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Effect of surgery and conservative treatment on clavicular shortening in midshaft clavicle fractures

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Abstract

Aim: Clavicle fractures mostly occur after a trauma in adults and 80% of them occur in the midshaft. Treatment is done conservatively and surgically. The aim of the study is to evaluate the effects of surgical and conservative treatments on clavicular shortening in terms of radiological evaluation retrospectively.

Materials and Methods: The patients over the age of 18 with a midshaft clavicle fracture, who applied to our center between 2015 and 2020 and were treated conservatively and surgically, were included in the study. In both treatment groups, the clavicle lengths on the fractured side and the intact side of the patient were measured on the posterior-anterior thorax radiography, and the relevant shortness of length was determined. The rates of Clavicular Shortening and other complications occurred in both treatment groups were evaluated

Results: Ages of the patients included in the study were between 18 and 71 (mean 35.6 ±12.2years) and 48 of them were treated conservatively and 28 were treated surgically. Clavicle length was determined as 158 ±11.2 mm and shortness as 8.2±9.4 mm on average in the patients with a midshaft fracture, who were treated conservatively. In the patients with midshaft fracture, who were treated surgically, the length of clavicle was measured as 164±12.6 mm and shortness as 3.1±5.2 mm. Statistically significant short clavicle length was determined in the patients who were treated conservatively ($p < 0.05$). While 11 (22.9%) complications were observed in the patients treated conservatively, 9 (32.1%) complications were observed in those treated surgically.

Conclusions: A lower rate of clavicular shortening was found in the surgical treatment of midshaft clavicle fractures. This can be one of the reasons for the increase in the tendency to surgery, as it preserves the anatomy and biomechanics of the shoulder better.

Introduction

Clavicle fractures constitute 2.6-4% of the adult fractures and 35% of the shoulder fractures [1]. Simple falls, sports injuries, and traffic accidents are the most common causes of clavicle fractures. They are more frequently seen in men. Clavicle fractures are classified as lateral, midshaft and medial parts according to anatomic location of the fracture of clavicle of which is divided into three equal length segments [2]. While 80% of the clavicle fractures occur in the midshaft, 15% occur in the lateral region, and 5% in the medial region [3, 4]. In previous studies, it was reported that the results of conservative treatment in mid-shaft clavicle fractures were quite good. Because the evaluation of these patients was based more on union rather than function, cosmetic and activity level [5, 6, 7]. In the studies conducted today, problems such as non-union, weakness, limitation of function in the shoulder, and ongoing pain have been detected as a result of conservative treatment for such fractures. In fact the consequences of conservative treatment are not as perfect as known [8, 9]. This has led to the development of new treatment approaches and has increased the popularity of surgical treatment [10, 11]. Conservative and surgical treatment indications for midshaft clavicle fractures have been discussed in the literature. Although there is no exact consensus, the presence of open fractures, floating shoulder, skin-irritating fracture fragments, and neurovascular damage take place among the indications for surgical treatment in clavicle fractures [12]. While conservative treatment of midshaft clavicle fractures are mostly performed by arm sling or posterior clavicular bandage, surgical treatment options are plate fixation or intramedullary pin fixation after oen reduction of the fragments [13, 14]. The success

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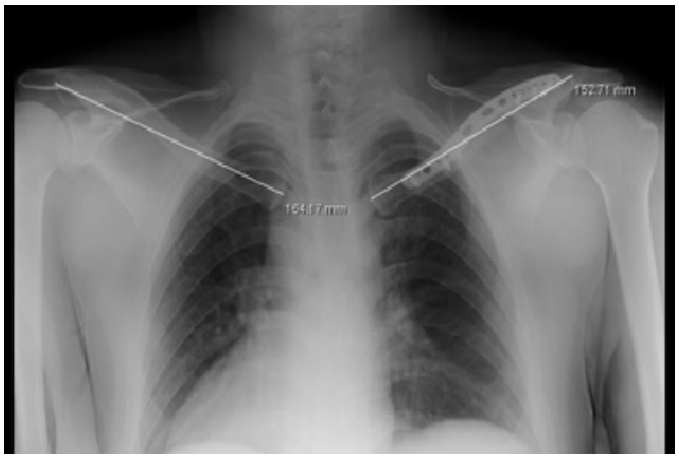

Figure 1. Measuring the length of surgically treated clavicle fracture and intact side

of these two treatment modalities, is mostly compared by their union rates, complications, and functional results.

It has been reported that clavicular shortening, that occurs after conservative and surgical treatment, has an important role in the healing of such fractures and the recovery of shoulder functions [15, 16]. The aim of the present study is to compare the radiological results of surgically and conservatively treated midshaft clavicle fractures and to determine the effect of these two treatment approaches on clavicular shortening.

Materials and Methods

The study was started after obtaining the approval of the ethics committee (Ethics committee number no: 2021/10-15). One hundred ninety-two patients, who applied to our center between 2015 and 2020 due to clavicle fracture, were retrospectively evaluated. Conservatively and surgically treated patients having a midshaft clavicle fracture, who were over the age of 18 and had posterior-anterior thorax radiographs as control radiographs, were evaluated. The patients under the age of 18, 1\3 proximal and 1\3 distal clavicle fractures, and pathological fractures were not included in the study. After the exclusion and inclusion criteria, a total of 76 patients were included in the study. Demographic data, treatment modalities, and follow-up periods of the patients were noted. In both treatment groups, the clavicle lengths on the fractured side and contralateral side of the patient were measured on the posterior-anterior thorax radiography and the relevant clavicular shortening was determined. The measurements were made by two orthopedic specialists who had no knowledge about this study, and results were statistically analyzed. The rates of clavicular shortening in the patients, who were treated conservatively and surgically, were compared at the end of the treatment. While measuring the length of the clavicle, it was measured as the distance between the most medial of the sternal end and the most lateral of the acromial end of both clavicles separately for standardization [17] (Figure 1). Complications occurred as a result of both treatments and the approach to complications was determined.

Table 1. Complications observed in clavicle fractures

	Surgery (28)	Conservative (48)
Non-union	1 (3.5%)	7 (14.5%)
Infection	2 (7.1%)	0
Implant irritation	5 (17.8%)	0
Protuberance on the union region	0	2 (4.1%)
Keloid tissue	1 (3.5%)	0
Acromioclavicular joint anomalies and chronic pain	0	2 (4.1%)
Total	9 (32.1%)	11 (22.9%)

Surgical indication

Open fractures, floating shoulder, presence of fracture fragments disturbing the skin, presence of neurovascular damage, and midshaft clavicle fractures with a shortness of more than 20 mm were accepted as surgical treatment indications in the study [1,12].

Statistics

SPSS 21.0 (IBM Corporation, Armonk, NY, USA) statistics program was used for data assessment. Numerical data were expressed as mean±standard deviation, numerical data that were non-parametric or did not comply with normal distribution were expressed as Median (minimum-maximum), and qualitative data were expressed as percentages. Mann-Whitney-U test was used to compare the binary groups formed by the continuous variables that were non-parametric or did not comply with normal distributions. $p < 0.05$ was considered as statistically significant.

Results

Ages of the patients included in the study were between 18 and 71 (mean 35.6 ±12.2 years) and 52 of them were male and 24 were female. Of the patients, 48 were treated conservatively and 28 surgically. Mean follow-up period was found as months 32.3 (8-48) months. In the surgically treated patients group, the length of clavicle was measured as 164±12.6 mm and shortness as 3.1±5.2 mm. When the results of both groups were compared, a statistically significant clavicular shortening was determined in the conservatively treated patients group ($p < 0.05$).

Complications

In the conservative treatment group, 11 (22.9%) complications were found. Non-union developed in 7 (14.6%) of them, 2 (4.1%) had a bulge in the 1/3 midpart of the clavicle, and 2 (4.1%) developed acromioclavicular problems in the shoulder. In the surgical treatment group, 9 (32.1%) complications were found. Of these complications, 5 (17.8%) had implant irritation, 2 (7.1%) had infection, 1 (3.5%) had non-union, and 1 (3.5%) had keloid tissue (Table 1.).

In 5 patients, who had implant irritation, the implant was removed by another surgery. The patients, at whom infections developed, had superficial tissue infections and they were recovered with oral antibiotic therapy. The patient suffering from keloid tissue underwent keloid excision process by plastic and reconstructive surgery.

Discussion

Clavicle midshaft fractures are generally treated conservatively using a clavicular bandage and a simple arm sling. However, especially in recent studies, high rates of non-union and shoulder dysfunction were found in such fractures that were treated conservatively. This had increased the trend to surgery in midshaft clavicle fractures. In recent meta-analysis studies, the rate of non-union was found to be 15% in conservative treatment of midshaft clavicle fractures, while it was 2.2% in the patients treated surgically [9]. Again, in the recent studies, functional results of the surgical treatments performed with appropriate indications were found to be better [18-21].

During the evaluation of the results of conservative and surgical treatments, shoulder functions and complication rates are especially observed. Clavicle shortness, which occurs after healing of clavicle mid-shaft fractures, has been reported in the literature to be effective on shoulder dysfunction [15, 16, 22]. In the present study, a higher rate of shortness was observed in conservatively- and surgically treated clavicle midshaft fractures when the clavicle length of the fractured side was compared with the non-fractured side.

However, although the amount of shortness is not an exact consensus, it is stated that if it is more than 15 or 20 mm, it may have a negative effect on the functions [13, 23]. In the study, no significant dysfunction was observed in any of the treatment approach. It was thought that this might be due to the low rate of shortness of mean 8 mm in conservative follow-ups and mean 3 mm in surgical treatments. In addition, the fracture fragments shorter than 20 mm, which are accepted as a relative surgical indication in the literature, was accepted as an absolute surgical indication in the clinic and surgical treatment was performed [24]. Considering this relative indication as an absolute indication probably caused the low detection of clavicle shortness in our treatment results. In surgical treatment, clavicular shortening is determined less, and functional results are reported to be more successful [20, 21]. This is thought to be caused by better preservation of anatomical structure and biomechanics in surgical treatment.

In the biomechanical studies, it was determined that the clavicular shortening caused a change in the maximum muscle moments around the shoulder girdle [25]. Thus, it was considered that this may cause limitation in the shoulder movements as a consequence of its negative effect on scapula kinematics [26, 27, 28]. Despite all these studies, the rate of clavicular shortening occurring after the midshaft fractures and the mechanism of action on the shoulder girdle are still not fully explained, and they continue to be discussed in the literature. This is thought to play a role in the dynamic structure of the shoulder girdle and the presence of many structures participating in its movements.

In case of a surgical intervention in clavicle midshaft fractures, two options are preferred in general; these are intramedullary nailing and screw plating [29]. Plating has advantages such as anatomical reduction and rigid fixation against its disadvantages such as wide incision and subsequent plaque irritation [12, 30]. In intramedullary nailing, advantages such as smaller incision, shorter surgery time, and shorter hospitalization are present, while the absence of anatomical reduction, rigid fixation, and complications such as pin migration are considered as its disadvantages [31, 32].

There are publications stating that the rate of complications in surgical treatment is relatively higher [33]. On the contrary, there are also some publications stating that complications are more common in the surgical treatment approach [22]. In the present study, all the complications were evaluated together, and it was found that the complication rates were higher in the patients subject to surgical treatment. According to the observations and the literature review, the most discussed issues are non-union seen in conservative treatments and implant-related complications in surgical treatments. Non-union is the most frequently seen complication of conservative treatments and is seen in the range of 14% to 24% [34, 35, 36]. In this series, it was seen at a rate of 14.5% that is similar to the literature. Thus, this causes late-term surgery, prolonged treatment time, and workforce loss. Implant irritation is the second most frequent complication in surgical treatments, and it requires a secondary surgery in its treatment [33, 37]. In the current study, the implants were removed via a second operation due to the implant irritation in five cases, who were treated surgically. In the second surgery, there is an increase in the rate of workforce loss and surgery-related complications. Other complications seen in the treatment of midshaft clavicle fractures after conservative treatment are protuberance on the union region and acromioclavicular joint anomalies (joint subluxation, arthrosis, and persistent pain) that occur in the fracture site after union [22, 34, 35]. Protuberance was occurred in two cases and persistent pain in acromioclavicular joint was observed in two cases. Other complications that are seen in the patients, who were surgically treated, are non-union, infection, keloid occurred in the incision scar, and numbness due to iatrogenic nerve injury [22, 38, 39]. In the present series, non-union occurred in one case, infection in two cases, and keloid tissue in one case. These complications were treated, and the patients recovered completely without developing a chronic deformity, however, only one of the cases, who was subject to conservative treatment, had persistent but not very disturbing pain in the acromioclavicular region.

Limitations

The study has some limitations. One of them is that the study is retrospective, and the second is that the number of the cases is low. Third important limitation is that post-treatment shoulder functions are not evaluated via the scoring systems. This could not be done due to two reasons. One was that the current study evaluated the radiological results, and the second was that the patients were not brought to the hospital environment and exposed

to the risk of COVID-19 pandemic.

Conclusion

A lower rate of clavicular shortening was found in the surgical treatment of midshaft clavicle fractures. This may lead to an increase in the tendency to surgery due to the reason that it preserves the anatomy and biomechanics of the shoulder better. However, it was not determined how clavicular shortening was effective on shoulder functions. It is believed that this can be determined by further prospective and biomechanical studies.

References

1. Kapıcıoğlu M,Bilse K. Klavikula kaynamamaları. TOTBİD Dergisi.2017; 16:493–98.
2. Ropars M, Thomazeau H, Huten D. Clavicle fractures. OrthopTraumatolSurg Res. 2017;103:53-59.
3. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. J Shoulder Elbow Surg. 2002;11:452–6
4. Robinson CM. Fractures of the clavicle in the adult: epidemiology and classification. J Bone Joint Surg Br. 1998;80:476-84.
5. Simom P. Fractures and non-unions of the clavicle. In Bentley G, eds, European Instructional lectures. European Instructional Course Lectures 2009; 9: 75-9.
6. Lazarus MD, Seon C. Fractures of the clavicle. In: Bucholz RW, Heckman JD, Court-Brown C, eds. Rockwood and Green's fractures in adults vol 1, 6th ed. Lippincott Williams & Wilkins; 2006;1212-55.
7. Rowe CR. An atlas of anatomy and treatment of midclavicular fractures. ClinOrthopRelat Res. 1968;58:29-42.
8. Nowak J, Holgersson M, Larsson S. Sequelae from clavicular fractures are common: a prospective study of 222 patients.ActaOrthop. 2005;76:496-502.
9. Zlowodzki M, Zelle BA, Cole PA, et al. Treatment of acute midshaft clavicle fractures: systematic review of 2144 fractures. J Orthop Trauma. 2005;19:504-507.
10. Basamania CJ, Rockwwod CA. Fractures of the clavicle. In: Rockwood CA, Matsen FA, eds. The shoulder vol 1 Philadelphia: Saunders Elsevier 2009; 406-13.
11. McKee MD, Pedersen EM, Jones C, et al. Deficits following nonoperative treatment of displaced midshaft clavicular fractures. J Bone Joint Surg Am. 2006; 88: 35-40.
12. Van der Meijden OA, Gaskill TR, Millett PJ. Treatment of clavicle fractures: current concepts review. J Shoulder Elbow Surg. 2012;21:423–29
13. Hill JM, McGuire MH, Crosby LA. Closed treatment of displaced middle-third fractures of the clavicle gives poor results. J Bone Joint Surg Br. 1997;79:537-41.
14. Kabak S, Halici M, Tuncel M, Avsarogullari L, Karaoglu S. Treatment of mid-clavicular nonunion: comparison of dynamic compression plating and low-contact dynamic compression plating techniques. J Shoulder Elbow Surg. 2004;13:396-403.
15. De Giorgi S, Notarnicola A, Tafuri S, et al. Conservative treatment of fractures of the clavicle. BMC Res Notes 2011; 4: 333.
16. Potter JM, Jones C, Wild LM, Schemitsch EH, McKee MD. Does delay matter? The restoration of objectively measured shoulder strength and patient-oriented outcome after immediate fixation versus delayed reconstruction of displaced midshaft fractures of the clavicle. J Shoulder Elbow Surg 2007; 16: 514-8.
17. Smekal V, Deml C, Irenberg A, et al. Length determination in midshaft clavicle fractures: validation of measurement. J Orthop Trauma.2008; 22: 458-62.
18. Kong L, Zhang Y, Shen Y. Operative versus nonoperative treatment for displaced midshaft clavicular fractures: a meta-analysis of randomized clinical trials. Arch Orthop Trauma Surg. 2014;134:1493-1500
19. Lenza M, Buchbinder R, Johnston RV,et al. Surgical versus conservative interventions for treating fractures of the middle third of the clavicle. Cochrane Database Syst Rev. 2013;(6):CD009363
20. Woltz S, Krijnen P, Schipper IB. Plate fixation versus nonoperative treatment for displaced midshaft clavicular fractures: a meta-analysis of randomized controlled trials. J Bone Joint Surg Am. 2017; 99:1051-57
21. Xu J, Xu L, Xu W, Gu Y, Xu J. Operative versus nonoperative treatment in the management of midshaft clavicular fractures: a metaanalysis of randomized controlled trials. J Shoulder Elbow Surg. 2014;23:173-81.
22. Canadian Orthopaedic Trauma Society. Nonoperative treatment compared with plate fixation of displaced midshaft clavicular fractures. A multicenter, randomized clinical trial. J Bone Joint Surg Am. 2007; 89:1-10.
23. Eskola A, Vainionpaa S, Myllynen P, et al. Outcome of clavicular fracture in 89 patients. Arch Orthop Trauma Surg. 1986;105:337-38.
24. Oroko PK, Buchan M, Winkler A, Kelly IG: Does shortening matter after clavicular fractures? Bull HospJt Dis. 1999;58:6-8.
25. Hillen RJ, Bolsterlee B, Veeger DHEJ. The biomechanical effect of clavicular shortening on shoulder muscle function, a simulation study.ClinBiomech (Bristol, Avon). 2016;37:141-46.
26. Kim D, Lee D, Jang Y, et al. Effects of short malunion of the clavicle on in vivo scapular kinematics.J Shoulder Elbow Surg. 2017; 26:286-92.
27. Su WR, Chen WL, Chen RH, et al. Evaluation of three-dimensional scapular kinematics and shoulder function in patients with short malunion of clavicle fractures.J Orthop Sci. 2016; 21:739-44.
28. Matsumura N, Ikegami H, Nakamichi N, et al. Effect of shortening deformity of the clavicle on scapular kinematics: a cadaveric study. Am J Sports Med. 2010;38:1000-1006.
29. Wiesel B, Nagda S, Mehta S, Churchill R. Management of Midshaft Clavicle Fractures in Adults. J Am AcadOrthop Surg. 2018;26:468-76.
30. Wang XH, Guo WJ, Li AB,etal.Operative versus nonoperative treatment for displaced midshaft clavicle fractures: a meta-analysis based on current evidence. Clinics (Sao Paulo). 2015;70:584-92.
31. Frigg A, Rillmann P, Perren T, et al. Intramedullary nailing of clavicular midshaft fractures with the titanium elastic nail: problems and complications. Am J Sports Med. 2009;37:352-59.
32. Bachoura A, Deane AS, Kamineni S. Clavicle anatomy and the applicability of intramedullary midshaft fracture fixation. J Shoulder Elbow Surg. 2012;21:1384-90.
33. Guerra E, Previtali D, TamboriniS,et al.Midshaft Clavicle Fractures: Surgery Provides Better Results as Compared With Nonoperative Treatment: A Meta-analysis. Am J Sports Med. 2019;47:3541-51.
34. Fuglesang HF, Flugsrud GB, Randsborg PH, et al. Radiological and functional outcomes 2.7 years following conservatively treated completely displaced midshaft clavicle fractures. Arch Orthop Trauma Surg. 2016;136:17-25.
35. Woltz S, Stegeman SA, Krijnen P, et al: Plate fixation compared with nonoperative treatment for displaced midshaft clavicular fractures: A multicenter randomized controlled trial. J Bone Joint Surg Am. 2017; 99:106-12.
36. Robinson CM, Court-Brown CM, McQueen MM, Wakefield AE.Estimating the risk of nonunion following nonoperative treatment of a clavicular fracture. J Bone Joint Surg Am. 2004;86-A: 1359-65
37. Vannabouathong C, Chiu J, Patel R, et al. An evaluation of treatment options for medial, midshaft, and distal clavicle fractures: a systematic review and meta-analysis. JSES Int. 2020 ;4:256-71.
38. Hulsmans MH, van Heijl M, Houwert RM, et al: High irritation and removal rates after plate or nail fixation in patients with displaced midshaft clavicle fractures. ClinOrthopRel Res. 2017; 475: 532-39.
39. Naimark M, Dufka FL, Han R, et al: Plate fixation of midshaft clavicular fractures: Patient-reported outcomes and hardware-related complications. J Shoulder Elbow Surg. 2016;25:739-46.