

# QUANTITATIVE MAGNETIC RESONANCE IMAGING AS MARKER OF SYNOVIAL MEMBRANE REGENERATION AND RECURRENCE OF SYNOVITIS IN ARTHRITIC KNEE JOINTS TREATED WITH ARTHROSCOPIC SYNOVECTOMY - A 1-YEAR FOLLOW-UP STUDY

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## Introduction

Previous studies have shown that MRI allows reliable estimation of volumes of inflamed synovial membrane in arthritic knee joints (1,2). Surgical removal of as much as possible of the synovial membrane by arthroscopic surgery (arthroscopic synovectomy) are in many countries frequently used in therapy-resistant knee joint synovitis. Clinical efficacy data are varying, but generally encouraging (3,4). However, longitudinal studies, which follow the regeneration of the synovium and analyze the timing and frequency of recurrent synovial inflammation, do not exist, probably mainly due to the lack of non-invasive follow-up methods.

The aim of the present investigation was, by performing repeated MRI, to study synovial regeneration and the recurrence of synovitis following arthroscopic knee joint synovectomy in patients with rheumatoid arthritis (RA) and other (non-RA) causes of persistent knee joint synovitis.

## Material and methods

**Patients.** Fifteen knees of 12 patients were included prior to arthroscopic synovectomy (9 knees). The underlying disease was RA in 9 knees (7 patients), while 6 knees (5 patients) had other causes of persistent arthritis (juvenile RA: 2 knees (1 patient), unspecified monarthritis: 3 knees; osteoarthritis: 1 knee).

**Clinical procedure:** MRI, standard blood tests (including s-C-reactive protein (s-CRP) and the erythrocyte sedimentation rate (ESR)), and a clinical examination were obtained before surgery, and 1 day, 7 days, 2 months and 12 months after surgery.

**Surgical procedure:** Firstly, at 4 preselected sites, macroscopic signs of synovitis were graded and synovial biopsies (later graded by a histopathologist for histologic signs of synovitis) were obtained. Secondly, as much synovium as possible was removed by a synovial resector, equipped with a suction device, through 3-4 portals (anteromedially, anterolaterally, and 1-2 portals in the suprapatellar recess).

**MRI:** Continuous transversal and sagittal T1-weighted spin-echo MR-images (TR/TE/slice thickness = 500-750ms/15-17ms/5mm) were obtained before and after i.v. injection of 0.05 mmol gadolinium-DTPA/kg body weight.

**Assessment of synovial membrane and joint fluid volumes:** By means of image processing software, the synovial membrane and the joint fluid of each transversal MR slice were outlined and the areas automatically calculated (5). Total volumes of synovial membrane and joint fluid were calculated by summation of slices.

**Assessment of cartilage and bone erosions:** Each of 6 regions was graded as follows: 0: No erosions, 1: Non-penetrating pannus-induced cartilage erosions 2: Penetrating pannus-induced cartilage erosions; 3: Presence of bone erosions. An erosions score, calculated as the sum of the gradings, were calculated (6,7).

## Results

Baseline data are given in Table 1. MR-images obtained at days 1 and 7 after surgery were characterized by massive amounts of intraarticular debris, effusion and bleeding, and diffuse enhancement from the periphery of the joint cavity was observed. As a consequence, only results from baseline and months 2 and 12 are reported. At baseline, median synovial membrane volumes were 55 cm<sup>3</sup> (range 8 - 128 cm<sup>3</sup>) in RA knees and 55 cm<sup>3</sup> (range 21 - 177 cm<sup>3</sup>) in non-RA knees. Volumes of membrane and fluid were significantly reduced after 2 months and 12 months, compared with month 0 (Table 2). No significant differences between volumes in RA and non-RA knees were observed at any time. Synovial membrane volumes at month 2 were significantly inversely correlated with the duration of clinical remission, both as regards all knees considered

together (Spearman rho=-0.67; p<0.05), RA-knees (rho = -0.76; p<0.05) and non-RA knees (rho = -0.83; p<0.05). No correlation with the rate of erosive progression was found.

A considerable amount of inflamed synovium was found in many knees at both 2 and 12 months after synovectomy, indicating that the synovium quickly regenerates and that recurrence of some degree of synovitis after few months is frequent.

## Conclusions

The synovial membrane has regenerated 2 months after arthroscopic knee joint synovectomy and it often shows signs of recurrent synovitis. However, compared with pretreatment volumes, synovial membrane and joint fluid volumes are significantly reduced both 2 and 12 months after synovectomy. Synovial membrane volumes 2 months after arthroscopic synovectomy were inversely correlated with the duration of clinical remission, suggesting that MRI may have a value as predictor of longterm clinical effect in arthritis.

## References

1. Østergaard et al. Scand J Rheum 1995; 24: 305-11
2. Østergaard et al. Arthritis Rheum 1997; 40: 1856-67
3. Arnold & Kahman. Arthritis Rheum 1989; 32: 108-11
4. Combe et al. Arthritis Rheum 1989; 32: 10-14
5. Østergaard et al. Scand J Rheumatol 1994; 23: 197-202
6. Østergaard et al. MAGMA 1994; 2: 91-100
7. Østergaard et al. J Rheumatol 1996; 23: 1151-61

Table 1: Baseline data. Values are medians (ranges) and MW the Mann-Whitney test.

	All knees	RA knees	non-RA knees	non-RA vs. RA (MW)
Number of knees (patients)	15 (12)	9 (7)	6 (5)	
Age (years)	58 (20 - 70)	64 (20 - 70)	25 (20 - 60)	p<0.01
Duration of knee symptoms (years)	7 (0.2 - 13)	2 (0.2 - 13)	2.5 (0.2 - 10)	p<0.05
Knee pain (VAS)	6.3 (2.8 - 10)	7.2 (5.7 - 10)	3.7 (2.8 - 8.8)	NS
Number of swollen and/or tender joints	5 (1 - 26)	7 (5 - 26)	1.5 (1 - 5)	p<0.01
s-CRP (mmol/l)	170 (30-1590)	324 (50-1413)	119 (30-590)	NS
ESR	42 (8 - 95)	45 (10 - 95)	41 (8 - 70)	NS
Macroscopic synovitis (average grade)	3.3 (1.0 - 4.0)	3.3 (1.0 - 3.8)	3.1 (2.3 - 4.0)	NS
Histologic synovitis (average grade)	1.8 (0.0 - 2.7)	1.8 (0 - 2.7)	1.9 (0.3 - 2.0)	NS
Synovial membrane volume (cm <sup>3</sup> )	61 (8 - 177)	55 (8 - 128)	66 (21 - 177)	NS
Joint fluid volume (cm <sup>3</sup> )	41 (6 - 173)	35 (9 - 94)	70 (6 - 173)	NS
Bone erosion score	0 (0 - 5)	1 (0 - 5)	0 (0 - 1)	p<0.05
Progression in bone erosion score	0 (0 - 4)	0 (0 - 4)	0 (0)	NS
Duration of clinical remission (days)	360 (30 - 360)	330 (30 - 360)	360 (30 - 360)	NS

Table 2: Synovial membrane and joint fluid volumes after synovectomy.

Values are medians (ranges in brackets). MW indicates the Mann-Whitney test.

	All knees	RA knees	non-RA knees	non-RA vs. RA (MW)
<b>Synovial membrane volumes (cm<sup>3</sup>)</b>				
Month 0	62 (21 - 177)	59 (46 - 128)	66 (21 - 177)	NS
Month 2	49 (18 - 86)	49 (19 - 86)	50 (18 - 74)	NS
Month 12	44 (1 - 73)	42 (9 - 73)	45 (1 - 61)	NS
Wilcoxon-Pratt test (p-value)				
Month 0 vs. 2	<0.05	NS (0.09)	<0.05	
Month 0 vs. 12	<0.01	<0.05	NS (0.06)	
Month 2 vs. 12	NS (0.16)	NS (0.74)	NS (0.08)	
<b>Joint fluid volumes (cm<sup>3</sup>)</b>				
Month 0	45 (6 - 173)	36 (15 - 94)	70 (6 - 173)	NS
Month 2	18 (3 - 49)	28 (6 - 40)	11 (3 - 49)	NS
Month 12	17 (0 - 77)	18 (5 - 77)	15 (0 - 47)	NS
Wilcoxon-Pratt test (p-value)				
Month 0 vs. 2	<0.01	<0.05	<0.05	
Month 0 vs. 12	<0.05	NS (0.31)	<0.05	
Month 2 vs. 12	NS (0.66)	NS (0.80)	NS (0.50)	