Percutaneous screw fixation of scaphoid fractures has gained popularity over the years. The disadvantages of a long period of cast immobilisation 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 and active population. Biomechanical studies showed that greater fixation strength is obtained when the screw is placed centrally than eccentrically. Central screw placement can however be technically demanding. In the use of a volar percutaneous approach, the trapezium and the shape of the scaphoid impede central screw placement. Different approaches are available to overcome this difficulty. The volar percutaneous transtrapezial approach facilitates and allows more accurate central screw placement compared to approaches that try to avoid the trapezium. The surgical technique of this approach is described.

Keywords: scaphoid; percutaneous; fracture; volar; technique.

**INTRODUCTION**

Of all carpal bones, the scaphoid is the one most commonly fractured. It accounts for 50 to 80% of all carpal bone fractures (1). Mainly young, active individuals are subject to fractures of the scaphoid. In 80% the fracture occurs at the scaphoid waist (11). These fractures are usually considered to be stable and have a good tendency to heal with conservative treatment. Traditionally, immobilisation in a below elbow cast is the most accepted treatment. Union rates vary from 88 to 95% (6,8,10,16). Despite these excellent union rates, 8-12 weeks of cast immobilisation may not be accepted by the young and active population, because of professional or sports related activities or for social reasons (19). Moreover, disadvantages of cast immobilisation, such as stiffness and decreased grip
strength are reported in the literature \((12,17,20)\). As an alternative to conservative treatment, percutaneous screw fixation, has gained popularity. This treatment allows a more rapid return to work and sports activities \((2,3,4,7,12,18,19)\).

In 1970, Streli was one of the first to describe a percutaneous technique for fixation of scaphoid fractures \((21)\). Since then, others have reported on the results of this technique. Several series have proven that percutaneous fixation of scaphoid fractures has a high union rate \((3,13,16,22)\). In 1991, one of the first large series reported a union rate of 89% at 4.2 months, in 146 patients with acute scaphoid fractures. One of the latest series, by Meermans and Verstreken in 2008, showed a 100% union rate in 35 patients with an average time to radiological union of 6.4 weeks \((16)\). Moreover, the percutaneous technique allowed earlier return to work and a shorter time to radiological union than fractures treated conservatively \((3,13)\).

In a biomechanical study, McCallister et al \((2003)\) showed that the strength of the fixation is greater when the screw is placed centrally as opposed to eccentrically \((15)\). Dodds et al \((2006)\) confirmed these data and stated that a long, centrally placed screw, with purchase of the screw threads in the subchondral bone, provides better fixation \((9)\). However, central screw placement can be technically difficult and requires a high level of skill \((4,7,19)\). When using a standard percutaneous volar approach, central screw placement is complicated by the shape of the scaphoid and obstruction by the trapezium \((5,14)\). These difficulties may be overcome by opening the scaphotrapezial joint and manipulation of the scaphoid or by using a more radial entry point on the distal pole of the scaphoid, which could lead to suboptimal placement of the screw. As an alternative to this, a percutaneous transtrapezial approach can be used. This surgical technique will be described.

The ideal indication for the use of this technique is an acute nondisplaced or minimally displaced (< 1 mm) fracture through the middle third of the scaphoid. In displaced fractures, reduction can sometimes be obtained by closed manipulation. If not, an arthroscopically assisted or open reduction manoeuvre is performed. Proximal pole fractures can better be fixed through a dorsal approach and are excluded, as are comminuted fractures.

**Surgical technique**

The patient is placed in a supine position with the affected hand on a radiolucent arm board. No traction devices are applied. The procedure is carried out under general anaesthesia or brachial plexus block and under tourniquet control. To obtain central screw placement in this percutaneous technique, the central axis of the scaphoid is determined with fluoroscopy, both in the frontal and lateral plane. Along this axis a guide wire is placed on the skin. The central axis is subsequently marked on the skin.

![Fig. 1A & 1B. — Central axes of scaphoid marked on the skin](image-url)
skin with a marker pen (Fig. 1A and 1B) in the two planes.

A stab incision is made over the distal half of the trapezium, at the intersection of the two lines. Next, a guide wire is drilled through the trapezium into the scaphoid. The guide wire is advanced along the lines marked on the skin and under fluoroscopy until it reaches the proximal cortex of the scaphoid (Fig. 2).

The position of the guide wire is carefully checked for central placement in both the frontal and lateral plane. To determine the appropriate screw length, an identical second guide wire is drilled also transtrapezially and next to the first until it reaches the distal cortex of the scaphoid (Fig. 3).

The difference between the two wires is measured and the screw length is determined. The second guide wire is removed. To prevent backing out of the first wire one can choose to advance it into the distal radius. Subsequently, a drill (2 mm) is used before a cannulated Headless Bone Screw (Gebrüder Martin GmbH & Co. KG, Tuttingen, Germany) is placed over the guide wire into the scaphoid (Fig. 4). Next, the guide wire is removed. Final position of the screw is checked in all planes (Fig. 5A & 5B).

Postoperatively, a volar splint is applied for a duration of 2 weeks. The patients are advised to elevate the hand the first days for control of swelling. Respectively, non-steroidal-anti-inflammatory-drugs and pain medication are prescribed for postoperative swelling and pain control. The first postoperative follow-up is at 2 weeks and then every 4 weeks. At each follow-up radiographs are taken to assess fracture healing. The duration of follow-up depends on radiographic fracture healing and clinical evaluation.

**DISCUSSION**

Adequate patient selection is essential for a good outcome and prevents most complications. It is again emphasized that unstable, comminuted and proximal pole fractures should not be treated with
this technique. If the screw is technically well-placed, few complications are noted so far. Complications can occur due to eccentric screw placement. As reported by Dodds et al. (2006) and McCallister et al. (2003) this results in less fixation strength (9,15). One of the advantages of the trans-trapezial technique is that it not only allows exact central placement of the screw, but it also makes this technically demanding procedure easier. Drawing lines on the skin along the central axis of the scaphoid in the posteroanterior and lateral plane, facilitates the insertion of the guide wire, and allows to use less fluoroscopy. No manipulation of the wrist or scaphoid is necessary, nor is a more complex setup with traction, which could displace or distract a non-displaced fracture. In the early stage of the use of this technique, prominence of the screw head in the scaphotrapezial joint was the most common complication. In a series of 35 patients treated with this technique, in 3 patients the screw had to be removed because of persistent pain after fracture healing. Symptoms fully resolved after removal of the screw (16). Protrusion of the screw in the scaphotrapezial joint can be avoided by careful evaluation of the fluoroscopic images during surgery. A pronated oblique view, combined with ulnar deviation and 45° of flexion of the wrist, best allows evaluation of the scaphotrapezial joint. If screw removal is considered to be necessary, a guide wire is drilled using the described volar percutaneous transtrapezial approach. The guide wire is overdrilled with the 2 mm drill bit up to the screw. The screw can then be removed.

In the use of the transtrapezial technique, there is some concern for the unavoidable iatrogenic damage to the articular surface of the scaphotrapezial joint. Degenerative changes in the scaphotrapezial joint could arise due to cartilage damage at the scaphotrapezial joint. The size of this cartilage defect at the scaphotrapezial joint has a diameter of 2 mm due to the use of the corresponding drill. A study by Meermans and Verstreken of 35 patients treated with this technique for acute scaphoid waist fractures showed no degeneration of the scaphotrapezial joint at 3-year follow-up (16). A more recent study, with a mean follow-up of 6 years of the same population confirmed these findings.

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