Is It Possible to Revascularize a Necrotic Proximal Fragment in Scaphoid Non-union?

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Introduction

Vascularized bone grafts (VBG) from the distal radius are becoming increasingly used in the treatment of scaphoid non-union, and several donor sites have been described (1-4). Those cases with avascular necrosis of the proximal fragment or those previously treated with failure of standard techniques are usual indications (5). Although many published outcomes so far are encouraging (6), their effectiveness is still controversial in those cases with true necrosis of the proximal fragment (7,8).

The purpose of this study is to investigate if the VBG we usually perform, pedicled with the first septal artery of the dorsal radius (3,9), is able to achieve bone healing and revascularization of the necrotic proximal fragment.

Material and Methods

Out of 27 patients with scaphoid non-union treated at our Department with a pedicled VBG (Fig. 1) by the same surgeon from 1998 to 2003, 10 cases were identified which fulfilled two criteria: lack of enhancement in preoperative Gd-DTPA MRI and intraoperative evidence of bone necrosis, defined as punctate bleeding absence in the proximal fragment. Those cases with doubtful enhancement or deficient bleeding were excluded of the present study.

These 10 cases were males (mean 28 years old), with non-union present for 7 years as an average. Non-union was located at the medium third in 3 cases and at the proximal third in 7 cases. All the patients were evaluated pre and postoperatively through clinical examination,

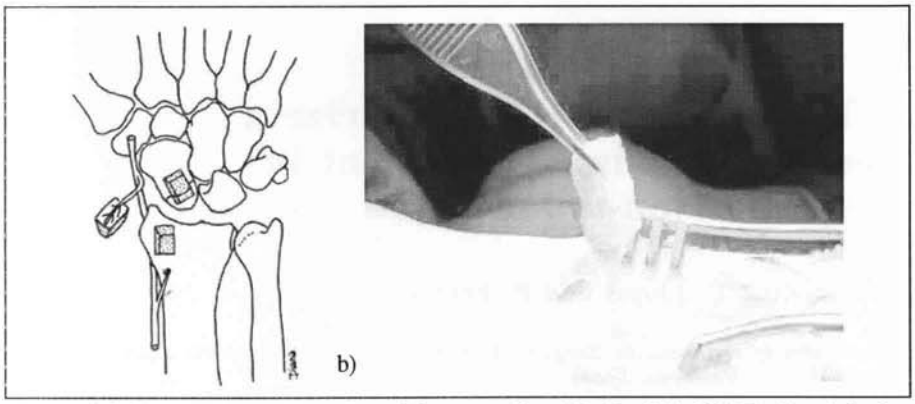

Figure 1. Schematic representation of the procedure (a). Pedicled VBG after deflating the tourniquet (b).

standard x-rays and gadolinium-enhanced MRI. In 5 cases an additional MRI was performed in the early postoperative period.

Postoperatively, a multislice-CT scan with multiplanar (MPR) and surface reconstruction was performed in all cases in order to assess bone healing. Mean follow-up was 33 months.

Results

Standard x-ray examination showed bone healing in 5 cases, doubtful healing in 2 and persisting non-union in the remaining 3 cases. MPR-CT scan examination confirmed complete bone healing in 6 cases (in those 5 cases already known plus one doubtful case), whereas the remainder failed to consolidate or showed only a weak bone bridge. Gadolinium-enhanced MRI rendered a good contrast uptake in the 6 cases with complete union (Fig. 2). This enhancement was similar to that of the other carpal bones in those patients with longer follow-up and was increased in the proximal fragment in those patients with shorter follow-up. No diffuse enhancement was observed in the proximal fragment of the failed 4 cases, although it could be recognized at VBG level in all of them.

There was no correlation between clinical outcome and image studies. Postoperatively, mean power grip was 76 % of the opposite unaffected side and mean range of wrist flexion and extension was limited to 56 % of the opposite side. All patients experimented alleviation of pain, which was rated 2.8 as an average on a visual analogue scale.

Discussion

In our experience, avascular necrosis of the proximal fragment is the

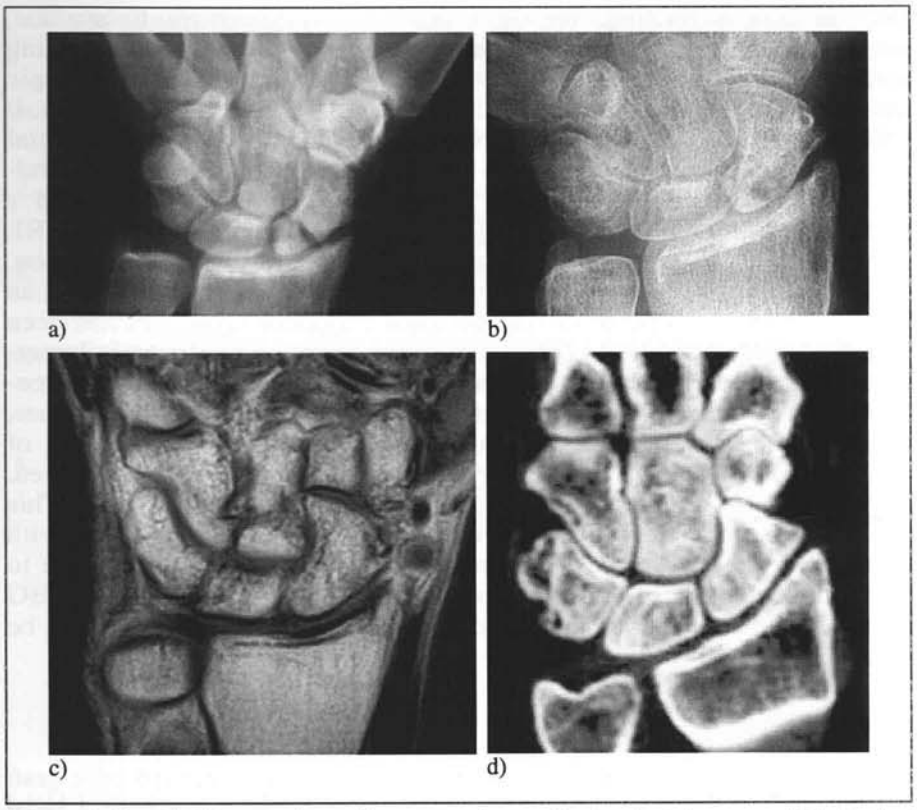

Figure 2. Scaphoid non-union with a necrotic proximal pole (a), successfully healed (b). Normal contrast uptake can be observed three years later with gadolinium-enhanced MRI (c). MPR-CT scan shows complete reconstruction (d).

most important prognostic factor, in order to achieve bone healing in scaphoid non-union. For this reason, vascular assessment of the scaphoid should be included in the preoperative planning as a routine. Although increased radiographic density of the proximal pole has been classically associated to avascular necrosis, this approach is no longer valid (10,11). Gadolinium-enhanced MRI is currently the most reliable imaging method for investigating the vascularity of the proximal pole (12), obtaining confirmation at the time of operation. Still, some published series do not report their cases with necrosis or use no reliable method of diagnosis (3,13).

With regard to bone healing assessment, standard x-rays often fail to give accurate information and MPR-CT scan should be used when doubt remains. The disparity of healing periods and consolidation rate reported by several authors (3,7,8,9,13,14), in despite of using the same

IOV, is quite surprising. We think that these different results are due, not only to the vascular factor already mentioned, but also to the imaging method of assessment used. MPR-CT scan allows to obtain an isotropic image, which offers a true reconstruction in all space planes. The most valid reconstruction is that one obtained in coronal and oblique-sagittal plane. In the present study, MPR-CT scan confirmed the positive findings of x-rays and clarified two doubtful cases. We also observed a good correlation between MPR-CT scan and gadolinium-enhanced MRI. All the patients with demonstrated union showed signs of revascularization.

Revascularization becomes apparent during the first months as an increased contrast uptake of the proximal fragment. This fact has been experimentally validated (15), being a manifestation of the early hyperaemic response. There is a progressive changing to a normal enhancement with evolution, becoming similar to that of the other carpal bones, which is the expression of a complete reconstruction. In four cases of our series, revascularization of the proximal fragment was not obtained, nevertheless contrast uptake of the VBG remained in those cases. This fact could be explained by occurrence of interposed fibrous tissue with barrier effect between the VBG and the proximal pole, probably due to micromovement. If so, with a better adaptation and fixation of the VBG to the recipient bed, an increased rate of revascularizations could be obtained.

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