AYRIŞMIŞ, ORTA HAT KLAVİKULA KIRIKLARINDA CERRAHİ TEDAVİNİN FONKSİYONEL SONUÇLARININ DEĞERLENDİRİLMESİ: GERİYE DÖNÜK, ORTA DÖNEM TAKİP SONUÇLARIMIZ

Evaluation of Functional Outcomes in the Surgical Treatment of Displaced Middle-Third Clavicular Fracture: A Retrospective Study and Mid-Term Follow-Up

Musa Uğur MERMERKAYA, Fatih KARAASLAN

Bozok Üniversitesi, Tıp Fakültesi, Ortopedi ve Travmatoloji ABD, Yozgat

Musa Uğur MERMERKAYA, Yrd. Doç. Dr.
Fatih KARAASLAN, Yrd. Doç. Dr.

ÖZET

Amaç: Bu çalışmanın amacı ayrışmış orta hat klavikula kırıklarının cerrahi tedavisinde açık redüksiyon ve internal kilitli plak ile tespitin orta dönem sonuçlarını değerlendirmek.

Gereç ve Yöntem: Ağustos 2011 ve Temmuz 2013 arasında açık redüksiyon ve internal kilitli plak ile tespit yapılan 23 hasta (9 [39,1%] erkek, 14 [60,9%]; ortalama yaş 6,8±12,4 yıl) çalışmaya dahil edildi. Tüm hastalar son kontrollerinde Disabilities of the Arm, Shoulder and hand (DASH) ve Constant Shoulder (CS) skorları ile değerlendirildi.

Bulgular: Ortalama takip süresi 28,6 ay (12-44 ay) ve ortalama kaynama süresi 14.1 ±2,6 hafta (aralık: 10-20 hafta) idi. Hiçbir hastada kaynamama ya da implant yetmezliği gelişmedi. Son kontrollerinde ortalama CS ve DASH skoru 86,3±3,5 (80-93) ve 14,0±4,2 (6,8-25) idi.

Sonuç: Ayrışmış orta hat klavikula kırıklarının cerrahi tedavisinde açık redüksiyon ve internal kilitli plak ile tespit iyi fonksiyonel sonuç sağlamaktadır.

Anahtar kelimeler: *Klavikula; Ayrışmış; Kırık; Açık redüksiyon; Plak ile tespit*

ABSTRACT

Background: The aim of this study was to evaluate the mid-term functional outcomes of open reduction and internal locked-plate fixation in the surgical treatment of displaced middle-third clavicular fractures.

Method: We performed a retrospective review of 23 consecutive patients (9 [39.1%] male, 14 [60.9%] female; mean age, 46.8 ± 12.4 years) who underwent open reduction and internal locked-plate fixation between August 2011 and July 2013. All patients were clinically rated at the final follow-up visit using the Disabilities of the Arm, Shoulder and Hand (DASH) and the Constant Shoulder (CS) scores.

Results: The average follow-up duration was 28.6 months (range: 12–44 months) and the mean union time was 14.1 ± 2.6 weeks (range: 10–20 weeks). None of the patients experienced nonunion or implant failure. At the final follow-up, the mean CS and DASH scores were 86.3 ± 3.5 (range: 80–93) and 14.0 ± 4.2 (range: 6.8–25), respectively.

Conclusion: Surgical treatment using open reduction and internal fixation of displaced middle-third clavicular fractures results in good functional results, has a high rate of union, and provides good functional outcomes with locked-plate fixation.

Key words: *Clavicle; Displaced; Fracture; Open reduction; Plate fixation.*

İletişim:
Yrd. Doç. Dr. Musa Uğur MERMERKAYA,
Bozok Üniversitesi, Tıp Fakültesi, Ortopedi ve Travmatoloji ABD, Yozgat
Tel: +90(532)3346696
e-mail:
drugurmermerkaya@gmail.com

Geliş tarihi/Received: 19.10.2015
Kabul tarihi/Accepted: 29.01.2016

Bozok Tıp Derg 2016;6(1):7-12
Bozok Med J 2016;6(1):7-12

Bozok Tıp Derg 2016;6(1):7-12
Bozok Med J 2016;6(1):7-12

INTRODUCTION

Fractures of the clavicle are common and account for 2.6–4% of all reported fractures, with mid-shaft fractures constituting approximately 80% of all clavicle fractures (1,2). In adults, 4–7% of diaphyseal fractures result in non-union, increasing to 15–20% for completely displaced fractures (3,4). Clavicle fractures are traditionally treated conservatively. Indications for surgical treatment are open fractures, fracture ends irritating the skin, accompanying neurovascular injury, floating shoulder injury, patients with polytrauma, and cases of nonunion following conservative treatment. Good or excellent functional results can be achieved with conservative treatment for clavicle fractures in children and adolescents where cortical contact is maintained (5,6). However, high nonunion and symptomatic malunion rates following the conservative treatment of displaced and comminuted fractures, the high functional expectations of patients, and the development of implant technology have led to an increase in the use of surgery (7-11).

The aim of this study was to retrospectively evaluate the radiological and clinical outcomes of open reduction and internal fixation of completely displaced clavicular fractures using locked anatomic plates.

METHODS

Patients who were treated between August 2011 and July 2013 for a displaced midshaft fracture of the clavicle, which encompassed Robinson type B1 and 2 fractures (12), were initially included in our study. Undisplaced (less than a shaft of displacement), open, or pathologic fractures, fractures at the proximal or distal end of the clavicle, fractures with cortical continuity, accompanying fractures of the shoulder girdle, accompanying acromioclavicular joint pathologies and/or rotator cuff tears, as well as an age below 18 years or an associated brain injury (grades II and III), were excluded from the study. On applying these criteria, a total of 23 patients were retrospectively enrolled in the study. The study group consisted of 9 males and 14 females who underwent at least 1 year of follow-up. The mean age of the patients was 46.8 years (range: 22–63 years) at the time of surgery. The nature of the surgical intervention was explained and all patients signed an informed consent form concerning the operative technique. One of the senior authors performed all surgical procedures at a single center. Standard and 20° caudal anterior-posterior shoulderradiographs were evaluated for all patients after neurovascular examination (Fig. 1). One gram of first generation cephalosporin (Cefazolin) prophylaxis was administered to all patients 30 minutes before surgery. Patients were operated on under general anesthesia while in the beach chair position. A straight incision was made over the fracture line and patients were treated with contoured or pre-contoured locked plates manufactured by Synthes (West Chester, PA, USA)or Acumed (Hillsboro, OR, USA; Fig. 2). The surgical technique forclavicular open reduction internal fixation was via a superior plating approach. The type of plate,reduction technique, number of intrafragmentary lag screws, and the use of locking or non-locking screws was determined by the fracture type.

Patients were non-weight-bearing and wore a sling postoperatively for 2 weeks. They progressed to an active and passive range of motion after 2 weeks and then to weight-bearing activity at 6 weeks. Physical therapy was prescribed for all patients to restore the range of motion and strength. At the end of the 6th month, all activities were permitted without limitation. Radiologically visible callus formation after 24 weeks was accepted as evidence of delayed union while the non-formation of callus, pathological movement, and pain after 24 weeks were defined as nonunion (10,11). Implant failure was described as a loss of anatomical reduction with bending of the plate or a broken plate and loosening of the screws (13).

For the clinical evaluation, we used the Disabilities of the Arm, Shoulder and Hand (DASH) (14) and the Constant Shoulder (CS) (15) scores at the final follow-up. We arranged appointments at our outpatient clinic for patients to undergo X-ray, and CS and DASH scoring at final follow-up after surgery.

Statistical Analysis

Data analysis was performed with Statistical Package for the Social Sciences (SPSS) for Windows software (ver. 17.0;IBM Corp., Armonk, NY, USA). Determination of normal distributions of continuous variables was performed by a Shapiro Wilk test. Continuous variables are shown as means ± standard deviation (min-max). Otherwise, the number of cases and percentages are shown for categorical data. The mean differences in both the QuickDASH (a shortened version of DASH) and CS scores between groups were compared by a Student's t test. The associations among continuous variables were evaluated by Spearman's rank correlation analyses. A p-value less than 0.05 was considered statistically significant.

RESULTS

The study group consisted of 23 (9 males, 14 females) patients who underwent at least 1 year of follow-up. The mean age of the patients was 46.8 years (range: 22–63 years) at the time of surgery. In total, 13 patients had left- and 10 patients had right-sided fractures. The averagefollow-up period was 28.6 months (range: 12–44 months) and the mean union time was 14.1 ± 2.6 weeks (range: 10–20 weeks). None of the patients experienced nonunion or implant failure or implant irritation at the final follow-up, and no superficial or deep surgical site infections were present during the early and late postoperative periods.

At the final follow-up, the mean CS and DASH scores were 86.3 ± 3.5 (range: 80–93) and 14 ± 4.2 (range: 6.8–25), respectively (Table 1). No significant difference was found for the DASH and CS scores according to age, gender, or side (Table 2).

Table 1: Demographical and clinical characteristics of the patients

Variables	n (%)	mean ± SD	min-max
Age (years)		46.8 ± 12.4	22–63
Gender			
Female	14 (60.9)		
Male	9 (39.1)		
Side			
Right	10 (43.5)		
Left	13 (56.5)		
Follow-up (month)		28.6 ± 8.3	12–44
Union (week)		14.1 ± 2.6	10–20
DASH score		14.0 ± 4.2	6.8–25
CS score		86.3 ± 3.5	80–93

n, number of cases; SD, standard deviation; min, minimum; max, maximum; DASH, disabilities of the arm, shoulder, and hand; CS, constant shoulder.

Table 2: DASH and CS scores according to age, gender, and operation side

Variables	DASH score	CS score
Age (years)		
Age below median	12.6 ± 3.7	85.8 ± 3.3
Age above median	15.5 ± 5.5	86.8 ± 3.8
p-value †	0.182	0.501
Gender		
Female	14.1 ± 4.2	86.6 ± 3.3
Male	13.9 ± 5.9	86.0 ± 4.0
p-value †	0.913	0.713
Side		
Right	12.9 ± 4.3	85.3 ± 2.7
Left	14.9 ± 5.2	87.1 ± 3.9
p-value †	0.359	0.217

DASH, disabilities of the arm, shoulder, and hand; CS, constant shoulder.
† Student's t test.

DISCUSSION

Even though clavicular fractures are common in traumatology, precise recommendations concerning their treatment remain difficult to determine and controversial. In addition, there are high rates of nonunion and symptomatic malunion of clavicle fractures occurring after high-energy trauma combined with a shortening greater than 20 mm, displacement, angulation greater than 30º, or fragmentation (16). It is reported that malunion impairs the static anatomical relations of the shoulder girdle and leads to restriction of the extension and abduction movements of the glenohumeral joint (17). In addition, shoulder asymmetry and related cosmetic displeasure has been reported due to shortening greater than 20 mm (3). In this study, the primary indications for surgery in midshaft fractures were a shortening greater than 20 mm and a segmented-comminuted fracture type. Neer's work from the 1960s shows a very low rate of nonunion (18) and has been the basis for recommendations of conservative treatment for a long period of time. Recently published works, however, reveal a significantly higher rate of nonunion and more unsatisfied patients with conservative treatment compared to those who underwent surgery (7,19). A Canadian multicenter randomized trial showed plate fixation to be superior to conservative treatment in relation to nonunion rate, patient satisfaction, and clinical scores (DASH and CS) (10). The literature provides strong statistical indications that an operation significantly reduces the risk of nonunion (20,21,22) and thereby improves the clinical outcome. The findings from the patients in our study are consistent with those cited in previously-published articles.Ozleret al. reported implantirritationwasdetected in two (12.5%) patientsin 16 patients over a mean follow-up period of 24.6 months, with requiring implant removed (22). On the other hand in our study none of the patients experienced implant irritation early and late postoperative periods. However, an operation is more likely to cause complications at the beginning compared to conservative treatment and might require a second operation for implant removal. Multiple randomized trials in adults have demonstrated improved rates of union and functional outcomes with primary operative fixation of displaced midshaftclavicular fractures compared with non-operative treatment (23,24).

In a prospective clinical study with 73 clavicle fractures (age: 20-50 years), 45 patients underwent operation with superiorly-placed, pre-bent reconstruction plates while 28 patients were treated conservatively with a simple shoulder-arm sling. Better results were reported after surgery in terms of malunion, nonunion, and functional scores (25).

This study was limited by its observational and retrospective design and relatively small number of patients. We also did not include a control group for comparison. The ideal scenario would be to perform a prospective, multicenter, randomized trial. Comparative studies of the long-term outcomes of different surgical techniques, incorporating larger case series with similar qualifications, are required in the future.

In conclusion, surgical treatment with open reduction and internal fixation of displaced middle-third clavicular fractures results in good functional results, has a high rate of union, and provides good functional outcomes with locked-plate fixation.

REFERENCES

1. Nordqvist A, Petersson C The incidence of fractures of theclavicle. Clin Orthop Relat Res1994 ;300:127–132
2. Postacchini F, Gumina S, De Santis P, Albo F Epidemiology of clavicle fractures. J Shoulder Elbow Surg 2002;11(5):452–456
3. Robinson CM, Court-Brown CM, McQueen MM, Wakefield AE Estimating the risk of nonunion following nonoperative treatment of a clavicularfracture. J Bone JointSurg Am 2004;86-A(7):1359–1365
4. Eskola A, Vainionpaa S, Myllynen P, Patiala H, Rokkanen P Outcome of clavicular fracture in 89 patients. ArchOrthopTraumaSurg 1986;105(6):337–338
5. Faldini C, Nanni M, Leonetti D, Acri F, Galante C, Luciani D, et al. Nonoperative treatment of closed displaced midshaft clavicle fractures. J OrthopTraumatol 2010;11:229-36.
6. Lazarides S, Zafiropoulos G. Conservative treatment of fractures at the middlethird of theclavicle: therelevance of shortening and clinical outcome. J ShoulderElbowSurg 2006;15: 191-4.
7. McKee MD, Pedersen EM, Jones C, Stephen DJ, Kreder HJ, Schemitsch EH, et al. Deficits following nonoperative treatment of displaced midshaft clavicular fractures. J Bone Joint Surg Am 2006;88:35-40.
8. Jeray KJ. Acute midshaft clavicular fracture. J Am Acad Orthop Surg 2007;15:239-48.
9. Zlowodzki M, Zelle BA, Cole PA, Jeray K, McKee MD, Evidence-Based Orthopaedic TraumaWorking Group. Treatment of acute midshaft clavicle fractures: systematic review of 2144 fractures: on behalf of the Evidence Based Orthopaedic Trauma Working Group. J OrthopTrauma 2005;19:504-7.
10. Canadian Orthopaedic Trauma Society. Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures. A multicenter, randomized clinical trial. J Bone JointSurg Am 2007;89:1-10.
11. Pearson AM, Tosteson AN, Koval KJ, McKee MD, Cantu RV, Bell JE, et al. Is surgery for displaced, midshaft clavicle fractures in adultscost-effective? Resultsbased on a multicenter randomized, controlled trial. J OrthopTrauma 2010;24: 426-33.
12. Robinson CM. Fractures of the clavicle in theadult. Epidemiology and classification. J Bone JointSurg. 1998;80(3):476–84.
13. Smekal V, Irenberger A, Struve P, Wambacher M, Krappinger D, Kralinger FS.Elasticstableintramedullary nailing versus nonoperative treatment of displaced midshaft clavicular fractures-a randomized, controlled, clinicaltrial. J OrthopTrauma 2009;23:106-12.
14. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of thearm, shoulder, andhand). The upper extremity collaborative group (UECG). Am J IndMed 1996;29:602-8.
15. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res 1987;(214): 160-4.
16. Nowak J, Holgersson M, Larsson S. Can wepredict long term sequelae after fractures of the clavicle based on initial findings? A prospective study with nine to ten years of followup. J Shoulder Elbow Surg 2004;13:479-86.
17. Ledger M, Leeks N, Ackland T, Wang A. Short malunions of theclavicle: an anatomic and functional study. J Shoulder Elbow Surg 2005;14:349-54.

18. Neer 2nd CS. Nonunion of theclavicle. J AMA. 1960;172:1006-11.
19. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. J Bone JointSurg. 1997;79(4):537-9.
20. Robinson CM, Goudie EB, Murray IR, Jenkins PJ, Ahktar MA, Read EO, et al. operative treatment for displaced midshaft clavicular fractures: a multicenter, randomized, controlledtrial. J Bone JointSurg Am. 2013;95(17):1576–84
21. McKee RC, Whelan DB, Schemitsch EH, McKee MD. Operative versus nonoperative care of displaced midshaft clavicular fractures: a meta-analysis of randomizedclinicaltrials. J Bone JointSurg Am. 2012;94(8):675–84.
22. Ozler T, Güven M, Kocadal AO, Uluçay C, Beyzadeoğlu T, Altıntaş F. Locked anatomic plate fixation in displaced clavicular fractures. ActaOrthopTraumatolTurc. 2012;46(4):237 42.
23. Robinson CM, Goudie EB, Murray IR, Jenkins PJ, Ahktar MA, Read EO, et al. Open operative treatment for displaced midshaft clavicular fractures: a multicenter, randomized controlled trial. J Bone JointSurg Am 2013;95:1576-84.
24. Virtanen K, Remes V, Pajarinen J, Savolainen V, Bjorkenheim JM, Paavola M. Sling compared with plate osteosynthesis for treatment of displaced midshaft clavicle fractures: a randomizedclinicaltrial. J Bone JointSurg Am 2012;94(17):1546-53
25. Kulshrestha V, Roy T, Audige L. Operative versus nono perative management of displaced midshaft clavicle fractures: a prospectivecohortstudy. J OrthopTrauma 2011;25(1):31-8.