

Case Report

Percutaneous Coracoclavicular Tightrope Reduction of a Displaced Distal Clavicular Fracture: A Case Report

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Case

A 34-year-old male presented with a Neer type IIa clavicle fracture after a direct fall on the right shoulder following a cycling accident. The patient subsequently underwent percutaneous reduction and fixation with a coracoclavicular TightRope. The postoperative course was uncomplicated, and radiographic union was noted at 12 weeks postoperatively. The patient reported no further complaints with full range of motion of

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his shoulder and had a QuickDASH, SANE, ASES, and Constant Murley score of 100 at one year post-operatively.

Conclusion

Neer type II clavicle fractures can be notoriously unstable when managed non-operatively. Although multiple treatment modalities have been utilized, there remains some debate regarding the optimal surgical approach. Due to its minimally invasive nature and avoiding the risk for future hardware removal, coracoclavicular TightRope placement might be an excellent treatment option for patients with distal clavicle fractures.

INTRODUCTION

Clavicle fractures are common traumatic injuries and represent 2% to 10% of all fractures (Karl, Olson, and Rosenwasser 2015). While most clavicle fractures can be treated conservatively, Neer type II distal fractures most often require surgical fixation as these fracture types can be unstable and are associated with high non-union rates (up to 44%) (Banerjee et al. 2011; Robinson and Cairns 2004). While multiple surgical approaches have been suggested, such as open reduction and fixation (ORIF), intramedullary screw fixation, and trans-acromial wire or pin fixation (Oh et al. 2011; Banerjee et al. 2011; Scadden and Richards 2005), the optimal treatment approach for these fractures remains under debate (Oh et al. 2011). Most of these treatments are also associated with symptomatic hardware, and many patients (20-40%) require a secondary operation for implant removal (Oh et al. 2011; Good et al. 2012).

In patients with distal clavicle fracture with high-grade acromioclavicular (AC) joint and coracoclavicular (CC) ligament disruption (Neer type IIa), a TightRope can be used to reinforce the CC ligaments in order to stabilize the AC joint (Zhao et al. 2019). Furthermore, this procedure has also been recently used as an augmentation procedure in patients with distal clavicle fractures treated with trans-acromial pins or distal locking plates (Hanflik et al. 2014; Jou et al. 2011). More recently, however, some surgeons have reported on similar surgical techniques to fixate unstable distal clavicle fractures with CC ligament stabilization only (Zheng, Lu, and Liu 2019; Yagnik, Porter, and Jordan 2018). All reported techniques thus far use an open or arthroscopic approach (Struhl and Wolfson 2016; Stegeman et al. 2013; Oh et al. 2011; Cho, Jung, and Kim 2017; Zheng, Lu, and Liu 2019). We present the case of a 34-year-old patient with a displaced Neer Type IIa clavicular fracture treated with percutaneous knotless fixation using a coracoclavicular TightRope.

CASE REPORT

A 34-year-old male presented for clinical evaluation of shoulder pain six days after a traumatic bike accident. Focused physical examination of the painful right shoulder showed restricted range of motion (ROM), pain with palpation of the clavicle, and mild clavicular deformity without skin tenting. Neuromotor and vascular examinations of the upper and lower arm were intact.



Figure 1. Plain AP X-ray of a displaced right distal clavicle fracture (Neer type IIa).

Radiographs of the right clavicle in anterior-posterior (AP) and AP cephalic view were obtained and revealed a distal clavicle fracture with mild elevation of the proximal fragment and widening of the coracoclavicular interval (Figure 1). The AC joint was not affected. Using the Neer classification, this injury was classified as a Type IIa distal clavicle fracture. After discussing treatment options, the patient consented for percutaneous reduction and internal fixation with a double button coracoclavicular TightRope system. The patient underwent surgery eight days after injury.

Following regional anesthesia, the patient was placed in the beach chair position. Fluoroscopy was placed in the “over the top” position to allow a direct AP view of the coracoid. This view enables localization of a small longitudinal incision on the superior aspect of the distal clavicle directly superior to the coracoid. Dissection was carried down to the superior aspect of the clavicle. The periosteum was divided with electrocautery to expose the superior surface of the clavicle. Reduction was achieved by placing an inferiorly directed force on the distal clavicle (Figure 2A). Once the reduction was confirmed, a spade tip drill pin was visually centered AP on the clavicle and mediolateral on the coracoid. Once centered, it was drilled inferiorly through the clavicle and coracoid process quadracortically under direct fluoroscopic visualization (Figure 2B) with the goal of being towards the bend or base of the coracoid, and not towards the tip of the coracoid. The pin was then removed (Figure 3A), and the fixation was deployed. The fixation device was

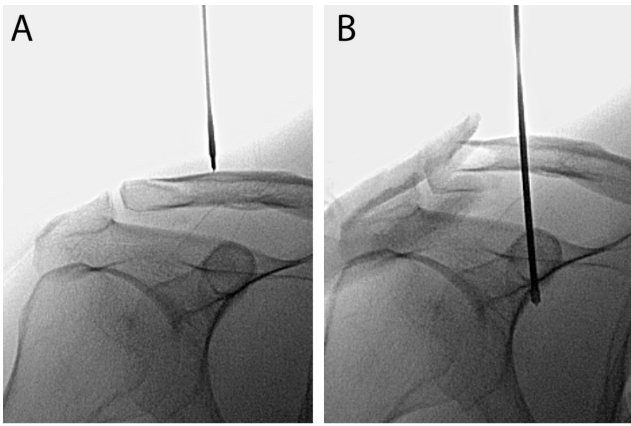


Figure 2. Intra-operative fluoroscopy of the right clavicle. (A) Reduction of fracture attained through inferiorly directed force by drill tip. (B) Quadracortical drilling through both the clavicle and coracoid process.

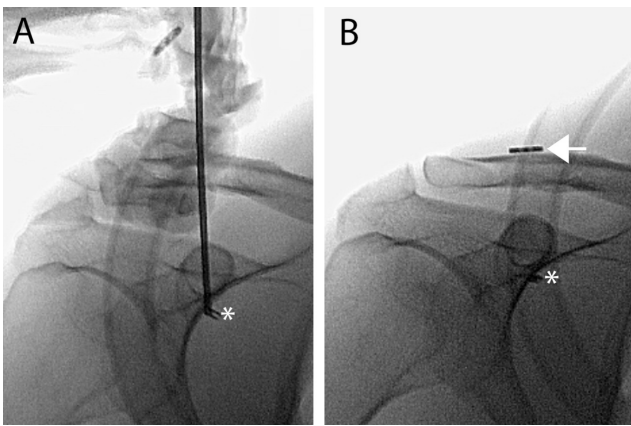


Figure 3. Intra-operative fluoroscopy of the right clavicle. (A) Release of biceps tenodesis button (asterisk) after pin removal is shown. (B) Final intra-operative reduction is shown with a proximal dogbone (arrow) attached to distal biceps tenodesis button (asterisk) by a knotless Tightrope.

constructed with a proximal biceps tenodesis button that was outfitted with a bone-to-bone TightRope. After fluoroscopic confirmation that the tenodesis button was through the caudal cortex of the coracoid, the locking pin was removed allowing the button to be flipped. Once flipped, the Tightrope was placed over a dogbone button on the superior aspect of the clavicle and tightened up in standard fashion. Alternating half hitch knots were then used to back up the fixation of the Tightrope, thereby completing the procedure ([Figure 3B](#)).

The arm was placed in a sling in the operating room. At one week post-operatively, the patient returned to clinic and was clinically progressing without the use of any narcotics. Repeat radiograph of the right clavicle was obtained and showed good alignment. After five-weeks the patient was found to have passive forward flexion of 90°, external rotation of 10°, and internal rotation to the back pocket, with radiograph of the clavicle showing good alignment and

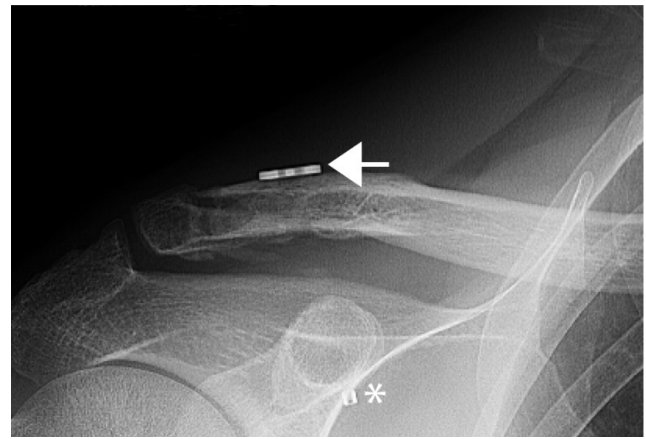


Figure 4. Plain AP X-ray of right clavicle three months after surgery. Dogbone (arrow) and biceps tenodesis button (asterisk) are retained without migration.

interval healing. The patient then started formal physical therapy to regain full ROM. At three months post-operatively, the patient had full ROM and there was no pain on palpation of the clavicle, while radiograph of the clavicle showed continued good alignment with callus formation ([Figure 4](#)). The patient was cleared for gradual resumption to full activity level as tolerated. At one year post-operatively the patient had full range of motion of the right shoulder. Functional outcome scores showed a QuickDASH score of 100, SANE score of 100, American Shoulder and Elbow Surgeons Score (ASES) of 100, and a Constant Murley score of 100.

DISCUSSION

Distal clavicle fractures are a frequently seen traumatic injury in patients suffering direct shoulder trauma. Although multiple surgical treatment options currently exist, there remains a debate regarding the optimal operative approach (Neer, C. S., 2nd 1968; Rokito et al. 2002). Direct osteosynthesis is most commonly achieved with either a pre-contoured locking plate or a hook plate with similar clinical and radiological success rates (Zhang et al. 2014; J. Wang et al. 2021). However; while the risk of non-union is low following these procedures, the incidence of hardware removal is high. Coracoclavicular TightRope placement offers the advantage of a minimally invasive percutaneous surgical approach while avoiding the risk for hardware removal.

CC stabilization was initially used as augmentation for trans-acromial fixation of distal clavicle fractures (Moatshe et al. 2018). When reviewing previously used CC stabilization techniques, CC reduction can either be performed using inflexible screw fixation or flexible suture fixation (Boonard et al. 2018). Although screws have shown low non-union rates, they are associated with high rates of hardware removal (Banerjee et al. 2011). Sutures, on the contrary, have shown low rates of hardware removal, but there is a high concern regarding osteolysis at contact points (Goldberg et al. 1997). The current technique avoids both osteolysis at contact points and the need for future

hardware removal. Another advantage of this minimally invasive technique is that this procedure can also be performed in cases with small or comminuted distal fragments (Rieser et al. 2013; Singh et al. 2019; Zheng, Lu, and Liu 2019). However, there are also some disadvantages of this procedure as isolated CC stabilization only provides strong vertical translational fixation while anterior-posterior planar fixation remains limited. Although this weaker anterior-posterior stability may pose a higher risk of failure, this has not been reflected in similar CC fixation techniques in the current orthopedic literature (Rieser et al. 2013; Singh et al. 2019; Zheng, Lu, and Liu 2019; Stegeman et al. 2013).

When reviewing studies focusing on indirect osteosynthesis treated with flexible CC stabilization only, several studies using the Tightrope system have been recently published (Chen, Chen, and Shih 2002; S. J. Wang and Wong 2008). Although several similarities exist, there are notable differences with the presented technique. First of all, all previous reports have used arthroscopy or open surgery with dissection of the deltoid fascia to expose the fracture site and coracoid process, while the present technique is performed percutaneously (Struhl and Wolfson 2016; Zheng, Lu, and Liu 2019; Cho, Jung, and Kim 2017; Stegeman et al. 2013; Oh et al. 2011). Our minimally invasive approach avoids damage to nearby neurovascular structures and can be performed using moderate sedation. However, the disadvantage of performing this technique percutaneously is that the fracture site cannot be visualized. Therefore, any interposing soft tissue may not be cleared, potentially leading to higher non-union rates (Blake et al. 2017). In addition, most other authors have used knotted fixation, which has been associated with bone bruising, sinus formation, and slippage (Flinkkila et al. 2015; Yagnik et al. 2019; Ilahi et al. 2008; Noonan et al.

2016), while the current described technique is performed using knotless fixation.

It should be noted that not all patients with distal clavicle fractures are eligible for this procedure. As the entire load is placed on one implant, there is a potential risk of coracoid fracture as this has been reported in up to 7% of cases with similar techniques of TightRope fixation using the coracoid (Cho, Jung, and Kim 2017; Flinkkila et al. 2015; Robinson et al. 2010; Yagnik et al. 2021). Therefore, patients with poor bony integrity may have a relative contraindication for this technique, while CC stabilization cannot be performed if the coracoid process is fractured (Zheng, Lu, and Liu 2019). Finally, although significant comminution of the distal fragment should not preclude this technique, incision extension to the fracture site should be considered to assure appropriate reduction and clearance of interposing soft tissue or small bony fragments.

In conclusion, the presented case shows appropriate reduction and healing of a distal third clavicle fracture following percutaneously placed TightRope system to stabilize the CC ligament. The minimally invasive nature of this procedure avoids both functional impingement and the need for future hardware removal.

CONFLICT OF INTEREST

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