

The Superiority of Surgery in Caring for Clavicle Fractures

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Nonoperative treatment for clavicle fractures



Surgery for Clavicle fractures

Topics to Cover

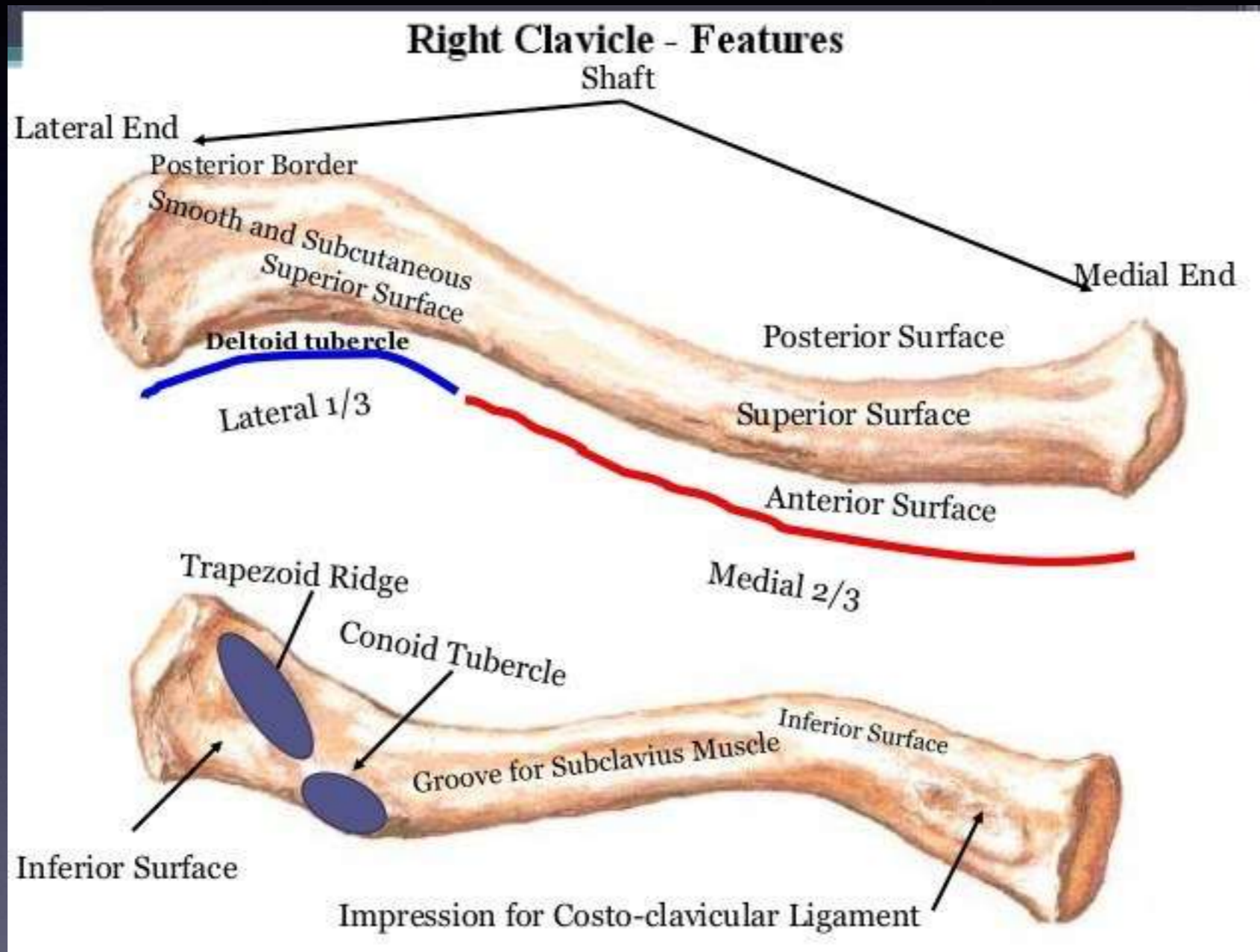
- Pertinent anatomy
- Why is surgery indicated??
- Surgical technique
- Post-operative management
- Cases



Why Clavicle Fractures

- Comprise 2-10% of all fractures
- Frequently seen in cycling, contact sports, simple falls

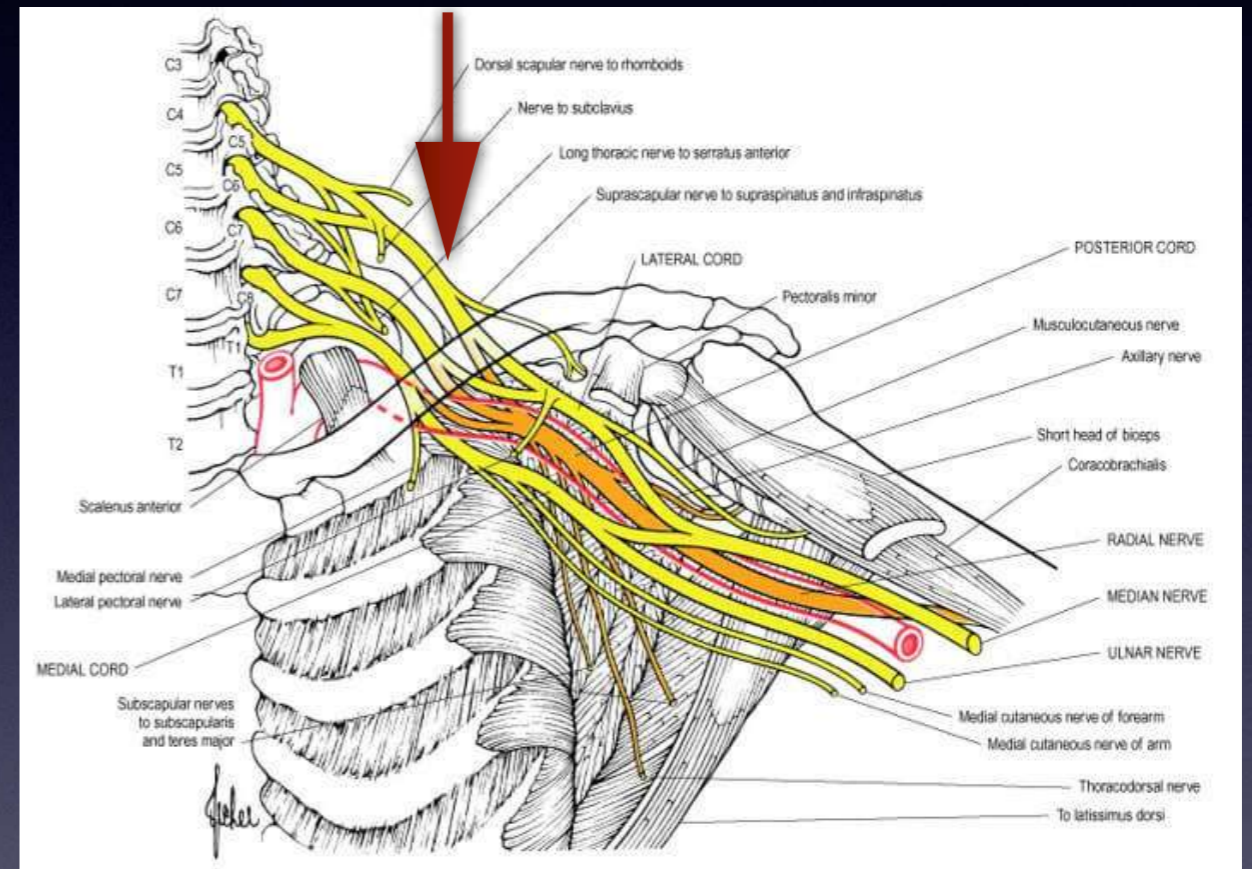




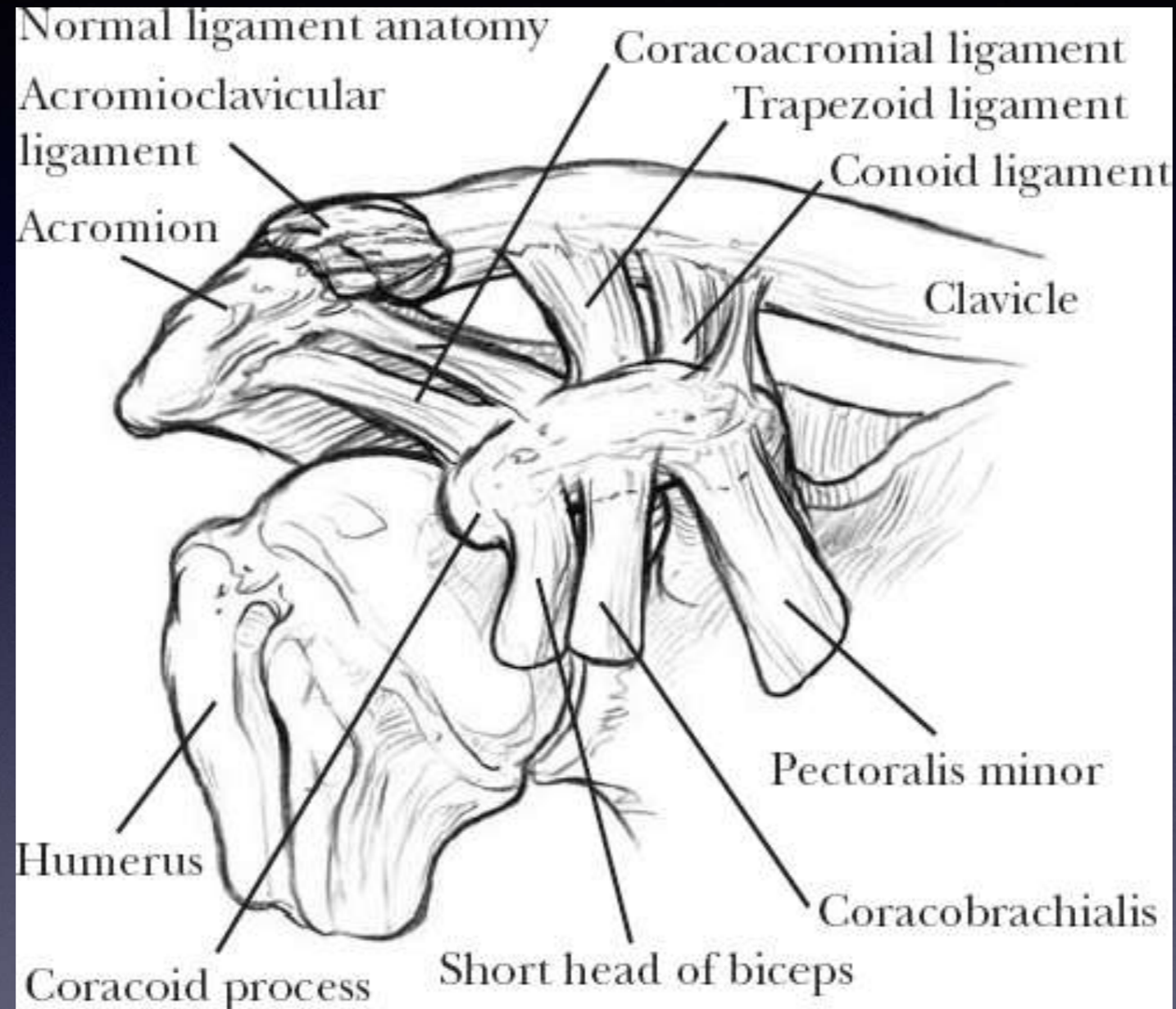
Osseous anatomy

Anatomy

- Pertinent Soft tissue
- Divisions of brachial plexus
 - Direct/Indirect
- Subclavian artery
- Upper lobe of lung



Lateral Clavicular anatomy



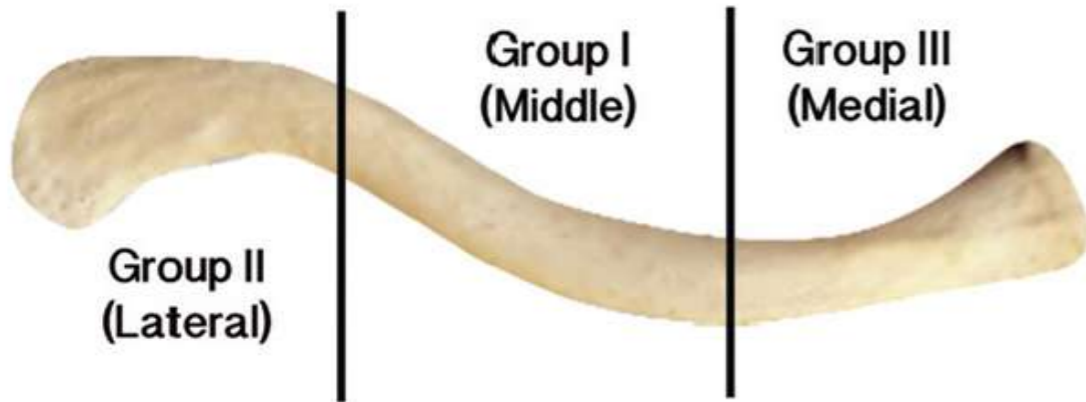
Function

- Stabilizes shoulder girdle
- Aids in abduction and forward elevation
 - Most assistive >90 deg

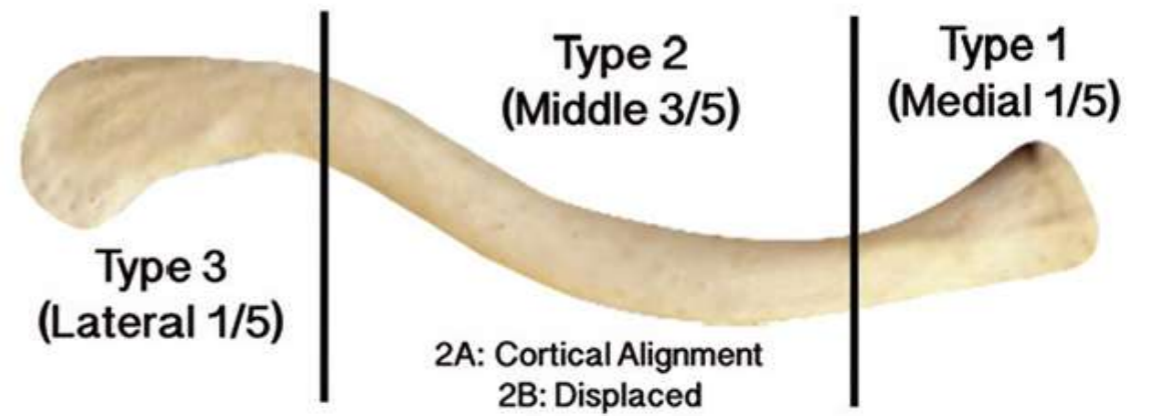


Classification Systems

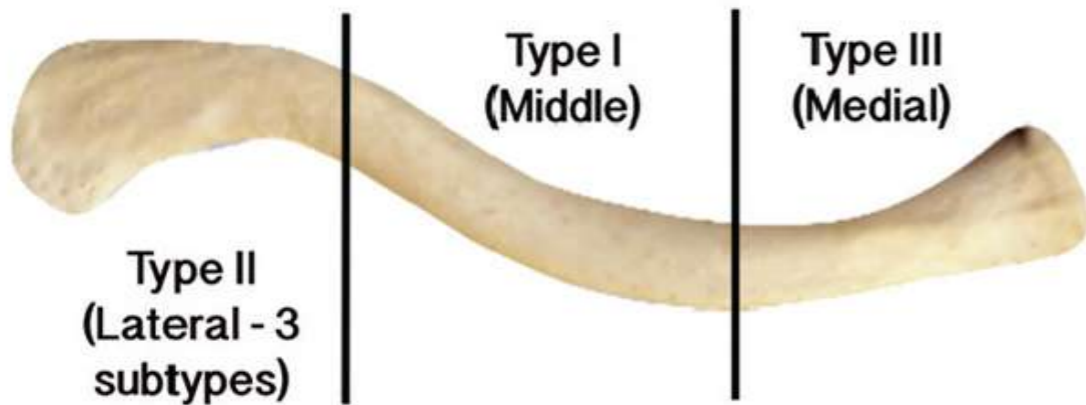
ALLMAN



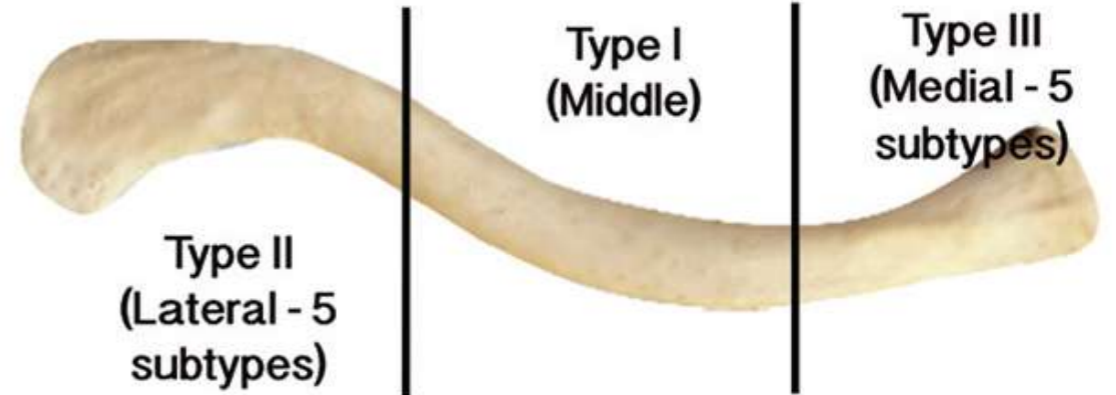
ROBINSON



NEER



CRAIG



Why Surgical Treatment??

- Relative Indications:
 - >2 cm shortening
 - >100% displacement
 - Z-type fracture₍₁₎
 - Notable comminution
 - Displacement >100%:strongest predictor of (-)symptoms/sequelae₍₉₎



Why Surgical Treatment??

- Open injuries
 - Imply higher energy injury
 - Greater displacement-need to stabilize to protect soft tissues
- “Threatened” skin
 - Bone displacement can cause soft tissue necrosis



Why Surgical Treatment??

- Improve union rates
 - Initial nonunion rates of midshaft clavicle fractures: 0.1-0.8% ⁽¹⁾
 - Recent studies: rates increase to 15-20% ^(2,3)
- Established nonunions
 - Significant decreases in deltoid FE endurance when treated in delayed fashion ⁽¹¹⁾
 - No significant difference in DASH scores ⁽¹¹⁾



JBJS.ORG

Who Doesn't Heal??

- Risk Factors for Nonunion:^(26,27)
 - Female
 - Comminution
 - Advanced age
 - Fracture displacement
 - Smoking
- NNT: 7.5 to avoid nonunion ⁽⁷⁾
- Decreases to 1.7 in those >40% risk nonunion ⁽⁷⁾



Why Surgical Treatment??

- Maximize shoulder function
- Faster rehabilitation/recovery
 - Athletes
 - Return to work



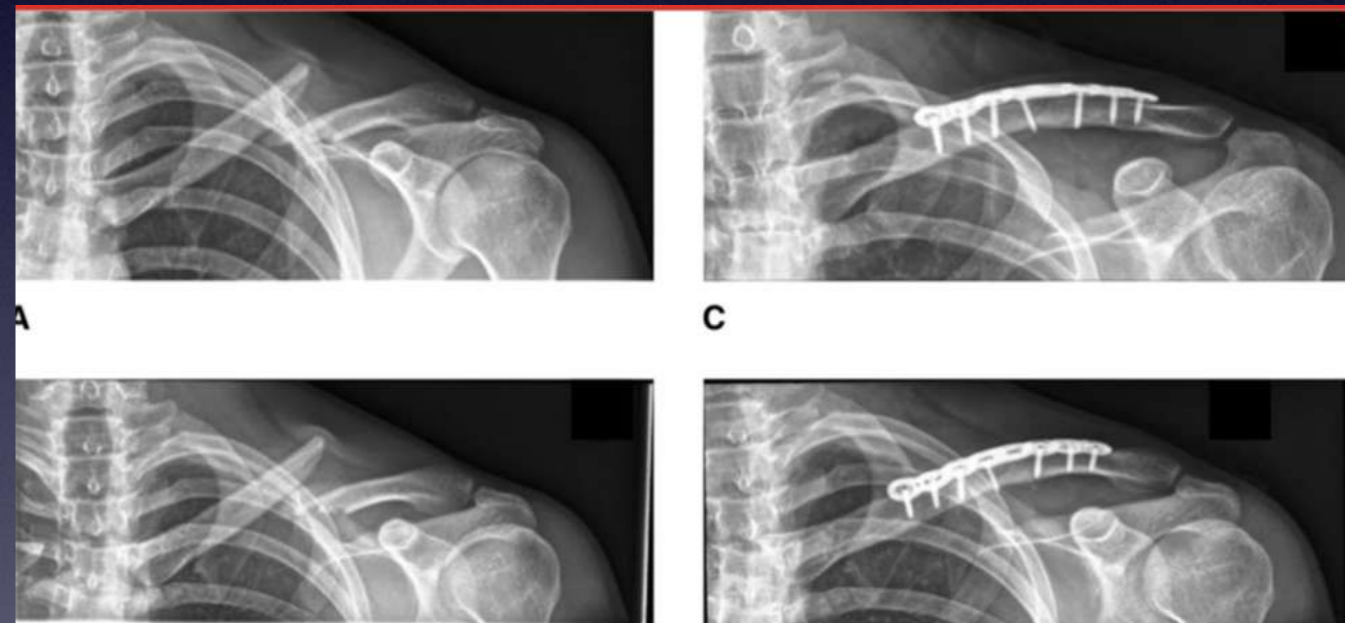
Why Surgical Treatment??

- Maximize shoulder function
 - Non-op N=92:⁽¹⁰⁾
 - 24% of patients had fair or poor DASH score
 - 53% reported residual pain at 2.7 yrs.
- >1.5-2 cm shortening, >100% displacement:
 - Correlated with pain, worse outcomes ⁽¹⁾



Why Surgical Treatment??

- COTS: RCT in 2007 ⁽¹⁾
 - N=132
 - ORIF: better functional outcomes (DASH)
 - Shorter time to union: (16.4 vs. 28.4 weeks)
 - Lower nonunion rates (3 vs. 14.2%)
 - Lower malunion rates



Why Surgical Treatment??

- Professional athletes:
 - Jack et al.:^(4,6)
 - Retrospective review NFL players
 - 32 non-op, 17 op:
 - Avg. return to play:
 - Non-op: 245 days
 - Op: 211 days

Why Surgical Treatment??

- Herbert-Davies et al:⁽⁵⁾
 - 15 NHL athletes (10/5)
 - Avg. return:
 - Op: 65 days
 - Non-op: 97.6 days



Year	Study	Number of Patients/	Method	Results	Level of Evidence
2017	Woltz et al ²¹	160	Plate and screws	23.1% nonunion rate in nonoperative group versus 2.4% in operative group. No difference in DASH or Constant scores between groups at all times points.	I
2015	Devji et al ²⁴	15 RCTs	IMNs	No difference in outcomes between operative and nonoperative groups. In both groups, 1 in 4 patients had complications. Functional outcomes trended towards operative fixation.	I
2014	Xu et al ²⁵	7 RCTs	Plate and Screws, IMNs	Operative treatment resulted in lower nonunion rate with plate favored over IMN in subgroup analysis. ORIF resulted in better outcomes than nonoperative treatment.	II
2013	Robinson et al ¹⁸	200	Superior precontoured plate	Found a 17% nonunion rate in nonoperative group versus 1% in operative group. Statistically significant improved DASH and Constant scores in operative group compared with nonoperative group at all time points.	I
2012	McKee et al ⁷	6 RCTs	Plate and Screws, IMNs	Statistically significant lower nonunion rate with operative (1.4%) versus nonoperative (14.5%) treatment. Operative intervention results in better short term return to function and activity but no longer term studies to see if difference is sustained.	I
2012	Virtanen et al ²⁰	60	Anterior-inferior plating	No difference in pain scores, DASH scores or Constant scores at one year follow up. Had 24% nonunion rate in nonoperative group compared with no nonunions in the operative group.	I
2009	Smekal et al ²²	68	IMN	Shorter time to union with operative intervention (12.1 versus 17.6 weeks) with no nonunions in operative group and a 10% nonunion rate in the nonoperative group. Sustained improvements in DASH and Constant scores at six months and two years in operative group.	I
2009	Judd et al ²³	57	IMN	Found no difference in SANE or L'Insalata scores with two groups of military personnel. Found a 3% nonunion rate in operative group and 4% in nonoperative group. High rate of complications (48%) in operative group because of pin prominence and irritation.	I
2007	Canadian Orthopaedic Trauma Society ¹	111	Plate and screws	Had statistically significant improved DASH and Constant scores in the operative group at all time points. Operative group had shorter time to union (16.4 versus 28.4 weeks) and lower nonunion rate (2.8% versus 14.2%). Had nine symptomatic malunions in nonoperative group that required subsequent surgery.	I



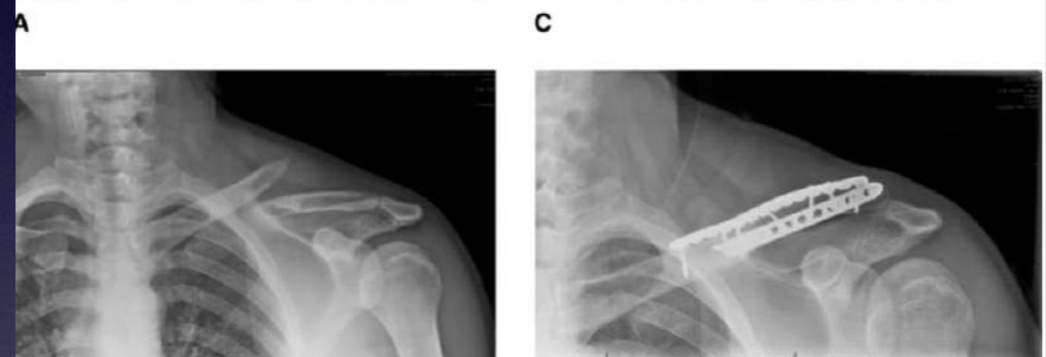
Why Surgical Treatment??

- Level I Study support:
- Faster healing times
- Lower nonunion risk
- Higher functional scores



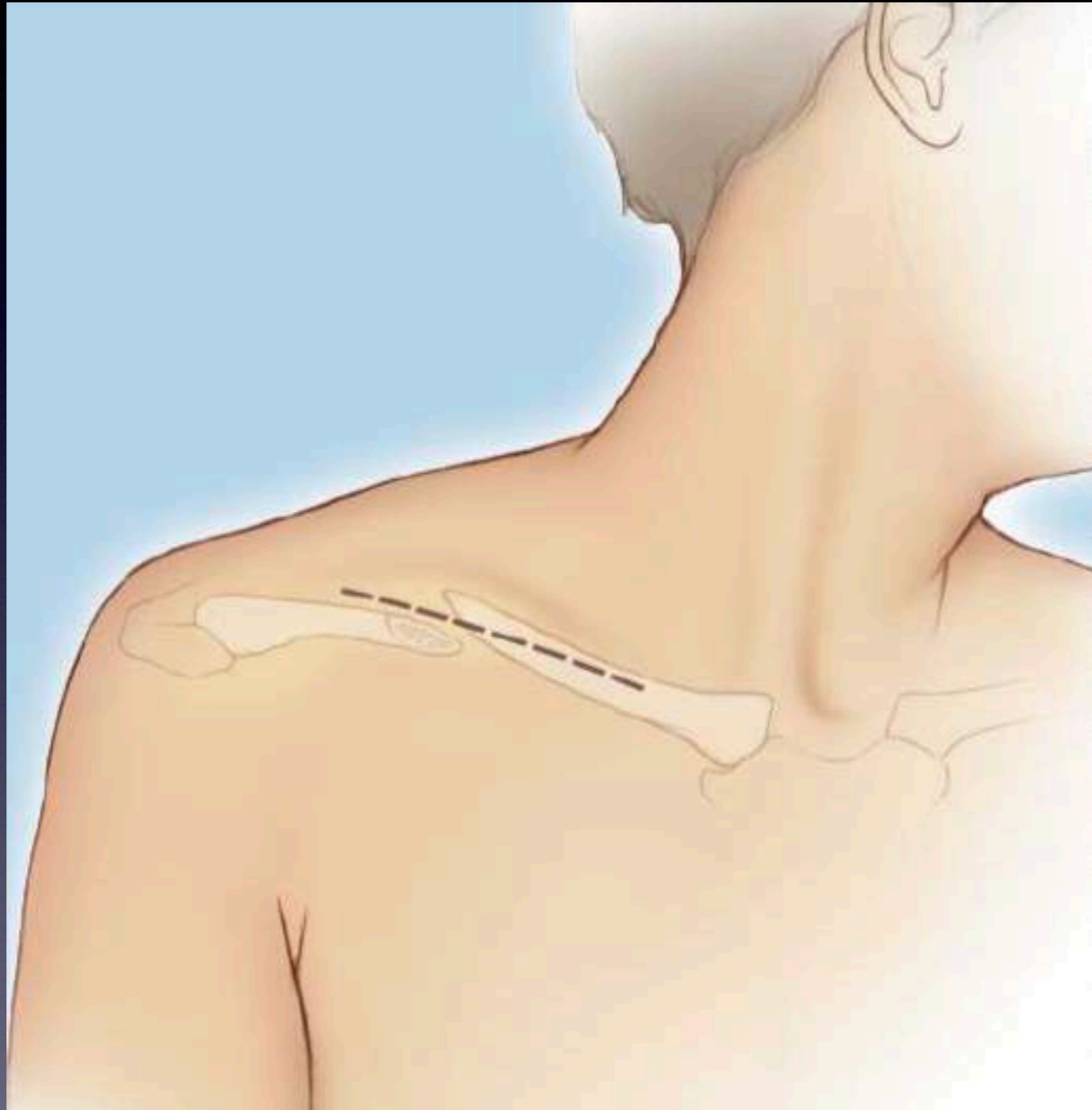
Surgical Options

- Plate and screws
 - Most accepted form
 - Most stability to displacement
- Intra-medullary pin
 - Minimally invasive
 - Problems with pin irritation
 - Must be removed

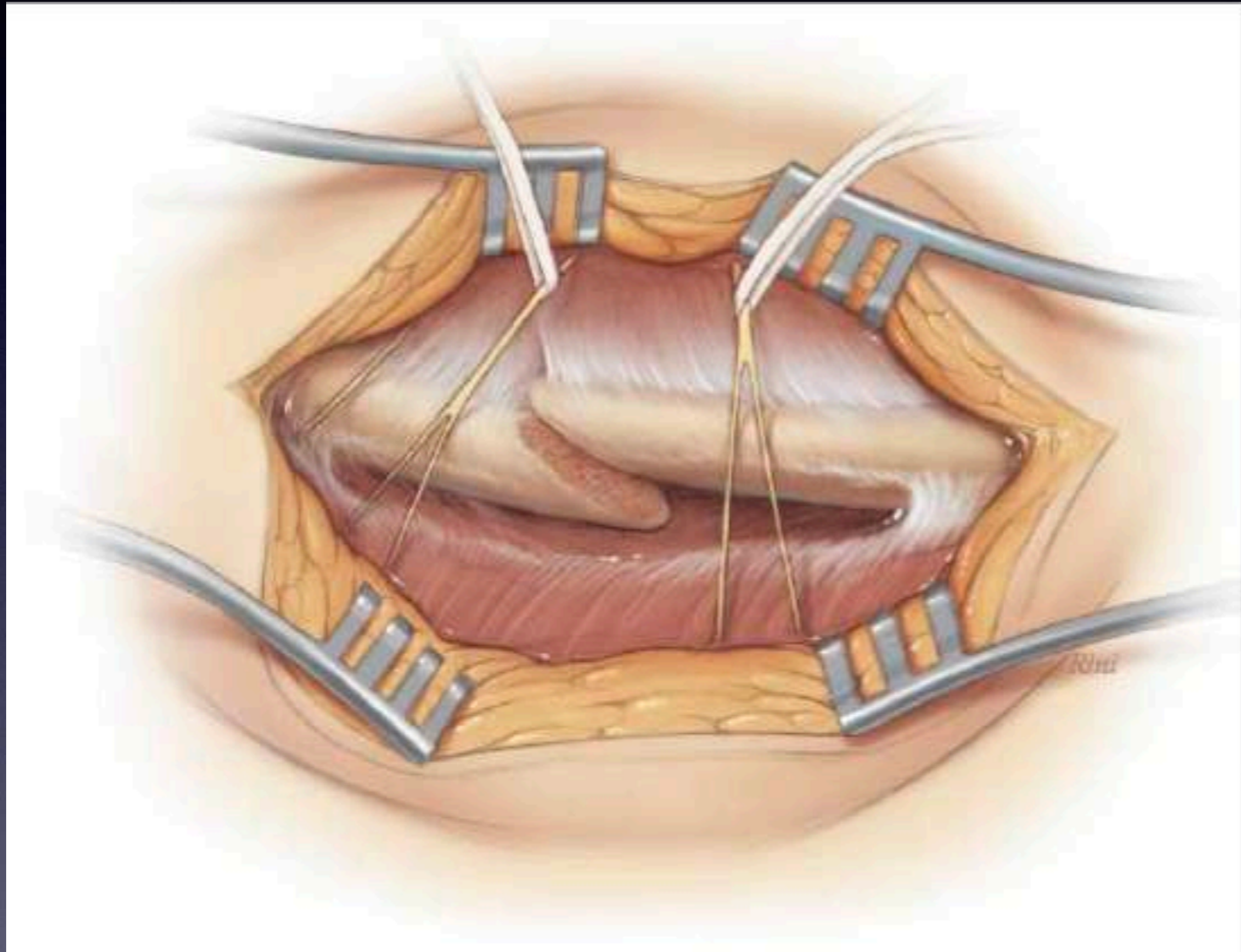


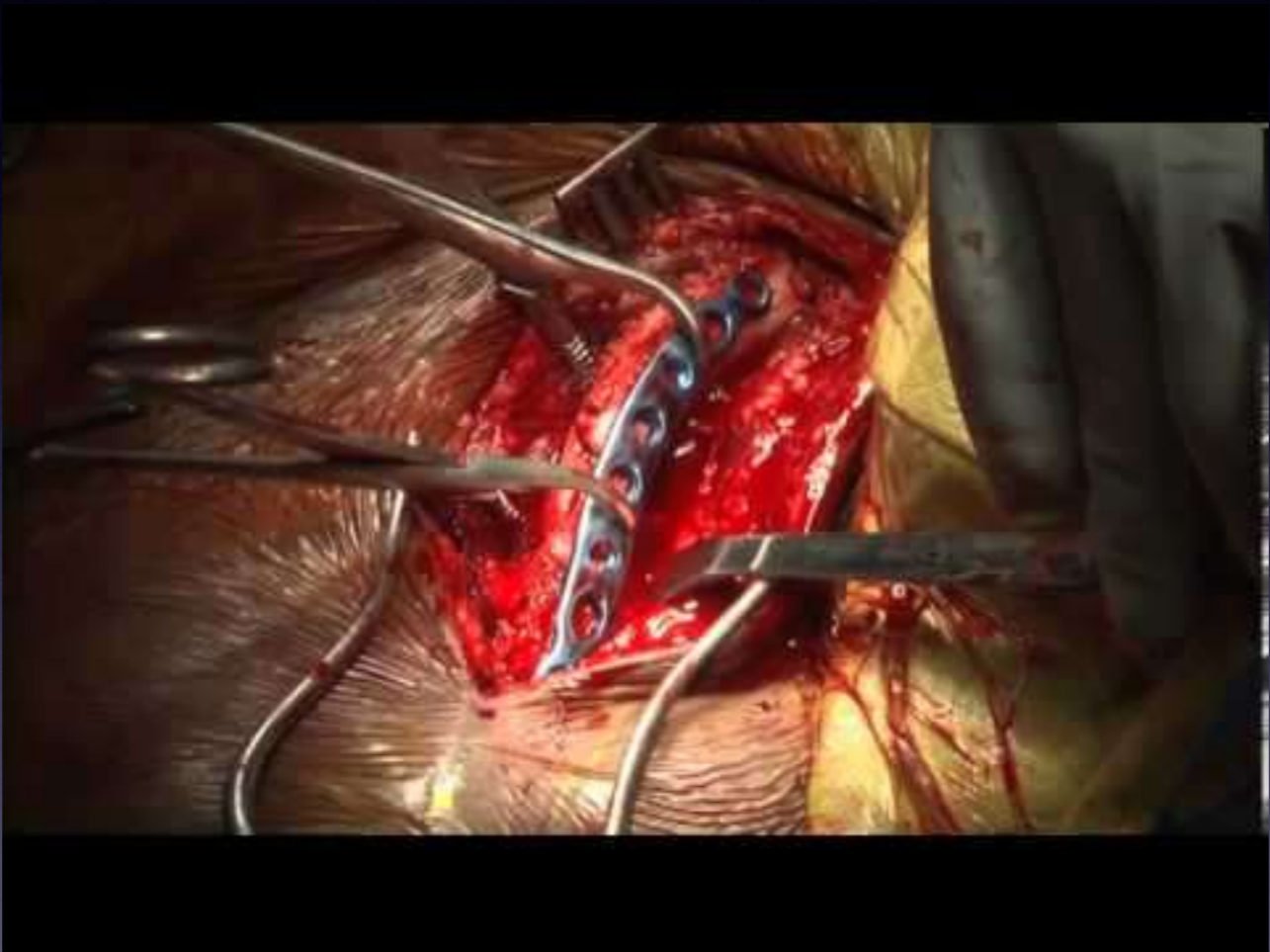


Courtesy of Synthes

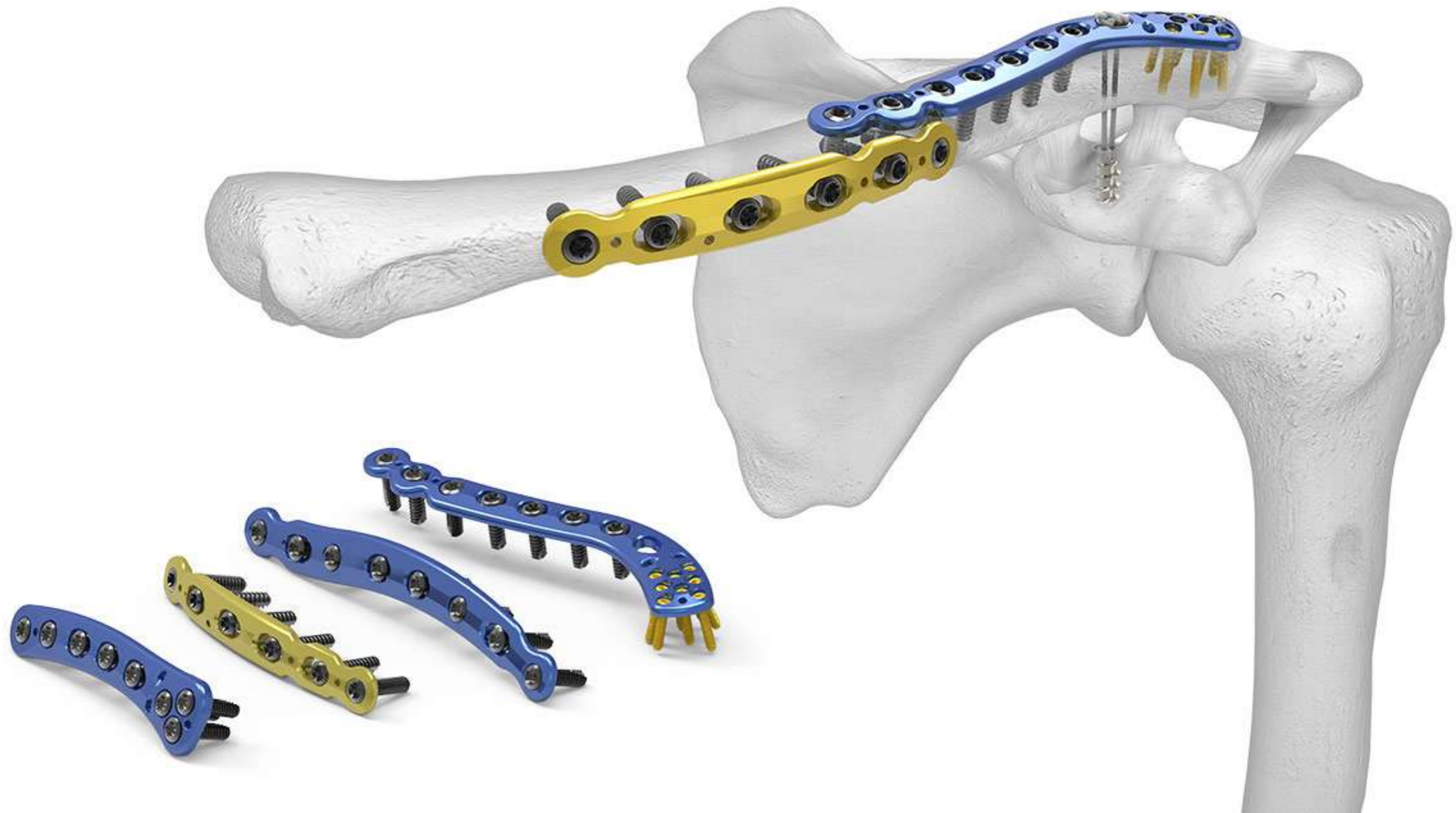


Courtesy of Synthes









Post-op Course

- Sling for comfort/discourage use
- ROM first two weeks
- Strengthening at 6 weeks
- Full return may take 4-6 mo.



Complications

- Symptomatic non/malunion
 - Both op/nonop Rx:
- Supraclavicular numbness
- Infection (2.6%)
- Revision surgery rates:
 - Nonunion (2.6%)
 - Malunion (1.1%)₍₁₂₎



CASE #1

- 12/17
- 18 yof tripped and fell
- Left shoulder deformity
- Skin intact
- No other abnormalities



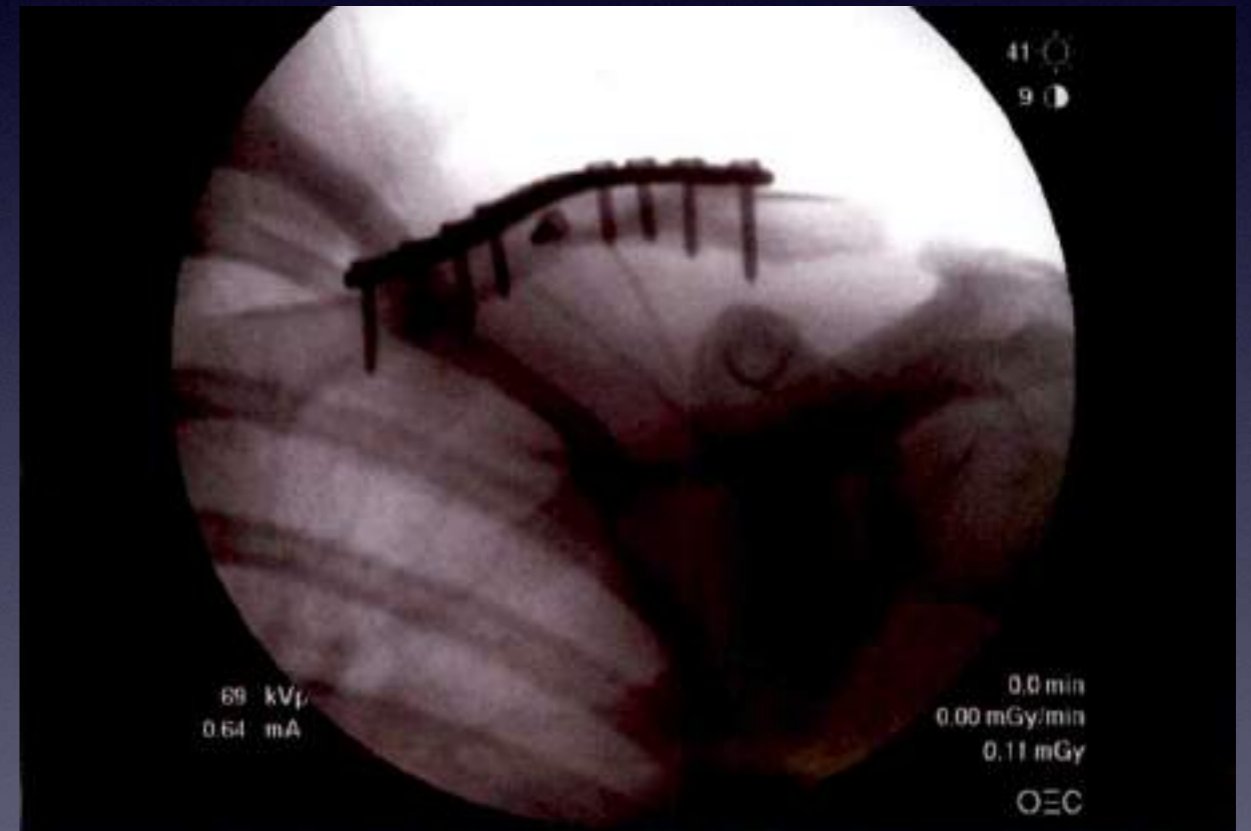
Source: K.J. Knoop, L.B. Stack, A.B. Storrow, R.J. Thurman:
The Atlas of Emergency Medicine, 4th Edition,
www.accessemergencymedicine
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CASE #1

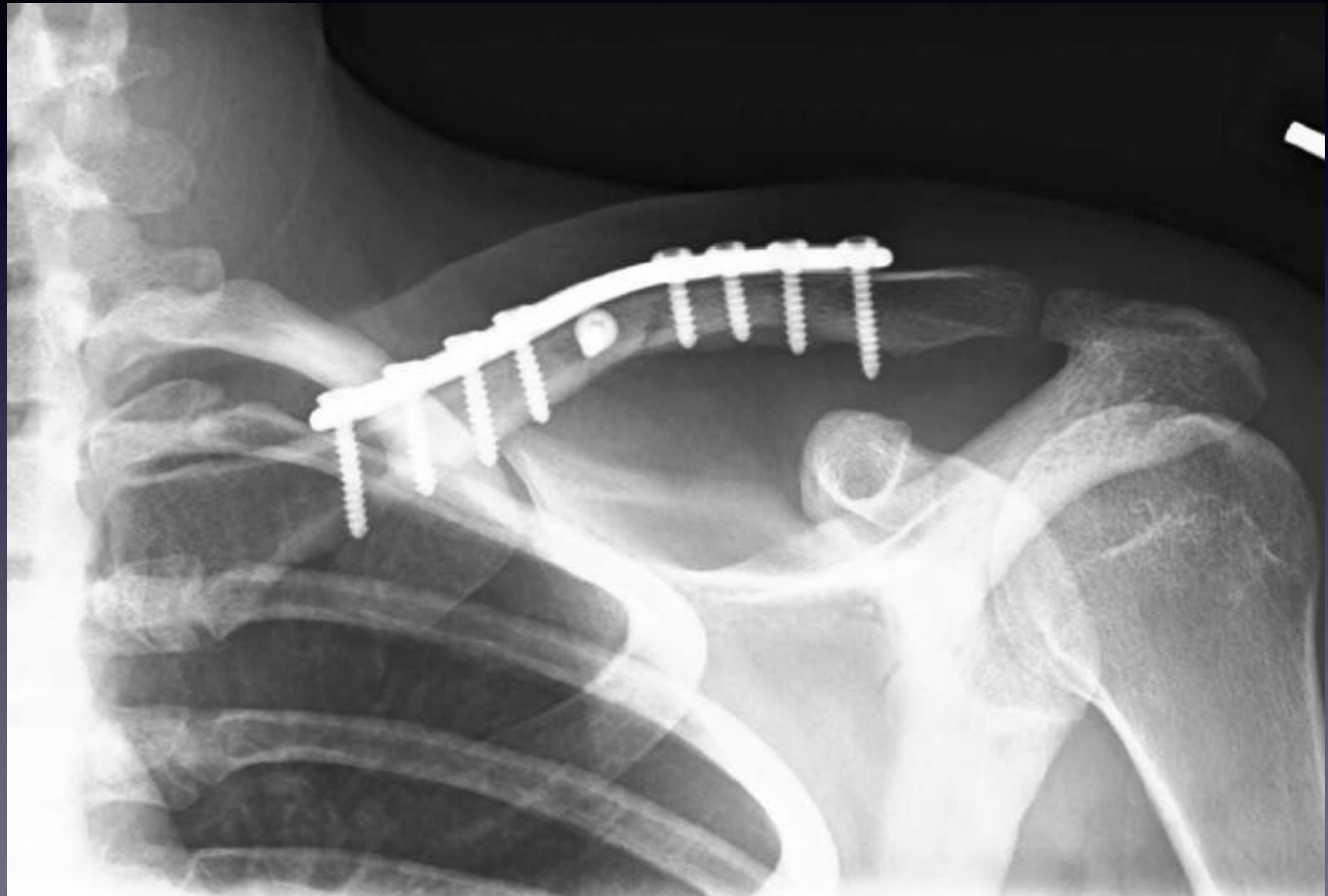


CASE #1

- 12/17
- Performed ORIF with plate and lag screw fixation



CASE #1



2 weeks post op

CASE #1



6 weeks post op

CASE #2

- 6/14
- 32 yom involved in MCC
- Right shoulder deformity
- Had multiple abrasions
- Otherwise healthy
- Closed injury, NVI



CASE #2



CASE #2

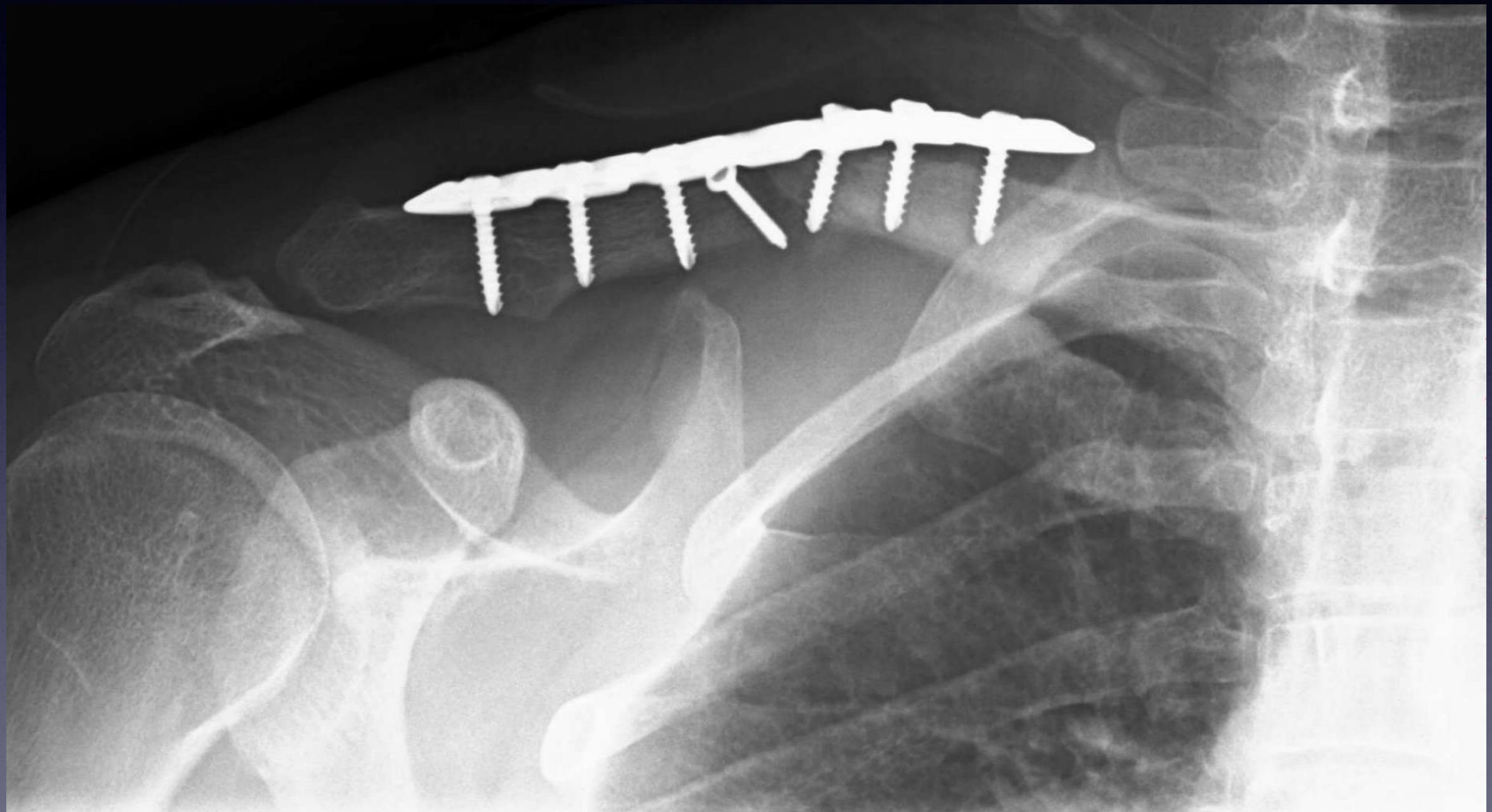
- 7/14
- ORIF right clavicle fracture
- Plate and screw fixation

CASE #2



2 weeks post op

CASE #2



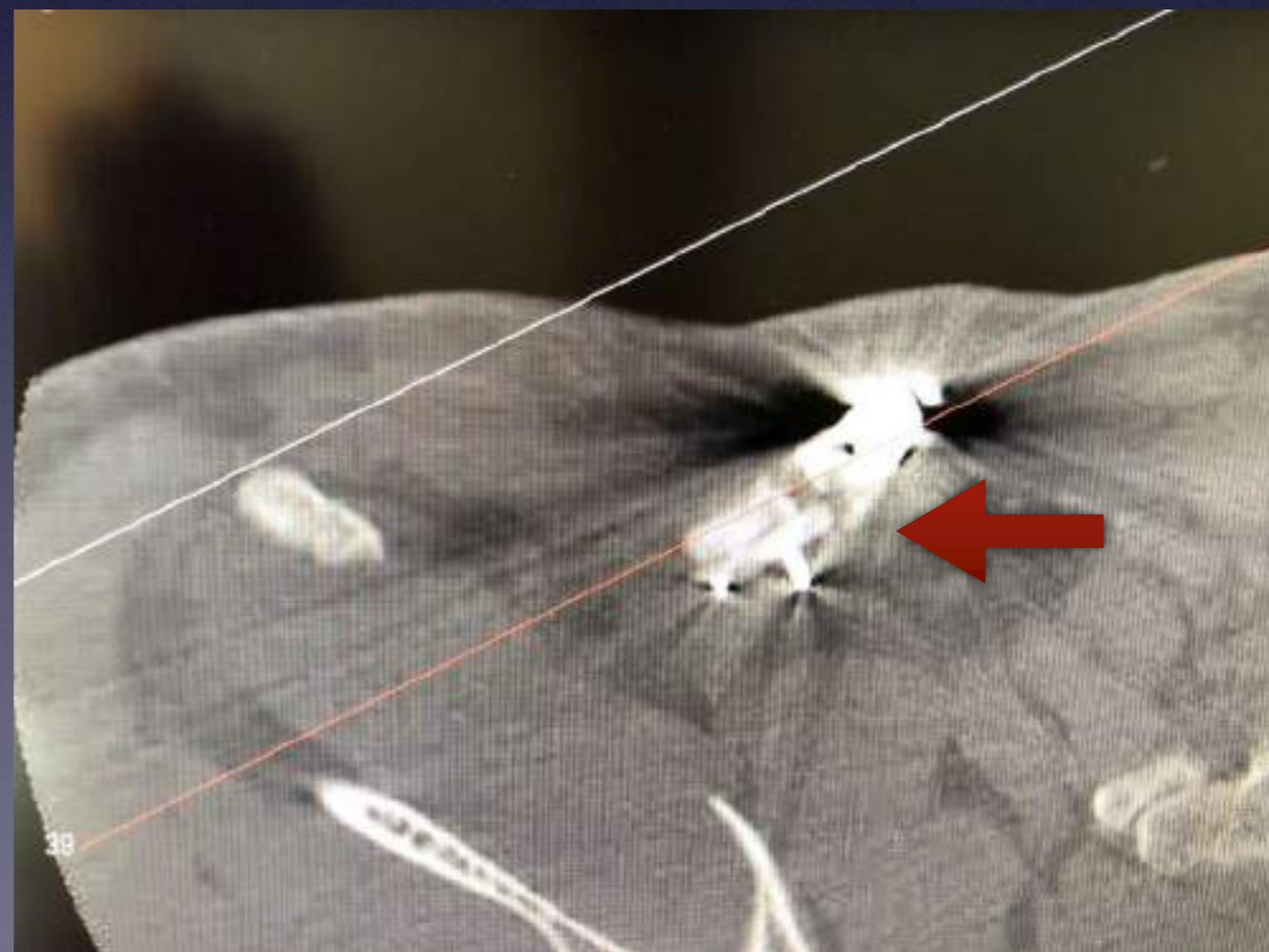
3 months post op

CASE #2

- 10/14
- No evidence of bridging bone
- Hardware failing
- No likelihood to bridge
- Obtained CT scan
- Decided to revise



CT scan



CASE #2



CASE #2



5/15

In Summary

- Surgery is an effective means of treatment
- It has potential to do provide earlier return to sport/work
- Has definite indications where it is superior to non-op treatment
- X-rays look a lot cooler



Surgery for Clavicle fractures





Thank You!!

- 1. Canadian Orthopaedic Trauma Society: Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures: A multi center, randomized clinical trial. *JBJS Am* 2007;89:1-10.
- 2. Hill JM, McGuire MH, Crosby LA: Closed treatment of displaced middle-third fractures of the clavicle gives poor results. *J Bone Joint Surg Br* 1997;79:537-539.
- 3. McKee MD, Pedersen EM, Jones C, et al: Deficits following nonoperative treatment of displaced midshaft clavicular fractures. *J Bone Joint Surg Am* 2006;88:35-40.
- 4. Jack RA, et al. Performance and return to sport after nonoperative treatment of clavicle fractures in National Football League players. *Orthopedics* 2017;40:e836–e843.
- 5. Herbert-Davies J . *BMJ Open Sport Exerc Med*. 2018; 4(1): e000371.
- 6. Jack RA, Sochacki KR, Navarro SM, et al. Performance and return to sport after clavicle open reduction and internal fixation in National Football League players. *Orthop J Sports Med* 2017;5:232596711772067 10.1177/2325967117720677

- 7. Robinson CM et al: Estimating the risk of nonunion following nonoperative treatment of a clavicular fracture. J Bone Joint Surg Am 2004;86-A:1359-65.
- 8. Murray IR et al: Risk factors for nonunion after nonoperative treatment of displaced midshaft fractures of the clavicle. J Bone Joint Surg Am 2013;95:1153-1158.
- 9. Nowak J et al: Sequelae from clavicular fractures are common: A prospective study of 222 patients. Acta Orthop 2005;76:496-502.
- 10. Fuglesang HF et al: Radiological and functional outcomes 2.7 years following conservatively treated completely displaced midshaft clavicle fractures. Acta Orthop Trauma Surg 2016;136:17-25.
- 11. Potter JM et al: Does delay matter? The restoration of objectively measured shoulder strength and patient-oriented outcome after immediate fixation versus delayed reconstruction of displaced mid shaft fractures of the clavicle: J Shoulder Elbow Surg: 2007;16(5):514-18.
- 12. Leroux T, et al: Rate of and risk factors for reoperations after open reduction and internal fixation of midshaft clavicle fractures: A population-based study in Ontario, Canada. J Bone Joint Surg Am 2014;96:1119-25.