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ORIGINAL PAPER

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Arthroscopic synovectomy in haemophilic arthropathy of the knee

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Abstract From January 1996 to January 2001, arthroscopic synovectomies were performed in 28 knees with haemophilic arthropathy. The mean follow-up period was 5 years and 11 months. Six portals (two anterior, two suprapatellar, two posterior) and a posterior trans-septal portal were used in all cases. The average Hospital for Special Surgery (HSS) knee score increased from 56.4 to 71.5 points at the last follow-up. The average frequency of haemarthrosis reduced from five times per month before operation to once per month. The amount of factor replacement decreased from a mean of 4,633 U to 1,505 U. Progression of arthritis was observed radiographically in three cases at the last follow-up. An arthroscopic synovectomy of the knee using appropriate arthroscopic portals is a useful method in treating haemophilic patients as it decreases bleeding episodes, amount of factor replacement and knee pain.

Résumé De janvier 1996 à janvier 2001, des synovectomies arthroscopiques ont été exécutées dans 28 genoux avec une arthropathie hémophilique. Le suivi moyen était 5 années et 11 mois. Six abords (deux antérieurs, deux suprarotuliens, deux postérieurs) et un abord trans-septal postérieur ont été utilisé dans tous les cas. Le score moyen du genou de l'Hôpital pour Chirurgie Spéciale (HSS) a augmenté de 56,4 à 71,5 points au dernier examen. La fréquence moyenne d'hémarthrose s'est réduite de cinq fois par mois avant l'opération à une fois par mois aprés. La quantité moyenne de remplacement de facteur a diminué de 4,633 à 1,505 unités. Dans l'évaluation radiographique, la progression de l'arthrite a été observée dans trois cas au dernier suivi. Une synovectomie arthroscopique du genou qui utilise des abords arthroscopiques appropriés est une méthode utile pour traiter les malades hémophiliques, diminuant les épisodes de saignement, la quantité de facteur et les douleurs du genou.

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Introduction

Haemarthrosis is the most common and most disabling manifestation of haemophilia and leads to haemophilic arthropathy, capsular fibrosis and joint contracture. In particular, chronic haemophilic arthropathy of the knee causes synovitis, cartilage destruction, epiphyseal overgrowth and fibrosis of the periarticular structures.

In the early stage of joint involvement, a person with haemophilia experiences recurrent haemarthroses caused by hypertrophic synovitis. To control recurrent episodes, prophylactic management may be necessary, giving frequent factor replacement in sufficient dosage to prevent breakthrough bleeding [18]. However, synovectomy may still be necessary in joints that have not responded to prophylactic management. For a long time, open synovectomy has been the standard operative treatment [14]. However, excessive loss of motion following an open synovectomy has stimulated a need for alternative techniques. Against this background, arthroscopic synovectomy has been proposed as an effective means of controlling bleeding episodes without loss of motion [19]. But the arthroscopic approach, especially into the posterior compartment, may be difficult in haemophiliac patients due to bony deformity, osteophytes and soft-tissue contracture, and incomplete synovectomy may result. The trans-septal portal [1] was used to overcome the technical difficulties that are compounded by the extensive synovial villi that fill the joint space in haemophilic synovitis. Our hypothesis was that an arthroscopic synovectomy of the haemophilic knee could be completed using six portals and the posterior trans-septal portal. The purpose of this study was to evaluate the clinical and radiological results after arthroscopic synovectomy using this approach in haemophilic knees with recurrent haemarthroses.

Materials and methods

A total of 28 knees in 26 patients underwent arthroscopic synovectomies between January 1996 and January 2001. In our series, the indication for synovectomy was recurrent bleeding with sub-acute or early chronic synovitis that did not respond to extensive medical management, including prophylactic coagulation factor replacement, physical therapy and activity modification. Additional indications included rapid deterioration of joint function or chronic pain in advanced arthropathy (stage III or IV). All patients were male, and the mean follow-up period was 5 years and 11 months (range 3 years and 6 month to 8 years and 7 months). Mean patient age at the time of surgery was 17.8 (range 8–37) years. Twenty-five patients had haemophilia A (factor VIII deficiency), and one had haemophilia B (factor IX deficiency). The level of factor VIII was severe (less than 1%) in eight patients, moderately severe (1–5%) in 17 patients and mild (over 5%) in three patients. The mean frequency of haemarthrosis was five times per month, with a range of three to 12 times a month. The average amount of factor required to control bleeding episodes was 4,633 U (range 750–14,000 U). Radiographic staging was based on the classification of Arnold and Hilgartner [2]. In stage I, there are no skeletal abnormalities, only soft-tissue swelling about the joint. Stage II is characterised by osteoporosis and overgrowth of the epiphyseal regions of the joint. The subchondral bone remains intact, and the cartilage space is preserved. In stage III, there is evidence of subchondral cyst formation; however, the cartilage space remains intact, with only minimal narrowing. In stage IV, all of the changes noted previously are more pronounced, with subchondral bone disorganisation, and significant narrowing of the cartilage space is evident. Stage V, the end stage, is characterised by loss of cartilage space and marked destruction of joint surfaces. The stage of knee-joint involvement in our study was classified radiographically as stage II in four knees, stage III in 18 knees and stage IV in six knees. Sixteen patients were hepatitis C positive, and two patients were hepatitis B positive while no patient was HIV positive.

Haematological management

Before surgery, all patients were tested for CBC (complete blood count), PTT (partial thromboplastin time), PT (prothrombin time), factor level and inhibitors. None had inhibitors. On the day before surgery, 50 U of factor VIII (65 U for factor IX) were injected per kilogram of body weight. Immediately before surgery, a coagulation test was performed and, if required, additional units of factor VIII or IX were given to ensure factor activity of 100% during surgery. Factor concentration was kept at 100% until the second post-operative day, over 50% until the seventh post-operative day, and over 20% until the 14th post-operative day. As the half-life of factor VIII and factor IX was 8 and 12 h, respectively, factor VIII was administered three times a day whereas factor IX was given twice a day.

Operative procedures and post-operative care

An arthroscopic synovectomy was carried out with a tourniquet under general anaesthesia. Initially, a routine arthroscopic examination of the knee joint is performed to evaluate the synovium through anterolateral, anteromedial, lateral suprapatellar and medial suprapatellar portals. The arthroscope was passed from the anterolateral portal to the posteromedial compartment through the intercondylar notch, and then the posteromedial portal was made with direct arthroscopic visualisation. To create the trans-septal portal, a posteromedial approach of the arthroscope was made, and a motorised shaver was inserted through the anteromedial portal and towards the posteromedial compartment through the intercondylar notch. Without disrupting the PCL bundle, a small hole was made in the central portion of the posterior septum behind the PCL using the shaver. The arthroscope could then reach the posterolateral compartment through the small hole (posterior trans-septal portal). Thus, the posterolateral portal could be made with direct arthroscopic visualisation (Fig. 1). The most extensive synovectomy possible, including the posterior compartment, was per-

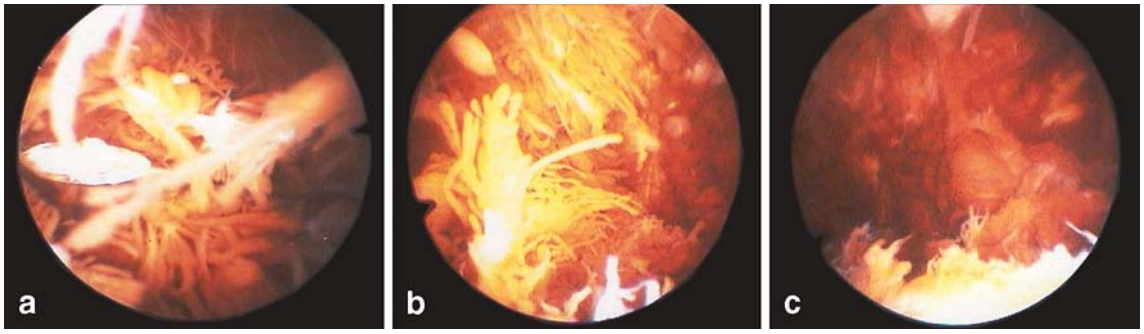

Fig. 1 Pre-operative arthroscopic pictures: **a** posteromedial compartment through the anterolateral portal, **b** posterolateral compartment through the anteromedial portal, **c** suprapatellar pouch through the anterolateral portal

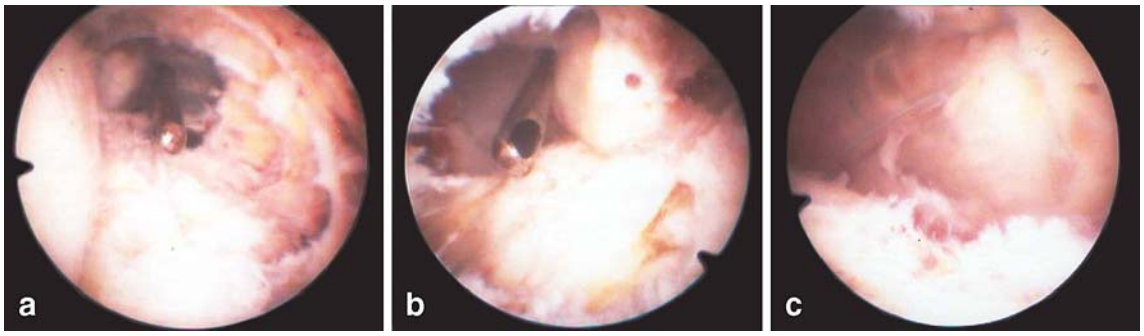

Fig. 2 Post-operative arthroscopic pictures: **a** posterior transseptal portal through the posterolateral portal, **b** posterior trans-septal portal through the posteromedial portal, **c** suprapatellar pouch through the anterolateral portal

formed (Fig. 2). In addition, meniscectomy, chondroplasty and lysis of adhesions were carried out when necessary. A vacuum-type drain placed within the knee and a bulky compression dressing consisting of a soft roll and an elastic bandage were maintained until the second post-operative day. Patients began continuous passive exercises on the second post-operative day. They spent an average of 14 (range 7–23) days in hospital, and the average number of factor concentrates administered during the stay was 53,648 U (range 27,750–105,500 U).

Evaluation of results

Clinical results based on frequency of bleeding, amount of factor replacement, range of motion (ROM), subjective judgement by patients (graded as significant improvement, moderate improvement, no improvement or deterioration) and Hospital for Special Surgery (HSS) knee score were evaluated. For radiographic evaluation, the Arnold–Hilgartner scale was used.

Results

Frequency of haemarthrosis and amount of factor replacement

At the last follow-up, the frequency of knee haemarthrosis reduced from the average five times a month (range one to 12 times) to an average of once a month (range zero to six times). Factor VIII concentrate replacement declined from the average 4,633 U (range 750–14,000 U) to an average of 1,505 U (range 0 –12,000 U) per month.

Table 1 Subjective evaluation of operative result (n=28)

	Number of knees
Significant improvement	16
Moderate improvement	3
No improvement	6
Deterioration	3

Range of motion

Before operation, the average flexion contracture was 6° (range 0–35°), and the average flexion was 112° (range 30–135°). At the last follow-up, the average flexion contracture decreased to 5° (range 0–25°), and seven out of the total 28 knees did not show flexion contracture. The average flexion also reduced to 107° (range 20–135°) at the last follow-up. Six knees showed no change in flexion, 12 knees gained an average of 13° flexion and ten knees lost an average of 29° flexion.

Subjective judgement and Hospital for Special Surgery (HSS) knee score

Nineteen cases reported significant to moderate improvement, and nine cases found no improvement or deterioration (Table 1). The average HSS score improved from 56.4 (range 34–72) points to 71.5 (range 41–89) points at the last follow-up.

Roentgenographic stage (Arnold–Hilgartner scale)

At the last follow-up, no roentgenographic progression was observed in 25 cases (Fig. 3). The remaining three cases made progression, one case moving from stage II to stage III and the other two from stage III to stage IV.

Complications

No complications, except for one case of haemarthrosis, were observed. This one complication was successfully treated with aspiration, factor substitution, compression and cold packs.

Discussion

With moderate haemophilia, a patient may bleed five or six times a year. The patient usually bleeds following mild

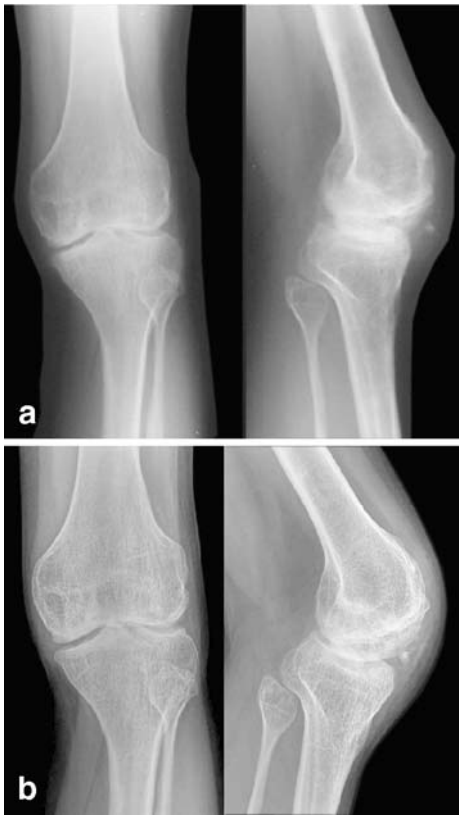

Fig. 3 **a** Pre-operative radiograph of a 26-year-old patient with severe haemophilia A showing stage III radiographic findings. **b** Radiograph taken at 5 years and 5 months after a synovectomy, indicating no change and no progression

trauma, and the level of factor VIII or IX is between 1% and 5% of normal. On the other hand, a patient with severe haemophilia may have two or three bleeding episodes per month and bleed spontaneously following minimal trauma or during daily activities. The level of factor VIII or IX is less than 1% in this case.

Petterson et al. [10] showed that radiographic changes were extremely rare before the age of three in haemophilic arthropathy. But some changes appear between ages three to six years and after six years; almost all the patients with severe haemophilia have radiographic evidence of arthropathy, which progresses until skeletal maturity. After maturity, arthropathy progresses at a much slower pace.

Treatment of haemophilic arthropathy is divided into prophylactic treatment and treatment after development of haemophilic arthropathy. Prophylactic treatment prevents spontaneous bleeding and development of haemophilic arthropathy by administering factor replacement and maintaining the plasma level over 1% of normal. The time when a patient begins to bleed into the joints varies but usually occurs before the age of four. Therefore, some centres wait until two to four joint bleeding episodes take place before starting prophylaxis whereas others perform it as soon as the diagnosis is made [4]. As conservative treatment of haemophilic arthropathy, factor replacement, NSAIDs, joint aspiration, immobilisation and physical therapy are used. The persistence of synovitis or recurrent bleeding after 3–6 months of conservative therapy is usually considered an indication for surgical or non-surgical synovectomy. With disabling end-stage haemophilic arthropathy, joint replacement or arthrodesis can be performed.

Alternative procedures for surgical synovectomy are radioisotope or chemical intra-articular injection of a sclerosing agent. Colloidal P32, chromic phosphate, 90-Yetrium, 186-Rhenium and radioactive gold are the radioisotopes used for injection while osmic acid, hyaluronic acid and rifampicin have been tried in osteoarthritis and successfully used to treat haemophilic arthritis. Rodriguez-Merchan [12] reported a prospective study to determine optimal treatment, including radiation synovectomy, open synovectomy and arthroscopic synovectomy, for chronic haemophilic synovitis of the knee and synovitis of the elbow. Synovectomy (by any method) significantly reduced bleeding episodes but did not halt radiographic deterioration of the joints. It was thought that radiation synovectomy was the best choice for patients with persistent synovitis of the knee and elbow failing to respond to a 3-month trial of prophylactic factor replacement. If two to three consecutive radio-synovectomies at 3- to 6-month intervals had been ineffective or when the radiographic score was more than two points, an open synovectomy was indicated. But we have no experience with radiation synovectomy.

Surgical synovectomy is performed either through an open or an arthroscopic procedure. Open surgical synovectomy for haemophilic arthropathy was first carried out by Storti in 1966 and reported in 1969 [14]. He reported improvement in joint function and a significant decrease in the number of recurrent haemarthroses. But Storti [15, 16] and other authors [3, 5, 8, 9, 11, 13] have also stated that despite the reduced frequency of haemarthroses, the procedure caused loss of joint motion.

With the development of arthroscopic procedures in the 1970s, an arthroscopic synovectomy was first performed in 1980 as an alternative to the open method. Wiedel [18] reported that an arthroscopic synovectomy not only reduced recurrent haemarthrosis but also maintained or improved the ROM of the knee. An arthroscopic synovectomy has some advantages, such as lower complication rates and earlier recovery than open methods. But the technical skills required for a complete arthroscopic synovectomy are demanding due to bony abnormalities, disorganised joint, loss of motion and dense intra-articular and synovial fibrosis. In 1992, Triantafyllou et al. [17] compared eight open synovectomies of the knee with five arthroscopic synovectomies. The frequency of knee haemarthrosis reduced in both open and arthroscopic synovectomy groups. In the open synovectomy group, five knees showed a net loss of motion (average 24°), two knees a minimal net increase (average 5°) and one knee no change. In the arthroscopic synovectomy group, a net gain of motion was found in four knees (average 55°) while a net loss of motion (25°) was reported in only one knee. In a 3 year and 11 month follow-up study, the average losses of flexion contracture and flexion were 1° and 5°, respectively, proving that an arthroscopic synovectomy was successful in maintaining ROM.

In the present study, the average HSS knee score increased from 56.4 to 71.5 points at the last follow-up. The fre quency of haemarthrosis reduced from an average of five times per month before operation to once per month. The mean amount of factor replacement decreased from 4,633 U to 1,505 U. Average flexion reduced from 112° to 107° at the last follow-up. Six knees showed no change in flexion, 12 gained an average of 13° flexion and ten lost an average of 29° flexion. However, the average flexion contracture decreased from 6° to 5°, and seven out of the total 28 knees did not show flexion contracture at the last follow-up.

Limbird and Dennis [7] reported that with immediate continuous passive motion after an arthroscopic synovectomy, all patients except one returned to or improved on their pre-operative ROM. Patients began active assisted ROM exercises and continuous passive motion exercises on the second post-operative day to prevent loss of motion.

Ahn and Ha [1] described that with a posterior trans-septal portal, complete arthroscopic visualisation of the posterior compartment and easier arthroscopic procedures for the posterior compartment of the knee joints are possible. No complications such as injuries of the popliteal neurovascular structures occurred in their experience. Authors of the present study performed the most extensive synovectomy possible, both anterior and posterior, with six portals (anterolateral, anteromedial, lateral suprapatellar, medial suprapatellar, posterolateral and posteromedial portals) and a posterior trans-septal portal.

Klein et al. [6] pointed out that although a synovectomy could not reverse pre-existing degenerative changes, patients with stage III or less-severe disease gained better results. Wiedel [19] also reported on a 10–15 year follow-up of original arthroscopic synovectomies that, though successful in controlling recurrent haemarthrosis and probably slowing progression, did not halt the development of haemophilic arthropathy. In the present study, 25 out of 28 cases did not show roentgenographic progression, and of the remaining three, one case moved from stage II to stage III and the other two from stage III to stage IV.

The limitations in our study may be that 5 years and 11 months follow-up is too short a time period to conclude that arthropathy is prevented or delayed and the study is retrospective rather than prospective and randomised. There is thus no comparison with a control group to evaluate the study objectively.

An arthroscopic synovectomy of the knee using appropriate arthroscopic portals is a useful method of treating haemophilic patients, as it decreases bleeding episodes, amount of factor replacement and knee pain. However, long-term studies are required to determine the effects of an arthroscopic synovectomy on the progression of haemophilic arthropathy.

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