Fractures of the distal third of the clavicle

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Anatomy

- **static stabilizers**: AC ligaments (4), CC ligaments (trapezoid & conoid)

- **dynamic stabilizers**: deltoïd and trapezius muscles

Anatomy

- For **small** displacements the **capsule and AC ligaments** are the primary restraints to posterior (89%) and superior (68%) translation.


Anatomy

- For **larger** displacements, the **conoid** ligament is the primary restraint (62%) to superior translation, while the AC ligaments are still the primary restraint to posterior translation.

- **Trapezoid** ligament is the primary restraint to **compression** at both small and large displacements.

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Biomechanics

- With forward elevation-abduction to 180° there is 5° to 8° of rotation at the AC joint.

- During arm elevation, the clavicle, with respect to the thorax, undergoes elevation (11° to 15°) and retraction (15° to 29°).

- When AC joint is intact, scapular motion (3 planes, 2 translations) is synchronously coupled with arm motion by the clavicle.


AC joint should not be fixed, either by fusion, hardware (screws, plates, pins) or coracoclavicular screws.

Motion will be lost, limiting shoulder function, or the hardware may fail.

Epidemiology

10% to 30% of all clavicle fractures

Male > female

Older patients

Stable fracture patterns generally heal uneventfully with nonsurgical management
Deforming forces

weight of the arm, scapular rotation
Mechanism of injury

Moderate or high-energy traumatic impact
- Falling on the outstretched hand
- A direct blow to shoulder.

Direct impact occurs at the acromion, usually with the arm in an adducted position.
Clinical examination

Inspection

Beware of inferior or posterior displacement

Fracture displacement may cause the proximal fragment to tent the skin, as in AC joint separation

Paresthesias resulting from swelling or injury to the supraclavicular nerves are common

Palpation

Evaluate pain
Look for instability with stress
Radiological examination

Anteroposterior View

Zanca View - better for distal clavicle
(AP with cephalic tilting of 15° and use of only 50% of the standard shoulder penetration strength)
Radiological examination

3D – CT reconstruction

better estimates shortening, displacement and progress of union
Classification

Type 1 (medial third)

Type 2 (midshaft)

Type 3 (distal third)

Cortical alignment fractures (type 3A)
- Extra-articular (type 3A1)
- Intra-articular (type 3A2)

Displaced fractures (type 3B)
- Undisplaced (Type 2A)
- Extra-articular (type 3B1)
- Angulated (Type 2A2)
- Isolated or comminuted segmental (Type 2B2)
- Intra-articular (Type 3B2)
Classification


Type I fractures occur lateral to the CC ligaments but spare the AC joint.

The proximal fragment is stabilized to the coracoid process by the CC ligaments and to the distal fragment by the deltotrapezial fascia.

Type I fractures often are only minimally displaced.
**Classification**

**Type III** fractures are similar to type I fractures in that they also occur distal to the CC ligaments.

Type III fracture extends into the AC joint, but are relatively stable and typically are minimally displaced.

Risk of posttraumatic **AC joint arthropathy**
Classification

In all type II fractures, the proximal fragment is detached from the CC ligaments. The distal fragment remains attached to the scapula via the AC joint capsule.

In type IIA fracture, the fracture lies medial to the conoid ligament.

In type IIB fracture, the fracture lies between the conoid and trapezoid ligaments.
**Classification**

**Type IV** involve disruption of the periosteal sleeve. These fractures are injuries to the growth plate in which the epiphysis and physis typically maintain their relationship to the shoulder Joint.

In type V fracture, only a small inferior cortical fragment remains attached to the CC ligaments. The stability of the distal and proximal fracture fragments is compromised.
Treatment options

Nonoperative (Type I & III)

Sling immobilization for 2 weeks and shoulder motion is initiated as soon as the initial pain improves.

Repeat radiographs are obtained at 6-week follow-up to monitor for fracture displacement.

Risk of delayed-onset symptomatic AC arthrosis, which can be managed with distal clavicle resection.
Treatment options

**Operative** (Type II)

- Transacromial wire fixation
- Modified Weaver-Dunn procedure
- Tension band
- CC screw fixation
- CC loop augmentation
- Plate fixation (Hook, distal radius)
- Arthroscopic treatment
- Other techniques
Reported Rates of Nonunion Following Nonsurgical Management of Type II Distal Clavicle Fractures

<table>
<thead>
<tr>
<th>Management</th>
<th>Average Follow-up</th>
<th>Outcome</th>
<th>No. of Symptomatic Nonunions</th>
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<tbody>
<tr>
<td>12 nonsurgical</td>
<td>4 mo&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8 delayed union (67%), 4 nonunion (33%)</td>
<td>4</td>
</tr>
<tr>
<td>4 excision</td>
<td>NR</td>
<td>N/A</td>
<td>NR</td>
</tr>
<tr>
<td>7 ORIF</td>
<td>3 mo&lt;sup&gt;b&lt;/sup&gt;</td>
<td>All united</td>
<td>0</td>
</tr>
<tr>
<td>Nonsurgical</td>
<td>14.3 mo</td>
<td>3 nonunion (30%)</td>
<td>0</td>
</tr>
<tr>
<td>20 nonsurgical</td>
<td>3 y</td>
<td>9 delayed union (45%), 6 nonunion (30%)</td>
<td>6</td>
</tr>
<tr>
<td>23 surgical</td>
<td>21 mo</td>
<td>All united</td>
<td>0</td>
</tr>
<tr>
<td>Nonsurgical</td>
<td>15 y</td>
<td>5/18 nonunion (28%)</td>
<td>2</td>
</tr>
<tr>
<td>16 nonsurgical</td>
<td>53.5 mo</td>
<td>7 nonunion (44%)</td>
<td>2</td>
</tr>
<tr>
<td>14 ORIF</td>
<td>59.8 mo</td>
<td>All united</td>
<td>0</td>
</tr>
<tr>
<td>72 nonsurgical, 3 excision, 11 delayed surgery</td>
<td>6.2 y</td>
<td>32/86 nonunion (37%)&lt;sup&gt;f&lt;/sup&gt;</td>
<td>11</td>
</tr>
<tr>
<td>Nonsurgical</td>
<td>24 wk</td>
<td>25.4% nonunion&lt;sup&gt;h&lt;/sup&gt;</td>
<td>NR</td>
</tr>
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Studies involving clinical assessment in patients with distal clavicular nonunions have indicated that only **20% to 34%** were symptomatic and eventually required surgical fixation.
(1) The reported rate of radiographic nonunion of all types of distal clavicle fractures reflects that of Neer’s original series.

(2) Fracture displacement, as seen in most Neer type II fractures, is associated with the development of nonunion.

(3) Radiographic nonunion does not always correlate with symptomatic nonunion.

(4) Patients who develop symptomatic nonunion may or may not require additional surgery.
Transacromial wire fixation (Neer)

Nonunion
Infection
AC joint arthrosis
KW migration
KW breakage
Shoulder stiffness

Protected full range of shoulder motion before KW removal
Extra-articular application to avoid arthrosis

All patients (12) had bony union

Mean period of healing 11.5 weeks

3 patients had proximal or distal skin irritation
Intramedullary fixation of Neer type 2 fractures of the distal clavicle with an AO/ASIF screw

J.E. Scadden*, R. Richards

4.5 mm AO/ASIF malleolar screw
Modified tension band for displaced type 2 lateral end clavicle fractures

Laxman Rijal · Gopal Sagar · Anshumala Joshi · Khima Nand Joshi

16 patients
average age 36.25
No loss of reduction
average time of union 10.75 weeks
near normal range of motion
Skin impingement in four cases
Kirshner wires backed out in one case
No infection or breakage
OPERATIVE TECHNIQUES FOR DISPLACED DISTAL CLAVICLE FRACTURES

ROBERT A. ARCİERO, MD

Operative Techniques in Sports Medicine, Vol 12, No 1 (January), 2004: pp 27-31

Goldberg technique

Levy technique
Comparison of Clinical Results of Surgical Treatment for Unstable Distal Clavicle Fractures by Transacromial Pins With and Without Tension Band Wire

Yu-Chuan Tsuei¹,², Man-Kuan Au¹, William Chu¹,² *

6 pin migrations
Combined with:
3 residual displacement &
1 recurrent fracture

1 pin migration
Combined with:
1 residual displacement
Coracoclavicular screw

Technically demanding as a result of the fairly narrow area within the coracoid that is available for screw fixation.

High rate of fixation failure due to screw cutout or loosening

The screw often limits shoulder movement and often needs to be removed once the fracture has unit
The cortical ring sign: A reliable radiographic landmark for percutaneous coracoclavicular fixation

Grant E. Garrigues, MD\textsuperscript{a,*}, Milford H. Marchant Jr., MD\textsuperscript{b}, Gemma C. Lewis, BS\textsuperscript{a}, Anil K. Gupta, MD, MBA\textsuperscript{a}, Marc J. Richard, MD\textsuperscript{a}, Carl J. Basanania, MD\textsuperscript{c}
Coracoclavicular Augmentation ± fixation

Indirect reduction of dislocated medial fragment using tapes, sutures, dacron, anchors

Reinforcement of other fixation techniques (KW, plates)

Even new implants (Tight rope) or arthroscopic techniques


Type 2 fractures of the distal clavicle: A new surgical technique

Jerome A. Goldberg, MB, BS, FRACS, FA Orth A, Warwick J. M Bruce, MB, BS, FRACS, FA Orth A, David H. Sonnabend, MB, BS, BSc (med), FRACS, FA Orth A, and William R. Walsh, PHD, Sydney, Australia

No 5 sutures

Dacron tape

[Image of a shoulder X-ray]
1 nonunion/19 patients,
2 pt delayed union
2 pt clavicular erosion
1 pt with malunion
Clavicular plating

Small and mini-fragment locking plates
technical note

Stable fixation of distal clavicle fracture with comminuted superior cortex using oblique T-plate and cerclage wiring

e Hyun Yoo*, Jun Dong Chang, Young Jin Seo, Jae Hyuk Shin
Treatment of distal clavicle fracture with distal radius volar locking compression plate

YU Chao 俞超, SUN Yue-hua 孙月华*, ZHAO Chang-qing 赵长清, SHI Ding-wei 史定伟 and WANG You 王友

<table>
<thead>
<tr>
<th>Table 1. Clinical data of the 6 patients after surgery</th>
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<tbody>
<tr>
<td>Patient No.</td>
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<tr>
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<td>1</td>
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<td>5</td>
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<td>6</td>
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Clavicular plating

- violation of the AC joint
- need for implant removal
- bending or redislocation
- increased risk of infection
- acromial fracture
- rotator cuff injury
36 patients
mean age 36.2 years
median follow-up 28 months
mean time to union 3 months
union rate was 95%.
92% of plates were removed.
median time to removal was 4.5 months

Two patients presented months later after falls
with fractures around the medial end of the
hook plate.
Clavicular HP did not offer more clinical advantages than with KTBW in treating unstable distal clavicle fracture.
Surgical Treatment for Unstable Distal Clavicle Fracture with Micromovable and Anatomical Acromioclavicular Plate

Qingjun Liu*, Jianyun Miao*, Bin Lin**, Kejian Lian

18 pt
Solid union in all
Follow-up 18 months
No postop complications
425 cases Neer II fractures
60 conservative, 365 surgically.
105 coracoclavicular stabilization
162 hook plate
42 intramedullary fixation
16 interfragmentary fixation,
40 K-wire plus tension band wiring.

33.3% nonunions in the nonsurgical group
1.6% nonunions, and 22.2% complications
For the nonsurgical treatment, the functional outcomes were generally acceptable despite the high nonunion rate.

The nonsurgical treatment could be considered as the first line treatment after sufficient counsel with the patient.

The nonunion rate is high, however, the functional outcome is acceptable in most of the cases with nonunion.

If the surgical treatment is considered, the intramedullary screw fixation, CC stabilization and interfragmentary fixation would be preferred because of their low complication rate.