Arthroscopic Management of Synovial Osteochondromatosis of the Elbow

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Abstract: Primary synovial chondromatosis is characterized by newly formed chondral or osteochondral nodules in the synovial membrane, which may detach and form loose bodies. The loose bodies can be calcified or ossified, and the condition is termed synovial osteochondromatosis. Three distinct stages can be identified in primary synovial chondromatosis: 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. Surgical treatment has been recommended as the first choice of therapy in phases II and III disease. Complete synovectomy and removal of all loose bodies is advisable for prevention of recurrence of the disease. In this technical note, the technical details of arthroscopic removal of loose bodies and synovectomy for the management of synovial osteochondromatosis of the elbow is described.

Compared with open procedures, the arthroscopic approach has many advantages, including a shorter rehabilitation period and higher patient satisfaction.

Primary synovial chondromatosis (PSC) is a rare, benign proliferative pathologic condition with benign metaplasia of the synovial membrane that affects the fibroblasts of the synovial joints, tendons, and bursas.1-3 It is characterized by proliferation of chondrocytes and newly formed chondral or osteochondral nodules in the synovial membrane.3 These nodules may detach and form loose bodies.4 The loose bodies can be calcified or ossified, and the condition is termed synovial osteochondromatosis. Recently, clonal karyotypic abnormalities have been reported in chromosome 6 in patients with synovial chondromatosis, suggesting a neoplastic origin.4 PSC can affect any joint, but the great majority of the cases involve the knee. The elbow is the most affected joint in the upper limbs.2 Because the dominant elbow is more commonly involved, biomechanical stress might be a causal factor in PSC in the elbow.7 Three distinct stages can be identified in PSC: 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.5 The early clinical manifestations are often insidious, and the diagnosis is commonly delayed for several months to years.1

Symptoms of synovial chondromatosis can be grouped as inflammatory, mechanical, and due to pressure effects.3 Sudden onset of severe loss of elbow extension and flexion range of motion can occur as caused by mechanical block from deposition of chondral fragments in the olecranon and coronoid fossae, respectively and this is always associated with severe pain.6 The pressure effects of an increasing volume of synovium together with the development of loose bodies can by itself cause intrusive pain.3 Neurologic symptoms also may develop due to the pressure effects on adjacent nerves, particularly the ulnar nerve, although lesions of the posterior interosseous and median nerves have been reported.3

Differential diagnoses include other conditions in which inflammation of the synovial membrane and loose body formation occur (secondary synovial chondromatosis), e.g., osteoarthritis, trauma, and osteochondritis...
Secondary synovial chondromatosis is a rare condition characterized by the growth of particles separated from the articular cartilage or osteophytes in joint diseases. The other differential diagnoses should include synovial chondrosarcoma, calcifying aponeurotic fibroma, hydroxyapatite deposition, pigmented villonodular synovitis, elbow tuberculosis, and rheumatoid arthritis.

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. Both arthroscopic and open synovectomy and removal of loose bodies could give a satisfactory result, but the arthroscopic approach has many advantages, including a shorter rehabilitation period and greater patient satisfaction.

The purpose of this technical note is to describe the details of arthroscopic synovectomy and removal of loose bodies for management of synovial osteochondromatosis of the elbow. It is indicated for phases II and III diseases especially when associated with painful locking symptoms. The development of neurologic symptoms also is indicated for surgical treatment.

Patients with mild, tolerable symptoms and just worry about the risk of malignant transformation, which is extremely rare.

The development of neurologic symptoms.

Increasing limitation of elbow movement due to progression of associated degenerative changes is a relative indication for surgical treatment.

Table 1. Indications and Contraindications of Arthroscopic Management of Synovial Osteochondromatosis of the Elbow

| Phases II and III diseases, especially when associated with painful locking symptoms. | Patients with mild, tolerable symptoms and just worry about the risk of malignant transformation, which is extremely rare.

Table 1. Indications and Contraindications of Arthroscopic Management of Synovial Osteochondromatosis of the Elbow

| Indications                                                                 | Contraindications                                                                 |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Phases II and III diseases, especially when associated with painful locking symptoms. | Patients with mild, tolerable symptoms and just worry about the risk of malignant transformation, which is extremely rare. |
| The development of neurologic symptoms.                                     |                                                                                 |
| Increasing limitation of elbow movement due to progression of associated degenerative changes is a relative indication for surgical treatment. |                                                                                 |

Surgical Technique (With Video Illustration)

Preoperative Planning and Patient Positioning

The definitive diagnosis of synovial chondromatosis of the elbow joint requires a comprehensive medical history, physical examination, radiographic investigation, and pathologic evidence.

Preoperative radiographs are useful to identify radiopaque loose bodies and signs of osteoarthritis (Fig 1). The characteristic radiologic appearance of PSC in the elbow is of a “nest-like” arrangement of round or oval radiopacities demonstrating a finally stippled appearance due to patchy calcification and are more usually confined to the anterior compartment of the elbow joint. Magnetic resonance imaging is used to evaluate joint effusion, synovial thickening, and free bodies.

The patient is in prone position with an arm support to keep the shoulder 90° abduction and elbow 90° flexion. An ipsilateral arm tourniquet is used to provide a bloodless surgical field. Fluid inflow is driven by gravity and an arthro-pump is not used. A 4.0-mm, 30° arthroscope (DYONICS; Smith & Nephew, Andover, MA) is used for this procedure.

Portal Placement

The procedure is performed via the posterolateral, posterocentral, soft spot, proximal medial, and anterolateral portals. The posterocentral portal is at the midline between the humeral epicondyles and over the triceps. The posterolateral portal is at the same level as the posterocentral portal and at the lateral edge of the triceps muscle. The soft spot portal is located at the soft spot between the radial head, olecranon process, and lateral humeral epicondyle. The proximal medial portal is 2 cm proximal to the medial humeral epicondyle and just anterior to the intermuscular septum. The anterolateral portal is established by inside out technique with the Wissinger rod passes through the proximal medial portal and pierces the capsule at the point just proximal and anterior to the radial head.

Fig 1. Arthroscopic management of synovial osteochondromatosis of the right elbow. The patient is in prone position. Radiographs of the elbow of the illustrated cases showed the loose bodies (LB).
The medial and lateral humeral epicondyles, olecranon process, radial head, and the biceps are outlined with skin markers. The ulnar nerve is palpated and confirmed that it is not subluxated and has not been previously transposed.

**Posterior Compartment Arthroscopy**

The elbow joint is filled by injecting normal saline via the soft spot between the lateral humeral epicondyle, olecranon process, and radial head. A skin incision is made at the posterolateral portal and the subcutaneous tissue is bluntly dissected down to the lateral edge of the posterior capsule. The capsule is then pierced with the trocar-cannula (DYONICS; Smith & Nephew). The trocar is removed and the proper intra-articular positioning of the cannula is confirmed by drainage out of normal saline via the cannula. The arthroscope is then inserted into the cannula. A needle is inserted into the elbow joint via the posterocentral portal site. Proper intra-articular positioning of the needle is confirmed arthroscopically. A stab incision is made at the posterocentral portal down to the elbow joint to create the posterocentral portal.

The posterolateral portal is the viewing portal and the posterocentral portal is the working portal (Fig 2). The loose bodies are removed with a hemostat, starting from small ones and then the large ones (Fig 3). This can avoid excessive extravasation as the capsular incision is needed to be enlarged for removal of the large loose bodies. This follows by complete synovectomy of the posterior compartment using an arthroscopic shaver (DYONICS; Smith & Nephew). During this step, the adherent bodies can be identified and removed.

During synovectomy of the posteromedial gutter, it is important to have the shaver blade facing away from the capsule and using minimal suction (Fig 4). Synovectomy should be done under strict arthroscopic supervision to avoid ulnar nerve injury. The portals can be switched for completion of synovectomy.
Lateral Compartment Arthroscopy

The posterolateral portal is the viewing portal. A needle is inserted via the soft spot portal and the proper intra-articular positioning of the needle is confirmed arthroscopically. A skin incision is then made at the soft spot portal and the subcutaneous tissue is bluntly dissected with a hemostat. The capsule is pierced by the tip of the hemostat. The soft spot portal is then created and serves as a working portal (Fig 5). The loose bodies are removed with a hemostat and synovectomy is performed. To achieve complete synovectomy, the synovial recess deep to the annular ligament is debrided (Fig 6).

Anterior Compartment Arthroscopy

The proximal medial and the anterolateral portals are interchangeable as the viewing and working portals. A skin incision is made at the proximal medial portal and the subcutaneous tissue is bluntly dissected with a hemostat till the medial intermuscular septum is felt. The deep fascia is pierced with the hemostat and the blunt dissection is continued at the anterior surface of the septum and the distal humerus towards the radial head until the medial edge of anterior capsule is reached. The capsule is pierced by the trocar-cannula via the proximal medial portal. The trocar is then replaced by the arthroscope and the arthroscope is advanced laterally to the point just anterior and proximal to the radial head. Leaving the cannula in situ, the arthroscope is replaced by a Wissinger rod. The capsule is pierced by the tip of the rod. A skin incision is made over the tip of
the rod and the anterolateral portal is created. The rod is further advanced to pass through both portals and the cannula is switched to the anterolateral portal. The rod is removed and the arthroscope is inserted into the cannula. With the anterolateral portal as the viewing portal, the loose bodies are removed with a hemostat via the proximal medial portal. The large adherent body can be cut into smaller ones before removal (Fig 7).

Synovectomy of the medial part of the anterior compartment is performed. After that, the portals can be switched by the Wissinger rod technique. With the proximal medial portal as the viewing portal and the anterolateral portal as the working portal, the loose bodies at the lateral part of the anterior compartment can be removed and synovectomy of lateral part of the anterior compartment can be performed (Fig 8, Video 1, Table 2).

Additional procedures including capsulectomy and cheilectomy of the olecranon and coronoid processes and fossae can then be performed in patients with osteoarthritis to improve the range of movement and relieve the impingement pain. After the operation, the wounds are closed with simple sutures and elbow mobilization is started on the second postoperative day.

**Discussion**

PSC of the elbow frequently leads to secondary osteoarthritis that deteriorates over time. Removal of loose bodies and synovectomy at early phase of the disease may prevent the occurrence of secondary osteoarthritis.

In the literature, recurrence of this disease after surgical treatment of PSC has been reported in up to 22% of the cases. The cause is generally attributed to incomplete synovectomy or removal of free bodies. It is believed that recurrence implies that there is a greater chance of malignant transformation to chondrosarcoma. Complete removal of all of the involved synovium is advisable in patients with PSC as this is likely to reduce the risk of future recurrent loose body formation. Although intraoperative appearances as usually presenting a local nest-like arrangement of synovitis and a varying number of loose or adherent bodies and general synovitis of the elbow joint is not a feature of PSC, arthroscopy of all compartments of the

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**Table 2. Pearls and Pitfalls of Arthroscopic Management of Synovial Osteochondromatosis of the Elbow**

| Pearls | Pitfalls |
|--------|----------|
| Small loose bodies should be removed before removal of the large ones. | Using the medial portals in case of ulnar subluxation can cause ulnar nerve injury. |
| Suctioning via the arthroscopic shaver can suck the loose bodies towards the shaver. | The loose body should be firmly grasped before removal to avoid dropping of the loose body in the subcutaneous tissue. |
| The synovium should be checked for any adherent bodies. | |
| Large loose body can be cut into small pieces before removal. | |
| Debridement of the synovial recess deep to the annular ligament is necessary for complete synovectomy. | |
| The shaver should not be inserted too deep into the synovial recess to avoid injury to the interosseous nerve at the level of radial neck. | |
| Synovectomy at the posteromedial gutter should be done under strict arthroscopic supervision and the suction should be kept to a minimal and the shaver blade should face away from the capsule. | |

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**Table 3. Advantages and Risks of Arthroscopic Management of Synovial Osteochondromatosis of the Elbow**

| Advantages | Risks |
|-----------|-------|
| Less soft-tissue trauma | Ulnar, median, or radial nerve injury |
| Better cosmetic result | Incomplete synovectomy and recurrence of the disease |
| Fewer wound complications | Residual loose bodies |
| | Compartment syndrome of forearm due to excessive extravasation |
| | Triceps tendon injury |
| | Damage of the articular cartilage |

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**Fig 8. Arthroscopic management of synovial osteochondromatosis of the right elbow.** The patient is in the prone position. Anterior compartment arthroscopy is performed with the proximal medial portal as the viewing portal and the anterolateral portal as the working portal. Synovectomy is performed with an arthroscopic shaver. (AS, arthroscopic shaver; C, capitellum; IS, inflamed synovium; LB, loose body.) The synovium should be checked for any adherent bodies. Large loose body can be cut into small pieces before removal. Debridement of the synovial recess deep to the annular ligament is necessary for complete synovectomy. The shaver should not be inserted too deep into the synovial recess to avoid injury to the interosseous nerve at the level of radial neck. Synovectomy at the posteromedial gutter should be done under strict arthroscopic supervision and the suction should be kept to a minimal and the shaver blade should face away from the capsule.
involved elbow are still advisable to achieve complete synovectomy and removal of all loose bodies.

This minimally invasive technique has the advantage of less soft-tissue trauma, better cosmetic result, and fewer wound complications. The potential risks of this technique include nerve injury (ulnar, median or radial nerves), incomplete synovectomy and recurrence of the disease, residual loose bodies, compartment syndrome of forearm due to excessive extravasation, triceps tendon injury, and damage of the articular cartilage (Table 3). This is not technically demanding and can be attempted by average elbow arthroscopists.

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