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Review article

Giant cell tumor of tendon sheath: Open surgery or arthroscopic synovectomy? A systematic review of the literature

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ABSTRACT

Purpose: Giant cell tumor of tendon sheath (GCTTS), formerly known as pigmented villonodular synovitis (PVNS), is a benign, locally aggressive, proliferative disorder of the synovium involving a joint, bursa, or tendon sheath. Treatment of GCTTS involves early surgical resection to limit articular destruction and the risk of recurrence. Synovectomy remains the treatment of choice for GCTTS, but without clear consensus to make an open or arthroscopic synovectomy and no certainty on the responsibility of surgery in the evolution towards the degenerative osteoarthritis. The aim of this study was to evaluate the long-term clinical outcomes and the rate of recurrence of open or arthroscopic excision of GCTTS of the four most frequently involved joints: the shoulder, hip, knee and ankle.
Methods: We performed a systematic review of literature in September 2015. The keywords were "villonodular synovitis" AND "surgical treatment". The two authors analyzed 413 articles, according to title and abstract. Forty articles were selected, read entirely and references were analyzed.
Results: Thirty-three articles were selected.
Conclusion: Our review of literature showed that arthroscopic excision is effective for localized type of GCTTS for all four joints. In diffuse type GCTTS, the efficacy of arthroscopic synovectomy has only been shown for the knee joint. In the other joints, early diagnosis can improve clinical outcomes, but we cannot certify that surgical treatment avoids osteoarthritis degradation.
Study design: Review of literature, level of evidence IV.

1. Introduction

Pigmented villonodular synovitis (PVNS) or Giant cell tumor of tendon sheath (GCTTS) is a rare benign tumour [1] of uncertain etiology that was first described in 1882 by Chassaignac. It is characterized by synovial proliferation of a joint, a tendon sheath or a bursa in young patients. Intraarticular GCTTS affects most frequently knee joint, but may also proliferate within the hip, ankle and shoulder. Descriptions of other locations are rare, in particular in hand with extra articular locations [2,3]. Localized forms are often nodular and involve the joints, bursa and tendon sheaths, while diffuse forms are mainly intraarticular [4]. This benign, highly proliferative tumour may result in massive joint destruction making early and total surgical synovectomy highly important. Either open or arthroscopic surgery can be performed [5]. The main risk is recurrence and articular destruction [6,7], which can require non-conservative surgical management [8,9]. Diffuse forms recur more frequently than localized forms [10]. Numerous studies have been performed on this subject, but there is no consensus. In diffuse forms, the usual surgical treatment is open total synovectomy [10], while arthroscopic synovectomy is usually indicated in localized forms [11]. A systematic review of the literature performed in the knee [12] did not show any difference in clinical outcome and reported fewer complications with arthroscopic synovectomy for diffuse GCTTS.

The goal of this systematic review of the literature was to analyze the clinical outcomes and the rate of recurrence following open and arthroscopic synovectomy. This bibliographic search was performed for the 4 most frequently involved joints: the shoulder, hip, knee and ankle.

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2. Materials and methods

This systematic review is structured according to the recommendations in the literature [13] and was drafted based on the "PRISMA checklist" for systematic reviews of the literature and metaanalyses [14].

2.1. Selection criteria

Inclusion criteria were all articles that reported the clinical outcome and the rate of recurrence of surgical treatment of GCTTS involving the shoulder, hip, knee or ankle. The following preselection criteria were chosen:

- all patients who were at least 18 years old;
- in whom GCTTS was the primary indication for surgery;
- for whom it was the first surgical intervention on the involved joint;
- with at least one year of postoperative follow-up;
- with a clinical and radiological evaluation at the final follow-up.

Selected studies were:

- not limited by the date of publication;
- written in French or in English;
- with an abstract available online.

In case of disagreement on the selection of an article, a consensus was reached after discussion between the two authors (TN and FG). The articles reporting series with adjuvant treatment [15–20] and series with a follow-up less than 1 year to determine the rate of recurrence [21] were excluded. Articles that did not fulfil our selection criteria were also excluded (epidemiological study, histological study, letters, technical notes, case reports without a review of the literature or with an unclear methodology).

2.2. Research strategy

In September 2015, a bibliographic search was performed in PubMed, Medline, CINAHL, Cochrane and Embase databases, with no time limit. MesH Keywords were "villonodular synovitis» AND "surgical treatment». Two of the authors (TN and FG) independently selected the articles that responded to the question. The initial selection was based on reading the abstracts. The selected articles were then read entirely and the bibliographic references of each article were analyzed to confirm that no major article on the subject was excluded during the initial MeSH keyword search. The scientific quality of the selected articles was evaluated according to the level of evidence of each [22]. A total of 413 articles were examined. Fig. 1 summarizes the article selection process.

3. Results

Forty articles were selected and read. Seven articles were excluded due to weak methodology (size of the population, heterogeneous diseases, unclear clinical evaluation, surgical treatment not described or limited information compared to previously selected studies) [23–30]. One article was selected for the hip and ankle. Table 1 summarizes the distribution of the studies in relation to the involved joint and the number of operated patients. In case of a review of the literature associated with the description of a clinical case, the cases were only counted once.

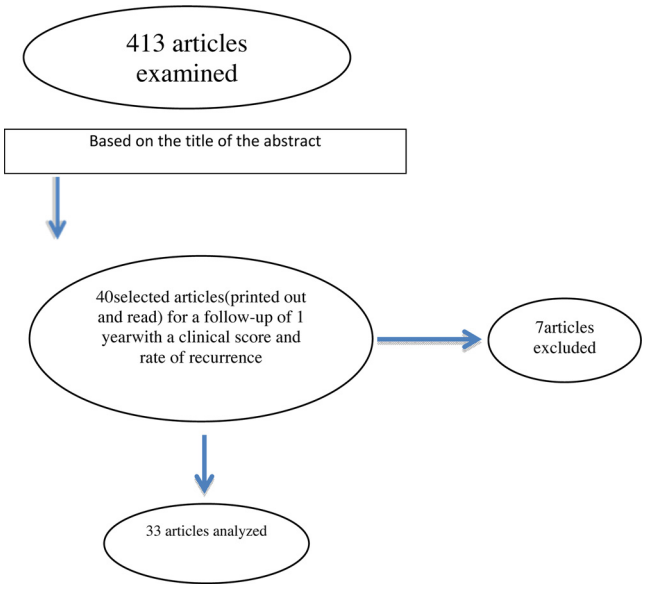

Fig. 1. Selection of articles by two authors.

3.1. Shoulder joint

There are very few studies in the literature on the management of GCTTS in the shoulder. In 1999, only 25 cases had been described in the English language literature [31] managed by open synovectomy in all cases. Muller et al. [31] performed a systematic review of the literature and a description of one case of localized GCTTS. Mahieu et al. [32] reported two cases of diffuse GCTTS treated by arthroscopic synovectomy. The preoperative diagnosis was difficult and arthroscopic excision of the lesions resulted in a satisfactory clinical outcome without recurrence.

Good clinical results were obtained with arthroscopic synovectomy for diffuse GCTTS (2 years and 8 months of follow-up) as long as total synovectomy was performed (articular and subacromial space) [33]. According to Gumina et al. [34], diffuse GCTTS of the shoulder is frequently associated with a full thickness rotator cuff tear. Arthroscopic synovectomy and subacromial space debridement were performed in the 9 cases. The clinical outcome at the final follow-up (Constant score [35] and subjective shoulder value) were lower than in the control group without synovitis or osteoarthritis (arthroscopic debridement for irreparable rotator cuff tear alone). The poor clinical outcomes were found to be due to the presence of osteoarthritis secondary to GCTTS. In 5 cases, the association of arthroscopic synovectomy and rotator cuff tear repair resulted in a satisfactory clinical outcome without recurrence and no osteoarthritis at 22 months of follow-up [36].

According to Johansson et al. [37], open synovectomy is necessary to obtain complete resection.

Table 1
Distribution of the studies selected depending on the involved joint.

	Number of studies	Number of patients
Glenohumeral joint "Shoulder"	6	46
Coxofemoral joint "Hip"	7	114
Tibiofemoral joint "Knee»	15	1245
Tibiotalar joint "Ankle"	6	43

3.2. Hip joint

Ma et al. [38] described 12 cases of diffuse hip GCTTS with management by open synovectomy alone in 2 cases and synovectomy associated with total hip arthroplasty in 10 cases because of bone loss.

Open synovectomy alone was performed if the articular cartilage was preserved [39]. Vastel et al. [40] reported open synovectomy with surgical dislocation of the hip in all cases of diffuse GCTTS (16 cases) and associated total hip arthroplasty in 50% of the cases. There was recurrence in one patient following synovectomy combined with arthroplasty. At 16 years of follow-up osteoarthritis had developed in the 8 cases treated by synovectomy alone.

Gonzales Della Valle et al. [41] described 5 cases of diffuse GCTTS of the hip. One case was treated by synovectomy alone with recurrence at 9 years of follow-up requiring total hip arthroplasty, and 4 cases was treated by synovectomy and arthroplasty without recurrence at 13 years of follow-up. In an associated review of the literature, they described 55 cases that were treated by either open synovectomy (47%) or synovectomy combined with arthroplasty. Ten cases of recurrence were described (9 in the synovectomy alone group).

For Byrd et al. [42], arthroscopic synovectomy provides satisfactory results at 2 years of follow-up for both localized (3 cases) or diffuse (10 cases) of GCTTS. The rate of recurrence was similar between the two groups.

According to Descamps et al. [43], conservative treatment (open synovectomy) is only possible in diffuse GCTTS of the hip if an early diagnosis is obtained. A diagnosis by clinical and radiological evaluation was difficult to determine with two diagnostic errors in 2 cases of diffuse GCTTS in the study by Rydholm et al. [44] and delayed management resulting in severe osteoarthritic deterioration contraindicating conservative treatment. Synovectomy was combined with total hip arthroplasty.

Open synovectomy was performed with the same surgical approach by all authors and two authors surgically dislocated the hip.

3.3. Knee joint

In a review of the literature (10 studies), Rodriguez-Merchan et al. [45] did not find any significant difference between open and arthroscopic synovectomy for recurrence (26.7% versus 24.6% respectively), postoperative complications (5.7% versus 3.2% respectively) or the development of osteoarthritis (20% versus 17.1% respectively). In an analysis of 60 studies, Auregan et al. [12] showed that there was a significantly lower rate of postoperative complications with arthroscopic compared to open synovectomy (0% versus 19.3% respectively). There was no significant difference in local recurrence (22.6% for open surgery; 16.1% for arthroscopy).

There was no recurrence of localized GCTTS treated arthroscopically at the final follow-up (3 to 6 years) according to 4 authors [11,46–48] with significantly improved clinical functional scores [47]. Auregan et al. [5] reported a significant improvement in clinical outcome at 7 years of follow-up in 21 cases of arthroscopic synovectomy (14 nodular and 7 diffuse forms), and two cases of recurrence at 2 and 5 years of follow-up in the diffuse group.

The rate of recurrence following arthroscopic synovectomy was 14% at 3.5 years of follow-up according to Zvijac et al. (12 cases of diffuse and 2 cases of localized GCTTS) [49] and 57% at 7 years for Jain et al. (diffuse cases) [48].

Colman et al. [50] reported a rate of recurrence of 9% in 103 cases of diffuse GCTTS treated by arthroscopic synovectomy combined with open posterior synovectomy, compared to 62% with arthroscopic anterior and posterior synovectomy. Mollon et al. [51] also found a low rate of recurrence with combined synovectomy (open and arthroscopic) for both diffuse and localized GCTTS.

The clinical outcome of partial arthroscopic synovectomy for diffuse GCTTS was not as good, with a higher rate of recurrence than with total arthroscopic synovectomy [52]. Ogilvie-Harris et al. [53] reported similar results with 1/11 cases of recurrence in diffuse GCTTS treated by total arthroscopic synovectomy and 5/9 with progressive osteoarthritis treated by partial arthroscopic synovectomy.

According to Gu et al. [54], recurrence was more frequent following open synovectomy (4/20) than arthroscopic synovectomy (1/21) and the clinical outcome was better (Lysholm and IKDC scores [55]) in patients with non-invasive surgery. There was no preoperative difference between the two groups (diffuse GCTTS in most cases). In the study by Nakahara et al. [56], recurrence was observed following open synovectomy (diffuse or localized), in 2/17 cases with postoperative stiffness and secondary osteoarthritis in 4/17 cases at 6 years of follow-up. Flandry et al. [57] reported 2/25 cases of recurrent diffuse GCTTS treated by open synovectomy at 5 years of follow-up with postoperative articular adhesions as the main complication in 8 cases.

3.4. Ankle joint

In the study by Ma et al. [38], open synovectomy was performed in 3 cases (one nodular and 2 diffuse forms) and arthroplasty in 1 case of diffuse form with no recurrence at the final follow-up. Sung et al. [58] described 10 cases of GCTTS (7 diffuse, 3 localized) and reported recurrence in 40% a mean 6 months after open synovectomy.

In the series by Stevenson et al. [59], clinical results were good (AOFAS score 92) in 11 cases of diffuse GCTTS of the ankle at 5 years of follow-up and were comparable between open and arthroscopic tibiotalar synovectomy. There was no recurrence.

For Korim et al. [60], most cases of localized GCTTS (22 cases) are found in the forefoot, while diffuse GCTTS (6 cases) is located in the tibiotalar joint with osteoarthritis at presentation in 50% of cases. The clinical outcome following treatment is better for localized GCTTS (according to the American Orthopaedic Foot and Ankle Society [AOFAS] [61]). The rate of recurrence following open surgery was 12.5% for diffuse GCTTS of the ankle.

An extraarticular location in the hindfoot was frequent (6/9 cases) for Sharma et al. [62]. Friscia et al. [63] considered open synovectomy to be the first-line treatment.

4. Discussion

Arthroscopic synovectomy is indicated for localized GCTTS in the 4 joints studied in this review [31,44,47,58] and for diffuse GCTTS of the knee. At present, there are no results in the literature to validate arthroscopic treatment alone for diffuse GCTTS of the shoulder, hip or ankle. The lack of evidence concerning the shoulder, the hip and the ankle is a limitation of this study.

GCTTS is a rare and benign tumour characterized by proliferation of the synovial membrane [23,64]. Diffuse intraarticular forms involve, in descending order, the knee (80% of cases), hip (10%), ankle (5 to 7%), wrist (2 to 3%), shoulder (2%) and elbow (1 to 2%), but all the joints can be affected. Early diagnosis makes it possible to provide appropriate surgical management before the onset of osteoarthritic degeneration [6] and to reduce recurrence. Recurrence is more frequent in diffuse forms in large joints [24]. Because of frequent recurrence, the most extensive surgical resection possible should be performed but no current element allows to say that the natural evolution of the tumour is more degenerative than after surgical treatment [65].

4.1. Shoulder

The diagnosis of GCTTS should be suspected in case of unidentified pain of shoulder in young patients and an MRI suggesting malignant lesions (localized or diffuse) [31].

Results in the literature show that arthroscopy provides better assessment of shoulder lesions and more effective synovectomy without postoperative complications than open synovectomy [25].

Our review of the literature showed that resection of lesions in the intraarticular and subacromial space must be possible [33]. Association with a rotator cuff tear is frequent and influences the treatment strategy and the functional prognosis [33,36]. Arthroscopic synovectomy and rotator cuff tear repair is then performed with better clinical results than synovectomy alone [36] or than synovectomy and debridement [34]. In case of diffuse GCTTS without rotator cuff injuries, the lack of high quality studies makes it impossible to recommend open or arthroscopic synovectomy.

4.2. Hip

In case of diffuse forms, the reference treatment is open synovectomy, but the clinical outcome is not as good as in other joints and is associated with significant morbidity (surgical hip dislocation is often necessary to obtain a complete synovectomy) [40]. The comparison between natural evolutions of the disease versus aggressive synovectomy is not evaluated in literature.

The literature suggests that new arthroscopic approaches should help improve access to peripheral articular compartments for successful total synovectomy, thus reducing postoperative morbidity [26]. For Krebs et al. [27], hip arthroscopy can be used to diagnose and identify lesions in early stage synovial disease. In case of localized GCTTS, synovectomy should be performed arthroscopically if the lesion is accessible and total resection is possible.

In our review of the literature, an arthroscopic biopsy was indicated in the presence of joint pain of unknown etiology in young patients to obtain a diagnosis [44]. However, the diagnosis was often delayed [44] so that the patient was not managed until significant osteoarthritic deterioration had developed and total hip arthroplasty combined with open synovectomy was required in 83% of the cases in the study by Ma et al. [38] and 50% in Vastel et al. [40]. The long-term follow-up of diffuse GCTTS of the hip joint treated by synovectomy alone shows that osteoarthritis develops in 100% of the cases at 16.7 years of follow-up [40]. Recurrence is possible even after arthroplasty and synovectomy [8,38,40]. Gonzales et al. [41], Gitelis et al. [39] and Descamps et al. [43] recommend open synovectomy alone when articular cartilage is preserved and synovectomy associated with total hip arthroplasty in case of severe osteoarthritic degeneration.

4.3. Knee

There are numerous robust articles published on the GCTTS of the knee, which is the most frequently involved joint. The efficacies of arthroscopic synovectomy of the knee and the low morbidity and mortality have been validated in the literature [66,67].

There was a consensus in our review of the literature that localized forms should be treated by arthroscopic synovectomy, with a recurrence rate of nearly 0% [5,48]. Localized lesions can mimic meniscal or another intraarticular diseases resulting in diagnostic errors [68] and the diagnosis may only obtained during surgery [47]. Numerous authors have emphasized the importance of high quality MRI imaging to obtain a diagnosis, locate the lesion and determine the surgical strategy [69]. Our review of the literature has shown that lesions are located by order of frequency in the lateral recessus, suprapatellar recessus, Hoffa fat pad, posterior compartment of the knee, the femoral notch, then the lateral and medial compartments [46,47]. Moreover, a history of injury was identified in one third of cases [11]. An associated extraarticular lesion is a cause of treatment failure when arthroscopy is used alone [56].

According to our study, the rate of recurrence of diffuse GCTTS is 4.7 [54] to 16.1% [12], following arthroscopic synovectomy and 8 [57] to 22.6% [12], following open synovectomy. Moreover, the duration of surgery, the length of the hospital stay and the clinical results at the final follow-up (Lysholm and IKDC scores [55]) supports the strategy of arthroscopic synovectomy [54]. Arthroscopic synovectomy should be complete to prevent recurrence [52,53]. The use of several arthroscopic portals (at least 3) is a factor of diagnostic and therapeutic success [52].

Colman et al. reported a recurrence rate of only 9% in case of anterior arthroscopic synovectomy and posterior open synovectomy compared to 62% for an arthroscopic treatment alone [50].

4.4. Ankle

There are multiple locations in the lower limb extremity: talocrural joints, subtalar, mid-foot, metatarsophalangeal or interphalangeal. In the literature, bone lesions were identified in 70% of the cases [64]. Our review of the literature shows that extra articular involvement of the ankle is frequent [62]. Open synovectomy in case of diffuse GCTTS of the ankle is the first line treatment allowing complete excision of lesions for Friscia et al. [63].

Recurrence of diffuse GCTTS is frequent and the rate varies from 0 [59] to 40% [58]. The clinical outcome of diffuse GCTTS of the ankle or foot is good following both open and arthroscopic synovectomy [59]. Recurrence of localized GCTTS is rare and the localized GCTTS is mostly located in the forefoot [60]. Our review of the literature shows that open synovectomy is the reference-first line treatment in cases of diffuse GCTTS because of frequent extra-articular lesions. If localized lesions are accessible to arthroscopy, arthroscopic synovectomy is indicated.

5. Conclusion

Although localized forms can often be treated by arthroscopic synovectomy, whatever the diseased joint, surgical management of diffuse forms is more complex. The rate of recurrence depends on whether resection of diseased tissue is complete but we do not have the answer of the superiority of aggressive surgical synovectomy versus natural evolution of the disease on clinical outcomes at long-term follow-up.

For diffuse forms, the existing literature shows the efficacy of arthroscopic synovectomy for the knee. In case of extensive lesions or extraarticular locations, arthroscopic and open surgery should be combined to avoid failure.

Disclosure of interest

The authors declare that they have no competing interest.

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