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# Treatment of Neer Type 2 fractures of the distal clavicle with coracoclavicular screw

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**Objective:** The aim of this study was to assess the outcome of coracoclavicular screw fixation in displaced distal clavicular fractures.

**Methods:** Sixteen patients with Neer Type 2 displaced distal clavicle fractures were treated with open reduction and internal fixation. Fixation was performed using a coracoclavicular screw with washer application. After union the screw was removed under local anesthesia. Radiographic evaluation was performed and the clinical outcome was assessed using the Constant score.

**Results:** All patients achieved painless osseous unions. However, one patient showed significant displacement of the fracture due to loosening of the screw one month after surgery. The screw was removed and the fracture was healed with some deformity. All patients returned to their pre-injury level in 3 months. The mean Constant score was 98.

**Conclusion:** Coracoclavicular screw fixation in the treatment of distal clavicular fractures is a reliable, simple and cost effective technique.

**Key words:** Clavicle; coracoclavicular screw; fracture; fractures of the distal clavicle.

Fractures of the clavicle account for 44% of shoulder girdle fractures, and 5% of all skeletal fractures. Among clavicle fractures, 10 to 15% involve the distal end of the clavicle.[1]

Distal clavicle fractures are divided into three types according to the Neer classification.[2] In Type 1 fractures, ligaments are intact with less fracture displacement. Conservative therapy is recommended for these types of fractures. In Type 2 fractures, the medial fragment is detached from the coracoclavicular ligaments. Therefore, the lateral fragment maintains its position while the medial fragment is displaced. Frequently, internal fixation is recommended for Type 2 fractures. Finally, Type 3 fractures involve only the articular surface of the acromioclavicular joint. A concern with Type 3 fractures is that arthritis or osteolysis may develop in the acromioclavicular joint in later periods and may require resection of the distal clavicle.[3-5]

Neer Type 2 distal clavicular fractures can be further divided into two subgroups, depending on the rupture of coracoclavicular ligaments. In Type 2A,

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both conoid and trapezoid ligaments attached to the distal segment are intact. In Type 2B, the trapezoid ligament remains attached to the distal segment, while the conoid ligament is ruptured. In some patients both the conoid and trapezoid ligaments are ruptured. Therefore, there is a significant displacement and increased risk of nonunion due to lack of contact between the coracoclavicular ligament and the medial segment in Type 2B.[6]

The present study aimed to assess the outcome of patients whose Neer Type 2 distal clavicle fractures were treated with fixation using a spongious screw following reduction.

## Patients and methods

A total of 16 patients (12 male, 4 female) were treated with open reduction and internal fixation for Type 2 distal clavicle fractures according to the Neer classification, between 2000 and 2008 (Fig. 1). The mean age was 35.9 (range: 20 to 62) years. The follow-up period was between 2 and 8 years. Fractures were caused by falling injuries in 13 patients and traffic accidents in 3.

Each patient was clinically evaluated using the Constant Score.[7]

All surgical interventions were performed in the beach chair position under general anesthesia. It is important to have the shoulder and clavicle away from the table to facilitate both reduction and the use of fluoroscope. An incision of nearly 3 cm was made from the clavicle to the coracoid process parallel with the Langer line. After subcutaneous development, an incision was made directly over the clavicle to reach the coracoid. Following indirect reduction of the fracture, the clavicle and coracoid were drilled respectively, with a 3.2 mm drill. The clavicle was then drilled further, using a 4.5 mm drill, and an appropriate size short-threaded spongious screw was inserted with a washer (Fig. 2).

Postoperatively, the arm was placed in a shoulder sling. The patient was instructed not to move his/her arm in over 90 degrees of abduction or flexion until the removal of the screw.

The patients were evaluated according to the Constant scoring system. The union was assessed radiologically at weeks 1, 2, 3 and 6. In the event of any radiographic evidence of nonunion at Week 6, the patient was scheduled for further follow-up every 10 days until confirmation of union.

## Results

The screw was removed after union was achieved. The mean time for screw removal was postoperative week 7 or 8. A physiotherapy program was initiated to achieve full range of motion in the shoulder following removal of the screws. None of the patients developed a fracture after screw removal. No restricted range of motion or loss of muscle strength were observed during follow-up. None of the patients had complaints of pain during exercise.

The mean Constant score was 98 points (range: 92 to 100) for all patients. Radiological improvement was observed at Week 7, in most cases. None of the patients had complaints at the final follow-up in which they had full range of motion.

**Fig 1.** A Type 2 distal clavicle fracture as a result of a motorcycle accident.

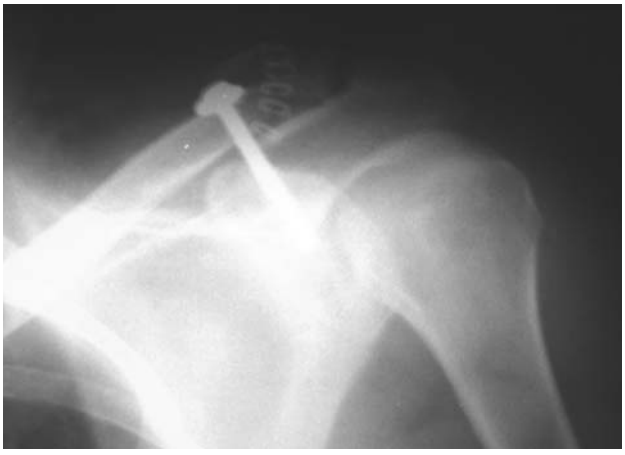

**Fig 2.** Reduction and fixation with a coracoclavicular screw, without opening the fracture line.

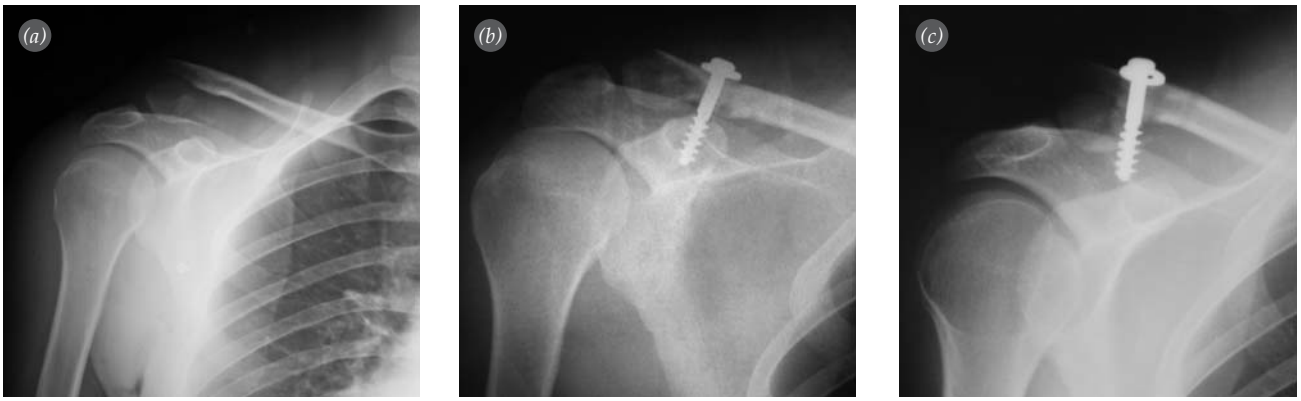


**Fig 3.** **(a)** Radiograph of a Type 2 distal clavicle fracture after a falling injury. **(b)** Postoperative radiograph after screw fixation. **(c)** Follow-up radiograph one month later shows the failure of the fixation.

During follow-up, we had an implant failure in one patient (Fig. 3). This patient had difficulties in cooperation due to mental retardation. Therefore, the screw was removed and the fracture was left to heal on its own. Union was observed in the fracture at approximately Week 10. The follow-up at Year 2 showed that the distal end of the clavicle healed with deformity (Fig. 4). Despite this deformation in the fracture line, the patient had a full range of motion (Fig. 5). He had no pain during shoulder exercises. No postoperative complications were observed.

## Discussion

In contrast to the conservative treatment of central and medial fractures of the clavicle, surgical treatment is recommended for Neer Type 2 distal fractures.[4,8,9] We preferred to use surgical treatment for the Type 2 distal clavicle fractures because non-sur-

**Fig 4.** Control radiograph taken 2 years after the injury. Note the deformity at the distal end of the clavicle. There is no arthritic change at the acromioclavicular joint.

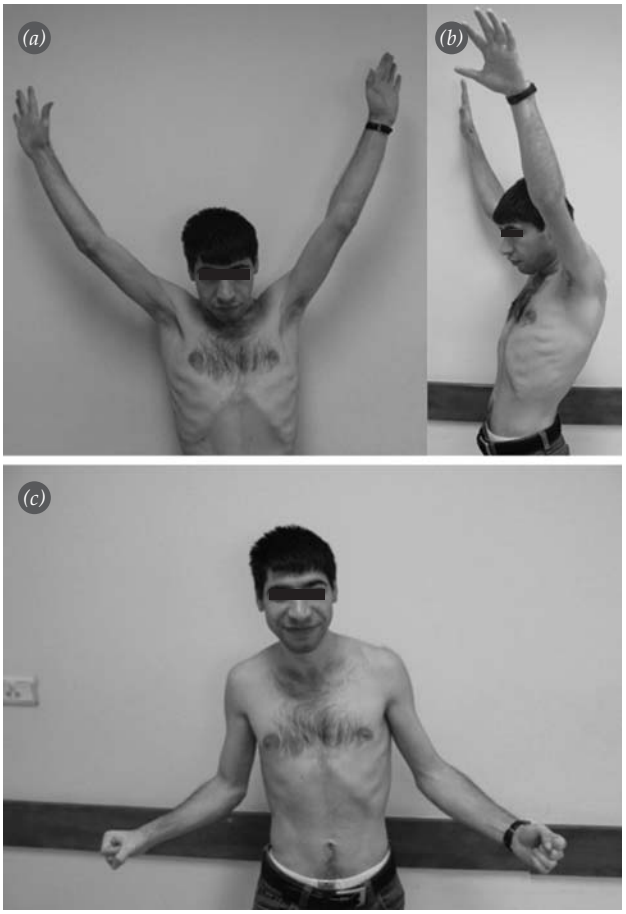


**Fig 5.** **(a, b)** Forward elevation. **(c)** External rotation. Patient's range of motion after 2 years. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

gical treatment of Neer Type 2 fractures results in nonunion in 22 to 33% of cases and a 3-month delayed union in 45 to 67% of cases.[3,4] In addition to a slow rate of healing, they produce inherent shoulder deformity.[5] Furthermore, this nonunion is painful.[10] In a series of 30 patients with Type 2 distal clavicle fractures, where half received surgical treatment and the other half received conservative treatment, 40% of patients who received conservative treatment showed nonunion, and a further 40% showed delayed union. Eighty-three percent of patients with nonunion were symptomatic, requiring later surgical treatment. All patients with delayed union were symptomatic, and only one patient required distal clavicular excision.[11]

Several fixation techniques have been described in the literature.[4,12-14] These techniques include transacromial Kirschner wire fixation,[15,16] fixation by coracoclavicular screws,[12,14] plates,[15,17,18] dynamic transfer,[19] coracoclavicular fixation by sutures such as Dacron band or PDS[19] or cerclage wire[4] fixation. Each has advantages and disadvantages. Based on these publications, it appears that there is still no golden standard in the surgical treatment of such fractures despite the availability of many approaches. Neer recommends transacromial Kirschner wire fixation.[1] However, Kirschner wire fixation has an infection and nonunion rate of 32%.[9] Kirschner wire, osteosynthesis, cerclage and plaque fixations can be insufficient in eliminating muscle strength that elevates the proximal segment and maintaining the reduction.[20] Death due to migration of the Kirschner wire to the thoracic cavity or mediastinum has also been reported.[21-23] Furthermore, many authors do not recommend the use of Kirschner wire and cerclage in the shoulder girdle area.[9] An extensive dissection is made during fixation with coracoclavicular Mersilen band (Ethicon Ltd, Scotland) in order to reach the base of the coracoid process and fatigue fractures can be exposed in the coracoid process.[9,24,25] Plate fixations are not practical as the distal segment is small and fixation of this metaphyseal type of bones is weak. Fixation of small lateral fragment with a plate is difficult.[18,26] Fixation can be extended over the acromion[26] but requires a broad exposure with a high risk of devascularization of the clavicle. The subcutaneous material may not have a good aesthetic appearance in lean patients. Furthermore, refracture is possible after fixator removal.[9,18] In addition, screws may damage the rotator cuff, due to an extension of the plate toward the acromion.[26] Use of the AO hook plate may result in acromial osteolysis and the removal of material requires general anesthesia.[27] Use of transarticular implants and dissection of the acromioclavicular joint appears to lead to a 10% incidence of ostoearthritis of the acromioclavicular joint. Use of larger implants further increases this risk.[21] In the present study, we used minimal soft tissue dissection and avoided extensive interventions which might have interfered with the integrity of the acromioclavicular joint. Screw removal was performed under local anesthesia between Week 7 and Week 10 after radiographic evidence of union.

The surgical incision was not large. Scar tissue formation was kept at minimum with an incision made parallel to the skin creases.

Early mobilization may result in screw loosening and displacement of the fracture line associated with clavicular rotation. Therefore, arm exercises up to shoulder level were allowed during the period prior to the removal of the implant. Full range of motion was allowed at Week 6 after screw removal. Patients' daily activities were not restricted during this period. A shoulder sling was used only outside for rest. None of the patients had shoulder stiffness at the last follow-up.

Type 2 distal clavical fractures are instable because the ligamentous continuity between the coracoid and the proximal fragment is lost. Thus, the proximal segment is remarkably displaced superiorly or posteriorly. A high rate of delayed union or nonunion, from 30% to 45%, was reported in different series.[4,12,13,28,29]

The loss of screw fixation is a potential complication. A study by Harris et al. showed a good strength of fixation.[30] Bicortical fixation in the coracoid provides a load to failure of 750 to 1000 N, which is nearly approximate to the strength of the native acromioclavicular and coracoclavicular ligament complex, whereas a hook plate has a 460 N load to failure.[30]

In our series, only one patient had screw cut-out. The key points include use of a spongious screw and

placement of the screw onto both cortices of the base of the coracoid. It provides sufficient fixation of the fracture without any need for ligamenteous repair. Fazal et al. also used coracoclavicular screws in the fixation of Type 2 distal clavicular fractures.[9] However, they exposed the fracture fragments for a direct open reduction. We believe that we had no negative impact on the healing of the fracture as we performed indirect closed reduction without impairing the circulation at the fracture site. As mentioned previously, the exposure of small distal fragments may also disrupt blood supply to these fragments.

Another argument is the necessity of the repair of coracoclavicular ligaments. In Type 2 distal clavicle fractures, there is usually a portion of the coracoclavicular ligament which remains attached to the distal fragment, although these ligaments are ruptured from the proximal fragment. A sufficient acromioclavicular stability has been observed after fracture union.[1,12] Furthermore, those who performed coracoclavicular ligament repair[5,6,8,12,21] and those who did not[1,9,12,20] had similar outcomes. We didn't perform coracoclavicular ligament repair. None of the patients had acromioclavicular joint instability after the union.

In conclusion, coracoclavicular screw fixation in the treatment of distal clavicular fractures is a reliable, simple and cost effective technique. The advantages of this technique include small exposure, indirect reduction of the fracture, and no need to open the fracture line which improves fracture healing.

**Conflicts of Interest:** No conflicts declared.

## References

1. Jin CZ, Kim HK, Min BH. Surgical treatment for distal clavicle fracture associated with coracoclavicular ligament rupture using a cannulated screw fixation technique. J Trauma 2006;60:1358-61.
2. Neer CS 2nd. Fractures of the distal third of the clavicle. Clin Orthop 1968;(58):43-50.
3. Nordqvist A, Petersson C, Redlund-Johnell I. The natural course of lateral clavicle fracture: 15 (11–21) year follow-up of 110 cases. Acta Orthop Scand 1993;64:87-91.
4. Levy O. Simple minimally invasive surgical technique for treatment of Type 2 fractures of the distal clavicle. J Shoulder Elbow Surg 2003;12:24-8.
5. Wang SJ, Wong CS. Wang SJ, Wong CS. Extra-articular Knowles pin fixation for unstable distal clavicle fractures. J Trauma 2008;64:1522-7.
6. Chen CH, Chen WJ, Shih CH. Surgical treatment for distal clavicle fracture with coracoclavicular ligament disruption. J Trauma 2002;52:72-8.
7. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res 1987;(214):160-4.
8. Mall JW, Jacobi CA, Philipp AW, Peter FJ. Surgical treatment of fractures of the distal clavicle with polydioxanone suture tension band wiring: an alternative osteosynthesis. J Orthop Sci 2002;7:535-7.
9. Fazal MA, Saksena J, Haddad FS. Temporary coracoclavicular screw fixation for displaced distal clavicle fractures. J Orthop Surg (Hong Kong) 2007;15:9-11.
10. Jupiter JB, Leffert RD. Non-union of the clavicle. Associated complications and surgical management. J Bone Joint Surg Am 1987;69:753-60.
11. Rokito AS, Zuckerman JD, Shaari JM, Eisenberg DP, Cuomo F, Gallagher MA. A comparison of nonoperative and operative treatment of Type II distal clavicle fractures. Bull Hosp Jt Dis 2002-2003;61:32-9.
12. Ballmer FT. Gerber C. Coracoclavicular screw fixation for unstable fractures of the distal clavicle. J Bone Joint Surg 1991;73:291-4.
13. Edward DJ, Kavanagh TG. Flannery M.C. Fractures of the distal clavicle: A case for fixation. Injury 1992;23:44-6.
14. Yamaguchi H, Arakawa H, Kabayashi M. Results of the Bosworth method for unstable fractures of the distal clavicle. Int Orthop 1998;22:366-8.
15. Golser K, Sperner G, Thoni H, Resch H. Early and intermediate results of conservatively and surgically treated lateral clavicular fractures. [Article in German] Aktuelle Traumatol 1991;21: 148-52.
16. Kona J, Bosse MJ, Staeheli JW. Type II distal clavicle fractures: A retrospective review of surgical trauma. J Orthop Trauma 1990;4:115-20.
17. Hessmann M, Gotzen L, Kirchner R, Gehling H. Therapy and outcome of lateral clavicular fractures. [Article in German] Unfallchirurg 1997;100:17-23.
18. Dağlar B, Delioğlu ÖM, Minareci E, Taşbaş BA, Bayrakcı K, Günel U. Distal klaviküla ayrışmalı kırıklar için yeni bir tespit yöntemi: Kilitli distal uç radius plağı. Acta Orthop Traumatol Turc 2009;43:324-30.
19. Katznelson A, Nerubay J, Oliver S. Dynamic fixation of the avulsed clavicle. J Trauma 1976;16:841-4.
20. Flinkkilä T, Ristiniemi J, Hyvönen P, Hämäläinen M. Surgical treatment of unstable fractures of the distal clavicle. A comparative study of Kirchner wire and clavicular hook plate fixation. Acta Orthop Scand 2002;73:50-3.
21. Bezer M, Aydın N, Güven O. The treatment of distal clavicle fractures with coracoclavicular ligament disruption: a report of 10 cases. J Orthop Trauma 2005;19:524-8.

22. Leonard JW, Gifford RW Jr. Migration of a Kirschner wire from the clavicle into the pulmonary artery. Am J Cardiol 1965;16:598-600.
23. Liu HP, Chang CH, Lin PJ, Chu JJ, Hsieh HC, Chang JP, et al. Pulmonary artery perforation after Kirschner wire migration: case report and review of the literature. J Trauma 1993;34:154-6.
24. Hughes PJ, Bolton-Maggs B. Fractures of the clavicle in adults. Curr Orthop 2002;16:133-8.
25. Webber MC, Haines JF. The treatment of lateral clavicle fractures. Injury 2000;31:175-9.
26. Basamina CJ, Rockwood CA. Fractures of the clavicle. In: Rockwood CA, Matsen FA, Wirth Na, Lippitt SB, editors The shoulder. 4th ed. Philadelphia; Saunders-Elsevier; 2009. p. 381-451.
27. Tambe AD, Motkur P, Qamar A, Drew S, Turner SM. Fractures of the distal third of the clavicle treated by the hook plating. Int Orthop 2006;30:7-10.
28. Neviaser RJ. Injuries to the clavicle and acromioclavicular joint. Orthop Clin North Am 1987;18:433-8.
29. Brunner U, Habermeyer P, Schweiberer L. Special status of lateral clavicula fracture. [Article in German] Orthopade 1992;21:163-71.
30. Harris RI, Wallace AL, Harper GD, Goldberg JA, Sonnabend DH, Walsh WR. Structural properties of the intact and the reconstructed coracoclavicular ligament complex. Am J Sports Med 2000;28:103-8.