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Joint Replacement Surgery in Patients with Rheumatoid Arthritis in South Korea: Analysis of a Large National Database

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Background: We aimed to investigate the current trend of joint replacement surgery incidence in patients with rheumatoid arthritis (RA) in South Korea and to compare the incidence of joint replacement surgery in each affected joint.

Methods: We performed this big data analysis to investigate the current trend of joint replacement surgery incidence in patients with RA in South Korea and to compare the incidence of joint replacement surgery in each affected joint. This retrospective study was based on data from the Korea National Health Insurance claims database.

Results: The prevalence of RA increased every year (0.13% in 2008, 0.25% in 2016). The number of newly diagnosed patients increased from 29,184 in 2010 to 38,347 in 2016. The incidence rate of joint replacement surgery in patients with RA increased from 0.72% in 2010 to 4.03% in 2016. The knee (68.3%) was the most commonly replaced joint. The relative risk (RR) of additional joint replacement surgery was highest for the shoulder joint (RR,1.454; 95% confidence interval, 0.763–2.771). The median time from diagnosis to surgery was the shortest in the elbow joint (379 days) and the longest in the shoulder joint (955 days). The median time for each joint was short in order of the elbows, ankles, hips, knees, and shoulders ($p < 0.01$).

Conclusions: The most frequently and initially replaced joints were different, but the prevalence and incidence of RA, as well as those of joint replacement surgery, have recently increased in South Korea. Joint replacement surgery in RA was the highest for the knee joint. The median time from diagnosis to surgery was shortest for the elbow, followed by the ankle, hip, knee, and shoulder. Regardless of whether patients are symptomatic, evaluation of large joints such as the knee, elbow, ankle, and hip should be considered from an early stage.

Keywords: *Rheumatoid arthritis, Joint replacement surgery, Arthroplasty*

Rheumatoid arthritis (RA) is a chronic inflammatory disease characterized by continuous destruction and deformation of multiple joints, leading to dysfunction of the affected joints. Although RA cannot be completely cured yet, recent early intensive treatment strategies involving prompt treatment initiation and targeting early remission have been reported to help prevent disease progression effectively.[1-4] Furthermore, as treatment modalities are improved due to the development of anti-rheumatic drugs, the number of patients suffering from end-stage joint destruction has been reported to decrease.[5-8]

However, despite marked improvement of treatment strategies and pharmacologic treatments, a considerable number of patients still need a joint replacement surgery.[6-11] Joint replacement surgery is an important

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therapeutic option in patients with RA with intractable joint pain and advanced stage of joint destruction. Nevertheless, there are no recent studies about the incidence rate of joint replacement surgery in patients with RA in South Korea. Furthermore, to the best of our knowledge, there have been no studies comparing the incidence of joint replacement surgery in each affected joint. A proper understanding of this trend is indispensable since it would help establish a long-term treatment plan for patients with RA. For the above reasons, we aimed to retrospectively investigate the current incidence of joint replacement surgery in patients with RA in South Korea and compared the incidence of joint replacement surgery in each affected joint.

METHODS

The current study was approved by the Institutional Review Board (IRB) of National Health Insurance Service Ilsan Hospital (No. NHIMC 2017-12-023). The requirement for informed consent was waived by the IRB due to the retrospective nature of the study.

This retrospective study was based on data that include 90% of the national data compiled from healthcare providers across South Korea.[12] This study used National Health Insurance Service-National Sample Cohort. The authors alone are responsible for the content and writing of the paper. From January 2008 to December 2016, data of patients > 19 years old who received inpatient or outpatient treatment with diagnostic codes for RA (International Classification of Disease [ICD]-10 list: M05 [seropositive rheumatoid arthritis] or M06 [other rheumatoid arthritis]) were extracted. RA was defined as the presence of a claim with the diagnostic code for RA and a prescription for disease-modifying antirheumatic drug (DMARDs). To minimize the possibility of other causes of arthritis, patients with diagnostic codes for degenerative arthritis, traumatic arthritis, inflammatory polyarthropathy, and infectious arthritis and those > 70 years old were excluded from the study. Patients with unclear records were also excluded. Moreover, in order to determine the exact incidence, only newly diagnosed patients with the abovementioned diagnostic codes from January 2010 to December 2016 were analyzed (Fig. 1).

Demographic data including sex, age, diagnosis date, and operation date were analyzed. Joint replacement surgery in patients with RA was analyzed from the time of diagnosis until December 2016. ICD-10 procedure codes for joint replacement surgery were used.

The prevalence of RA was calculated as the number of cases per 100 people from 2008 to 2016, while the incidence of RA from 2010 to 2016 was estimated as the number of new patients with RA per 10,000 person-years (PYs). Prevalence is the proportion of a population with a specific characteristic in a given time period, but incidence means the occurrence of new cases of disease. So we needed to wash out the at least 2-year data. The year-specific population from 2008 to 2016 based on the Korean National Statistics Office was used to determine the prevalence of RA. The population aged 19–70 years from 2010 to 2016 was used to determine RA incidence. The relative risk (RR) of additional joint replacement surgery for each joint was analyzed. To assess the duration from RA diagnosis to surgery, a Kruskal-Wallis test with post-hoc analysis was used. All statistical analyses were performed with SAS Enterprise Guide 7 (SAS Institute Inc., Cary, NC, USA). The level of significance was set at $p < 0.05$.

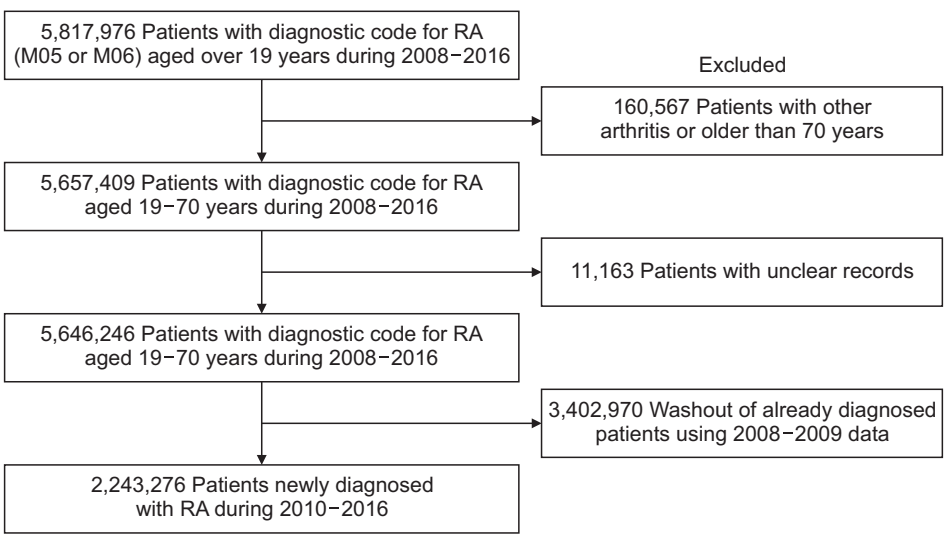

Fig. 1. Flowchart of patient inclusion in the study. RA: rheumatoid arthritis.

RESULTS

Demographic Data

The prevalence, incidence, and demographic data, including age and sex of patients with RA, were investigated using 5,657,409 records of the Korea National Health Insurance (KNHI) database from 2008 to 2016. The number of patients with RA increased from 64,238 in 2008 to 129,754 in 2016. The prevalence of RA increased every year from 0.13% in 2008 to 0.25% in 2016. (Fig. 2), while the number of newly diagnosed patients increased from 29,184 in 2010 to 38,347 in 2016 (Fig. 3). RA incidence in those over 65 years of age increased with 8.80, 10.52, and 9.96 per 10,000 PYs in 2010, 2015, and 2016, respectively (Fig. 4). Mean age at diagnosis was 49.6 ± 12.86 years over the observational period.

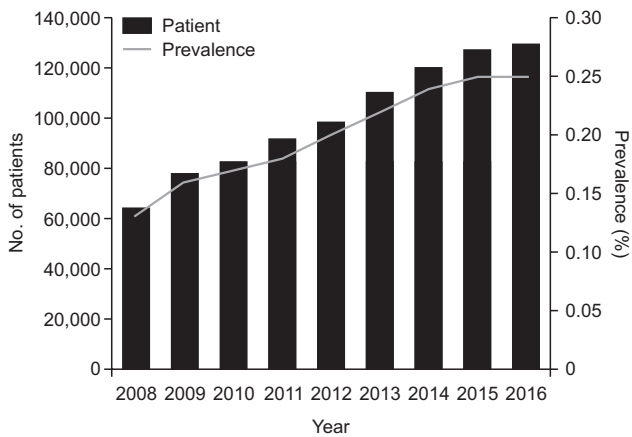

Fig. 2. Number and prevalence of patients with rheumatoid arthritis in South Korea from 2008 to 2016.

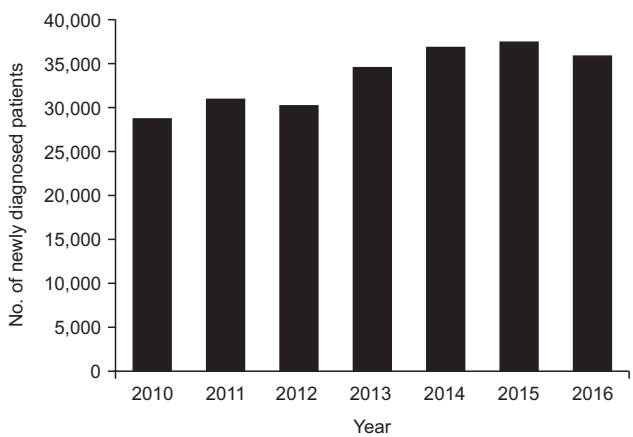

Fig. 3. Number of newly diagnosed patients with rheumatoid arthritis in South Korea from 2010 to 2016.

Joint Replacement Surgery

A total of 239,411 patients were newly diagnosed with RA from 2010 to 2016. Of these, 6,189 (2.57%) underwent joint replacement surgery. The incidence rate of joint replacement surgery in patients with RA based on the date of surgery significantly increased from 0.72% in 2010 to 4.03% in 2016. Of 29,184 patients diagnosed with RA in 2010, 210 patients (0.72%) underwent surgical treatment within 1 year. Additional 1,516 (5.19%) patients underwent joint replacement surgery until December 2016.

Regarding patients who underwent joint replacement surgery, the mean age at the time of joint replacement surgery was 61.6 ± 8.76 years, showing a statistically significant increase from 59.01 ± 9.16 years in 2010 to 62.99 ± 8.23 years in 2016 ($p < 0.01$). The proportion of patients at the time of joint replacement surgery also increased significantly from 32.06% in 2010 to 52.21% in 2016 ($p < 0.01$) (Fig. 5). From 2010 to 2016, most of the patients diagnosed with RA were women (167,028 vs. 72,413, $p < 0.01$). Similarly, more female patients underwent joint

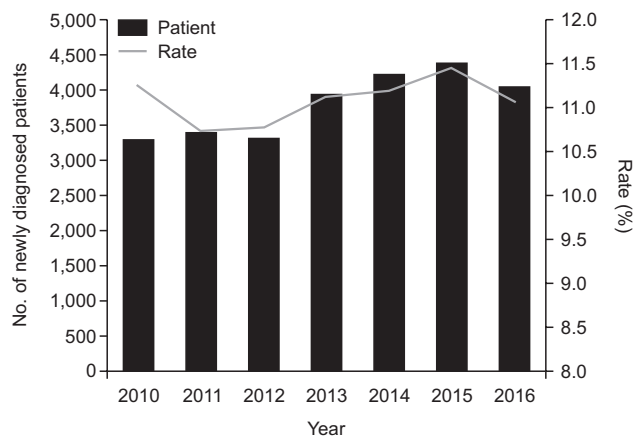

Fig. 4. Number and rate of newly diagnosed patients over 65 years of age.

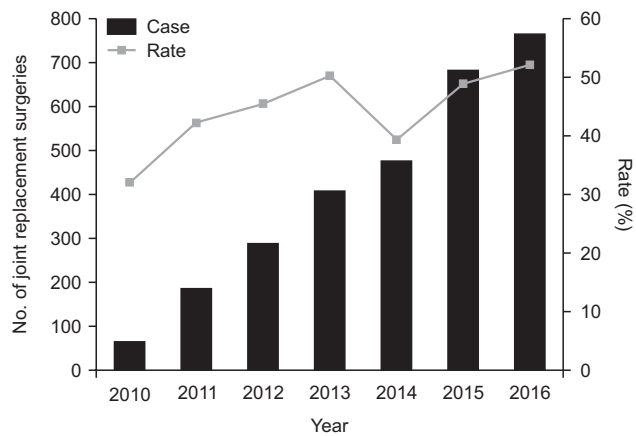

Fig. 5. Number and rate of joint replacement surgeries in all cohorts.

replacement surgery (4,898 vs. 1,291, $p < 0.01$). However, the proportion of male patients diagnosed and undergoing joint replacement surgery also increased (Fig. 6).

The frequency of each joint replacement surgery was as follows: 4,237 cases (68.3%) of knee replacement, 1,580 cases (25.4%) of hip replacement, 171 cases (2.76%) of ankle replacement, and 135 cases (2.13%) of shoulder replacement (Table 1). Of the 6,189 patients who underwent joint replacement surgery, 4,758 required a single surgery, while 630 patients underwent 2 joint replacements, 44 patients underwent 3 joint replacements, 5 patients underwent 4 joint replacements, and 3 patients underwent 5 joint replacements. The first surgery was performed on the knee, hip, ankle, shoulder, and elbow in 3,359 (70.5%), 1,255 (26.3%), 144 (3.0%), 119 (2.5%), and 47 (0.98%) cases, respectively. Similarly, the second surgery was performed on the knee, hip, elbow, ankle, and shoulder in 414 (65.0%), 145 (23.0%), 10 (1.58%), 9 (1.42%), and 6 (0.95%) cases, respectively (Table 2). The RR of additional joint replacement surgery for another joint in patients who already underwent joint replacement surgery was highest for the shoulder joint (RR, 1.454; 95% confidence interval, 0.763–2.771), followed by the hip, knee, ankle, and elbow (Fig. 7).

The median time from the diagnosis of RA to joint replacement surgery was 836 days for patients during the 5 years of follow-up. The median time from diagnosis to surgery was shortest for the elbow joint (379 days), followed by the ankle (626 days), hip (764 days), and knee (860 days) and longest for the shoulder joint (955 days, $p < 0.01$) (Fig. 8).

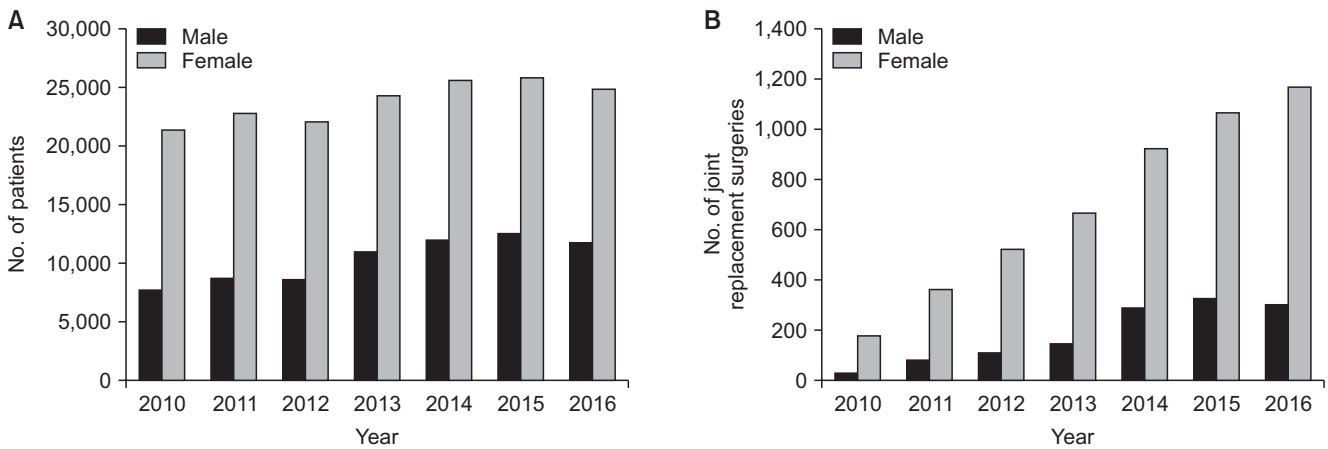

Fig. 6. Sex difference in the number of patients diagnosed with rheumatoid arthritis (A) and the number of joint replacement surgeries (B).

Table 1. Number and Incidence Rate of Joint Replacement Surgery in Patients with RA According to Each Joint during 2010–2016

Year	Knee	Hip	Ankle	Shoulder	Elbow	Finger or toe	Wrist	Total surgeries		No. of patients with RA
								Case	Rate (%)	
2010	157	44	3	2	3	1	-	210	0.72	29,184
2011	346	69	12	14	8	1	-	450	1.43	31,545
2012	462	144	15	6	9	1	-	637	2.07	30,753
2013	585	164	36	17	13	1	-	816	2.31	35,338
2014	769	382	29	24	12	2	-	1,218	3.23	37,678
2015	877	441	35	33	9	3	-	1,398	3.65	38,347
2016	1,041	336	41	39	13	3	1	1,474	4.03	36,596
Overall	4,237	1,580	171	135	67	12	1	6,203	2.59	239,441

RA: rheumatoid arthritis.

Table 2. Number of 1st to 6th Surgeries Performed on Each Joint During 2010–2016

Surgery	Knee	Hip	Ankle	Shoulder	Elbow	Finger or toe	Wrist	Total
1st	3,359	1,255	144	119	47	12	1	4,758
2nd	414	145	9	6	10	-	-	630
3rd	11	7	3	-	-	-	-	44
4th	3	1	-	4	-	-	-	5
5th	1	2	-	-	-	-	-	3
6th	-	-	-	-	-	-	-	3

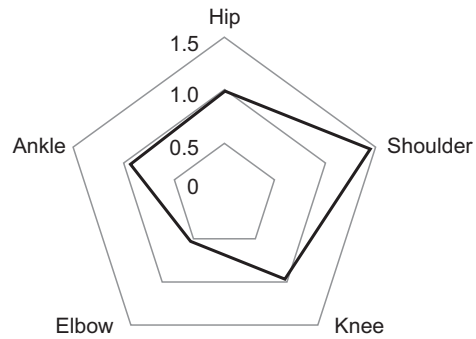

Fig. 7. Relative risk of additional surgery according to the first operated joint. The risk was higher when the first joint was the shoulder, followed by the hip, knee, ankle, and elbow; the difference was not statistically significant.

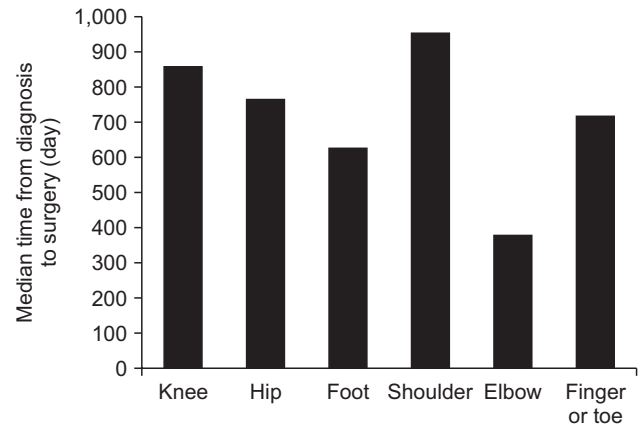

Fig. 8. Duration from diagnosis to joint replacement surgery (days) in patients newly diagnosed with rheumatoid arthritis from 2010 to 2012.

DISCUSSION

The strength of our study is that we analyzed the prevalence and incidence of RA, as well as joint replacement surgery trends, in patients with RA based on big data from the KNHI claims database for the last 9 years. In this study, the frequency of joint replacement surgery and the duration from diagnosis to surgery were analyzed for each joint. Our findings provide information to help predict the progression of RA and establish treatment plans. Our study showed that the number of patients diagnosed with RA in South Korea from 2008 to 2016 was 352,805 and the prevalence of RA increased from 0.13% in 2008 to 0.25% in 2016. The number of newly diagnosed patients from 2010 to 2016 was 239,441, with about 30,000 new RA diagnoses every year. Previous studies using the KNHI claims found a similarly increasing RA prevalence in Korea, ranging from 0.26% in 2007 to 0.32% in 2012.[13,14] In previous studies, patients with RA were defined using the RA diagnostic and drug prescription codes. However, in our study, only patients 19–70 years old with claim data that included the RA diagnostic code were enrolled. In those above 70 years of age, it is difficult to distinguish the reason of joint destruction from between rheumatism and degenerative arthritis. This difference in RA definition might explain the lower prevalence found in our study compared to previous studies. The RA prevalence rate has also been reported to have increased from 0.41% in 2004 to 0.54% in 2014 in the USA and from 0.49% in 1996 to 0.9% in 2010 in Canada.[15,16] The RA prevalence in South Korea is increasing every year, which may be due to an increase in new RA diagnoses, more aggressive treatment leading to an increased survival, an increase in the aging background population, and improved medical care in patients previously diagnosed with RA.

At the 6-year follow-up, the incidence of joint replacement surgery in patients with RA was 2.57%. In a previous study, at least 1 large joint replacement surgery was found in 4% and 14% of patients after 6 and 12 years of follow-up, respectively.[17] Similarly, hip joint replacement surgery was found in 6% and 8.3% of patients after 6 and 15 years of follow-up, respectively.[18,19] Rates of joint replacement surgery among patients > 65 years old

increased over the study period from 32.06% in 2010 to 52.21% in 2016. This result indicates that more joint replacement surgeries have been performed to restore joint function in the elderly. Furthermore, DMARDs and biologic agents effectively reduce inflammatory damage in patients with RA. Similarly, previous studies reported that the age at surgery among patients with RA was gradually increasing, approaching the mean age at surgery among patients with noninflammatory conditions.[11,20,21] A recent study suggested that current RA therapy would allow patients to defer a surgical procedure until an older age.[21]

According to our data, hand or foot joint replacement surgery was only performed on 13 patients; most joint replacement surgeries were performed on large joints, especially in the knee joint. Total knee arthroplasty was the most common arthroplasty type. The frequency of joint replacement surgery was higher for the knee, followed by the hip, ankle, shoulder, and elbow. The frequency of use for hand and foot may be low because the technology for small joint arthroplasty has not been developed yet. In addition, the frequency of small joints such as hand and foot may be low because more resection arthroplasty or fusion procedure is required. The most commonly replaced joints and the most rapidly destroyed joints were different.

The median time from diagnosis of RA to joint replacement surgery in our study was 836 days. The median time according to each joint was shorter for the elbow, followed by the ankle, hip, knee, and shoulder (379 days, 626 days, 764 days, 860 days, and 955 days, respectively). In contrast, the RR of additional joint replacement surgery tended to be higher for the shoulder, followed by the hip, knee, ankle, and elbow. This finding indicates that patients undergoing shoulder joint replacement surgery have a higher risk of requiring additional joint replacement surgery in another joint. This is thought to be due to the fact that shoulder joint destruction is relatively slow; therefore, when shoulder joint replacement surgery is performed, other joints are already damaged, which increases the RR of joint replacement surgery in other joints. Considering these two abovementioned findings, the order of joint destruction could be estimated. Joint destruction is thought to progress faster in the elbow, followed by the ankle, hip, knee, and shoulder. Regular radiographic examinations for large joints should be performed in addition to routine examinations for small joints, such as those of the hand and foot.[22]

This study has several limitations. First, the study had an observation period of only 9 years. Considering the natural history of RA, it may be considered short for a condition that requires continuous treatment throughout the life course. Therefore, it does not reflect the overall natural course of the disease. Further studies with longer follow-up periods will better reflect the natural history of the disease. Second, because our data were based on the KNHI claims database, it is thought that there were multiple codes and data that were missing; additionally, diagnoses were not validated by chart review. Third, in our study, patients over 70 years old who underwent joint replacement surgery were excluded due to the difficulty in distinguishing the exact cause of surgery. As seen in our study, joint replacement surgery according to the progression of RA was common in patients over 70 years old and was expected to increase gradually, but our study did not reflect this trend.

This study showed that the prevalence of RA recently increased in South Korea. Moreover, the incidence of joint replacement surgery also increased in the first 7 years of follow-up. The most frequent site for joint replacement surgery was the knee joint. The median time from diagnosis to surgery according to each joint was shortest for the elbow, followed by the ankle, hip, knee, and shoulder. Regardless of whether patients are symptomatic, evaluation of large joints such as the knee, elbow, ankle, and hip should be considered from an early stage.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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