Osteochondral Autograft Transplantation for Proximal Lunate Articular Defects

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J Wrist Surg 2017;6:329–333.

Abstract

Keywords

- ▶ osteochondral autograft transfer surgery
- ▶ osteochondral autograft transplantation surgery
- ▶ proximal lunate
- ▶ radiocarpal joint
- ▶ wrist

Background No consensus treatment option for focal osteochondral defects of the proximal lunate exist in the literature. Surgical management has thus far been limited to salvage procedures such as proximal row carpectomy and partial arthrodesis.

Case Description We report our experience using the osteochondral autograft transplantation surgery (OATS) procedure in two young, active patients with focal osteochondral defects of the proximal lunate. At mean follow-up of 6 years, sustained improvements in pain, motion, and function were observed. Both patients reported high levels of satisfaction and neither experienced any complications.

Literature Review To our knowledge, this is the first report describing the use of OATS to treat proximal lunate defects.

Clinical Relevance OATS is a valuable surgical option for treating focal chondral defects of the proximal lunate, with positive outcomes at greater than 5 years postoperatively. This may be an especially useful technique for younger, active patients, and those wishing to maintain maximum functionality.

Originally described for treatment of chondral defects in the knee, osteochondral autograft transplantation surgery (OATS) has become popular as the treatment for cartilage defects of the elbow,¹ distal radius,² and metacarpophalangeal (MP) and interphalangeal (IP) joints,³ while utilizing graft from a range of sources, including the knee,^{1,3} rib,⁴ and ipsilateral carpus.² Although outcomes following OATS at the wrist have been mostly positive, reports have thus far been limited to the distal radius,² proximal scaphoid,⁵ and proximal capitate.^{6,7} To our knowledge, there have been no prior reports of OATS performed for treatment of proximal lunate chondral defects. Here, we present our experience with long-term follow-up of two active patients with osteochondral defects of the proximal

lunate that were treated successfully with the OATS procedure.

Case Presentation

Case 1

A 20-year-old left-hand-dominant male college student presented to our center complaining of chronic right wrist pain, decreased motion, and subjective weakness 17 months after he sustained a 10-m fall while working on the roof of a construction site. He sustained multiple injuries including a left open both-bone forearm fracture and bilateral distal radius fractures. He underwent emergent open reduction internal fixation of his forearm and bilateral wrist fractures

received

October 23, 2016

accepted after revision

January 20, 2017

published online

March 6, 2017

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Tel: +1(212) 584-4662.

DOI <https://doi.org/10.1055/s-0037-1599215>.
ISSN 2163-3916.

Table 1 Comparison of pre- and postoperative outcomes

	Patient 1			Patient 2		
Measure	Pre-op	12 mo follow-up	78 mo follow-up	Pre-op	4 mo follow-up	64 mo follow-up
F/E Inj.	50/35	60/55	60/60	40/40	50/40	60/50
F/E UA	65/60	65/60	65/60	70/60	65/60	65/60
RD/UD Inj.	10/20	NR	25/35	15/25	NR	25/30
RD/UD UA	25/35	NR	25/35	20/40	NR	25/35
Grip strength Inj. ^a	20	40	44	25	32	41
Grip strength UA ^a	33	42	46	36	36	39
VAS pain (rest)	4	0	0	2	NR	0
VAS pain (activity)	8	3	1	7	NR	0
QuickDASH	49	23	8	53	NR	5
PRWE	55	NR	4	47	NR	6

Abbreviations: F/E, flexion/extension Arc (degrees); Inj., injured side; NR, not recorded; PRWE, patient-rated wrist examination; RD/UD, radial deviation/ulnar deviation (degrees); UA, unaffected side.

^aAll grip strengths were measured using Jamar dynamometer at setting III and reported in kilograms.

on the day of injury at an outside institution. Postoperatively, despite extensive rehabilitation under the guidance of an occupational therapist, the patient continued to experience right wrist pain that worsened as his activity level was gradually increased. He was particularly concerned with his inability to lift heavy weights and difficulty with prolonged periods of playing intramural ice hockey as both activities were limited by pain.

Fig. 1 Preoperative (A) posteroanterior (PA) and lateral radiographs of the right wrist of a 20-year-old man 17 months after previous distal radius fracture fixation. Note the scalloped appearance of the proximal lunate suggesting focal arthrosis with a malunited volar ulnar corner of the distal radius.

At our initial evaluation, the patient had no gross deformity of either wrist but complained of tenderness over his right wrist volarly. Active wrist motion was notably limited on the right with 50-degree flexion (F), 35-degree extension (E), 10-degree radial deviation (RD), and 20-degree ulnar deviation (UD) as compared with the left (65-degree F, 60-degree E, 25-degree RD, 35-degree UD; see ►Table 1). Grip strength tested with the Jamar dynamometer (Sammons Preston, Inc., Bolingbrook, IL) was also significantly worse on his right side compared with his left side, at 20 versus 33 kg, respectively. Radiographs of the right wrist demonstrated a focal area of lunate arthrosis and an apparent malunited volar-ulnar corner of the distal radius (►Fig. 1). Because of the preexisting hardware over the volar radius, the decision was made to forego advanced imaging and proceed with a diagnostic wrist arthroscopy and possible transfer of an osteochondral plug from the left knee to the right proximal lunate defect.

Fig. 2 Intraoperative image demonstrates focal area of arthrosis on the proximal lunate.

Fig. 3 After the defect on the proximal lunate is sized, it is (A) drilled using a cannulated reamer to accept a cylindrical osteochondral plug (B).

During arthroscopy, the articular surfaces of the radius and scaphoid were grossly intact, with the exception of mild chondromalacia that was noted at the volar-ulnar aspect of the distal radius. A full-thickness osteochondral defect at the base of the lunate was clearly visualized, while the triangular fibrocartilage complex (TFCC) and extrinsic and intrinsic ligaments were all grossly intact. In light of the defect on the lunate and relative preservation of the articulating aspect of the distal radius, we elected to proceed with OATS to the lunate defect, using a plug harvested from the contralateral left knee. Following dorsal arthrotomy and flexion of the wrist, the diameter of the lunate defect (**Fig. 2**) was sized at 8 mm using the corresponding sizer from the OATS instrumentation set (Arthrex, Inc, Naples, FL). An 8-mm-round by 8-mm-deep osteochondral graft from the left lateral femoral condyle was obtained using standard harvesting techniques that have been described previously.^{2,3} With the wrist in flexion, the recipient site on the lunate was prepared by drilling perpendicular to the plane of the defect using a cannulated reamer as described by Tang and Imbriglia (**Fig. 3**).⁶ The graft was tamped into position achieving an interference fit and the wrist was then passively ranged

with full motion noted without crepitus (**Fig. 4**). The capsule was closed with 3-0 Vicryl sutures and the skin was closed with 4-0 interrupted nylon sutures. The patient's wrist was placed in a bulky volar splint, and he was allowed to weight-bear on his lower extremity as tolerated. Active range of motion with therapy began 1 week after the surgery, then followed by resisted motion for strengthening at 1 month. By 2 months he was permitted to perform all activity as tolerated.

Fig. 4 An osteochondral plug is placed in the recipient site and tamped into position to achieve an interference fit.

Fig. 5 PA radiograph at greater than 6 years postoperatively from an OATS to the proximal lunate suggests incorporation of osteochondral graft without progression of radiolunate arthrosis.

Twelve months postoperatively, the patient was significantly improved with regard to pain and function, his physical examination was comparable to his dominant left side, and he denied any knee discomfort at that time (►Table 1). At final follow-up of 78 months, he demonstrated continued clinical improvement, his radiographs showed no progression of arthrosis at his radiolunate joint (►Fig. 5), and he reported high-level of satisfaction.

Case 2

A 40-year-old right-hand-dominant male chief financial officer complained of persistent right wrist pain following a right wrist arthroscopy with TFCC repair and hamate chondroplasty by the senior author 2 years prior. The patient was noted at that time to have a type II lunate without visible abnormalities of the proximal surface of the lunate. Physical examination demonstrated persistent crepitus at the radiolunate joint, and decreased range of motion (40-degree F, 40-degree E, 15-degree RD, 25-degree UD) and grip strength (25 kg) compared with the contralateral side (70-degree F, 60-degree E, 20-degree RD, 40-degree UD, 36 kg; see ►Table 1). Magnetic resonance imaging revealed focal degenerative changes of the proximal lunate (►Fig. 6).

Diagnostic arthroscopy revealed complete eburnation down to the bone of the proximal lunate with normal-appearing cartilage of the lunate fossa on the radius. The TFCC and all ligaments were grossly intact. The remaining surgical procedure and postoperative rehabilitation regimen were the same as for the patient in case 1.

Four months postoperatively, the patient was able to return to playing 18-holes of golf, with very minor knee aches after prolonged activity (►Table 1). At 64 months, he had no pain or other complaints, and reported high-level of satisfaction.

Discussion

Until recent years, symptomatic cartilaginous defects involving the hand or wrist would often require some form of salvage procedure or arthroplasty. Proximal row carpectomy (PRC) and arthrodesis are both salvage techniques that sacrifice functionality.⁸ Conversely, though arthroplasty generally maintains function, complication and revision rates remain high even with latest implant technologies.⁹ Furthermore, none of these options are favored in younger or high-demand patients. The advent of OATS has provided surgeons a viable option for these patients, although its use in the hand and wrist has thus far been limited.

Some studies have reported successful treatment of osteochondral defects of the wrist with OATS. The largest such series to date included eight patients with proximal capitate chondrosis who underwent OATS to the proximal capitate with concomitant PRC,⁶ including five who were followed for more than 8 years.⁷ Though pain was mostly improved in that cohort, it is difficult to gauge what magnitude of improvement was due to the PRC alone without a control group. Ho and colleagues reported a series of four patients with defects of the lunate fossa of the distal radius that were treated successfully with OATS using graft harvested from the knee.⁶ At mean follow-up of 4 years, improvements were noted in pain, performance scores, motion, and grip strength. Of note, the authors also performed the grafting arthroscopically.⁶ In the only report of which we are aware utilizing OATS for a proximal carpal lesion, Lee et al treated a case of scaphoid osteochondritis dissecans with OATS from the knee supported by additional cancellous iliac crest bone graft placed at the recipient site.⁵ That patient required immobilization of the wrist for 8 weeks, and at 2 years postoperatively, motion was maintained while pain and grip strength were markedly improved. Although the authors did not report any pain

Fig. 6 Preoperative MRI of a 40-year old man with persistent right wrist pain following an arthroscopic TFCC repair and hamate chondroplasty 2 years earlier. (A) Coronal 3D T2-weighted SPGR imaging demonstrates proximal lunate arthrosis and preserved articulations with the scaphoid and capitate. (B) Sagittal 2D T2-weighted TSE imaging depicts fluid signal between cartilage surfaces, suggesting deep cartilaginous delamination.

related to the harvest sites, potential morbidity associated with three separate operative sites may limit the procedure's widespread use.

We elected to perform the OATS procedure on two patients for which the treatment options were quite limited. For our patient in case 1, we did not consider PRC or limited arthrodesis as legitimate options given his young age. Similarly, although PRC may be considered for some patients in their fifth decade of life, our second patient's desire to continue playing golf regularly made this option undesirable. For both patients, final outcomes were largely positive with improvements in pain and function. Additionally, both patients reported that they were "highly satisfied," and would "definitely have surgery again," on our outcomes questionnaire.

Perceived drawbacks of this procedure are mostly related to graft harvest. Although there is the potential for morbidity associated with the procedure at the knee, in more than 15 patients for whom the senior authors have harvested osteochondral grafts from the knee to treat hand and wrist defects, this has mostly been described as mild "achiness," and has never persisted for more than 6 months postoperatively. For those hand and wrist surgeons who feel less comfortable with the harvesting technique, we recommend a collaborative effort between the hand surgeon and a sports medicine specialist. As we generally use the contralateral knee for our harvest, a second surgeon provides the added advantage of being able to perform portions of each procedure simultaneously, thus reducing operative time.

We feel that the potential advantages of this procedure warrant its use, particularly in the patients whose age or activity level makes salvage procedures undesirable. Based on our encouraging results in this small report, future studies in more patients and those with other carpal defects may offer additional insight into the utility of this procedure.

Note

This study was performed at the Philadelphia Hand Center of the Thomas Jefferson University Department of Orthopaedic Surgery.

Conflict of Interest

None.

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