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ORIGINAL ARTICLE

Reducing unnecessary fixation of midshaft clavicle fractures

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Abstract

Purpose Displaced midshaft clavicle fractures have a non-union rate of 10–20%. Those who unite with conservative treatment have similar outcomes to those who undergo operative treatment; therefore, protocols to identify potential non-unions are important to avoid unnecessary surgery. The aim of this study is to report one such protocol.

Methods A protocol was introduced, where all isolated closed displaced midshaft clavicle fractures were initially managed non-operatively in a sling. At 2 weeks patients were assessed clinically and those who were struggling with their symptoms were offered surgery, with the remainder mobilised as comfortable. All cases treated at one centre over a three-year period, with a minimum follow-up of one-year underwent case note review.

Results Between 2015 and 2017 613 clavicle fractures were managed through clinic. 347 were middle third (56%), 75% were male, mean age 41(range16–97). Forty-one middle third clavicle fracture patients underwent early fixation. Eleven patients required late fixation for symptomatic delayed, non- or malunion, 6 for symptomatic non-unions and 1 was a symptomatic malunion. For displaced fractures the early operative rate was 17.8%, and symptomatic non/malunion rate was 3.2%. This led to a total operative rate of 21%.

Conclusion A protocol for managing clavicle fractures has demonstrated an effective management of these injuries. It is cost-effective reducing the number of patients with displaced fractures requiring fixation with a fixation rate of 21% whilst reducing the rate of symptomatic non- and malunion (3.2%). The management pathway is simple and could be introduced into any orthopaedic outpatient department with ease.

Keywords Clavicle · Fracture · Trauma · Non-union · Protocol · Reducing cost

Introduction

Middle third clavicle fractures are a common injury accounting for 5–10% of all fractures [1] with management options including operative treatment with open reduction and internal fixation and non-operative treatment in a sling and gentle mobilisation. There has been an exponential increase in the operative treatment of clavicle fractures in the recent years as previous studies have suggested improved functional outcomes [2, 3]. However, recent evidence has demonstrated that operative management is not primarily indicated for clavicle fractures [4–8], nor it is financially viable [9, 10]. More recent large studies have demonstrated that patients who go on to unite with conservative treatment have similar outcomes to those treated operatively [11–17]. Displaced midshaft clavicle fractures have a non-union rate of between 10 and 20% [4, 18–20], and therefore, the goal of treatment should be to identify patients at high risk of non-union, and treat the remainder non-operatively. Excluding the risk of non-union, non-operative treatment has the benefits of lower cost, avoids potential risks of surgery and a significant rate of hardware removal [11]. A recent study has suggested that DASH scores at 6 weeks post-injury can predict non-union [21]. As functional ability to perform certain tasks is the predominant feature of the DASH score this may relate to clinical assessment and therefore may be in it is own right an important predictor. Protocols that aim to identify patients that are at risk of non-union are important so that healthcare resource can be targeted, and patients do not undergo unnecessary surgery. The aim of this study is to report on one such protocol in practice for the management of middle third clavicle fractures.

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Patients and methods

A protocol was introduced for the management of middle third clavicle fractures primarily managed through outpatient fracture clinic in a single centre. Patients sustaining clavicle fractures are seen within 24 h of presentation to ED in fracture clinic. The protocol dictated that all isolated closed midshaft clavicle fractures were initially managed non-operatively in a sling. The exception to this were in patients with open fracture, floating shoulder, compromised skin, pathological fracture, severe chest trauma and those with neurovascular injury in whom acute fixation was required. The remaining patients underwent further fracture clinic follow-up at 2 weeks at which point all patients were clinically reviewed. Patients were clinically examined for deformity, assessment of soft tissues, range of motion, shoulder position and progression of symptoms. Patients who were struggling with significant symptoms not improving, or who requested operative fixation, were offered surgery with the remainder treated non-operatively, with further routine follow-up until clinical and radiographic union. Non-operative treatment involved the use of a sling for comfort with mobilisation as tolerated by symptoms and referral to physiotherapy. An

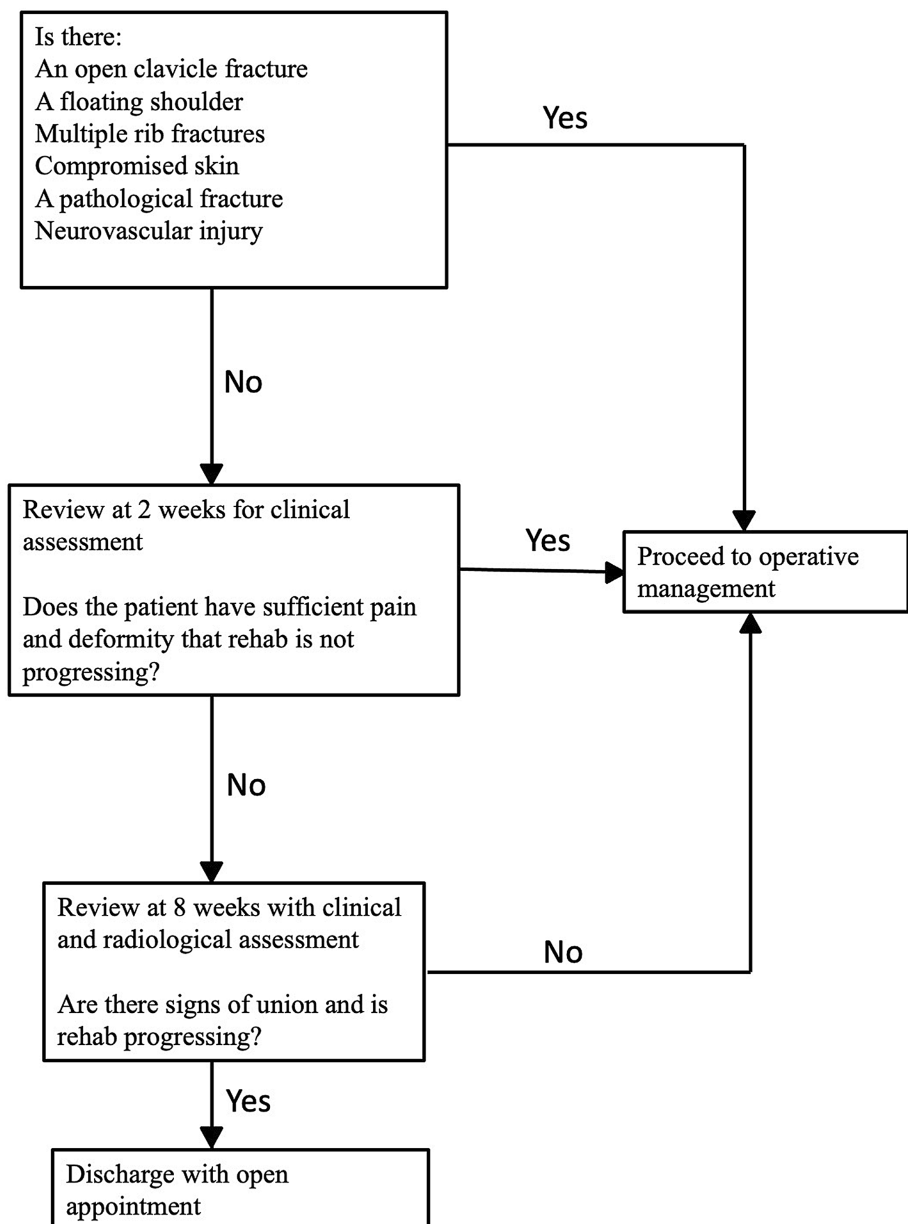

Fig. 1 Middle third clavicle fracture outpatient management

Table 1 Clavicle fracture data

Total number of clavicle fractures						613		
Medial third			Middle third			Distal third		
11			347 (56%)			255		
Total number of middle third clavicle fractures						347		
Male						262 (75%)		
Female						85 (25%)		
Age						41 years (16–97)		
Displaced fractures						225 (65%)		
Total number of 100% displaced fractures						225		
AO classification								
A1	A2	A3	B1	B2	B3	C1	C2	C3
12.8%	21.6%	13.2%	6.6%	14.1%	13.8%	13.8%	2.9%	1.2%

observational study of patients managed through this protocol was carried out. All cases treated at one centre over a three-year period from January 2015 to December 2017 inclusive were identified from fracture clinic attendance with a minimum follow-up of one year. Case notes and radiological studies for these patients were subsequently reviewed. Data collected included patient demographics, classification of the fracture as per AO and Neer, timing of surgery, incidence of non-union or symptomatic malunion and the requirement for subsequent surgery. The protocol is demonstrated in Fig. 1.

Results

Between January 2015 and December 2017 inclusive 613 clavicle fractures were managed through fracture clinic. Of these 347 were middle third (56%), 255 were distal and 11 medial fractures. Of the 347 middle third fractures 262 (75%) were male, with a mean age 41 (range 16–97) and 225 (65%) were displaced fractures as per Neer classification (100% displaced). The OA classification for the middle third fracture group was as follows: A1 (13.8%), A2 (21.6%), A3 (13.2%), B1 (6.6%), B2 (14.1%), B3 (13.8%), C1 (13.8%), C2 (2.9%) and C3 (1.2%). This data is demonstrated in Table 1. The following results report on the displaced mid-shaft fractures of which there were 225.

Forty-one middle third clavicle fracture patients underwent early fixation. Two of these were managed out with the protocol and were excluded (1 enrolled in another trial, 1 other). Six patients (2.7%) underwent acute fixation (3 polytrauma, 2 skin compromise, 1 open fracture). A further 33 of the 219 patients (15%) were managed operatively early through the protocol with the number of days to operation 4–57 with a median of 15 days. 11 patients required late fixation for symptomatic delayed non-union or malunion, and of these 4 had not been managed through the protocol treated initially elsewhere or were polytrauma patients who did not undergo fixation acutely. Of the 7 cases included time to surgery was 193–494 days with an average of 378 days and were all displaced as per Neer classification. Six of these were symptomatic non-unions (2.7%) and 1 was a symptomatic malunion (0.5%). The results are displayed in Fig. 2. The AO classification for the non-union patients was as follows: A1 3(27%), A2 3(27%), A3 1(9%), B2 2(18%) and B3 2(18%). Using the protocol, the early operative rate was 21% for displaced fractures, the later non-union or symptomatic malunion rate was 3.2% for displaced midshaft fractures. This led to a total operative rate of 21% for displaced midshaft fractures.

Discussion

Patient review within the protocol was established at 2 and 8 weeks as the most appropriate timings. At the 2-week appointment it was possible to determine which patients were making clinical progress with improvement in symptoms of pain and increased movement which was experienced in the majority of patients. It was also possible to identify the patients who still had very significant symptoms with minimal improvement. Attendance at 8 weeks was a significant duration from the time of injury to demonstrate return to function and evidence of union. Patients who still had significant problems would undergo further review or consider surgery. Consultation with the patient regarding surgery was part of an informed treatment and consent process. We found that in the patients attending at 24 h after injury who were very keen to pursue operative management had changed their opinion at the two-week review after experiencing progress with improvement in their symptoms and avoiding a need for an operation. From review of the notes there were no patients with documented improving

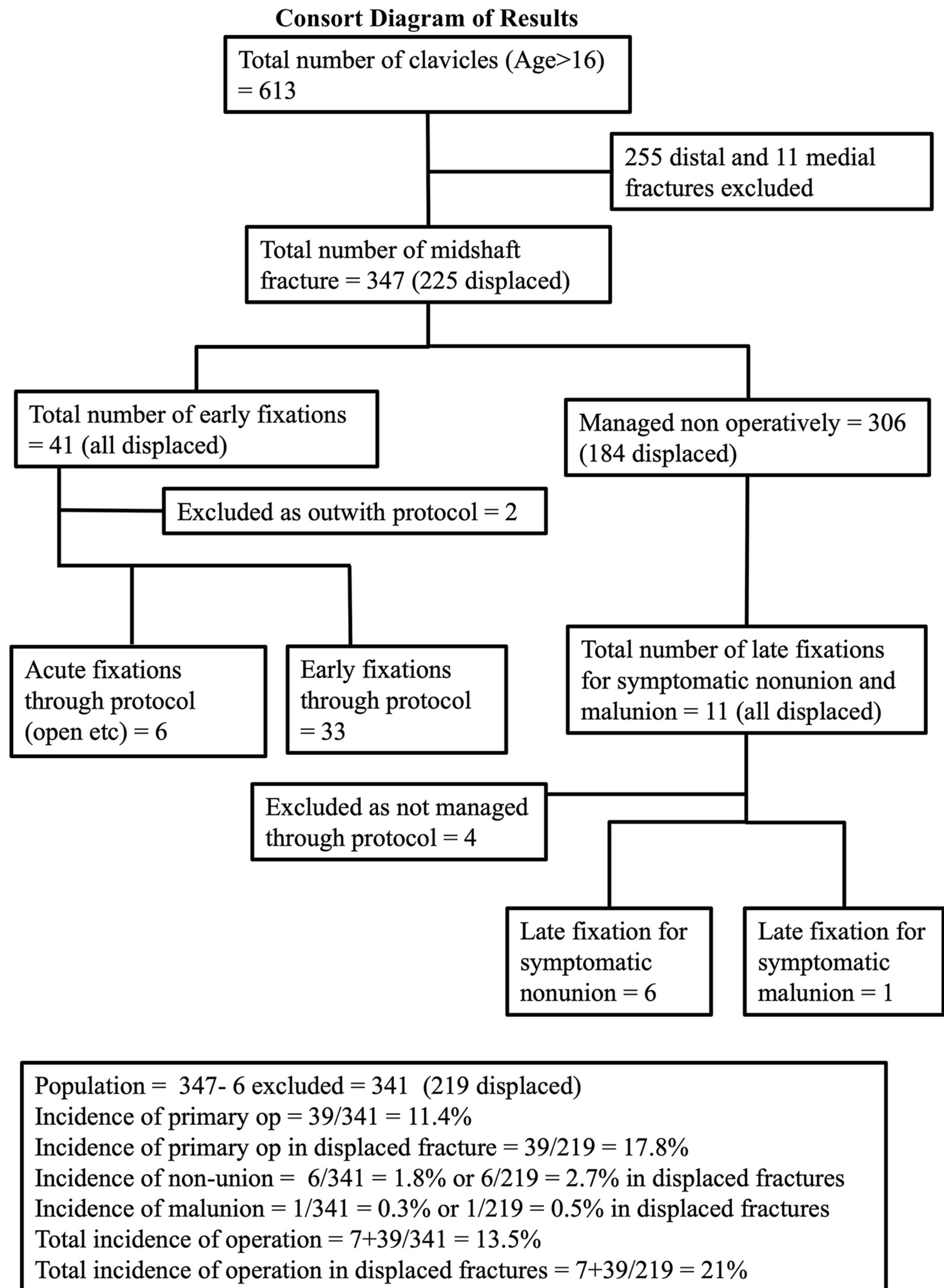

Fig. 2 Consort diagram of results

symptoms at two weeks who still underwent operative management. With the patients who still had significant symptoms at two weeks, an informed discussion was had regarding pros and cons of treatment options. This included potential risks of operative treatment versus risk of non-union with non-operative treatment. This had an impact on the time to surgery data. The median time to surgery was 15 days which fits with the protocol. There was some variation in the timing of the two-week follow-up which was approximate due to timings of fracture clinic. From review of the clinic notes there were a number of patients who pursued operative treatment at an earlier stage which was agreed based on surgeon patient discussion. There were also delayed cases in patients who were keen to avoid operative management and despite ongoing significant symptoms at the two-week review, continued with non-operative treatment until the 8-week review and thereafter underwent surgery. There would be some variation in assessment between examining surgeons but in general it was apparent between patients whom were 'struggling' with their symptoms and those who were not. The patients who were progressing generally had reduced tenderness to palpation at the fracture

site, resolving night pain and pain at rest, could hang their arm out with the sling and be able to elevate the arm to varying degrees. Consequently, patients who were 'struggling' generally had significant ongoing pain in the sling, to palpation of the fracture site and had inability to affect any significant movement of the shoulder.

Operative management is not a necessity for a successful outcome as a primary treatment of patients with displaced middle third clavicle fractures. Instead selecting patients for fixation who are predicted to go on to non-union is the key to balance treatment and achieve good overall patient outcomes. Means of patient selection that achieve this allow targeting of healthcare resources whilst reducing cost and avoid patients undergoing unnecessary surgery with associated operative risk. The protocol introduced in this hospital for the management of middle third clavicle fractures has demonstrated through this observational study an effective means of managing these injuries. It is cost-effective reducing the number of patients requiring fixation with an overall fixation rate of 21% of displaced fractures. The rate of fixation has been seen to be as high as 79% of displaced fractures in the literature [22]. We have also demonstrated it is effective in reducing the rate of symptomatic non-union (2.7%) and symptomatic malunion (0.5%) requiring operative management. The median time to surgery is 15 days partly due to timing of team fracture clinics and fairly quick access to operative treatment. Limitations of the study include lack of functional or patient reported outcomes. Symptomatic non-unions or malunions were only identified by those severe enough that they required late fixation after failing non-operative treatment. There is a potential to loss of follow-up for symptomatic malunions or non-union who subsequently underwent delayed fixation elsewhere. Despite this, however, even allowing for this the symptomatic non-union and malunion rate is well below 10–20% as quoted in the literature [4, 18–20]. In conclusion this management pathway is simple and reduces unnecessary surgery, associated complications and cost. Given its simplicity it could be introduced into any orthopaedic outpatient department with ease.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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