Technique of Proximal Pole Scaphoid Fracture Fixation Using a Retrograde Pin Placement but Antegrade Screw Placement: A Case Example

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ABSTRACT

The scaphoid is the most commonly fractured bone of the carpal row. Because of its precarious blood supply, scaphoid fractures are predisposed to avascular necrosis (AVN) and nonunion. This is especially true with fractures of the proximal pole. To decrease the risk of nonunion and AVN, surgical treatment of proximal pole scaphoid fractures is recommended, which facilitates fracture consolidation and long-term wrist function. We describe a 16-year-old adolescent boy who presented with a fracture of the proximal pole of the scaphoid, initially managed nonoperatively. Subsequent imaging findings revealed nonunion of the scaphoid bone. For treatment, a percutaneous fixation was chosen with a retrograde pin placement and antegrade screw placement. At 3 months postoperatively, the patient returned to competitive sports (ie, American football and basketball). Radiographs at 6 months postoperatively revealed promising healing. The described approach can provide an effective option for treating scaphoid fractures with nonunion.

Keywords: Scaphoid Bone, Nonunion, Percutaneous Fixation

INTRODUCTION

The scaphoid is a complex bone that presents a unique challenge for fracture healing and surgical fixation. The gold standard of treatment remains controversial, despite numerous studies on management of nonunion. Scaphoid fractures rarely involve the proximal pole (6%) and more often involve the tuberosity (17%), waist (66%), and distal pole (11%). Fractures of the proximal pole are especially prone to nonunion and avascular necrosis owing to their tenuous and retrograde blood supply.

Scaphoid fractures are most commonly seen in men between the ages 10 to 29 years, especially men with high physical demands (eg, military training or sports). In patients with displaced fractures or proximal pole involvement, surgical treatment is indicated owing to lower rates of long-term complications compared to nonoperative management. An analysis of different surgical fixation techniques can help minimize complications and improve long-term outcomes. We describe a surgical technique using retrograde placement of a K-wire and antegrade placement of a screw.

TECHNIQUE

A healthy 16-year-old adolescent boy presented to the orthopaedic clinic with a proximal pole scaphoid fracture and an ulnar collateral ligament (UCL) injury of the right thumb at the metacarpophalangeal joint. The patient was a student athlete and right-hand dominant. He reported a history of experiencing multiple right-hand injuries while playing American football. His first scaphoid fracture was treated with immobilization for 3 months in an outside facility; however, the patient was still experiencing pain and reduced range of motion without considerable improvement.

Physical examination findings revealed tenderness to palpation over the ulnar side of the thumb and over the proximal pole of the scaphoid. The patient’s range of motion was grossly intact, with some pain experienced during wrist extension. Slight laxity of the UCL was noted at the right thumb metacarpophalangeal joint. Radiographs showed nonunion of the scaphoid fracture about the right proximal pole (Figures 1A and 1B). After discussing the diagnosis and radiographic results with the patient and his parents, surgical fixation of the scaphoid fracture and repair of the UCL were recommended.
Fixation was performed using a slightly modified percutaneous approach. Under fluoroscopic guidance, the scaphoid K-wire was placed in a center-center position in a retrograde fashion using a volar approach, with the wrist in hyperextension (Figure 2). The starting point of the pin placement was slightly radial to ensure proper capture of the central portion of the proximal pole. Fluoroscopy was then used to confirm central capture of the proximal pole fracture fragment. The wrist was then flexed and the 0.045 K-wire pin was advanced dorsally. A stab incision was made along the dorsal K-wire to allow drilling in an antegrade fashion, through the nonunion site of the fracture and into the distal pole of the scaphoid. Owing to the fragment size, a 2.5-mm Reduct screw (Skeletal Dynamics, Miami, FL) was used. Successful placement of the screw, compression, and re-approximation at the nonunion site was appreciated on fluoroscopic images (Figures 3A and 3B). The patient was placed in a thermoplastic volar resting splint, which was prefabricated by our occupational therapy team at the preoperative visit.

At 3 weeks postoperatively, the patient reported minimal pain that was well managed with immobilization and over-the-counter pain medication. Radiographs at the first postoperative visit confirmed adequate screw placement and compression at the fracture site. The patient was advised to avoid bearing weight and use his thermoplastic splint for immobilization.

At every subsequent follow-up visit, the patient reported decreased pain and increased range of motion. At 3 months postoperatively, radiographs showed more than 50% of trabeculation across the fracture site; thus, the patient was allowed to return to playing American football and basketball. At the final follow-up 6 months postoperatively, radiographs showed promising trabeculation across the fracture site, which provided evidence of fracture consolidation (Figures 4A and 4B).

DISCUSSION

Surgical fixation techniques used for treating the scaphoid are still a topic of discussion among hand surgeons, especially in the context of nonunion. We present a slightly modified surgical fixation technique that generated fracture reduction and compression, which resulted in fracture union and our patient’s return to competitive sports.

Some authors have recommended the dorsal antegrade approach when treating proximal pole fractures to ensure adequate capture of the proximal fragment. Other authors have found that fracture union and functional outcome remain the same regardless of use of dorsal or volar approaches. The current case showed the capture of a small proximal pole fragment.

Figure 1. At initial presentation 4 months after the injury, radiographs of the right wrist show nonunion of the proximal pole of the scaphoid fracture without displacement. A) Scaphoid view. B) Anteroposterior view.

Figure 2. Intraoperative view of the wrist position during antegrade K-wire placement.
using a volar approach to retrograde pin placement and a dorsal approach to antegrade screw placement. Using this technique through a volar approach, we captured the scaphoid in a center-center fashion with the guide wire without notable difficulty. This technique allowed successful capture of the central axis of the scaphoid, maximizing the screw length, which has been shown to be biomechanically optimal.\(^{10,11}\)

Most scaphoid fractures treated by the senior author (DM) are waist fractures, approached volarly. The senior author has been developing skills for a volar approach to retrograde placement of K-wires. Therefore, even when treating proximal pole fractures, the K-wire is placed volarly because of ease of this technique. However, percutaneous scaphoid fixation is technically challenging even for experienced surgeons. Surgeons should consider the scaphoid bone geometry and visualize its 3D shape while inserting the K-wire. This can be facilitated by drawing the axis of the scaphoid bone on the patient under fluoroscopic guidance.

When treating proximal pole fractures, there is a risk of fragmentation of the small proximal fragment. Subsequently, an attempt to place the K-wire should be minimized.

Using a volar approach for drilling can be complicated by the local anatomy, such as the trapezium that can impede proper screw placement. Therefore, the second step of this technique involves placing the screw using a dorsal antegrade approach. This also ensures successful capture of the proximal...
pole fragment and helps minimize its displacement during drilling and screw placement.

In recent years, surgeons have advocated to change the surgical techniques used to treat nonunion of the scaphoid bone. When treating patients with this injury, the recognized management has been to use either non-vascularized or vascularized bone graft during internal fixation using a cannulated screw.12,13 However, Slade et al14 has contested this approach and found that nonunion of the scaphoid can be treated with internal fixation alone. Authors have used this technique with a union rate varying between 85.7% and 100%.15-19 Notably, most cases involved patients with scaphoid waist fractures and not the proximal pole, as in the current case. The findings of the current case show that even with proximal pole fracture nonunion, it is possible to obtain union without the added morbidity of a bone graft. Because these findings will not change surgical plans, it has led surgeons such as the senior author to forgo advanced imaging preoperatively. This represents a radical change in the way we treat nonunion of scaphoid fractures, and it is not widely accepted among hand surgeons.

We describe a case study using a technique that offers an alternative option for treating nonunion of proximal pole scaphoid fractures. It allows for optimal guidewire placement using the volar retrograde approach; additionally, it captures the proximal pole fragment with compression using the dorsal approach and antegrade screw placement. Further studies with more patients are needed to understand and compare different techniques for treating proximal pole scaphoid nonunion, especially regarding fixation alone. However, the described surgical approach can provide an effective method of treating fracture nonunions. The difficulty of treating scaphoid fractures presents an opportunity for improvement in surgical techniques to decrease the rates of nonunion, reduce time of immobilization, and improve long-term patient outcomes.

REFERENCES