Lunate Reconstruction Using Osteochondral Vascularized Graft in Kienböck's Disease

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Abstract

Keywords

- Kienböck's disease
- lunate morphology
- medial femoral condyle
- osteochondral vascularized graft
- microsurgery

There is a general consensus that the pathogenesis for Kienböck's disease remains uncertain, though it is probably related to nonphysiologic stress transmission across the lunate, acting in concert with one of several possible vascular abnormalities. Most surgical treatments focus on mechanical aspects rather than real physiopathology, but in the recent years several articles have shown the utility of vascularized grafts in the treatment of Kienböck's disease, especially in its early stages. The authors present a case of a successfully reconstruction of a IIIA stage Kienböck's disease with an osteochondral vascularized graft from medial femoral condyle.

Introduction

Several theories have been proposed to explain the patho-anatomy of Kienböck's disease.¹ Ulnar variance has long been suggested as a factor in the development of this disease, but no direct link has been found.² Lunate morphology and local osseous anatomy have also been identified as a potential etiologic and prognostic factor in Kienböck's disease.^{1,3} Variations in vascular anatomy have also been proposed as a cause of Kienböck's disease. Disruption of venous outflow has also been proposed as an etiology for Kienböck's disease. Increased intraosseous pressure due to a venous outflow disruption has been demonstrated in vitro in necrotic lunates, but in recent years some microsurgical procedures to treat avascular necrosis in bones other than the lunate have been successful.^{3–6}

The authors present the case of a successful reconstruction of a IIIA stage Kienböck's disease with an osteochondral vascularized graft from medial femoral condyle (MFC).

Case Report

A 59-year old right-handed woman, employed as a cleaner, visited the clinic complaining of progressive pain in her left hand, which she had experienced for several years. She had no history of trauma and had no other relevant medical records, except that she was a smoker. Physical examination

revealed moderate tenderness in the dorsal aspect of the wrist, with limitation in the range of movement. Posterior-anterior and lateral radiographies were performed and showed an advanced collapse of the lunate. A magnetic resonance imaging (MRI) was performed afterwards confirming the Kienböck's disease (stage IIIA, Lichtman) (►Fig. 1). The patient was offered surgical treatment at this moment, but it was refused. After 4 months a new magnetic resonance imaging (MRI) was performed showing a progression in the lunate collapse (►Fig. 2A), and on this occasion, the patient agreed to undergo surgical treatment, consisting of osteochondral vascularized graft from the MFC.

A dorsal approach was used for the debridement of the necrotic lunate, the receptor vessels were prepared, and the osteochondral graft from the MFC⁵ was harvested. The graft was fixed using two Kirschner wires (►Fig. 3).

The vascular pedicle was subcutaneously tunneled to the anterior aspect of the wrist where the terminolateral vascular anastomosis to the radial vessels were performed. No skin paddle was harvested to monitor the graft. The wrist was immobilized by a long-arm dorsal splint postoperatively. The splint and the Kirschner wires were removed after 6 weeks in the clinic, and the patient began range of movement exercises. After 12 months, wrist flexion was 30 degrees and extension was 50 degrees (up from 20 and 30 degrees, respectively). Pronation and supination remained unaltered, and pain measured by AVE was of 1 (previously of 7).

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Fig. 1 Coronal and lateral views of MRI showing necrosis of the lunate, IIIA Lichtman stage.

At 12 months an MRI showed vascularization signs of the lunate with no progression of the collapse in comparison with the preoperative MRI (►Fig. 2B). Physical examination at this time showed a 50% increase in grip strength compared with the contralateral side, with a functional range of movement of the wrist (►Fig. 4). The patient was able to return to her previous work and sports activity.

Discussion

The physiopathology of the Kienböck's disease remains uncertain.⁷ Joint-leveling procedures to mechanically unload the lunate articular surface to prevent carp degeneration can be achieved with several procedures.³ Determination of the proper procedure for each specific patient depends on the length relationship between the radius and ulna.

Several treatments have been proposed for articular cartilage lesions with no promising outcomes.

Microsurgical techniques have proved to be useful in the treatment of nonunion and bony defects, as they provide vascularized bony tissue, but osteochondral grafts for reconstructing articular defects remains underused. In 2013, del Piñal et al⁸ reported good midterm outcomes, using vascularized osteochondral grafts from the third metatarsal base to reconstruct articular malunions of distal radius fractures.

Sakai published the vascularized periosteal bone graft from the MFC base on the descending geniculate artery.⁹ This corticocancellous or corticoperiosteal vascularized graft has been popularized over the past years, and it has been used in multiple anatomical locations to solve cases of nonunion of different bones,^{4,10,11} although the largest series that have been published are of proximal pole scaphoid nonunion.

A variation of the original technique was described to harvest osteochondral vascularized grafts to provide a potential solution to proximal pole nonunion of the scaphoid.¹² Higgins published a series of 16 patients, achieving in 15 cases the complete osseous consolidation.

In this other publication, the same author used the osteocartilaginous graft to treat advanced case of Kienböck's disease. In this series, 16 patients were treated using this technique, with an average follow-up of 1 year. Seventy-five percent of the patients reported complete pain relief. Computed tomographic (CT) scans showed a completed healing of the reconstructed lunates in all cases except in one. One patient required revision to a total wrist arthrodesis. Lichtman radiographic staging of Kienböck improved in four patients from a 3A to a 2 at 1-year follow-up. In 10 patients, the Lichtman stage remained unchanged (but did not progress), and in the remaining two patients, it progressed from 3A to 3B but did not require further surgery.⁵

The authors did not observe an improvement in the Lichtman stage, but revascularization signs were identified in the MRI with no further collapse of the lunate (►Fig. 3). Lichtman et al have recently proposed a new treatment algorithm based on radiographic findings,^{13,14} with the addition of information on osseous viability gained from advanced MRI techniques¹⁵ and cartilage damage from arthroscopy.¹⁶ Following this algorithm,¹ stage IIIA/IIIB of Lichtman's classification, with MRI showing partial or total necrosis of the lunate (stages B/C of Schmitt) with intact cortex/cartilage or partial collapse of the lunate (stage 0/1 of Bain), should be treated using a vascularized bone graft, leaving pedicled

Fig. 2 (A) Four months later further collapse of the carpus can be seen in MRI. (B) Coronal and lateral views of MRI showing vascularization signs and no progression of further carpus collapse.

Fig. 3 (A) Vascularized graft from the medial femoral condyle. (B) Inset of the bone graft through a dorsal approach in the previously debrided lunette. (C) Intraoperative image showing a detail of the end-to-side anastomosis. (D) Intraoperative radiography showing Kirschner wire fixation of the graft in a posterior-anterior view.

Fig. 4 Clinical images showing the patient's wrist range of motion postoperatively.

grafts to treat lunate osteonecrosis with no cartilage impairment. The authors intraoperatively checked the severe cartilage damage to the lunate, so that they decided to use the osteochondral graft from the MFC to reconstruct the cartilage.

Regarding to the potential donor site morbidity, Windhofer et al¹⁷ published this retrospective revision of 45 patients who underwent medial femoral trochlea (MFT) vascularized graft. After average follow-up of 26 months, no early postoperative donor site complications were sustained and no major complications were reported. All 45 patients had a stable knee and patella as determined by routine physical examination. Range of motion at final follow-up was equal to the contralateral side with no loss of terminal knee extension and 120 degrees of knee flexion. Postoperatively knee discomfort was time-limited in the vast majority of the patients, and no radiographic or MRI sign of osteoarthritis were found at 29 months postoperatively.

The patient did not experience complications in the donor site, and she started active mobilization of the knee with partial weight bearing.

Conclusion

The osteochondral graft from the MFC is one of the best alternative treatments of advanced stages of Kienböck's disease providing very good radiologic and clinical outcomes, with minor donor site morbidity. Complications of the surgery are minimal. On the other hand, the surgical procedure is technically demanding and requires a high grade of specialization.

Conflict of Interest

None.

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