

# Posttraumatic osteonecrosis and nonunion of distal pole of scaphoid

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## ABSTRACT

Posttraumatic osteonecrosis of distal pole of scaphoid is an extremely rare with only two reported cases so far. We present a case of a 30-year-old male with a 2-year-old posttraumatic osteonecrosis and nonunion of distal pole of scaphoid left wrist. He presented with complaints of pain and restriction of movements. There was no evidence of radiocarpal arthritis. He was managed with open reduction and internal fixation with k-wires, supplemented by a pronator quadratus based muscle pedicle bone graft. The fracture union was achieved at 6 months. After 2 years, he had almost complete range of wrist motion and had returned to his preinjury level of functional activity. His MRI (magnetic resonance imaging) scans showed evidence of revascularization suggesting successful incorporation of bone graft.

**Key words:** Posttraumatic osteonecrosis scaphoid, posttraumatic nonunion scaphoid, muscle pedicle bone graft

## INTRODUCTION

Scaphoid is the most common carpal bone to fracture, its diagnosis is frequently delayed and is more prone to osteonecrosis and nonunion.<sup>1</sup> The incidence of osteonecrosis following fractures of the scaphoid is reported between 13% and 50% with higher chances in fractures of proximal one-fifth of the scaphoid and it usually occurs in proximal pole.<sup>2-5</sup> Only two published reports could be traced in the literature reporting posttraumatic osteonecrosis of distal pole of scaphoid.<sup>6,7</sup> We present a rare case of posttraumatic osteonecrosis and nonunion of distal pole of scaphoid.

## CASE REPORT

A 30 year old male presented to the outpatient department in January 2010 with complaints of increasing pain and stiffness in the left wrist for the last 2 years following a fall on outstretched hand. He took treatment in form of massage

for two and half months and no radiological investigations were done for his injury. He returned to stitching clothes, his profession, after two and a half months. His wrist pain increased progressively along with restriction of movements to such an extent that he had to discontinue his job. On examination his left wrist (non-dominant) showed gross restriction of motion with just 10 degrees of dorsiflexion and 15 degrees of palmar flexion. There was mild tenderness on radial side of wrist, which was more marked in the anatomical snuffbox. Radiographs showed a nonunion of scaphoid with avascular necrosis of distal pole with no evidence of radiocarpal arthritis [Figure 1a]. The lateral intrascaphoid angle as observed in the lateral view was 60° indicating a mild humpback deformity; however, luno-capitate angle was 0°, indicating absence of carpal instability. There was no loss of carpal height. The carpal height ratio was 50% (45-60%), ruling out a carpal collapse. Computed tomographic (CT) scan of right wrist showed the distinct fracture line in the scaphoid with cystic changes in the adjacent region of bony fragments and a sclerotic distal fragment [Figure 1b].

An open reduction and internal fixation of the nonunion with k-wires supplemented with a pronator quadratus muscle pedicle bone graft was planned.<sup>8</sup> The scaphoid was exposed through a standard palmar approach after extending the incision beyond the distal palmar crease by 2 cm [Figure 2a]. Nonunion was exposed and fractured surfaces cleared of fibrous tissue. The distal fragment was retrieved, which was approximately 1 × 0.5 cm in size. No bleeding could be observed in the distal fragment on curettage of its fractured surface, confirming avascular distal

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fragment as preoperative MRI was not done in this patient for assessing avascularity. The nonunion was reduced and a 2.0 mm k-wire was passed across the fracture site from distal to proximal fragment, under fluoroscopic guidance. We had planned fixation with Herbert's screw, however, because of the fear of crushing the small sized distal fragment, we preferred k-wire. The pronator quadratus muscle pedicle bone graft was harvested and transposed to the nonunion site. A second k-wire was now introduced, which held the graft in position and supplemented the fixation of the fracture [Figure 2b]. The wound was closed in layers with a suction drain in place. The wrist was immobilized in a below elbow plaster of paris cast in neutral flexion. The postoperative radiographs showed a reduction in the lateral intrascaphoid angle to 46° from a preoperative 60° [Figure 3a]. The pop cast was continued for 12 weeks followed by gradual mobilization and range of motion exercises. At 6 months, sound union at the fracture site was observed radiographically and was confirmed by CT scan [Figure 3b and 3c]. He returned to (stitching clothes) job at 4 months and resumed his part time farming activities after k-wire removal at 6 months,

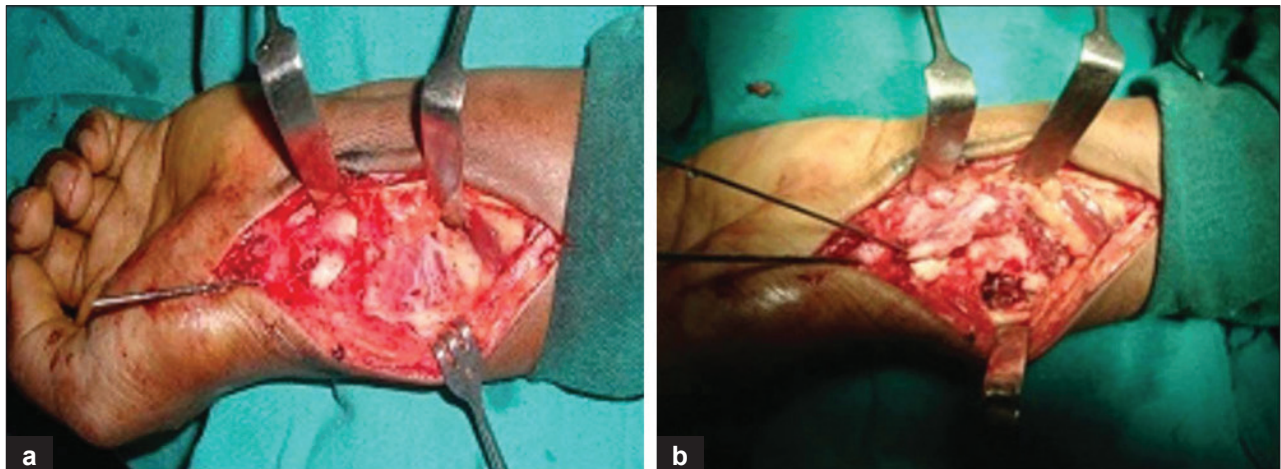
postoperatively. At 2 years followup, he was able to perform all activities of daily living and had attained his pre-injury functional level. He still experiences mild pain after heavy work and has restriction of terminal 10° of palmar flexion [Figure 4a]. His Disabilities of the arm, Shoulder and Hand (DASH) Score was 4.25, which is consistent with good hand function. The magnetic resonance imaging (MRI) scan of the left wrist showed evidence of revascularization 2 years post-injury suggesting successful incorporation of pronator quadratus muscle pedicle bone graft [Figure 4b].

## DISCUSSION

The osteonecrosis of proximal pole and nonunion are common complications of scaphoid waist fractures owing to its precarious blood supply.<sup>4,9</sup> Blood supply to scaphoid comes mainly (70-80%) through the dorsal ridge vessels, which arise from the radial artery or the intercarpal artery and supply the scaphoid from distal to proximal direction after entering small foramina on the dorsal aspect of its waist.<sup>4,9</sup> Smaller contribution (20-30%) comes from the laterello-volar vessels, branches from radial artery or its superficial palmar branch, which enters the scaphoid through the tubercle and again supplies the proximal pole from distal to proximal direction.<sup>9</sup> Hence, any fracture through the waist tends to leave the proximal fragment avascular, resulting in high rates of avascular necrosis of proximal pole. The site of entry of the dorsal vessels is variable—they enter distal to the waist in 14%, at the waist in 79% and proximal in 7%.<sup>10</sup> If all the dorsal vessels enter the bone proximal to the waist, a fracture through the waist can lead to osteonecrosis of the distal fragment if (1) the volar vessels get damaged at the time of injury, or (2) there is an anomalous deficient vascularization of the distal pole.<sup>11</sup> Even then, posttraumatic avascular necrosis of distal pole of scaphoid is an extremely rare occurrence with only two reported cases so far.<sup>6,7</sup> The osteonecrosis of both poles of



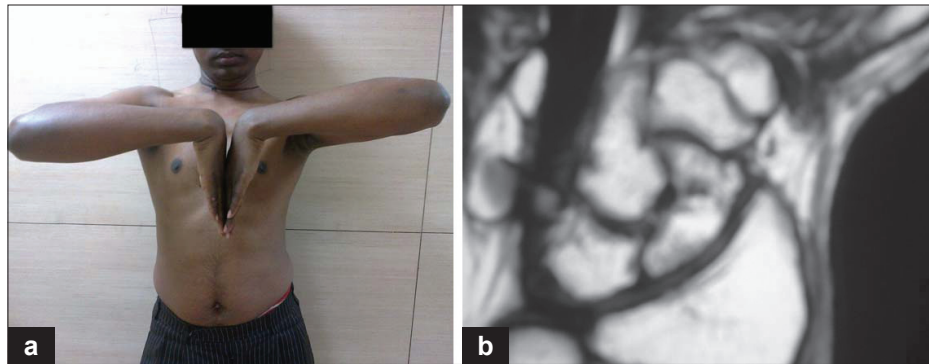
**Figure 1:** (a) X-ray wrist joint anteroposterior view in ulnar deviation showing nonunion with avascular necrosis of distal pole of scaphoid (b) CT scan confirming the nonunion and a sclerotic distal fragment



**Figure 2:** Clinical photographs showing (a) exposure through a palmar approach (b) fixation of the graft and scaphoid nonunion



**Figure 3:** Postoperative x-ray wrist joint showing (a) graft and k-wires in situ with reduction in lateral intrascaphoid angle (b) union after 6 months (c) Union confirmed on CT scan



**Figure 4:** (a) Clinical photograph at 2 years showing range of motion (b) MRI scan after 2 years showing evidence of revascularization

scaphoid following a waist fracture in a 12-year-old boy is also reported.<sup>12</sup>

Our patient had nonunion and avascular necrosis of distal pole of scaphoid, hence, a procedure which could achieve union as well as revascularize the avascular fragment was required. Pronator quadratus based vascularized pedicle bone graft is a standard technique for treating avascular necrosis which was used in conjunction with k-wire fixation.<sup>8</sup>

Our patient had a mild humpback deformity as shown by the lateral intrascaphoid angle of 60°. Intra-operatively it was corrected under fluoroscopic guidance before fixing the fracture with k-wires. However, the postoperative radiographs showed partial correction to 46° and there was a concern regarding future development of arthrosis.<sup>13</sup> However, we decided to let the scaphoid unite in this position since this much of angulation is compatible with good long term function. Jiranek *et al.*, reported 26 patients of carpal scaphoid nonunions treated with bone grafting, 13 of which had lateral intrascaphoid angles of greater than 45°. <sup>14</sup> However, all these patients showed excellent function and high patient satisfaction at 11 years' followup indistinguishable from those

with normal scaphoid alignment, suggesting that osteotomy and surgical treatment of a malunion is not indicated for most patients with healed scaphoid fractures.

Although distal pole avascular necrosis is an extremely rare complication of scaphoid fractures, treatment is similar to that for proximal pole avascular necrosis and nonunion i.e., open reduction, adequate internal fixation and muscle pedicle bone grafting. The present case has been successfully managed, using this strategy and has resulted in a good clinical, radiological and functional outcome at 2 years after surgery.

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