

견봉 쇄골 관절 손상 및 원위 쇄골 골절
Acromioclavicular Joint Injury
And Distal Clavicular Fracture

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Acromioclavicular Joint Injury

- # 9% of Shoulder Girdle Injuries
- # Adults in 20s. (43.5%)
- # M:F=5:1
- # Incomplete vs. Complete=2:1
- # Two categories
 1. Acute Traumatic Injury
 2. Chronic Degeneration : Repetitive Microtrauma

Anatomy & Biomechanics

- diarthrodial joint involving the medial facet of the acromion and the distal clavicle.
- Six degrees of freedom moving in Ant./Post. as well as Sup./Inf. Planes.
- meniscus like fibrocartilaginous disk covered with hyaline cartilage.
- Stabilizers: Static and Dynamic
 - # Static Stabilizer
 1. Capsular (AC) ligament: Sup. Inf. Ant. Post.
 2. Extracapsular (CC) ligament: Trapezoid and Conoid
 3. CA ligament
 - # Dynamic Stabilizer: Deltoid and Trapezius
- # AC ligament: primary horizontal stability(AP translation)
 - Average Insertion on the capsule
 - 16.7 mm Post.-Sup.
 - 12.8 mm Ant.-Sup.
 - Max. average distance: 16.1 mm from the joint line.
 - Greatest distance: 20 mm from the joint line.

Keep in mind during distal clavicle excision !!

- Post. Horizontal instability can cause abutement of the posterolateral portion of the clavicle into the spine of the scapula.

- Serial section Study (Contribution of resistance to post. Displacement)

56% Superior Ligament

25% Posterior Ligament

Saving Sup. & Post. Ligament !!

CC ligament: - vertical stability(superoinferior)

- Trapezoid and Conoid ligaments

- Both are post. To the Pectoralis minor attachment on the coracoid

- Two function

1) Synchronous scapulohumeral motion by attaching the clavicle to the scapula

2) Strengthen the acromioclavicular articulation

Motion of the AC Joint

- 5 to 8 degrees of motion

- Elevated 35 degrees with full elevation

- Ap translation 35 degrees with abduction and extension

- Rotated 45 degrees to full overhead position

- Synchronous scapular-clavicular rotation coordinated by the CC ligaments.

CC fixation can migrate as well as to break over time.

AC joint injury classification (Rockwood)

- Type I: sprain of the AC ligament with intact AC and CC ligaments and a stable joint

- Type II: AC ligaments disrupted
CC ligaments intact

- Type III: disruption of both the AC and CC ligaments
complete dislocation of the AC joint and an unstable joint

- Type IV: posterior displacements of the clavicle
distal clavicle becomes interposed within the fibers of the trapezius m.

- Type V: Exaggerated superior dislocation of the joint of 100% to 300%, increasing the CC distance two to three times, including disruption of the deltotrapezial fascia.

- Type VI: tearing of both the AC and CC ligaments
the displacement is interior with the clavicle in a subacromial or subcoracoid position

Injury mechanism

- direct force: falling onto the position of the shoulder with the arm at the side in an adducted position
 - : most common cause of acromioclavicular injury
- indirect force: upward indirect force by the upper extremity
downward indirect force through the upper extremity

Physical Exam

Type III vs. Type V Clinically - See Video !!

X-ray evaluation

- Anteroposterior views: usually overpenetrated
- Axillary views and lateral
- Zanca views: 10~15 degree upward tilt of the x-ray beam affords a clear view of the acromioclavicular joint (50% of the standard shoulder AP penetration strength)
- Anteroposterior stress views: type II, III injury
 - 10 to 15 lb of weight hanging from the wrists
 - CC distance
- Stryker notch view: demonstrate fractures of the base of the coracoid

Treatment

Type I, II AC joint injury: Nonsurgical treatment

Type III AC joint injury: Controversial

Type IV, V, VI AC joint injury: Surgical treatment

Treatment of Type III

- Trend toward initial nonoperative treatment in most cases
- Rockwood: nonoperative treatment particularly in patients who participate in contact sports.
- Philips et al.: Meta-analysis 1172 patients
 - 88% of operative group, 87% of nonop. group-satisfactory results
 - The need for further surgery (59% operative vs. 6% nonop.)
 - Infection(6% vs. 1%)
 - Deformity(3% vs. 37%)

Pain and ROM were not significantly affected.

The authors did not recommend surgery for Type III in patients.

- McFarland: Survey of Major-league baseball team
- consider later reconstruction in Athlete and Laborer

Nonsurgical treatment

Phase I: Pain control, immediate protective ROM, isometric exercise

Phase II: Strengthening exercise using isotonic contraction

Phase III: Unrestricted functional participation with the goal of increasing strength, power, endurance, and neuromuscular control

Phase IV: Return to activity with sports-specific functional drills

Surgical Treatment

- 1) Primary AC Stabilization
- 2) Dynamic Muscle Transfer
- 3) Primary CC and Extra-articular Stabilization
- 4) Distal Clavicle Resection and CA Ligament Reconstruction

Primary AC Stabilization

- smooth or threaded Steinmann pins with AC or CC ligament repair
- Transfixing is demanding (thin acromion and curved clavicle)
- Hardware removal, Pin migration, Breakage
- Surgical trauma to the joint
- Wolter plate

Dynamic Muscle Transfer

- : transfer of the short head of the biceps with or without the coracobrachialis
- : Transferred tendon act as a dynamic depressor of the clavicle.
- : Ferris et al.-20 patients. Half with continued aching at AC joint
- : variable results and risk of nonunion or injury to the musculocutaneous nerve.

Primary CC and Extra-articular Stabilization

- coracoclavicular screw: Bosworth (1941) screw: local anesthesia
Kennedy (1968): Modified Bosworth technique
Tsou (1989): cannulated coracoclavicular screw
percutaneous insertion
coracoclavicular ligament repair
deltoid and trapezius repair
- Cerclage fixation

Bearden: two coracoclavicular loops of wire

Dacron or other synthetic tape

PDS suture or cerclage

- Clavicle erosion, failure of fixation, infection reported

- Morrison and Lemos

loop should be placed at the base of the coracoid

inserted through a hole at the junction of the anterior and middle third of the clavicle

If loop is posterior or goes around the clavicle, it tends to displace the clavicle anteriorly

Distal Clavicle Resection and CA Ligament Reconstruction

: Weaver and Dunn 1972

: Kawabe and Shoji-acromial bone block

Arthroscopic Distal Clavicle Resection

Mumford(1941): type II dislocation with arthritis of the joint

if type III dislocation, in addition to the excision of the distal clavicle + reconstruction of the coracoclavicular ligaments

See Video !!

Author's Approach

- Diagnostic Arthroscopy

- CA ligament release at the base of the acromion arthroscopically for preservation of length

- A suture is placed in the end of the ligament and brought out the anterior portal

- Straight incision

- Horizontal incision of the deltotrapezial fascia

- About 1 cm resection of the distal clavicle (2~3 mm from medial edge of the acromion and 7~8 mm from lateral edge of the clavicle)

- Two Drill holes are made 5~6 mm medial to the distal end of the clavicle

- Reduction using reduction clamp

- 9~10 PDS suture passed through the coracoid base and tied over the clavicle

- CA ligament transferred and tied

- Deltotrapezial fascia imbrication

Complications of Surgical Treatment

- Hardware migration

- Loss of reduction
- Infection
- Calcification
- Erosion
- Osteolysis
- Chronic pain

Conclusion

- most patients do well with nonsurgical treatment and regain acceptable shoulder function
- complication of nonsurgical management are relatively uncommon
- complication following surgical management are more common, but overall incidence remains low
- Type I,II,III needs a nonoperative management. and Type IV,V,VI needs a operative intervention.

Distal clavicular fracture

Allman's classification

Group I-fractures of the middle third

Group II-fractures of the distal third

Group III-fractures of the medial third

Crig's classification

Group I-fracture of the middle third

Group II-fracture of the distal third

type I-minimal displacement (interligamentous)

type II-displaced secondary to a fracture medial to the coracoclavicular ligaments

A. Conoid and trapezoid attached

B. Conoid torn, trapezoid attached

type III-fracture of the articular surface

type IV-ligaments intact to the periosteum(children) with displacement of the proximal fragment

type V-comminuted, with ligaments attached neither proximally nor distally, but to and inferior, comminuted fragment

Group III-fracture of the proximal third

- type I-minimal displacement
- type II-displaced (ligaments ruptured)
- type III-intra-articular
- type IV-epiphyseal separation (children and young adults)
- type V-comminuted

Group II-fracture of the distal third

12~15% of all clavicular fractures
subclassified according to the location of the coracoclavicular ligaments relative to the location of the coracoclavicular ligaments relative to the fracture fragments

Neer's classification

type I-most common (4:1)

- ligaments remain intact to hold the fragments together and prevent rotation, tilting or significant displacement
- interligamentous fracture occurring between the conoid and the trapezoid or between the coracoclavicular and acromioclavicular ligaments

type II-coracoclavicular ligaments detached from the medial segment

- conoid and trapezoid may be on the distal fragment
- conoid ligament may be ruptured while the trapezoid ligament remains attached to the distal segment (IIB)
- four forces act on this fracture that may impair healing and may be contributing factors to the reported high incidence of nonunion

type III - involve the articular surface of the acromioclavicular joint alone

** Although type II fractures may have intra-articular extension, in type III fracture there is a break in the articular surface without a ligamentous injury

* the type III injury may be confused with a first-degree acromioclavicular separation

* 'weightlifter's clavicle' resorption of the distal end of the clavicle may occur from increased vascularity secondary to microfractures that lead to this resorption

type IV-occur in children

may be confused with a complete acromioclavicular separation

pseudodislocation of the acromioclavicular joint

coracoclavicular ligaments remain attached to the bone or the periosteum, the proximal fragment ruptures through the thin superior periosteum and may be displaced upward by muscle forces

X-ray evaluation

anteroposterior and lateral views of the trauma series, 40-degree cephalic tilt views

Neer' recommendation to accurately assess the extent of the injury and the presence or absence of associated ligamentous damage

1. anteroposterior view includes both shoulders on one plate with the patient erect and with 10 lb of weight strapped to each wrist.
2. anterior 45-degree oblique views, with the patient erect and the injured shoulder against the plate, gives a lateral view of the scapula and shows the medial fragment posteriorly with the outer fragment displaced anteriorly
3. posterior 45-degree oblique view, with the patient erect and the injured shoulder against the plate, also demonstrates the extent of separation of the two fragments.

Treatment of the distal clavicle

type I: - with a sling for comfort

- early isometric exercises and discontinuation of the immobilization

type II: - immobilization is difficult.

- the fragments are distracted by muscle forces and the weight of the arm.

- the proximal fragment is unstable and has no ligamentous attachment.

- if there is obvious bone contact, as manifested by crepitus and a radiographic bone wedge, nonoperative treatment should be considered.

- open reduction and internal fixation.

depends on the size of the lateral fragment and on the position and integrity of the coracoclavicular ligaments relative to the fragments

- encircling wires, pins, sutures binding the proximal fragment to the coracoid process

- open intramedullary fixation utilizing the Knowles pin

type III: - extension of type II injury into the joint

- treated as a type II injury

- if they lead to symptomatic late degeneration of the acromioclavicular joint,

- the 2 cm of clavicle may be excised with little morbidity and excellent results

- if treated surgically, the distal fragment should be retained because of its attachment to the coracoclavicular surface or severe comminution

REFERENCE

1. Allman FL: Fractures and ligamentous injuries of the clavicle and its articulation. *J Bone Joint Surg Am* 49: 774-784, 1967.
2. Allman FL Jr: Fractures and ligamentous injuries of the clavicles and its articulation, *J Bone Joint Surg*, 49A: 774-784, 1967.
3. Baarber FA: Complete posterior acromioclavicular dislocation: A case report. *Orthopedics*, 10: 493-496, 1987.
4. Ballmer FT and Gerber C: Coracoclavicular screw fixation for unstable fractures of the distal clavicle: A report of five cases. *J Bone Joint Surg Br* 73 :291-294, 1991.
5. Basamania CJ: Medial instability of the shoulder: A new concept of the pathomechanics of acromioclavicular separations. Paper presented at a Day Meeting of the American Orthopaedic Society for Sports Medicine Specialty, 2000, Orlando, FL.
6. Beckman T: A case of simultaneous luxation of both ends of the clavicle. *Acta Chir Scand* 56 :156-163, 1923.
7. Bergfeld JA, Andrish JT, Clancy WG: Evaluation of the acromioclavicular joint following first-and second-degree sprains. *Am J Sports Med*, 6: 153-159, 1978.
8. Bernard TN Jr, Brunet ME, Haddad RJ Jr: Fracture of the middle third of the clavicular joint: A report of four cases and review of the literature. *Clin Orthop*, 175: 227-232, 1983.
9. Bosworth BM: Complete acromioclavicular dislocation, *N Engl J Med*, 241: 221-225, 1949.
10. Cahill BR: Atraumatic osteolysis of the distal clavicle: A reviews. *Sports Med*, 13: 214-222, 1992.
11. Cahill BR: Osteolysis of the distal part of the clavicle in male athletes. *J Bone Joint Surg Am* 64 :1053-1058, 1982.
12. Cook DA, Heiner JP: Acromioclavicular joint injuries. *Orthop Rev*, 19: 510-516, 1990.
13. Cox JS: The fate of the acromioclavicular joint in athletic injuries. *Am J Sports Med*, 9: 50-53, 1981.
14. Eberle C, Fodor P, and Metzger U: [Hook plate (so-called Balsler plate) or tension banding with the Bosworth screw in complete acromioclavicular dislocation and clavicular fracture.] *Z Unfallchir Versicherungsmed* 85 :134-139. 1992.
15. Edwards DJ, Cavanaugh TG, and Flannery NC: Fractures of the distal clavicle: A case for fixation. *Injury* 23 :44-46. 1992.
16. Egol KA, Connor PM, Karunakar MA, et al: The floating shoulder: Clinical and functional results. *J Bone Joint Surg Am* 83 :1188-1194. 2001.

17. Eidman DK, Siff SJ, and Tullos HS: Acromioclavicular lesions in children. *Am J Sports Med* 9 :150-154, 1981.
18. Flatow EL, Duralde XA, Nicholson GP, Pollock RG, Bigliani LU: Arthroscopic resection of the distal clavicle with a superior approach, *J Shoulder Elbow Surg*, 4: 41-50, 1995.
19. Gurd FB: The treatment of complete dislocation of the outer end of clavicle: A hitherto undescribed operation. *Ann Surg* 113 :1094-1097, 1941.
20. Hackstock H and Hackstock H: Surgical treatment of clavicular fracture. *Unfallchirurg* 91 :64-69, 1988.
21. Harnroongroj T, Tantikul C, and Keatkor S: The clavicular fracture: A biomechanical study of the mechanism of clavicular fracture and modes of the fracture. *J Med Assoc Thai* 83 :663-667, 2000.
22. Heppenstall RB: Fractures and dislocations of the distal clavicle. *Orthop Clin North Am* 6 :477-486, 1975.
23. Houston HE: An unusual complication of clavicular fracture. *J Ky Med Assoc* 75 :170-171, 1977.
24. Jacobs P: Posttraumatic osteologies of the outer end of the clavicle. *J Bone Joint Surg Br* 46 :705-707, 1964.
25. Kappakas GS, McMaster JH: Repair of acromioclavicular separation using a Dacron prosthesis graft. *Clin Orthop*, 131: 247-251, 1978.
26. Larsen E, Bjerg-Nielsen A, Christensen P: Conservative or surgical treatment of acromioclavicular dislocation: A prospective, controlled, randomized study, *J Bone Joint Surg*, 68A:552-555, 1986.
27. Lester CW: The treatment of fractures of the clavicle. *Ann Surg* 89 :600-606, 1929.
28. MacDonald PB, Alexandr MJ, Frejuk J, Johnson GE: Comprehensive functional analysis of shoulders following complete acromioclavicular separation. *Am J Sports Med*, 16: 475-480, 1988.
29. Madsin B: Osteolysis of the acromial end of the clavicle following trauma. *Br J Radiol*, 36: 822-828, 1963.
30. McCandless DN and Mowbray M: Treatment of displaced fractures of the clavicle: Sling vs. figure-of-eight banage. *Practitioner* 223 :266-267, 1979.
31. Meislin RJ, Zuckerman JD, Nainzadeh N: Type III acromioclavicular joint separation associated with late brachial-plexus neurapraxia. *J Orthop Trauma*, 6: 370-372, 1992.
32. Murphy OB, Bellamy R, Wheeler W, Brower TD: Post-traumatic osteolysis of the acromial end of the clavicle. *Clin Orthop*, 109: 108-114, 1975.
33. Nelson CL: Abstract repair of acromioclavicular separations with knitted Dacron graft. *Clin. Orthop*, 143:289, 1979.
34. Nordqvist A, Petersson C, and Redlund-Johnell I: The natural course of lateral clavicle fracture. *Acta Orthop Scand* 64 :87-91, 1993.
35. Nuber GW, Bowen MK: Acromioclavicular joint injuries and distal clavicle fractures. *J Am Acad Orthop Surg*, 5: 11-18, 1997.
36. Parkes JC and Deland JD: A three-part distal clavicle fracture. *J Trauma* 23 :437-438, 1983.
37. Park JP, Arnold JA, Coker TP, Harris WD, Becker DA: Treatment of acromioclavicular separations; A retrospective, controlled, randomized study. *J Bone Joint Surg*, 68A: 552-555, 1986.
38. Richards RR: Acromioclavicular joint injuries, in Heckman JD(ed): instructional course lectures 42. Rosemont, IL, American Academy of Orthopaedic Surgeons, pp 259-269, 1993.
39. Rockwood CA: Treatment of the outer clavicle in children and adults. *Orthop Trans* 6 :472, 1982.
40. Salter Jr, Nasca RJ, Shelly BS: Anatomical observations on the acromioclavicular joint and supporting ligaments, *Am J Sports Med*, 15: 199-206, 1987.
41. Stam L, Dawson I: Complete acromioclavicular dislocations: Treatment with a Dacrom ligament injury,

- 22: 173-176, 1991.
42. Tsou PM: Percutaneous cannulated screw coracoclavicular fixation for acute acromioclavicular dislocations. Clin Orthop, 243: 112-121, 1989.
 43. Urist MR: Complete dislocation s of the acromioclavicular joint. The nature of the traumatic lesion and effective methods of treatment with an analysis of forty-one cases. J Bone Joint Surg, 15: 199-206, 1987.
 44. Urist MR: The treatment of dislocation of the acromioclavicular joint: A survey of the past decade. Am J Surg. 98: 423-431, 1959.
 45. Wang SJ, Liang PL, Pai WN, et al: Experience in open reduction and internal fixation of mid shaft fractures of the clavicle. J Surg Assoc ROC 23:7-11, 1990.
 46. Weaver JK and Dunn HK: Treatment of acromioclavicular injuries, especially acromioclavicular separation. J Bone Joint Surg Am 54 :1187-1198, 1972.
 47. Weaver JK, Dunn HK: Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. J Bone Joint Surg, 54A: 1187-1194, 1972.
 48. Widner LA and Riddewold HO: The value of the lordotic view in diagnosis of fractured clavicle. Rev Int Radiol 5 :69-70, 1980.
 49. Winkler H, Schlimp D, and Wentzensen A: Treatment of acromioclavicular joint dislocation by tension band and ligament suture [German]. Aktuelle. Traumatol 24 :133-139, 1994.
 50. Wurtz LD, Lyons FA, Rockwood CA Jr: Fracture of the middle third of the clavicle and dislocation of the acromioclavicular joint: A report of four cases. J Bone Joint Surg, 74A: 133-137, 1992.
 51. Yates DW: Complications of fractures of the clavicle. Injury 7 :189-193, 1976.
 52. Zenni EJ Jr, Krieg JK, and Rosen MJ: Open reduction and internal fixation of clavicular fractures. J Bone Joint Surg Am 63 :147-151, 1981.