

# Clavicle Fractures & Sternoclavicular Joint Fracture - Dislocations

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# Epidemiology

## Common injuries

Incidence ~ 1: 1000 – 2000

## Birth trauma vs. sports

Norquist CORR 1994

Yang et al, Injury 2010

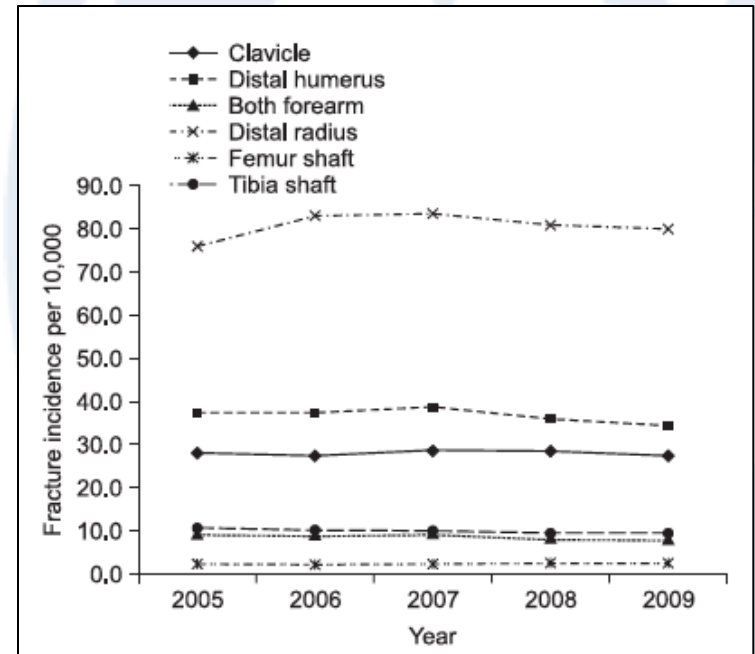
Park et al, COS 2013

Robinson JBJSB 1998

Hsaio et al, Mil Med 2012

### Incidence Patterns of Pediatric and Adolescent Orthopaedic Fractures According to Age Groups and Seasons in South Korea: A Population-Based Study

Moon Seok Park, MD, Chin Youb Chung, MD, In Ho Choi, MD\*, Tae Won Kim, MD<sup>†</sup>,  
Ki Hyuk Sung, MD<sup>†</sup>, Seung Yeol Lee, MD, Sang Hyeong Lee, MD<sup>†</sup>, Dae Gyu Kwon, MD<sup>†</sup>,  
Jung Woo Park, MD<sup>†</sup>, Tae Gyun Kim, MD, Young Choi, MD, Tae-Joon Cho, MD\*,  
Won Joon Yoo, MD\*, Kyoung Min Lee, MD



# Objectives

## Surgical versus conservative interventions for treating fractures of the middle third of the clavicle (Review)

Lenza M, Buchbinder R, Johnston RV, Belloti JC, Faloppa F



*“...**evidence is insufficient** to indicate whether surgical or conservative treatment is best...Treatment options must be chosen on an **individual basis**, after **careful consideration of the relative benefits and harms**...”*

# Goal #1: Bony healing

> 90 - 95% in most series

Risk factors for nonunion:

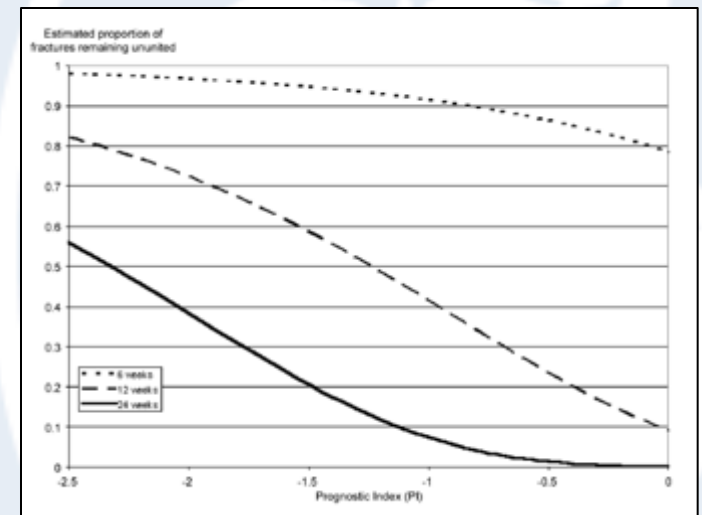
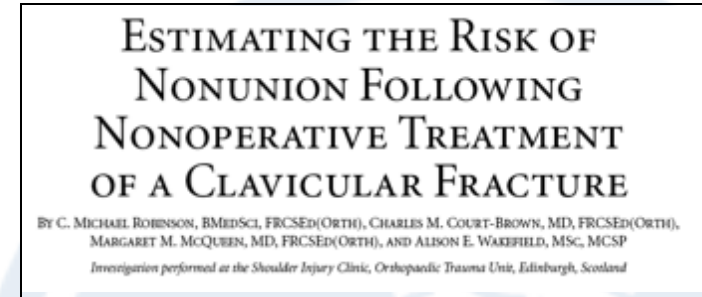
- Older age
- Displacement > 2 – 2.5 cm
- Comminution

Robinson et al, JBJS 2004

Murray et al, JBJS 2012

Brinker et al, JBJS 2005

Randsborg et al, JPO 2013



# Non-operative treatment

No difference between sling vs. figure-8 brace

Andersen et al, AOS 1987

## Advantages

- $\geq 95\%$  union
- Remodeling in young
- Avoid surgical risks

### Treatment of clavicular fractures

#### Figure-of-eight bandage versus a simple sling

Seventy-nine out-patients with midclavicular fractures were included in a prospective, randomized trial comparing treatment with a figure-of-eight bandage and a simple sling. Sixty-one patients completed the study and were reevaluated clinically and radiographically after 3 months.

We found that treatment with a simple sling caused less discomfort and perhaps fewer complications than with the figure-of-eight bandage. The functional and cosmetic results of the two methods of treatment were identical and alignment of the healed fractures was unchanged from the initial displacement.

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Thirdday.blogs.com



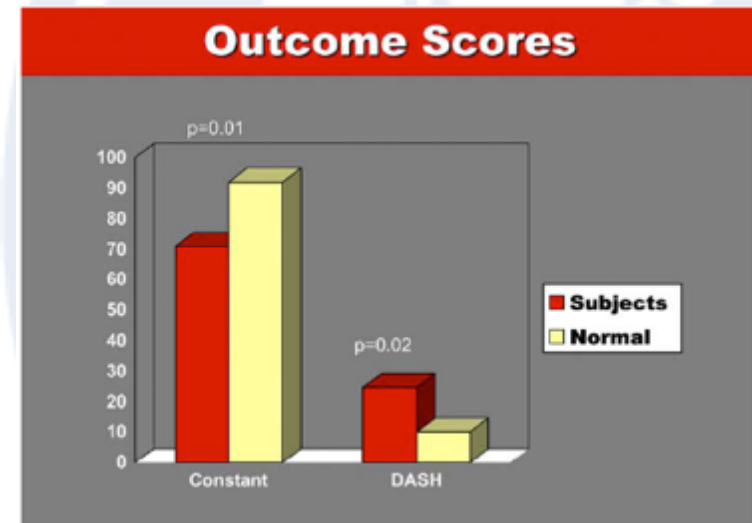
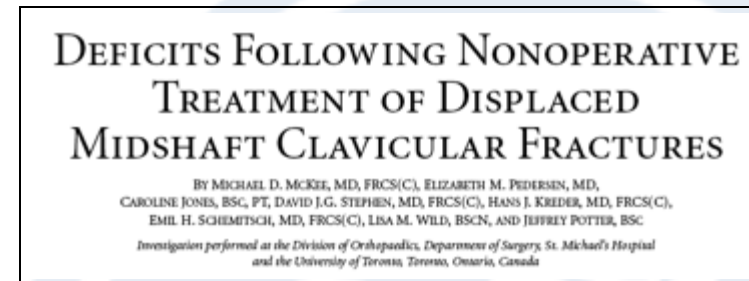
Orthoseek.com

# Goal #2: Maximize function

## Clavicle malunions

- 30 patients, 19 – 67 yrs
- ROM preserved
- Lower flexion & abduction strength and endurance
- Worse Constant and DASH

McKee et al, JBJS 2006



# Goals of treatment

## Canadian Orthopaedic Trauma Society, JBJS 2007

- 132 patients
- Age 16 – 60 years
- Faster union (16 vs 28 wks)
- Higher Constant, DASH
- Higher patient satisfaction

COT, JBJS, 2007

Nonoperative Treatment Compared  
with Plate Fixation of  
Displaced Midshaft Clavicular Fractures

A Multicenter, Randomized Clinical Trial

By the Canadian Orthopaedic Trauma Society



Fig 1.A  
Anteroposterior radiograph of a displaced midshaft clavicular fracture. Note the difference in diameter of the clavicular shaft of the proximal and distal fragments at the fracture site, suggesting that a substantial degree of rotation has occurred.



# Goals of treatment

Trend for more surgery

- 5% → 20%

Increased surgical rate

- Younger surgeons
- Older patients
- Recent literature

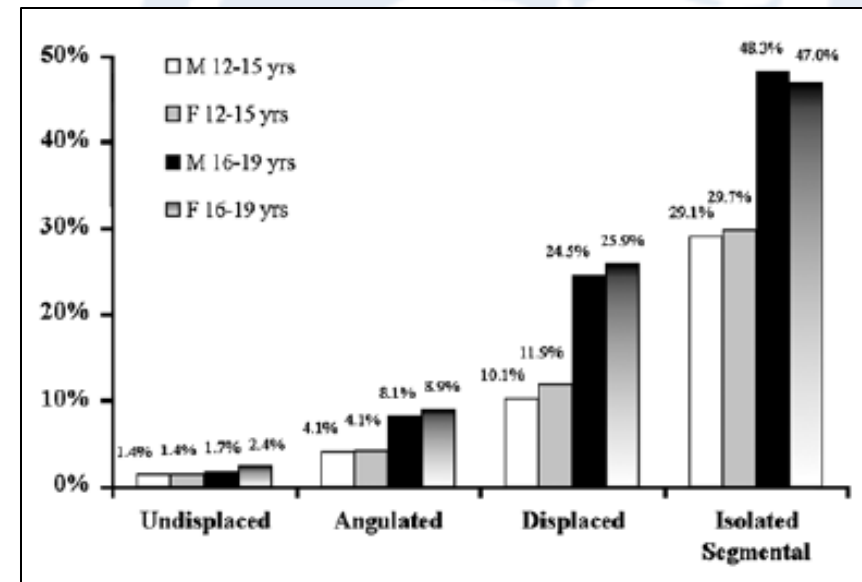
Carry et al, JPO 2011

Heyworth et al, POSNA 2012

Pandya et al, JAAOS 2012

## A Survey of Physician Opinion Adolescent Midshaft Clavicle Fracture Treatment Preferences Among POSNA Members

Patrick M. Carry, BA,\* Ryan Koonce, MD,† Zhaoxing Pan, PhD,‡ and John D. Polousky, MD§





# But...

Children are not small adults...

Does adult data apply to children?



# Surgical treatment

## Advantages in children:

- Surgery safe & effective
- Faster union (7.4 vs 8.7 wks)
- Earlier return to activities (12 vs 16 weeks)

Mehlman et al, JPO 2009

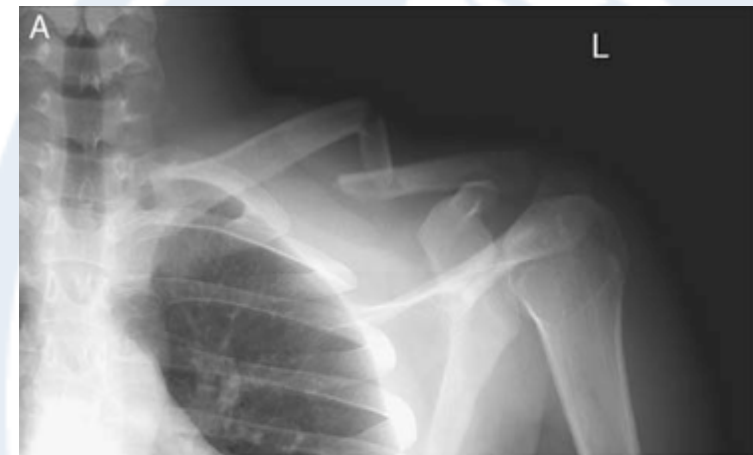
Vander Have et al, JPO 2010

Namdari et al, JPO 2011

COT, JBJS 2007

## Operative Versus Nonoperative Treatment of Midshaft Clavicle Fractures in Adolescents

*Kelly L. Vander Have, MD, Aaron M. Perdue, MD,  
Michelle S. Caird, MD, and Frances A. Farley, MD*



# Surgical techniques

## Flexible IM nails

Rapp et al, JPO 2013

## Clavicle pins

Frye et al, JPO 2012

## Plates and screws

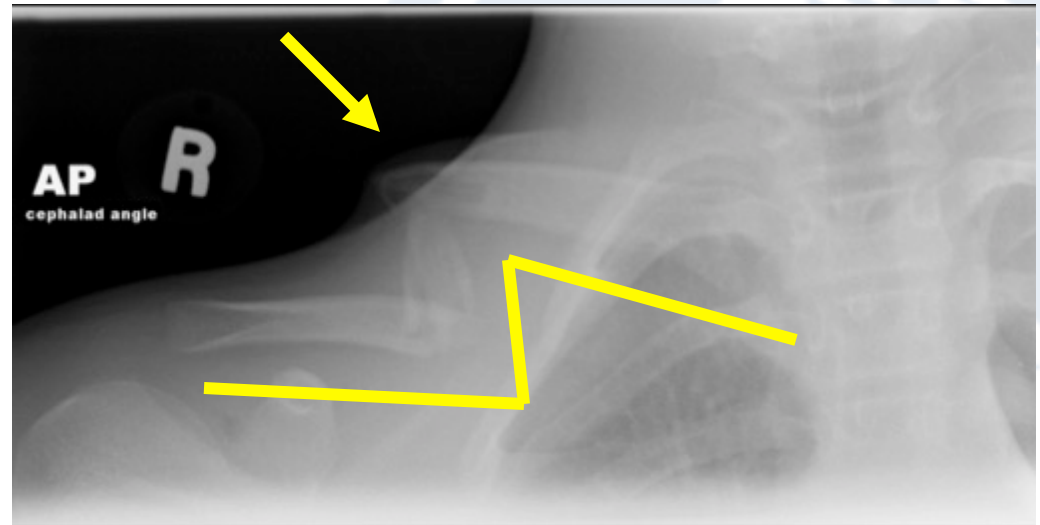
Elastic Stable Intramedullary Nailing for Displaced

Operative Treatment of Adolescent Clavicle Fractures With  
an Intramedullary Clavicle Pin

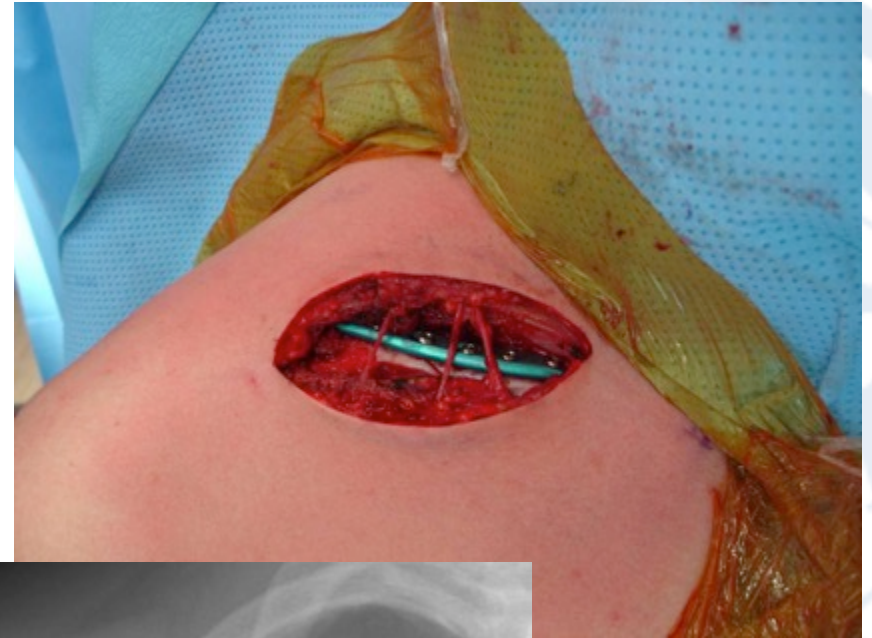
*Benjamin M. Frye, MD, Sheila Rye, MS, Edward Barry McDonough, MD,  
and George K. Bal, MD, FACS*



# Surgical techniques



# Surgical techniques



# Non-operative treatment

Malunion NOT associated with poor motion, function

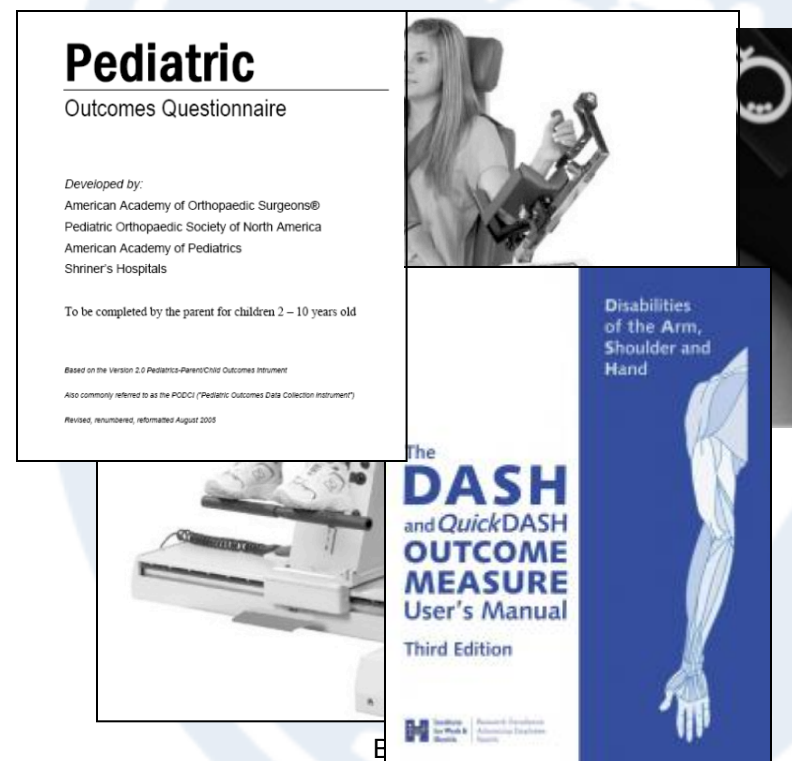
Bae et al, JPO 2013

- > 2cm shortening
- Excellent motion, strength, outcomes (PODCI, DASH)

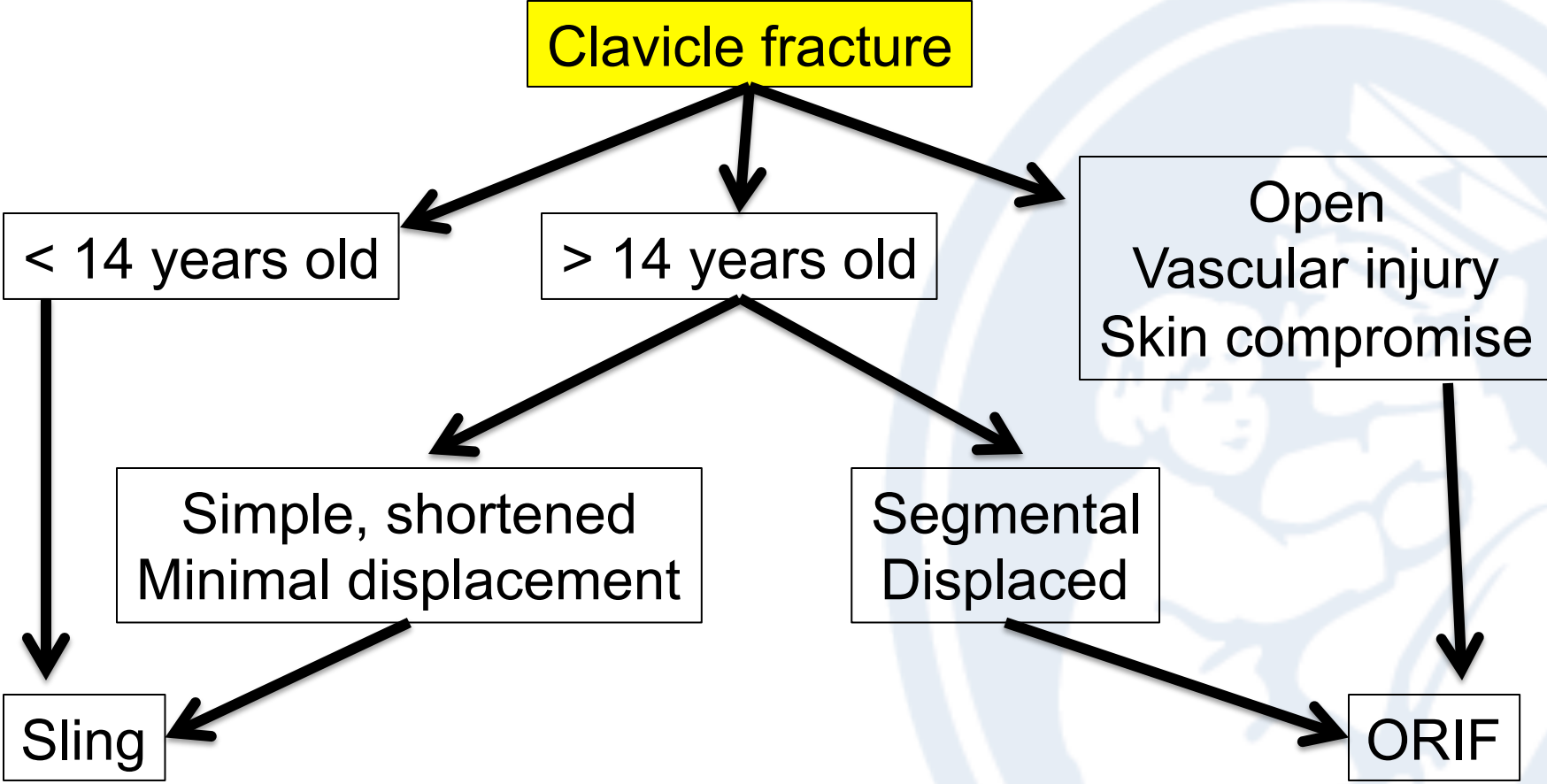
Schulz et al, JBJS 2013

Randsborg et al, JPO 2013

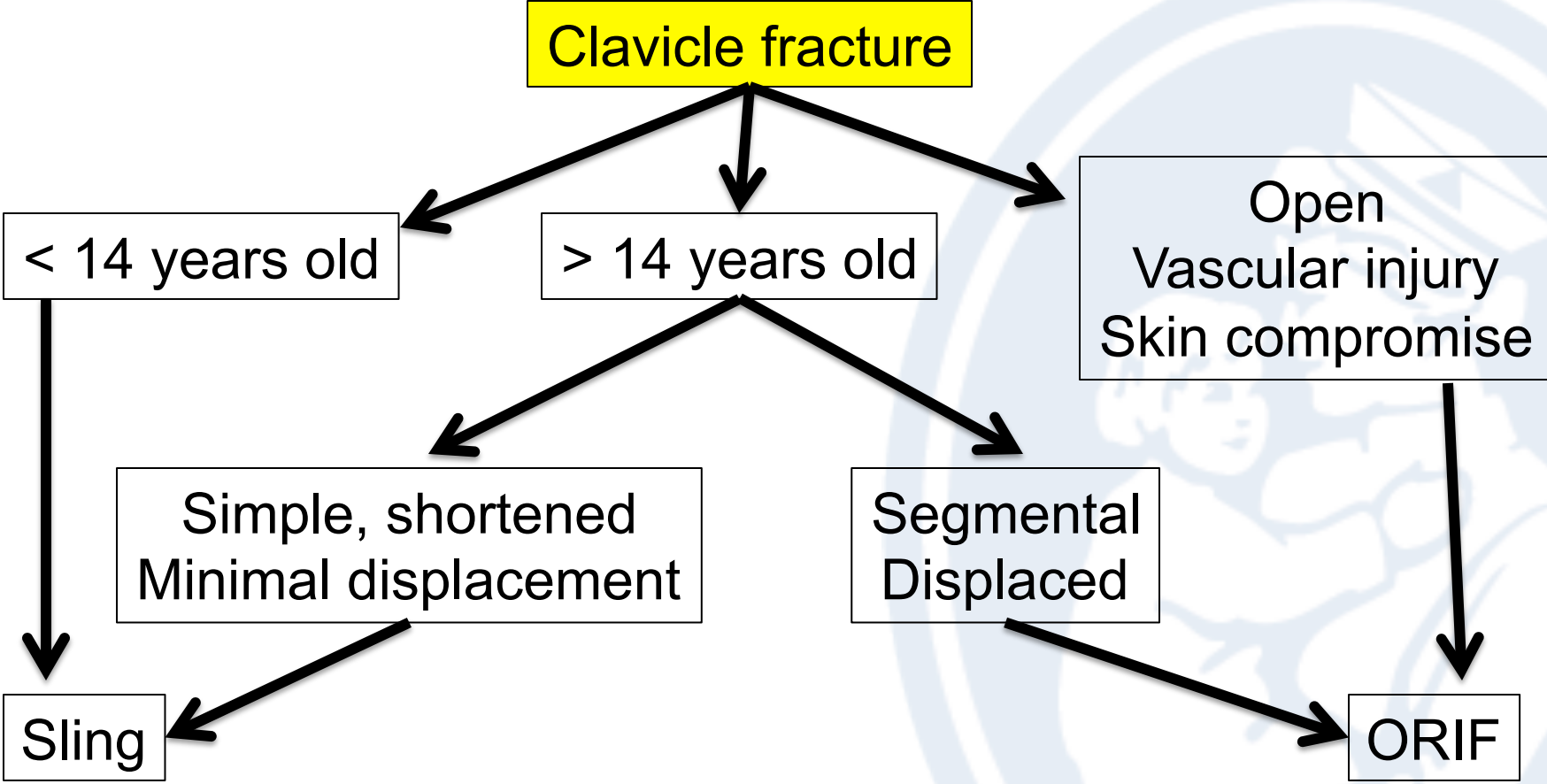
Wall et al, POSNA 2013



# Proposed algorithm\*

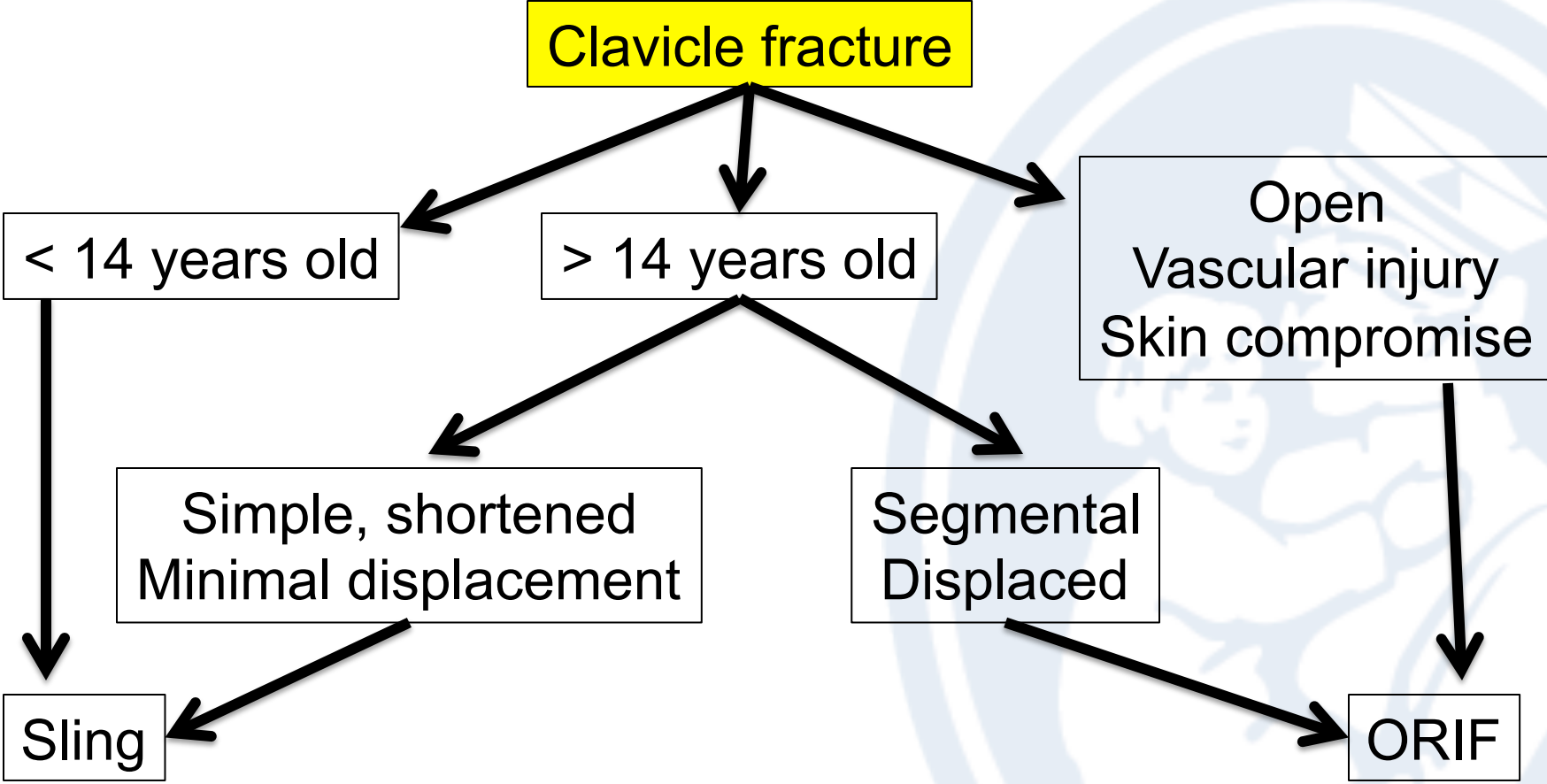


# Proposed algorithm\*

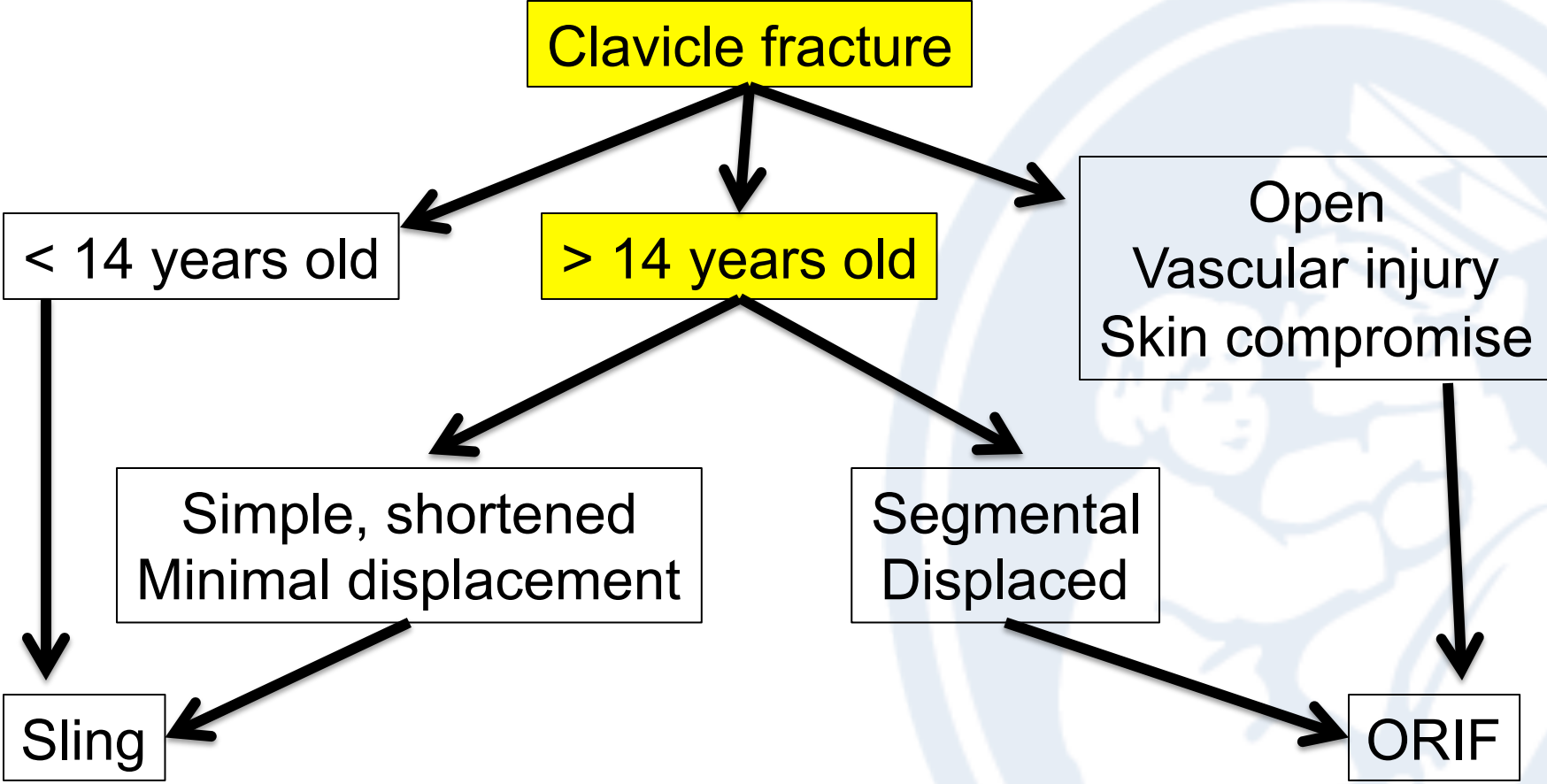




# Proposed algorithm\*



# Proposed algorithm\*



# Summary

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Nonunion rare

Malunion does not lead to limited ROM, weakness, or poor outcomes in pediatric patients

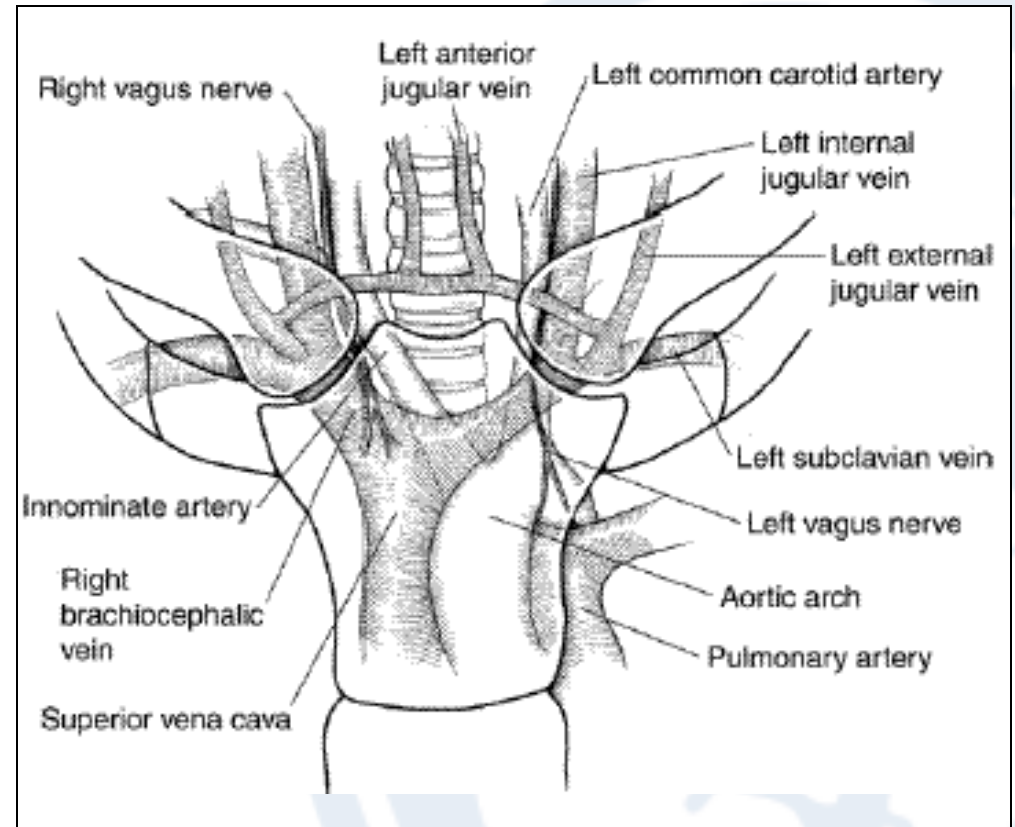
Surgery for older adolescents, segmental & displaced



# Anatomy

## Adjacent structures:

- Trachea
- Esophagus
- Great vessels
- Brachial plexus



Higgenbotham & Kuhn, JAAOS, 2005.

# Clinical presentation

Indirect > direct mechanism

- Sports-related

Bony prominence (anterior)

Mediastinal compression (posterior)

- Venous engorgement
- Dysphagia, odynophagia
- Dysphonia
- Brachial plexus injury



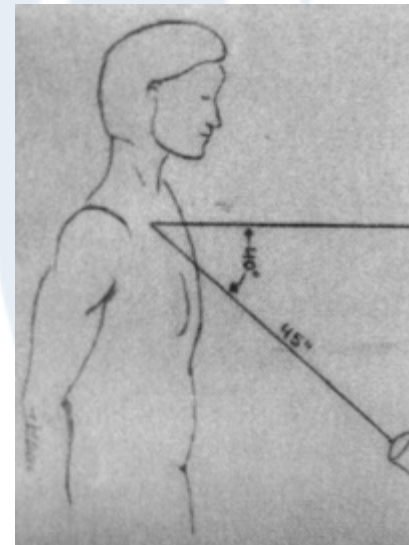
# Radiographic evaluation



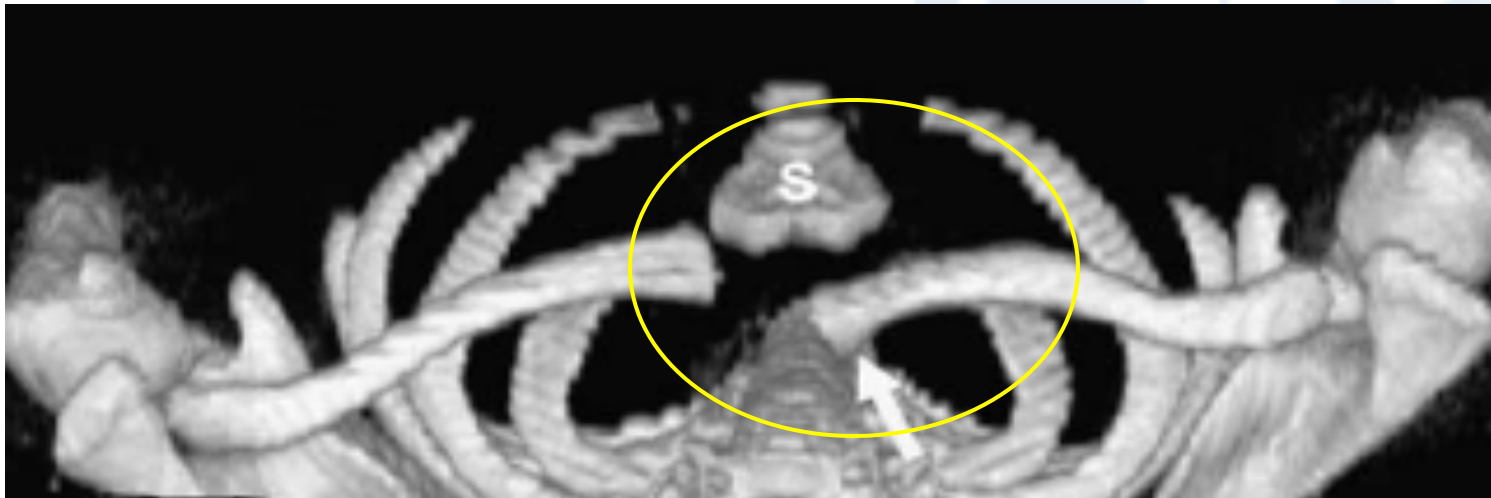
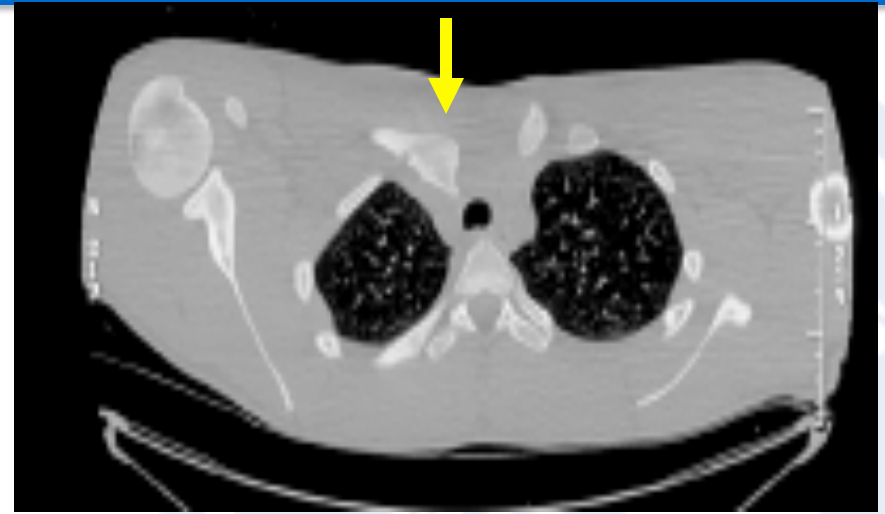
Carmichael et al, Skeletal Radiol, 2006.

## Serendipity view (Rockwood)

- Patient supine
- Cassette behind chest
- Beam angled 40° cephalic
- Both SCJ's visualized



# Radiographic evaluation



Carmichael et al, Skeletal Radiol, 2006.



# Treatment: acute anterior

## Symptomatic treatment

- Sling & swathe for comfort
- PT for scapular retraction, biofeedback



## Good results, few complications

Fery & Sommelet, Int Orthop, 1988

De Jong & Sukul, JOT, 1990

# Treatment: acute posterior

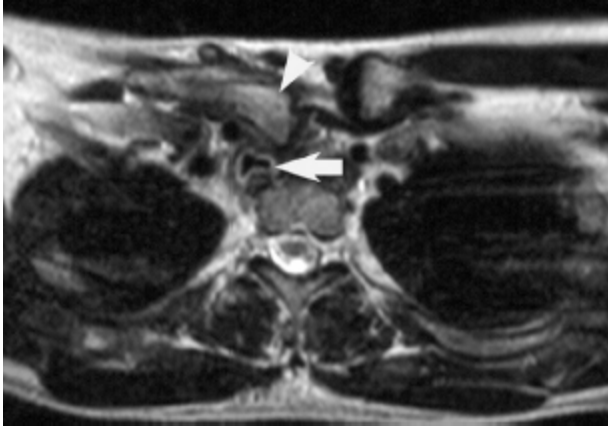
Sequelae of posterior injuries:

- Tracheal stenosis
- Esophageal compression
- TE fistula
- Pneumothorax
- Great vessel compression
- Brachial plexopathy
- Sepsis
- Death



Seen in initially asymptomatic patients!

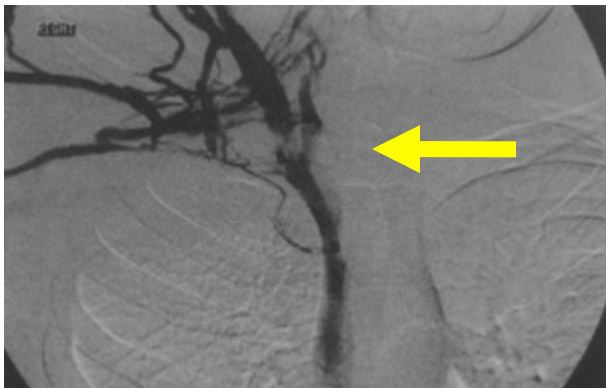
# Acute posterior



Nakavama et al, Ann Thor Surg, 2007.



Jougou et al, Ann Thor Surg, 1996



Emms et al, JSES, 2002.



Jain et al, JBJS-B, 2002.

# Acute posterior

Closed reduction

- Definitive treatment?
- SCJ remodelling?

Disadvantages:

- Recurrent instability
- Safety of percutaneous techniques

Waters et al, JPO, 2003

Goldfarb et al, JBJS, 2001



# Treatment: Acute posterior

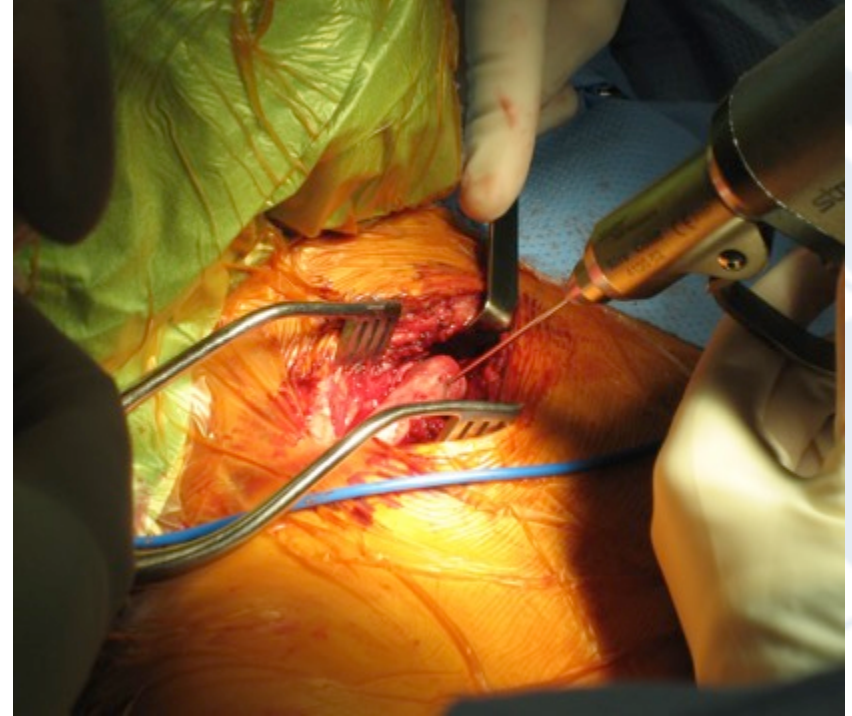
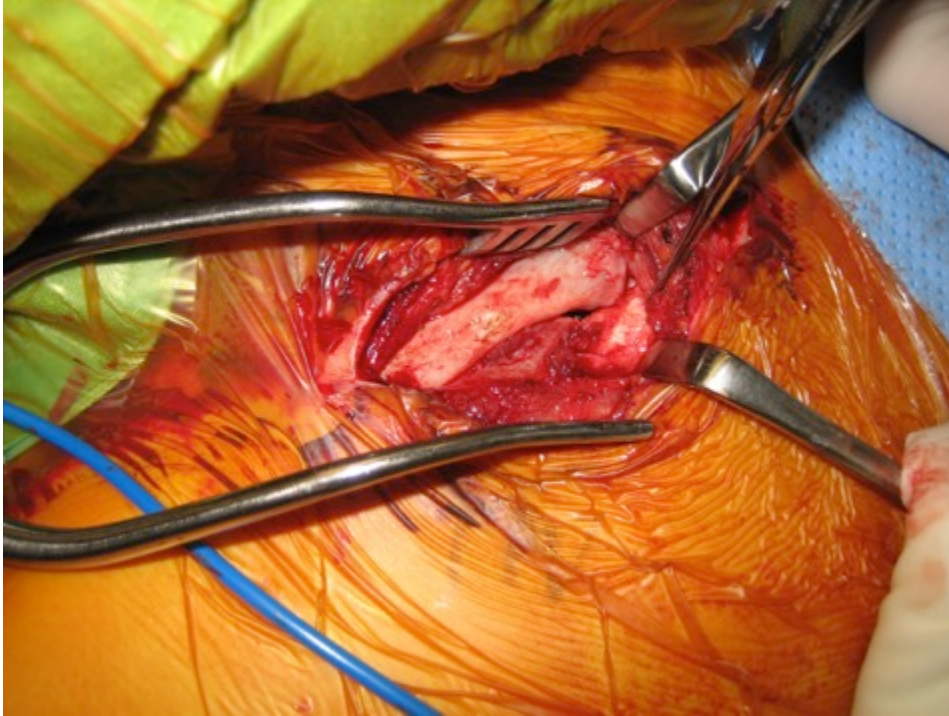


General/thoracic surgery back-up

Modified beach chair position

Transverse incision based on medial clavicle

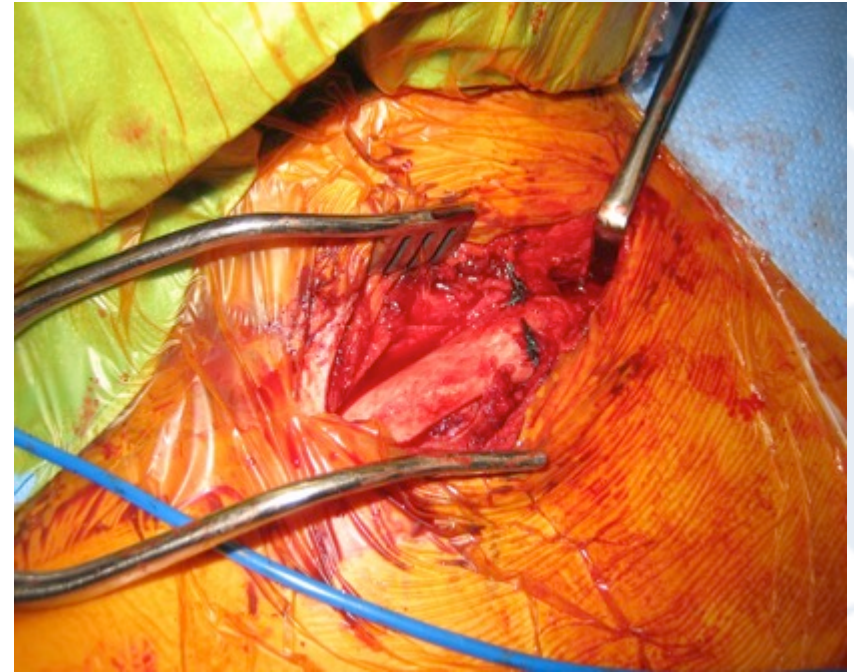
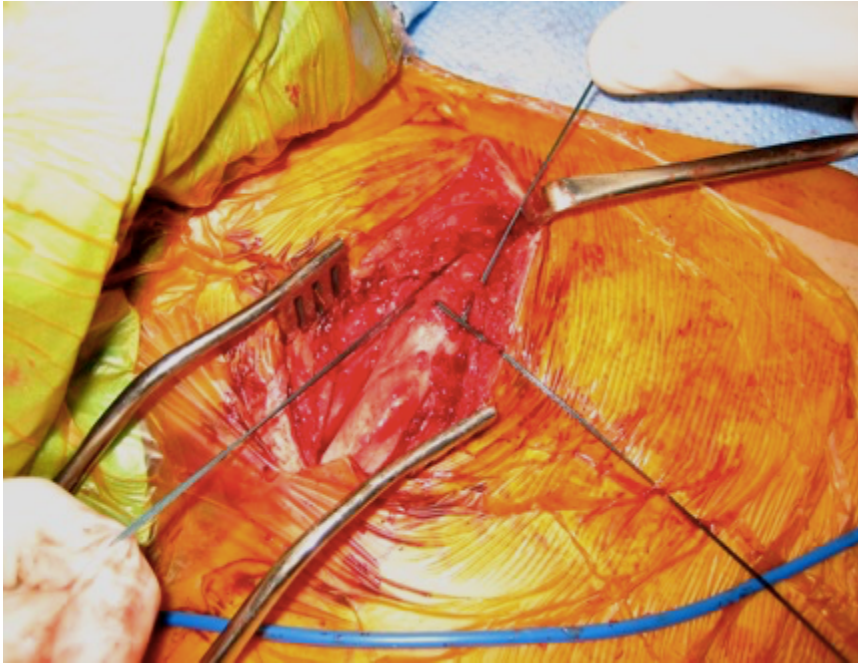
# Treatment: Acute posterior



Open reduction

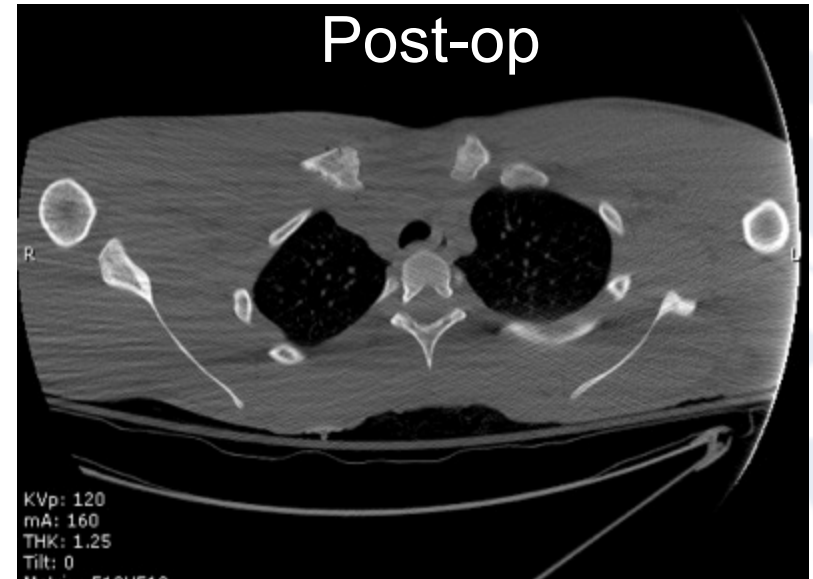
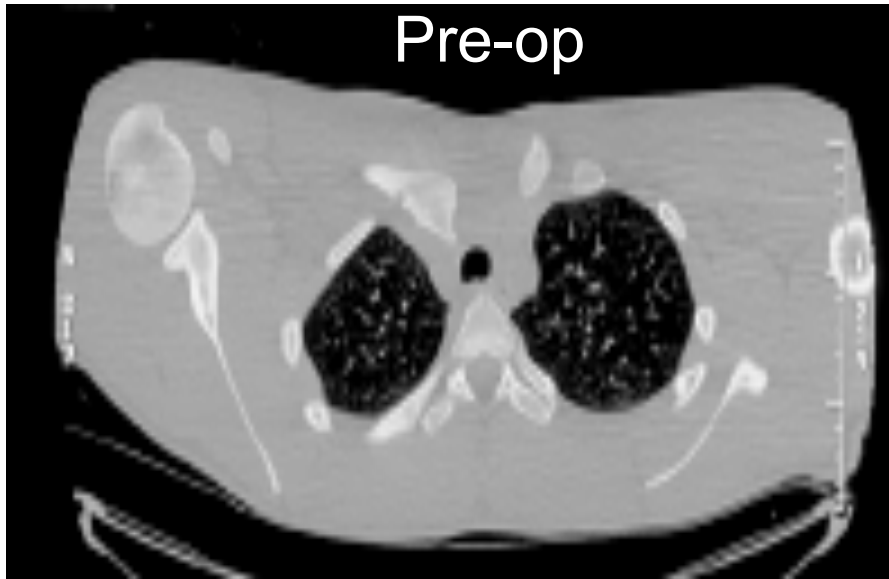
Drill holes in medial clavicle and epiphysis/sternum

# Treatment: Acute posterior



Pass and tie sutures  
Repair periosteum, ligaments  
Check stability

# Treatment: Acute posterior



Post-op CT

Sling immobilization x 4-6 weeks

Activity restriction x 3-6 months





# Treatment: Acute posterior

Waters et al, JPO, 2003

- 13 patients
- Mean age 14.6 years
- 85% sports-related
- 15% true dislocations
- Full motion, strength, and unrestricted activity
- No complications

Short-Term Outcomes After Surgical Treatment of Traumatic Posterior Sternoclavicular Fracture-Dislocations in Children and Adolescents

\*Peter M. Waters, MD, †Donald S. Bae, MD, and ‡R. Kumar Kadiyala, MD, PhD

*Study conducted at The Children's Hospital, Boston, Massachusetts*



# Treatment algorithm

