쇄골 및 견봉쇄골 관절 손상

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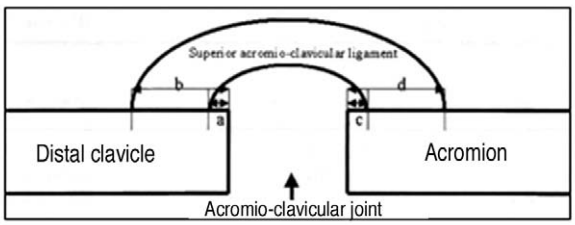
Functional Anatomy

1. Ligamentous Anatomy

• Superior AC ligament

- Thicker than inferior ligament: 2~5.5 mm
- Insert into clavicle and musculotendinous aponeurosis of the deltotrapezial fascia
- More defined insertion into distal clavicle (Salter, AJSM, 87)[40]

• Distances of superior AC ligament (Renfree, JSES, 03)[38]



Insertion point	Mean distance (mm) (range)	
	Men	Women
a	1.4±0.33 (0.8-1.8)	0.7±0.63 (0 -2.0)
b	5.5±1.7 (2.6-7.6)	3.6±0.78 (2.3-5.2)
c	1.1±0.37 (0.6-1.79)	2.0±0.5 (1.0-2.9)
d	8.1±0.75 (7.4-9.84)	4.7±0.98 (3.0-6.7)

• Coracoclavicular ligament

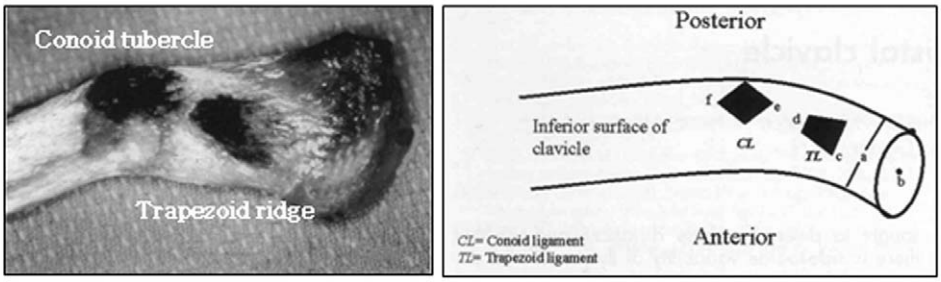
- Conoid (posteromedial) + trapezoid (anterolateral)
- Trapezoid

  0.8~2.5 cm in length and width (Salter, AJSM, 87)[40]

  Mean 15.3 mm in length (Harris, JSES, 01)[16]
- Conoid

- 0.7~2.5 cm in length, 0.4~0.95 cm in width (Salter, AJSM, 87)[40]

Distances of trapezoid and conoid ligament (Renfree, JSES, 03)[38]



Insertion point	Distance of insertion (mm)	
	Men	Women
b-c	16.7±2.4	16.1±1.4
b-d	28.2±5.7	26.6±5.2
b-e	33.5±4.4	28.9±2.5
b-f	49.7±5.4	44.4±4.4

2. Stabilizer of AC Joint

• Capsular ligament: AC ligament
  - Superior ligament
    Most robust among AC ligament[22]
    Reinforced by fascial attachment of deltoid and trapezius
• Extracapsular ligament: coracoclavicular ligament
• Dynamic stabilizer: deltoid and trapezius

3. Mechanics of AC Ligament

• Greater amount to constraint at small degrees of displacement
  : correspond to "physiologic load" in ROM of daily living
• According to amount of force
  - Small displacement in ant. & sup. direction
  : AC ligament resist 50% and 65% of force
  - Large displacement
  : conoid ligament contribute 70% and 60% (Fukuda, JBJS, 86)[12]
• Act as primary constraint for post. displacement & post. axial rotation of clavicle[12]
• Debski et al (JBJS, 01) [9]
  - If transect the AC joint: 100% displacement in ant. & post. directions

- Inf. AC ligament: 50% of restraint in all direction

4. Mechanics of Coracoclavicular Ligament

• Conoid ligament
  - Primary role in constraining ant. & sup. rotation & displacement of distal clavicle
  - With large displacement, its force increases
    Sup. displacement: 60% of total
    Sup. rotation: 82% of total
    Ant. displacement: 70% of total
    Ant. rotation: 72% of total (Fukuda, JBJS, 86) [12)]
• Trapezoid ligament
  - Contribute the least to sup. & horizontal displacement
  - Most of constraint (75%) against axial compression of clavicle toward the acromion at higher displacement[12)]

Structures primarily responsible for resisting displacement of the distal clavicle

Author	Direction of displacement		
	Ant.	Post.	Sup.
Fukuda[12)]	Conoid (large displacement)	AC lig.	Conoid (large displacement)
Lee[27)]	Inf. AC lig.	Trapezoid	
Debski[9)]	Sup. AC lig.(conoid with capsule transected)	Trapezoid (capsule transected)	Conoid (capsule intact & transected)
Klimkiewicz[23)]		Sup. AC lig.	
Salter[40)]			Trapezoid

AC Joint Injury

1. Incidence

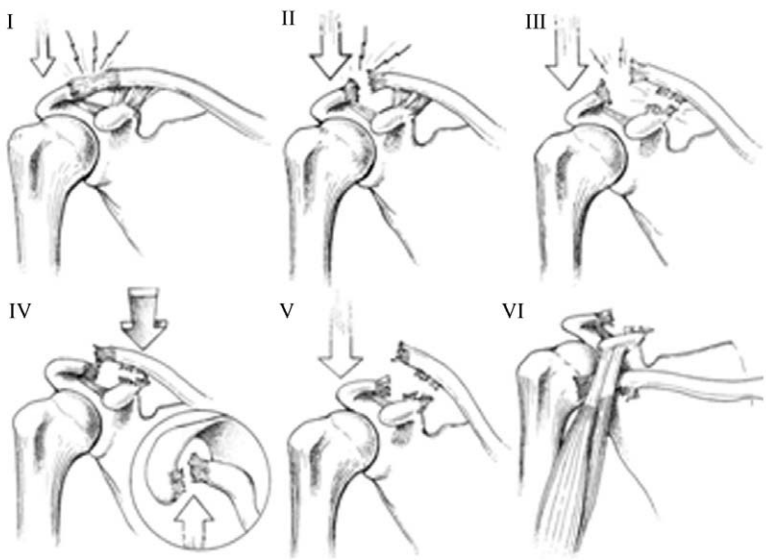
• 8-10% of shoulder injuries[35)]
• Two categories[41)]
  - Acute traumatic
  - Chronic degenerative[7)]

2. Mechanism of Injury[35,39)]

• Direct injury (m/c)
  - Falling or striking on shoulder with arm at the side
• Indirect injury
  - Upward or downward force through upper extremity

3. Classification (Rockwood, The Shoulder, 85) [39]

• Type I
  - Sprain of AC lig. only
• Type II
  - AC lig. and capsule disrupted, CC lig intact
  - Up to 50% vertical sublux.
• Type III
  - AC lig. & capsule disrupted, CC lig disrupted
  - Displaced superiorly by at least the thickness of clavicle
• Type IV
  - AC lig. & capsule disrupted, CC lig disrupted
  - Displaced posteriorly through the trapezius
• Type V
  - Complete detachment of deltoid & trapezius
  - Extreme sup. elevation of clavicle (100 to 200% of normal)
• Type VI
  - Displaced inferiorly to the acromion or coracoid process



4. Diagnosis

- History
- Physical exam.
  - Palpation
- Tenderness: for type I
  cf) cross-body adduction test (+)
- Direction of instability: difficult
  - Reduction: for type III
- Radiograph
  - Trauma series
  - AP stress view: 10~15 pds for type II, III, V
  - Striker notch view: fx. of coracoid base

5. Modalities of Treatment

- Type I, II: nonoperative[3,13,39]
- Type III: controversial[25,39]
  - Recommend nonoper. tx. for most of type III
  - Comparing nonoper. and oper.

Author		FU	Results	Etc
Larsen[26]	JBJS, 86		no differ.	except heavy worker
Bannister[2]	JBJS, 89	4 yrs	non-op.>op.	except heavy worker
Tibone[43]	AJSM, 92	4.5 yrs	inj.=non-inj.	non-op.
Pillips[36]	Cl. Orth, 98	metaanalysis	87%/88%	
			Additional surg.	6%/59%

- Operative indications[2,18,26,39,42]
  - Open injuries
  - Significant brachioplexus injury
  - Chronically symptomatic patient
  - Greater than 2 cm displacement
  - Significant prominent clavicle in laborer
  - High level overhead or throwing athlete

6. Nonoperative Treatment[18]

- Phase I: Pain control, immediate protective ROM
- Phase II: Strengthening exer. using isotonic exer.
- Phase III: Functional rehab.
- Phase IV: Return to activity with functional drill

7. Surgical Options[13,18,35,39]

- Primary AC stabilization
  - Transarticular fixation using pin
    - Phemister, Neviaser technique
    - Advatage: easy technique
    - Problem: high Cx[15,30]
      - Pin migration, breakage
      - Articular damage
  - Wolter plate[46]
- Primary extraarticular CC stabilization
  - Coracoclavicular screw & repair
    - Bosworth technique[5]
    - Problem
      - Screw loosening
  - Cerclage fixation
    - Two coracoclavicular loops of wire
    - Autograft: PL, semitendinosus (Wolf, Arthro, 01) [45]
    - Dacron tape or other synthetic graft (Kappakas, Clin Orth, 78) [21,32]
    - PDS cerclage
    - Problem[15]
      - Clavicle erosion
      - Failure of fixation
      - Infection
  - Suture anchor[6]
  - Arthroscopic reconstruction using fiberwire[45]

Structural properties of intact and reconstructed CC lig.

Method	Result (failure load)
Circlage fixation PDS, Polyethylene	 No signif difference (Motamedi, AJSM, 00)
Screw fix	Strength ↑, similar stiffness, only if bicortical purchase
CC sling & suture anchor	Similar strength, but greater deformation
CA lig. transfer	Weakest strength, least stiffness (Harris, AJSM, 00) [17]

• Distal clavicle resection and CC lig. reconstruction using CA lig.
  - Weaver and Dunn technique[44]
    Popular technique
  - Variant of Weaver and Dunn technique
    Used for both acute & chronic injury

• Distal clavicle excision
  - Mumford procedure
    Indication
      - Old symptomatic type II injury
      - AC arthrosis
    If CC lig. is disrupted, must be repaired or reconstructed
    Open/arthroscopic[4,11]

• Dynamic m. transfer
  - Dewar-Barrington technique
    Not recommend in acute injury
    High failure rate
      - Continue pain
      - Nonunion

8. Complications[15,42]

• Nonoperative
  - Skin problem
  - Posttraumatic arthritis[10]
    20% in conservatively treated type I, II injuries
  - Osteolysis of distal clavicle[37]
  - Neurovascular injury
    Traction on brachial plexus

• Postoperative
  - Loss of reduction
  - Hardware migration
  - Infection
  - AC arthritis, osteolysis
  - Erosion
  - Stiffness

9. Prognosis[13,18,39,42]

• Satisf. results in more than 90% (type III-VI)
  : Both oper. & nonoper. tx.
• In office worker
  : Nonoper. tx usually sufficies
• In heavy laborer
  : Better with surgical repair
• Cx following surgical tx. are more common
  : But, overall low incidence

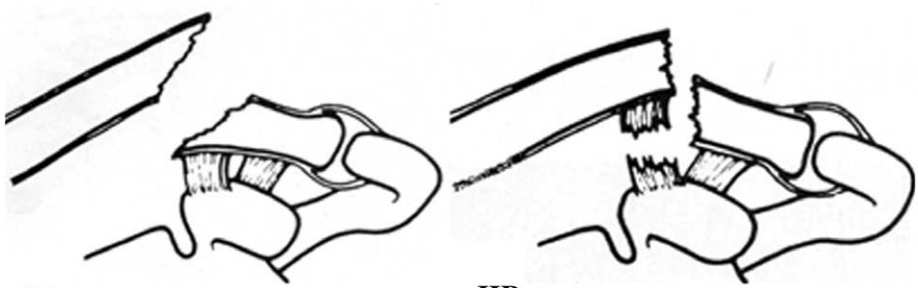
Distal Clavicle Fracture

1. Introduction[8,33,34,35]

• 12~15% of all clavicle fx.
• High rate of nonunion
• Classify according to status of CC lig.

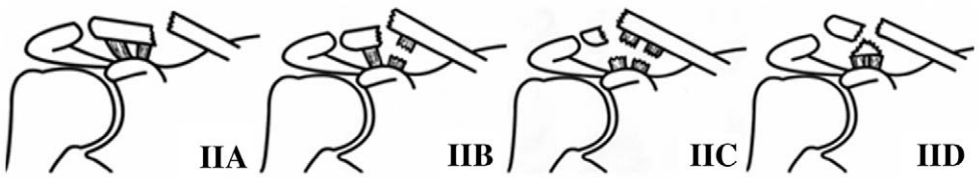
1. Classification

• Neer (Fractures, 84) [33]
  - Type I: Occur lat. to CC lig, but extraarticular fx. / stable fx.
  - Type II: Occur just med. to CC lig. / unstable fx.
    IIA: CC lig. attached to distal fragment
    IIB: Conoid lig. torn & trapezoid attached to distal segment



  - Type III: Occur lat. to CC lig., but extend to AC joint / stable fx.
    Craig (The Shoulder, 90) [8]
  - Group II: Fracture of distal third
    Type I, II(A,B), III: same as Neer classification
    Type IV: In children, lig. intact to periosteum with displacement of med. fragment / pseudodislocation
  - Type V: Comminuted, lig. attached to inferior comm. fragment

• Author' s thought
  - Type I: lat to CC lig, stable
  - Type II: Subclassify to A, B, C, D[8,19,33)]
  - Type III: Extend to AC joint
  A: non-displaced, B: displaced fragment



3. Four Forces That May Impair Healing in Type II

• Weight of the arm
• Pulling downward of pectoralis major & minor, LD
• Scapula may rotate the distal segment
• Trapezius & SCM

4. Radiographic Evaluation

• Shoulder trauma series
• Typical AC joint radiograph
  : Displacement, comminution, extension to joint
  - AP view
  - Cephalic tilted view (Zanca vew)

5. Modalities of Treatment[8,24,33)]

• Type I: Nonoperative, sling
• Type II: Operative
  - If there is obvious bone contact, consider nonoperative fx.
• Type III: Usually nonoperative
  - AC arthritis as late Cx: distal clavicle resection

6. Surgical Techniques

• Transacromial k-wire fixation
  - Problem: Delay in rehab, pin migration[28)], AC arthritis, nonunion

- K-wire and tension band wiring[20)]
  - No violation of ACJ
- Indirect reduction using CC fixation[1,47)]
  - Coracoclavicular screw
- Oper/percutaneous
  - Coracoclavicular sling: Merseline, Dacron tape
- Encircling wire, PDS or H-bond suture[14,29)]
- Etc
  - Wolter clavicular plate[31)]
  - Small T-plate

7. Author's Techniques According to Author's Classification

- Type IIA, B: ORIF with any possible fixation
  - K-wire and tension band wiring
  - If oblique fx, additional encircling wire or suture
- Type IIC: Coracoclavicular fixation
  - CC screw or sling
  - With/without additional k-wire or encircling suture
- Type IID
  - Keys
    Comm. fragment is attached to CC lig.
    Fragment should be restored to normal anatomy for maintaining integrity of CC lig.
  - Methods
    Encircling suture or wire passing through the CC lig. with fragment
    And, Additional fixation (k-wire and TBW)

8. Summary

- Many authors have advocated surgical tx. for type II because of high risk of nonunion.
- But, in a few reports, no correlations between the nonunion and functional disability.
- Reconstruction of integrity of the CC lig. (encircling suture) is important for rapid fracture healing.

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