Case Report

Using a point reduction clamp with a rubber stopper from a sterile bottle for reduction of a distal radius fracture

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ABSTRACT

Introduction: There are many choices of surgical treatment for a distal radius fracture. The goal of treatment in these injuries is stable anatomical reduction of the articular surface. In a coronal split fracture, the dorsal fragment tends to dorsal displacement during drilling or when applying the distal locking screws of the plate. Case presentation: We present an illustrative case from a larger series of a 65-year-old Thai woman with an intraarticular distal radius fracture with a dorsal fragment from a coronal-split configuration reduced and stabilized with a volar locking plate utilizing a large point reduction clamp held in place with a rubber stopper from a sterile glass bottle to counter the displacement effect of the drilling. Discussion: Using a large point reduction clamp with a rubber stopper from a sterile glass bottle enables this type of difficult fracture to be both reduced and stabilized with the locking screw easily inserted to stabilize the dorsal fragment without any further displacement. The rubber stopper acts to distribute the compressive force from the large point reduction clamp over a larger area allowing a more stable fracture stabilization, while at the same time reducing skin and soft tissue trauma at the dorsal aspect of the wrist. Conclusion: This workaround allows improved stability in reduction and stabilization of a coronal split intra-articular distal radius fracture. The advantage of this workaround is that it uses small things readily available in every operating room setting, and it does not require any special experience or skills.

1. Introduction

This surgical note with an illustrative case report was prepared following the SCARE criteria [1].

The distal radius fracture is the second most common fracture in elderly people (18% of all fractures) and the most frequent upper extremity fracture in women aged >50 years [2]. Although most distal radius fractures in elderly patients are managed nonoperatively, the use of internal fixation has increased in recent years [3]. Lafontaine et al. noted five factors that are associated with instability of a distal radius fracture, initial dorsal angulation >20°, dorsal comminution pattern, radiocarpal intraarticular involvement, associated ulna styloid fracture, and age >60 years. Fractures with more than three of these factors tend to some loss of post-reduction alignment following conservative treatment and usually proceed to corrective surgery [4]. There are various common surgical treatments for dealing with the distal radius fracture, most commonly closed reduction and percutaneous pinning, open reduction and internal fixation with volar or dorsal locking plate, and external fixation. The volar locking plate is the most popular modality in recent years because of its better ability to control a variety of fractures with good outcomes while reducing tendon complications associated with dorsal plates in up to 30% of cases [5,6].

Among the many patterns of distal radius fracture, intraarticular involvement is one of the complex patterns, constituting about 25% of such injuries [7]. The volar locking plate is the mainstay of treatment in intraarticular fractures because of its good functional outcome [8]. However, fracture reduction and stabilization is challenging in these complicated injuries. The goal of treatment in these injuries is anatomical reduction of the articular surface. In a coronal split fracture, the dorsal fragment tends to dorsal displacement during drilling or when applying the distal locking screws of the plate, which can result in a gap in the articular surface that can lead to post-traumatic arthritis of the radiocarpal joint [9,10]. In this case report we present a small addition to a standard technique to solve this displacement problem using a large point reduction clamp with a rubber stopper technique. The clamp applies a compressive force to the dorsal portion of the fracture which...
helps reduce the gap in the coronal plane and prevent further dorsal displacement of the fracture when drilling or applying the distal locking screws of the volar plate. The rubber stopper allows the clamp to distribute the force over a larger area of the fragment and also decrease skin and soft tissue trauma at the dorsal aspect when applying compression. A lateral radiograph can be taken under a fluoroscope to check the alignment without obstruction from this clamp.

2. Case presentation

This retrospective review of a series of cases with description of a slightly modified operative technique was approved by our institutional review board (IRB number 64-442-11-1). We reviewed the medical records of patients operated on for intraarticular distal end radius fracture with a coronal split during a 2-year period, January 2019 to January 2021. The rubber stopper technique had been used in ten patients undergoing open reduction and internal fixation with locking plate for distal radius fracture. Clinical and radiographic outcomes were followed for at least six months in all patients, during which all fractures showed good union and alignment with no reported complications. Following we describe an illustrative case in which this technique was used to help accomplish a secure reduction of a distal radius fracture.

A 65-year-old Thai woman presented with acute left wrist pain for 3 days after a fall on her outstretched hand. Past medical history, past surgical history, and family history were unremarkable. At the Orthopedic clinic a physical examination found marked tenderness at the left distal end of the radius with limited range of motion of the wrist. The distal neurovascular system was tested and found intact sensation and distal vascular perfusion. Plain radiographs and computed tomography showed an intraarticular distal radius fracture with a dorsal fragment from a coronal split configuration (Fig. 1). In a patient with an intraarticular distal radius fracture, the goal of treatment is anatomical reduction at the articular surface to close the articular gap. The hand surgeon decided to do open reduction internal fixation with a plate applied to the left distal end of the radius.

As this is a novel technique, we will describe the general operative technique. The patient is placed in the supine position with an arm board on the side of the wrist fracture sided and a tourniquet applied at the proximal arm. A modified Henry approach is used to open the skin and subcutaneous layers, followed by a deep incision at the flexor carpi radialis (FCR) tendon sheath, retracting the FCR tendon to the ulnar side. The FCR tendon sheath is retracted to the radial side to protect the radial artery. An L-incision is used to open the pronator quadratus muscle to expose the fracture site. The fracture is reduced by longitudinal traction and wrist flexion. For temporary fixation, one Kirschner wire is inserted into the radial styloid to the radial shaft fragment and another Kirschner wire is used to raft the articular surface. Then a volar locking plate [Adaptive II, Medartis] is applied and checked for proper location under a fluoroscope. A cortical screw is inserted in the oblong hole first and a third K-wire is inserted into the distal fragment for temporary fixation of the plate to the distal fragment of the fracture. Then, as illustrated in Fig. 3, a large point reduction clamp with an approximately 3–4 cm in width rubber stopper from a sterile glass bottle is inserted between the clamp end and the skin at the dorsal side of the wrist with the other end of the clamp on the other side of the wrist to compress the fracture site in the sagittal plane and allow secure reduction as the distal fragment is fastened to the plate. One side of the clamp is placed over the most distal screw hole of the plate and the other side of the clamp is placed at the dorsal side with the rubber stopper from a sterile glass bottle between it and the skin. The clamp is slowly compressed while being observed under a fluoroscope until the intraarticular gap is properly closed in the correct alignment. Closing the fracture gap and compression of the clamp to the plate both help to restore the volar tilt of a normal distal radius. Then the locking screws are inserted normally in the distal fragment. As can be seen in Fig. 3, when the clamp is applied as described, the dorsal fragment will be secured firmly in place and will not be dorsally displaced while inserting the distal locking screws, a common problem using the standard techniques when reducing these fractures (Fig. 4). After inserting screws in all the holes of the distal row of the plate, the clamp can be removed, and the other locking screws inserted normally in the proximal fragment. A drain is placed and the wound closed layer by layer. A volar short arm slab is applied for 2–3 days postoperatively, then changed to wrist support for 10–14 days. The patient is seen 2 weeks postoperatively to check the surgical wound and remove the sutures. Range of motion exercises are initiated at this visit. In our case, the patient was concerned about her hand function as she wanted to be able to return to doing her normal daily activities such as cooking. At her 1-year follow up, there were no complications and she was satisfied with her condition.

3. Discussion

The surgical indications for distal radius fractures following The American Academy of Orthopedic Surgeons (AAOS) 2009 guidelines are fractures with post-reduction radial shortening >3 mm, dorsal tilt >10°, or intra-articular displacement or step-off >2 mm [11]. A study by
Lafontaine et al. detailed five factors associated with instability of a distal radius fracture, initial dorsal angulation >20°, dorsal comminution pattern, radiocarpal intraarticular involvement, associated ulnar styloid fracture, and age >60 years [4]. An intraarticular fracture that splits the coronal plane with a dorsal fragment involves the problem of dorsal fragment displacement while inserting the distal screws during fixation. In our institute we have devised a way to mediate this problem using a large point reduction clamp with a rubber stopper from a sterile glass bottle for volar locking plate fixation. Fig. 1 illustrates an intraarticular distal radius fracture with a dorsal fragment split in the coronal plane, which is the situation for which our innovation was devised. A frequent problem in an intraarticular distal radius fracture involving a coronal split configuration (Fig. 2A and B) is the dorsal fragment which tends to dorsal displacement both in the reduction step and then during fixation. This issue is illustrated in Fig. 2A and B. During the insertion of a locking screw without the clamp, the dorsal fragment is pushed dorsally by the screw (C). If the desired fracture reduction position is maintained by a point reduction clamp with rubber stopper, the locking screw can be inserted and fixed to the dorsal fragment without any further displacement (D).

Fig. 2. A drawing showing an intraarticular distal radius fracture with a coronal-split configuration in coronal (A) and axial (B) views. During the insertion of a locking screw without the clamp, the dorsal fragment is pushed dorsally by the screw (C). If the desired fracture reduction position is maintained by a point reduction clamp with rubber stopper, the locking screw can be inserted and fixed to the dorsal fragment without any further displacement (D).

Fig. 3. A large point reduction clamp with a rubber stopper from a sterile glass bottle is applied to allow stable reduction and stabilization of the fracture.
stabilization when inserting the distal screws. Fig. 2C illustrates this problem, and how the dorsal fragment is pushed out of the desired alignment by the locking screw when there is nothing to maintain the reduction. But as we describe here, using a large point reduction clamp with a rubber stopper from a sterile glass bottle enables the fracture to be both reduced and stabilized with the locking screw easily inserted to stabilize the dorsal fragment without any further displacement as shown in Fig. 2D. The rubber stopper acts to distribute the compressive force from the point reduction clamp over a larger area allowing a more stable fracture stabilization, while at the same time reducing skin and soft tissue trauma at the dorsal aspect of the wrist.

This technique has the benefit of improving the reduction and stabilization process when inserting the distal locking screws from the volar side in distal end radius fixation. When using this technique, the gap can be closed and the dorsal fragment fixed correctly and firmly in place. Postoperative radiographs following one of recent our cases (Fig. 5) show acceptable alignment of the distal radius fracture (radial inclination 17°, radial height 9 mm, volar tilt 9°). As with any fixation, long-term follow-up is needed for evaluation based on functional scores, range of motion, union status, and postoperative complications, and all of our patients for whom we used this technique had problem-free recovery throughout the follow-up period.

Other methods of dealing with this problem have been attempted. For example, Henry et al. [12] used a large tenaculum to assist in reduction of a distal radius fracture. A postoperative radiograph at 6 weeks showed good alignment without further displacement of the fracture, but there was no long-term follow-up of their patient.

Possible complications from this technique are the same as can occur from open reduction and internal fixation with a volar locking plate in any distal radius fracture. In one retrospective study that included 576 patients with distal radius fractures treated by open reduction and internal fixation with a volar locking plate [13], the overall complication rate was 14.6%, with complications of carpal tunnel syndrome or change in sensibility in 5.2% of the patients and tendon complications in 4.7% (five flexor tendon ruptures and 12 extensor tendon ruptures). All four flexor pollicis longus ruptures were associated with insufficient reduction, e.g. persistent postoperative dorsal tilt and consequent volar...
protrusion of the plate. In extensor tendon ruptures, there was an association with screw penetration at the dorsal cortex. Our technique can compress the bone to the plate allowing the volar tilt of the distal radius to align properly with the configuration of the volar locking plate. To prevent extensor tendon rupture, the length of the screws can be checked peri-operatively under a fluoroscope in the lateral or dorsal tangential views.

4. Conclusion

Our technique utilizing a large point reduction clamp with a rubber stopper from a sterile bottle allows secure reduction and stabilization of a coronal-split intraarticular distal radius fracture. The notable advantages of this technique are that it requires only simple and readily available equipment that can be found in even smaller hospitals, and it does not require special experience or skill.

Ethical approval

The present study was approved by the Prince of Songkla University Institutional Review Board, Faculty of Medicine, Songklanagarind Hospital, Prince of Songkla University (IRB number REC 64-442-11-1).

Consent

Written informed consent was obtained from the patient for publication of this surgical note and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Registration of research studies

None.

Guarantor

Sitthiphong Suwannaphisit, MD.

Author contribution

Sitthiphong Suwannaphisit — Preparation of case, Literature review, Writing the paper.
Pasin Asawatreratanakul — Writing the paper.
Warangkana Fongsri and Porames Suwanno — Literature review and data preparation.

Declaration of competing interest

No conflicts of interest.

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Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.102966.

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