

Clavicle Fractures: Non-operative vs Operative Management

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Disclaimer

*No conflict(s) of interest in relation to
this presentation*



17 yo football player
Mid October of senior year
Also wrestles and plays baseball
Dominate arm

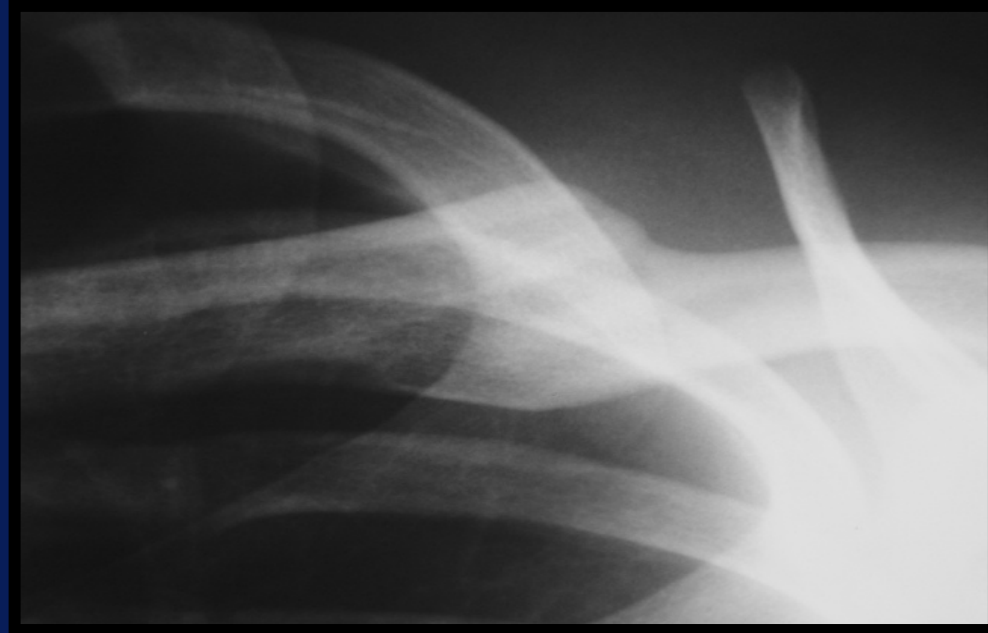


Acute, mid-shaft clavicle fractures

So what's the big deal?

- *“They all do fine”*
- *“They all heal”*

“Don't worry about it”



Acute, mid-shaft clavicle fractures

Non-operative treatment

The existing literature is relatively clear: they don't *all* do well with non-operative treatment !!



Acute, mid-shaft clavicle fractures

Non-operative treatment

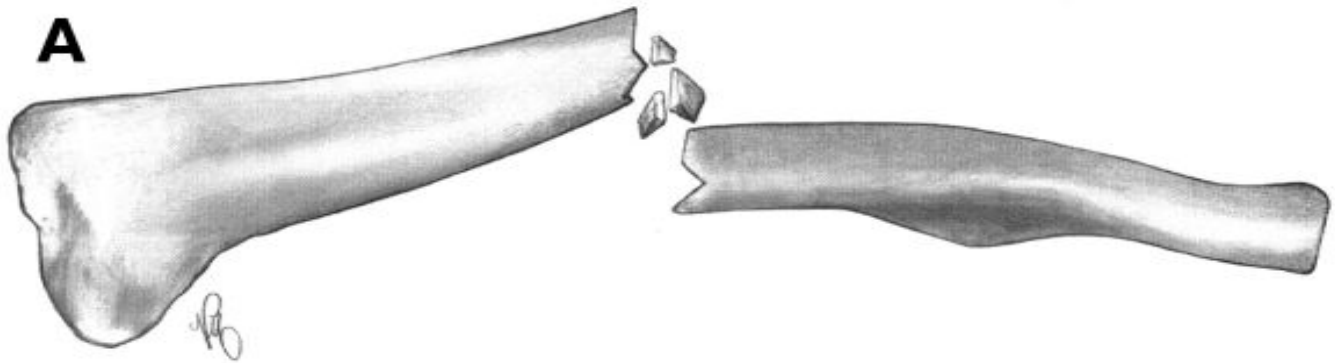
- Closed treatment of displaced middle-third fractures of the clavicle gives poor results. *Hill et al JBJS-Br., 1998.*
 - 242 consecutive clavicle fractures
 - Patient-based outcome assessment (questionnaire)
 - 52 / 242 completely displaced, middle-third
 - 15% nonunion
 - 31% unsatisfactory clinical results (pain, brachial plexus sx)
 - Factor associated with nonunion / poor results: *initial shortening*
> or = 2 cm

Acute, mid-shaft clavicle fractures

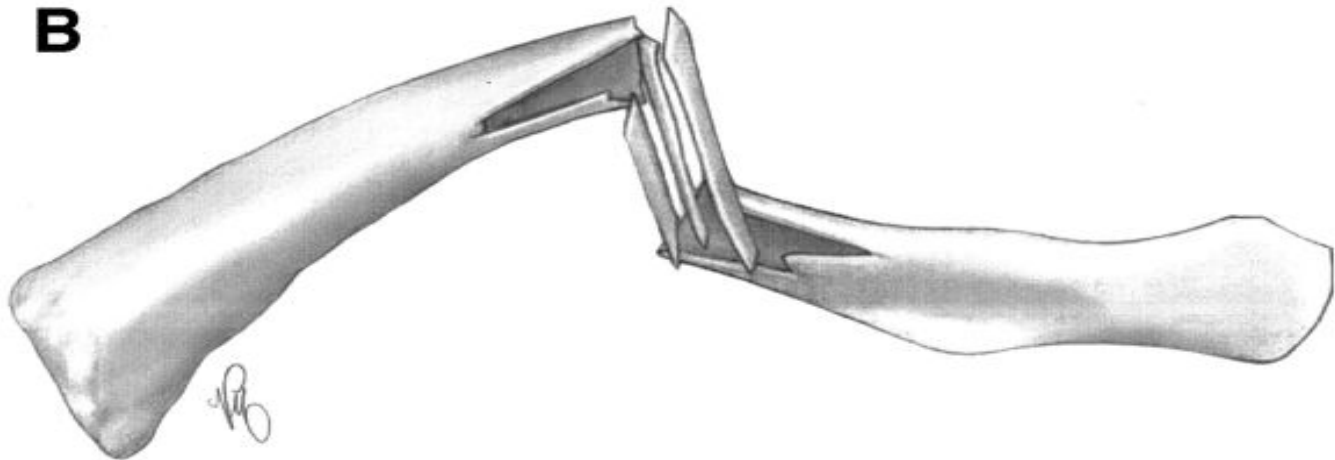
Non-operative treatment

- Can we predict long-term sequelae after fractures of the clavicle based on initial findings? A prospective study with 9 – 10 years follow-up (*Nowak, et al 2000*)
 - 245 consecutive clavicle fractures
 - 46% still with “sequelae” 9 years later (7% nonunion)
 - “No bony contact” was strongest predictor for sequelae
 - Comminuted fractures with “transverse” fragments

A



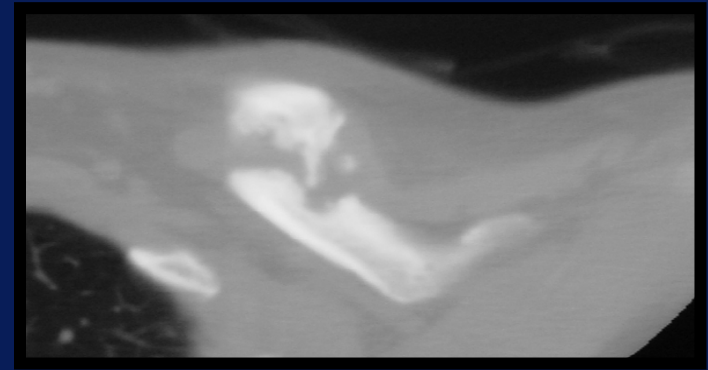
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Acute, mid-shaft clavicle fractures

Non-operative treatment

- Estimating the risk of nonunion following non-operative treatment of a clavicular fracture. Robinson et al. JBJS 2004.
 - 581 diaphyseal fractures
 - Overall 4.5% risk of nonunion
 - Significant increased incidence with . . .
 - Advancing age
 - Female gender
 - Displacement of fracture (“no contact”)
 - Presence of comminution



Acute, mid-shaft clavicle fractures

Non-operative treatment

- Estimating the risk of nonunion following non-operative treatment of a clavicular fracture. Robinson et al. JBJS 2004.

Age (yrs)	Displaced		Comminuted		Displaced & Comminuted		Not Displaced, Not Comminuted	
	Females	Males	Females	Males	Females	Males	Females	Males
25	19%	8%	7%	3%	33%	20%	3%	<1%
35	20%	11%	8%	4%	35%	21%	4%	<1%
45	25%	14%	10%	5%	37%	25%	5%	1%
55	28%	18%	12%	6%	42%	29%	6%	2%
65	33%	20%	18%	7%	47%	33%	7%	3%

Acute, mid-shaft clavicle fractures

Non-operative treatment

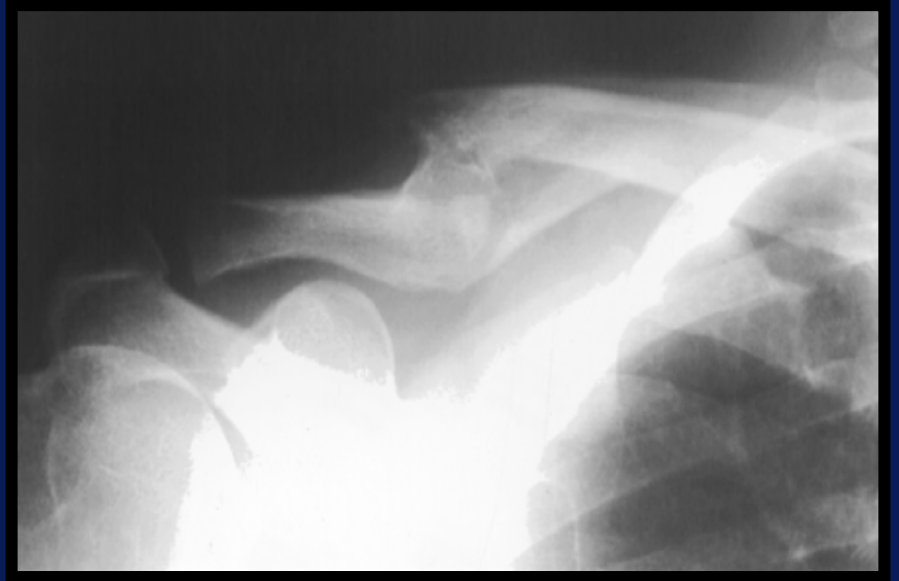
- Estimating the risk of nonunion following non-operative treatment of a clavicular fracture. Robinson et al. JBJS 2004.

	Displaced & Comminuted	
Age (yrs)	Females	Males
25	33%	20%
35	35%	21%
45	37%	25%
55	42%	29%
65	47%	33%

Displaced mid-shaft clavicle fractures

Deficits following non-operative treatment

- ▣ McKee, et al. JBJS 2006
 - ▣ 30 patients
 - ▣ All healed
 - ▣ “Patient-based” outcome measurements
 - ▣ Residual Disability
 - ▣ Strength Testing
 - ▣ Decrease Max 18-19%
 - ▣ Decrease Endurance 18-33%



Acute, mid-shaft clavicle fractures

Not so fast, surgeons . . .

- **Nordqvist et al**
 - 69 displaced fractures with no bony contact and 85 displaced / comminuted fractures
 - Only 1 of 7 non-unions had a poor result
 - Permanent clavicular shortening is common with no clinical sequelae
- **Oroko et al**
 - 41 patients with clavicle shortening of 15mm or more
 - Could not demonstrate relationship between shortening and shoulder function
- **Pedersen et al**
 - 90% of 99 patients had no pain at follow-up
 - Shortening and displacement were not risk factors for pain
- **Blomer et al**
 - 151 patients
 - Neither axial angulation nor shortening caused shoulder dysfunction

Acute, mid-shaft clavicle fractures

Why the contradictions in the literature?

“It is clear that patient-based outcome measures reveal residual impairment that surgeon-based or radiographic measures do not.”

McKee et al

McKee, et al JBJS 2007

Nonoperative vs plate fixation of displaced fractures

Multicenter, randomized clinical trial – 132 patients

- ▣ Operative treatment statistically better . . .
 - ▣ Constant / DASH score
 - ▣ Return to activities
 - ▣ Time to union
 - ▣ Non-unions
 - ▣ Symptomatic malunions
 - ▣ Patient satisfaction



Robinson, et al JBJS 2013

Nonoperative vs plate fixation of displaced fractures

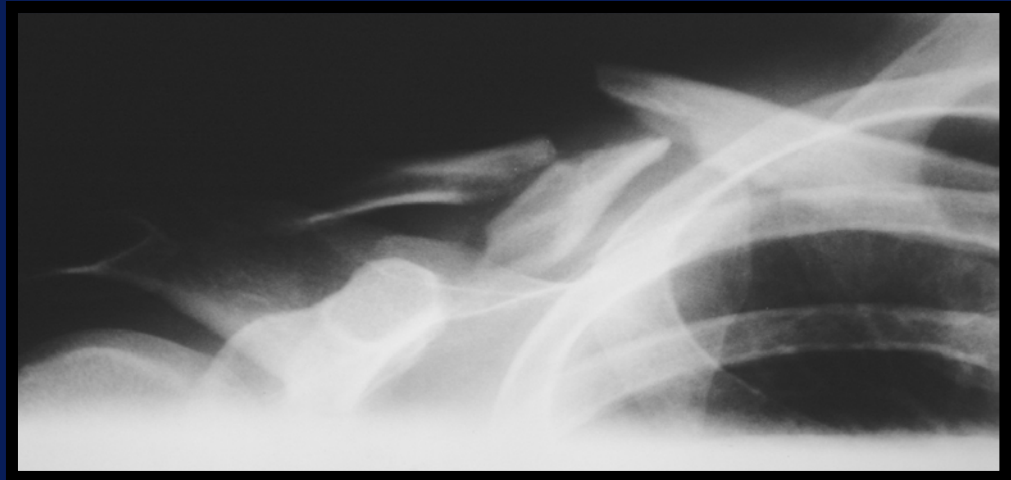
Multicenter, randomized clinical trial – 200 patients (16-60yo)

- At 1 year ORIF pts better than non-op
 - Lower Nonunion rate (1 vs 16)
 - Constant / DASH scores
 - Exclude non-unions then scores the same
 - Pt satisfaction
 - Shoulder droop/shoulder asymmetry/bump
 - Higher cost

Acute, mid-shaft clavicle fractures

“Evolving” indications for surgery – general patient population

- Degree of displacement / shortening
 - “No contact”
 - > 2 cm
- Communion
- Amount of “energy”
- Fracture pattern (“zed”)
- Patient-specific factors
 - Contact athletes
 - Year round athletes



Acute, mid-shaft clavicle fractures

Surgical technique options

- Compression plating
 - IM fixation
- Other creative techniques (?)



Acute, mid-shaft clavicle fractures

Technique options: plating

- The most commonly utilized technique
- Complications associated with ORIF / plating primarily related to plate selection and technical issues
 - Pre-contoured, anatomic plates



McKee, et al JBJS 2007

Nonoperative vs plate fixation of displaced fractures

Multicenter, randomized clinical trial

- Complications of ORIF – 9%
 - 3 / 67 (4.4%) infections
 - All managed initially with antibiotics and local wound care
 - Hardware removal after healing
 - No sequelae
 - 2 / 67 (3%) symptomatic hardware requiring removal
 - 1 / 67 (1.5%) broken plate (ATV accident 6 weeks post-op)
 - No catastrophic complications

Acute, mid-shaft clavicle fractures

Technique options: plating

The plate doesn't do it by itself !!



Mid-shaft clavicle fractures

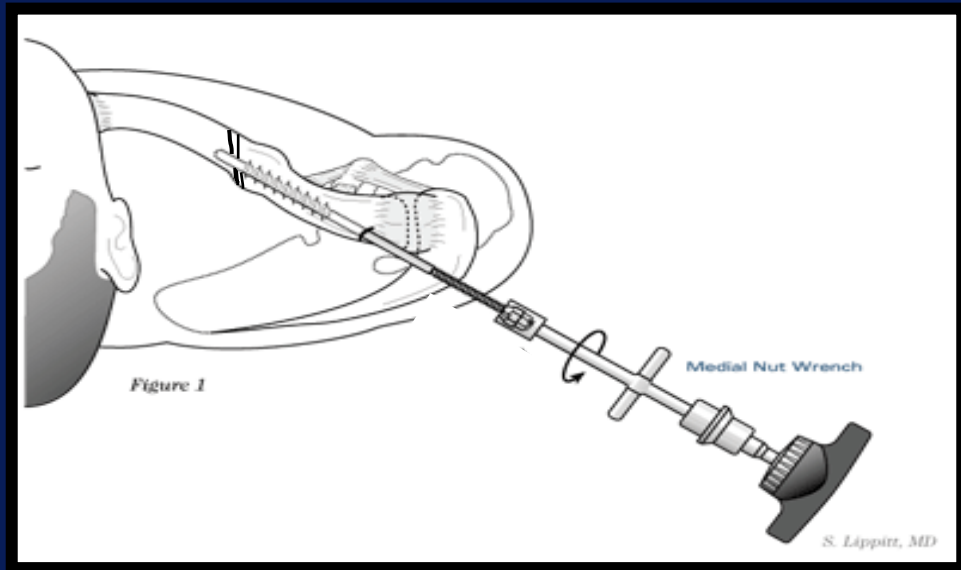
Surgical pearls - plating

- Identify / protect supraclavicular nerves
- Precise approach through delto-trapezial fascia
- Anatomic / compressive fixation
 - Pre-contoured anatomic plates
 - Avoid medial prominence
- Respect periosteum / soft-tissue attachments
- Bone graft substitute if comminuted
- Thick, “water-tight” delto-trapezial fascia repair

Acute, mid-shaft clavicle fractures

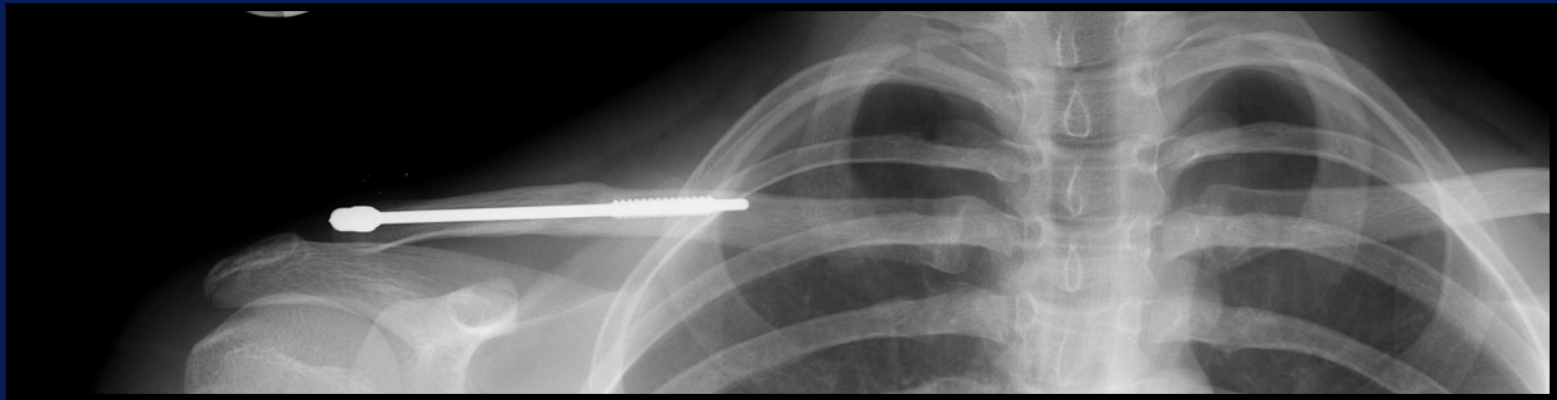
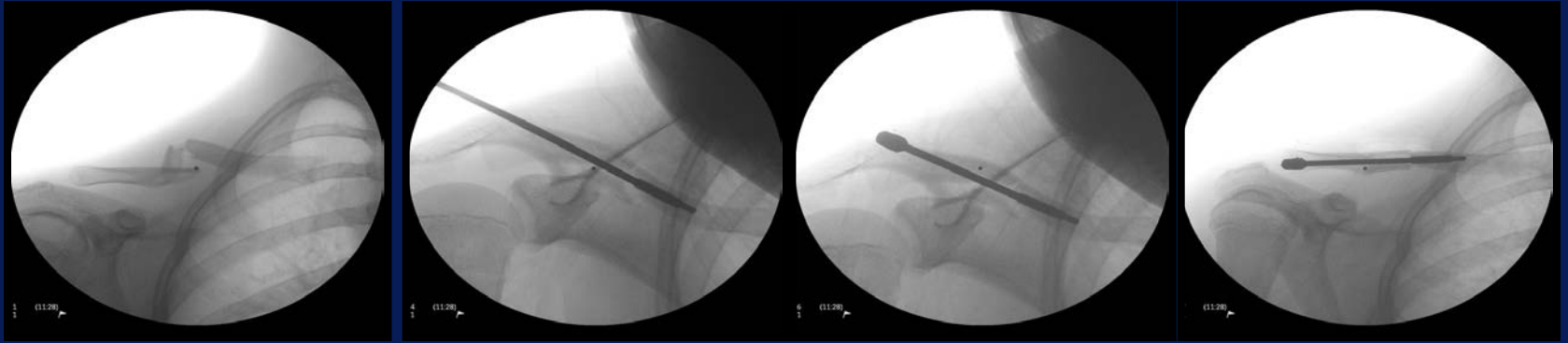
Technique options: IM fixation

- Stable fixation with thread on one end and “bolt” on the other
- Technique:
 - Open fracture site
 - Retro / anterograde placement of pin from behind AC joint
 - Engage medial, anterior cortex
 - Bolt behind AC joint to prevent migration



Acute, mid-shaft clavicle fractures

Technique options: IM fixation



Acute, mid-shaft clavicle fractures

Technique options: IM fixation

□ Advantages

- Less dissection
- More cosmetic
- No long-term retained hardware issues
- Ideal in younger patients with severe, acute fractures



□ Disadvantages

- All require hardware removal (2nd surgery)
- Bolt symptomatic



Acute, mid-shaft clavicle fractures

Technique options: intramedullary fixation

Neither does the pin !!



Acute, mid-shaft clavicle fractures

Complications of IM fixation

- Device dependent
 - Rockwood pin
 - Knowles pin
 - Hagie pin
 - Threaded Steinman pin
 - K-wires
- Complication rate very variable in the literature
- Range: 5% - 50%



Grass, Strauss, Chu, Ngarmukos, Boehme

Acute, mid-shaft clavicle fractures

Surgical pearls – intramedullary fixation

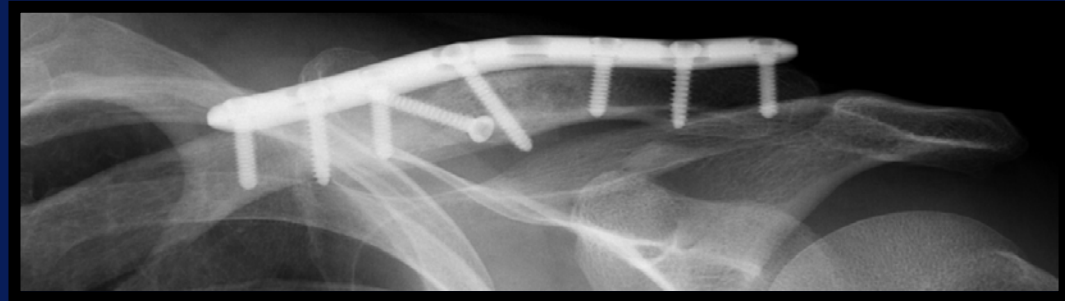
- Small incision over fracture; extend prn
- Largest diameter pin that will traverse canal
- Look via C-arm in different planes; stay centered
- Threads cross fracture site; reduce fragments anatomically
- Don't exit too high laterally
- “Cold weld” medial and lateral bolts together
- Cut pin as short as possible to minimize symptoms
- Suture comminution and delto-trapezial fascia closure



Timing?

Does delay matter?

- Potter, McKee, et al JSES 2007
 - 15 immediate vs 15 delayed fixation
 - No differences . . .
 - Healing
 - Strength of shoulder flexion
 - Shoulder abduction
 - ER
 - IR
 - DASH scores
 - Marginally better outcomes in Constant scores and in endurance strength with acute fracture repair



Case examples . . .



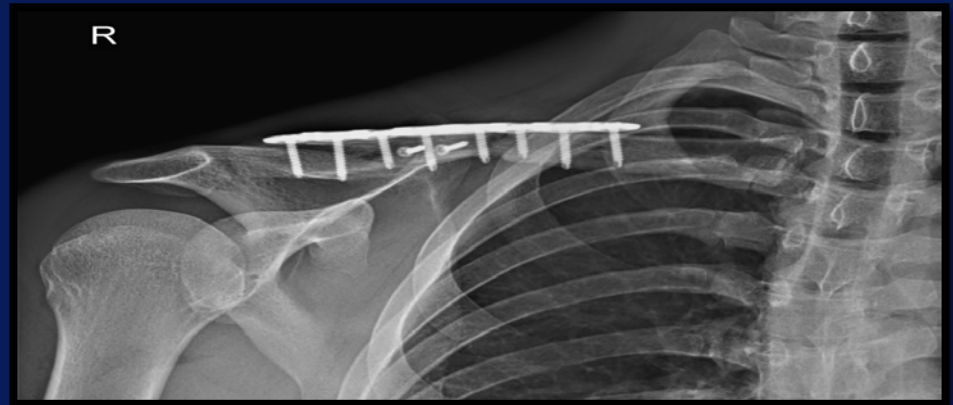
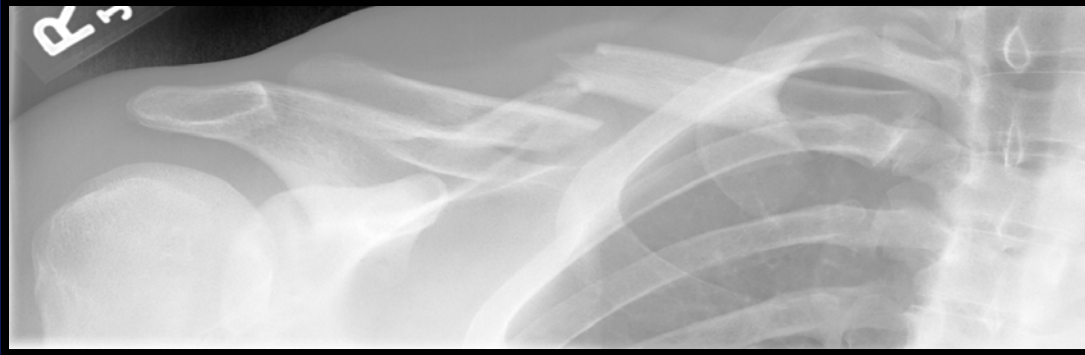
Acute, mid-shaft clavicle fractures

Patient-specific factors: HS FB Player



Acute, mid-shaft clavicle fractures

Patient-specific factors: 25 YOM manual laborer



Acute, mid-shaft clavicle fractures

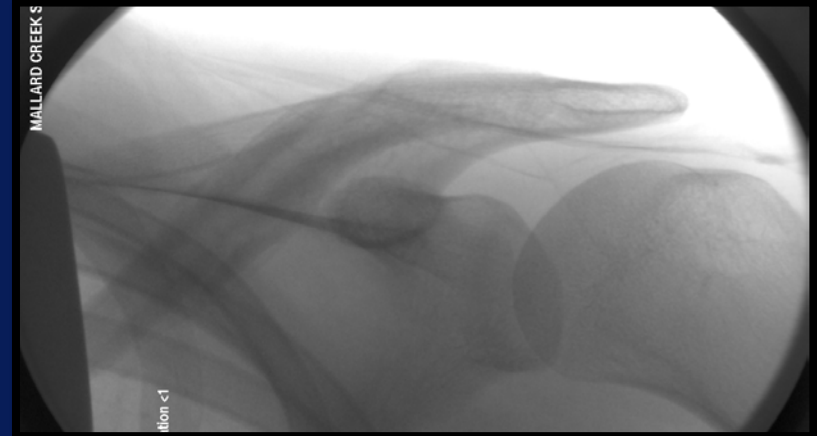
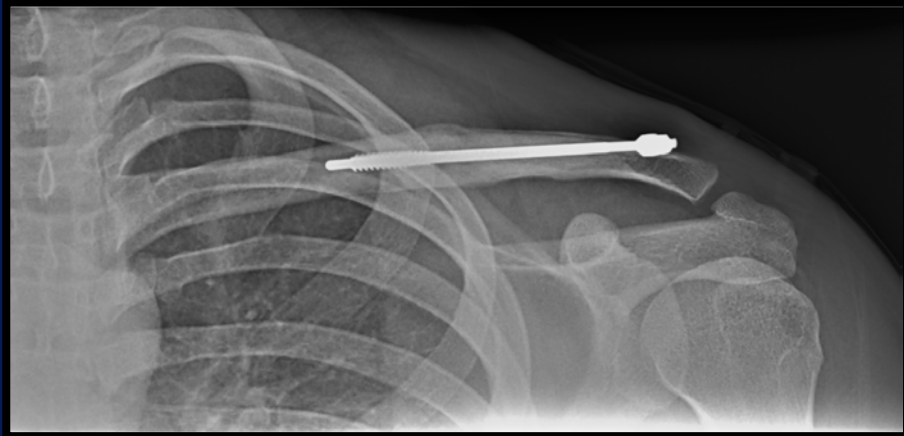
Patient-specific factors: 36 YOM construction worker

Dirt bike injury



Acute, mid-shaft clavicle fractures

Patient-specific factors: Missionary



Acute, mid-shaft clavicle fractures

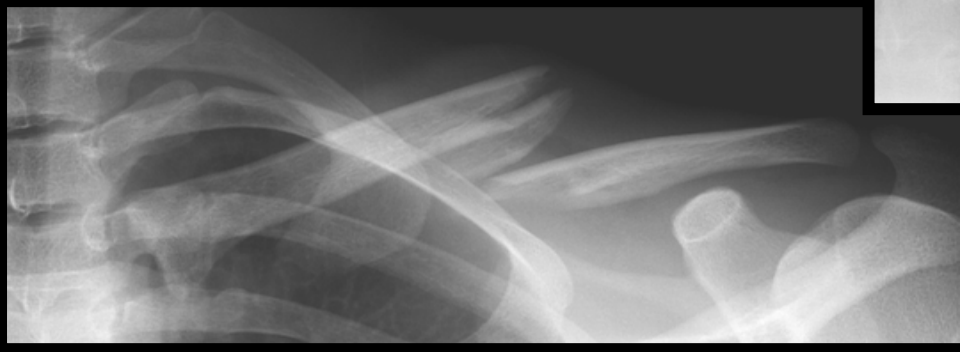
Patient-specific factors: Missionary

6 months later

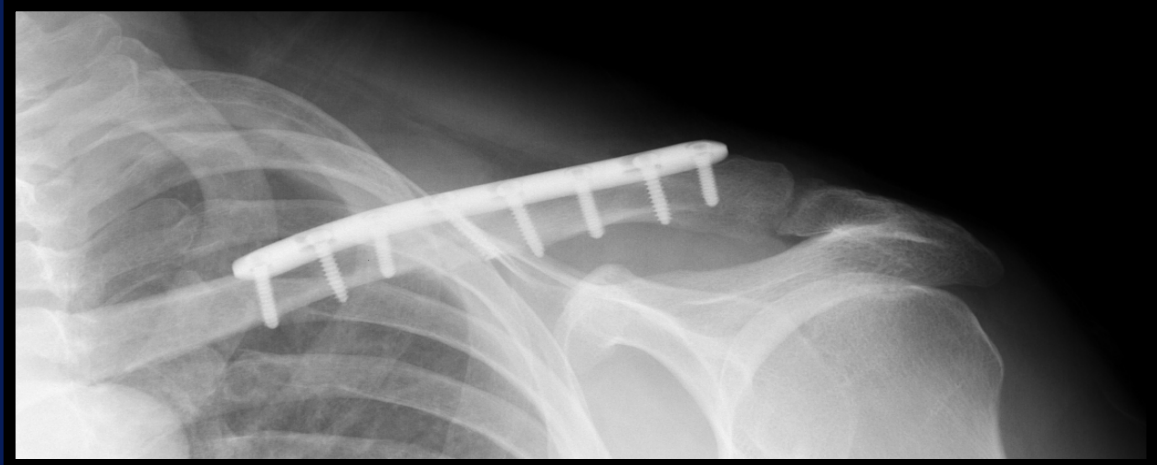


Acute fracture

15 year old boy



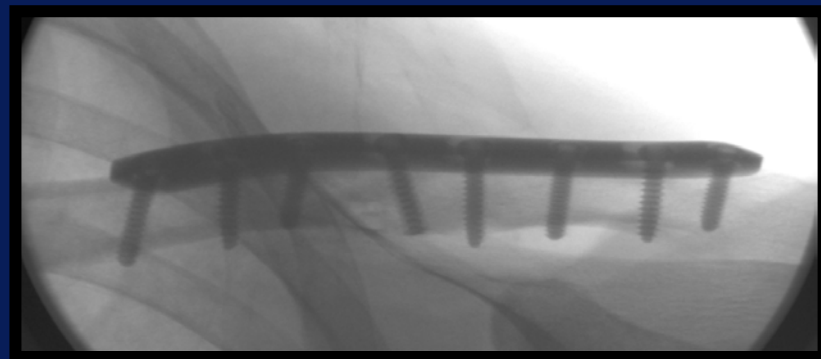
Malunion + thoracic outlet symptoms



Mid-shaft clavicle fractures

Implant selection: my personal preference

- Acute fractures
 - IM pin
 - Younger patients
 - Plate
 - Most patients
 - 2nd operation less desirable
- Nonunions
 - Plate

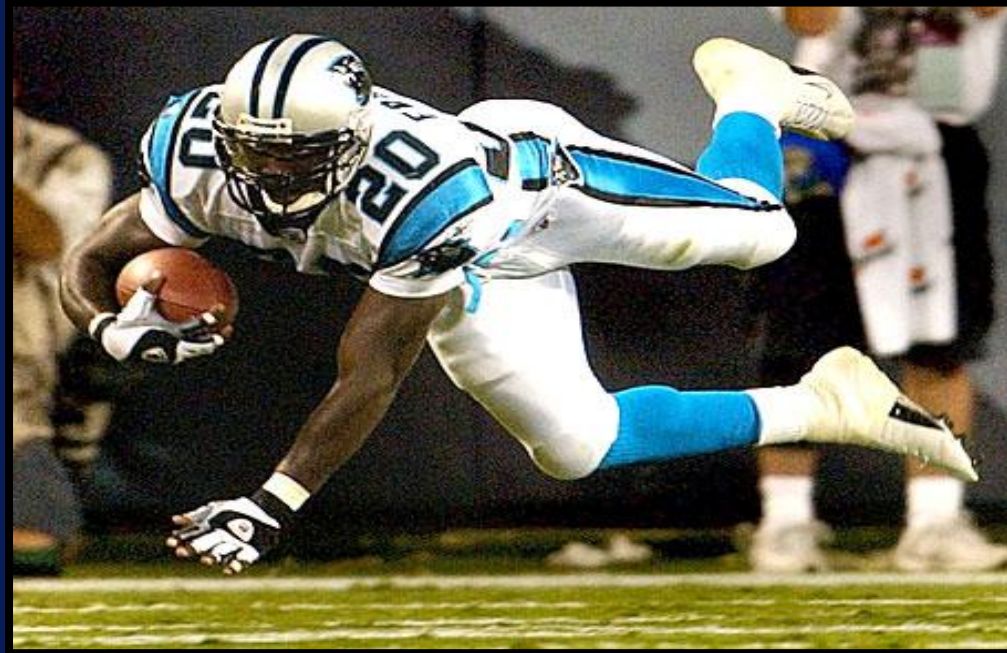


Acute, mid-shaft clavicle fractures

Summary

Although displaced mid-third clavicle fractures can be managed successfully without surgery. . .

Patient-based outcome studies suggest that a larger percentage of *displaced* mid-clavicle fracture results are “less than ideal”



Acute, mid-shaft clavicle fractures

Summary

- Factors potentially associated with poorer results include
 - • •
 - Degree of displacement / shortening > 2 cm (“no contact”)
 - High-energy / comminuted fractures
 - Fracture pattern (“zed”)
 - Displaced Type II distal clavicle fractures
 - Patient-specific factors (contact athletes)
- Operative management should be considered in these higher-risk clinical scenarios

Mid-shaft clavicle fractures

Implant selection: talking points

- Time to heal – return to activities
- Nonunion risks
- Expected outcomes
- Non-op complaints
- Operative complaints
- Cost (surgery, time lost from work)

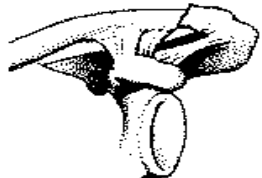


Lateral clavicle fractures

10-15% of all clavicle fractures

CLAVICLE FX - DISTAL THIRD

Neer, CORR 58:33



1
Undisplaced
coracoacromial
ligaments intact



2
Displaced
coracoacromial
ligaments
ruptured

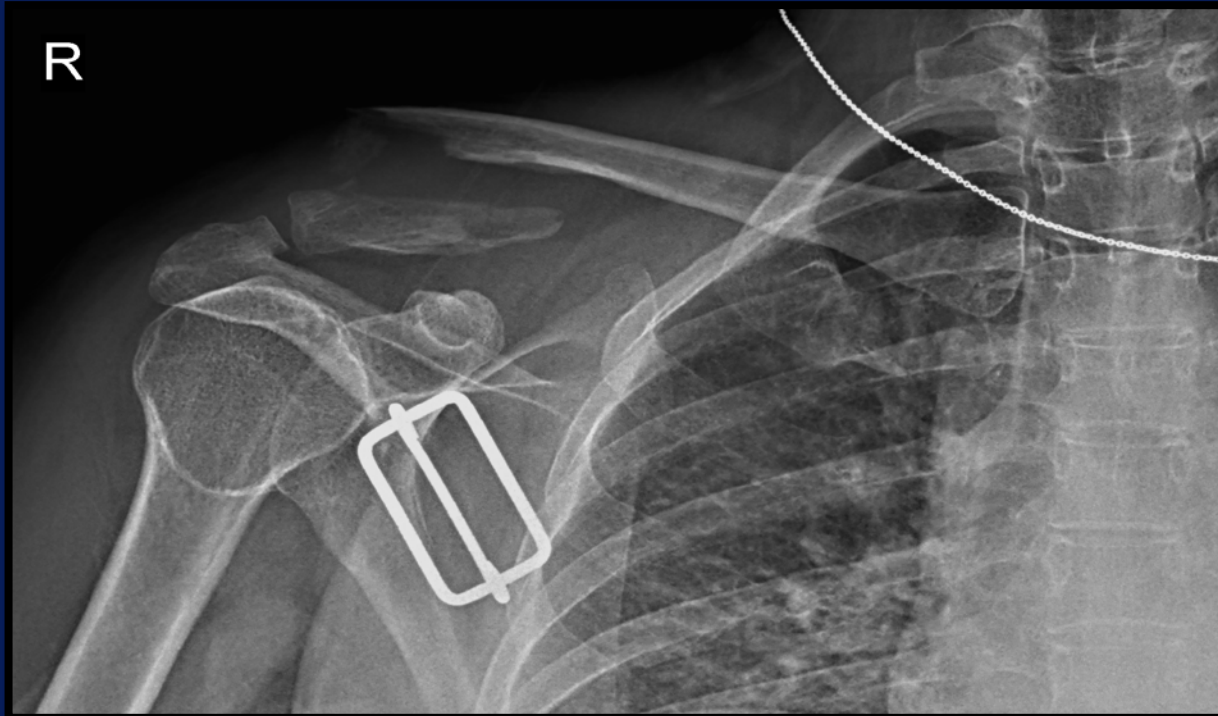


3
Intra-articular
AC joint



Lateral clavicle fractures

40 yo teacher – bike accident at the beach



Lateral clavicle fractures

10-15% of all clavicle fractures

- Natural history . . .
 - Charles S. Neer II, MD ~ 1/3 problematic
 - Nordquist Acta Orthop Scand '93 → 25% pain / nonunion
 - Robinson JBJS '04 → 21% required surgery



Displaced lateral clavicle fractures

- Treatment options . . .
 - Plating
 - Multiple “standard” options
 - Anatomic, pre-contoured plate
 - Coracoid fixation
 - Primary
 - Supplemental with other technique(s)
 - Hook plate
 - K-wires / TBW across AC joint
 - Other creative techniques . . .
 - Excise distal bone fragment(s) + modified Weaver-Dunn



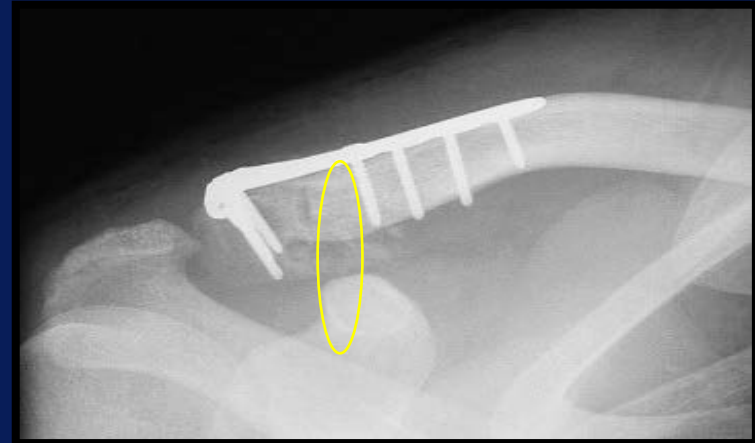
Lateral clavicle fractures

Plating

- Often inadequate lateral bone for standard plates
- Options . . .
 - Anatomic, pre-contoured plates

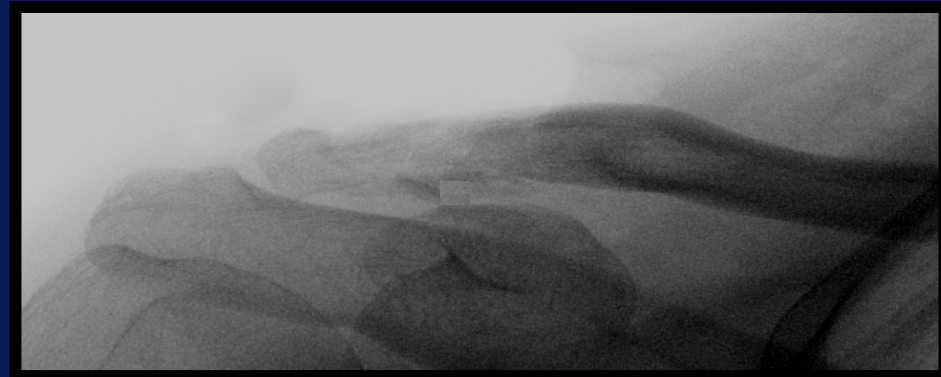


- Strongly consider supplemental coracoid sling fixation
 - Sutures or +/- graft



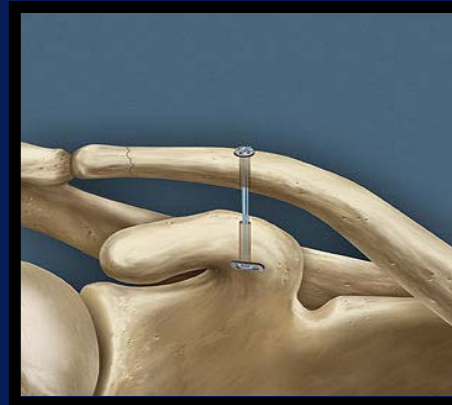
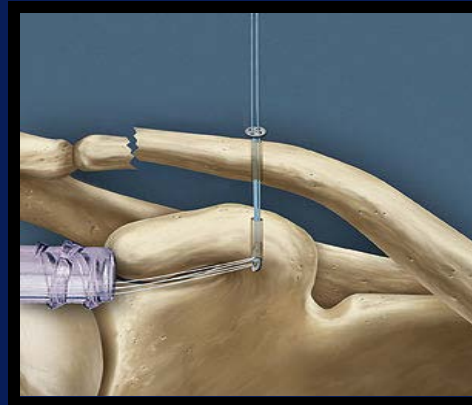
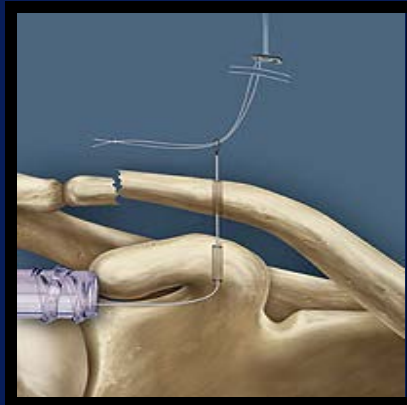
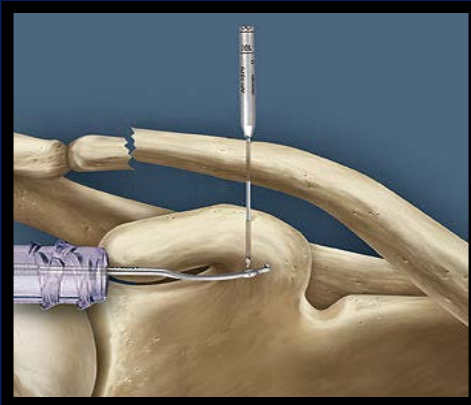
Lateral clavicle fractures

Coracoid fixation in isolation



Lateral clavicle fractures

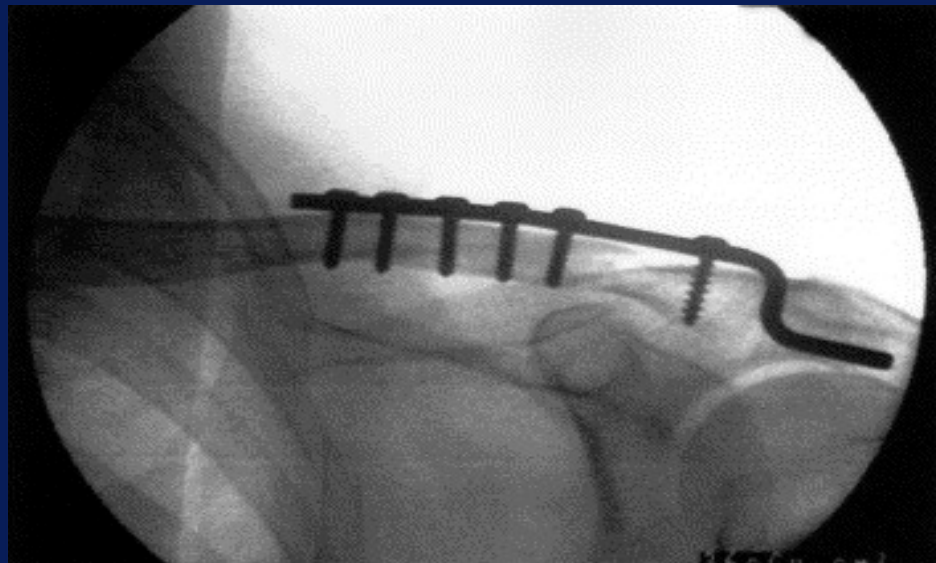
other techniques . . .



Lateral clavicle fractures

“Hook plate”

- Haidar, et al JSES 2006
 - 22 patients
 - 12 month minimum follow-up
 - Until plate removal, only 90° FE allowed
 - ROH 3-4 months
 - 21/22 ultimately healed
 - 86% satisfaction



Lateral clavicle fractures

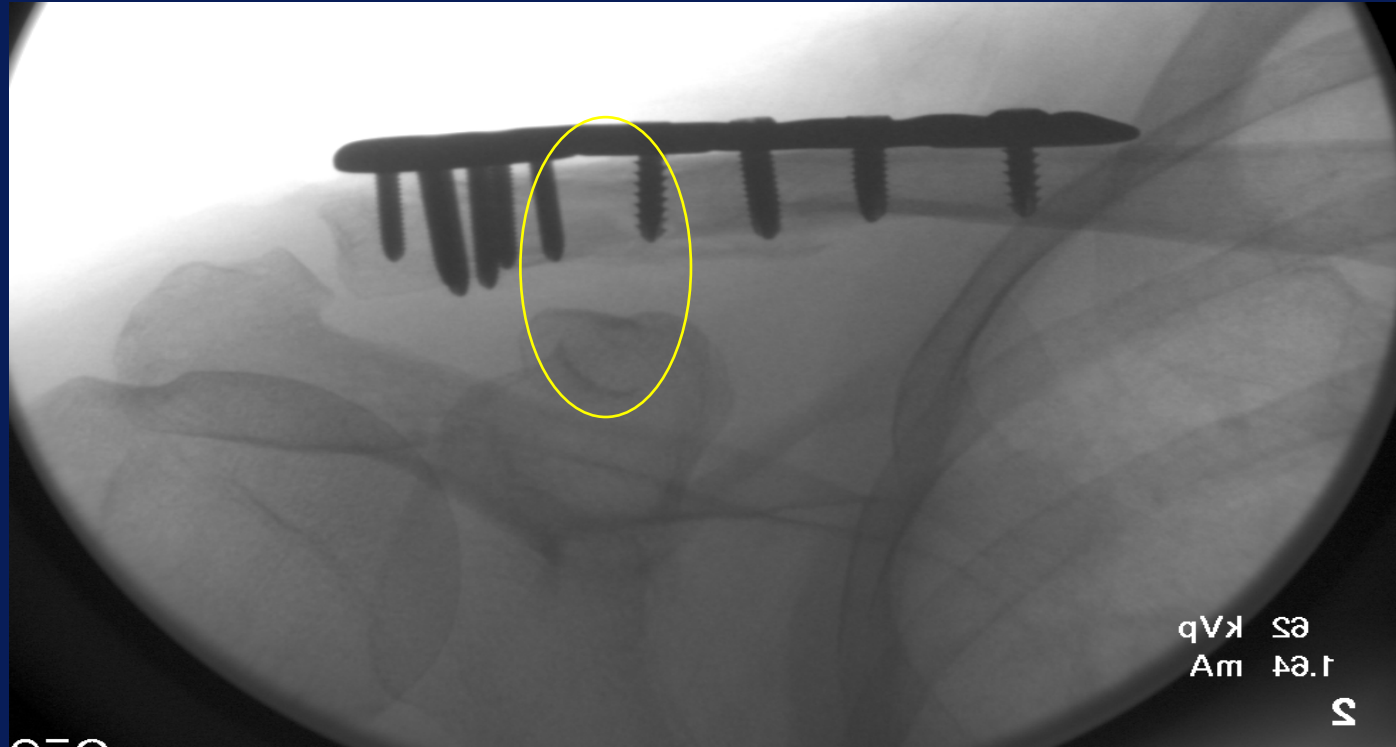
“Hook plate”

- Haidar, et al JSES 2006
 - “4 (18%) complications”
 - 1 malunion
 - 1 nonunion (“marked, subcutaneous bony prominence“)
 - 1 wound breakdown / exposed plate
 - 2 failure of fixation
 - 1 stress fracture medial to plate
 - (3 patients with asymptomatic “acromial erosion”)
 - 6/22 (27%) complications



Lateral clavicle fractures

Teacher





OrthoCarolina