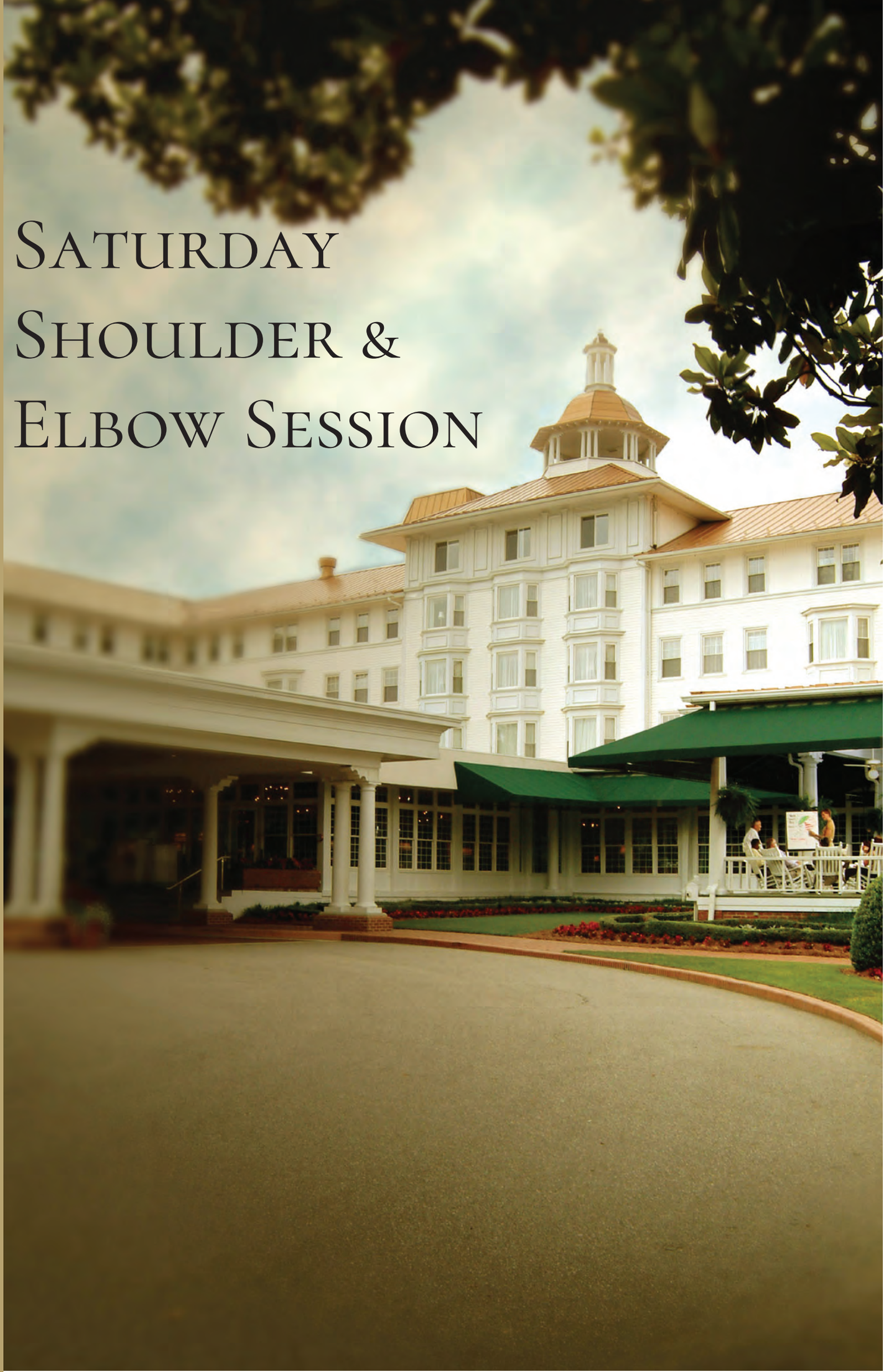
2016 NCOA Annual Meeting

Saturday Shoulder & Elbow Session



The Effect of Obesity on Fatty Infiltration of the Rotator Cuff in Patients without Rotator Cuff Tear

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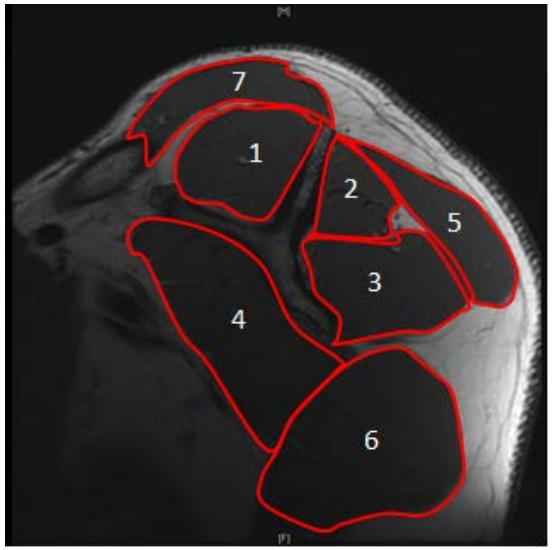
Grant E. Garrigues, MD[1]



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The authors have no relevant conflicts of interest to disclose.

Duke Orthopaedics

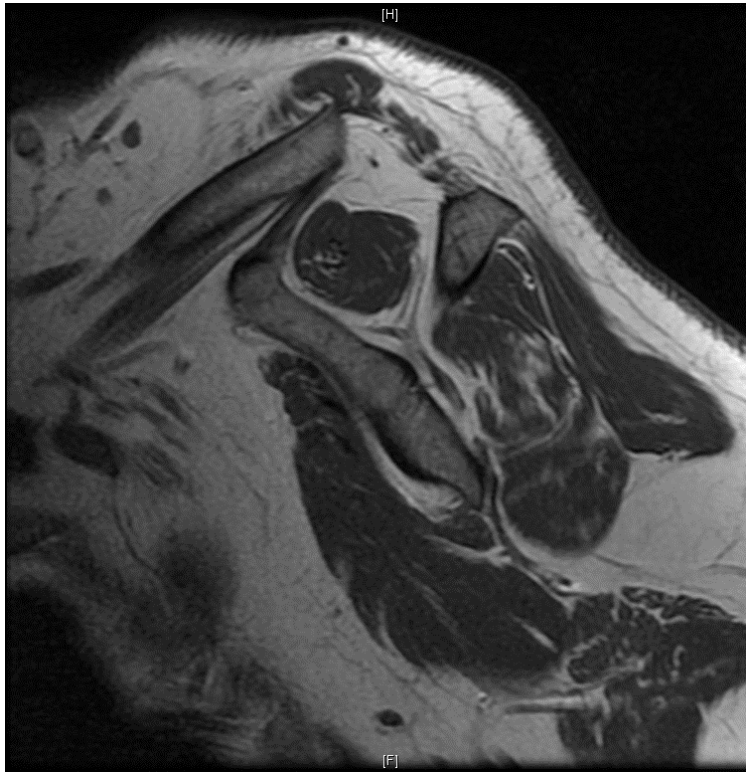
Introduction

Fatty Infiltration in the Rotator Cuff

- Irreversible
- Inferior outcomes
- Surgical decision-making

Goutallier classification system (Goutallier et al., 1994)

- Used by Fuchs et al. for MRI interpretation (1999)



Introduction

Goutallier Classification System

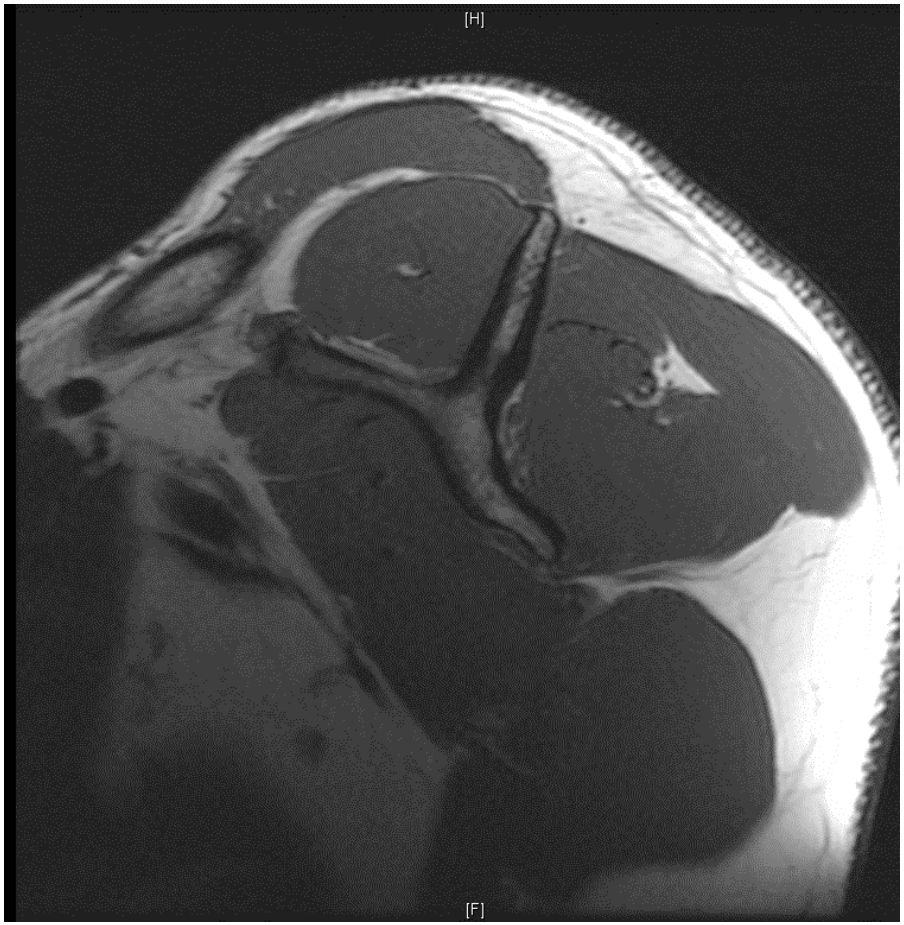
-**Stage 0: no fatty infiltration**

-Stage 1: some fatty streaks

-Stage 2: less fat than muscle

-Stage 3: as much fat as muscle

-Stage 4: more fat than muscle



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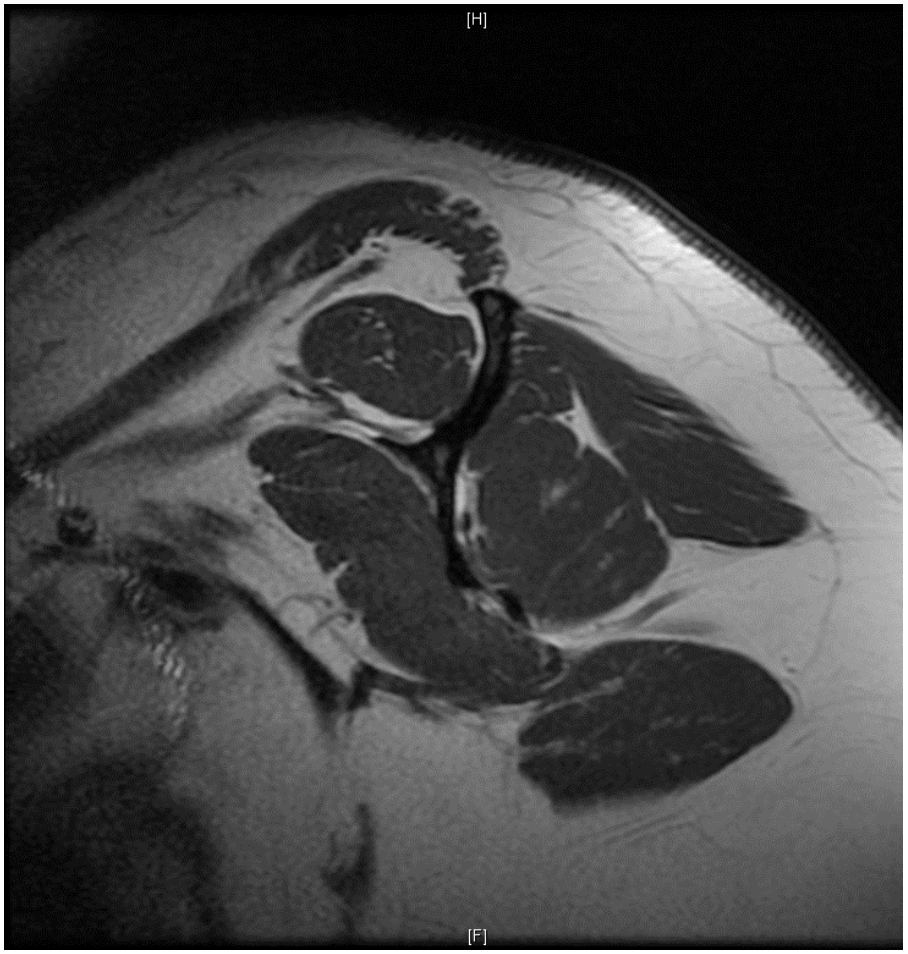

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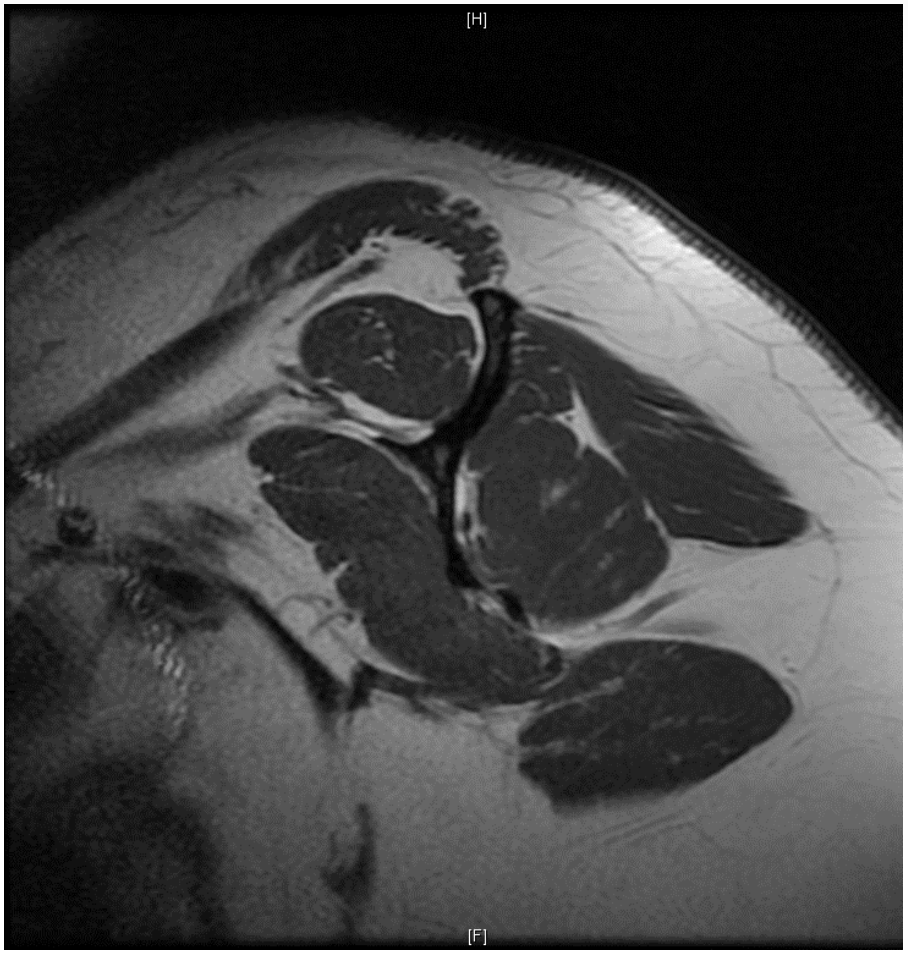

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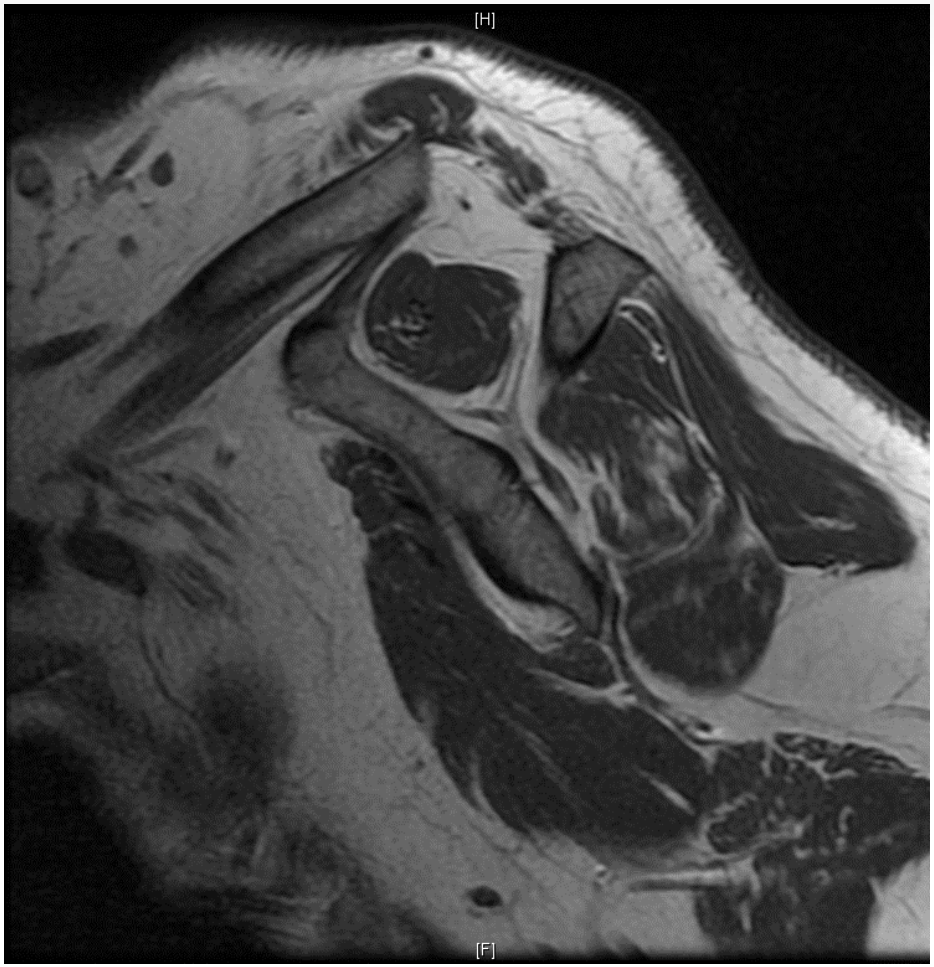


Introduction

Purpose

1. Describe the relationship between BMI and fatty infiltration of the rotator cuff in patients WITHOUT rotator cuff tear
2. Define a regional measurement of body fat for use with shoulder MRI interpretation

Hypotheses

1. Higher BMI is associated with higher Goutallier stage
2. Subcutaneous fat quantification is associated with BMI and with Goutallier stage

Materials and Methods

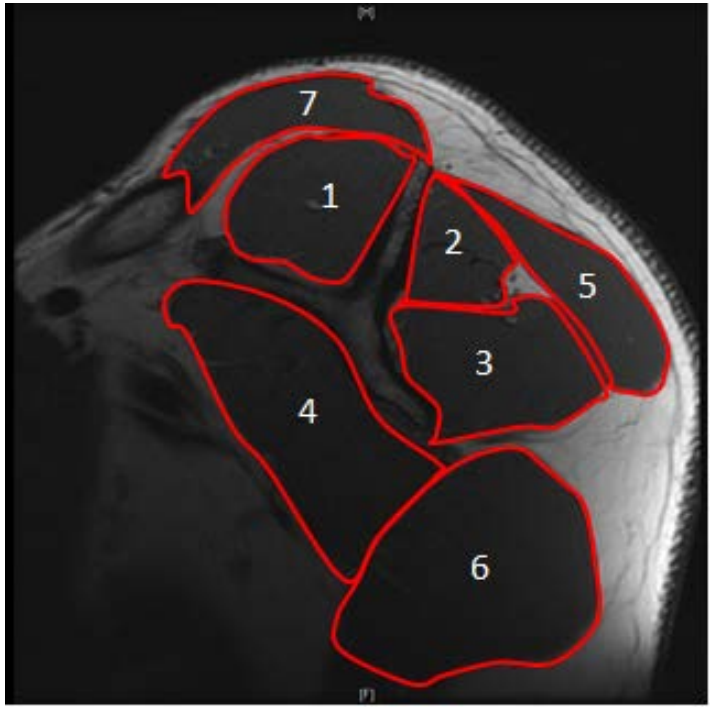
Institutional Review Board Approval

1088 consecutive MRIs from 1/2014-6/2015

Exclusion

- Rotator cuff tear (partial or full-thickness)
- Surgical history
- Avascular necrosis
- Cervical spine pathology
- Neuromuscular disease

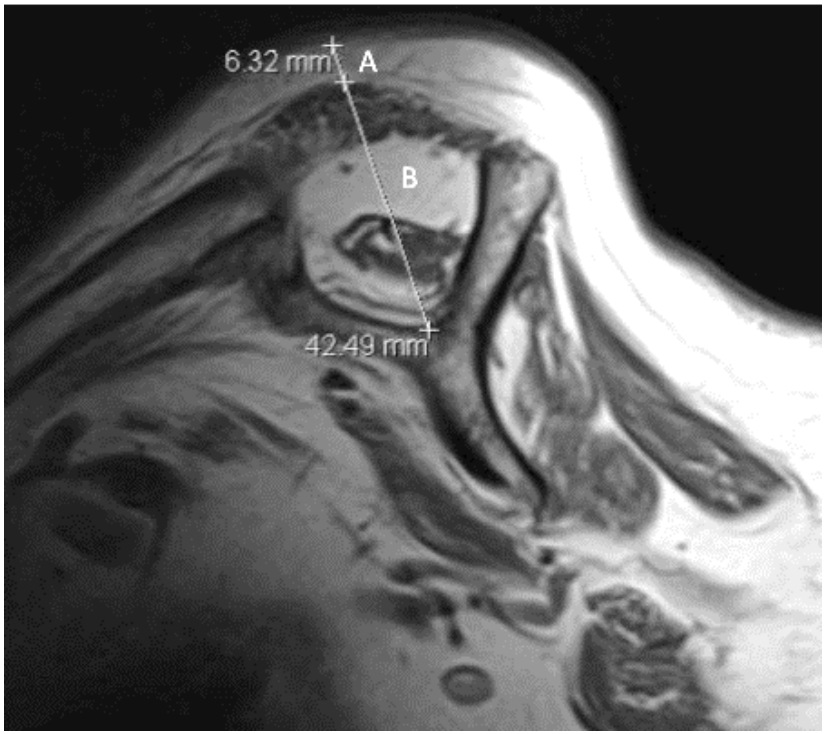
Included: 565 MRIs



Materials and Methods

BMI categories (25 patients from each, 100 patients total)

- I: <25
- II: 25-30
- III: 30-35
- IV: >35



Blinded interpretation by 4 readers

- Attending Orthopaedic Surgeon
- Attending MSK Radiologist
- Sports Medicine Fellow
- Orthopaedic Surgery Resident

Y-ratio: subcutaneous fat / fascia to bone

Results

2,287 total grades

- Stage 0: 62%
- Stage 1: 32%
- Stage 2: 5%
- Stage 3 + 4: 1%

Obese patients (BMI ≥ 30): 15.4% stage 2+

Non-obese patients (BMI < 30): 2.1% stage 2+ ($p < 0.001$)

Results

P-values representing significance of variation in Goutallier stage distribution by patient factors

Muscle	Age	Diabetes	Hypercholesterolemia	Tobacco
Supraspinatus	**<0.01**	**0.01**	0.21	0.77
Infraspinatus	**0.01**	**<0.01**	0.24	0.14
Teres Minor	0.66	0.22	0.58	0.94
Subscapularis	**<0.01**	**0.02**	**0.03**	0.37
Deltoid	0.48	0.10	0.69	0.07
Teres Major	0.22	0.66	0.67	0.24

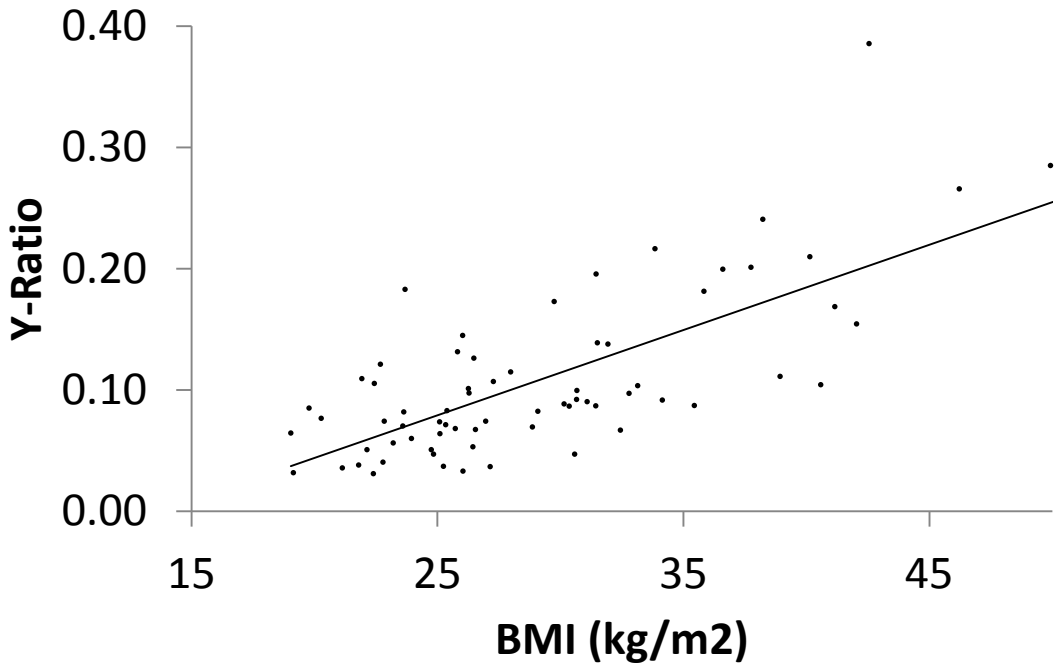
Results

Variation in Goutallier stage distribution by BMI category and Y-ratio among individual muscles, as represented by P-value

Muscle	BMI	Y-ratio
Supraspinatus	0.09	**<0.05**
Infraspinatus	**<0.05**	**<0.05**
Teres Minor	0.07	0.17
Subscapularis	**0.02**	**<0.05**
Deltoid	**<0.05**	**<0.05**
Teres Major	**<0.05**	0.05

Results

Relationship between Y-ratio and BMI



Intra-observer reliability: ICC = 0.98

Inter-observer reliability: ICC = 0.78

Conclusions

Fatty infiltration not solely attributable to rotator cuff tear

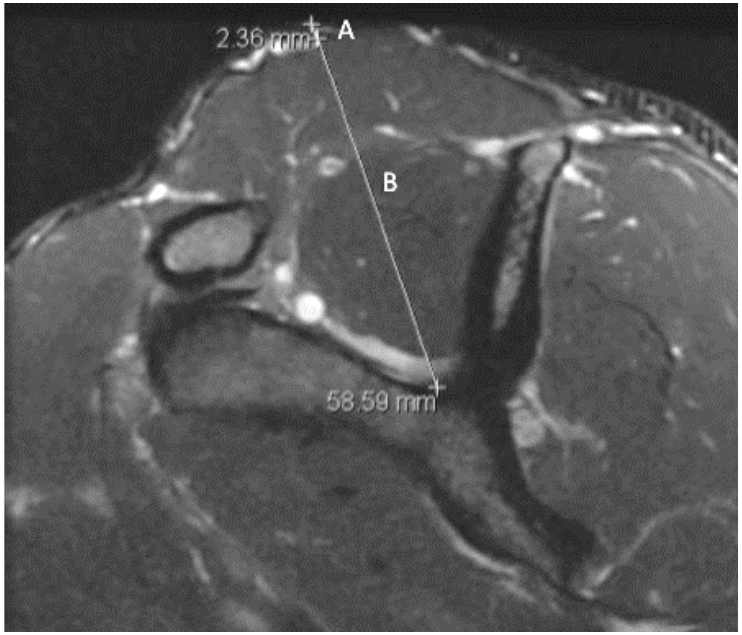
- BMI, Y-ratio, age, comorbidities
- Age association is previously reported

Implications

- Reversibility of fatty infiltration?

Y-ratio

- Regional fat quantification
- Use in muscular patients



Conclusions

Limitations

- No rotator cuff tear→ limits clinical applicability
- Differentiation and misclassification biases
- Low variability, concentration of low grades
- No physical examination

Future Directions

- Clinical associations
- Correction factor to for assessment utilizing BMI or Y-ratio

Efficacy of First Time Anterior Shoulder Dislocation Decision Tool

STEPHEN SMILEY

First Time Anterior Shoulder Dislocation (FTASD)

- FTASD 2% of population
- 80% in younger patients
- Different treatment options
  - Sling immobilization, external rotation immobilization, surgery
- Decision aids
  - Promote patient-provider communication, improve patients' knowledge and expectation of outcomes
- Decision modeling can characterize risk of instability
  - Characteristics include age, gender, activity level
- Patient Preferences
  - Avoiding surgery, pain, function, risk of recurrence, cost

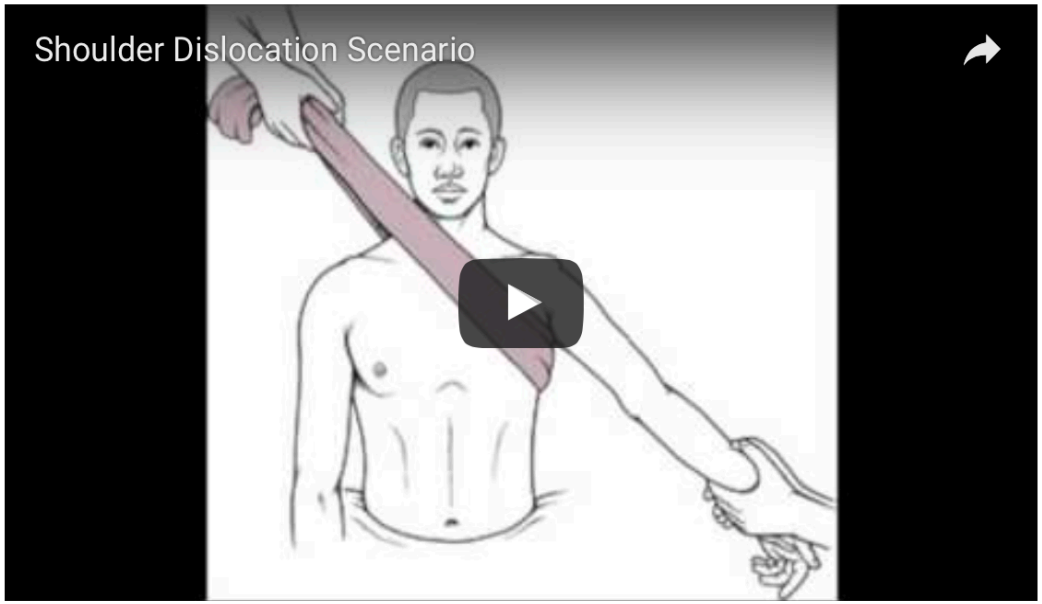
Developing Decision Tool

- Phase I
  - Test out survey, improve questions
- Phase II
  - Currently
  - 200 participants; Male, Female / 18-25, 25-35
  - Data

Education

Video

Before we get started on the survey for shoulder dislocations, we would like you to learn a little more about the injury. Please watch the video below before proceeding with the survey.



0% 100%

Education

There are several effects of a dislocated shoulder and its treatment:

1. Limited ability to move your arm
2. Avoiding activities that increase the risk of a repeat injury
3. Chance of another dislocation
4. Out-of-pocket cost to you

We will explain each of these effects and later in the survey we will ask you to think about how important these effects are to you.

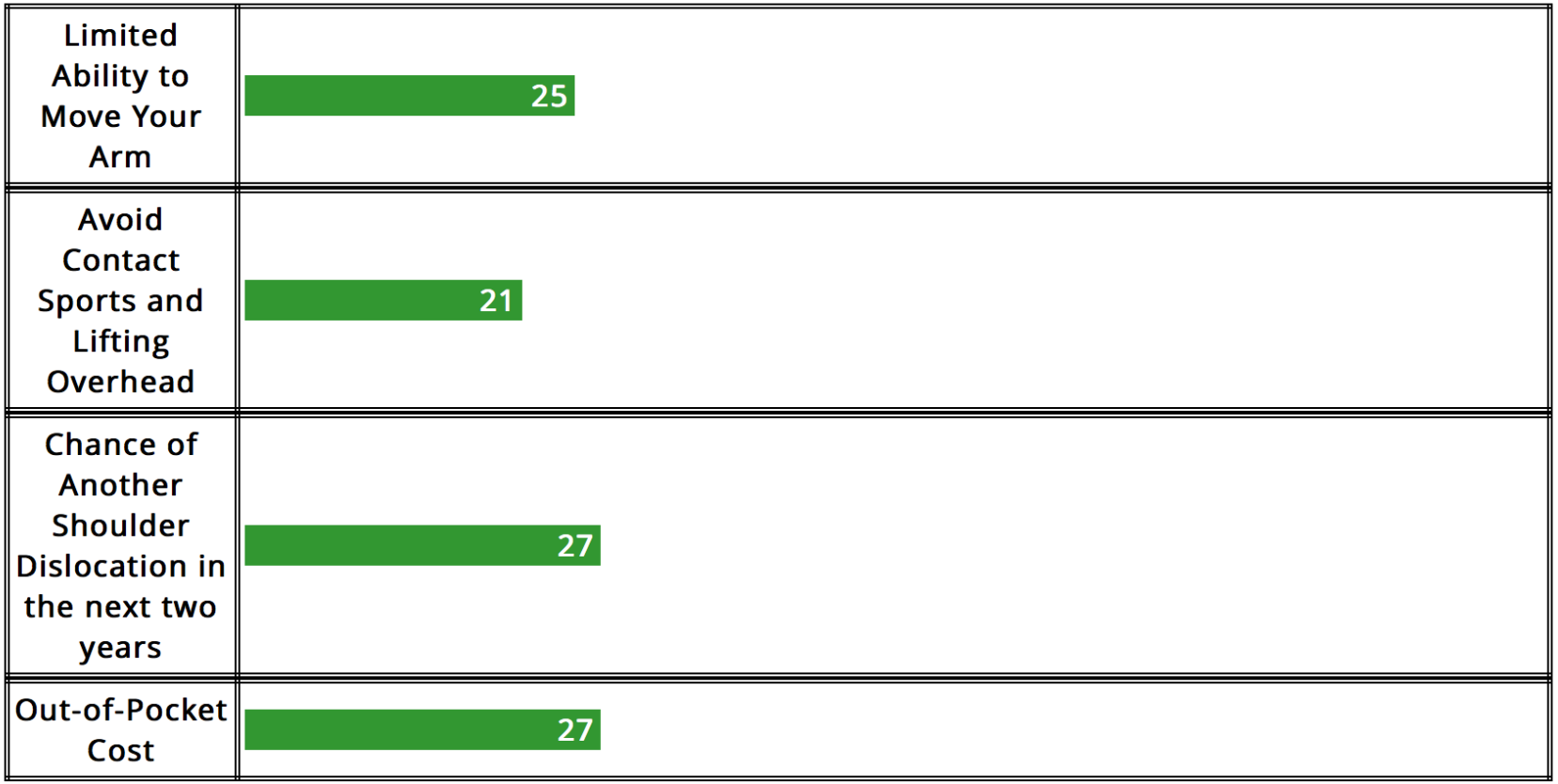
Conjoint Analysis

No limit on moving arm		**Arm in a sling for <u>one month</u>**
Avoid contact sports and lifting overhead for <u>3 months</u>	or	**Avoid contact sports and lifting overhead for <u>1 month</u>**
$1000 out-of-pocket cost		**$0** out-of-pocket cost

Strongly Prefer Left		Somewhat Prefer Left		Indifferent		Somewhat Prefer Right		Strongly Prefer Right
○	○	○	○	○	○	○	○	○

Preferences

Importance of Effects



Treatment Options

Which treatment option do you prefer?

- Arthroscopic Surgical Repair
- Non-operative Treatment
- Unsure

Knowledge Retention

Which treatment is more likely to reduce the risk of a repeated shoulder dislocations?

- Sling and physical therapy
- Surgical repair
- Both treatments have about the same effect

An active 17-year-old male who regularly plays hockey dislocated his shoulder. A 28-year-old man who works a desk job that requires minimal overhead lifting also suffered a dislocation. Who is more likely to experience a repeat shoulder dislocation?

- 17 year old male
- 28 year old male

Acceptability

Survey Review

The length of this tool was:

- ○ Too long
- ○ Too short
- ○ Just right

The amount of information was:

- ○ Too much information
- ○ Too little information
- ○ Just right

I found the information easy to understand.

- ○ Agree
- ○ Disagree
- ○ Unsure

The information provided helped me think deeply about the risks and benefits of each treatment option.

- ○ Agree
- ○ Disagree
- ○ Unsure

Acceptability

How useful would you find this decision tool if you just experienced a first time anterior shoulder dislocation?

Value:

Not useful (0) Extremely useful (100)

In general, how useful would you find this type of decision tool for other healthcare decisions?

- ○ Very useful
- ○ Somewhat useful
- ○ Not useful
- ○ Unsure

If you have faced a healthcare decision in the past where this decision tool would be useful, please list it here.

Analysis

- Data
  - 85 participants so far
- Outcomes?
  - Decisional Conflict Scale
  - Acceptability
  - Knowledge transfer

Acknowledgements

- Dr. Mather

Intramedullary Pin Fixation for Adolescent Clavicle Fractures

Ode GE; Larson TB; Connor PM; Fleischli JE; D'Alessandro DF

NCOA
Pinehurst, NC
October 9, 2016

Carolinas HealthCare System

OrthoCarolina
SPORTS MEDICINE CENTER

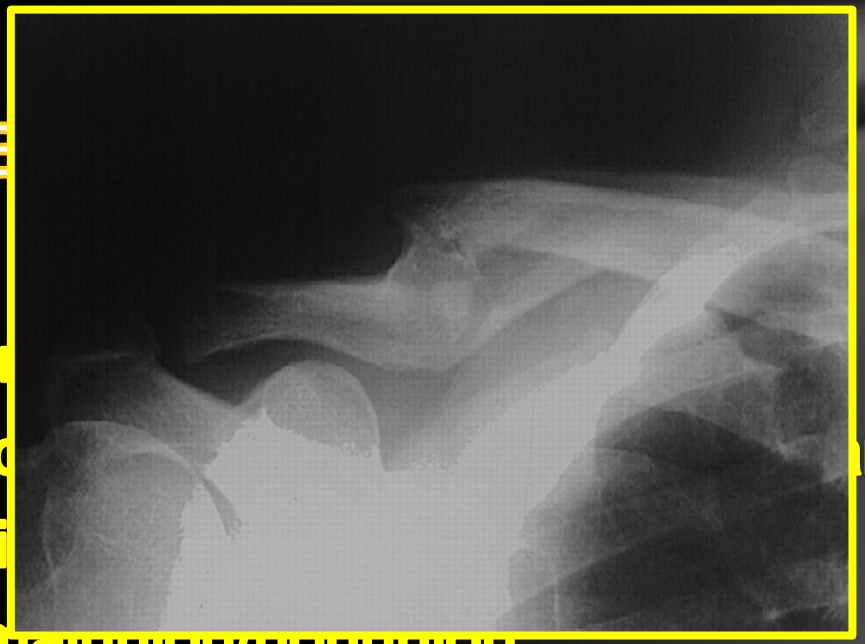
Disclosures

Authors have no disclosures related to this topic.

Displaced Midshaft Clavicular Fxs: Non-op vs Plate Fixation

Background: Shortened (>15-20mm) midshaft clavicle fx -

⇧ Risk for symptomatic non-union/ nonunion



McKee et al, JB (132 pts)

Plate vs. non-op:

- Faster time to u
- Improved functi nt scores)
- Higher satisfacti
- Lower rates of malunion/nonunion

Adolescent Midshaft Clavicular Fx: Non-op vs Plate Fixation

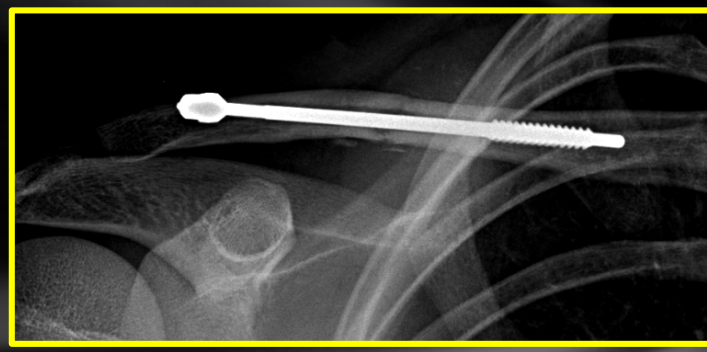
Vander Have et al, JPO 2010

42 pts (~15 yrs) – Plate vs Non-op

- No non-unions in **either group.**
- **Faster** time to union – 7.5 vs 9.9 wks
- **Faster** return to activity – 12 vs 16 wks

- **Non-op pts with displaced fx**
  - 5/12 (40%) developed **symptomatic *mal*union**
    - 4/5 (80%) → **corrective osteotomy**

Intramedullary Pin for Clavicle Fractures



- Alternative to plate fixation
- Less soft tissue insult
- Comparable union rates (in adults)
- Potential for earlier return to sports
  - Marlow, Open Orthop J 2012; Ahmad, JBJS Br 2009
- Requires routine removal

Role for adolescent clavicle fxs not well defined.

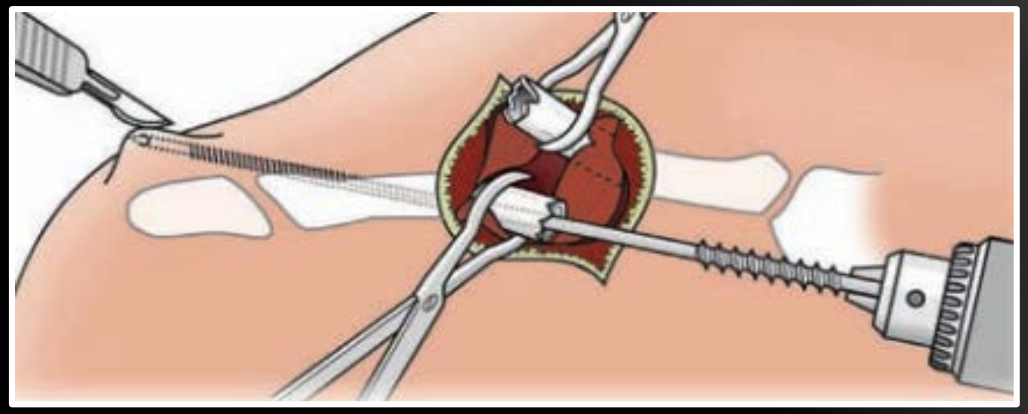
Purpose

- Analyze the characteristics of adolescent patients who underwent intramedullary pinning for acute clavicle fractures

- Evaluate:
  - Clinical outcomes
  - Radiographic outcomes
  - Functional outcomes

Study Design

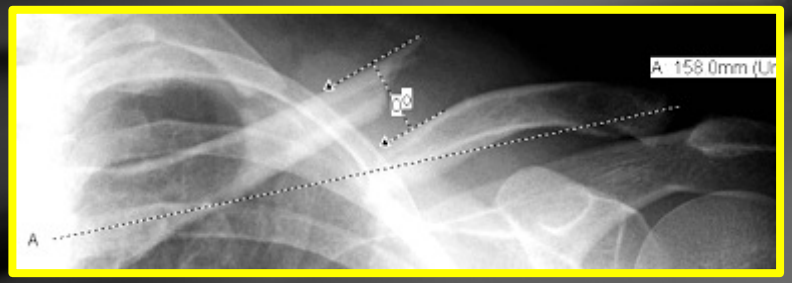
- 29 pts <18 yrs w/ closed midshaft clavicle fx
  - 2007 to 2013; 7 surgeons
- Fixation w/ IM pin
  - ***Rockwood Pin*** (Depuy, Warsaw IN)
  - Partially threaded locking pin



Study Design

Patient Demographics

- Age/Gender
- Activity level



Injury Characteristics

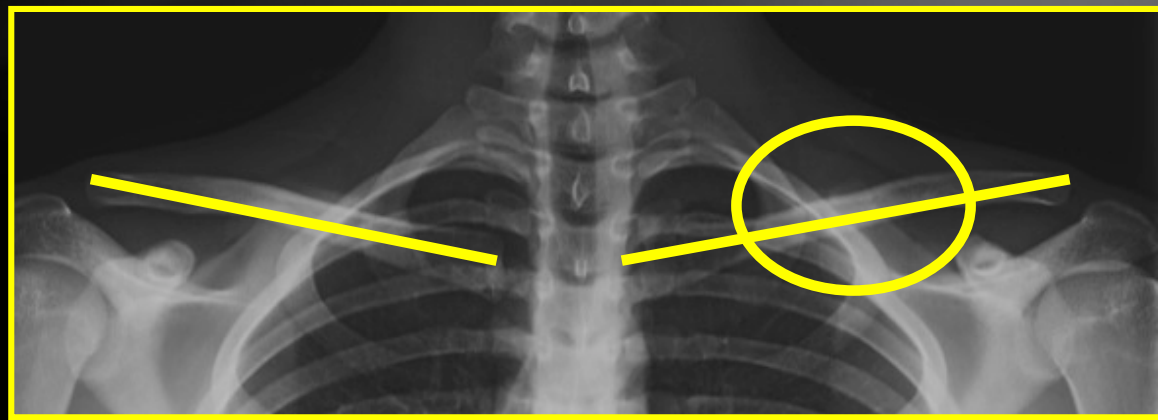
- Displacement/Angulation
- Simple/Multi-fragmentary

Treatment Outcomes

- Time to union (Bridging callus)
- Time to return to sports
- Complications

Follow-up Assessment

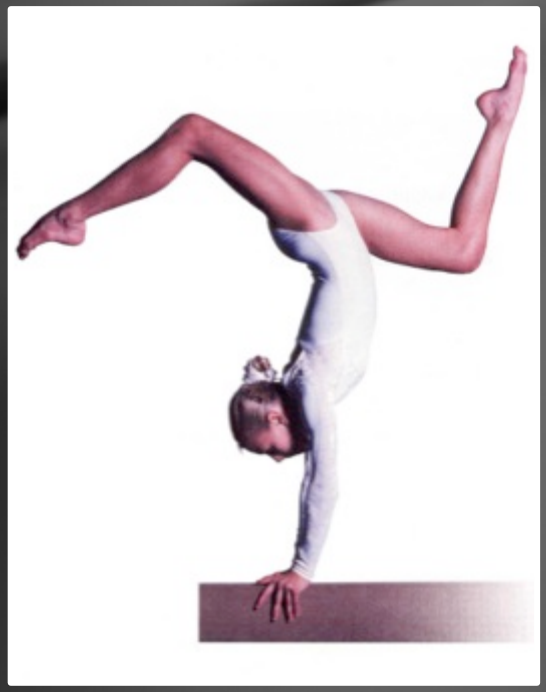
- >2 yrs out from surgery
- Functional assessment by independent examiner
  - ROM/Strength
  - Radiographic shortening - AP XR of both clavicles
- ASES score and level of satisfaction [0 -10 scale]



Results: Demographics

- 25 males, 4 females; ~14.8 yrs (11.4 – 17.8yrs)
- Student athletes 25/29 (86%)
- All high impact sports

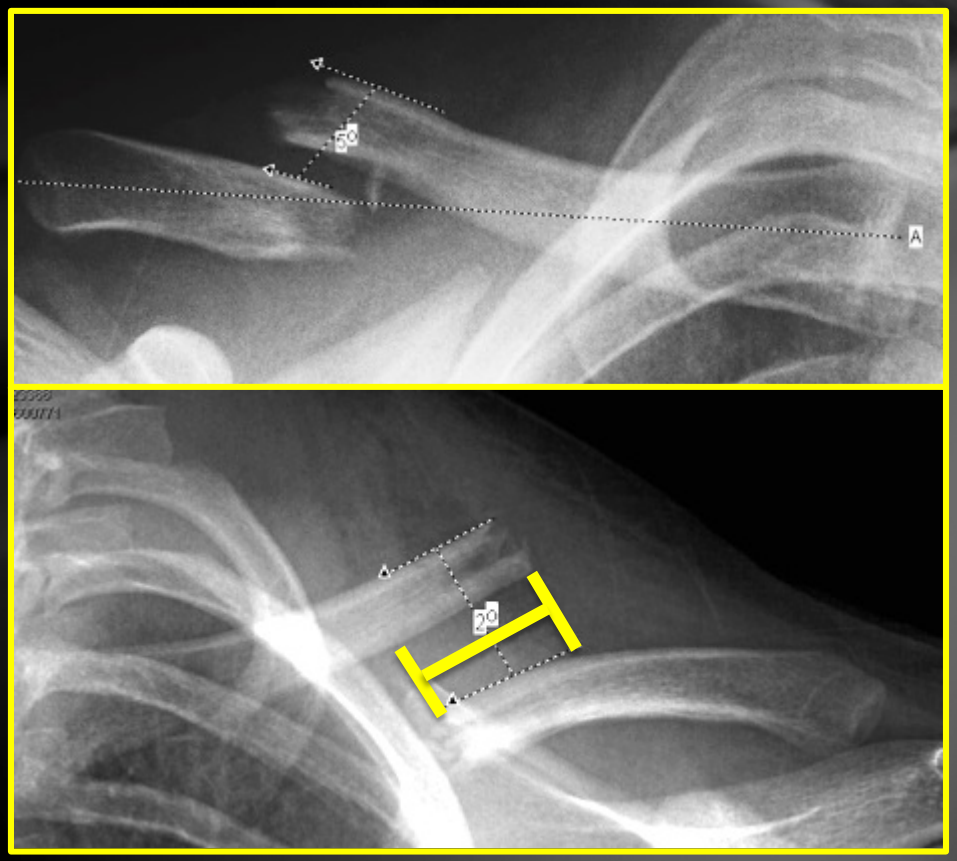
Football - 8	Basketball – 1
Dirt bike - 6	Gymnastics - 1
Lacrosse - 2	Equestrian - 1
Snow board - 2	Rugby - 1
ATV - 2	Skateboard- 1



Results: Fracture Pattern

≥ 100% Displacement

- 24/29 pts (83%)
- Avg 1.8 cm shortening

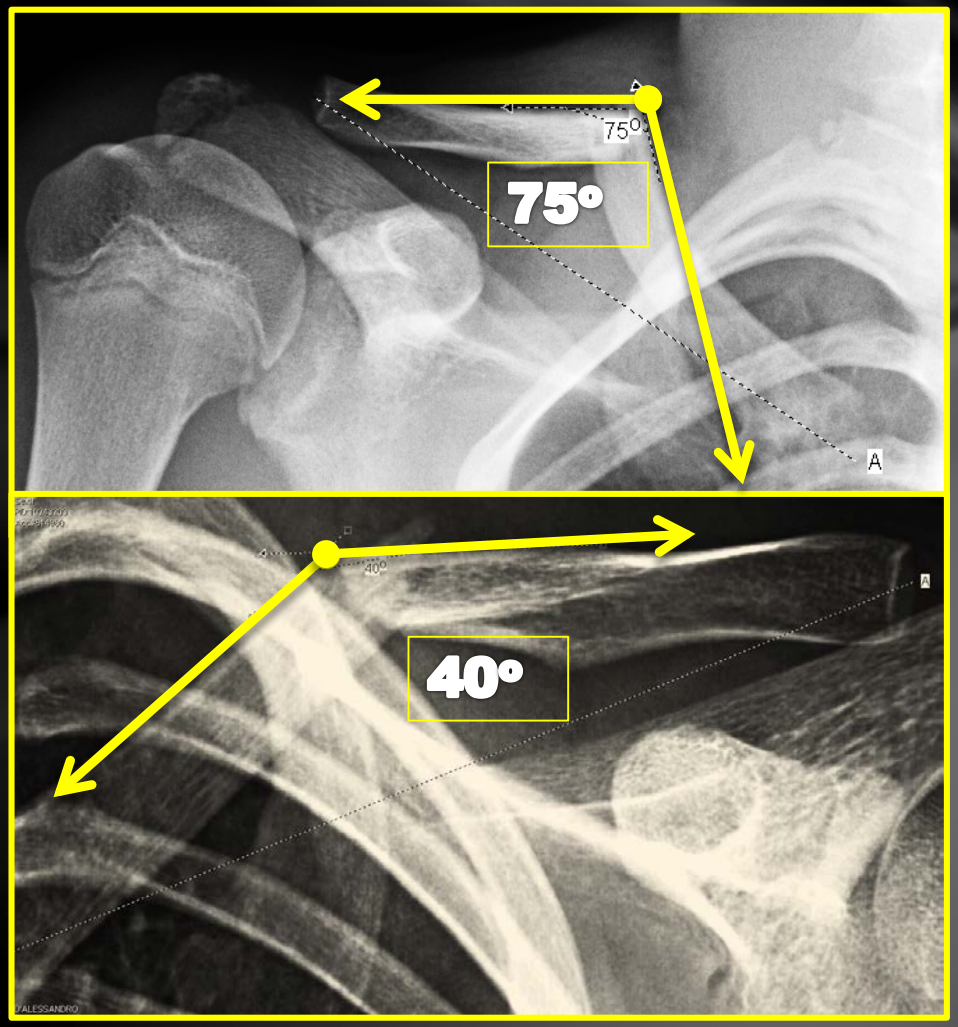


Results: Fracture Pattern

Severe Angulation

5/29 pts (17%)

- Range 28º – 75º



Results: Fracture Pattern

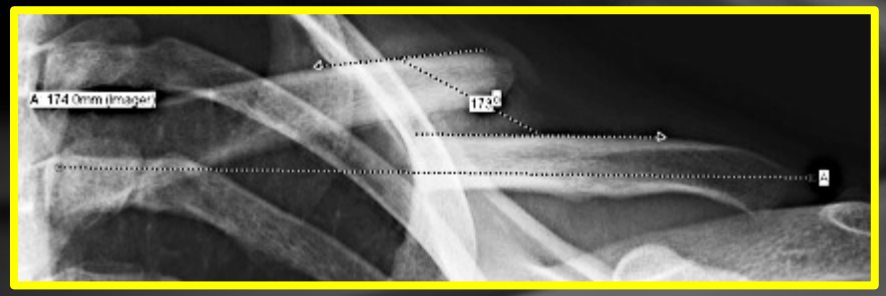
Simple (2 fragments)

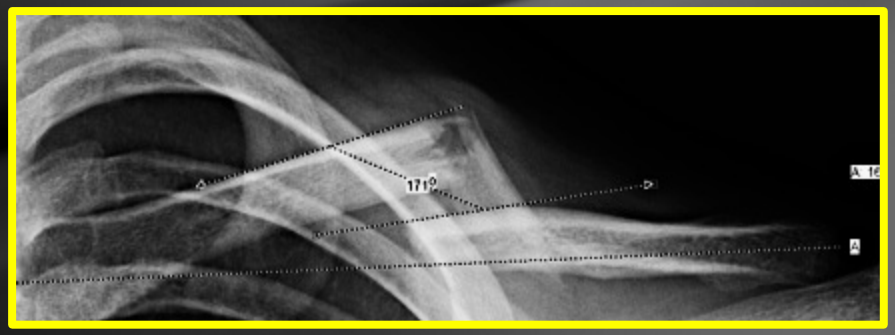
22/29 (76%)

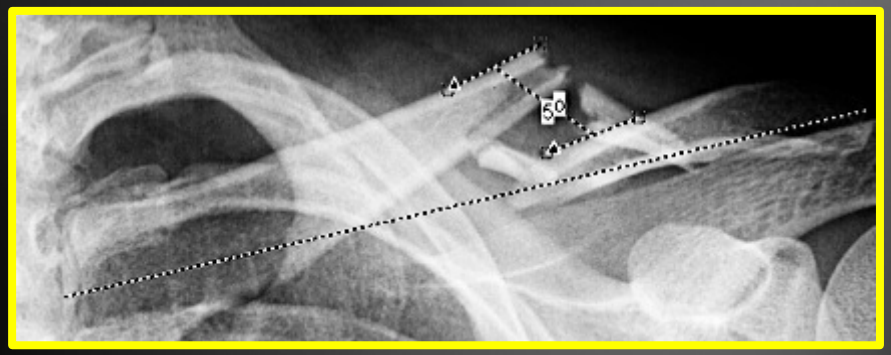
Multi-fragmentary

7/29 (24%)

- "Z"-Type/Segmental - 5/29
- Comminuted – 2/29

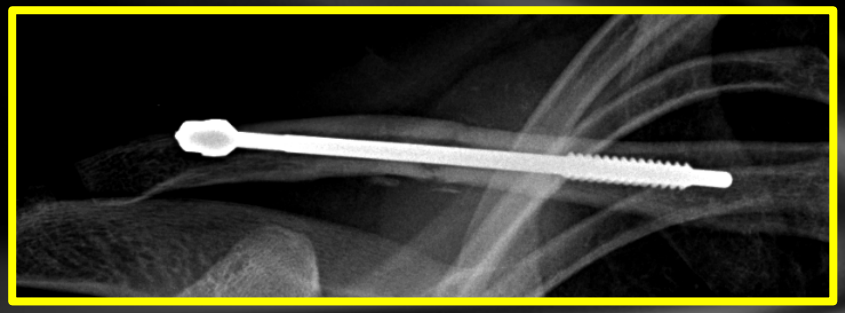




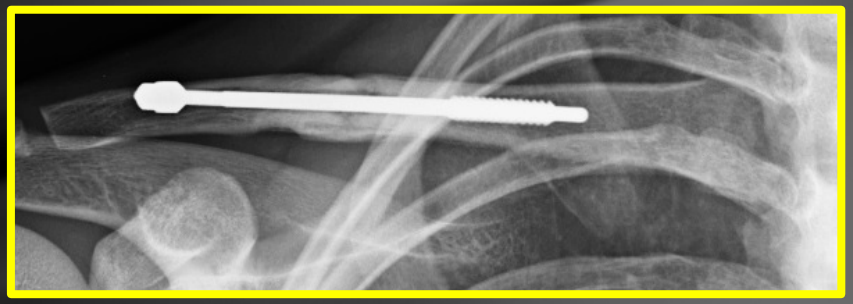


Results: Treatment Course

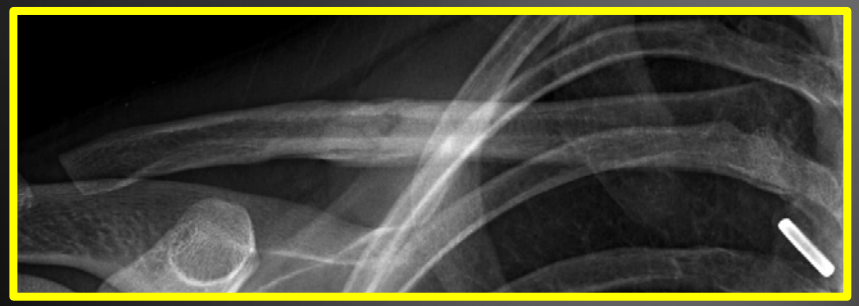
Time to Surgery (Date from injury)
- **9.8 days** (1 – 47 days)



Time to Union - 29/29 pts
- All went on to union
- **8 weeks** (4-14 wks)



Removal of hardware (28/29 pts)
- **13 weeks** from initial surgery (5 – 36 wks)



Results: Treatment Outcomes

Return to Sports

- 18 weeks (7-38 wks)

Return to Impact Sports

w/o Restrictions

- 20 weeks (7-38 wks)

Results: Complications

Major complications – **None**

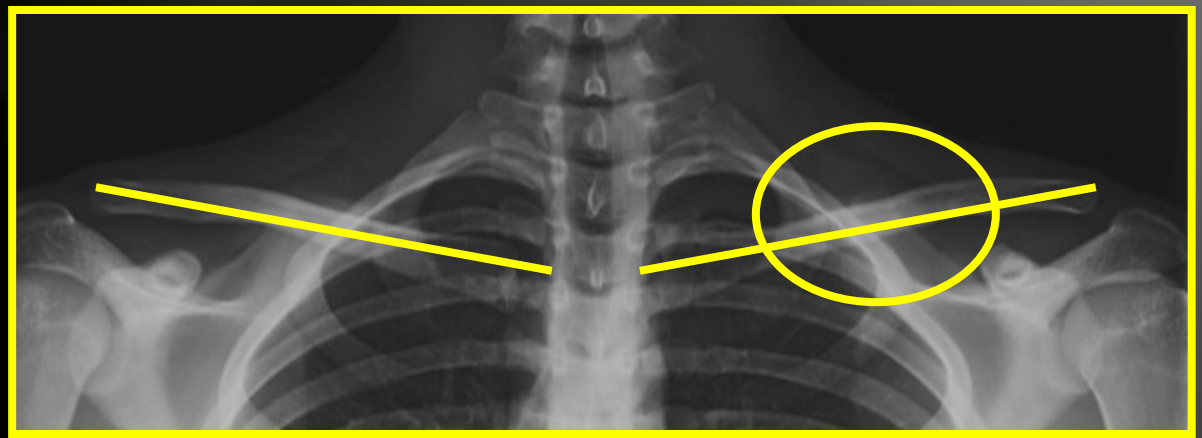
- No Re-operations (excluding planned removal)
- No pin migration, no neurovascular injury

Minor complications – 4/29 (14%)

- 3 - superficial wound breakdown
  - All resolved with HWR removal and oral abx
- 1 - Pin breakage at time of removal
  - No adverse sequelae

Follow-up Assessment >2 years

- **N= 8 (24 - 47 mos from date of surgery)**
  - Functional Assessment
  - Radiographic shortening
  - Satisfaction survey
  - ASES score



Results: Follow-up Assessment

ROM/Strength: Injured side =Uninjured side

Patient satisfaction score: 9.8/10 (8.8-10)

ASES score: 97/100 (range 79 – 100)

- Uninjured side 99/100 (93 – 100)

Residual shortening: -1mm (+6mm to -9mm)

- 3 pts with *lengthening* of injured side (+2 to +6mm)

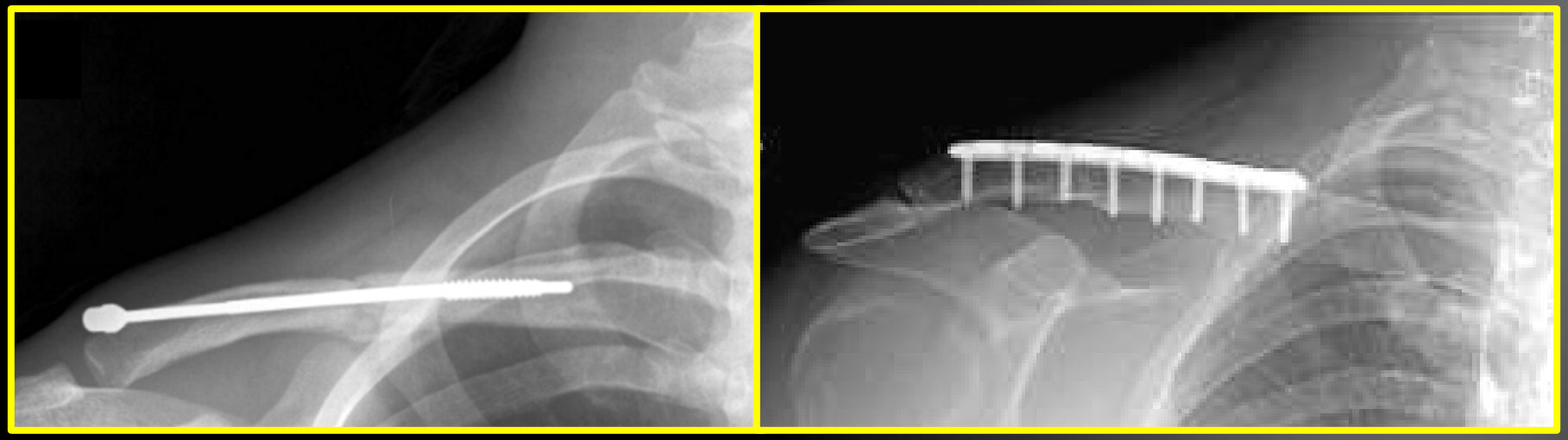
Limitations

- Retrospective
- No control group(s)
- Small numbers
  - 29 pts reviewed
  - 8 pts returning for >2 year evaluation

Discussion: Plate vs IM Pin (in adults)

- **No difference** - Constant score, Oxford score, rates of union, pain or ROM. (Ferran et al. *JSES*, 2010.)

- **No difference** – rates of nonunion, fixation failure, infection (Liu, et al. JOT 2010; Duan, et al. *JSES*, 2011)



Discussion: Plate vs IM Pin (in adults)

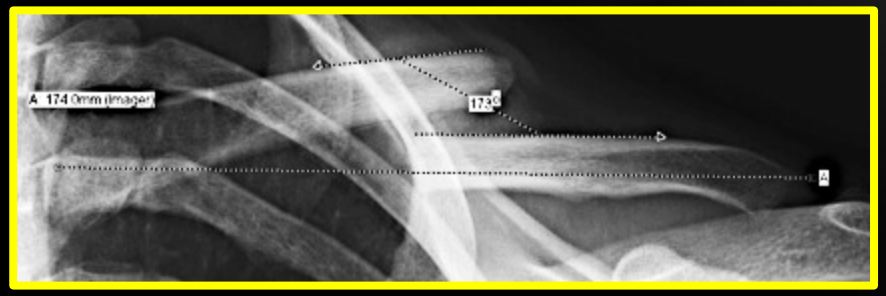
Higher rates - symptomatic hardware w/ plate (33% vs 10.2%)

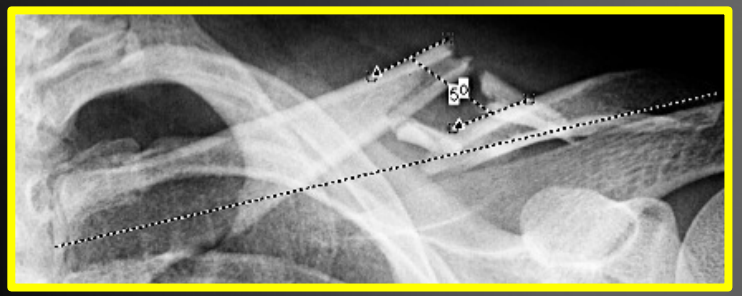
➢*Prominent plate, skin irritation, and persistent pain* (Duan, et Al. *JSES*, 2011.)

Conclusions

Explores role of IM clavicle fixation in the adolescent patient

- Highly active patient population
- All fxs with significant displacement (>15mm) or severe angulation, simple and multifragmentary





Conclusions

- Length stable fixation, 100% union
- Excellent functional outcomes
- Successful return to sports (no re-fractures)
- w/o long term morbidity of retained hardware

THANK YOU!

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Intraoperative Factors to Improve Radial Nerve Excursion at the Brachium: A Cadaveric Study

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Disclosure Statement

Integra LifeSciences Corporation provided the cadaveric specimens used in this research study.

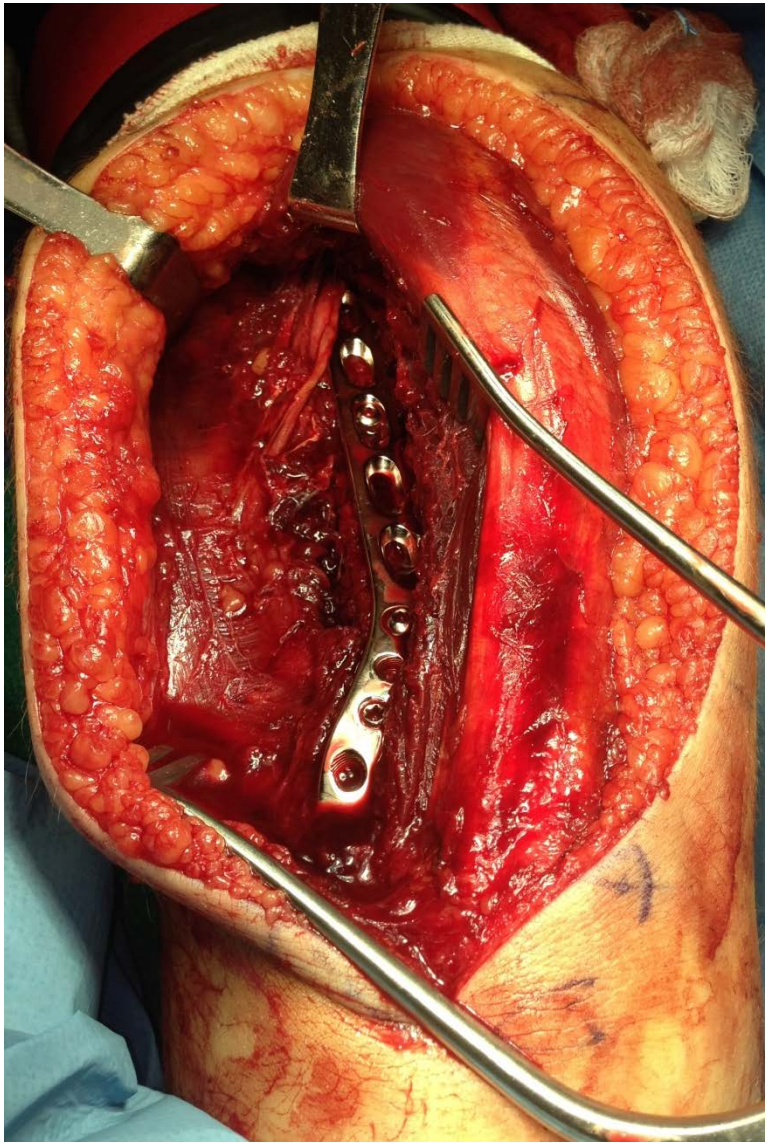
Radial Nerve Palsy

- 9.5-11.8% overall prevalence humeral shaft fractures (1.4% median, 3.8% ulnar) (Noble et al, *J Trauma* 1998; Shao et al, *JBJS Br* 2005)
  - 9% closed (Ekholm et al, *JOT* 2008)
  - 22% Holstein-Lewis (Ekholm et al, *JOT* 2008)
- 12-16% incidence after plating distal humerus fractures (Eglseder WA, *THUES* 2012; Jawa et al, *JBJS Am* 2006)
- Saturday night palsy
- Nerve elongation >8% may cause nerve ischemia (Clark et al, *JHS Am* 1992)
- Underlying mechanism behind this vulnerability remains incompletely defined

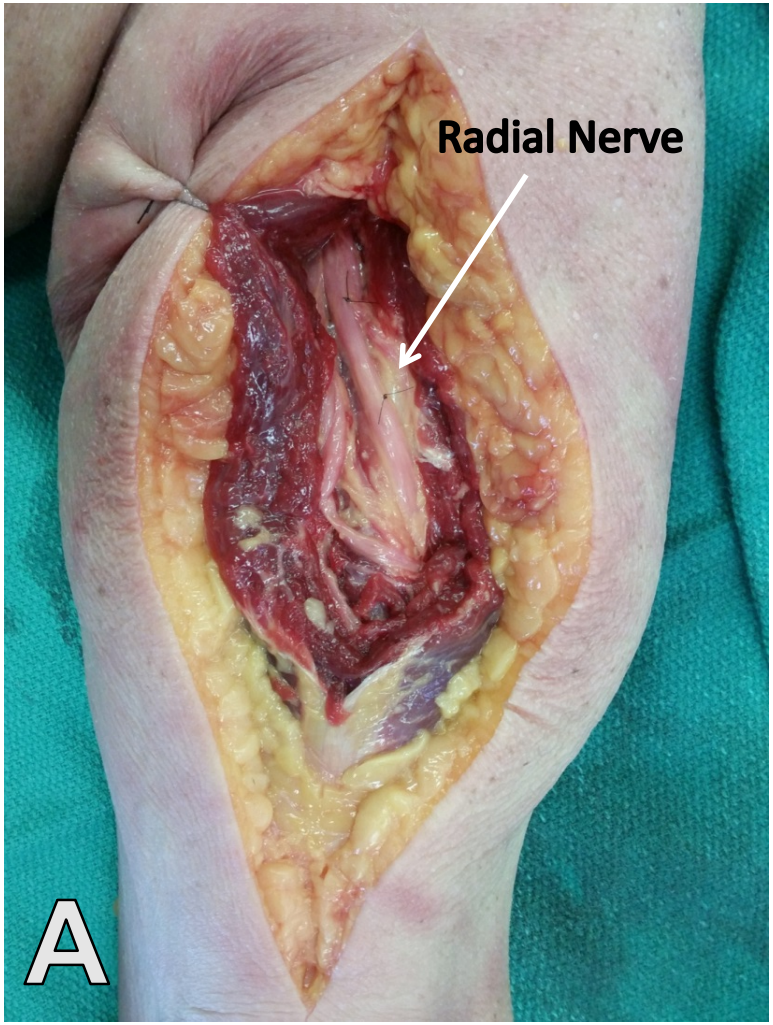
Hypothesis

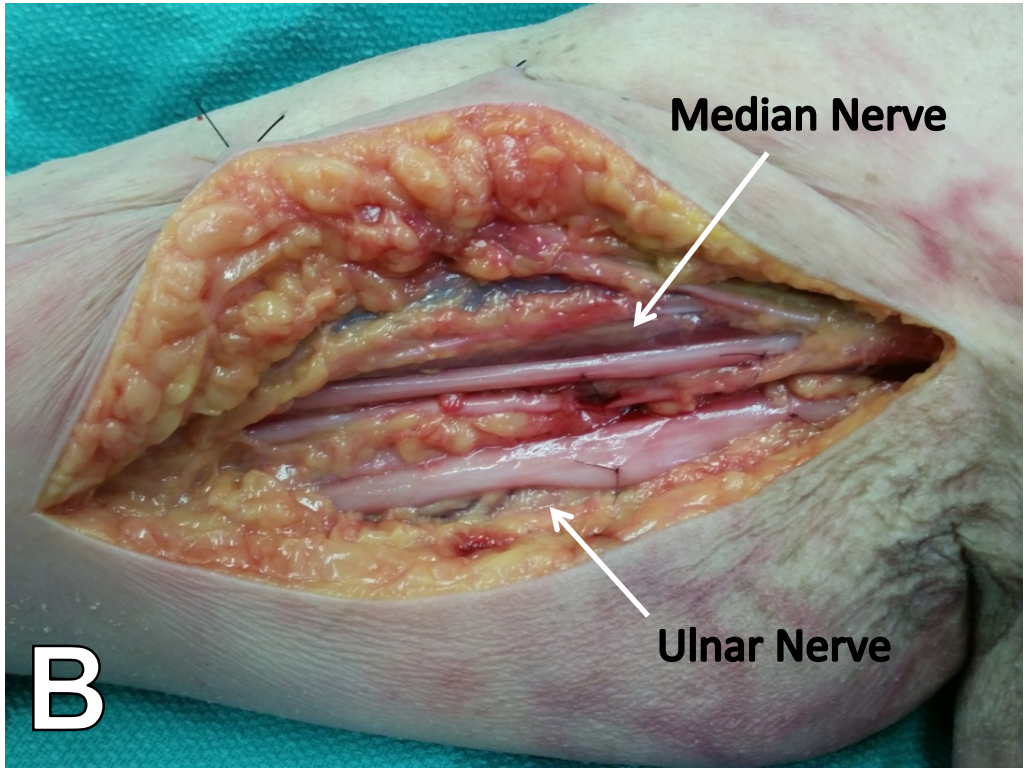
Radial nerve has ↑ vulnerability at the brachium:

- ↓ *Excursion vs. median and ulnar nerves*
- *(1) Elbow positioning*
- *(2) Anatomical tethering by the lateral intermuscular septum (LIS)*



Specimens



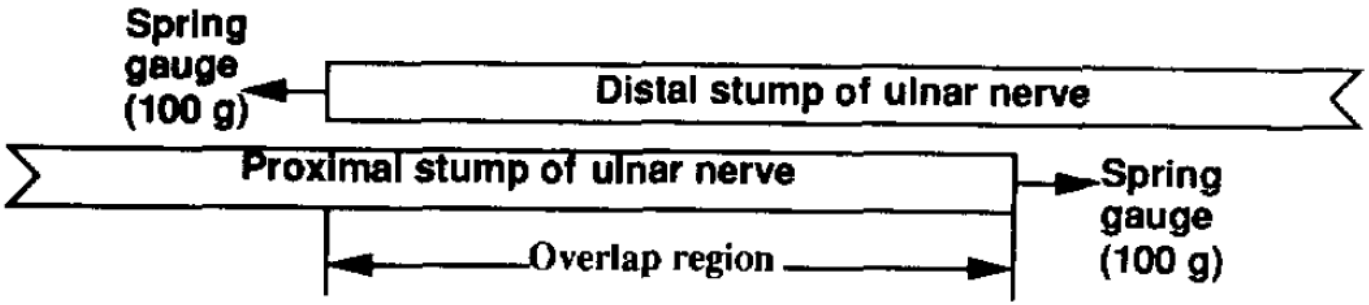


- 8 paired fresh frozen adult cadaveric upper extremities
- Mean age 63 years
- No history of upper extremity surgery

Experimental Protocol

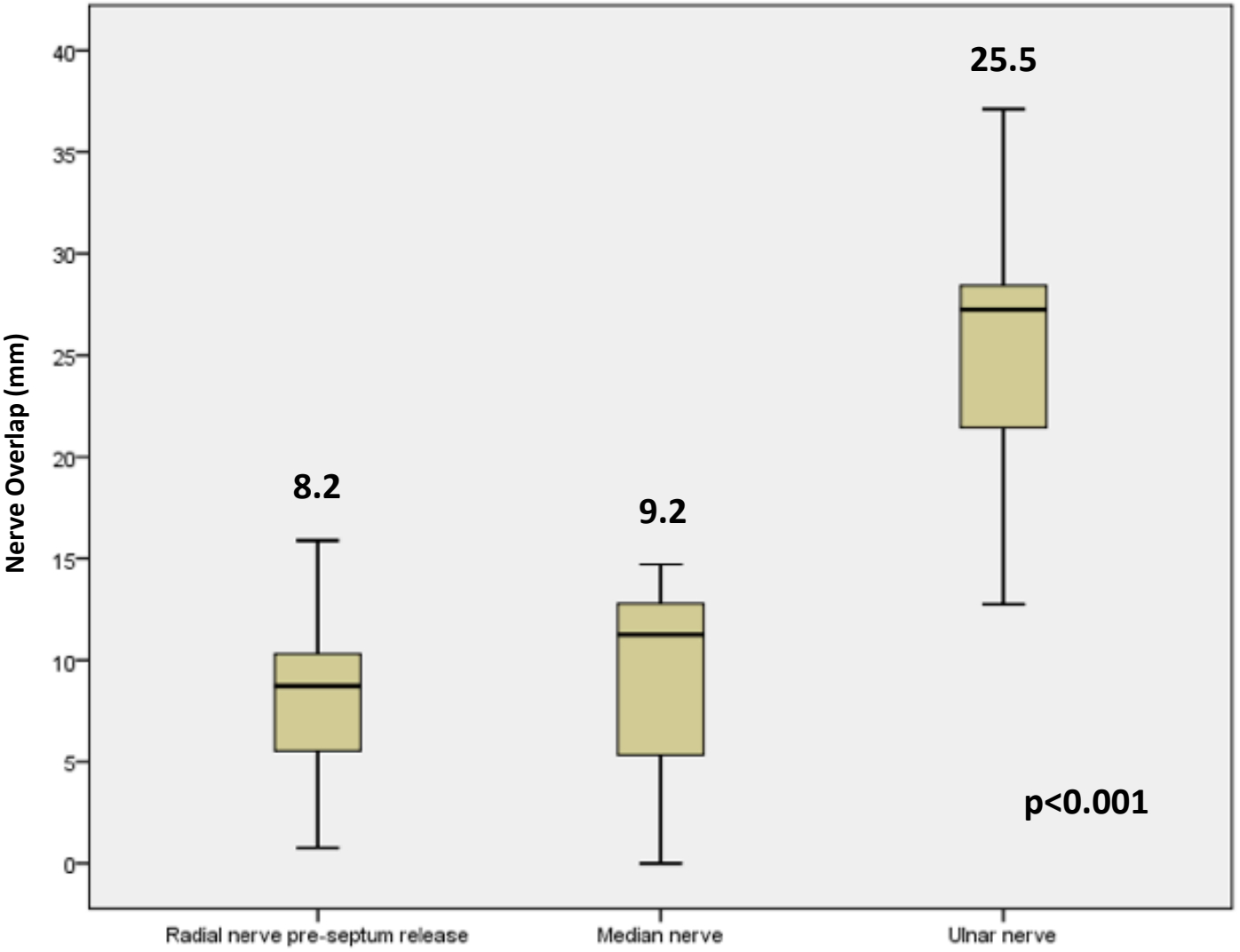
- Transected nerves at level of spiral groove
- Measured *in situ* tension & strain
- Determined nerve excursion 0-90° elbow flexion
- Repeated measurements after releasing LIS
- H&E stain

Mean resting tension:
47.0, 71.1, 16.3 g
Mean strain w/ 100 g load:
13.1%, 5.0%, 6.8%

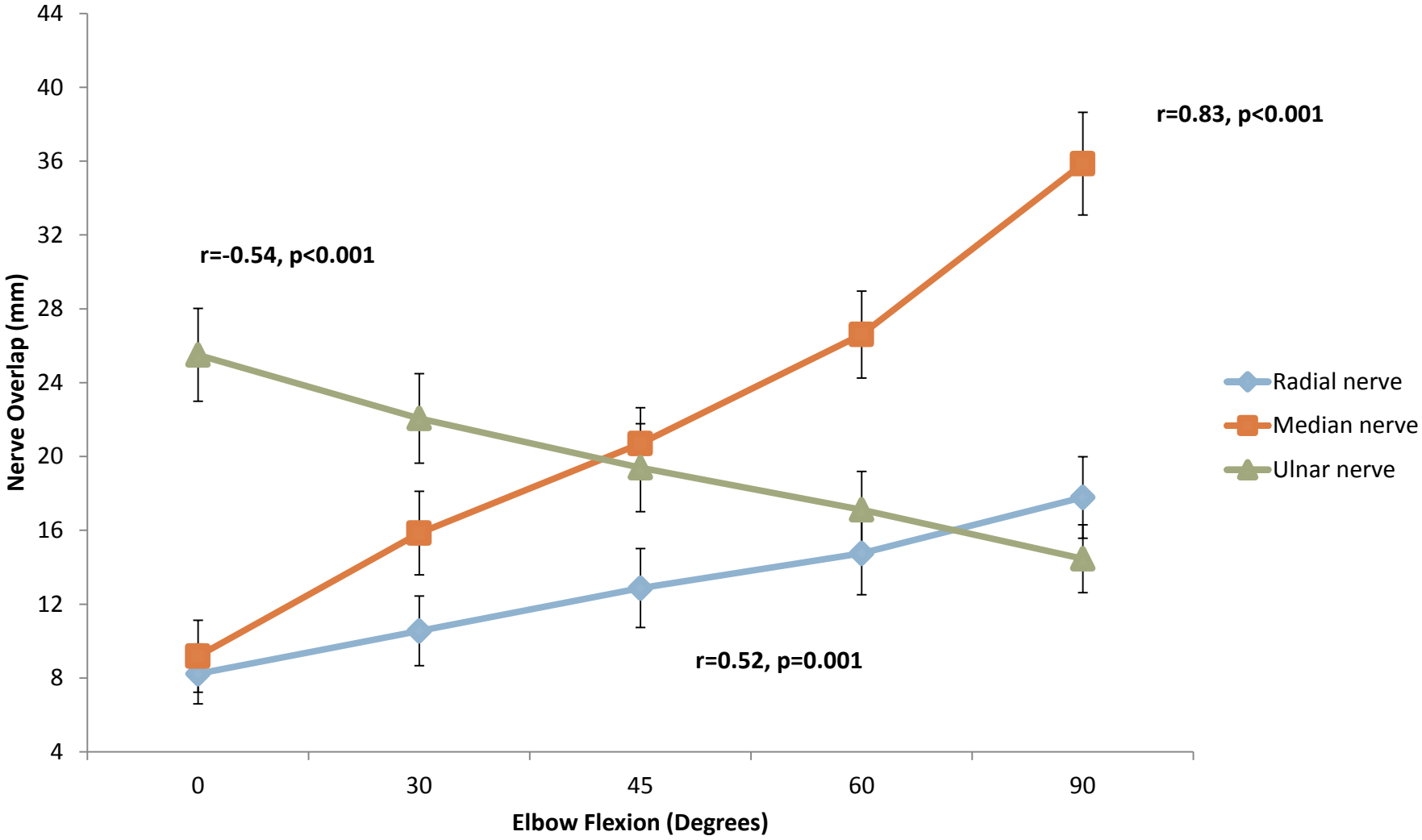


Abrams et al, *JHS Am* 1998

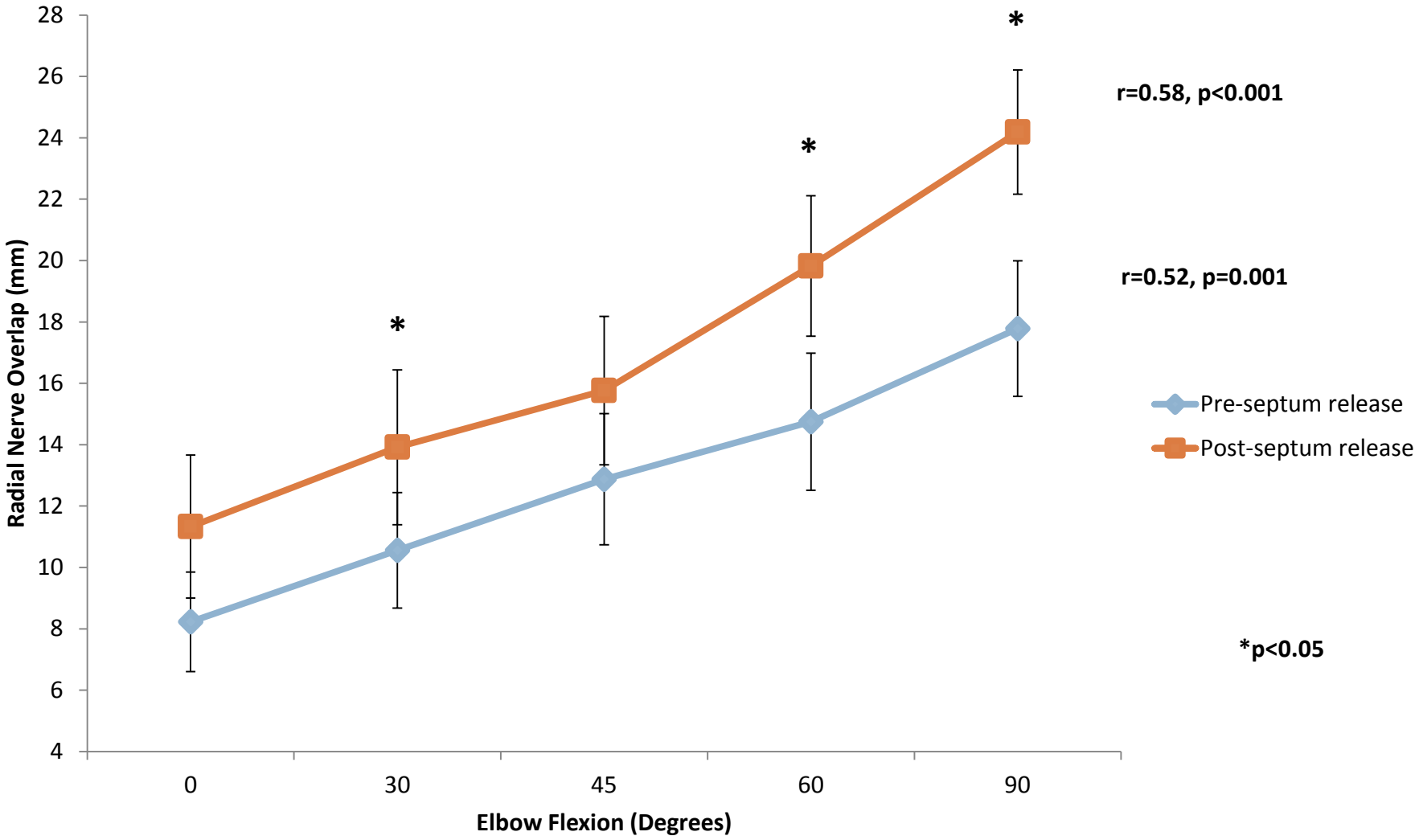
Baseline Nerve Excursion



Nerve Excursion vs Elbow Flexion



Radial Nerve Excursion ± Septum Release

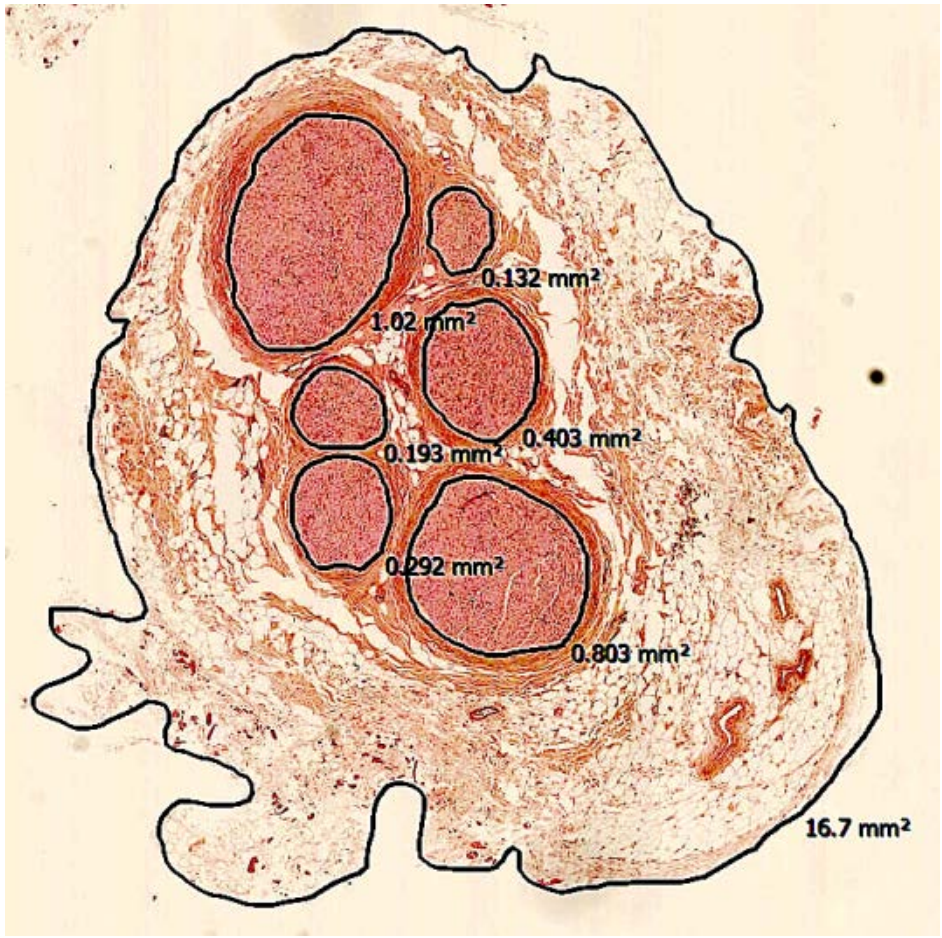


Radial Nerve Excursion

Elbow Flexion (°)	Pre-septum release (mm)	Post-septum release (mm)	Percent Change	P-value*
0	8.2	11.3	37.8%	0.075
30	10.6	13.9	31.8%	**0.037**
45	12.9	15.8	22.4%	0.060
60	14.8	19.8	34.4%	**0.003**
90	17.8	24.2	36.0%	**<0.001**
	2.17x	**2.95x**		

*__Boldface__ indicates statistical significance (p<0.05)

Hematoxylin & Eosin Stain



Radial 61.1%, Median 61.1%, Ulnar 63.3% (p=0.897)

Conclusions

- Radial & median nerve excursion **positively correlated** with ↑ elbow flexion
- Ulnar nerve excursion **negatively correlated** with ↑ elbow flexion
- LIS release **significantly improved** radial nerve excursion
- **No significant difference** in connective tissue composition

Summary Points

- Radial nerve has limited excursion at the brachium compared to median and ulnar nerves
- Flexing elbow to 90° **doubles** radial nerve excursion
- Releasing LIS and flexing elbow to 90° **triples** radial nerve excursion
- Connective tissue composition is not a main factor
- Recommend **releasing the anatomic tether of the LIS and flexing the elbow** during humeral fracture fixation to help prevent radial nerve palsy

Thank You