COLLAPSED SCAPHOID NON-UNION WITH DORSAL INTERCALATED SEGMENT INSTABILITY AND AVASCULAR NECROSIS TREATED BY VASCULARISED WEDGE-SHAPED BONE GRAFT AND FIXATION

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Patients with the specific problem of a collapsed Nakamura volar type, scaphoid synovial pseudarthrosis with avascular necrosis on both magnetic resonance imaging and intraoperative inspection were studied to determine the ability of a trapezoidal wedge-shaped structural bone graft vascularised by the 1,2 intercompartmental supraretinacular artery to simultaneously achieve correction of the scaphoid dimension and a high union rate. Fifteen patients with this specific problem were followed for a mean of 32.1 months and achieved union in all cases at a mean of 11.5 weeks. Improvements were seen postoperatively in wrist flexion and extension, grip strength, degree of dorsal intercalated segment instability and degree of scaphoid collapse. Two complications relating to the fixation technique occurred. Although technically difficult, it is possible to achieve a high rate of union for scaphoid pseudarthrosis while correcting substantial collapse deformity by the use of a structural, wedge-shaped, vascularised bone graft.

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Left untreated, scaphoid non-union results in arthritis with an incidence of 75% to 97% after 5 years and 100% after 10 years (Inoue and Sakuma, 1996; Ruby et al., 1985). Two types, viz. volar and dorsal, have been described by Nakamura et al. (1993). The volar type collapses into a humpback deformity over time through erosion of the volar and radial cortices, creating a true defect compared to the normal dimensions of the scaphoid (Oka et al., 2005; Tomaino et al., 2000). In the presence of volar collapse and dorsal intercalated segment instability (DISI), a wedge-shaped graft is needed to correct the deformity (Merrell et al., 2002). Scaphoid non-union sites may be filled with fibrous tissue amenable to simple compression fixation or be a true synovial pseudarthrosis with free flow of synovial fluid between the fragments and the sclerotic borders. The proximal pole fragment may be avascular. Magnetic resonance imaging (MRI) has been used pre-operatively to evaluate avascular necrosis and, then, correlated to success rates in scaphoid non-union reconstruction surgery (Sakuma et al., 1995). The combination of bone grafting and internal fixation has traditionally been used for reconstruction of scaphoid non-unions (Inoue et al., 1997; Trumble et al., 1996). Non-vascularised bone grafting was the original standard treatment, with an overall union rate of around 84%, but of only 47% in the presence of avascular necrosis (Merrell et al., 2002; Munk and Larsen, 2004). In an attempt to increase union rates, vascularised bone grafting was introduced, with the graft being harvested from a number of donor sites. The most popular is the 1,2 intercompartmental supraretinacular artery (1,2 ICSRA) (Zaidemberg et al., 1991). This is usually used as an inlay rectangular graft, inserted dorsally as a bridge between the two fragments (Steinmann et al., 2002; Uerpairojkit et al., 2000). Although, an inlay graft is appropriate for Nakamura dorsal type non-unions, it fails to address, or correct, the collapse seen in later stage volar type non-unions.

This article considers a population of patients for study who share a set of characteristics thought to be unfavourable for achieving successful scaphoid non-union reconstruction: collapsed volar type non-union with true synovial pseudarthrosis and avascular necrosis on both pre-operative MRI and intra-operative inspection. The reconstruction strategy considered optimal for this specific type of non-union was a trapezoidal bone graft and compression screw to correct the deformity, but using a graft which was also vascularised to address the effect of the avascular necrosis (Fig 1).

PATIENTS AND METHODS

Patients were selected for this study from a larger population of 64 patients undergoing reconstructive surgery for scaphoid non-union between January 2001 and December 2004. Inclusion criteria were limited to Nakamura volar type non-unions of at least 1 year duration with collapse into humpback deformity. Patients were included if pre-operative MRI scan demonstrated low signal intensity in the proximal pole on both T-1 and T-2 weighted images, the proximal pole did not demonstrate bleeding at the time of surgery and a true synovial pseudarthrosis was demonstrated at the time of surgery.

Fig 1 A true synovial pseudarthrosis is proven at the time of surgery, but is suggested by pre-operative X-rays demonstrating sclerosis along the margins of the two ununited scaphoid fragments and a cavity between them.

Fig 2 The cavitation within the apparent borders of a true synovial pseudarthrosis can necessitate substantial resection of sclerotic, poorly vascularised bone to reach good quality cancellous bone. This necessitates use of a large graft to restore the correct dimensions of the scaphoid.

Nineteen patients were identified who met these criteria, but four patients were excluded because they had not been followed up for the minimum of 1 year. The study, therefore, included 15 patients, 11 men and 4 women, with a mean (standard deviation) age of 23.6 (6.9) (range 15–43) years. The mean time from initial injury to surgery was 4.4 (5.7) (range 1–20) years. None of the patients had had previous scaphoid surgery. Mean follow-up was 32.1 (14.9) (range 12–59) months. Time to union was based on post-operative CT scans obtained by the Sanders method, using the criteria of mature bridging trabeculae as the standard to determining union.

Patients excluded were those with Nakamura dorsal type non-unions, delayed unions and volar type non-unions which did not meet the five stated inclusion criteria (Figs 2 and 3).

Patients were evaluated pre-operatively and during follow-up with goniometer measurements of wrist flexion and extension and Jamar dynamometer (position 2) measurements of grip strength. Pre- and postoperative radiographs were measured for DISI, as expressed by the capitolunate angle on the lateral radiograph, and scaphoid collapse, as expressed by the intrascaphoid lateral angle between the proximal and distal poles on the lateral radiograph.

Patients were operated on as outpatients under general anaesthesia using a laryngeal mask airway. A 6 cm, oblique, dorsoradial incision was made over the wrist from distal radial to proximal ulnar using the radial artery's emergence from under the dorsal margin of the extensor pollicis brevis as the most distal point of the incision. Superficial radial nerve branches were mobilised out of the operative field and the 1,2 ICSRA verified as present and of good calibre, running along the ridge between the first and second dorsal extensor compartments. Expected dimensions of the graft were known from the pre-operative imaging studies. The graft was centred approximately 11 mm proximal to the dorsal rim of the radius, where the best perforators of the artery are known to be, and the borders of the maximum possible graft size were drawn on the extensor retinaculum. Retinacular incisions were made on three