

Outcomes of Patients Receiving Proximal Row Carpectomy and Meniscus Interposition Allografts for the Treatment of End-Stage Wrist Arthritis: A Comparative Study

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Abstract

Background: Proximal row carpectomy (PRC) is a mainstay of wrist arthritis treatment; however, it is traditionally contraindicated in patients with an affected capitate. The use of soft tissue interposition grafts to resurface the radiocapitate articulation has been previously described to allow for PRC in these patients. In the current study, we reviewed our outcomes using knee meniscus allograft interposition to resurface the radiocapitate articulation in patients who would have otherwise been contraindicated for PRC. **Methods:** A retrospective study of patients who underwent PRC with or without meniscus interposition arthroplasty was performed from 2011 to 2022. Patient demographics (age, sex, occupation, hand dominance, etc) were collected. Improvement in pain was the primary outcome. Wrist range of motion and reconstructive failure requiring fusion were the secondary outcomes. **Results:** We identified a total of 83 patients and 43 met the inclusion criteria. Fifteen patients (35%) underwent PRC with meniscus interposition arthroplasty, and 28 patients (65%) underwent PRC alone. Patients with and without meniscus interposition arthroplasty had documented improvement in pain postoperatively (93% vs 95%, $P > .05$) at a median follow-up time of 11 (range, 3-38 months) and 9 months (range, 3-64 months), respectively. Postoperative wrist range of motion (flexion: +9 vs -4, $P > .05$, extension: +12 vs -4, $P = .10$) trended toward increase in patients undergoing meniscus interposition arthroplasty compared with PRC alone. **Conclusions:** Our short- to mid-term outcomes in patients with end-stage wrist arthritis affecting the capitate who undergo PRC and meniscus interposition arthroplasty are comparable with those receiving PRC alone.

Keywords: wrist, anatomy, allograft, basic science, arthritis, diagnosis, arthroplasty, osteoarthritis, post traumatic

Introduction

Proximal row carpectomy (PRC) is one of the main treatments for end-stage arthritis of the radiocarpal joint and results in an iatrogenic articulation between the radius and the capitate. One of the traditional contraindications of PRC is diseased cartilage of the lunate fossa and/or capitate, which would usually indicate a 4-corner fusion or wrist arthrodesis.^{1,2} Four-corner fusion carries an inherent risk of nonunion, dorsal impingement or other hardware issues, and progressive osteoarthritis.^{3,4} Population-level data have also suggested that PRCs are more cost-effective than 4-corner fusion.⁵⁻⁷ In addition, 4 corner-fusion and wrist arthrodesis reduce or prevent motion in the wrist, which may be more preserved with PRC.^{2,8}

The use of soft tissue interposition grafts (dorsal capsule and acellular dermal matrix) to resurface the radiocapitate articulation has been previously described to facilitate PRC

when otherwise contraindicated.⁹⁻¹² Salomon and Eaton¹⁰ have also suggested that the dorsal wrist capsule can be harvested and interposed in the joint space with successful outcomes even when partial capitate resection is necessary due to poor condition of the cartilage.

Meniscus allograft has long been used in the knee to treat various forms of joint degradation. This technique has been shown to be effective and durable even for long-term follow-up.¹³ Complication rates are low, with low reoperation and revision rates even in an athletic population.¹⁴⁻¹⁹

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Although predominantly used in the lower extremity, Nana-vati et al first described the use of meniscus allograft for proximal carpectomy in the hand in a cadaveric study, and others have followed demonstrating successful clinical results with resurfacing of hand and wrist joints.^{14,15,20-23} Here, we present our own experience with using meniscus allograft as an interposition graft to resurface the radiocapitate articulation in patients with end-stage wrist arthritis and concomitant arthritis of the lunate fossa and/or capitate.

Methods

A retrospective study was performed from 2011 to 2022, and CPT codes 25215 (carpectomy; all bones of proximal row) and 25332 (arthroplasty, wrist) were used to identify all patients who underwent PRC with or without meniscus interposition arthroplasty. Patient demographics (age, sex, occupation, hand dominance, etc) were collected. Improvement in pain was the primary outcome and determined through the preoperative and postoperative medical history. Wrist range of motion and reconstruction failure requiring a fusion procedure were the secondary outcomes. Patients were excluded if there was inadequate documentation regarding the primary/secondary outcomes or if follow-up was less than 3 months.

The operative technique for meniscus interposition arthroplasty has been previously reported by our group.^{20,21,23} The procedure is performed using a standard dorsal approach to the proximal wrist centered at the radiocarpal joint, followed by elevation of soft tissue and inspection of the articular surfaces of the proximal row, lunate fossa, and capitate. Excision of the proximal row is then performed with preservation of the radioscapocapitate ligament. Depending on which surface or surfaces demonstrate arthritic changes, the articular surface of either the arthritic lunate fossa or the capitate is then decorticated and knee meniscus allograft (MTF Biologics, Edison, New Jersey) of at least 2- to 3-mm thickness is custom cut to size intraoperatively and secured using extracapsular 4-0 permanent sutures. Meniscus allograft is polar in nature, reflecting the original quality of the cartilage in situ. When securing the graft, the rough surface of the graft is placed against the decorticated surface to facilitate cellular repopulation and the smooth side forms the new articular surface.

Postoperatively, patients are immobilized in a plaster splint for 3 to 4 weeks and then transitioned to a removable splint. Occupational therapy is initiated at 4 weeks starting with gentle range of motion. Weightbearing is permitted 6 weeks after surgery. The postoperative protocol was the same for patients who did and did not undergo arthroplasty with meniscus allograft.

Once the data were assembled, categorical variables were compared using χ^2 and Fisher exact tests as appropriate. Continuous variables were compared using Mann-Whitney

tests after confirming the lack of normal distribution. Results were considered significant when $P < .05$. All tests were conducted using SPSS (Statistical Package for the Social Sciences) Software (IBM Corp, Armonk, New York).

Results

We identified a total of 83 patients, and 43 met the inclusion criteria. Fifteen patients (35%) underwent PRC with meniscus interposition, and 28 patients (65%) underwent PRC alone. There were no significant differences in sex or age. Both patients with and without meniscus interposition arthroplasty had documented improvement in pain postoperatively (93% vs 95%, $P > .05$) at a median follow-up time of 11 (range, 3-38 months) and 9 months (range, 3-64 months), respectively. The patients in both groups had similar degrees of preoperative flexion and extension (Table 1), but postoperative changes to wrist range of motion (flexion: +9 vs -4, $P < .05$, extension: +12 vs -4, $P = .10$) tended to favor the meniscus group although were not statistically significant. No patients undergoing meniscus interposition arthroplasty required allograft removal or experienced reconstruction failure requiring arthrodesis. There were no incidences of graft infection or wound-healing issues necessitating graft removal in the meniscus group. There was insufficient documentation to compare absolute differences in Wong Baker pain scores or Disabilities of the Arm, Shoulder, and Hand scores due to the retrospective design of the study.

Representative radiographs of a patient who underwent PRC in the meniscus group are shown in Figure 1 at 12-month follow-up.

Discussion

Proximal row carpectomy and 4-corner arthrodesis have been demonstrated to be effective treatments for osteoarthritis of the wrist, but for patients with midcarpal arthritis, arthrodesis involving the capitate has traditionally been considered mandatory. The prospect of sacrificing motion can be unattractive to many patients, especially those who are young and active or use their hands for work. Furthermore, the placement of hardware for arthrodesis can be associated with complications and reoperation.

There has long been interest in resurfacing of the capitate to enable PRC in patients who would otherwise not be candidates. This began with Eaton and Salomon's description of interposition of the dorsal wrist capsule and now includes less used modalities such as implants and osteochondral grafting.^{17,18} These advances represent innovation in the treatment of wrist arthritis and efforts to improve outcomes, especially when arthritis is severe or patients are young with advanced disease. Implantable devices (including many of those used for 4-corner fusion) have varying

Table 1. Patient Demographics and Outcome Measures.

	PRC with meniscus (N = 15)	PRC alone (N = 28)	P value
Mean age (y)	61 ± 12	59 ± 12	>.05
Sex (male:female)	12:3	21:7	>.05
Diagnosis			
SLAC	15	24	
SNAC	0	2	
Not recorded	0	2	
Number of patients with prior wrist surgery	3	5	>.05
Median follow-up time (months, IQR)	10.5 (6, 22)	9 (5, 24.5)	>.05
Pain improvement after surgery	14	27	>.05
Preoperative flexion (°)	29 ± 16	37 ± 17	>.05
Postoperative flexion (°)	37 ± 20	33 ± 10	>.05
Preoperative extension (°)	33 ± 19	43 ± 16	>.05
Postoperative extension (°)	41 ± 10	42 ± 16	>.05
Need for graft removal	0	N/A	

Note. PRC = proximal row carpectomy; SLAC = scapholunate advanced collapse; SNAC = scaphoid nonunion advanced collapse; IQR = interquartile range.

**Figure 1.** Example of postoperative radiograph of patient status post proximal row carpectomy with placement of meniscus allograft.

rates of reported complications (from 0% to 39%).²⁴ These unpredictable results and lack of success in the long term mean that prosthetic implants for the hand and wrist have so far not lived up to the standard set by arthroplasty for the knee and hip.^{19,25}

The use of cadaveric meniscus for resurfacing the joint allows for the benefits of a PRC without excluding patients with midcarpal or end-stage arthritis. In our patient group,

postoperative changes to range of motion are similar to reported rates for traditional PRC performed for end-stage wrist arthritis.²⁶ Patients experienced improvements in pain and had no significant complications.

Future prospective studies are needed to define precisely the benefits of using meniscus interposition grafts compared with PRC alone. However, our study has demonstrated that meniscus interposition graft is a viable adjunct

to obviate the need for wrist arthrodesis in patients who would otherwise be contraindicated for PRC.

There are several limitations to this study. The first is the retrospective nature of the review, which does not always provide complete and granular data points. The second is the cost of using cadaveric allograft for common procedures. Allograft has several advantages, such as decreasing donor-site morbidity from the harvest of dorsal capsule or chondral bone and providing an off-the-shelf alternative to these products that is not limited by the donor materials available. The disadvantage is the cost and availability, which in some instances may be prohibitive.

Conclusions

Our study confirmed that knee meniscus interposition allografts can be successfully used to perform PRC in patients with end-stage wrist arthritis who would otherwise have received a partial or total wrist arthrodesis. Patients undergoing PRC with and without meniscus interposition grafts had improvements in pain, and we noted a trend toward increased range of motion in patients receiving meniscus interposition grafts when compared with traditional PRC.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: DAK is on the advisory board of MTF Biologics. The other authors declare no conflict of interest.

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