The Prevalence of Pisotriquetral Arthritis in the Setting of Scapholunate Advanced Collapse

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Abstract

Background Previous authors have reported pisotriquetral pain and subsequent pisiform excision following partial or total wrist fusion in patients with scapholunate advanced collapse (SLAC). Prior studies have not considered the potential role of SLAC biomechanics on pisotriquetral osteoarthritis (PT OA) development preoperatively.

Purpose To determine the prevalence and severity of PT OA in patients with SLAC as compared with a control population.

Patients and Methods Magnetic resonance imaging (MRI) studies of 24 patients with SLAC wrist and 24 sex- and age-matched control patients were analyzed. Patients with SLAC wrist were selected from a database of all wrist MRI studies performed at our institution from 2006 to 2015, excluding those with inflammatory arthritis, chondrocalcinosis, and incomplete or atraumatic scapholunate interosseous ligament rupture. Control patients underwent MRI for nonarthritic clinical indications and were chosen in an age- and sex-matched fashion. Patients undergoing MRI for triangular fibrocartilage complex injury, extensor carpi ulnaris tendinopathy, or ulnar-sided wrist pain were excluded from the control cohort. MRI grading of arthritic change at the pisotriquetral joint was assessed by a blinded musculoskeletal radiologist according to a four-category scale, with grade 4 indicating the greatest arthritic severity.

Results The prevalence of PT OA in the control cohort was found to be 37.5% compared with 41.7% in the SLAC cohort. The prevalence of greatest arthritic severity (grade 4) at the pisotriquetral joint was found to be 4.2% in the control cohort, compared with 16.7% in the SLAC cohort.

Conclusion We conclude that the overall prevalence of chondral wear at the pisotriquetral joint in SLAC wrist does not differ significantly from that found in control populations. We did identify a fourfold (but not statistically significant) increased prevalence of end-stage arthritis in patients with SLAC. Given reports of symptomatic PT OA developed following four-corner arthrodesis, we recommend preoperative vigilance for pisotriquetral pain in patients with SLAC arthritis.

Level of Evidence Prognostic level III.

Keywords

- pisotriquetral arthritis
- pisiform
- scapholunate advanced collapse

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Pisotriquetral osteoarthritis (PT OA) may manifest as pain at the hypothenar eminence,^{1,2} and may be caused by acute trauma or chronic instability.³ Previous authors have identified instability of the ligamentous stabilizers of the pisiform—that is, the pisometacarpal, pisohamate, and ulnar pisotriquetral ligaments—as potential causes of degenerative changes at the pisotriquetral joint and ulnar-sided wrist pain.³ Injury to the pisotriquetral joint may be masked by more severe concomitant trauma to the wrist or hand, by repetitive indirect trauma or chronic overuse of sharp pronation-supination, such as that seen in sports in which stroke play from the wrist is common,⁴ or by flexor carpi ulnaris contracture, which places sharp torsional stress on the pisotriquetral joint capsule.² Because the joint space is difficult to appreciate on radiographs, prior studies have focused on improving methods of detection of PT OA preoperatively, such as by obtaining radiographs of the wrist in 30-degree supination.¹ Magnetic resonance imaging (MRI) and arthrography have also been used to evaluate the pisotriquetral joint and its articular surfaces.⁵

The exact prevalence of PT OA is unclear, although over 200 individual cases have been reported in the literature.^{6–14} A previous cadaveric study examined the prevalence of exposed subchondral bone of the pisiform and triquetrum separately and simultaneously, and reported cartilage lesions on either joint surface in 75.0% of cases.¹⁵ A separate cadaveric study using MRI and MR arthrography reported cartilage lesions on the triquetrum and pisiform in 73 and 91% of cadaveric wrists, respectively.⁵ Given that symptomatic PT OA following partial or total wrist arthrodesis has been reported by several authors in the setting of scapholunate advanced collapse (SLAC),^{6,16,17} we sought to evaluate the prevalence and severity of PT OA in this patient population preoperatively. To our knowledge, prior studies have not reported this prevalence or quantified the percentage of exposed bone in live patients.

The purpose of this article is to determine the prevalence of PT OA in patients with SLAC as evaluated on cartilage-sensitive MRI, compared with a control population. We hypothesized that the prevalence and severity of PT OA would be higher among patients with SLAC wrist.

Methods

After obtaining institutional review board approval, we conducted a retrospective review of MRI studies performed at our institution to assess wrist pathophysiology. MRI studies of 24 patients with SLAC wrist and of 24 control patients were analyzed. Patients with SLAC wrist as originally defined by Watson and Ballet¹⁸ were selected from a database of wrist MRI studies, excluding patients with inflammatory arthritis, chondrocalcinosis, and incomplete or atraumatic rupture of the scapholunate interosseous ligament.¹⁹

Control patients were sex- and age-matched from the same database of wrist MRI studies for nonarthritic indications. Patients with clinical indications implicating ulnar-sided pathophysiology such as triangular fibrocartilage complex injury, extensor carpi ulnaris tendinopathy, or ulnar-sided wrist pain were excluded to prevent potential confusion with PT OA.

Clinical indications for control MRI studies included ganglion cyst (eight), dorsal- and/or radial-sided wrist pain (four), soft tissue mass (three), flexor carpi radialis tendinopathy (two), median neuritis (two), tendon injury (one), De Quervain tenosynovitis (one), carpometacarpal boss (one), finger pain (one), and radial sensory nerve lesion (one).

MRI studies were performed on a 1.5T or 3.0T clinical scanner (GE Healthcare, Waukesha, WI) using a standardized protocol. Coronal gradient and inversion recovery, and fast spin-echo sequences of the wrist in three orthogonal planes were acquired in all patients. MR images were evaluated by a single blinded radiologist with over 20 years of experience in musculoskeletal MRI. Cartilage at the pisotriquetral joint was graded according to a four-category scale: normal (grade 1), superficial wear (grade 2), high-grade wear including full-thickness chondral loss up to 25% of a joint surface (grade 3), and full-thickness chondral loss affecting greater than 25% of either joint surface (grade 4) (►Fig. 1).

Statistical Analysis

The prevalence of PT OA in each cohort was compared using a two-sided Z-test with pooled variance. A binary analysis was first performed to test for the prevalence of PT OA secondary to any chondral wear (defined as grades 3 and 4 combined) between the two cohorts, compared with pisotriquetral joints with intact cartilage (defined as grades 1 and 2 combined). A second two-sided Z-test with pooled variance was performed to assess the prevalence of grade 4 cartilaginous wear between the SLAC and control cohorts. Two power analyses were conducted to determine the number of patients required to test each hypothesis—that is, that there was an increased prevalence of grades 3 and 4 combined, and grade 4 alone, in the SLAC as compared with control cohort.

Results

Mean age of the control population was 60 (range, 40–76) years and 16 patients were male. Mean age of the SLAC population was 60 (range, 40–73) years and 16 patients were male. Of 24 pisotriquetral joints in the control cohort, 9 were read as arthritic (either grade 3 or 4) compared with 10 joints read as arthritic in the SLAC cohort. Binary analysis revealed the prevalence of PT OA in the control cohort (37.5%) was less than the prevalence in the SLAC cohort (41.7%). Although this difference did not reach statistical significance ($p > 0.05$), power analysis suggests that more than 2,000 patients in each cohort may be required to detect significant differences in effect sizes (►Table 1).

Of 24 pisotriquetral joints in the control cohort, 8 were read as grade 3 and 1 joint was read as grade 4. In comparison, six pisotriquetral joints were read as grade 3 in the SLAC cohort and four joints were read as grade 4. These data revealed that the prevalence of grade 4 PT OA in the SLAC cohort (16.7%) was four times that of the control cohort (4.2%), but these data were found to be not significant ($p > 0.05$) (►Table 2). Power analysis calculation, however, indicates that nearly 240 patients per cohort may be necessary to adequately detect differences in grade 4 prevalence.

Fig. 1 (A) Sagittal fast spin-echo MR image of the wrist in a 63-year-old man demonstrates normal articular cartilage at the pisotriquetral joint (arrow). (B) MRI of the wrist in a 66-year-old man with SLAC arthritis demonstrates extensively exposed bone and tilting of the pisiform suggestive of altered kinematics at the pisotriquetral joint (arrow).

Discussion

In normal patient populations, PT OA is typically associated with acute injury to the ligaments stabilizing the pisiform or chronic instability secondary to repetitive trauma.³ Although the exact prevalence of PT OA has not been reported, a 1998 cadaver study by Yamaguchi et al found exposed bone on the pisiform in 73.8% of 80 dissected cadaveric wrists, and exposed bone on the triquetrum in 75.0%.¹⁵ Exposed subchondral bone on the articular surface of both the pisiform and triquetrum in the same specimen was found to occur in 65.0% of dissected wrists.¹⁵ The average age of these cadavers was 72.5 (36–93) years. Theumann et al reported evidence of exposed bone on the pisiform in 91% of 22 cadavers examined using MRI and MR arthrography, and exposed bone on the triquetrum in 73%.⁵ The average age of specimens at the time of death was 75 (45–90) years. We were unable to identify reports on the prevalence of PT OA in SLAC wrist.

Table 1 Incidence of intact and arthritic pisotriquetral joints in control versus SLAC wrist

	Cohort		Total
	Control, n (%)	SLAC, n (%)	
Intact ^a	15 (62.5%)	14 (58.3%)	29 (60.4%)
Arthritic ^b	9 (37.5%)	10 (41.7%)	19 (39.6%)
Total	24 (100.0%)	24 (100.0%)	48 (100.0%)

Abbreviation: SLAC, scapholunate advanced collapse.

Note: $p = 0.768$.

^aIntact joints are defined by articular cartilage that is either normal (grade 1) or affected by superficial wear (grade 2).

^bArthritic joints are defined by high-grade chondral wear of articular cartilage including full-thickness chondral loss up to 25% of a joint surface (grade 3) or full-thickness chondral loss affecting greater than 25% of either joint surface (grade 4).

In our study, we found that full-thickness chondral loss of any degree (i.e., grades 3 and 4 combined) on either the pisiform or triquetrum articular surface was identifiable in 37.5% of patients, compared with the 73.8 to 75.0% figure reported by Yamaguchi et al and the 73 to 91% observed by Theumann et al. In light of the fact that PT OA is thought to develop with greater frequency in older patients,²⁰ the discrepancy between the figures reported in the literature and those found in our study may be due to the on average younger control population examined here.

The occurrence of grades 3 and 4 chondral wear combined was not found to be significantly less than the 41.7% prevalence of full-thickness chondral loss in the SLAC cohort. Of interest, however, was that 16.7% of pisotriquetral joints in the SLAC wrist cohort were found to have full-thickness loss affecting >25% of either joint surface compared with 4.2% in the control cohort, suggesting that the severity of PT OA may be greater in the setting of SLAC wrist than in control subjects with anatomic carpal alignment. While not statistically significant given the numbers studied and the overall high prevalence of PT OA, we feel that there may be a relationship

Table 2 Incidence of grades 3 and 4 chondral wear in control versus SLAC wrist

	Cohort		Total
	Control, n (%)	SLAC, n (%)	
Grade 1 or 2	15 (62.5%)	14 (58.3%)	29 (60.4%)
Grade 3	8 (33.3%)	6 (25.0%)	14 (29.2%)
Grade 4	1 (4.2%)	4 (16.7%)	5 (10.4%)
Total	24 (100.0%)	24 (100.0%)	48 (100.0%)

Abbreviation: SLAC, scapholunate advanced collapse.

Note: $p = 0.678$.

between the abnormal proximal carpal row alignment of dorsal intercalated segment instability (DISI) and advanced degenerative change in the pisotriquetral joint.

Several authors have commented upon the need for pisiform excision following partial or total wrist fusion.^{6,16,17} Gaston et al noted that five patients who underwent four-corner arthrodesis subsequently developed pisotriquetral pain requiring pisiform excision, as well as three patients who developed symptoms after total wrist arthrodesis, and one patient who developed symptoms after a four-corner arthrodesis was revised to a total wrist arthrodesis.⁶ All patients presented with symptomatic PT OA on average 15 months (range, 5–43) after fusion. A similar 2009 study found that 3 of 18 four-corner arthrodeses over a 10-year period at a single institution later required pisiform excision to relieve symptomatic pisotriquetral pain.¹⁶ Similarly, Ronchetti and Topper reported two of seven patients that required either pisiform or triquetrum excision following capitulate arthrodesis for SLAC and scaphoid nonunion advanced collapse.¹⁷ Although the exact incidence of subsequent pisiform excision may be difficult to discern given the current available literature, unspecified reports of “ulnar carpal pain” following limited and total wrist arthrodesis may implicate PT OA.^{6,21}

Our data suggest that PT OA is common in both SLAC and control populations, but that advanced stage arthritis may be more prevalent in patients with SLAC arthritis and DISI. It is plausible that pisotriquetral kinematics are altered with proximal row instability, malalignment, or wrist arthrodesis, leading to kinetic changes that aggravate preexisting degenerative joint disease.⁶

Future studies are necessary to determine if there is a positive correlation between PT OA preoperatively and subsequent development of symptomatic pisotriquetral pain following four-corner arthrodesis, to better determine if the unmasking of pisotriquetral pain is related to the abnormal carpal mechanics of SLAC or to altered load transfer secondary to a fused carpal mass. Better understanding of the etiology, progression, and identification of PT OA may help hand surgeons counsel at-risk patients who may benefit from concurrent pisiform excision at the time of partial or total wrist arthrodesis.

Conflict of Interest

None.

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