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Technical Note

A new technique for medial-end comminuted clavicle fractures

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ABSTRACT

Fractures of the medial comminuted clavicle are rare injuries but are associated with significant morbidity and mortality. Although rare, such injuries deserve rapid diagnosis and effective treatment to avoid future complications. An optimal, standardized operative treatment has not yet been established. We presented a medial-end comminuted clavicle fracture and demonstrated successful results using a bridging plate technique across the sternum maintaining reduction and achieving union. We aim to provide an alternative technique to fix a displaced periarticular medial clavicle fracture, which we believe is simple, safer and promising.

Introduction

Fractures of the clavicle are common injuries accounting for between 2.6% and 4% of adult fractures and 35% of injuries to the shoulder girdle [1]. Fractures of the medial clavicle are rare and account for approximately 2% of all clavicle fractures. These fractures are frequently accompanied by blood vessels and nerve damage as most of the fracture are caused by high-energy injuries. These fractures have traditionally been treated nonoperatively, even when they are significantly displaced. Concerns about catastrophic intraoperative complications have prevented a more aggressive operative approach to these fractures, with intervention classically being reserved for open fractures or fractures with neurovascular compromise [2]. However, nonoperative treatment of these fractures can lead to poor functional outcomes and symptomatic, painful nonunions; some studies reported an overall nonunion rate approaching 15%, and others reported that up to half of patients are symptomatic a year after injury [3]. And recent research demonstrates superior outcomes in those treated with surgical intervention, especially when symptomatic or where significant displacement exists [4].

In the last decades, diverse surgical techniques have been described for the treatment of medial clavicle fractures including K-wire or plate fixation, interosseous suturing, resection of the medial clavicle end and arthrodesis of the sternoclavicular joint. Recently, the use of small locking plates has been reported for periarticular medial clavicle fractures with good functional outcome [5]. All of these techniques have their shortcomings as well as strengths. However, because of the small number of patients presenting with medial clavicle fractures, there has not been set up a consensus about a standardized operative procedure. Nevertheless, with special regard to short medial fragments or periarticular fractures, a sufficient fixation is still challenging for orthopedic surgeons.

We presented a periarticular clavicle fracture, and treated with a bridging plate technique across the sternum to maintain reduction. We aim to provide a simple and safe alternative technique to fix a periarticular clavicle fracture as one of the treatment options.

Patients and methods

A previously fit and healthy 56-year-old male laborer was presented to our trauma surgery department with pain and swelling of the left sternoclavicular region and reduced range of motion of his left shoulder. This occurred after falling from a tree about 2 m high onto his left shoulder. The clinical examination showed an obvious anterior prominence of the left medial clavicle end with pressure pain. Active ROM of the left shoulder was limited for anteversion and abduction. The results of a neurovascular examination of his left arm were normal, and there were no other symptoms. Radiographs showed an intact acromioclavicular joint, whereas a mildly displaced, intraarticular fracture of the medial third of the left clavicle was revealed. A three-

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dimensional reconstructed computed tomography of the patient's left shoulder was performed, which demonstrated a fracture of the medial end of his left clavicle and posterior and superior displacement of the clavicular head. The clavicular head was comminuted and of little bone stock (Fig. 1).

Following confirmation of consent, the patient underwent a general anesthesia and was positioned on a fracture table in a beach chair position. A skin incision centered on the medial end of the left clavicle was made, dissection down to bone is carefully performed preserving the cutaneous nerves and protecting the posterior structures, sternoclavicular joint was exposed and identified and left intact. As the distal 2 cm of the clavicle is skeletonized using an elevator bluntly, a Darrach retractor should be used to protect the posterior structures. Another incision centered on the medial end of the contralateral clavicle was made, and the medial clavicle was exposed in the same manner. A subcutaneous tunnel connecting the two incisions was opened with a haemostat or artery forceps. Once the fracture is identified the fracture is reduced anatomically and held with reduction forceps. Then a low-profile, contoured, reconstruction plate (zimmer) with a locking sleeve screwed into its distal hole was held with a pen-like grip. The plate was tunnelled subcutaneously across the fracture site from one incision to the other. The plate was placed on the ventral surface of the clavicle and sternum centered on the proximal fracture fragment. Two K-wires were used provisionally to fix the plate onto the clavicle. Following confirmation, nonlocking screws were inserted in both the distal fragment and the contralateral clavicle to aid in the reduction of the fracture so as to pull the bone to the plate. Another drill hole was made in the medial end fracture of the clavicle and fixed with another screw. Intraoperative radiological examination of the fracture was obtained to identify the position of the plate and screws (Fig. 2). Additional screws were fixed until at least 6–8 cortices were held lateral and medial to the fracture site. A rigid fixation giving good stability to the fracture is achieved. The wound is closed in the usual fashion.

Results

The patient recovered well from surgery with satisfactory radiographic appearances of his clavicle. He underwent extensive physiotherapy immediately postoperatively and was discharged on the third postoperative day. He was reviewed in the outpatient clinic 8 weeks after discharge and was found to have full range of

Fig. 1. Medial-end comminuted clavicular fracture with little bone stock of the medial head fragment.

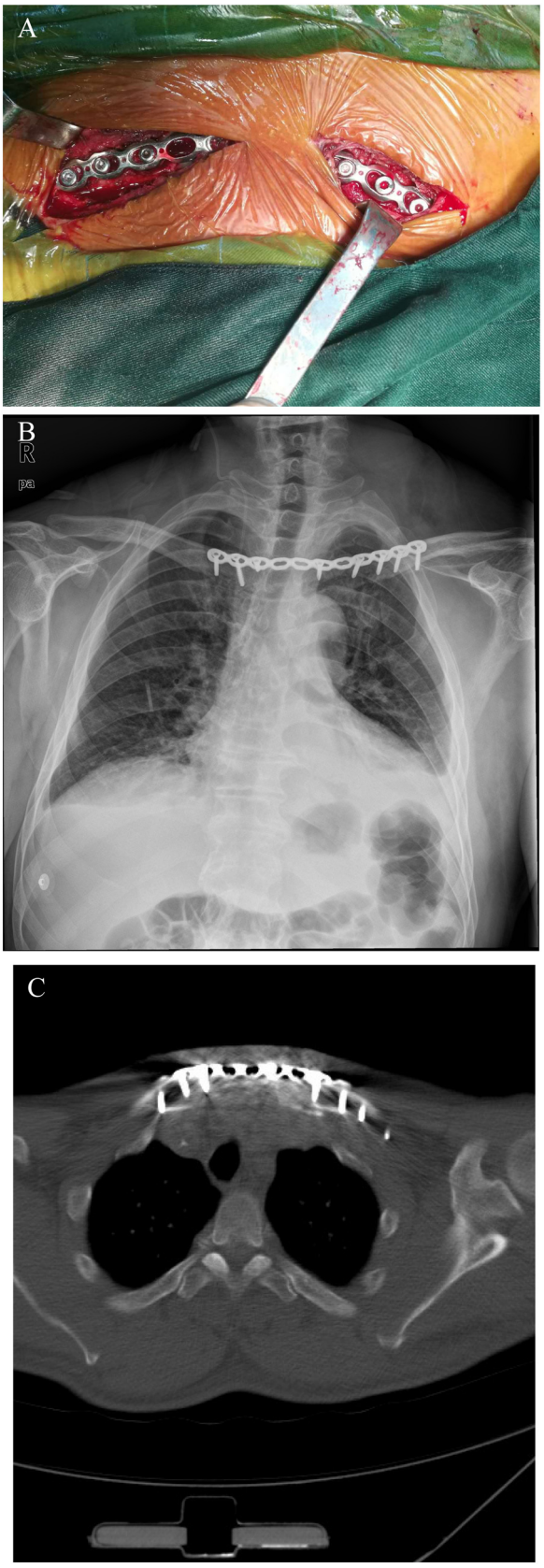

Fig. 2. (A.B.C.) Intraoperative photo (A) and postoperative radiological examination (B.C.) of the fracture was obtained to identify the position of the plate and screws.

movement of his left shoulder and no pain. The DASH score was 23.33, and he was very satisfied with the results of surgery six months later.

Discussion

Because of the small number of cases, an optimal, standardized operative treatment for medial-end clavicle fracture has not been yet established [6]. We aim to provide an alternative technique to fix a displaced periarticular medial clavicle fracture, which we believe is simple, safer and promising.

According to Edinburgh Classification, our case belongs to Type 1A2 fracture, which describes a fracture located within the one-fifth of clavicle bone lying medial to a vertical line drawn upward from the center of the first rib [7]. When the fracture fragments were exposed, we found that the clavicle head was comminuted and the bone fragment was very small, the medial fragment was just big enough for one screw, which would not guarantee a rigid fixation. Preferentially, we chose a reconstruction plate which is bendable and can easily be contoured to the clavicle. Our goal was to fix six cortices per fragment with three screws each, but the medial fragment was so small that only one screw could be inserted. As the manubrium sterni could only provide place for two unicortical screws, we consequently put two screws in the contralateral clavicle across the manubrium sterni. One author reported five medial-end clavicle fractures, one of the cases was also Type 1A2 periarticular fracture with a very small medial clavicle fragment. The fracture was finally fixed only with a screw and sutures which may not produce a strong fixation which enables early rehabilitation [8]. Transosseous fixation was also considered, but as can be seen from the 3-D reconstructed computed tomography, there is no appropriate position to make a perfect tunnel in the medial fragment. Additionally, the drill bit may further comminute the medial fragment bone, which makes the procedure more difficult. Worst of all, the thoracic inlet lies just behind the sternoclavicular joint, which contains the great vessels of the superior mediastinum, trachea, oesophagus, vagus and phrenic nerves. Any mistake of manipulations would cause fatal consequences. In another series of ten periarticular medial clavicle fractures, the author fixed a Type 1A2 fracture with a LCP pilon plate with the plate's arms cut and was applied across the sternoclavicular joint [9]. This seems to be a good choice, but the plate is relatively expensive and not immediately available in our hospital. What's more, placing too many screws in the manubrium sterni means putting greater risk to the great vessels of the thoracic inlet. Our technique perfectly avoided this dangerous situation, which is more safer. And with our technique, you can always place screws on the contralateral clavicle with great simplicity, which was another strength. Reconstruction plate is bendable and can easily be contoured to the clavicle, which makes skin irritation less likely. And also, the price of a reconstruction plate is relatively low, which means more patients can afford it without much effort.

As the reconstruction is applied across the sternoclavicular joint, range of motion of the SC joint was impaired, so the plate is to be removed as the fracture heals. However, range of motion of the shoulder seemed to be good with a DASH score of 23.33, biomechanical experiment should be conducted to elucidate the impairment of this technique on relating articular joints. Another weakness is that conclusions are only based on one case, always hardly sufficient to make a generalized conclusion. Additional studies using the case-study method may elucidate the truth of the conclusion drawn.

Conclusions

Fractures of the medial comminuted clavicle are rare injuries but are associated with significant morbidity and mortality. We presented a periarticular clavicle fracture and achieved successful results using a bridging plate technique across the sternum maintaining reduction and achieving union. We aim to provide an alternative technique to fix a displaced periarticular medial clavicle fracture, which we believe is simple, safer and promising.

Conflict of interest statements

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service and/or company that could be construed as influencing the position presented in, or the review of, the manuscript.

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