Technical Note

Coracoclavicular Stabilization With Two Loops of Equal Tension Using a Double O Loops Technique in the Distal Clavicle Fracture

Chaiwat Chuaychoosakoon, M.D., Yada Duangnumsawang, D.V.M., M.Sc., Prapakorn Klabklay, M.D., Tanarat Boonriong, M.D., and Adinun Apivatgaroon, M.D.

Abstract: The distal clavicle fracture is one of the most common injuries around the shoulder joint. There is no consensus regarding a gold standard treatment. Each technique has advantages and disadvantages. Currently, coracoclavicular (CC) stabilization is one of the most popular techniques because this operative procedure provides good stability of the fracture and has few complications. The CC stabilization is a suspensory fixation that consists of many two-CC-loop arrangements. It is, however, difficult to gain equal tension in both CC loops because one loop is always tighter and has greater action in maintaining bone alignment than the other loop. To solve this problem, we propose a double O loops technique to achieve two equal tension loops.

The clavicle fracture is one of the most common injuries around the shoulder joint, involving 44% to 66% of all shoulder fractures. Clavicle fractures are divided into proximal, middle and distal fracture areas. Twenty percent of clavicle fractures are distal third fractures that are usually classified using the Neer classification. This classification is based on the configuration of the fracture and the status of the coracoclavicular (CC) ligaments. Neer types I and III are quite stable because the fractures are nondisplaced or minimally displaced. The other types of distal clavicle fracture are less stable. The treatment is based on type of injury. There is a consensus that the treatment of choice in distal clavicle fracture type V is operative management. There is a wide choice of fixations. The surgical techniques are plate and screw fixation, hook plating, k-wire fixation, tension band wiring, CC screws, and CC stabilization. Currently, most surgeons prefer to perform CC stabilization to maintain the reduction and achieve the healing process in the distal clavicle fracture. The mode of CC stabilization is suspensory fixation. There are open procedures and arthroscopic-assisted procedures in CC stabilization. The advantage of the open procedure is that it is simple, but the intraarticular pathology cannot be evaluated.[1] There are many surgical techniques in CC stabilization, normally including two loops between the coracoid process and the clavicle. The most problematic aspect of this method is that it is almost impossible to achieve equal tension in the two loops; for ideal reduction outcome, both loops should have equal tension, but the tighter loop will have greater influence. The looser loop will act to maintain the reduction if the tighter loop fails or becomes loose. The surgeon can, however, set the tension equally by using a double O loops technique as described in this article.

Surgical Technique

The patient is placed in the supine position on the operating table. Next, regional anesthesia (interscalene block) combined with general anesthesia is performed. After anesthesia is induced, the patient is

From the Department of Orthopaedic Surgery and Physical Medicine, Faculty of Medicine, Prince of Songkla University, (C.C., P.K., T.B.), and the Faculty of Veterinary Science, Prince of Songkla University (Y.D.), Songkla, and the Department of Orthopaedic, Faculty of Medicine, Thammasat University (A.A.), Prathumthani, Thailand.

The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received September 20, 2019; accepted November 16, 2019.

Address correspondence to Chaiwat Chuaychoosakoon, M.D., Faculty of Medicine, Prince of Songkla University, Department of Orthopaedic Surgery and Physical Medicine, 15 Karnjanavanich Road, Hat Yai, Songkla 90112, Thailand. E-mail: psu.chaiwat@gmail.com

2212-6287/191144

https://doi.org/10.1016/j.eats.2019.11.010

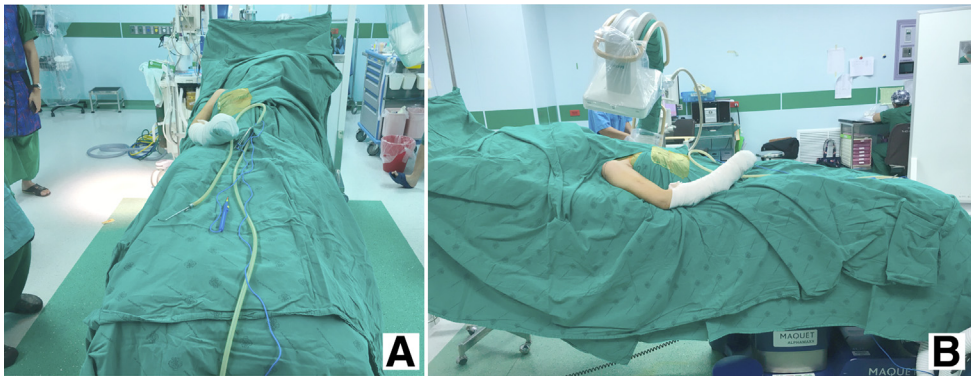

Fig 1. Modified semilateral decubitus position for coracoclavicular stabilization in right shoulder. (A) Frontal and (B) lateral view.

set in a modified semilateral decubitus position (Fig 1 A and B).[2] The patient is prepped and draped in a sterile fashion.

A sterile marker is used to outline the surface anatomy of the shoulder (Fig 2). A saber incision is made 5 cm over the shoulder from the distal clavicle to the tip of the coracoid (Fig 3A). The incision landmark is 2 cm medial to the fracture site. The deltoid fibers are separated to expose the coracoid process (Fig 3B). A certain kind of suture material such as Ethibond No. 2 (Ethibond, Somerville, NJ) is looped around the base of the coracoid process and behind the coracoacromial ligament from the medial aspect to the lateral aspect of the coracoid base using a 90° right angle clamp. In this step, the surgeon must continually keep in mind the neurovascular structures (subclavian artery, subclavian vein and brachial plexus) located medially and close to the coracoid process.[3] The Ethibond No. 2 is replaced with a shuttle loop using the shuttle relay technique (Fig 3C). The next step is at the clavicle area. The full thickness of the deltotrapezial fascia of the clavicle is incised in longitudinal plane over the clavicle and the fascia is peeled off from the bone using a periosteum elevator (Fig 3D). A double length of Ethibond No. 5 is formed. The loop end of the Ethibond No. 5 is passed underneath the coracoid process by using a shuttle suture then pulled upward and passed anterior to the anterior border of the clavicle. The other end of the double loop is passed posterior to the posterior border of the clavicle (Fig 4A). The fracture is then reduced by lifting the arm up. The Ethibond No. 5 is tightened to maintain the reduction (Fig 4B). The alignment is checked under a fluoroscope (Fig 5). For CC stabilization, the first tunnel (lateral tunnel) is created at the center of the clavicle and approximately 5 mm medial to the medial fragment of the fracture. The lateral limb of the shuttle suture is passed through the first tunnel of the clavicle using a stainless wire. The second tunnel (medial tunnel) is created at the center of the clavicle and medial to the first tunnel about 15 mm. The medial limb of the shuttle suture is passed through the second tunnel of the clavicle by a stainless wire. The 4-holes of a small plate are applied at the superior border of the clavicle. The shuttle is also passed through the holes of the clavicular plate. One limb of fiber wire No. 5 (Arthrex, Naples, FL) is passed through the lateral hole of the plate, the lateral tunnel of the clavicle, looped around the coracoid base and passed through the medial tunnel of the clavicle and the medial hole of the plate (Fig 6A). The other limb of the fiber wire No. 5 is passed through the medial hole of the plate (Fig 6B), the medial tunnel of the clavicle and looped around the coracoid base a second time (Fig 6C) then passed through the lateral tunnel of the clavicle and the lateral hole of the plate using the shuttle loop technique (Fig 6D). The fiber wire is tightened over the plate by a simple suture. With this technique, there is equal tension in both loops. The alignment is

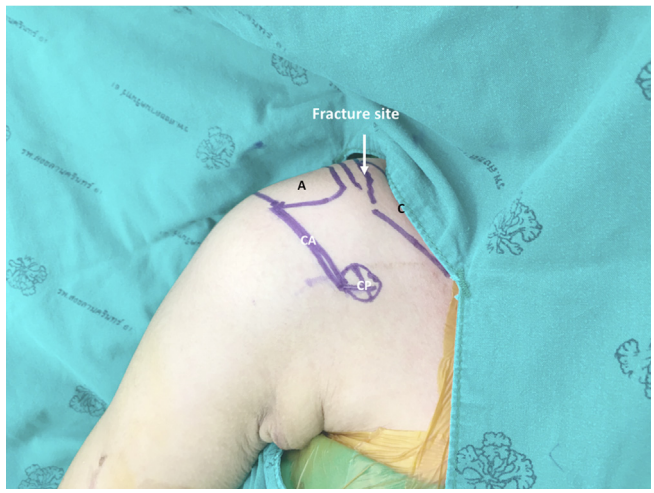

Fig 2. Overview of operating site in right shoulder. (A, acromion process; C, clavicle; CA, coracoclavicular ligament; CP, coracoid process.)

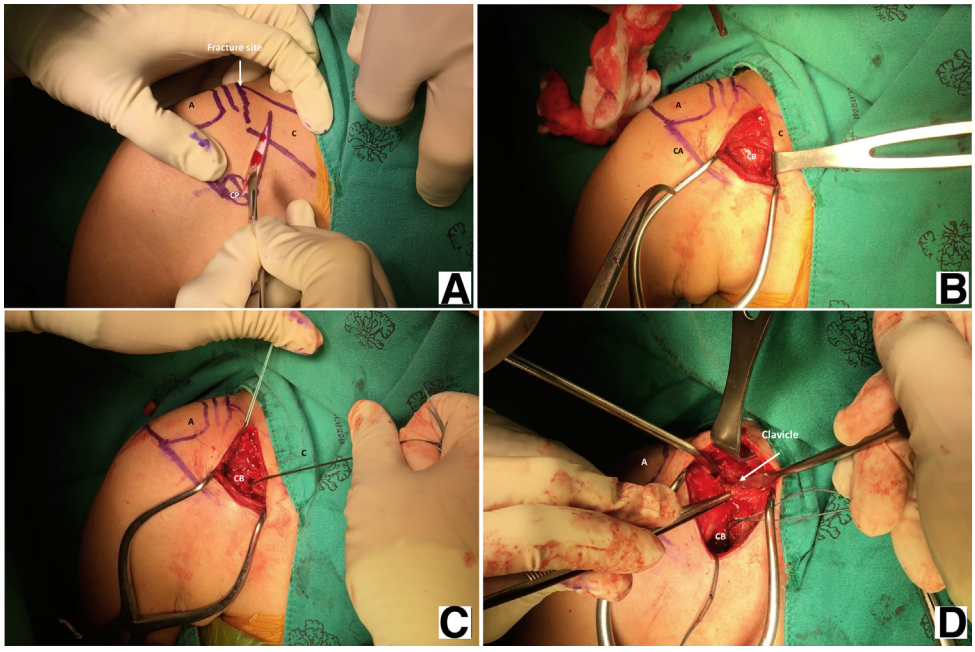

Fig 3. The surgical exposure of right shoulder. (A) A saber incision is made 5 cm over the shoulder, (B) The coracoid base is exposed, (C) The Ethibond No. 2 is replaced with a shuttle loop using the shuttle relay technique, (D) The full thickness of the deltotrapezial fascia is peeled off from the bone using a periosteum elevator. (A, acromion process; C, clavicle; CA, coracoclavicular ligament; CB, coracoid base.)

checked under a fluoroscope (Fig 7 A and B). The deltoid fiber is then repaired by Vicryl 3-0. The skin is closed layer by layer. The entire surgical technique is shown in Video 1, with audio narration. Tables 1 and 2 present tips, pitfalls, key points, advantages, and disadvantages of using this technique.

Postoperative Care

A shoulder abduction sling is used for 6 weeks. Controlled passive mobilization of the shoulder is allowed on the second day after surgery. Active assisted exercise of the shoulder is allowed in the sixth week after surgery. At 3 months' follow-up, the patient achieves the full range of motion of the shoulder, and the radiographic finding shows good alignment.

Discussion

The distal clavicle fracture is one of the most common fractures around the shoulder joint. It is mainly divided into stable and unstable fractures. The patient with an unstable distal clavicle fracture usually requires operative treatment. There are several surgical techniques to treat this fracture, including CC stabilization with synthetic sutures, tendon augmentation or screw systems,

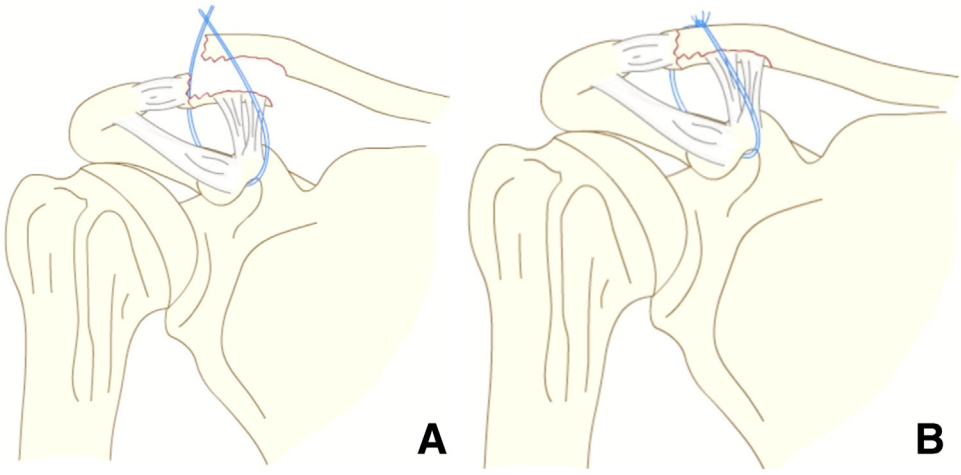

Fig 4. The steps of maintain the reduction. (A) The loop end of the Ethibond No. 5 is passed underneath the coracoid process by using a shuttle suture then pulled upward and passed anterior to the anterior border of the clavicle. The other end of the double loop is passed posterior to the posterior border of the clavicle. (B) The Ethibond No. 5 is tightened to maintain the reduction.

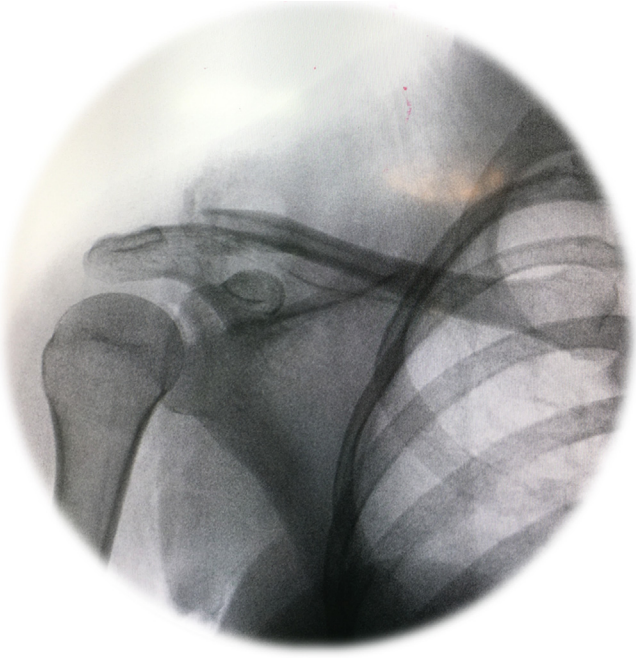

Fig 5. The alignment is checked under a fluoroscope.

fracture fixation methods using a plate and screw system, hook plating, tension band wiring, or K-wire fixation.

The two most popular techniques of fixation are CC stabilization with synthetic sutures and Hook plating. In CC stabilization, two areas are involved. The first area is the base of the coracoid process. The surgeon can do in this area in two ways. The first way is to pass a loop underneath the coracoid base. The second way is to make either one or two tunnels at this area. With this technique of making tunnels through the coracoid base, there is a risk of coracoid base fracture, especially in Asian patients who generally have a smaller coracoid base than other races, but the fixation is more rigid than the looped-under-the-coracoid-base technique, which involves the risk of suture grinding. The second area is the clavicular bone. Most surgeons create the clavicular tunnel by using the anatomical landmark of the native CC ligaments. In the technique beginning with a loop underneath the coracoid base, most surgeons use two loops for CC stabilization. It is, however, difficult to gain equal tension in both loops, and one loop is almost always tighter and has greater action in maintaining bone alignment than the other loop. In order to solve this problem, the surgeon can use the modified tight loop technique as described above. In hook plating fixation, the incision is longer than the CC stabilization technique and the surgeon must expose the acromion process in order to pass the hook of the plate under the acromion and posterior to the acromioclavicular joint. This fixation method is reliable and has few complications; however, it can lead to various adverse subacromial effects such as

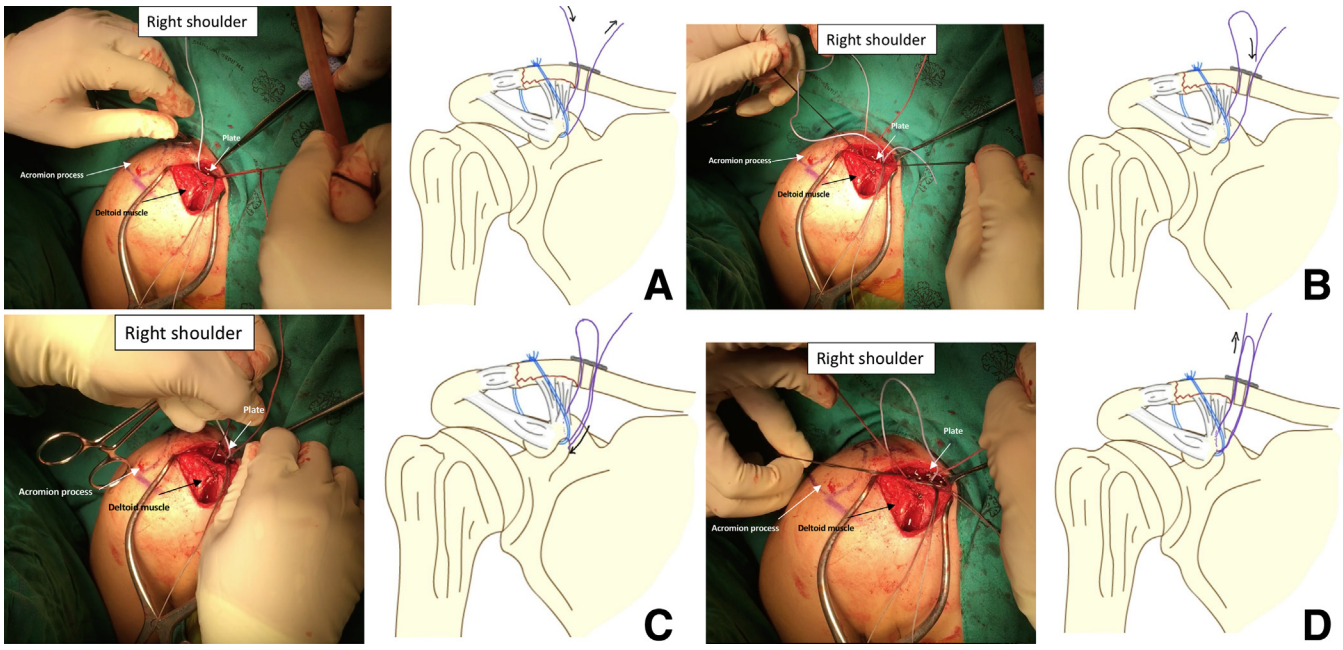

Fig 6. The steps of a double O loops technique. (A) One limb of fiber wire No. 5 is passed through the lateral hole of the plate, the lateral tunnel of the clavicle, looped around the coracoid base and passed through the medial tunnel of the clavicle and the medial hole of the plate. (B) The other limb of the fiber wire No. 5 is passed through the medial hole of the plate, the medial tunnel of the clavicle and (C) looped around the coracoid base a second time then (D) passed through the lateral tunnel of the clavicle and the lateral hole of the plate using the shuttle loop technique.

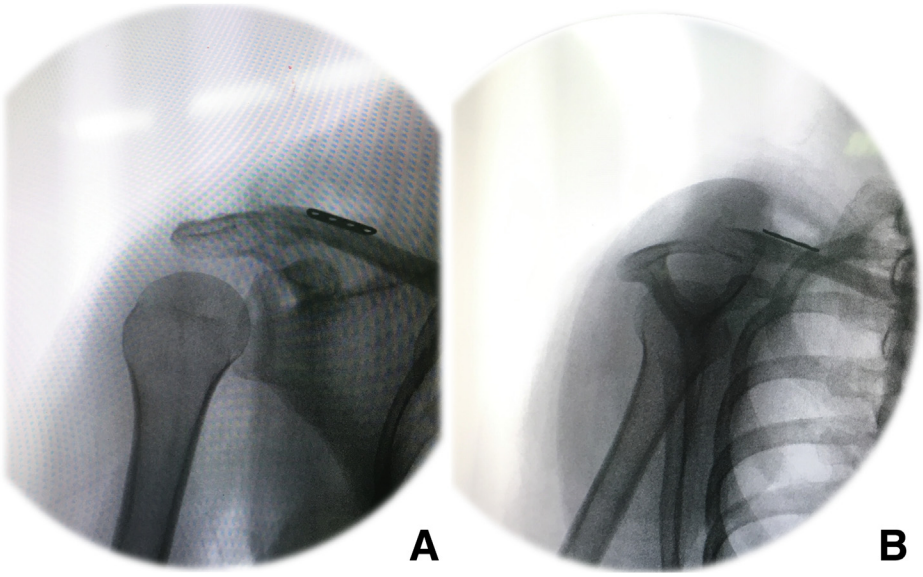

Fig 7. The alignment is finally checked under a fluoroscope: (A) anteroposterior and (B) lateral transcapular views.

Table 1. Pearls and Pitfalls

Pearls
• The fluoroscope is located on the side opposite to the injured shoulder.
• Reduce the clavicle by lifting the arm.
• To preserve the blood supply at the fracture site, the surgeon should not open the fracture site.
• The surgeon should reduce the distal clavicle fracture before the tunnel is created.
• Beware of creating the tunnel too laterally because of the poorer quality of the bone.
• The tunnel is created using a 2.5-mm drill bit that creates a hole through which the suture can be easily passed. Achieve equal tension in both loops by pulling up both limbs of the sutures before tightening.
Pitfalls
• There can be a risk of neurovascular injury if the surgeon dissects medially or inferiorly to the base of the coracoid process.
Key Points
• The base of the coracoid process is looped from the medial border to the lateral border.
• The clavicular bone cut out by suture material is prevented using 4 holes of a small plate.

Table 2. Advantages and Disadvantages

Advantages
• This technique is suitable for distal clavicle fracture (Unstable Neer type III, Neer type IV and type V).
• The technique provides better healing conditions because the fracture site is not exposed.
• The surgeon can set the tension equally by using a double O loops technique.
• There is less risk of fracture of the coracoid process.
Disadvantages
• The technique is not suitable for comminuted clavicle-coracoid fracture.

acromial osteolysis, subacromial shoulder impingement, or even rotator cuff tear, requiring a second operation to remove the implant.

The double-O-loops technique is a safe technique, easy to apply to achieve two equal tension loops, which overcomes the problem of unequal tension of the two loops.

Acknowledgement

The authors sincerely thank Konchanok Jaipakdee for allowing us to disclose the information, Konwarat Ninlachart for assistance with drawing the illustrations; and Dave Patterson for assistance in English editing.

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