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ORIGINAL PAPER

Arthroscopic synovectomy of the knee joint for rheumatoid arthritis

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Abstract

Objective To investigate the effect of knee arthroscopic synovectomy (AS) on the disease activity, quality-of-life (QoL), and the functional status of patients with rheumatoid arthritis (RA).

Materials and methods A retrospective analysis was conducted on the outcomes of AS performed on 138 RA patients; pre-surgery assessments were done using Disease Activity score (DAS 28) and Routine Assessment of Patient Index Data 3 (RAPID-3) on a multidimensional health-assessment questionnaire for disease activity, EuroQol-5D (EQ-5D) and the Short-Form Medical Outcomes Study (SF-36) for quality of life, and the Health Assessment Questionnaire (HAQ) for functional status. The pain response to SA was measured by a visual analogue score (VAS) and the Knee Society Score (KSS).

Results All parameters assessed in the study showed significant positive changes: the activity of the disease decreased, and patients' functional status and QoL improved.

Conclusion AS is effective treatment for recurrent synovitis of the knee in RA patients. This technique improves the functional status of patients and their quality of life and reduces the activity of the disease.

Keywords Rheumatoid arthritis · Synovectomy · Knee · Arthroscopy · Quality of life · Synovitis ·

For more than a decade, arthroscopic synovectomy (AS) has been used to manage persistent knee synovitis in rheumatoid arthritis (RA), which does not respond to non-operative treatment [1, 2]. Unfortunately, in available literature, we could not find enough useful information about effectiveness of this type of surgery. As rheumatoid arthritis is systemic disease, we always need to think about quality of treatment and disease activity. The effect of AS on the activity of RA is also discussed very seldom.

Although the effect of AS on the knee function has been studied quite extensively, there are virtually not enough reports on how this procedure changes quality of life (QoL). The effect of AS on the activity of RA is also discussed very seldom.

The purpose of the study was to evaluate the results of AS of the knee for RA patients, as well as its effects on the activity of disease, knee function, and patients' QoL.

Materials and methods

One hundred thirty-eight RA patients, who underwent the AS on 124 knees between 2003 and 2015, were included. The average age was 41.1 ± 14.3 years, with the duration of disease of 8.7 ± 6.6 years. All the patients had three months and persistent synovitis of one or both knees persisting against the background of disease-modifying anti-rheumatic drug therapy, as well as oral and intra-articular glucocorticoid (GC) therapy.

Prior to surgical intervention, the patients had undergone standard clinical examination to identify the number of painful or inflammatory joints. The radiographic stages of RA were identified based on Steinbroker [1, 3].

The disease activity before surgery was measured with Disease Activity Score (DAS 28) [4, 5] and Routine Assessment of Patient Index Data 3 (RAPID-3) [6]. For

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follow-up evaluation (3, 6, and 12 months after surgery), RAPID-3 only was used (after identifying significant correlation between the above scores with the use of contingency tables).

To evaluate changes in QoL and joint function, before and after the surgery (3, 6, and 12 months), all the patients filled out validated Russian versions of the Health Assessment Questionnaire (HAQ) [7], EuroQoL-5D (EQ-5D) [8], and Short-Form Medical Outcomes Study (SF-36) forms [9].

To measure the efficiency of AS from the perspective of knee pain management, the visual analog scale (VAS) and Knee Society Score (KSS) were used before and after (3, 6, and 12 months after surgery) surgery.

The degree of intra-articular changes identified arthroscopically was measured by Outerbridge score (grades 0–4) [10].

Radiology Each patient underwent a two-view (anteroposterior and lateral) radiographic examination of the knee before and one year after surgery. All the images were evaluated with the use of Larsen score [11].

Arthroscopy In all cases, surgery was performed under spinal anesthesia with the use of 30-degree arthroscope with two standard (anterolateral and anteromedial) portals. Additional (posteromedial) portals were used if needed. Shaver (4.5–3.5) and ablator electrodes were used. After surgery, active vacuum drainage was performed. Once the procedure was over, the patients would immediately (after 3–5 hours) start crutching with limited weight onto the operated limb. On the first day after the procedure, mobilization of patella started along with passive motion exercises and quadriceps reinforcement exercises.

For the *statistical analysis* of results, Statistica 8.0 for Windows (StatSoft Inc., USA) was used. The quantitative variables were described with the use of standard methods of variation statistics, for which the arithmetic mean (M), standard deviation (δ), 25th and 75th percentiles, and median patient number were calculated. The average values were presented as $M \pm \delta$. The qualitative variables were described as absolute and relative frequency ratios (percentages). Differences were considered significant at $p < 0.05$. To evaluate results, statistical analysis methods were used: Student's *t*-Criterion; non-parametric tests for variable samplings inconsistent with the normal distribution law (Mann-Whitney *U* Test, Wilcoxon Criterion). Different activity scores were compared with the use of contingency table analysis.

Results

Our results showed that AS is an effective and efficient method for recurrent knee synovitis in RA, helping to improve function and QoL, as well as reduce the activity of main disease.

Clinical characteristics of the patients included in the study are presenting in Table 1.

Prior to surgery, the activity of disease was moderate and estimated at 4.1 ± 0.7 based on DAS 28 and $12.7 + 5.4$ based on RAPID-3. By the third month after surgery, it reduced moderately to 9.9 ± 4.9, then to 7.9 ± 4.1 by the sixth month, and then to 2.5 ± 1.3 by the 12th month ($p < 0.05$). To evaluate the efficiency of treatment, we would consider the difference of scores before and after surgery. A satisfactory result was achieved by the third month after surgery (ΔRAPID-3 = 2.8 + 0.5; $p = 0.0005$). The results achieved by the sixth and 12th months were considered good (ΔRAPID-3 = 4.8 $\pm$ 1.3 and ΔRAPID-3 = 7.1 $\pm$ 1.7, respectively; $p < 0.001$).

Before the surgical intervention, the patients displayed moderate disability as per HAQ. Their average score was estimated at 1.25 ± 0.73; however, the extreme values were 0

Table 1 Clinical profile of RA patients prior to arthroscopic synovectomy

Characteristics	Values
Female, *n* (%)	103 (74.6)
Male, *n* (%)	35 (25.4)
Average age, years	41.7 ± 14.3
Average follow-up period, years	4.5 ± 2.5
Average duration of disease, years	8.7 ± 6.6
Duration of knee joint injury, years	5.2 ± 4.5
Duration of persistent synovitis of knee joint, years	2.4 ± 2.4
Rheumatoid factor +, %	83.3
Radiographic stage of RA, %	
I	5.6
II	50.0
III	29.6
IV	14.8
Knee function (according to ACR), %	
I	8.3
II	77.8
III	13.9
IV	0
Chondromalacia stage (according to Outerbridge), %	
1	21.3
2	38.0
3	27.8
4	12.9
Degree of radiographic change in the knee joint (according to Larsen), %	
1	25.0
2	59.3
3	15.7
4	0
5	0
hsCRP, mg/l	27.5 ± 17.6

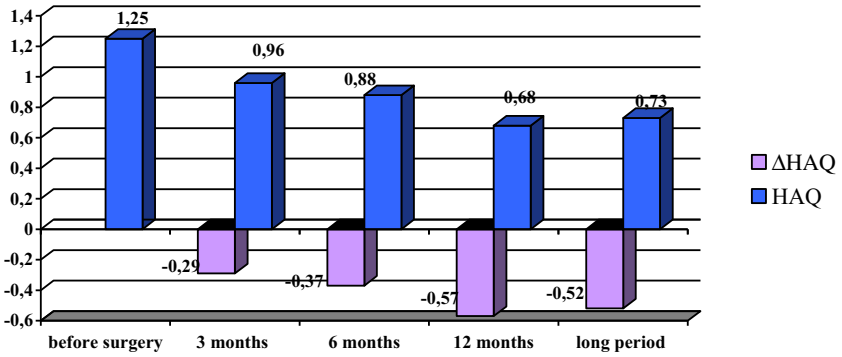

Fig. 1 Changes of HAQ and ΔHAQ. Note: the difference between preoperative and postoperative values is significant: $p < 0.05$

and 2.75. Thus, on top of those with minimal and moderate reduction in the degree of disability, almost every fourth patient (23%) had significant impairments.

Post-operatively, a reduction in HAQ score was noted (Fig. 1). The data obtained 12 months after surgery indicated a 50% improvement of the ACR score and a significant improvement of the FS in RA patients.

The VAS score also displayed positive changes—the pain reduced, and the most notable reduction was achieved after six and 12 months: from 52.5 ± 22.98 mm before surgery to 36.17 ± 24.95 mm after three months ($p < 0.005$), 27.6 ± 21.7 mm after six months ($p = 0{,}00008$), and 20.1 ± 18.2 mm after 12 months ($p < 0.005$).

Three months after surgery, the improvement of the KSS score was also significant. Thus, 35.2% of the patients reported weak or non-permanent pain (vs 13.9% before surgery, $p < 0.05$). The number of patients with permanent moderate pain reduced from 35.2 to 12.0% ($p < 0.005$), while in the same percentage of patients (12.0%), the pain in the knee disappeared ($p < 0.001$). It is important that before surgery, pain had been reported by all the patients. Subsequently, during the whole follow-up year, the severity of pain continued to reduce.

Therefore, AS of the knee joint proved to be an effective treatment, from the perspective of pain alleviation, and resulted in a significant reduction of pain in RA patients. Moreover, the FS of the patients also improved significantly. The combination of the factors above contributed a lot to the improvement of the patients' overall QoL.

Three months after surgery, the EQ-5D score increased from 0.40 ± 0.3 to 0.55 ± 0.3 (ΔEQ-5D = 0.15; $p = 0{,}005$), which indicated an insignificant clinical improvement. Satisfactory results were achieved six months after surgery: 0.66 ± 0.2 (ΔEQ-5D = 0.26; $p < 0.005$); 12 months after surgery and in a longer term, the results remained satisfactory: 0.70 ± 0.2 (ΔEQ-5D = 0.30; $p < 0.005$). After the sixth and 12th months post-operatively, the results were positive based on all scoring systems. The patient satisfaction rate also increased: from 50.9 ± 16.5 to 62.1 ± 18.6 mm after three months, to 68.2 ± 17.6 mm after six months, and 75.4 ± 16.0 mm after 12 months ($p < 0.005$).

The analysis of changes in SF-36 scores was used to evaluate progress in terms of physical activity, contribution of physical problems to overall disability, severity of pain, and general health perceptions and vitality of patients at the time of study, as well as measure the level of patients' social activity, the role of their emotional condition in daily activities, and the psychological health of patients.

Pre-operatively, all the patients' QoL scores, as per SF-36, were lower than those of the control population [1] (Table 2).

Table 2 QoL scores of RA patients according to SF-36, M ± δ

SF-36 scoring item	Prior to surgery ($n = 138$)	Control population ($n = 664$)[a]
PF	33.4 ± 8.6	51.18 ± 8.1
RP	40.7 ± 6.4	51.15 ± 9.6
BP	39.1 ± 6.7	51.1 ± 9.4
GH	41.2 ± 9.1	50.7 ± 9.4
VT	42.0 ± 8.2	50.9 ± 9.7
SF	41.3 ± 10.6	50.6 ± 9.5
RE	46.8 ± 10.3	51.2 ± 9.7
MH	43.7 ± 10.7	50.5 + 9.4

PF physical functioning, *RP* role physical, *BP* bodily pain, *GH* general health, *VT* vitality, *SF* social functioning, *RE* role emotional, *MH* mental health

[a] The difference between the SF-36 scores of the control population and patients' preoperative SF-36 scores is significant: $p < 0.0005$

Pre-operative PCS (physical component summary) and MCS (mental component summary) scores were lower too and estimated at 35.9 ± 6.9 and 47.5 ± 10.6, respectively.

The follow-up evaluation of the eight SF-36 scoring items confirmed that 12 months after surgery, the QoL scores of the patients improved significantly (Fig. 2). Improvements were noted in their scores of physical functioning, including daily living activities, walking, stair climbing, load carrying, and strenuous physical exercises. The daily living activities became easier to perform. The severity of bodily pain reduced significantly, along with its contribution to the inability to do normal living activities, including household chores and other functions. The scores of general health and vitality improved, and the patients displayed satisfaction with the level of their social functioning. The data collected during the study showed that the patients' physical impairment prior to surgery had been significant due to severe pain syndrome and unsatisfactory general health. These factors resulted in undue fatigability, dissatisfaction with the level social functioning, and emotional distress.

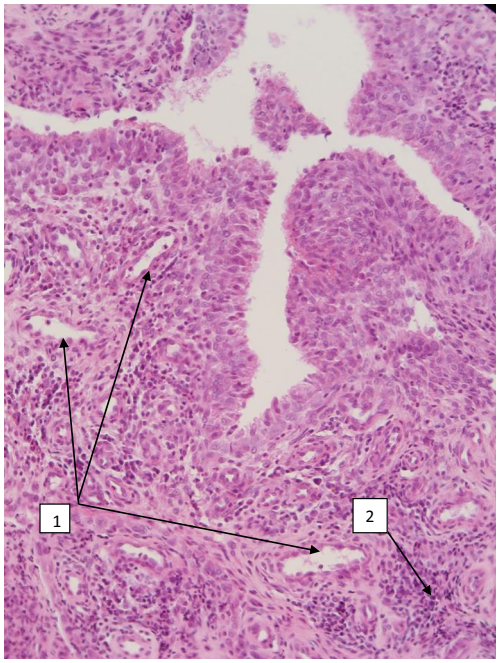

Fig. 3 Histological changes in synovial membrane in RA patients. The manifestation of angiogenesis (1), lymphoid infiltration (2), is an unfavorable of histology prognostic factors of early polyarticular involvement

Discussion

Clinical patterns and outcomes of the RA are in many ways determined by the inflammatory conditions in the synovium, which induce intra-articular lesion. The manifestation of angiogenesis, lymphoid infiltration, is unfavourable of histology prognostic factors of early polyarticular involvement, early development of joint erosions, and early disability (Fig. 3) [3]. Therefore, one of the main objectives of RA treatment is to prevent or slow down this destructive process. The modern rheumatology offers a wide range of capabilities; however, synovitis may take forms that are non-responsive even to the most advanced and aggressive methods of therapy. In such cases, the surgical removal of the synovial tissue (synovectomy) is the method of choice [12]. The available literature mostly addresses AS from the perspective of the improvement of the knee function based on the KSS score [13]. Pain reduction, lighter walking and stair climbing, improve range of motion, and suspension or reduction in the signs of synovitis—all these confirm the effectiveness of AS. According to U. Fiocco et al., given the obvious positive dynamics, the outcome of operative treatment can be considered favorable even despite insignificant signs of inflammation or destructive changes in the joint [14]. Some studies demonstrate that AS results in a meaningful pain reduction and improves the function of the knee and is a safe alternative treatment not even in the case of RA, but also in treatment of localized pigmented villonodular synovitis (LPVNS) [15–21].

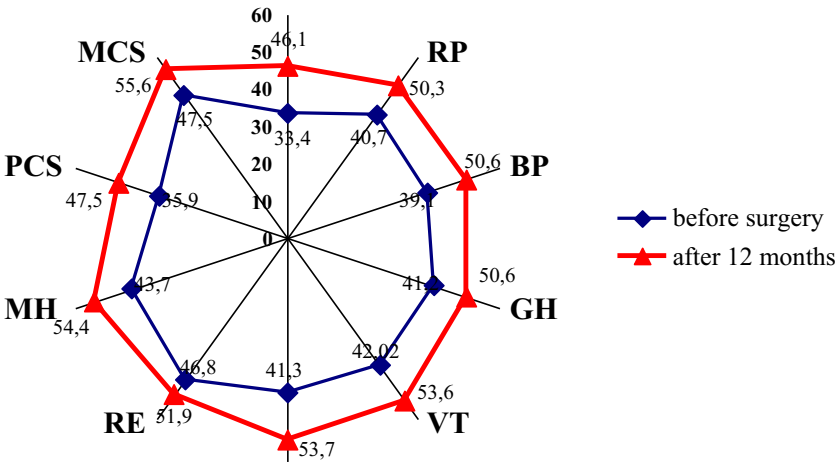

Fig. 2 Changes in QoL scores according to SF-36 ($p < 0.001$). (1) MH (Mental Health); RE (role emotional), VT (vitality), GH (general health), BP (bodily pain), RP (role physical), MCS (mental component summary), PCS (physical component summary). (2) The difference between the pre-operative and post-operative (after 12 months) SF-36 scores is significant; $p < 0.0005$

For the outcome to be positive, surgery must be performed on a knee with a good range of motion, no deformation, and intact cartilage. With these prerequisites in place, success is achievable in 75–82% of cases [15, 22–25].

It is for the first time that we measured RA activity after AS by means of RAPID-3. The use of this questionnaire became possible after a close correlation between RAPID-3 and DAS 28 scoring systems had been identified.

Our results regarding the effect of AS on the disease activity are confirmed by K. Kanbe et al.: these authors report that 12 months after the AS procedure, patients with persistent knee joint synovitis failing to respond to methotrexat and infliximab treatment demonstrate reduction in the DAS 26 score (from 5.58 ± 0.23 to 2.58 ± 1.49). Moreover, this reduction is significant after 1.5 months (3.87 ± 0.47) [26]. G.Q. Chen and colleagues confirm the efficiency of AS in combination with an adequate background anti-inflammatory therapy as a way to control the activity of RA [27].

Apart from the disease activity, the functional capacity of patients, and pain and QoL were improved.

Therefore, AS is an effective and efficient treatment method for recurrent knee joint synovitis with RA, helping to improve patients' functioning and quality of life, as well as reduce the activity of RA.

Compliance with ethical standards

Conflict of interests The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration ant its later amendments or comparable ethical standards.

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