Long-term follow-up of a vascularized metacarpal bone graft in the treatment of idiopathic avascular necrosis of the capitate

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Idiopathic avascular necrosis of the capitate is rare and few case reports have been published (1-4). The treatments described in the literature consist of resection arthroplasty using a tendon graft (1), intercarpal arthrodesis (2), vascularized bone graft (3) and splinting (4). Here, we report the long-term outcome of a patient with this rare condition who was treated with a vascularized bone graft from the base of the second metacarpus. The good clinical results and prevention of significant collapse maintained over the long term favours the use of this technique for the treatment of avascular necrosis of the capitate.

Key Words: Avascular necrosis; Capitate; Long-term follow-up; Second metacarpus; Vascularized bone graft

CASE PRESENTATION

A 40-year-old woman who worked in a liquor store complained of pain and swelling in her left wrist for three years. She had no history of trauma near the wrist. The pain had intensified in the previous four months, and she was treated with night splinting, physical therapy and corticosteroid injection by her primary orthopedist.

Physical examination revealed mild swelling at the dorsum of the left wrist and moderate tenderness. Wrist motion (left/right) was as follows: extension 40°/70°, flexion 45°/75°, radial deviation 15°/20° and ulnar deviation 30°/45°. Grip strength averaged only 8.4 kg on the left but 23.5 kg on the right.

All blood tests were normal. An x-ray of the left wrist revealed the decreased density and fragmentation of the proximal pole of the capitate (Figure 1). T1-weighted images obtained during magnetic resonance imaging (MRI) revealed a wide area of signal change and low signal intensity throughout the capitate (Figure 2).

Because her symptoms had not subsided over the previous four months despite adequate conservative therapy, surgical treatment was attempted. Exposure of the capitate through a dorsal approach revealed essentially normal cartilage, with no depression visible on the articular surface. A 9 mm × 6 mm × 12 mm segment of vascularized bone was harvested from the second metacarpal base and grafted into the cavity of the capitate using iatric cancellous bone chips and following the technique described by Makino (5) (Figure 3). The pathological diagnosis of the diseased bone sample was necrotic bone (Figure 4).

After four weeks in a short-arm cast, the patient underwent hand therapy for wrist motion and grip strength. T1-weighted MRI at 36 months revealed recovery of the signal intensity in the capitate, except at the proximal pole (Figure 5). Ten years postoperatively, she experienced only mild wrist pain on lifting of a heavy object and had returned to her job. The active range of motion of the involved wrist was extension 70° and flexion 75°. Grip strength of the left had improved to 18.4 kg from the preoperative value of 8.4 kg. Although plain x-rays continued to show a decreased density of the proximal pole, a progression of capitate compression was not observed (Figure 6).

DISCUSSION

Avascular necrosis of the capitate is rare and typically occurs after direct trauma, such as a fracture of the waist of the capitate associated with a scaphoid fracture, naviculocapitate syndrome or repeated minor injuries (6-8). In addition, idiopathic causes have been reported (1-4).

Various nonsurgical and surgical treatment options have been described. The former include plaster casts or splints, which were subsequently shown not to be effective (4). Surgical treatment has, to date, consisted of autogenous bone grafting and drilling (8), resection and interposition with a palmaris longus tendon or a fourth toe extensor tendon (1), a silicone prosthesis (7), and midcarpal or scaphocapitate arthrodesis (2.6). Both Vander Grend et al (6) and Whiting and Rotman (2) proposed the use of a limited arthrodesis involving the affected carpal bones in cases characterized by collapse and degenerative changes. Ideally, avascular necrosis of the capitate without collapse and arthritic changes of the scaphocapitate and capitulate joints can be managed successfully with revascularization. Preliminary evidence from revascularization in Kienböck disease suggests that, in revascularization of the capitate, vascularized bone grafts may be successful (5,9), unlike curettage of the capitate followed by nonvascularized cancellous bone grafting, in which the outcome is poor (8).

Vascularized bone grafts have been used in a variety of pathological settings (5,10,11). Hattori et al (3) treated avascular necrosis of the capitate with a vascularized pedicled bone graft based on the fourth extensor compartment artery. In a patient with scaphoid nonunion and avascular necrosis of the lunate and scaphoid, we used vascularized bone grafting from the base of the second metacarpus (5). There are several advantages to treatment involving vascularized bone: the vascular bundle of the second dorsal metacarpal artery is constant and sufficiently large to be dissected easily; additional cancellous bone grafting can be done in the same operative field by harvesting from the ipsilateral radial styloid process; the graft can be elevated with a radial-based or ulnar-based vascular pedicle; and an adequate length of the vascular bundle to the capitate is maintained.

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Long-term results >10 years regarding the use of a vascularized bone graft in the treatment of Kienböck's disease have been reported (12,13). In those studies, however, it remained unclear whether significant long-term improvement in the lunate height could be achieved. Nonetheless, disease progression was prevented and the clinical outcome scores were favourable. In our patient, significant changes in carpal height and the density of the proximal pole were not observed, but the relief of symptoms and the absence of further collapse of the capitate were maintained over the 10-year follow-up period. Based on the improvements observed on T1-weighted MRI 36 months postoperatively, which suggested revascularization, we recommend the use of a vascularized metacarpal bone graft for the treatment of avascular necrosis of the capitate.

REFERENCES