



EVALUATION OF PERCUTANEOUS SCREW FIXATION OF SCAPHOID FRACTURES

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INTRODUCTION: -

Scaphoid fractures constitute about 2-7% of all fractures with the highest occurrence in 3rd-decade young persons. Of all carpal fractures, 82-89% concern scaphoid fractures. The incidence in Western countries is approximately five fractures in every 10,000 inhabitants. However, because of the difficulty that scaphoid fractures often present, the exact incidence is unknown. It is well known that scaphoid fractures can be difficult to diagnose on initial radiographs. In cases of suspected scaphoid fracture where the initial radiographs are negative, magnetic resonance imaging is mandatory for diagnostics, while computed tomography has proven more reliable and accurate in the assessment of scaphoid fracture characteristics and union. The scaphoid forms an important mechanical linkage between the proximal and distal carpal rows. Approximately 80% of the surface of the scaphoid is covered with cartilage to articulate proximally with the distal radius, ulnarly with the lunate and capitate, and distally with the trapezoid and trapezium bone.

Percutaneous screw fixation has gained popularity. Percutaneous screw fixation of the scaphoid was first reported by Strelin in 1970. It allows for more rapid return to work and sports activities. This technique avoids the devascularization of the scaphoid and division of the carpal ligaments and provides a much more aesthetic scar. Potential points of entry for fixation devices are limited by approximately 80% of the surface of the scaphoid bone is covered with articular cartilage. An additional constraint is the boat shape of the scaphoid, requiring special skills on the part of the surgeon to maneuver a wire or a fixation device along the true central axis of the scaphoid.

MATERIALS AND METHODS

Between July 2020 and July 2023, 10 scaphoid fractures using the percutaneous scaphoid fixation technique were treated. There were 7 men and 3 women with a mean age of 25.8 years (range, 18-38 years). There were 5 scaphoid fractures on the right side and 5 on the left side. Mechanisms of trauma were fall on outstretched hands for 7 patients and road traffic accident for 3 patients. 8 fractures were on the dominant side and 2 were on the nondominant side. Mean time from injury to surgery was 2.5 weeks (range, 8 days to 3 weeks). Plain radiographs revealed the fractures in all cases. All patients had a preoperative evaluation.

Surgical technique: -

The patient was placed supine with the affected upper limb abducted 90° and the operated-on hand on a radiolucent arm board. General anesthesia was

used and a pneumatic tourniquet was inflated. The wrist was placed in a hyperextension mode with maximal ulnar deviation. To obtain central screw placement with this percutaneous technique, the central axis of the scaphoid was determined with fluoroscopy, in both the anteroposterior and the lateral planes. Along this axis, a guidewire was placed on the skin. Hyperextension and ulnar deviation of the wrist accompanied by thumb traction facilitated any necessary reduction of the fracture. Hyperextension assisted in bringing the trapezium dorsal to the insertion point of the guidewire, at the scaphoid tubercle. Ulnar deviation of the wrist also slid the scaphoid out from the radial styloid process. In this position, under image intensifier control, a 0.5-cm longitudinal incision was made at its most distal radial aspect. Blunt dissection was used to expose the distal pole of the scaphoid. A 1.1-mm percutaneous guidewire was introduced into the scaphoid, with great care taken to avoid bending the thin wire. It was directed in 2 views toward the center of the proximal pole of the fractured scaphoid and advanced until it arrived in an adequate position on both views. This required an appreciation of the 45° obliquity of the scaphoid in both anteroposterior and lateral planes. The guidewire track must be angled 45° dorsally and 45° medially, along the mid-axis of the scaphoid. The length of the guidewire within the scaphoid was determined by a depth gauge. The drill was inserted, using a guide to protect the soft tissues. Central screw placement is crucial because it is more biomechanically stable; however, this is technically difficult and requires a high level of skill. A self-tapping, 3-mm Herbert screw was then introduced with intensifier control and the wire was removed. Compression was confirmed by image intensifier. The end of the screw was buried beneath the distal surface of the scaphoid to avoid more damage to the scaphotrapezium joint. A 20-mm screw was sufficient in almost all the cases, with an 18- or 22- mm screw being used in a few.

Post operative protocol: -

A volar thumb slab splint was applied for approximately 2 weeks. Patients were advised to elevate the operated-on limb during the first days postoperatively to control swelling. Nonsteroidal anti-inflammatory drugs and pain medications were prescribed for postoperative swelling and pain control, respectively. The first postoperative follow-up visit occurred at 2 weeks. Active wrist range of motion was begun and was accompanied by hand grip exercises, provided no weight lifting occurred. After that, follow-up visits occurred every 4 weeks. At each follow-up visit,

radiographs were obtained to assess fracture healing. The duration of follow-up depended on radiographic fracture healing and clinical evaluation.

RESULTS

Functional Outcome

The authors used the modified Mayo wrist score in this study. Fractures were considered consolidated when follow-up radiographs in all planes showed significant trabeculation crossing the fracture, without pain. Union was achieved in all cases. Return to work ranged from 18 to 40 days depending on the patient's occupation, and return to active sports ranged from 49 to 70 days. Most of the delay was caused by needing radiologic evidence of fracture union. Full flexion, extension, and ulnar deviation were achieved in all patients at 6 weeks, and radial deviation was equal to the contralateral side after 3 months in 6 patients and after 4 months in 4 patients. Mean power grip was 90% of the contralateral hand at 6 weeks, and 98% at 3 months. Pinch grip rapidly returned to normal, with the mean value being equal to the contralateral side at 3 months. In this study, the average postoperative modified Mayo score was 98 (range, 95- 100). Postoperative complications such as wound infection, reflex sympathetic dystrophy, scar pain, hypertrophy, hardware failure or loosening, malunion, or avascular necrosis were not observed. Also absent was radiographic evidence of scapholunate instability or osteoarthritis at the site of screw insertion.

Radiologic Outcome

All patients had consolidated fractures. Radiographs showed that the screw was in a central position within the scaphoid in 8 patients but somewhat peripheral in 2 patients. In all cases, the fracture was bridged by the screw, and no migration or loosening was observed. Fracture union was seen at a mean of 57 days (range, 35-70 days). There has been no evidence of avascular necrosis, and none of the screws has been removed.



Pre OP X Ray



Intraoperative images



Intraoperative images



Post Op Xray

DISCUSSION

Bone healing occurs more quickly and postoperative immobilization is shorter with internal fixation than with nonoperative treatment. Percutaneous (minimally invasive) treatment has the advantages of internal fixation without the disadvantages of a wide surgical approach; the palmar ligament complex and local vascularity are preserved, while reflex sympathetic dystrophy, painful scar, and postoperative immobilization are avoided. Union was obtained in all patients at a mean of 57 days (range, 35-70 days). The range of movement after union was equal to that of the contralateral limb, and grip strength was 98% of the contralateral side at 3 months. Patients were able to return to sedentary work within 4 days and to manual work within 5 weeks. Because central screw placement is crucial, there are 2 screw portals—volar and dorsal. The volar approach might be preferred because the entry point to the bone can be detected more easily, there is little risk

of damaging the radiocarpal joint and the extensor tendons, the fracture is usually stabilized in extension, and there is often no need for additional maneuvers. Moreover, the volar approach may be preferable for fractures located close to the distal pole, while the dorsal approach may be preferable for proximal fractures. During the dorsal approach, the extensor tendon of the thumb and index finger and posterior interosseous nerve are at risk. During the volar approach, the superficial palmar arch and the recurrent branch of the median nerve may be injured. Use of a mini-incision to avoid anatomical risks has been suggested. According to Polsky et al and Jeon et al, there was no statistically significant difference in clinical outcomes, union times, and gripping and pinching strengths between patients treated with the dorsal vs the volar approach. In the current study, all cases were fixed through the volar approach. This seemed to be easier because all fractures were around the scaphoid waist. Regarding volar screw placement, controversy exists about whether to enter through the trapezium or avoid it. The data suggest that, in a cadaveric osteotomy-simulated scaphoid waist fracture model, the trans trapezium approach reliably achieves the central positioning of a screw in the proximal and distal poles. This position offers a biomechanical advantage compared with central placement in only the proximal pole. However, this technique may lead to scapho trapezium joint damage, so an entry point avoiding this joint is preferable.¹⁸ Regarding the use of the percutaneous technique for the treatment of recent and delayed scaphoid waist fractures, Wozasek and Moser described 25 cases with delayed union and 8 with established nonunion that were treated using a percutaneous dorsal approach. Bony healing was achieved in 81.8% after a mean of 82 months. However, the current authors agree with others²⁰⁻²² that it seems logical to use an open technique for the treatment of delayed scaphoid fractures because a bone graft is required. Also, the choice of the screw to use for fixation is a topic of debate. Herbert screws, headless compression screws, 3.5-mm cannulated screws, and Acutrak screws (Acumed, Hillsboro, Oregon) have been used. Shaw²³ and Rankin et al²⁴ showed that there were greater compression forces with the cannulated screw, but accepted the biological advantages of the headless Herbert screw, which can be buried within the scaphoid without disrupting its bony architecture. Newport et al found better compression with the Herbert screw. The Acutrak screw is a headless, tapered, self-tapping, and fully threaded device designed to provide interfragmentary compression. The Acutrak screw may therefore have some of the

advantages of the Herbert screw in being headless, having a variable pitch, and also providing improved interfragmentary compression. Adla et al found no significant difference in compressive effects between the Herbert screw and the Acutrak screw.

In the current study, 10 patients received the Herbert screw and the volar approach, with a union rate of 100% achieved. The average postoperative modified Mayo score was 98 (range, 95-100). There were no recorded complications. Others who used the same technique of fixation (ie, Ledoux et al for 23 patients, Inoue and Shionoya for 40 patients, and Brutus et al for 30 patients) reported a union rate of 100%.

CONCLUSION

Percutaneous screw fixation of scaphoid fractures has gained popularity due to improved instrumentation, low morbidity, and excellent results.

The disadvantages of a long period of cast immobilization are avoided, and this technique allows a more rapid return to work and sports activities than conservative treatment. Consequently, percutaneous screw fixation is appealing for the young, active population. Benefits of percutaneous screw fixation include a quicker time to union and a more rapid return to sports and work.

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