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## Long-Term Outcome of Hip Arthroplasty in the Setting of Synovial Chondromatosis

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### ABSTRACT

**Background:** Synovial chondromatosis (SC) is a rare disease involving cartilaginous metaplasia of synovial tissue. Treatment via synovectomy and loose body removal alone results in elevated recurrence rates, with up to 1 in 5 patients requiring conversion to a hip arthroplasty. The purpose of this study is to investigate outcomes of hip arthroplasty in the setting of SC, focusing on (1) disease-specific survival, (2) implant survivorship and complications, and (3) clinical outcomes.

**Methods:** We identified 26 patients with histologically confirmed SC who underwent hip arthroplasty between 1970 and 2015. Mean follow-up and patient age were 10 years (range 2–35) and 55 years (range 26–82), respectively. At the time of arthroplasty, 21 (81%) patients had “active” disease and underwent synovectomy. No constrained acetabular components were used. Six patients (23%) had a preoperative flexion contracture.

**Results:** The 15-year disease-free survival was 89%. Recurrence occurred in 3 patients at a mean of 0.8 years (range 0.03–1.2) postoperatively. Thirteen patients (50%) sustained a complication [most commonly aseptic loosening (n = 3, 12%)] and 7 required revision surgery. The 10-year and 15-year revision-free survival was 82% and 64%, respectively. Mean Harris Hip Score improved significantly from 50 (range 23–85) preoperatively to 82 (range 44–100) postoperatively (P < .001).

**Conclusion:** Arthroplasty with simultaneous synovectomy provides reliable pain relief and excellent disease-specific survival at long-term follow-up; however, revision and complication rates were high.

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Synovial chondromatosis (SC) is a rare disease involving cartilaginous, hyperplastic metaplasia of synovial connective tissue, first described by Reichel in 1900 [1–3]. Classification was further subdivided by Milgram [4], proposing 3 stages progressing from active synovial disease without loose bodies, to transitional lesions with both active synovium and loose bodies, to a final stage consisting of multiple loose bodies without evidence of synovial disease. Debate about the sequence of the events, originating from patients’ clinical presentations, led to the classification of primary

and secondary SC [5]. The former arises when diseased synovium produces osteocartilaginous nodules that detach and become loose bodies, while the latter occurs due to chondrocyte shedding in the setting of trauma, osteoarthritis, osteochondritis dissecans, avascular necrosis, or rheumatoid arthritis [5–7]. Patients, more frequently men, typically present in the 3rd–5th decades of life with pain, swelling, and decreased range of motion about the hip or knee [1,2,8]. Due to the vague nature of symptoms, patients often experience lengthy delays to accurate diagnosis which can lead to joint degeneration [9].

Mainstays of treatment for patients with SC of the hip consisted of open or arthroscopic synovectomy (partial or complete), with or without procedures to address chondral damage and labral tears [9–13]. Results with arthroscopic loose body removal suggest that 7%–58% of patients experience disease recurrence, and 1%–20% go on a hip arthroplasty, either a hemiarthroplasty or total hip arthroplasty (THA) at 3–6 years of follow-up [10–13]. There is a paucity of data, however, describing the outcomes of hip arthroplasty of this unique patient population. Studies are limited to case

Investigation performed at the Mayo Clinic, Rochester, Minnesota.

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**Table 1**  
Patient Characteristics.

Demographics	
Male	9
Female	17
Mean age (y)	54.9 (range 26–82)
Mean body mass index (kg/m <sup>2</sup> )	26.0 (range 20.0–34.1)
Disease characteristics	
Active disease	21
No disease at the time of arthroplasty	5
Extra-articular disease	4
Disease recurrence	3
Arthroplasty	
Cemented (5 total hip arthroplasty, 2 hemiarthroplasty)	7
Uncemented THA	9
Hybrid THA	9
Resurfacing	1
Patient function	
Mean preoperative Harris Hip Score	50 (range 23–85)
Mean postoperative Harris Hip Score	82 (range 44–100)

reports or small series with modest follow-up [8,14]. The aim of this study is to determine the long-term (1) disease-free survival, (2) implant survivorship and complications, and (3) clinical and radiographic outcomes of hip arthroplasty in patients with SC.

## Methods

A retrospective review of our institutional Total Joint Registry was performed subsequent to obtaining local Institutional Review Board approval. Patients diagnosed with SC and treated with hip arthroplasty between 1970 and 2015 were included. Initial query identified 28 patients; 2 were lost to follow-up after surgery and thus excluded. Mean follow-up among the remaining 26 patients was 10 years (range 2–35). There were 17 women and 9 men with a mean age of 55 years (range 26–82) and mean body mass index of 26.0 kg/m<sup>2</sup> (range 19–34.1) at the time of surgery. Tissue samples were sent for pathologic confirmation of SC at the time of arthroplasty in all patients. The extent of extra-articular involvement was determined by the treating surgeon and was extracted from operative notes. Disease recurrence was identified when patients presented with recurrent symptoms and had radiographs consistent with the diagnosis of SC.

### Surgical Technique and Prior Surgeries

All arthroplasties were performed by adult reconstructive surgeons at a single institution. The surgical approach utilized was posterior in 11 cases (42%), anterolateral in 10 (38%), trans-trochanteric in 4 (15%), and direct anterior in 1 (4%) (Table 1). Acetabular and femoral component fixation was obtained with hybrid implants (cemented femoral stem) in 10 cases (38%), uncemented implants in 9 (35%), and cemented implants in 7 (23%). There were 2 hemiarthroplasties and 1 metal-on-metal resurfacing arthroplasty in the cohort. No patients required the use of increased constraint. Six patients (23%) had a preoperative flexion contracture. Twenty-one patients (81%) had pathologic confirmation of active SC at the time of arthroplasty, with 4 (15%) having macroscopic extra-articular disease (Fig. 1). The remaining 5 (19%) patients had a history of pathologically confirmed SC and had previously had a surgical procedure to debride the hip.

Ten patients (38%) underwent a minimum of 1 surgical procedure (mean 2, range 1–4) for the treatment of SC prior to arthroplasty. Six patients had a single procedure, while 4 required multiple surgical interventions. Three patients had undergone surgical hip dislocation to facilitate complete synovectomy, 2 had

prior ipsilateral arthroplasties (1 THA, 1 bipolar hemiarthroplasty), and 1 underwent partial synovectomy and loose body removal without dislocation. Among those necessitating multiple surgeries, 2 patients underwent surgical hip dislocation with complete synovectomy and later required trochanteric hardware removal. One patient initially underwent arthrotomy with loose body removal and subsequently required surgical hip dislocation with cheilectomy of femoral osteophytes. The final patient necessitated 4 procedures including surgical hip dislocation, hardware removal, labral repair, and osteochondral autograft transplantation to the femoral head.

### Clinical Outcomes

Clinical and radiographic follow-up was obtained at 3 months, 6 months, 1 year, 2 years, and every 5 years thereafter according to institutional protocol. A standardized patient questionnaire is administered to all patients undergoing total joint arthroplasty and is used to determine Harris Hip Scores (HHS) preoperatively and at latest follow-up [15].

### Statistical Methods

Survivorship curves at 5, 10, and 15 years were produced using the Kaplan-Meier method [16]. Electronic medical records and diagnostic codes were reviewed to ascertain revision, reoperation, and complication data. Preoperative scores were compared to data obtained at the latest follow-up to determine the difference in HHS for all patients; those who experienced death, revision, or reoperation were censored at the visit prior to the event. All statistical tests were 2-sided and a *P* value < .05 was considered significant.

## Results

### Disease-Specific Survival

Survivorship free from symptomatic disease recurrence was 89% at 5, 10, and 15 years (Fig. 2). All 3 patients who experienced recurrence were diagnosed within 14 months of arthroplasty. One patient had return of pain 12 months postoperatively and required synovectomy in addition to trochanteric bursectomy. A second patient was diagnosed with recurrent disease after a fall 14 months postoperatively and was treated conservatively with physical therapy and stretching modalities. The final patient initially presented with intrapelvic disease recurrence and underwent resection with revision from bipolar hemiarthroplasty to THA; unfortunately, tissue samples collected at the time of revision later demonstrated conversion of SC to chondrosarcoma. Therefore, 9 days after revision, external hemipelvectomy was performed. This was the only amputation in the cohort, resulting in an overall limb salvage rate of 97% at 35 years. Due to this solitary case of chondrosarcoma arising in the setting of SC, the conversion rate in our series was 3%.

### Survivorship, Revisions, and Complications

The overall 5-year, 10-year, and 15-year survivorship free from any revision was 96%, 82%, and 64%, respectively (Fig. 3). Thirteen patients (50%) experienced at least one complication during the study period; 7 (27%) of which resulted in revision at a mean of 11 years postoperatively (range 3–16). One patient required revision at 16 years; however, survivorship analysis was terminated prior to this point due to censor-induced variability in the statistical model at long-term follow-up. Reasons for revision included aseptic loosening (*n* = 3; 2 acetabular, 1 femoral), conversion from hemiarthroplasty to

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