The percutaneous antegrade scaphoid fracture fixation—A safe method?

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Introduction

Percutaneous antegrade fixation of minimally and undisplaced scaphoid fractures by using a cannulated headless compression screw is an accepted alternative to plaster cast immobilisation. This technique may be used in the fixation of stable and unstable fractures. Benefits of percutaneous screw fixation are a quicker time to union, and a more rapid return to sport and work.4,7,19,31 The redundancy of a plaster cast following fixations circumvents the complications associated with immobilisation.6,12,31 Although retrograde fixation through a volar approach is a more frequently employed technique, the dorsal approach seems to be advantageous in fractures of the proximal pole, undisplaced midwaist fractures and well-aligned nonunions. Central placement of the screw in the long axis of the scaphoid may be better achieved through a dorsal approach.1,3,6,12,20,24–27 In the majority of cases antegrade scaphoid fixation by means of headless compression screws is performed percutaneously. The screw is inserted over a guide wire which maintains the alignment of the fracture fragments and secures the path of the screw through the scaphoid. This technique lends itself to a minimally invasive approach in its use.1,2,20,24 In this manner disruptions of soft tissues are minimised, hence reducing the biological insult and preserving bone perfusion. Nevertheless complications following percutaneous antegrade scaphoid fracture fixation do occur. Review of the literature reveals a complication rate of up to 29%. These studies are limited by their small patient numbers (n = 7–27).3,6,25–27

The purpose of this study was to quantify the rate of tendon, nerve and vessel injury in the dorsal percutaneous technique for the fixation of scaphoid fractures.

Materials and methods

The forearm and hand from 40 cadavers embalmed according to Thiel’s method were used. This unique embalming procedure was developed over a 30-year period in the department of anatomy in the University of Graz. It preserves tissue colour and consistency as well as allowing an almost full range of motion at articular joints.29 Extremities with arthrosis, evidence of trauma, scars or other pathological changes were excluded from this study. Pathological skeletal changes were detected by means of X-rays. Insertion of the guide wire for cannulated headless compression screws was performed by an experienced specialist according to established surgical technique.12,20,24 The forearm was pronated and the wrist...
flexed over a rolled up towel. The proximal pole of the scaphoid was located with the aid of the image intensifier. Following a short skin incision over the dorsum of the carpus, the guide wire was drilled antegrade into the centre of the proximal pole of the scaphoid (Fig. 1). The correct position of the guide wire was checked by using the so-called cortical ring sign of the scaphoid, which is obtained by superimposing the proximal and the distal poles of the scaphoid in the X-ray.20 If the guide wire was correctly located within the centre of the scaphoid, it was then advanced into the distal half (Fig. 2). The position of the wire was checked by fluoroscopy in four different views (anterior oblique, posterior oblique, lateral and posteroanterior with ulnar deviation).16 Subsequently the skin was removed and the soft tissues dissected in order to detect injuries (Fig. 3). All injuries were documented photographically; results were entered in a computerized database. All computations were performed using Microsoft Excel®.

Results

A total of forty hands of 40 different specimens (18 male, 22 female; 20 right, 20 left) were investigated. The cadavers had a mean age of 73 years (57–96 years). None of the examined cadaveric hands showed any nerve or vessel injury. Nevertheless, the rate of tendon injuries was clearly higher than expected. A tendon was said to be injured if the guide wire passed through it. This was determined by using loupes. Dissection of the hands showed a tendon injury in 5 out of 40 cases. Three different tendons were affected by the percutaneous inserted guide wires: the extensor pollicis longus tendon (EPL) on two occasions, the extensor carpi radialis tendon (ECR) on two occasions and the extensor digitorum tendon (ED) on one occasion. In all five cases, the tendon was pierced by the guide wire. No correlation between gender or side and likelihood of tendon injury was found.

Discussion

The scaphoid is the most commonly injured bone in the carpus. In a series of 72 fractures of the carpal bones Dunn found 82% whilst Leslie in a series of 247 found 89% to be fractures of the scaphoid with up to 11% of the fractures being those of the proximal pole.8,15 The treatment of these fractures in the adult remains a debated topic. Non operative management with cast immobilisation is not an entirely benign form of treatment. The majority of the fractures occur in young men and immobilisation in this group has an economic impact due to the time off work. Other associated problems include disuse porosis, joint stiffness and scaphoid mal-union.6,12,31 Nonunion occurs in 5–50% of scaphoid fractures depending on the quoted study with the majority affecting the proximal pole.14,15,22

Fixation of these fractures has been advocated by many authors. Pros and cons of the volar versus dorsal approach are discussed in the literature. Polsky et al. examined the differences between the two approaches in 26 patients and found no significant differences between the groups for range of motion, grip strength, pain level, and rate of union.21 The decision in choosing the approach is based on the anatomy of the fracture: insertion of the screw through the smaller fragment provides a more secure fixation as well as reducing the disruption to the blood supply of the scaphoid.5,16 The dorsal approach seems to be advantageous for fractures of the proximal pole, undisplaced fractures and well aligned nonunions. Placement of the screw in the central axis, is biomechanically advantageous and is easier when attempted dorsally. This

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Fig. 1. Correct entry point on proximal scaphoid pole was identified by means of fluoroscopy.

Fig. 2. The correctly located guide wire was advanced into the distal half.

Fig. 3. The guide wire was drilled through the extensor pollicis longus tendon.
approach carries the risk of damage to the articular cartilage of the proximal pole by the insertion of the screw. Palmar flexion of the wrist is essential for securing the correct entry point, possibly leading to a displacement of an unstable fracture. The volar approach is more advantageous for fixation of the fractures of the distal pole and unstable fractures, as the risk of fracture displacement is lower when dorsiflexing the wrist.1,3,17,21

The history of scaphoid screw fixation goes back over 50 years: McLaughlin described a technique using a Vitallium lag screw in 19 patients with good results in 1954.18 Some of his patients went on to require removal of the screw due to impingement and prominence of the screw head. These problems were overcome by the headless differential pitch screw invented by Herbert in 1977.14 The advent of the cannulated headless screw has made the percutaneous treatment of scaphoid fractures a reliable technique. It minimises the disruption to the soft tissues and therefore reduces the biological insult to a minimum.28 The central position of the guide wire within the scaphoid can be confirmed with the use of fluoroscopy in several planes prior to the insertion of the screw as this has been shown to be biomechanically advantageous.1,7,20 In the younger more active age group this also has the advantage of allowing a more rapid return to work and sporting activities.24,26,31 In a recent study, McQueen et al. reported a quicker time to union with low rates of complication going as far as to recommend that all active patients should be offered percutaneous stabilisation for fractures of the waist of the scaphoid.19

Review of the literature reveals the complication rate for the dorsal percutaneous method to be up to 2%.6,6,25–27 Unfortunately case numbers in these studies are low (maximum 27 cases). In our study, we aimed to detect the rate of soft tissue injuries with a larger series (40 cases). We showed the structures at risk to be the tendons of EPL, ECR and ED. In all these cases, the guide wire passed directly through the tendon. Subsequent drilling and implantation of the screw would have undoubtedly caused further damage leaving the tendons at risk of either immediate or delayed rupture. Although the established technique is “percutaneous”, the relatively high rate of tendon injury leads us to recommend extension of the skin incision in order to allow blunt dissection to the guide wire entry point. In this way, the tendons and other soft tissue structures may be safely retracted and protected as the guide wire is inserted and the path of the screw drilled prior to its implantation.

Conflict of interest

All authors disclose any financial and personal relationships with other people, or organisations, that could inappropriately influence the work.

References