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Research Article

Outcomes Following Open Reduction Internal Fixation (Orif) for the Treatment of Displaced Mid Shaft Clavicle Fractures

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Abstract

Objective: To evaluate the clinical and functional outcomes following open reduction internal fixation (ORIF) for the treatment of displaced mid shaft clavicle fractures.

Patients and Methods: A total of 56 patients were included in this study but only 45 patients were available at the last follow up from May 2016 to January 2018. Patients from 15 to 50 years age, who had visible deformity and had 100% displaced mid shaft clavicle fractures were included in the study. Functional outcomes were measured by using Disability of arm, shoulder and hand (DASH) scoring system. Bone union was assessed by radiological findings after 6 weeks and 12 weeks follow up post operatively.

Result: The mean age of the whole cohort was 32.3 years. Approximately 70% of our cohort comprised of male patients and 30% were females. Forty patients had united fractures on follow up radiographs at 12 weeks postoperatively with no pain and good range of motion at 6 months. Forty-three patients (95%) had no pain and returned back to their respective activities. The mean DASH score after 6 months of surgery was 16.10 (644.3) and at 12 months, it improved significantly to 3.77 (151.1).

Conclusion: The results of the current investigation demonstrated that 95% (43 out of 45) patients have good functional outcome with no complications We believe that ORIF should be considered as a primary treatment as it is a valuable option for treating displaced mid shaft clavicle fractures.

Keywords: *ORIF; Displaced Mid Shaft Clavicle Fracture; DASH; Bone Union*

Abbreviations

ORIF: Open Reduction and Internal Fixation; DASH: Disability of Arm, Shoulder and Hand; OPD: Out Patient Department

Introduction

Fracture clavicle is one of the most commonly encountered injuries in the emergency department [1]. Two to five percent of these injuries account for all adult fractures whereas ten to fifteen percent of all childhood fractures involve the clavicle [2]. About 70% to 80%

of these fractures are in the mid shaft of the bone and manifest some degree of displacement. Most common injury mechanism is due to direct trauma, such as fall on the shoulder with an outstretched hand [3]. Historically, Non-operative treatment was the mainstay for the management of these injuries. However, there are certain factors which increase the risk of non-union if these injuries are treated non-operatively including degree of displacement, comminution, age and co-morbidities. It has been reported that the risk of non-union is 3 times lesser if these injuries are treated operatively [4,5]. A previous systematic review comprising of 1,145 mid shaft clavicle fractures treated non-operatively showed that the rate of non-union for displaced mid shaft clavicle fractures was 15.1% [6]. Conservative management remains the treatment of choice for non-displaced mid shaft clavicle fractures, however the optimal treatment option for displaced mid shaft clavicle fractures remain controversial. According to some prospective studies, non-operative care of displaced mid shaft clavicle fractures lead to poor functional outcomes and disability [7,8]. The operative fixation for displaced mid shaft fractures of clavicle revealed good functional outcomes and early union as compared to the non- operative management [9]. As these injuries commonly effect young and active population so their priority is early union and early return to function. In an attempt to provide strong construct and earlier rehabilitation, we have evaluated retrospectively the functional outcomes of patients with displaced mid shaft clavicle fractures treated with open reduction and internal fixation (ORIF).

Methodology

In this single institutional retrospective case series, all patients with displaced mid shaft clavicle fractures from age 15 to 50 years, treated with ORIF, from May 2016 to January 2018 were included in this study. The surgical techniques were standardized for all patients. Patients who had visible deformity and had 100% displaced mid shaft clavicle fractures were included in the study.

Patients who were smokers or had any other addictions and patients who were suffering from any other infection were excluded from the study. All patients were prospectively reviewed in our out-patient department (OPD) to determine clinical and radiological outcomes at 6 months and 12 months post operatively. Outcome data included patient's demographics, clinical and radiological union, pain intensity, functional outcome of operated arm and complications like mal union, infection, implant removal, severe pain, loss of sensation etc.

Functional outcomes were measured by using Disability of arm, shoulder and hand (DASH) scoring system. Bone union was assessed by radiological findings after 6 weeks and 12 weeks follow up post operatively. Delayed union was defined as healing between 12 weeks to 24 weeks and non- union when healing had not occurred by 24 weeks. DASH scores were obtained on interviews from patients after 6 months and 12 months postoperatively after patient's consent.

A total of 56 patients were included in this study but only 45 patients were available at the last follow up. The data was analyzed by using SPSS software version 21 [10].

Result

The total of 56 patients was identified from our data base who met the inclusion criteria and 11 were excluded because of lack of data and being lost to follow up. Approximately 70% of our cohort comprised of male patients and 30% were females. The mean age of the whole cohort was 32.3 years. The mean time from injury to surgery was 7-days. Forty five patients completed the DASH questionnaire but four patients were not available for radiological examination after 12 weeks of surgery. These four patients were completely satisfied by their surgeries, reporting full range of motion, good muscle strength with no crepitus and no paresthesia at fracture site. We therefore, assumed that they had united fractures in addition to forty one patients who were examined clinically with radiographs (Figure 1). Among these 41 patients, we found one delayed union according to the follow-up radiographs. Forty patients had united fractures on follow up radiographs at 12 weeks postoperatively with no pain and good range of motion at 6 months (Figure 2A-2C). Only 2 patients were not satisfied with the final results due to pain. Forty-three patients (95%) had no pain and returned back to their respective activities. Only 1 patient had mild to moderate pain which required analgesics. Two patients had paresthesia but they were not bothered with the symptoms. Two patients had discomfort when lying on affected side.

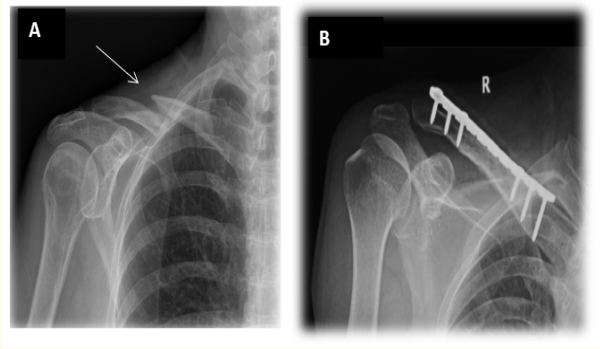

Figure 1: *A. Displaced mid shaft clavicle fracture. B. Radiograph after 12 weeks of ORIF.*

Figure 2: *Post-operative patient showing full range of motion at 6 months following surgery.*

There were total of 2 patients in this series who had post-operative complications. One patient had infection after ORIF which settled with oral anti-biotics and post- operative care. One patient had loss sensation at the surgical site which hasn't recovered yet as shown in table 1.

Complications	Number of participants (n)	Percentages (%)
Infection	1	2.3
Loss of sensation (Anasthesia)	1	2.3
None	43	95.5

Table 1*: List of complications post-operatively.*

The mean DASH score after 6 months of surgery was 16.10 (644.3) and at 12 months, it improved significantly to 3.77 (151.1). The paired- T test was used to compare the DASH score at 6 and 12 months. A significant improvement was noted at 12 months DASH score as compared to 6 months DASH score ($P < 0.05$), as illustrated in table 2.

	Mean	n	SD	p-value
DASH 12 months	4.2477	44	4.94761	< 0.01*
DASH 6 months	17.9886	44	13.35832	

Table 2: *Comparison of DASH using paired T-test.*

Discussion

Displaced mid shaft clavicle have historically been treated non-operatively, with the intent that little functional loss will result regardless of significant residual radiographic malalignment [11]. However, many other studies recommended operative treatment for displaced mid shaft clavicular fractures. This change in perspective is supported by studies from Canadian Orthopaedic Trauma Society [12], where they reported functional deficits and higher non-union rates after having nonsurgical treatment of mid shaft displaced clavicle fractures when it was compared with internal fixation. A study by Hill., *et al*. [7] supported operative treatment after evaluating their results of patients managed conservatively. They reported that 15% of the whole cohort developed nonunion and 31% reported unsatisfactory results due to pain and discomfort. In conclusion they recommended that open reduction and internal fixation is the best option for severely displaced mid shaft clavicle fractures. The results of the current study are consistent with the past literature. All of our patients have good range of motion, muscle strength and decreased rate of non- union.

In order to compare the functional outcomes in operative and non-operative cases, a meta- analysis of randomized clinical trials showed that ORIF provides more rapid return of function and minimizes early residual disability [13]. Operative treatments are also cost effective as patients return soon to their work [14]. All of our patients returned back to their activities within 3 months post operatively. Steven., *et al*. [15] conducted a retrospective study on return to athletic activity after midshaft displaced clavicle fracture treated with ORIF and he found that 67% of athletes returned to athletic activity at < 12 weeks where as 23% returned at < 6 weeks. Only 4 patients had minor complications. Another study by Thyagarajan [16] based on a nonrandomized comparison of intramedullary fixation versus plating versus non-operative treatment of 17 displaced midshaft fractures in each group, recommended intramedullary pin fixation over plating and over nonoperative treatment. They reported no nonunion in the operative group when compared with non-operative group (4 out of 17 = 24%) non-unions for non-operative treatment. However, none of our patient had intramedullary fixation and all patients underwent ORIF with plate fixation.

Leroux T., *et al*. [17] conducted a retrospective study to evaluate the reoperation risk factors after ORIF. They had evaluated 1350 patients who had undergone ORIF for displaced mid shaft clavicle fracture and identified 332 patients (24.6%) who underwent one or more additional clavicle operations within two years after the index clavicle ORIF. The most common cause for reoperation was removal of implant secondary to nonunion, malunion, and infection. According to our study, only one patient required re operation due to infection, however, our follow up period is short. Mirzatolooei F., *et al*. [18] conducted a similar but comparative study between operative and non-operative management of clavicle fractures. According to this study, the mean DASH scores for operative and non- operative group were 8.6 and 21.3 respectively ($p < 0.001$). In our patients, the mean DASH score significantly decreased at 12 months as compare to 6 months post-operatively from 17.98 to 4.24 respectively. Similar studies in the past showed that the average DASH score decreased to 4.0 ± 8.9 after plate fixation in displace clavicle fractures [19].

Conclusion

The results of the current investigation demonstrated that 95% (43 out of 45) patients have good functional outcome with no complications We believe that ORIF should be considered as a primary treatment as it is a valuable option for treating displaced clavicle fractures. However, we accept that our study is a retrospective case series with a small sample size and short-term outcomes only. Further prospective and long-term studies may be necessary to evaluate long term functional outcomes after ORIF in comparison to non- operative management.

Conflict of Interest

There is no conflict of interest or financial interest exists in this study.

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