ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2016;50(3):298–302
doi: 10.3944/AOTT.2015.15.0023

Distal clavicular fracture treatment with suture anchor method

Ahmadreza MIRBOLOOK[1], Mirmostafa SADAT[2], Mohammadreza GOLBAKHSH[3], Mohammad Sadegh MOUSAVI[4], Amirmohammad GHOLIZADEH[4], Sepehr SAGHARI[5]

[1]Department of Orthopedics and Traumatology, Guilan University of Medical Sciences, Rasht, Iran
[2]Department of Orthopedics and Traumatology, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran
[3]Department of Orthopedics and Traumatology, Tehran University of Medical Sciences Tehran, Iran
[4]Department of Orthopedics and Traumatology, Medical Faculty, Guilan University of Medical Sciences, Rasht, Iran
[5]Department of Orthopedics and Traumatology, Orthopaedic Research Center, Guilan University of Medical Sciences, Rasht, Iran

Objective: The aim of this study was to evaluate the results of the suture anchor fixation in the treatment of distal clavicle fractures.

Methods: This cross series study included 43 patients (27 males, 12 females; mean age: 40.1±10.18 years) with type II unstable distal clavicle fractures. The fractures were fixed by 2 pins and 1 suture anchor. All patients were followed at postoperative months 3, 6, and 12 and underwent clinical and radiographic evaluation after 1 year, ongoing at 6-month intervals thereafter. Demographic data were recorded on the first postoperative day. At third and 12th month follow-up, Constant-Murley Shoulder Outcome Score (CMS) was used to assess performance of the acromioclavicular joint, and Visual Analog Scale questionnaire was used to assess patient satisfaction.

Results: Based on CMS scores 1 year after surgery, 37 patients were in excellent condition, and 2 patients were in good condition. Mean surgical case duration was 43.25±4.01 min. These results indicate that there was no significant association between CMS scores and surgical case duration. Mean time to union in our patients was 4.46±0.96 months.

Conclusion: We were able to observe optimal results in our patients by using closed reduction and suture anchors without opening the fracture site, thus allowing physiological processes in union without complications of complete union, while also preventing additional costs such as removing the device.

Keywords: Clavicular fracture; distal; suture anchor.

Level of Evidence: Level IV, Therapeutic Study.

Treatment of distal clavicle fractures remains a controversial topic in orthopedics. These injuries are not uncommon and constitute approximately 21% of clavicle fractures.[1] Distal clavicle fractures have lower incidence than fractures of the middle third, accounting for 10%–15% of all clavicle fractures. Specific fracture patterns were was first described by Neer,[2] who classified distal fractures into 3 types, as follows: type I fractures occur

Correspondence: Mohammadreza Golbakhsh, MD.
Tehran University of Medical Sciences Tehran, Iran.
Tel: +989111394179 e-mail: dmrgolbakhsh@yahoo.com

Submitted: December 23, 2014 **Accepted:** November 16, 2015

Available online at
www.aott.org.tr
doi: 10.3944/AOTT.2015.15.0023
QR (Quick Response) Code

lateral to coracoclavicular (CC) ligaments, usually with minimal displacement; type II fractures usually occur more medial to the CC ligaments; and type III fractures are intra-articular. Neer found that type II fractures of the distal clavicle are significantly displaced and at greater risk of nonunion compared to the other types. Other studies have confirmed these findings, reporting rates of 22%–50% for nonsurgical methods.[3–5] Given the success of acute operative stabilization and high risk of acquired nonunion, several researchers have proposed early surgical treatment for these injuries to avoid acquired problems caused by delayed surgery. There is evidence to support both surgical and nonsurgical treatments, including K-wires, tension band fixation, and CC fixation with sutures or screws. Poor fixation still remains a challenge.[6–8] Recently, standard plating with hook-plate design (Synthes, West Chester, PA, USA) has shown promising results.[9,10] Despite improved union rates, complications of this method are relatively common, such as fracture, displacement, and plate removal due to subacromial pain.[11] Existing studies have suggested using suture anchors for distal radius fractures.[12] The present study examined the suture anchor method with closed reduction.

Patients and methods

In this study, 43 patients with type II unstable distal clavicle fractures were evaluated. Exclusion criteria included patients with multiple, pathologic, or bilateral clavicle fractures.

Surgery was performed under general anesthesia in the semi-sitting position. One dose of intravenous cefazolin (1000 mg) was administered to all patients 30 minutes before surgery. After closed reduction of the fracture controlled by fluoroscope, 1 threaded pin was placed through the acromion along the clavicle and was bent to prevent migration. The fracture was fixed in the reduction position, and an incision was made proximal to the fracture site. A longitudinal incision was made approximately 5 cm from the distal clavicle to the coracoid process (Figure 1). A 2.7-mm drill was used to create 2 holes in the clavicle, 1 suture anchor (5-mm titanium anchor with 2 sutures, IKARIUS #3/4, Orthomed SA, St. Jeannet, France) was inserted in the base of the coracoids, and the arms were pulled through the holes and tied over the clavicle in an over reduction position (Figure 2). Shoulder arm sling was used for 2 weeks postoperatively. Pins were removed under local anesthesia after 6 weeks, and daily activities and rehabilitation programs resulted in full range of motion. Return to intense activities was possible at the end of the third month. All patients were followed at postoperative months 3, 6, and 12 and underwent clinical and radiographic evaluation after 1 year, ongoing at 6-month intervals thereafter (Figures 3–5). Demographic data–including age, gender, time interval between injury and surgery, type of injury, and surgical method–were recorded on the first postoperative day. Constant-Murley Shoulder Outcome Score (CMS) was used at postoperative months 3 and

Fig. 1. Suture anchor placement in coracoid process. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

Fig. 2. Arms of suture anchor being extracted from holes made by 2.7-mm drill in the clavicle. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

12 in order to assess performance of the joint. Patient satisfaction at the time of these follow-ups was evaluated by Visual Analog Scale (VAS) questionnaire. During follow-up, complications including infection and malunion or nonunion (based on Zanca radiographic view) were evaluated. Loss of reduction and clavicular shortness were evaluated in each patient by measuring and comparing the side of fracture with the opposite side on follow-up radiographs. Data were analyzed using SPSS software (version 16.0, SPSS Inc., Chicago, IL, USA). A p value of <0.05 was considered significant.

Fig. 3. Preoperative anteroposterior clavicle radiograph.

Fig. 4. Postoperative anteroposterior clavicle radiograph.

Results

Among the 43 patients with type II clavicle fractures, 39 were enrolled in our study (27 males, 12 females). Mean patient age was 40.1±10.18 years, and mean follow-up period was 27.8 months (range: 12–54 months). Mean time interval between injury and surgery was 5.12±1.23 days. One superficial infection was recorded. CMS scores for all patients at 3 and 12 months postoperatively were 74.10±4.71 and 92.33±4.06, respectively. According to VAS scores, patient satisfaction was 8.15±1.18 at 3 months and 9.12±0.89 at 12 months. Table 1 shows patients' functional status based on CMS scores at 3 and 12 months postoperatively. Thirty-seven patients were in excellent condition and 2 patients were in good condition at 12 months postoperatively. Mean duration of surgery was 43.25±4.01 min, and there was no significant relationship between CMS scores and duration of surgery (minutes per patient) ($p=0.701$ and $p=0.179$ for 3 months and 12 months, respectively). Mean time to union in our patients was 4.46±0.96 months. On radiologic evaluation, malunion, delayed union, nonunion, loss of reduction, and clavicular shortness were not observed in any patients.

Fig. 5. Anteroposterior clavicle radiograph at 6-month follow-up.

Table 1. Patients' functional status based on Constant-Murley Shoulder Outcome Score at 3 and 12 months postoperatively.

	Count	
	n	%
Postoperative 3 months		
Excellent	6	15.4
Good	21	53.8
Acceptable	12	30.8
Fair	0	.0
Postoperative 1 year		
Excellent	37	94.9
Good	2	5.1
Acceptable	0	.0
Fair	0	.0

Discussion

The clavicle is a common site of traumatic fractures. Most clavicle fractures can be successfully treated by nonsurgical methods. However, Neer type II distal clavicle fractures without CC ligament are at high risk of complications such as nonunion or shoulder dysfunction due to conservative treatments. Oh et al. examined 425 type II fractures and showed that nonsurgical treatment results in nonunion in 33.3% of cases, and surgical treatment results in nonunion in 1.6% of cases.[12] While various treatment methods have been proposed for these fractures,[2,4,6,13] there is no consensus regarding which one is best. Fixation with intramedullary K-wire is a simple procedure,[2] but many researchers do not propose it because of complications including pin migration, infections caused by pin, and failure of fixation.[2,14,15] Transacromial fixation with threaded pins is safer than with smooth pins, as the threading prevents pin transmission.[7] However, delayed complications of the acromioclavicular joint, such as arthrosis, still remain a concern. Scadden and Richards obtained good results from fixation using malleolar screws,[16] though their use for comminuted fractures or small distal fragments is limited. Wang and Wong reported fixation with extra-articular pins as an indirect method for the treatment of unstable distal clavicle fractures, with no additional damages to the acromioclavicular joint.[17] However, radiolucency around the pins in all cases and pin transmission in 8 cases (32%) necessitated a second surgery for pin removal in all cases. Fixation with plate using hook plates has been proven effective in recent years, but a second surgery to remove the hardware in order to prevent subacromial impingement and rotator cuff tears is essential.[7,11,18] In addition, fixation with plate is associated with acromial fracture in patients with osteoporosis.[11,19] This method was used in the present study. Following closed reduction of the fracture controlled by fluoroscope, 1 threaded pin was placed indirectly through the acromion along the clavicle and was bent to prevent migration. The fracture was fixed in the reduction position, and an incision was made proximal to the fracture site. Two holes were created in the clavicle using a 2.7-mm drill, and 1 suture anchor was inserted in the base of the coracoid. The present study is notable in that, contrary to similar studies, the fracture site was not opened, allowing fracture union biologically without any further manipulation.[2,15,16] Complete fracture union and high performance scores based on CMS scores strongly support this therapeutic approach. Chen et al. reported distal clavicle fracture treatment with the use of Mersilene tape.[20] They repaired torn CC ligaments and fixed fractured segments with a wire. We believe these steps to be unnecessary, as solid bone union was expected. Unnecessary methods can enhance soft tissue stripping and devascularization. In a retrospective study, Seyhan et al. compared the clinical results of 3 fixation techniques in the treatment of Neer type IIB fractures. They hypothesized that anatomic locking plate and CC stabilization with suture-endobutton technique provides more stable and biomechanically superior fixation with lower complication rates when compared with other treatment methods. They reported anatomic locking plate combined with suture-endobutton for CC ligament reinforcement to be a reliable method to achieve osteosynthesis and stabilization in Neer type IIB distal clavicle fractures without compromising the physiology of the shoulder.[21] In our study, single CC fixation in all patients with type II distal clavicle fractures was effective even in patients with crushed distal segments or osteoporosis. Reduction recovers CC space and changes the fracture pattern from type II to type I. In Neer classification, the CC ligament remains as type I, and conservative treatments are discussed.[7] Repair of the torn CC ligament was unnecessary because its remnants were of poor quality and undetectable. In this approach, no hardware requires removal, and no damage occurs to the CC joint. However, some studies have suggested that this process may be associated with risk of clavicle and coracoid erosion or even of coracoid tip fracture.[2,13–16] Nevertheless, no complications were reported during the follow-up period of 27.8 months. While 2 patients experienced pain and expressed concern about postoperative exercises, these complaints were resolved without complications through proper rehabilitation. Thus, pendulum exercises appear to be necessary immediately after surgery to prevent shoulder joint stiffness. Finally, patient satisfaction at 12 months postoperatively showed that this

treatment method achieved the desired therapeutic results. Use of closed reduction and internal fixation with suture anchor without opening the fracture site, thereby allowing biological processes, is successful in achieving union, in addition to preventing additional costs such as device removal. The technique used in this study can provide favorable results in treatment of patients with distal clavicle fractures.

Conflics of Interest: No conflicts declared.

References

1. Ballmer FT, Gerber C. Coracoclavicular screw fixation for unstable fractures of the distal clavicle. A report of five cases. J Bone Joint Surg Br 1991;73:291–4.
2. Bezer M, Aydin N, Guven O. The treatment of distal clavicle fractures with coracoclavicular ligament disruption: a report of 10 cases. J Orthop Trauma 2005;19:524–8.
3. Brouwer KM, Wright TC, Ring DC. Failure of superior locking clavicle plate by axial pull-out of the lateral screws: a report of four cases. J Shoulder Elbow Surg 2009;18:22–5.
4. Charity RM, Haidar SG, Ghosh S, Tillu AB. Fixation failure of the clavicular hook plate: a report of three cases. J Orthop Surg (Hong Kong) 2006;14:333–5.
5. 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.
6. Edwards DJ, Kavanagh TG, Flannery MC. Fractures of the distal clavicle: a case for fixation. Injury 1992;23:44–6.
7. Flinkkilä T, Ristiniemi J, Hyvönen P, Hämäläinen M. Surgical treatment of unstable fractures of the distal clavicle: a comparative study of Kirschner wire and clavicular hook plate fixation. Acta Orthop Scand 2002;73:50–3.
8. Harris TG, Lynch SA. Acromioclavicular joint separations: update, diagnosis, classification, and treatment. Current Opinion in Orthopaedics 2003;14:255–61.
9. Flinkkilä T, Ristiniemi J, Lakovaara M, Hyvönen P, Leppilahti J. Hook-plate fixation of unstable lateral clavicle fractures: a report on 63 patients. Acta Orthop 2006;77:644–9.
10. Goldberg JA, Bruce WJ, Sonnabend DH, Walsh WR. Type 2 fractures of the distal clavicle: a new surgical technique. J Shoulder Elbow Surg 1997;6:380–2.
11. Hackenbruch W, Regazzoni P, Schwyzer K. Surgical treatment of lateral clavicular fracture with the "clavicular hooked plate". [Article in German] Z Unfallchir Versicherungsmed 1994;87:145–52.
12. Oh JH, Kim SH, Lee JH, Shin SH, Gong HS. Treatment of distal clavicle fracture: a systematic review of treatment modalities in 425 fractures. Arch Orthop Trauma Surg 2011;131:525–33.
13. Klein SM, Badman BL, Keating CJ, Devinney DS, Frankle MA, Mighell MA. Results of surgical treatment for unstable distal clavicular fractures. J Shoulder Elbow Surg 2010;19:1049–55.
14. Robinson CM, Cairns DA. Primary nonoperative treatment of displaced lateral fractures of the clavicle. J Bone Joint Surg Am 2004;86-A:778–82.
15. 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.
16. Scadden JE, Richards R. Intramedullary fixation of Neer type 2 fractures of the distal clavicle with an AO/ASIF screw. Injury 2005;36:1172–5.
17. Wang SJ, Wong CS. Extra-articular knowles pin fixation for unstable distal clavicle fractures. J Trauma 2008;64:1522–7.
18. Mizue F, Shirai Y, Ito H. Surgical treatment of comminuted fractures of the distal clavicle using Wolter clavicular plates. J Nippon Med Sch 2000;67:32–4.
19. Chiang CL, Yang SW, Tsai MY, Kuen-Huang Chen C. Acromion osteolysis and fracture after hook plate fixation for acromioclavicular joint dislocation: a case report. J Shoulder Elbow Surg 2010;19:13–5.
20. Chen CH, Chen WJ, Shih CH. Surgical treatment for distal clavicle fracture with coracoclavicular ligament disruption. J Trauma 2002;52:72–8.
21. Seyhan M, Kocaoglu B, Kiyak G, Gereli A, Turkmen M. Anatomic locking plate and coracoclavicular stabilization with suture endo-button technique is superior in the treatment of Neer Type II distal clavicle fractures. Eur J Orthop Surg Traumatol 2015;25:827–32.