Meniscal Allograft Interposition Combined with Proximal Row Carpectomy

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Abstract

Background Proximal row carpectomy (PRC) is contraindicated in wrists with preexisting arthritis of the proximal capitate or radiolunate fossa. Patients with these conditions frequently pursue wrist arthrodesis with its associated functional limitations.

Questions/Purposes The purpose of this study was to evaluate the results of using lateral meniscal allograft interposition (LMAI), in combination with PRC, in patients with symptomatic wrist arthritis. The primary question is whether this allograft will allow wrist function comparable to that in patients having only a PRC. A secondary question was to determine the short-term longevity of the allograft.

Patients/Method Between 2006 and 2012, nine wrists underwent PRC with LMAI. Patient demographics and rates of complication or graft failure were determined. During independent clinical exams, functional outcomes were reviewed, patients completed a Disabilities of the Arm, Shoulder, and Hand (DASH) scores, and radiographs were taken.

Results Four patients met the inclusion criteria, having clinical follow-up at an average of 4.2 years. DASH scores at the time of follow-up ranged from 9 to 33, with an average of 24. Average radiocapitate joint space in the first postoperative radiograph was 2.8 mm compared with 1.8 mm at the time of final follow-up. No wrists went on to arthrodesis.

Conclusion Early outcomes of PRC with LMAI are comparable to those results found in the literature of PRC alone. LMAI with PRC may be a valid short-term option as a motion-preserving procedure in those patients contraindicated to having a PRC alone.

Level of Evidence Level IV

Keywords

- proximal row carpectomy
- meniscal allograft

Proximal row carpectomy (PRC) has traditionally been an effective surgical option for those with symptomatic wrist arthritis. This procedure has been demonstrated to preserve wrist range of motion (ROM)¹ while minimizing pain.² However, in those who have preexisting proximal capitate or lunate fossa arthritis, a PRC is contraindicated as this procedure further increases peak pressures as well as decreases contact areas within the radiolunate fossa.³ Today this group of patients frequently pursues wrist

arthrodesis, which may result in unacceptable functional limitation.

In 2009, Nanavati et al³ demonstrated that the interposition of a lateral meniscal allograft (LMAI) (► **Fig. 1**) in the radiocapitate articulation restored pressures and contact areas to those of a normal wrist. The benefit of LMAI over traditional PRC is that the meniscal graft serves as a cushion by improving contact pressures in an arthritic radiocapitate joint. When compared with arthrodesis or four-corner fusion,

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Fig. 1 Lateral meniscal allograft. Nonabsorbable suture was used to secure the anterior and posterior horns to create custom fit for the distal radius articular surface. (Reprinted with permission from Navati et al.³)

there is a shorter time of immobilization following surgery and it eliminates the risk of nonunion which is an important consideration in an elderly population with poor bone quality. In the glenohumeral joint, LMAI has been shown to improve contact pressures.⁴ Based on this principal, several authors have demonstrated the efficacy of lateral meniscal interposition in treating arthritis of the glenohumeral joint.^{5–7} However, recently, Lee et al⁸ have reported on some inconsistent results and complications using this allograft for resurfacing the glenoid at a mean of 4.3-year follow-up.

The purpose of this study was to determine whether use of a LMAI combined with PRC would be a valid motion-sparing treatment option for those patients who are contraindicated in having a PRC alone. The questions asked in this study are first to determine whether this allograft will allow wrist function and motion comparable to that in patients having

only a PRC and second to determine the short-term longevity of the allograft.

Methods

This study was approved by our institutional review board. Patients were identified by means of search for CPT (current procedural terminology) codes for PRC with allograft modifier. Nine patients with degenerative or posttraumatic disorder of the wrist underwent PRC with meniscal allograft interposition between 2006 and 2012. All patients were contraindicated for having a PRC alone, as they had radiographic evidence of arthritis affecting the proximal capitate or the lunate fossa of the radius. Indications for surgery included persistent wrist pain with failure of nonoperative modalities for more than 3 months, including nonsteroidal anti-inflammatory drugs, physical therapy, bracing, and injections.

Five patients were excluded from the analysis due to two having insufficient outcome data, one having only a 20-month follow-up, one having the PRC and the meniscal allograft at two different surgical times, and one having a distal radius malunion.

For the four included patients, the average age at the time of surgery was 72 years (range: 62–78 years) (► **Table 1**). Two had surgery on their dominant extremity and one patient had a radial styloidectomy in addition to the PRC and LMAI. None of the patients had inflammatory arthritis or diabetes. Three of the patients had a past history of tobacco use. One of the patients had wrist pain related to a worker's compensation claim. Three patients were retired at the time of surgery. The patient who was employed returned to work full time as an administrator. Following surgery, one previously retired patient started a part-time job at an after-school program.

Table 1 Patient summary data at the time of follow-up unless otherwise noted

Variable	Patient			
	1	2	3	4
Age (y)	62	73	78	76
Gender	Male	Male	Male	Female
Diagnosis	SLAC III	Radiolunate arthrosis (not rheumatoid related)	SLAC III	Kienbock stage IV
Follow-up (mo)	36	65	38	64
DASH score	9	33	32	21
Pain level	2.5	7	4	1
Pain medication	None	None	Acetaminophen	None
Occupation at the time of surgery	Administrator	Retired electrician	Retired factory worker	Retired
Return to work	Yes	Part time		
Same activities	Yes	Yes	Yes	No
Post-op RC space (mm)	1.91	2.95	2.56	4
Follow-up RC space (mm)	0.81	2.4	2.25	1.79

Abbreviations: DASH, Disabilities of the Arm, Shoulder, and Hand; RC, radiocarpal; SLAC, scapholunate advanced collapse.

Fig. 2 Illustration of lateral meniscal allograft secured to the distal radius. Four or five absorbable suture anchors were used to secure the periphery of the graft to the articular surface of the distal radius.

Etiology of wrist arthritis included stage III scapholunate advanced collapse (SLAC; two patients), stage IV Kienbock disease (one patient), and end-stage lunate and lunate fossa arthritis (one patient).

In each patient, a standard dorsal approach was made to the wrist. A posterior interosseous neurectomy was performed in addition to a proximal row carpectomy. When indicated due to impingement, radial styloidectomy was performed. A cryopreserved lateral meniscal allograft was then prepared using nonabsorbable suture to attach the anterior and posterior horns together. This method created an oval shape that conformed nicely to the entire articular surface of the distal radius (►Fig. 2). Custom graft sizing was not required to obtain acceptable fit and alignment. Four or five absorbable suture anchors were utilized to attach the periphery of the graft in a horizontal mattress fashion. The capsule was then reapproximated while incorporating the periphery of the meniscal graft dorsally. Retinaculum and

skin were closed in standard fashion. Following surgery, patients were placed in a short-arm cast for 4 weeks. At that time, patients were provided a removable splint for 2 weeks. ROM exercises were started following cast removal.

The four included patients returned for a retrospective review of their surgery. At the time of their visit (average: 4.2 years after surgery; range: 36–65 months), radiographs were taken and they completed a questionnaire, noted their pain level, and completed a Disabilities of the Arm, Shoulder, and Hand (DASH) score evaluation. Retrospective chart review was conducted to gather demographics, surgical indications, complication, and graft failure rate.

At the time of their visit, a physical examination by an independent medical examiner was performed to assess ROM and grip strength. Grip strength was measured using a Camry electronic hand dynamometer (Zhongshan Camry Manufacturer and Trading Co. Ltd., Guangdong, China). ROM was measured with a Prestige Medical Protractor Goniometer (Northridge, CA) and included wrist flexion and extension, as well as forearm pronation and supination.

Questionnaires were also utilized at this time to assess return to work status, current pain medication use, and pain level. Pain levels were assessed on a 1 to 10 scale, with 10 representing the worst pain and 1 being the least amount of pain. DASH score was also assessed. To objectively compare radiocapitate space, postoperative radiographs were compared with radiographs taken at the time of this follow-up visit. Radiocapitate space was measured on the lateral radiograph as the distance between the most proximal portion of the capitate and the most proximal portion of the lunate fossa. This distance was meant to serve as an indirect measurement of joint space preserved by the meniscal allograft.

Results

Patients receiving a meniscal allograft along with PRC retained wrist function and motion in contrast to what might be expected with a total wrist fusion. The average postoperative wrist flexion–extension arc was 93 degrees, which was measured as being 77% of the contralateral extremity (►Table 2), and supination and pronation were found to be 97% of the nonoperated side. The average maximal grip strength was 79% of the opposite extremity.

Average radiocapitate joint space in the first postoperative radiograph (►Figs. 3 and 4A) was 2.8 mm compared with 1.8 mm at the time of follow-up (►Fig. 4B). DASH scores ranged from 9 to 33, with an average of 24.

Table 2 Average wrist flexion-extension, forearm rotation, and grip strength

	Wrist flexion (degrees)	Wrist extension (degrees)	Forearm supination (degrees)	Forearm pronation (degrees)	Grip strength (N)
Operated wrist	47 (7)	46 (8)	79 (8)	83 (3)	50 (22)
Contralateral	71 (7)	56 (4)	81 (8)	86 (4)	63 (17)

Note: Numbers in parenthesis denote standard deviation.

Fig. 3 Postoperative posterior-anterior radiograph immediately following proximal row carpectomy with lateral meniscal allograft interposition. Radiocapitate space represents successful allograft interposition.

The average pain score at the time of final visit was rated as 3.6 out of 10 on a pain scale. No patients went on to wrist arthrodesis.

Discussion

PRC is an effective motion-sparing procedure for pain relief in those with symptomatic wrist degeneration. Common pathways that progress into end-stage radiocarpal arthritis include SLAC

wrist, Kienbock disease, and perilunate fracture/dislocations. In those with proximal capitate or lunate fossa arthritis, PRC is generally contraindicated and wrist arthrodesis or four-corner fusion is typically performed in this group as salvage procedures. This study examined the suitability of LMAI combined with PRC to expand the indications for motion-preserving surgery.

Obvious limitations of this study include its small sample size and lack of a control group, as well as a failure to obtain baseline pain levels and DASH scores preoperatively. Prospective clinical research on this topic is obviously needed. Alternative procedures include those reported by Salomon and Eaton⁹ in which an interposition of the dorsal capsule was used in conjunction with a PRC with a partial capitate shortening and by Tang and Imbriglia¹⁰ in which osteochondral grafting of the capitate was performed.

Our primary question in this study was whether LMAI combined with PRC will allow comparable function and motion compared with patients having PRC alone. Even though we found a reduction in postoperative flexion and extension, our results were comparable to those in the literature where PRC was performed alone in regard to ROM and grip strength. Tomaino et al¹ found grip strength of 77% and flexion–extension arc of 64% compared with the contralateral side after an average 6-year follow-up of patients with PRC alone. Other studies of PRC alone reported up to a 94% maximum grip strength, but most were much less than this.^{2,11} At a minimum of 20 years, patients with PRC alone have been found to have flexion–extension arc of 68 degrees and grip strength of 72% of the contralateral extremity.¹² These numbers appear comparable to our findings of motion and grip strength with LMAI and suggest that the addition of LMAI does not affect wrist motion and function when compared with just PRC.

Similarly, Didonna et al¹³ reported on a group of 22 wrists 10 years after PRC, and found an average DASH score of 9 compared with our average finding of 33. This article reported on a much younger patient population (38 vs. 72 years). This

Fig. 4 (A) First follow-up lateral radiograph demonstrating preserved radiocapitate space, representing the lateral meniscal allograft. Lateral radiographs were used to measure changes in radiocapitate space over the follow-up period. (B) Lateral radiograph in the same patient demonstrating partial narrowing of radiocapitate space 5 years following lateral meniscal allograft interposition.

study group also had less advanced arthritic changes preoperatively, as all included patients did not have arthritis of the capitolunate joint.

Didonna et al¹³ in their study of PRC found that at least partial loss of radiocapitate space was common after a 10-year follow-up. They stated that there did not seem to be a correlation between radiographic changes with subjective and objective outcome. Our study also demonstrated a loss of radiocapitate space after an average of 4.2 years. We do not know whether the reduction in radiocapitate space found in our study is due to degeneration of the graft or due to bony changes in the capitate or radiolunate fossa.

A second question we asked in this study was to determine the short-term longevity of the allograft. LMAI graft failure rates in the setting of wrist arthritis have not been previously described. However, there are studies that describe complication and graft failures when LMAI is used in the glenohumeral joint. Nicholson et al⁶ found a 17% reoperation rate when using meniscal allograft in combination with shoulder hemiarthroplasty. Three of five of their complications were thought to be the result of tearing or displacement of the meniscal graft. Similarly, these patients experienced pain and loss of ROM with 0 mm of joint space demonstrated on radiographs.

This study supports the consideration of the use of a meniscal allograft in conjunction with a PRC in those patients who might otherwise be considering a total wrist fusion. The use of an allograft may delay the need for a total fusion which would alter a patient's motion and function. We recommend that this procedure be considered in those patients who have failed conservative treatment for wrist osteoarthritis affecting the proximal capitate and lunate facet. Examples would be patients with advanced stages of SLAC, scaphoid non-union advanced collapse (SNAC), and Kienbock disease.

We do not recommend that this procedure be considered for those patients with radiocarpal arthritis as a result of distal radius malunion or carpal instability adaptive. Pogue et al¹⁴ have demonstrated that contact pressures of the radiocarpal joint are affected by distal radius malunion and therefore we would argue that these pressures would cause undue stress on the meniscal allograft. This has been demonstrated clinically in one patient with distal radius malunion who had early graft disintegration following PRC with LMAI. We also do not recommend this procedure in those with active infection or those affected by inflammatory or crystalline arthropathies that would compromise soft-tissue stability.

Conflict of Interest

None.

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