

# Arthroscopic management of elbow synovial chondromatosis

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## Abstract

**Objective:** We aimed to identify factors that affect pain, complications, and function following elbow arthroscopy for elbow synovial chondromatosis.

**Methods:** We retrospectively reviewed the cases of all patients with elbow synovial chondromatosis treated by arthroscopic synovectomy and loose body removal between January 2000 and January 2016 at our institution. Eleven patients were enrolled (8 male; mean age, 41.7 years). The mean duration of symptoms was 13.7 months, and all patients had a decreased range of motion (ROM) in the affected elbow. By Milgram criteria, there was 1 phase II case, and 10 cases were phase III.

**Results:** All patients were followed postoperatively (mean follow-up, 65 months). The preoperatively restricted ROM of 100° flexion (range, 78°–120°) and extension of 30° (range, 15°–40°) were improved to 130° flexion (range, 120°–140°) and –5° hyperextension (range, –10°–0°). Pain, recorded as the pain subscore of the American Shoulder and Elbow Surgeons questionnaire for elbows, was significantly improved from 32 points (range, 20–50) preoperatively to 85 (range, 70–100) postoperatively (on a scale ranging from 0 [worst pain] to 100 [pain-free]). Recurrence occurred in 2 patients (18.2%) who then received arthroscopic synovectomy and loose body removal again. There were no fractures or neurovascular complications, and no patient developed an infection.

**Conclusion:** Arthroscopic management of synovial chondromatosis of the elbow was an effective and safe therapeutic method. After the intervention, immediate and durable improvement of elbow function can be expected.

**Abbreviations:** ASES = American Shoulder and Elbow Surgeons, DASH = Disabilities of the Arm, Shoulder, and Hand, mASES = modified American Shoulder and Elbow Surgeons questionnaire for elbows, MCS = menal component summary, MRI = magnetic resonance imaging, PCS = physical component summary, ROM = range of motion, SF-36 = short form 36, VAS = visual analog scale.

**Keywords:** arthroscopic management, elbow function, synovial chondromatosis

## 1. Introduction

Synovial chondromatosis is a rare benign proliferative condition with metaplasia of the synovial membrane resulting in a monoarticular arthropathy characterized by newly formed foci of cartilage.<sup>[1]</sup> The disease usually occurs between the third and

fifth decades of life and is 2 times more common in males than in females.<sup>[2]</sup> Synovial chondromatosis can involve any joint, but the vast majority of cases involve the knee, followed by the hip, elbow, wrist, ankle, and shoulder. This defect can also be found in the extra-articular bursae and tendon sheaths in the extremities.<sup>[3–6]</sup> The early clinical manifestations are often insidious, and the diagnosis is commonly delayed for several months to years. Both open and arthroscopic synovectomy and removal of loose bodies have been performed.<sup>[20]</sup> It should be noted that the risk of postoperative recurrence and malignant transformation after surgery has been reported.<sup>[8]</sup>

The first case of synovial chondromatosis in the elbow was reported by Henderson in 1918.<sup>[2]</sup> Recently, there have been a few articles documenting synovial chondromatosis of the elbow chiefly focusing on pathogenesis, radiological findings, and surgical results (Table 1).<sup>[4,12–21]</sup> Synovectomy and removal of loose bodies in the patients with elbow synovial chondromatosis may delay the progression of elbow degenerative changes.<sup>[4]</sup>

In this study, we retrospectively reviewed cases of elbow synovial chondromatosis treated with arthroscopic synovectomy and loose body removal at our institution to identify factors that affect pain, complications, and function following elbow arthroscopy.

## 2. Methods

We retrospectively enrolled all patients with elbow synovial chondromatosis treated by arthroscopic synovectomy and loose body removal at our institution between January 2000 and

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*Ethics and consent to participate:* This study was approved by the 2nd Xiangya Hospital of Central South University Committee for Clinical Research—reference number 2012-S231 and conducted in accordance with the Declaration of Helsinki. All participants provided informed consent to participate in this study. All methods were performed in accordance with the relevant guidelines and regulations.

*Availability of data and materials:* The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

The authors have no conflicts of interest to disclose.

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**Table 1****Well-documented cases with synovial chondromatosis of the elbow in the English literature.**

Study	Number	Mean age range (y)	Sex (M/F)	Side (R/L)	Treatment	Mean follow-up range (y)	Recurrence	Malignancy	Matastasis
Kamineni et al	12	39 (14–58)	10/2	6/ 6	Open or arthroscopic synovectomy/loose body removal	8.2 (2–15).	5/12	–	NR
Mueller et al	12	29.6 (19–50)	10/2	10/2	Open or arthroscopic synovectomy/loose body removal	16.8 (1.25–36.3)	0/12	–	NR
Flury et al	24	45 (22–77)	15/4	13/6	Open or arthroscopic synovectomy/loose body removal	4.67 (1–14.67)	0/19		NR
De Smet	1	35	1/0	0/1	Open synovectomy/loose body removal	0.75	NR	NR	NR
Narasimhan et al	1	11	0/1	0/1	Arthroscopic synovectomy/loose body removal	2	1	–	NR
Sachinis et al	1	38	0/1	0/1	Open synovectomy/loose body removal, radiotherapy, athroplasty, revision after athroplasty	7	1/1	+	+

NR = not reported.

January 2016. Demographic and clinical features were recorded for each. Preoperatively, all patients reported their level of pain using a visual analog scale (VAS) ranging from 0 (maximum pain) to 10 (pain-free). All cases were staged according to Milgram criteria. Magnetic resonance imaging (MRI) was used in all patients to evaluate joint effusion, synovial thickening, and free bodies. Preoperative X-rays were obtained to identify radiopaque loose bodies and signs of osteoarthritis. Cases of osteoarthritis were graded according to the criteria of Kamineni et al.<sup>[4]</sup>

After arthroscopic synovectomy and loose body removal, prophylactic anti-inflammatory treatment (celecoxib, 200 mg, daily [Celebrex, Pfizer Inc, New York City, NY]) was provided to all patients. Physiotherapy was started on the second postoperative day.

Postoperatively, patients were subjectively and objectively evaluated using the modified American Shoulder and Elbow Surgeons questionnaire for elbows (mASES), Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, and short form 36 (SF-36). Pain, function, and degree of satisfaction with the operation are factors included as subscores in the mASES score (for each, 100 is the maximum and 0 is the minimum). The preoperative VAS pain scale (where 0 indicates maximum pain and 10 indicates pain-free) was normalized to a scale of 0 to 100 (American Shoulder and Elbow Surgeons [ASES] scale) to allow scores to be compared. For example, a pain level of 3 on the preoperative VAS corresponded to a pain level of 30 on the ASES scale. The DASH score, which is a self-assessment score, was inverted and given a maximum of 100 and a minimum of 0. On the SF-36, the mental component summary (MCS) and the physical component summary (PCS) were recorded. The cohort DASH and SF-36 scores were compared with corresponding scores of a normal group of patients after correction for pre-existing comorbidities. Postoperative patient evaluations were performed at 6 weeks, 3 months, 6 months, and 1 year, and then annually (Fig. 1).

This study was approved by the Second Xiangya Hospital committee for clinical research (NO. 2000-S231). Informed consent for treatment and publication of individual clinical details and images was obtained from all patients participating in the study.

### 3. Statistical analysis

Statistical significance between the pre- and postoperation was evaluated using Student *t* test. A *P* value < .05 was considered to be significant.

### 4. Results

During the study period, 11 patients (8 male; mean age, 41.7 years [range, 27–51]) with elbow synovial chondromatosis were treated by arthroscopic synovectomy and loose body removal. The right elbow was involved in 7 patients and the left in 4. All patients had chronic elbow swelling, pain, and functional disorder without evidence of infection such as fever or sinus formation. The mean duration of symptoms was 13.7 months (range, 5–17). All patients received follow-up (mean follow-up, 65 months [range, 16–103]).

The patients showed a decreased elbow range of motion (ROM) (Table 2). The preoperatively restricted ROM of 100° flexion (range, 78°–120°) and extension of 30° (range, 15°–40°) improved to 130° flexion (range, 120°–140°) and –5° hyperextension (range, –10°–0°) at the latest follow-up (*P* < .05). Pronation and supination were not substantially restricted preoperatively and were not influenced by the operation.

The mean preoperative VAS score was 3.2 (range, 2–5). The pain subscore of the ASES improved from 32 points (range, 20–50) preoperatively to 85 points (range, 70–100) postoperatively, indicating significant pain reduction (*P* < .05).

According to Milgram criteria, there was 1 phase II case and 10 cases were phase III. According to the osteoarthritis criteria of Kamineni et al, there were only 5 cases of mild osteoarthritis. Postoperatively, the mean DASH score was 93 points (range, 67–100). Postoperatively, the mean SF-36 PCS score was 51 points (range, 34–60), and the mean MCS score was 52 points (range, 42–68). These results did not change throughout the postoperative follow-up period.

Elbow synovial chondromatosis recurred in 2 patients (18.2%) after arthroscopic synovectomy and loose body removal. There were no fractures, neurovascular complications, or infections after surgery.

### 5. Discussion

Synovial chondromatosis is characterized by a benign synovial proliferation that leads to the formation of chondral or osteochondral foci. The disease may be self-limiting and is classified as either primary or secondary. Primary synovial chondromatosis results from a proliferation of chondrocytes in the synovial membrane, leading to the formation of cartilaginous loose bodies. Secondary synovial chondromatosis is a rare condition characterized by the growth of particles separated from the articular cartilage or osteophytes in joint diseases.<sup>[7]</sup> Synovial chondromatosis has been reported in 33 different locations in the



**Figure 1.** A, An X-ray demonstrates many oval-shaped calcifications but no degenerative change in a patient with synovial chondromatosis. B, T2-weighted coronal, sagittal, and axial magnetic resonance images show an obvious joint effusion, synovial thickening, and multiple free bodies in a patient with synovial chondromatosis. C, An arthroscopic image shows multiple small and large free fragments filling the joint space in a patient with synovial chondromatosis; free bodies removed; pathologic analysis reveals no evidence of malignancy and the findings are consistent with synovial chondromatosis (C). D, An X-ray shows no recurrence of loose bodies and bone erosions in a patient with synovial chondromatosis 12 months after arthroscopic synovectomy and loose body removal.

body and can also occur in children.<sup>[8]</sup> Milgram described 30 cases of synovial chondromatosis and identified 3 distinct stages: phase I is active synovitis without loose bodies, phase II shows nodular synovitis along with loose bodies, and phase III is characterized by the presence of loose bodies with the resolution of synovitis.<sup>[10]</sup> In our study, there was 1 phase II case, and 10 were phase III cases. Recently, clonal karyotypic abnormalities have been reported in chromosome 6 in patients with synovial chondromatosis, suggesting a neoplastic origin.<sup>[11]</sup>

The definitive diagnosis of synovial chondromatosis of the elbow joint requires a comprehensive medical history, physical

examination, radiographic investigation, and pathological evidence. Typical clinical findings include loss of range of motion and joint snapping and locking.<sup>[4,15]</sup> However, cubital bursitis, ulnar nerve palsy, and posterior interosseous nerve palsy are not infrequent signs, owing to the close relationship between the joint capsule and surrounding nerves.<sup>[16-18]</sup> It is also noteworthy that synovial chondromatosis can present as a soft tissue tumor.<sup>[19]</sup> The definitive diagnosis of loose bodies observed on plain radiographs can be difficult. Therefore, MRI has been recommended as more reliable and accurate than other studies. A thorough radiological examination is essential for the diagnosis

and surgery planning. The differential diagnoses should include synovial chondrosarcoma, osteochondritis dissecans, calcifying aponeurotic fibroma, hydroxyapatite deposition, pigmented villonodular synovitis, elbow tuberculosis, and rheumatoid arthritis.<sup>[22–23]</sup>

Either conservative treatment or surgery can be used to treat synovial chondromatosis of the elbow. Pain relief can be achieved by nonsurgical therapy in phase I (nonsteroidal anti-inflammatory medications and corticosteroid injection). Surgical treatment has been recommended as the first choice of therapy in phases II and III by most authorities. Kamineni et al presented the cases of 12 patients with synovial chondromatosis of the elbow treated by synovectomy and compared the clinical features of primary and secondary synovial chondromatosis.<sup>[4]</sup> Flury et al<sup>[20]</sup> reported that both arthroscopic and open techniques could give a satisfactory result, but the arthroscopic approach has many advantages, including a shorter rehabilitation period and higher patient satisfaction. However, in most primary hospitals in China, elbow arthroscopy is still in a preliminary stage and cannot be a therapeutic choice.

The postoperative recurrence rate of synovial chondromatosis varies according to several studies.<sup>[24–26]</sup> Disease recurrence is usually caused by incomplete synovectomy or removal of free bodies. de Sa et al<sup>[24]</sup> reported 197 cases of synovial chondromatosis of the hip treated by hip arthroscopy and found a recurrence rate of 7.1% (14/197). Galat et al<sup>[25]</sup> reported 8 cases of synovial chondromatosis of the foot and ankle and found a recurrence in 3 (37.5%) patients and subsequent malignant transformation in 2. McCarthy et al<sup>[26]</sup> reviewed 155 cases of primary synovial chondromatosis and identified 4 with locally aggressive neoplastic behavior and chondrosarcoma-like histology. Sachinis et al reported the rare case of elbow chondrosarcoma secondary to synovial chondromatosis. The patient underwent multiple operations and ultimately received a custom-made elbow arthroplasty.<sup>[21]</sup> In our study, recurrence occurred in 2 of 11 cases, which is comparable with the recurrence rate reported by others. Importantly, recurrence implies a greater chance of malignant transformation to chondrosarcoma. The possibility of malignant transformation also needs to be considered when a periosteal reaction and cortical erosion are observed in a case of synovial chondromatosis, although this outcome is rare. A recent report indicates that radiotherapy is a beneficial treatment for recurrent lesions and fibroblast growth factor-9 is a potential therapeutic target in cases of primary synovial chondromatosis.<sup>[27]</sup>

The mean follow-up in the cases we have reported was 65 months, and the patients remained free from pain and showed no signs of recurrence throughout this period. Arthroscopic synovectomy with the removal of loose bodies was a good treatment for our patients with synovial chondromatosis of the elbow and has many advantages over traditional open approaches. Further observation of the patients is necessary to identify the long-term incidence of recurrence and malignant transformation.

The weaknesses of our study are the absence of a control group and our small number of patients. Nevertheless, the present study described a successful alternative technique for the treatment of the challenging problem of elbow synovial chondromatosis.

In conclusion, arthroscopic synovectomy was a safe and effective treatment for synovial chondromatosis of the elbow. After the intervention, immediate and durable improvement of elbow function can be expected.

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## Author contributions

**Investigation:** Xinzhan Mao.

**Writing – original draft:** Weihong Zhu.

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