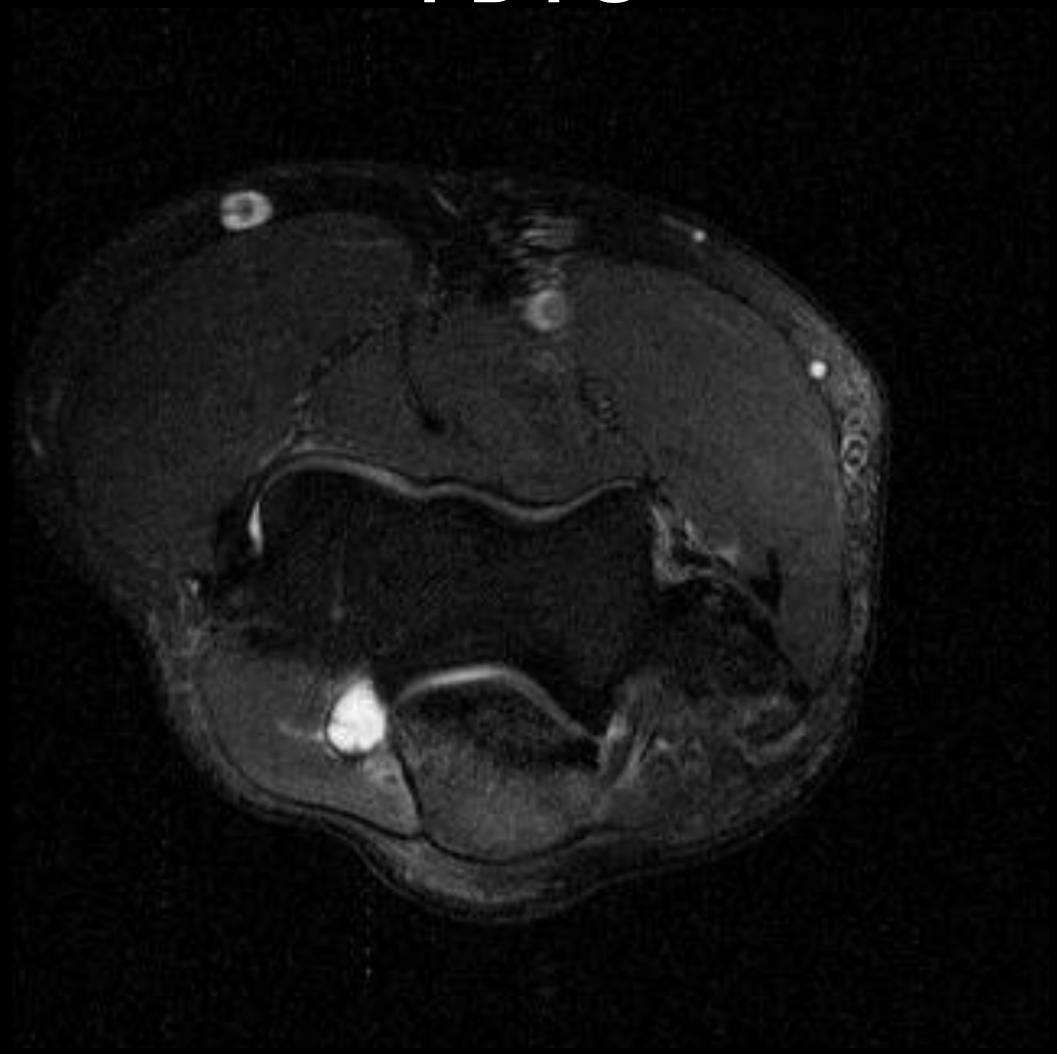

Courtesy of Brady Huang, MD

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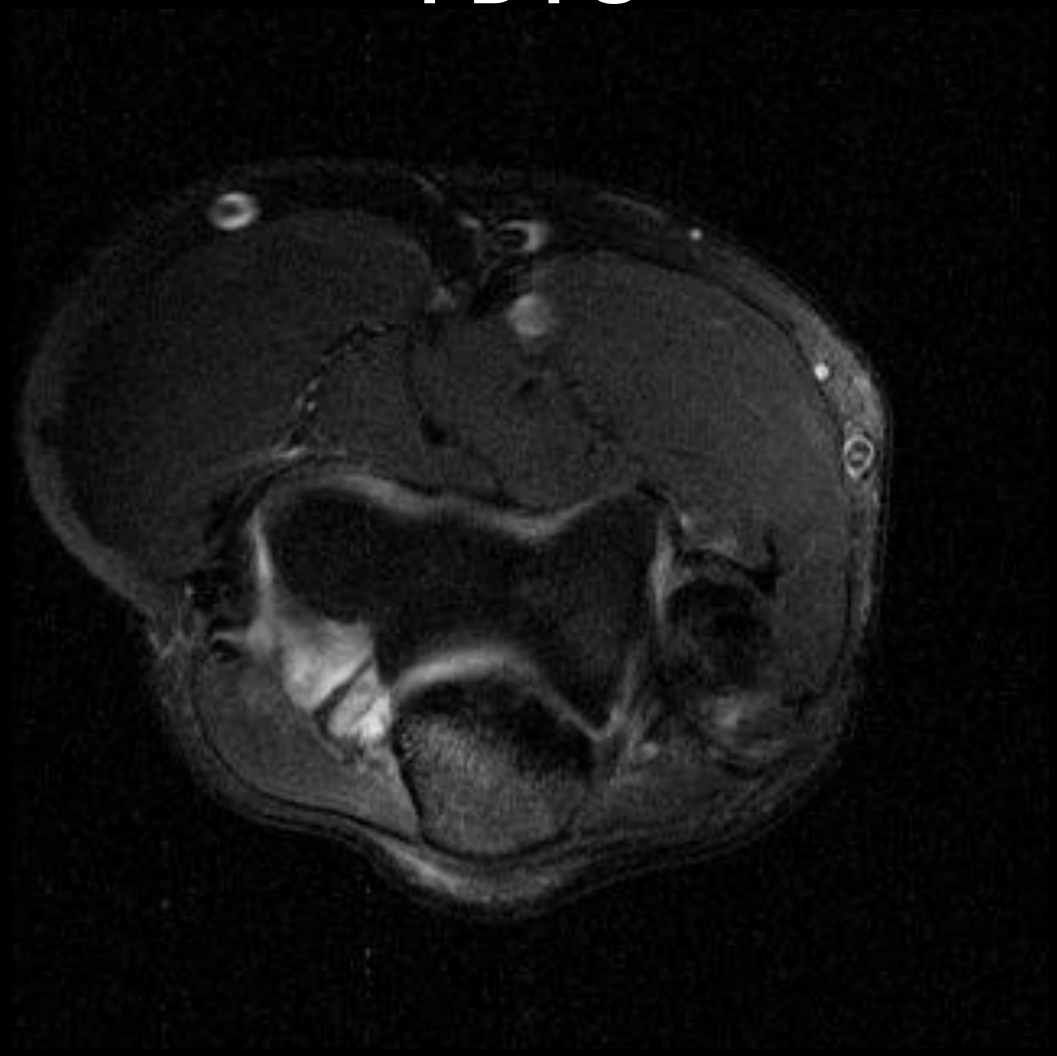

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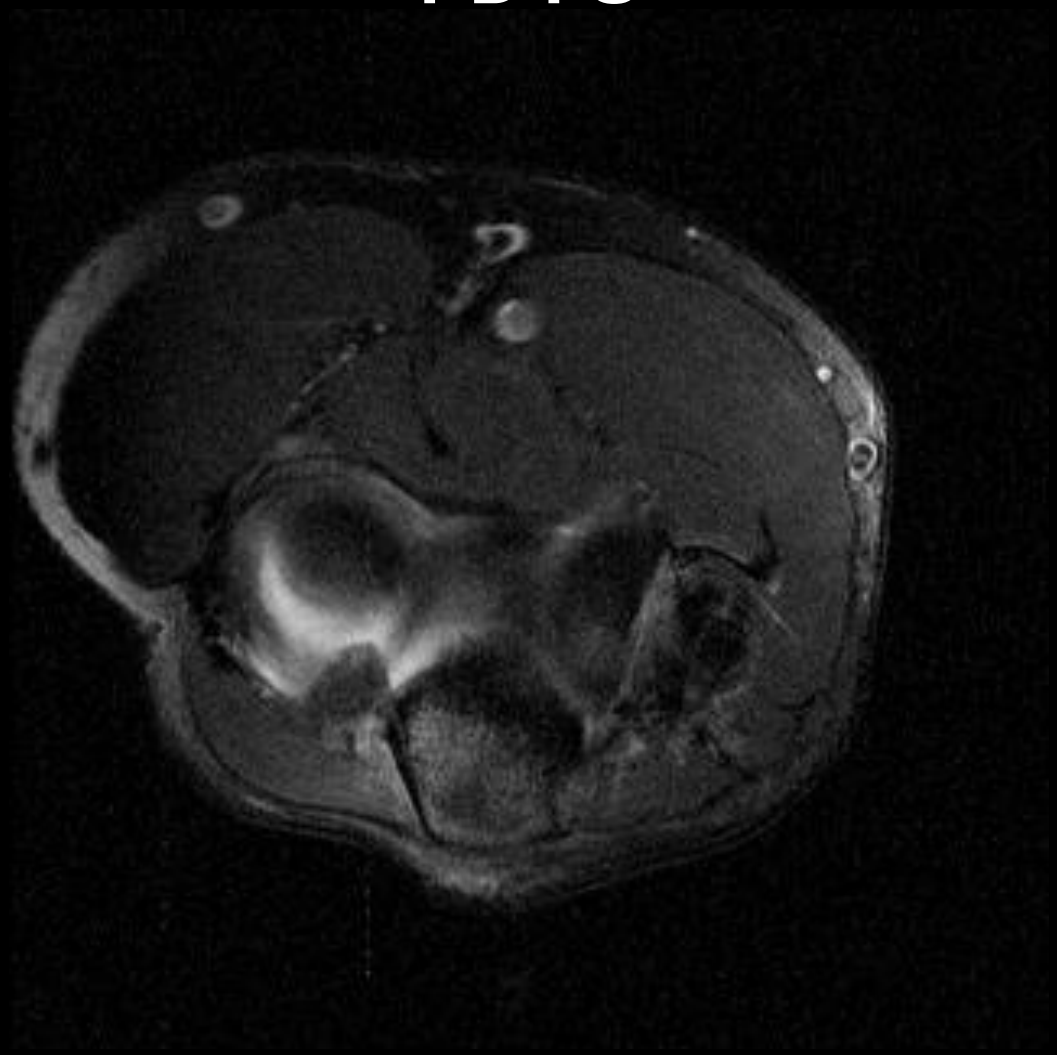

Courtesy of Brady Huang, MD

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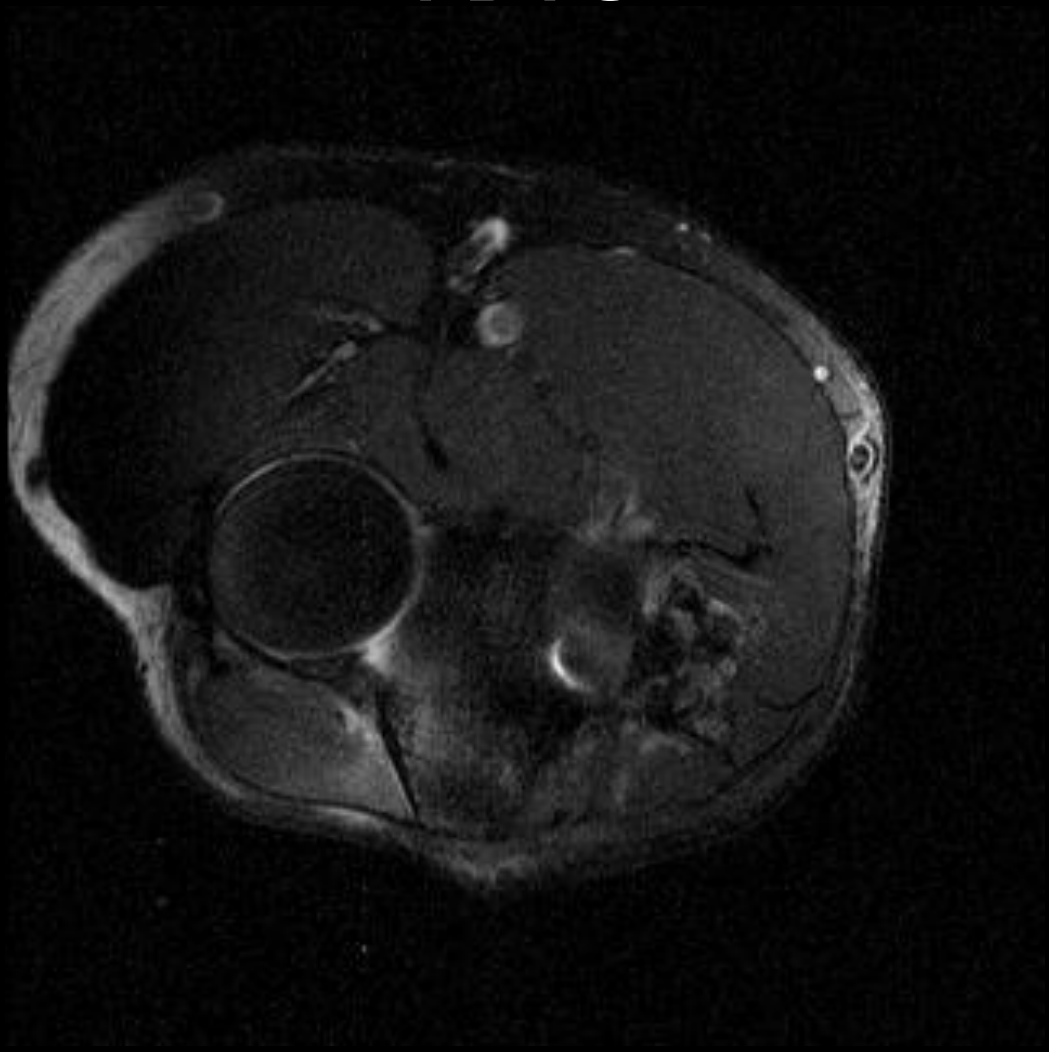

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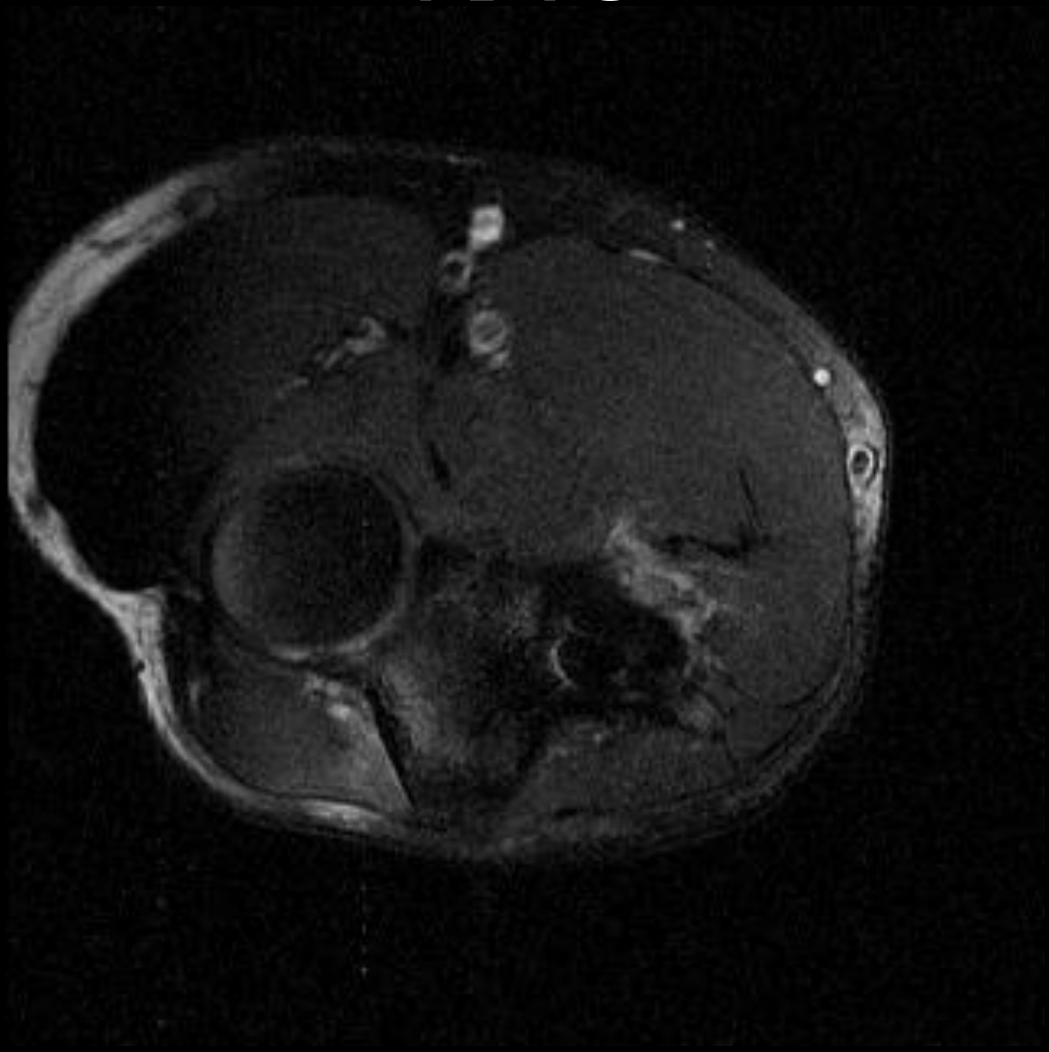


Courtesy of Brady Huang, MD

Avulsion of Medial Epicondyle After UCL Reconstruction

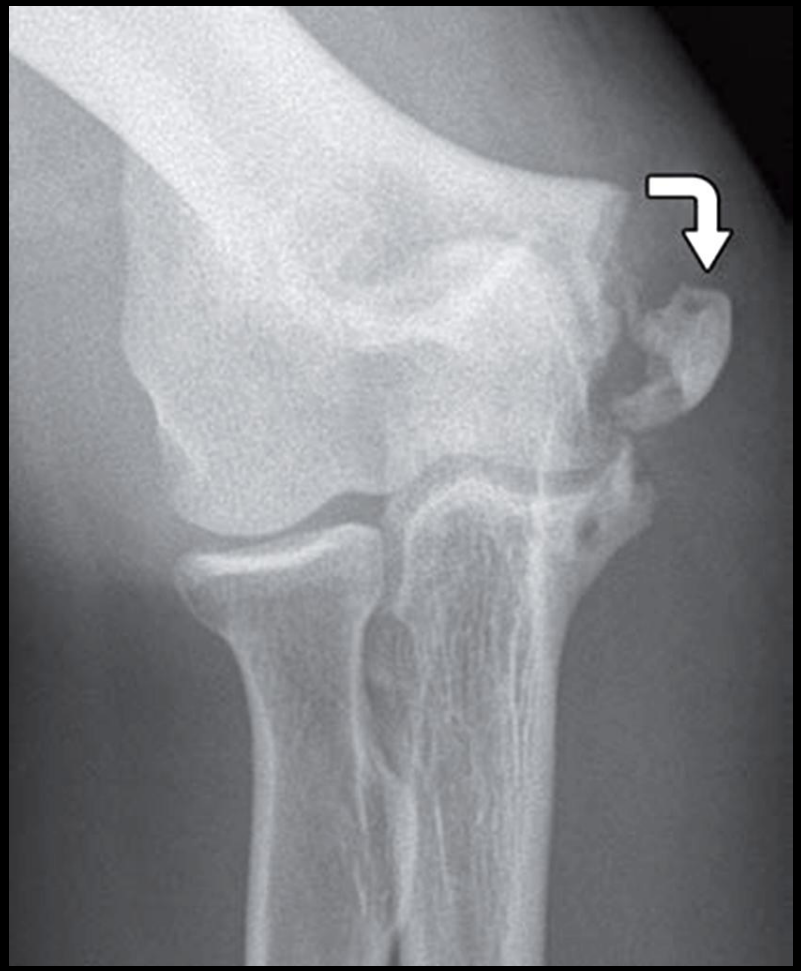
- Series of 7 players with prior UCL reconstruction with medial epicondyle avulsion fractures
  - All fractures involved the humeral tunnel
    - Humeral tunnel acts as stress riser
  - Professional and college baseball players

AJR 2008; 190:595-598

21 y/o college pitcher with medial elbow pain 12 month after UCL reconstruction

Post-op UCL recon

After pitching injury



AJR 2008; 190:595-598

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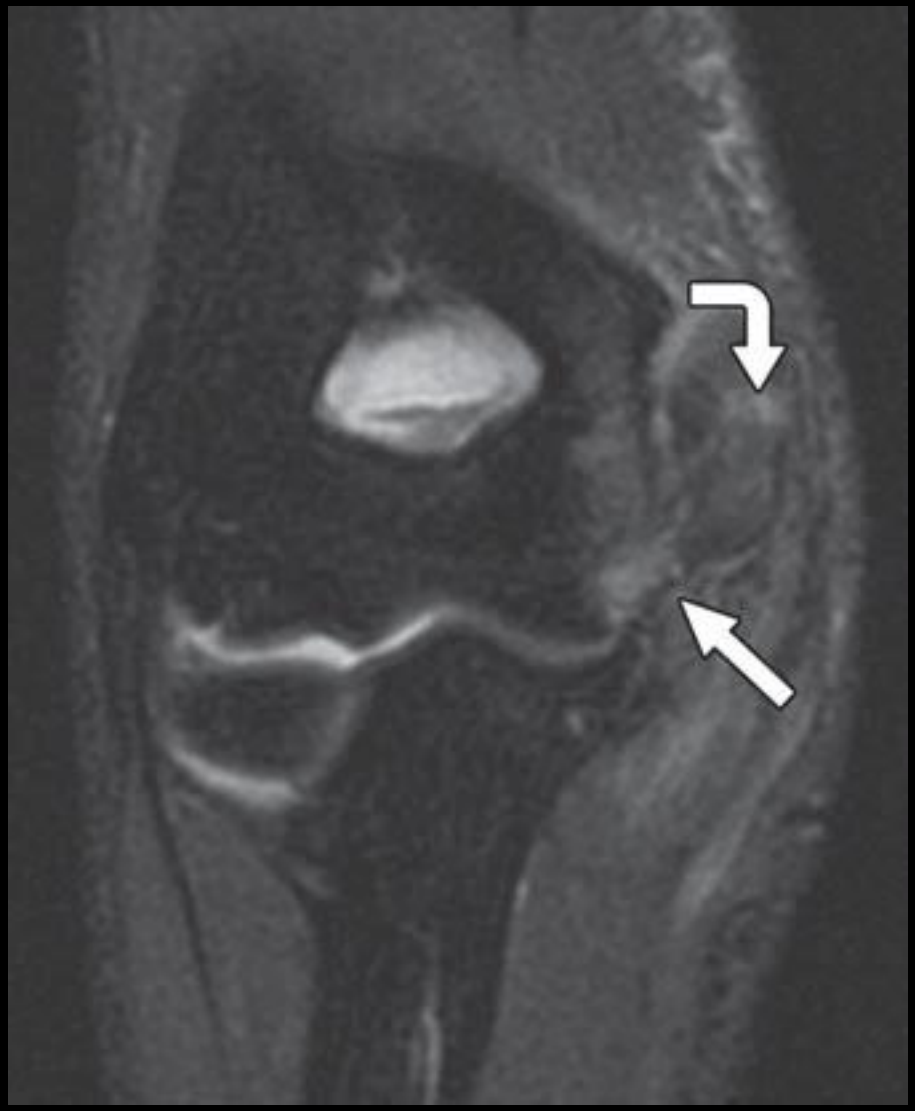

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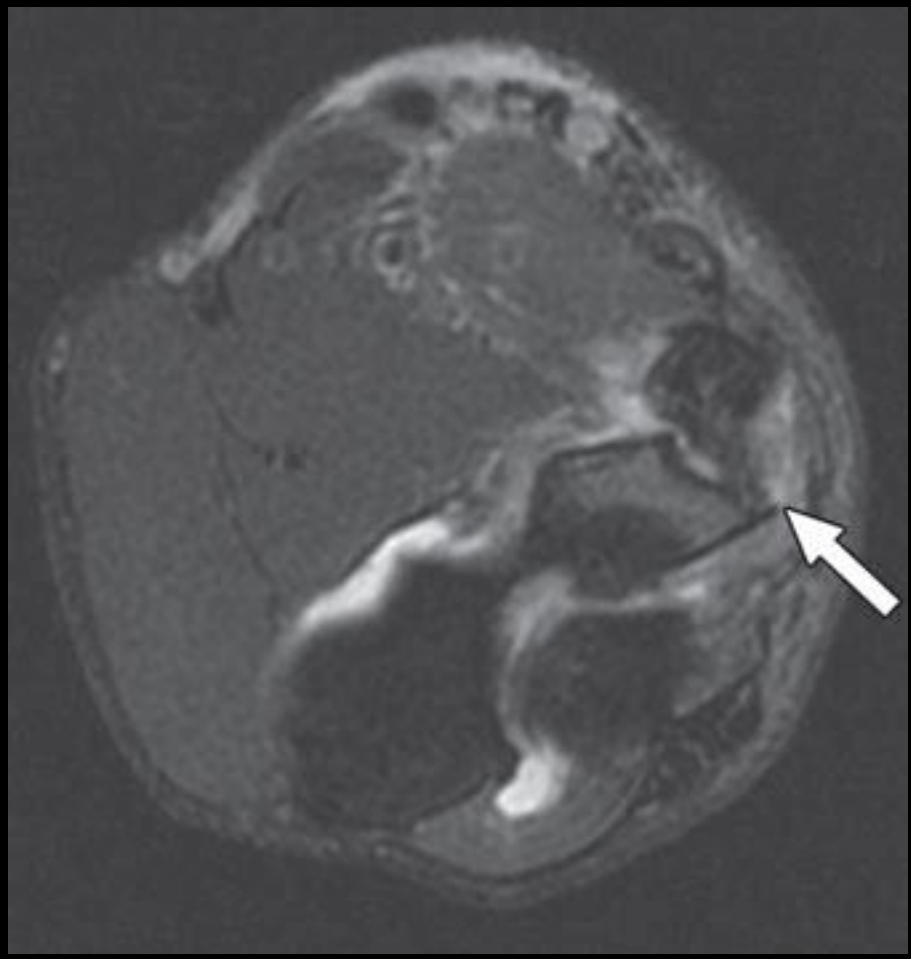
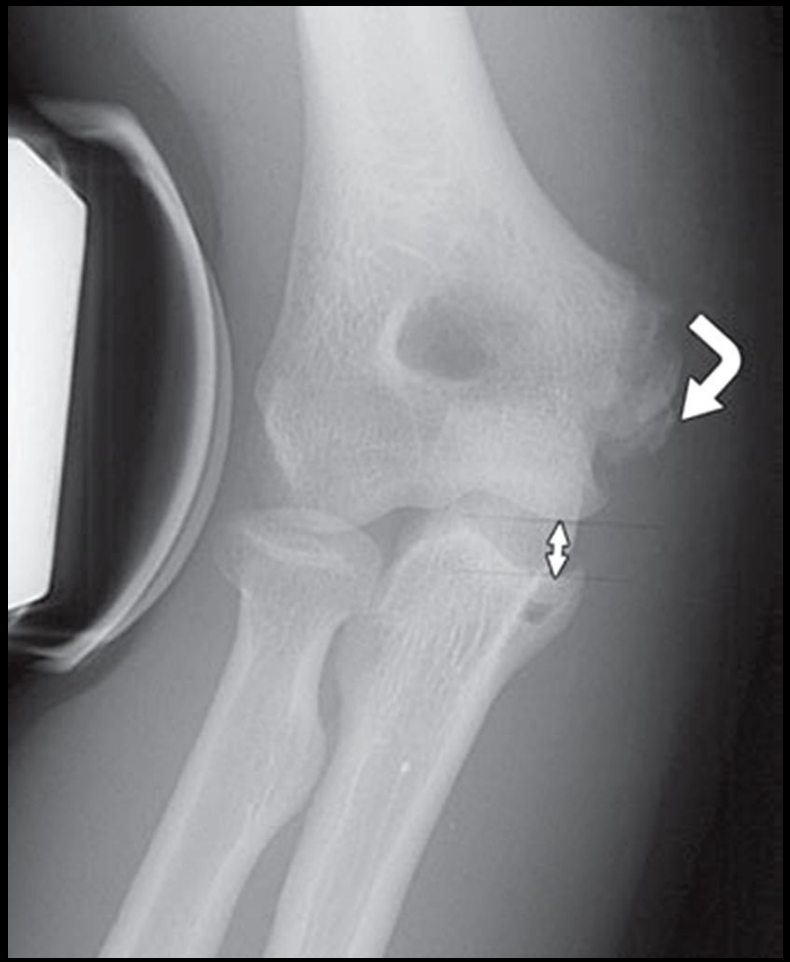


AJR 2008; 190:595-598

22 y/o college catcher with medial elbow pain 2.5 months after UCL reconstruction

AP without stress

Valgus stress view



AJR 2008; 190:595-598

Avulsion Fracture of Sublime Tubercle

- Failure from chronic repetitive valgus stress usually occurs at UCL
- More uncommon failure at sublime tubercle, first reported in 1998

Am J Sports Med 2004; 32:1158-1164

19 y/o minor league pitcher

Courtesy of Tudor Hughes, MD & Mini Pathria, MD

19 y/o minor league pitcher

Courtesy of Tudor Hughes, MD & Mini Pathria, MD

21 y/o minor league pitcher with medial elbow pain

AJR 1998; 170: 627-628

Ulnar Neuritis

- Injury to ulnar nerve due to
  - Traction from valgus stress
  - Compression from adhesions, osteophytes, flexor muscle hypertrophy
  - Friction from ulnar nerve subluxation
    - Ulnar nerve tends to sublux anterior to medial epicondyle going from elbow extension to flexion

Ulnar Neuritis

- Symptoms
  - Paresthesias, shooting pain of medial elbow extending to ring and little fingers
  - Tendency to drop objects
- UCL injury is potential underlying cause of ulnar neuritis
  - In the presence of UCL injury, need to treat UCL injury for ulnar neuritis to resolve

Ulnar Neuritis - Treatment

- Non-surgical
  - Active rest, anti-inflammatory medications, cryotherapy, physical therapy, gradual return to activity
- Surgical
  - Submuscular or subcutaneous anterior ulnar nerve transposition
  - If underlying cause is UCL insufficiency, concomitant treatment UCL & ulnar nerve necessary

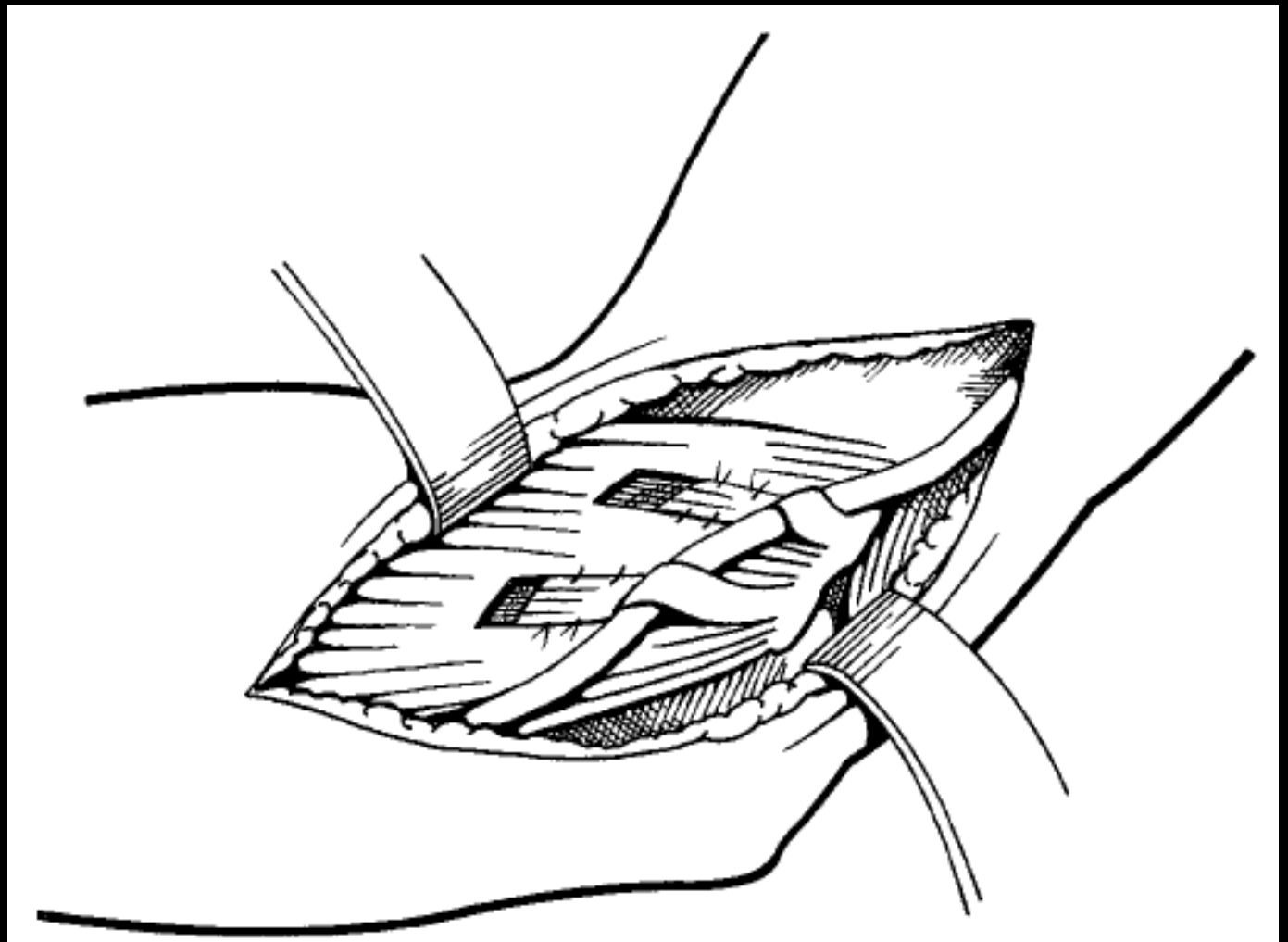


Figure 6. Fascial slings for ulnar nerve transposition.

Am J Sports Med 2000; 28:16-23

POSTERIOR ELBOW INJURIES

From the internet

Olecranon Injuries

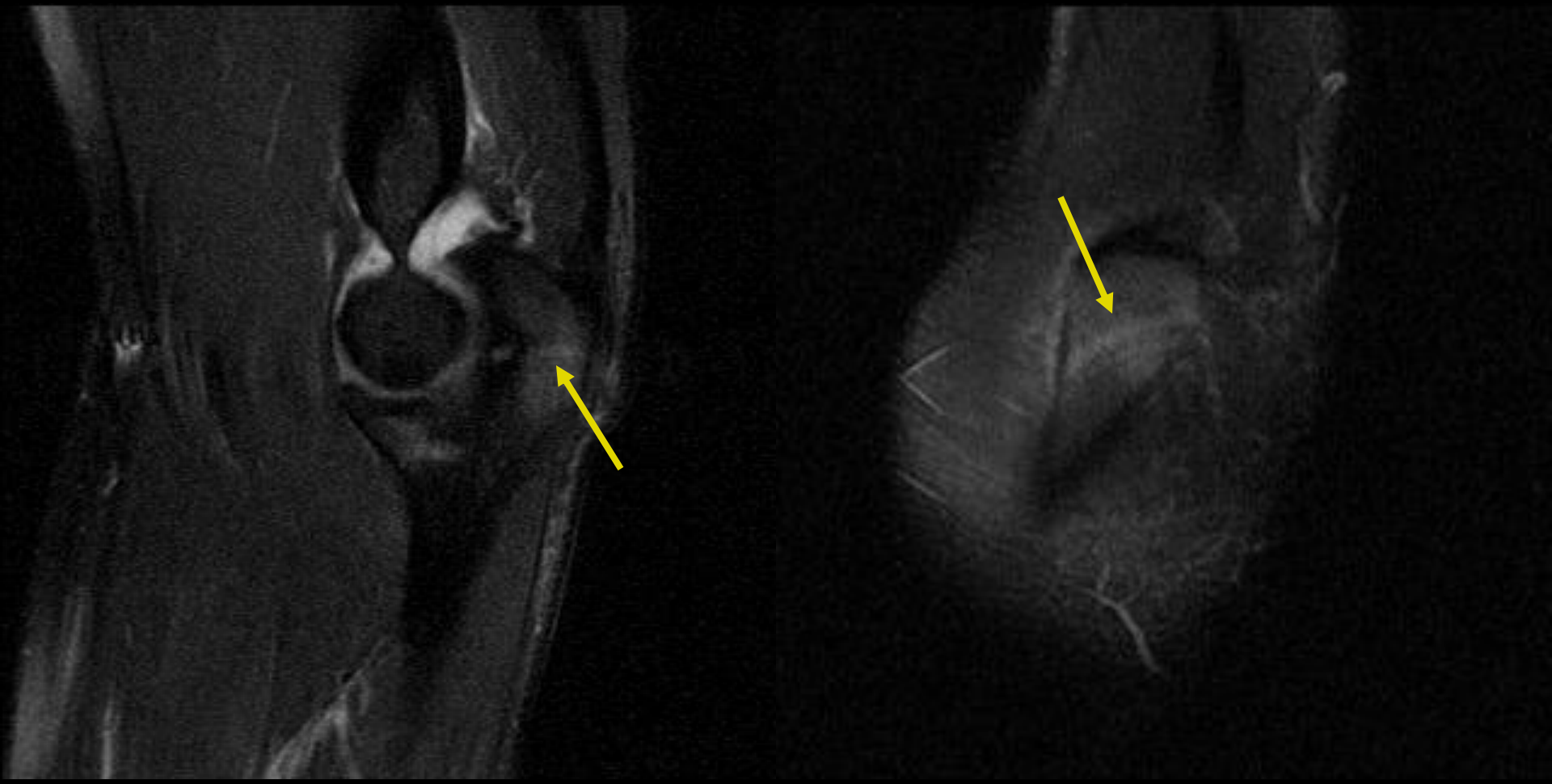
- From repetitive triceps contraction occurring with deceleration during follow through phase
  - In childhood - olecranon apophysitis, osteochondrosis
  - In older adolescents – olecranon apophyseal avulsion or apophyseal stress fracture
  - In skeletally mature – valgus extension overload syndrome or olecranon stress fracture

Olecranon Stress Fracture

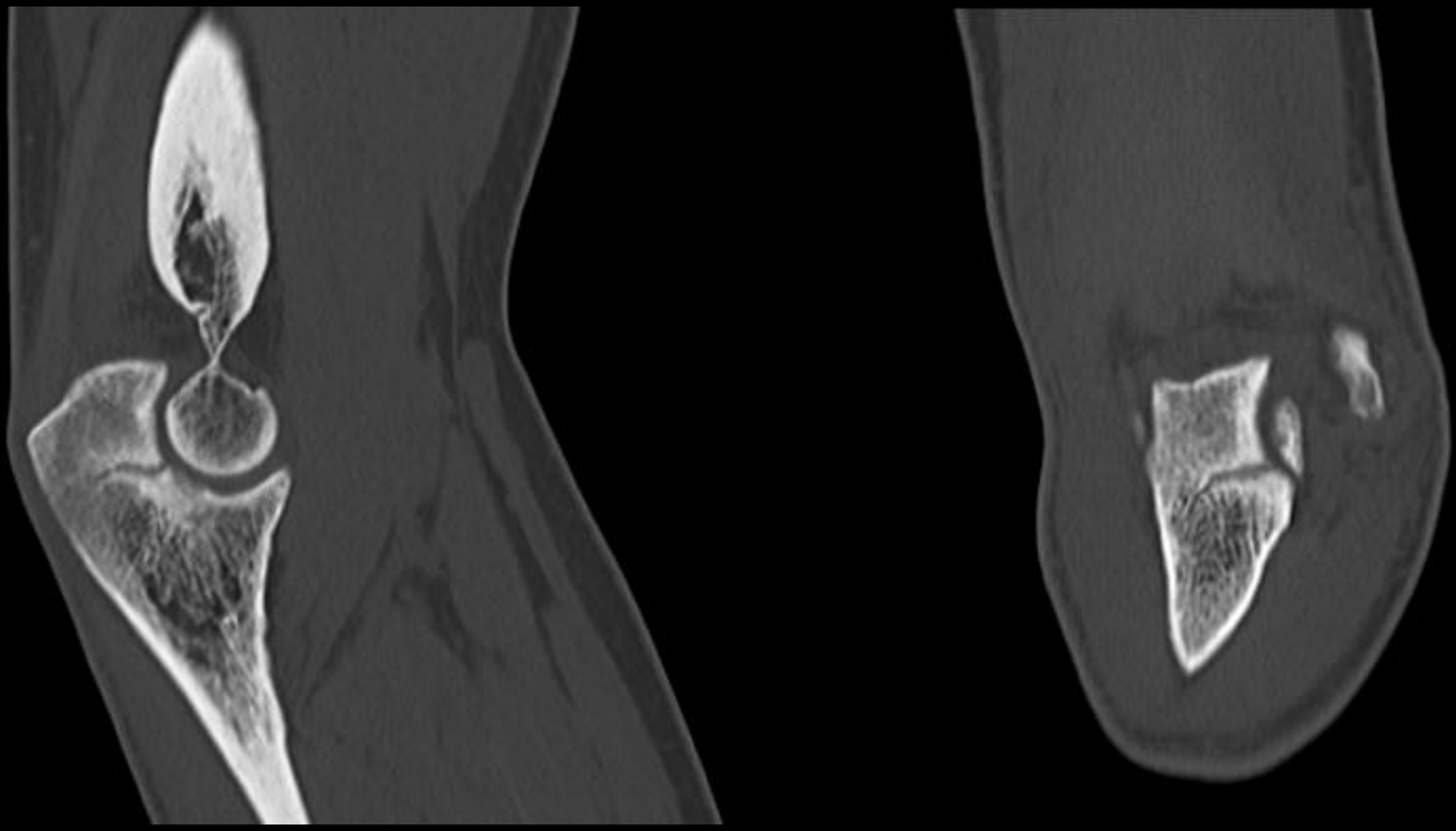
- Causes
  - Repetitive microtrauma to olecranon from olecranon impingement
  - Triceps tensile stress overload
- Treatment: non-surgical vs. surgical ORIF

Am J Sports Med 2003; 31:621-635

25 y/o R handed minor league pitcher



Courtesy of Brady Huang, MD



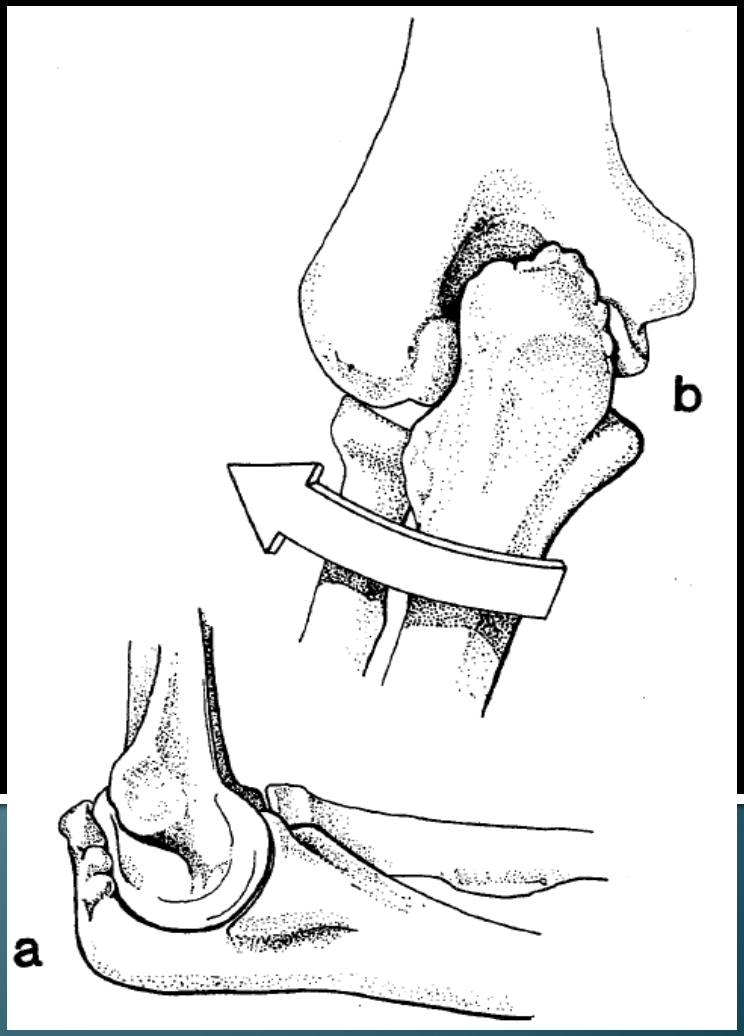
Courtesy of Brady Huang, MD

Valgus Extension Overload Syndrome

- Presentation: pain between acceleration and follow through phases

Valgus Extension Overload Syndrome

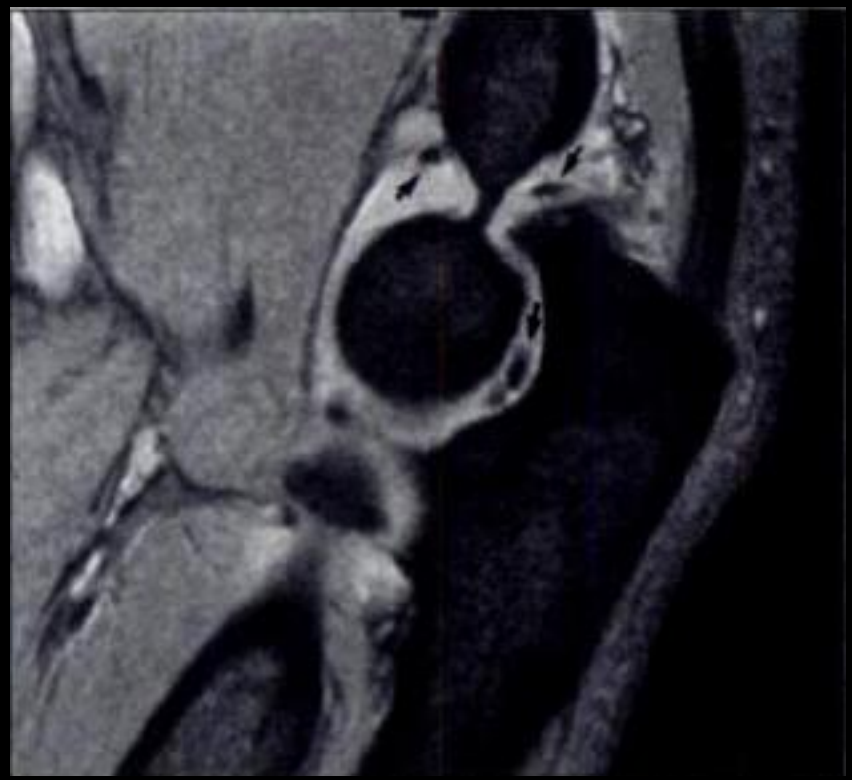
- Posteromedial aspects of olecranon process and trochlea are sites of impingement with valgus extension stress, particularly with UCL insufficiency
  - Occurs at 30° elbow flexion during deceleration phase of throwing (Am J Sports Med 2004; 32:1607-1615)



Am J Sports Med 1983: 11:83-88

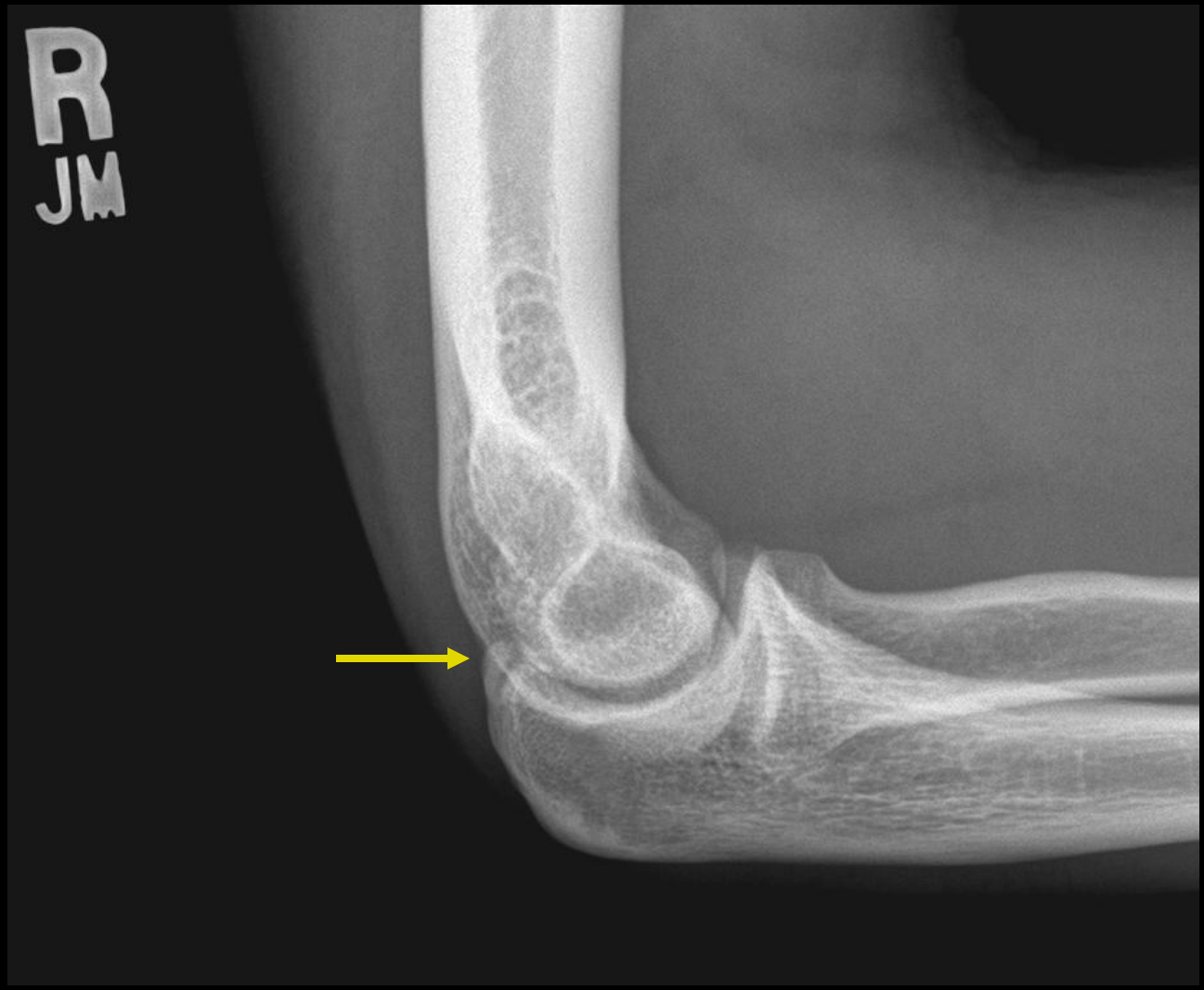
Posteromedial Impingement

- Leads to development of PM olecranon osteophytes and bone sclerosis
- Kissing lesions – cartilage damage on PM olecranon & trochlea (medial wall of olecranon fossa)
- Intra-articular bodies in posterior or radiocapitellar compartments, from fractured olecranon osteophytes



AJR 1996; 167:325-331

19 y/o R handed pitcher with posterior elbow pain



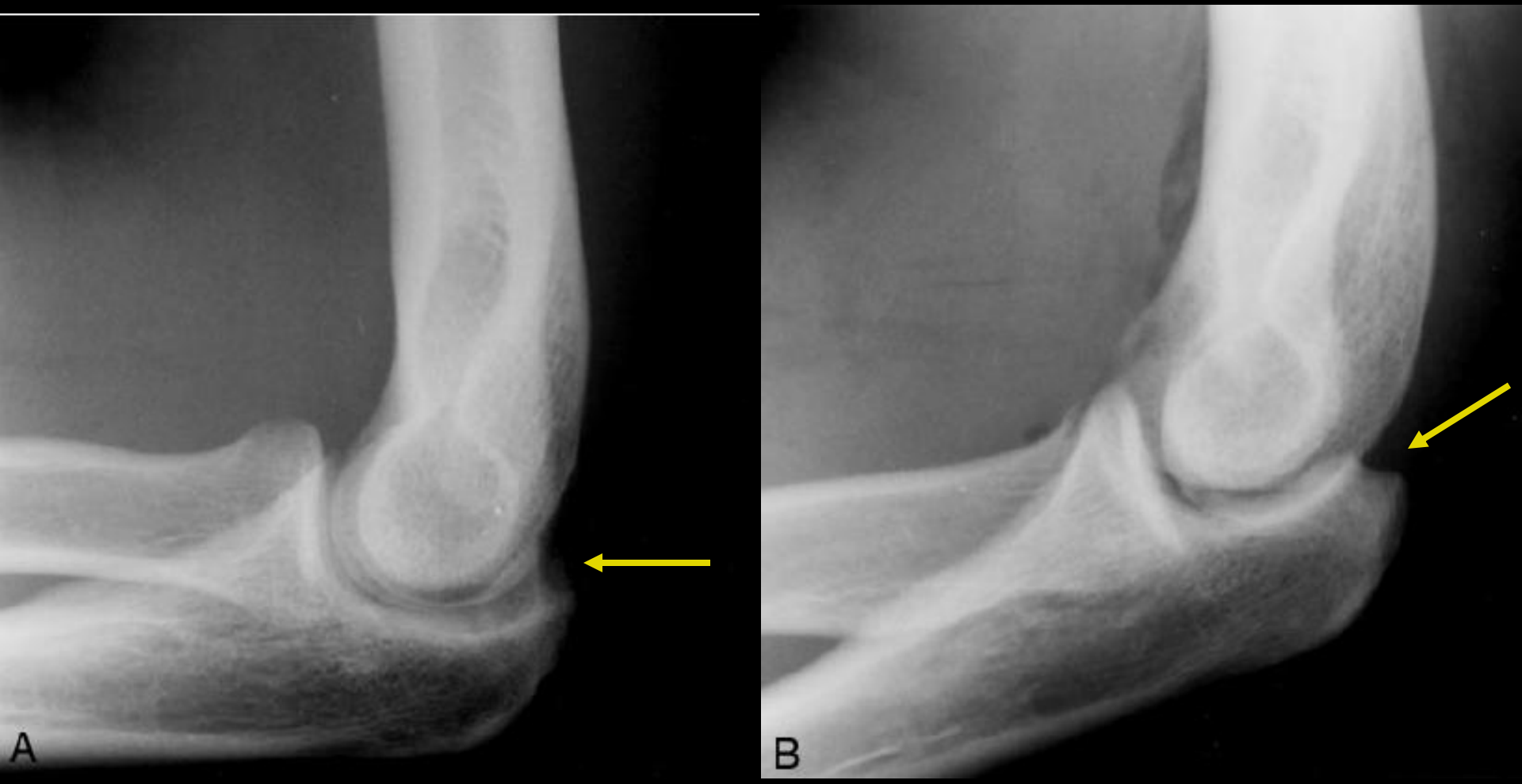
Courtesy of Brady Huang, MD

Valgus Extension Overload Syndrome - Treatment

- Non-surgical
  - Rest, rehabilitation, gradual return to activity
- Surgical
  - Open osteophyte excision & intra-articular body removal
  - Arthroscopic debridement/decompression

Posterior olecranon osteophyte

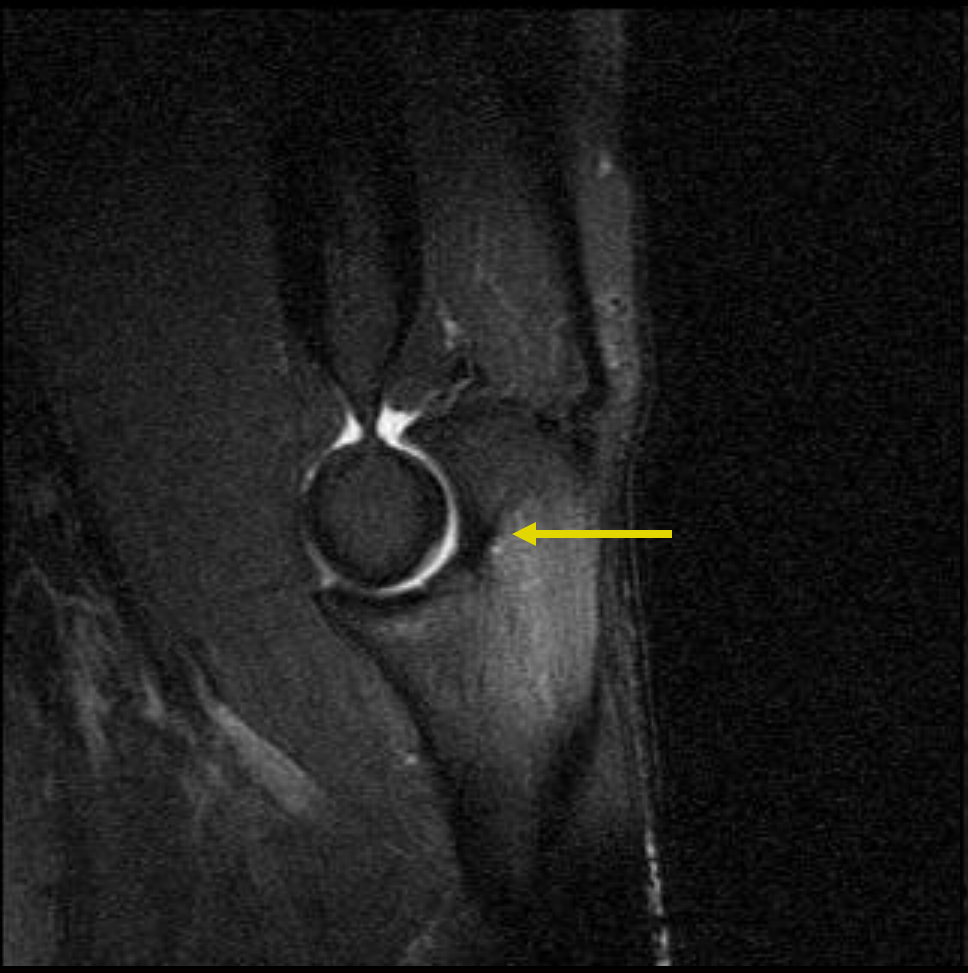
Following arthroscopic decompression



Am J Sports Med 2003; 31:621-635

25 y/o R handed minor league pitcher

PD FS



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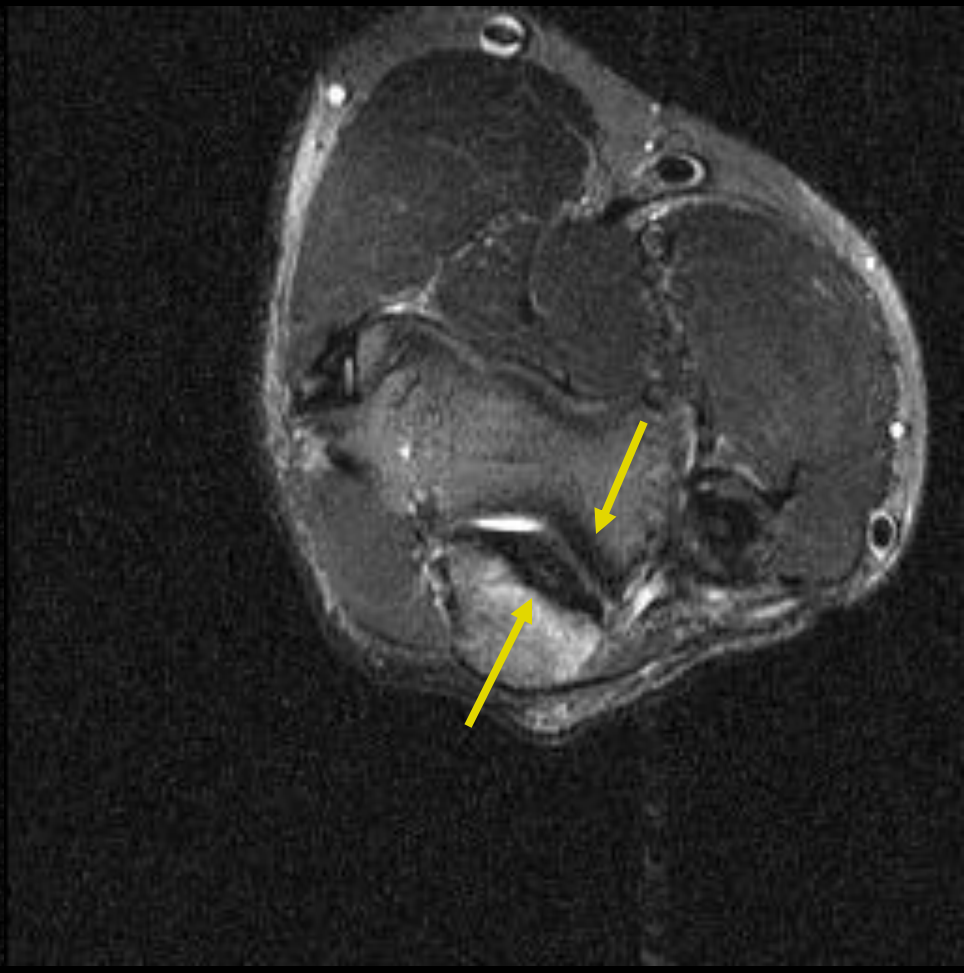
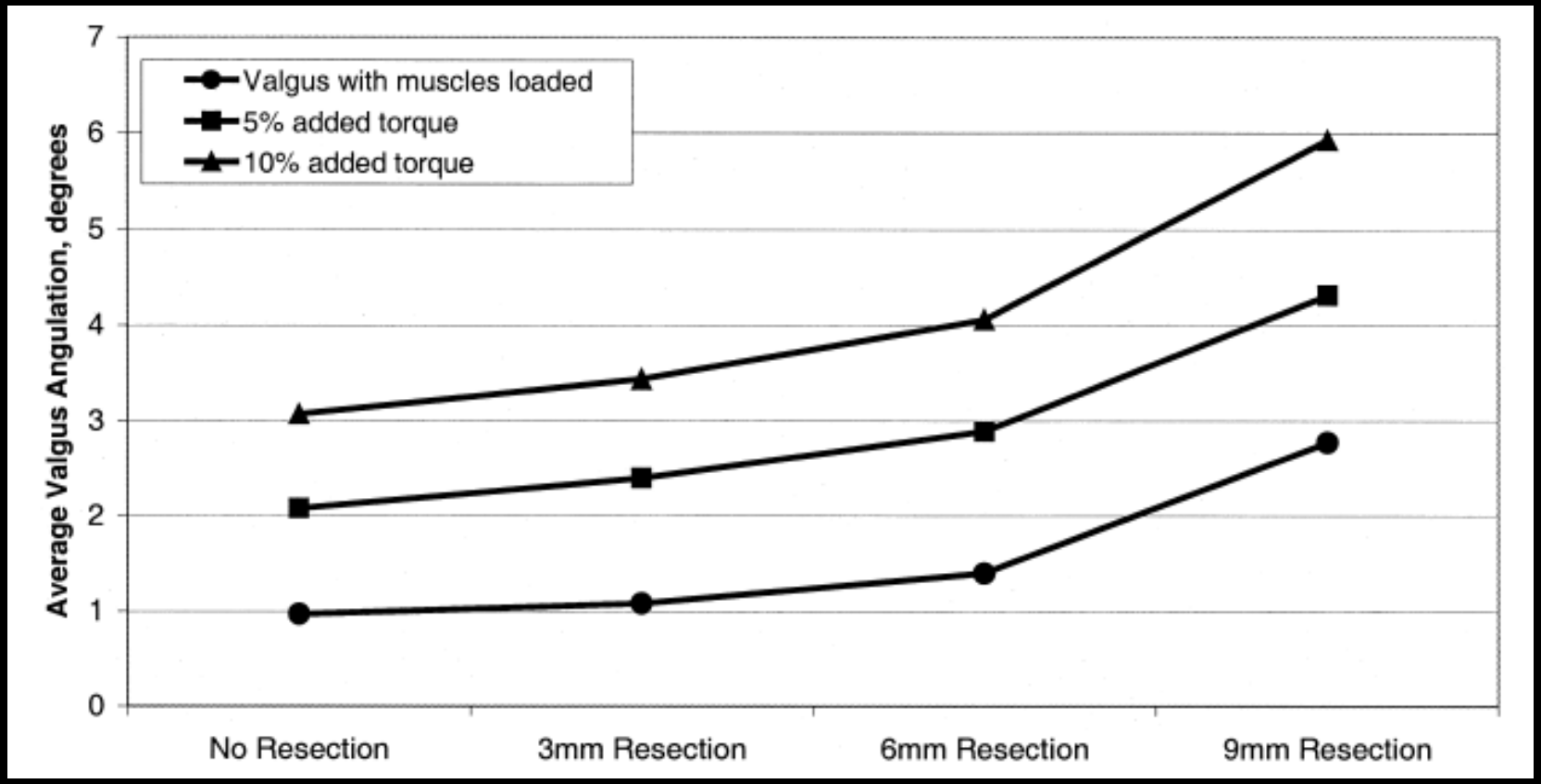


Courtesy of Brady Huang, MD

Partial Posteromedial Olecranon Resection: A Kinematic Study

By S. Kamineni, MD, H. Hirahara, MD, S. Pomianowski, MD, P.G. Neale, MS, S.W. O'Driscoll, PhD, MD, N. ElAttrache, MD, K.-N. An, PhD, and B.F. Morrey, MD



JBJS 2003; 85:1005-1011

Femoralization of Distal Humeral Shaft

Courtesy of Brady Huang, MD

The Future of Elbow Injuries…

…The End

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