Research Article

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Radiographic Patterns of Radiocarpal and Midcarpal Arthritis

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Abstract

Introduction: The purpose of this study was to determine the specific locations of radiocarpal and/or midcarpal joint osteoarthritis (RC/MC OA).

Methods: A total of 1,007 wrist radiographs were screened for the presence of RC/MC OA. The locations of the degenerative changes were identified. In addition, the observers then determined whether the observed patterns fell under the scapholunate advanced collapse (SLAC) pattern.

Results: The SLAC pattern did not represent the majority of observed degenerative changes. Almost one-third of the patients had degenerative changes present at the radiolunate or scaphocapitate articulations in the absence of radioscaphoid changes. Women have a lower risk of arthritis compared with men (odds ratio, 0.306; $P < 0.05$). Increasing age correlated with the presence of arthritis (odds ratio, 1.05; $P < 0.05$).

Conclusion: Contrary to the previous reports in the literature, our cohort demonstrated that <50% of wrist OA fell into the category of SLAC arthritis.

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Institutional Review Board Approval was obtained for this study.

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Osteoarthritis (OA) of the wrist and hand is a common cause of disability. The most common pattern of wrist arthritis was described by Watson and Ballet[1] in 1984 as resulting from chronic scapholunate insufficiency, and has been termed scapholunate advanced collapse (SLAC) wrist. Their description of the SLAC wrist includes a progression through three stages beginning with radial styloid-scaphoid changes, progressing to proximal radioscaphoid arthritis, and culminating in midcarpal (MC) arthritis. These investigators found a 4.5% prevalence of wrist OA, not including the scaphotrapeziotrapezoidal (STT) joint.[1,2] Since that study over 30 years ago, however, there has been little investigation into the prevalence and patterns of radiocarpal and/or MC joint osteoarthritis (RC/MC OA).

The purpose of this study was to determine the radiographic patterns and specific locations of RC and MC joint OA. We hypothesized that the prevalence of OA would be greater with increasing age and male sex, and that the SLAC pattern would represent the most common pattern of degeneration.

Methods

The methodology used in this investigation was based on a similar study

Figure 1

Zones of the radiocarpal and midcarpal joints. (1) Radial styloid, (2) radioscaphoid, (3) radiolunate, (4) scaphocapitate, (5) capitolunate, (6) triquetral-hamate, and (7) triquetral–lunate.

evaluating the prevalence of STT OA.[3] Institutional Review Board approval was obtained for this study. The roster of patients was created by searching the radiology database for Current Procedural Terminology (CPT) codes 73100 (wrist, two views) and 73110 (wrist, minimum of three views) to identify all consecutive patients who presented to our orthopaedic practice for the treatment of general hand or wrist complaints, including neuropathies, tendinopathies, and trauma.

The presence of wrist radiographs with visualization of both the MC and RC joints on a minimum of two views was required for inclusion in the study. Only the most recent wrist radiographs were used when more than one radiographic evaluation for the same patient was identified. Patients were excluded if they were younger than 18 years, if there were inadequate views, or if they had radiographic evidence of hand or wrist fracture or previous wrist surgery.

One thousand seven radiographs were included in the study over a 3-month period and formed the basis of this report. The average patient age was 54 years (age range, 18–97 years), with 393 men (age range, 21–95 years) and 614 women (age range, 18–97 years). Radiographs were reviewed by a senior fellowship–trained hand surgeon using a PACS [picture archiving and communication system]-based digital radiography system (Sectra AB). Each radiograph series was evaluated for degenerative changes in the RC or MC joints, and those displaying evidence of OA were selected. The following radiographic characteristics were taken into consideration: joint space narrowing, presence of osteophytes, and sclerotic and cystic changes. Patients with radiographic evidence of Kienbock disease, isolated STT arthritis, or inflammatory arthritis (eg, diffuse symmetric joint space narrowing, erosive or cystic changes, periarticular osteopenia) were excluded.

A roster of patients with RC/MC OA was thus generated. Three fellowship-trained hand surgeons were asked to evaluate these radiographs on two separate occasions, spaced 4 weeks apart. The location of the degenerative changes relative to each specific joint was tabulated using a numerical system of seven unique zones adapted from the original study by Watson and Ballet[1] (Figure 1). In addition, the reviewers were asked to determine whether signs of inflammatory arthritis were present (with the intent of excluding these patients) and to classify the arthritic patterns into SLAC or scaphoid nonunion advanced collapse (SNAC) according to the established radiographic criteria.[1,4] To be considered an SLAC pattern of OA, degenerative changes had to be present in the radial styloid-scaphoid joint, the entire radioscaphoid joint, or the radioscaphoid and capitolunate joints. The presence of diastasis of the scapholunate joint of ≥4 mm was noted. Interobserver and intraobserver reliability for the presence of degenerative changes and the zone classification were calculated.

A logistic regression analysis was performed to measure the relationship between the presence of arthritis and age and sex. For the classification of individual segments, the Fleiss kappa was used to estimate reliability. Agreement was classified according to the criteria of Landis and Koch.[5] Interrater reliability was calculated by pooling both assessments, and similarly, intrarater reliability for the two exposures of pooled clinicians. The total number of segments classified as arthritic was similarly compared using the intraclass correlation coefficient. These statistics were calculated using the "irr" package in R 3.3.0 (R Foundation for Statistical Computing).

Results

Forty-nine radiographs in 47 patients with RC/MC OA were identified, to yield a prevalence of 4.9% in our patient population. Patient charts of all 47 patients included did not reveal any evidence of history of inflammatory disease or previous trauma. Seventeen (40%) of the 47

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Figure 2

Percent involvement of radiocarpal and midcarpal zones.

Table 1

Non-SLAC Patterns of RC and MC OA

Zone(s) of Carpal Involvement	Location(s)	No. of Patients
3	Radiolunate	9
1, 2, 3	Radioscaphoid, radiolunate	4
1, 4	Radial styloid, scaphocapitate	2
4	Scaphocapitate	1
1, 5	Radial styloid, capitolunate	1
5, 7	Capitolunate, triquetral-lunate	1
1, 2, 3, 5	Radioscaphoid, radiolunate, capitolunate	1
1, 4, 5, 6	Radial styloid, scaphocapitate, capitolunate, triquetral-hamate	1

MC = midcarpal; OA = osteoarthritis; RC = radiocarpal; SLAC = scapholunate advanced collapse

patients with degenerative changes were women and 30 (60%) were men. The average age of all patients with RC/MC OA was 55 years (range, 23–96 years). Logistic regression analysis demonstrated that women have a lower risk of arthritis compared with men (odds ratio, 0.306; $P < 0.05$). Increasing age was positively correlated with the presence of arthritis (odds ratio, 1.05; $P < 0.05$).

The prevalence of the carpal zones affected by degenerative changes is detailed in Figure 2. Twenty-five patients (51%) had RC/MC OA not defined by the SLAC pattern of arthritis. A subtotal of 32% of the patients with RC and MC OA had degenerative changes present at either the radiolunate or scaphocapitate articulations in the absence of radioscaphoid degenerative changes. Five patients (10%) had changes consistent with the SNAC pattern (three type 1, two type 2, and one type 3) (Table 1). Twenty-four patients (49%) had changes consistent with the SLAC pattern as defined earlier. Of these, 11 patients (22%) had SL diastasis. The breakdown of these SLAC patterns with diastasis was as follows: eight type 2, two type 3, and one type 4. Of the 13 patients without SL diastasis, there were two type 1, ten type 2, and one type 3. Examples of zone 3 and zone 5 arthritis are demonstrated in Figures 3 and 4.

Figure 3

Radiographs of a wrist with isolated zone 3 osteoarthritis.

Reliability was determined using the Fleiss kappa. The interobserver and intraobserver reliability, and frequency of involvement, for each zone of articulation are listed in Table 2. All the observers identified at least one zone with degenerative changes. None of the observers categorized any of the radiographs as displaying inflammatory arthritis. The pooled kappa for the interobserver agreement was calculated at 0.55, and the pooled kappa for the intraobserver agreement was 0.79. These results indicate moderate and substantial agreement.

Discussion

We found an overall prevalence of either RC or MC OA of 4.9%, a rate similar to the original findings by

Figure 4

Radiographs of a wrist with zone 4 and 5 osteoarthritis.

Table 2

Interobserver and Intraobserver Reliability and Frequency of Involvement for Each Zone of Involvement

Radiocarpal and Midcarpal Zones	Interobserver Agreement	Intraobserver Agreement	Rate of Occurrence, (%)
1	0.515	0.758	69.90
2	0.643	0.856	55.10
3	0.590	0.821	35.20
4	0.529	0.712	22.96
5	0.557	0.75	26.28
6	0.465	0.834	4.85
7	0.461	0.677	5.87
Pooled	0.550	0.785	—

Watson and Ballet.[1] Moreover, in accordance with our hypothesis, we found the presence of arthritis more common in men and more common in patients of advanced age. Contrary to our hypothesis, we found that <50% of arthritic patterns fell into the SLAC category of RC/MC OA. For example, based on the zone of carpal involvement, 10% of patients had SNAC patterns of RC/MC OA, and at least 41% of patients revealed degenerative changes not involved in the traditional SLAC pattern. Furthermore, a subtotal of 32% of the patients with RC and MC OA had degenerative changes present at either the radiolunate or scaphocapitate articulations in the absence of radioscaphoid degenerative changes.

Although the SLAC pattern of wrist arthritis was common in our study, most of our patients did not have the SLAC pattern of OA. Other conditions can result in wrist arthritis, some of which result in patterns similar to but distinct from SLAC. The differential diagnosis of SLAC arthritis includes pseudogout, idiopathic osteonecrosis, and STT arthritis.[6] In particular, pseudogout has been purported as having a unique staging, beginning with SL widening, a more extended scaphoid, and proximal scaphoid pole erosion followed by pancarpal arthritis.[7] In addition, STT arthritis may occur in wrists with DISI [dorsal intercalated segment instability] alignment without proximal row disruption.[8] This may be due to an attenuation of the secondary stabilizers of the distal scaphoid, and a progression to MC arthritis in nearly 50% of patients with STT arthritis has been noted with relative sparing of the radioscaphoid joint.[9] Finally, nondissociative MC instability can be a predisposing factor to MC OA.[10,11]

The prevalence of OA in the various joints of the hand has been examined by several investigators. Haugen et al[12] reported the prevalence of distal and proximal interphalangeal joint OA in a general population of over 1,200 radiographs to be 29% and 13.5% for men and women, respectively. The prevalence of the thumb carpometacarpal joint OA has been better defined and is thought to be present in approximately 21% to 32% of the general population.[12–14] Similarly, OA of the STT joint is believed to be about 16%, and advanced age and female sex correlate with the presence of disease.[3]

The prevalence and patterns of RC/MC OA, however, have not been extensively studied. Watson and Ballet[1] described the prevalence of wrist OA and reported on a series of patients treated surgically for SLAC wrist. In a review of 4,000 radiographs, they found a prevalence of 4.5% (excluding those involving only the STT joint). The most common degenerative patterns consisted of the SLAC wrist (57%), followed by STT OA (27%), and a combination of SLAC and STT (15%). Although the authors provide a numerical chart denoting each RC and MC joint, no information is given regarding whether

degenerative changes were identified in each of these locations other than those involved in the SLAC and STT patterns. Based on the data provided, it would appear that the authors did not identify OA in other locations, such as the radiolunate or radioscaphoid joints. In addition, although it is a prevalence study, no information is provided regarding sex and age of the study group. As part of the Framingham Osteoarthritis Study, Haugen et al[12] reported the overall prevalence of wrist and hand arthritis to be 1.7% and 1.0% for men and women, respectively, using only the Kellgren–Lawrence grade >2 as a cutoff. Katzel et al[15] reported a 24% prevalence of MC arthritis in a patient population with basal joint arthritis. Finally, Katayama et al[16] described the prevalence of ulnar RC and distal radioulnar OA in the Japanese population and found an incidence of 12.8%.

Interobserver and intraobserver reliability in the diagnosis of OA and localization of the carpal zones involved were moderate and substantial, respectively. Similarly, the interobserver reliability for the diagnosis and staging of the SLAC and SNAC patterns was fair, whereas the intraobserver reliability was substantial. Vishwanathan et al[17] evaluated the agreement of SLAC and SNAC and found a moderate and substantial agreement for the interobserver and intraobserver reliability, but only slight and fair agreement for the interobserver and intraobserver reliability for SNAC. It may be the case that the assignment of degenerative joint disease to carpal articulations is more reliable than SLAC and SNAC assignments because it is simpler and easier to identify individual arthritic segments compared with additional criteria in diagnosing different SLAC and SNAC stages.

There are several limitations of this study. First, one observer screened the radiographs initially. As such, there is the possibility that some radiographs with RC/MC OA were not included in the analysis, which would have resulted in an underestimation of prevalence. Conversely, it is unlikely that patients were overdiagnosed with RC/MC OA because all observers concurred that the patients on the list had arthritis in at least one area. Second, our population of patients was obtained from one surgical practice and may not be reflective of a national or international cohort of patients. However, our practice is a large regional practice of 14 hand surgeons spanning 2 northeastern states with office locations over an area of >2,500 square miles and as such represents a large regional sampling. Finally, the radiographs evaluated were garnered from a group of patients who presented to a hand surgeon's office for treatment; as such, there is a possibility of bias and an overestimation of prevalence. Nevertheless, these were patients who presented for a multitude of complaints, not just wrist pain, and this study follows methodologies similar to those of other prevalence studies in the literature. Moreover, any bias effect or overestimation does not affect one of the more important findings of the study, which suggests that SLAC may not be the most common pattern of RC/MC OA.

In conclusion, we found a prevalence of RC/MC OA in 4.9% of patients. Contrary to previous reports in the literature, the SLAC pattern of arthritis does not represent the majority of the patterns of degeneration encountered, and isolated degenerative involvement of the radiolunate and scaphocapitate joints is often present. Further studies to elucidate the mechanisms of degenerative changes are necessary to improve the evaluation and treatment of this condition.

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