Dorsal percutaneous screw fixation of delayed or nonunion of scaphoid fractures

Decision making with MRI

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Abstract

Purpose The purpose of the present study is to evaluate scaphoid delayed fractures or nonunions treated by percutaneous fixation with MRI correlations.

Methods We evaluated 33 consecutive scaphoid delayed unions or nonunions treated by dorsal percutaneous fixation at a mean 16 months (range, seven to 48 months) after the operation. There were 31 male and two female patients with an average age of 29 years (range, 25–33 years).

Results Pre-operative MRI revealed no signs of avascular necrosis. At the latest follow-up, all patients had good or excellent results.

Conclusion We suggest dorsal percutaneous screw fixation for scaphoid delayed fractures or nonunions after eliminating the presence of AVN by pre-operative MRI examination.

Keywords Scaphoid · Delayed union · Nonunion · Percutaneous fixation

Introduction

It is generally agreed that scaphoid delayed unions or non-unions are treated by open reduction, rigid internal fixation and bone grafting [1]. Recently, some articles

indicating dorsal percutaneous screw fixation without bone grafting appeared in the literature, all with excellent results [2–6].

It is well known that scaphoid fractures are prone to avascular necrosis (AVN), and such a possibility should be ruled out for a safe treatment [7, 8]. Magnetic resonance imaging (MRI) is accepted as an important step in such an approach [7, 8]. Careful review of the literature revealed no report of MRI investigation before percutaneous fixation for scaphoid fractures and in our opinion such an approach carries the risk of AVN. So we report our experience with dorsal percutaneous screw fixation for scaphoid delayed or nonunions with MRI correlation for decision making.

Patients and methods

In this retrospective study, 33 scaphoid delayed or non-unions treated in a three-year period were reviewed. The series consisted of only isolated scaphoid delayed or non-unions with MRI images in normal density. Patients with fresh fractures (less than two months) were treated either by casting or fixation depending on the choice of the surgeon. If the MRI images were consistent with AVN, patients were handled as described elsewhere [8]. Patients with other associated injuries were also excluded in order to prepare a uniform group.

Twelve patients had been treated by casting before, and the remaining were neglected cases. There were 31 male and two female patients with an average age of 29 years (range, 25–33 years). Fifteen of the cases had proximal pole and 18 had waist fractures (Table 1). The mean duration of fractures was 7.6 months (range, two to 36 months). Fractures between two and three months were described as delayed union and older than three months as nonunion [4]. By these criteria, 20 of the cases were delayed and 13 were nonunions.

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Table 1 Summary of the patients

Characteristic	Description	Value	Description	Value
Gender	Male	31	Female	2
Fracture location	Proximal pole	15	Waist	18
Union	Delayed	20	Nonunion	13
Prior treatment	Casting	12	No treatment	21

MRI scans were obtained of all patients as sequential 4-mm thick images with 1.5 Tesla MRI scanner and a 3-in circular surface coil. T₁- and T₂-weighted images were obtained and specifically evaluated for evidence of AVN. All examinations were interpreted by staff radiologists who were blinded to the study and by the surgeon himself. Only the patients with normal intensity were included in the series (Fig. 1). Patients

Fig. 1 **a** Scaphoid fracture occurred 12 weeks previously. **b** MRI shows normal intensity. **c** 18 months after the operation

Fig. 2 A guide wire was driven under image intensifier control

with radiological signs of AVN were handled as described elsewhere [8].

Patients were placed in a supine position after either brachial block or general anaesthesia. The wrist was hyperflexed and a small stab transverse incision was placed over the dorsal and proximal edge of scaphoid. With a small haemostat, the stab was carefully developed until the bone was felt, in order to avoid injury to extensor tendons and superficial branch of radial nerve. Then, a guide wire was driven under image intensifier control (Fig. 2) and a hole was drilled over the guide wire, then an appropriate size of cannulated screw was placed (Fig. 3). The wrist was immobilized in a short-arm splint which was removed at six weeks and active exercises were encouraged.

The study was approved by the local ethical committee and the patients were informed about the publication.

Fig. 3 Cannulated screw is being placed percutaneously

Results

All fractures were united successfully without any additional procedures. At the latest follow-up (mean, 16; range, seven to 48 months after the operation), patients were evaluated by the criteria of Cooney et al. [9]. By this criteria, pain, range of motion, grip strength and return to regular employment were evaluated and all patients had good or excellent results. This means that all patients returned to their employment without pain but with slight decrease (10 % compared to the uninjured side) in range of motion or grip strength in 13 patients. In nine patients both grip strength and range of motion were greater than the normal wrist.

Radiological examination at the latest follow-up revealed no signs of AVN or humpback deformity.

Discussion

Studies have shown that delayed or nonunion scaphoid fractures should be treated by internal fixation [1]. However, open approaches, either dorsal or palmar, have some certain problems including soft tissue stripping, damage to ligaments, especially radioscapophcapitate and radiolunate ligaments leading to instability, injury to the already damaged blood supply leading to AVN, infection, reflex sympathetic dystrophy, painful scar formation and stiffness [1–6, 8, 10–12]. For these reasons, there has been a trend towards percutaneous fixation of such fractures [2–5].

Most of the literature regarding percutaneous fixation of scaphoid fractures is performed by palmar approach. However, Jeon et al. reported a comparison of palmar and dorsal percutaneous fixation and found no difference in terms of union time and clinical outcome and they concluded the dorsal approach to be better, allowing more precise placement of the screw [1].

Review of the literature revealed a limited number of case series of dorsal percutaneous fixation of scaphoid delayed or nonunions [2–5] and none of them reported AVN. On the other hand, AVN is the most important complication of scaphoid fractures and occurs due to the disruption of precarious blood supply [1, 8], and the risk for AVN increases if the fracture is left untreated [1]. For this reason, this risk should be eliminated before attempting to fix the fracture. The first step for such an approach is MRI [1, 8]. If MRI shows normal intensity, fractures can be fixed safely percutaneously. If not, then observation of punctuate bleeding is mandatory and open reduction is required.

The result of our series is comparable with others in that we also obtained union in all 33 patients, which is equal to the sum of all delayed or nonunion scaphoid fractures treated by dorsal percutaneous approach reported to date. Also, all our patients had excellent or good results. Our strategy to

eliminate the risk of AVN offers us more security in order to prevent additional operations due to AVN. In about one third of our patients (13), range of motion of the operated side was greater than the uninjured side. This is probably due to the normal difference between the ranges of motion of the upper extremity [13].

One of the major concerns for this approach may be the lack of grafting. However, the need for grafting for such non-unions is not certain [14], and some additional procedures are utilized to promote healing [15, 16]. Reaming of the scaphoid in preparation for the screw creates an opportunity to establish bleeding of the bony surfaces [5]. This mechanism probably occurs for all our cases united without grafting.

The major limitation of the present study is the lack of a control group, so the results cannot be compared with the other treatment modalities including palmar percutaneous fixation, open reduction or conservative treatment. Another important limitation is the retrospective design of the study and these prevent more definitive conclusions. Nevertheless, dorsal percutaneous screw fixation for scaphoid delayed or non-unions seems a reasonable treatment after eliminating the presence of AVN by preoperative MRI examination

Conflict of interest The authors declare that they have no conflict of interest.

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