Arthrographic study of the rheumatoid knee. Part 2. Articular cartilage and menisci

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SUMMARY The changes of the articular cartilage and of the menisci in 129 knee joints with classical rheumatoid arthritis have been investigated by an improved arthrographic technique. The changes of the intra-articular components on the arthrograms coincided well with direct views at arthroscopy and surgery. The changes of the articular cartilage on the arthrograms were graded as normal, deposit and pooling, thinning, filling defect, destruction, and disappearance, and those of the menisci as normal, degeneration, tear, and disappearance. The results showed that: (1) The radiographs did not always reflect the changes of those intra-articular components in the early stages; especially in stage 2 they showed various conditions from intact to destruction. (2) The changes of the menisci were less advanced than those of the articular cartilage in the early stages. (3) The changes in those components progressed almost symmetrically in both compartments. It is necessary to appreciate not only the pathological condition of the bones of the knee joints but also that of the intra-articular components to devise more careful programmes of treatment for rheumatoid knees.

In general the intra-articular pathological conditions of the rheumatoid knee joint are evaluated by clinical findings and plain radiographs. However, it is difficult to appreciate the pathological conditions in the intra-articular components such as the articular cartilages, menisci, and ligaments on such information alone. Furthermore, since salvage operations are increasingly used for severely damaged rheumatoid knees, accurate information of the internal

pathology is necessary. By improving the method of double contrast arthrography,¹ it has become possible to apply this technique to rheumatoid knees.

In this paper the relationship between plain roentgenograms and the pathological conditions of the articular cartilages and menisci in 129 rheumatoid knee joints are discussed.

Materials and methods

This arthrographic study was undertaken on 129 knee joints of patients with classical rheumatoid arthritis according to the American Rheumatism

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Fig. 1 *Material.*

Association criteria (Fig. 1). Thirty-four were male joints and 95 female joints. The knee joints were divided into 3 groups by the roentgenographic classification of Steinbrocker.² Stage 1 comprised 56 joints (male 18, female 38), stage 2, 53 joints (male 15, female 38), and stage 3, 20 joints (male 1, female

19). Most of these joints were examined periodically for several years by arthrography. The pathological condition of some of these joints was confirmed by direct vision at arthroscopy and/or surgery.

Arthrography as previously reported was used.³⁴ Four arthrograms, 2 anteroposterior views for the

Fig. 2 Changes of articular cartilage on arthrograms of the knee with rheumatoid arthritis and relation to direct vision.

lateral and the medial compartment, a lateral view, and a skyline (axial) view were routinely obtained. Evaluation of the plain roentgenograms was based on Steinbrocker's classification.² The normal articular cartilage was displayed very smoothly and evenly, and the stains made by the contrast medium are thin and constant.

When the articular cartilage was eroded, the appearance became obscure with increasing deposit and pooling of the contrast medium (Fig. 2). In cases of ulceration by invasion of the synovial tissues the surface appeared abnormal as unevenness, localised thinning, and notable pooling of the contrast medium. In cases of advanced cartilagenous destruction a filling defect reaching to the subchondral area could be recognised. No deposition of the contrast medium could be seen on the exposed bone area.

These pathological changes of the articular cartilage on the arthrograms were graded as normal, deposit and pooling, thinning, filling defect, destruction, and disappearance; the findings correlated well with those seen at arthroscopy and/or surgery. They were categorised normal, slight change (deposit, pooling and/or thinning), moderate change (filling defect and/or thinning), and severe change (destruction and disappearance).

A cross-section of the corpus of the meniscus was imaged in an acute-angled triangle with its apex towards the centre of the joint. Some thin prolongations of the anterior and posterior horns were spread to the tibial spines.

When the menisci were degenerate, their appearance similar to that of the articular cartilage, became obscure, and the deposit of the contrast medium increased (Fig. 3). The severely degenerate

Fig. 3 Changes of menisci on arthrograms of the knee with rheumatoid arthritis and relation to the direct vision.

or torn menisci lost their original shapes by invasion of the contrast medium into the degenerated parts, fractures, and fissures. Those pathological changes of the menisci on the arthrograms were also evaluated as normal, degeneration, and tear and/or disappearance, which coincided well with direct views.

Results

PLAIN ROENTGENOGRAMS

Comparison of the stages of the medial and the lateral compartments of the rheumatoid knees showed no difference between these 2 compartments in 90.1% (Table 1). Of the remainder, in 9.1% the

Table 1 Relationship of the stage between medial compartment and lateral compartment of the tibio-femoral joint (numbers are percentages)

Lateral	Medial		
	Stage 1	Stage 2	Stage 3
Stage 1	46.3	7.4	0
Stage 2	0	29.8	1.7
Stage 3	0	0.8	14.0

medial was more advanced than the lateral in its stage, and the reverse was found in only 0.8%.

Joints with different stages in the medial and the lateral compartment were seen in the earlier stages. In the advanced stage, such as late stage 3, most of the joints were at the same stage in both compartments. The pathological changes of the rheumatoid knee joints generally advanced at the same rate bilaterally and finally resulted in destruction.

ARTICULAR CARTILAGE

In stage 1 only 16.1% showed no pathological change on the arthrograms; a slight change such as attrition and erosion could be seen in 78.5% and moderate change such as ulceration in 5.4% (Fig. 4). These changes in the articular cartilage were never demonstrated on plain radiographs.

Although in the stage 2 group the plain radiographs showed only slight change, by arthrography a moderate change of the articular cartilage could be seen in 26.7% and severe changes in 4.4%. This means that one-third of the joints with a slight change on the plain radiographs had actually

STAGE / CARTILAGE - 1

STAGE		1 (56 JTS)	2 (45 JTS)	3 (20 JTS)
CHANGE OF CARTILAGE	NORMAL	16.1	2.2	
	SLIGHT DEPOSIT	37.5	8.9	
	POOLING AND/OR THINNING	41.0	57.8	
	MODERATE FILLING DEFECT	5.4	26.7	
	SEVERE DESTRUCTION		4.4	5.0
	DISAPPEARING			95.0

% TOTAL 121 JOINTS

Fig. 4(a) Relationship between stage and changes of articular cartilage—1.

STAGE / CARTILAGE - 2

STAGE		1 (56 JTS)	2 (45 JTS)	3 (20 JTS)
CHANGES OF CARTILAGE	NORMAL	16.1	2.2	
	SLIGHT		66.7	
	MODERATE	5.4	26.7	5.0
	SEVERE		4.4	95.0

% TOTAL 121 JOINTS

Fig. 4(b) Relationship between stage and changes of articular cartilage—2.

STAGE / MENISCUS

LATERAL			CHANGE OF MENISCUS	MEDIAL		
STAGE 3	STAGE 2	STAGE 1		STAGE 1	STAGE 2	STAGE 3
	22.2	71.4	NO CHANGE	71.4	22.2	
5.0	60.0	23.2	DEGENERATION	28.6	69.0	10.0
5.0	13.3	5.4	TEAR		2.2	5.0
80.0			DISAPPEARANCE		2.2	85.0
10.0	4.5		UNDETECTED		4.4	
% TOTAL 121 JOINTS						

Fig. 5 Relationship between stage and changes of menisci.

already advanced to a moderate stage or beyond. In the stage 3 group all joints showed severe change, and the articular cartilage had already vanished in up to 95% on the arthrograms. It is apparent that plain radiographs do not always express the pathological changes of the intra-articular components well, particularly in the stage 2 group, which is the most important clinically.

MENISCI

The changes of the menisci in the rheumatoid knees were almost equal in the medial and lateral compartment. This pattern differed greatly from that of the osteoarthritic joint, in which the medial meniscus is more severely damaged than the lateral in general. It was similar to the articular cartilage in that the pathological changes of the medial became more severe as the stage advanced.

In stage 1 there were no abnormal findings on the arthrograms in 71.4% of the medial and the lateral menisci. A slight change, mainly degeneration, could be seen in 28.6% of the medial and 23.2% of the lateral. A torn meniscus was recognised only in 5.4% laterally and a severe change such as disappearance was never seen in the stage 1 group.

In stage 2 the proportion of the normal menisci decreased to 22.2% on both sides. The degenerative changes of the menisci increased up to 69.0% in the medial 60.9% in the lateral. Torn menisci occurred in 2.2% of the medial and 13.3% of the lateral. Though torn menisci could be observed more frequently laterally, disappearance of the menisci, a much more severe change, was recognised only medially. In stage 3 all joints showed changes in the menisci. Only 5% of the medial menisci and 10% of the lateral showed slight change, and in 5% of each side torn menisci could be observed. The medial menisci had already disappeared in 85% and the lateral in 80%. Most of the menisci, therefore, at this stage showed severe changes.

These results suggest that plain radiographic

findings do not always reflect the pathological change in the menisci, particularly at stage 2.

Discussion

Pathological changes in the rheumatoid knee joint usually begin from synovial tissue and extend to the articular components such as the cartilage, menisci, and ligaments until the joint is destroyed completely. There is no doubt that the destruction of the cartilage especially influences the prognosis of the joint function.

As Steinbrocker's classification of the stage from plain radiographs is not only simple but easy to apply, it has been popular in the evaluation of the pathological condition of rheumatoid joints. However, more detailed classifications have come into use recently,⁶ because it is necessary to express intra-articular conditions with great accuracy. Arthrography is superior to plain radiography in providing intra-articular information.

As shown in Fig. 6, in the stage 1 group the degree of cartilaginous change is almost the same for the femoral condyles and the tibial condyles and also in the medial and lateral, which means that cartilaginous change is advancing symmetrically. The pattern of meniscal change is similar to that of the cartilage.

In the stage 1 group 16.1% of the joints showed no abnormal change in the cartilage in the medial and the lateral compartments. On the other hand in 71.4% the medial and lateral menisci were normal on the arthrograms. These results suggest that at this early stage the cartilaginous change is ahead of that of the menisci. In the stage 2 group, though the change of the cartilage, as in the stage 1 group, is symmetrical in the medial and the lateral compartments, the cartilaginous change of the femoral condyles is a little more advanced than that of the tibial condyles. The characteristic of the pathological conditions of the intra-articular components in this stage varies greatly from normal to severe, and

Fig. 6 Relationship between stage and changes of intra-articular components of the individual joint on arthrograms. ■ Indicates existence of change.

almost similar results can be seen in the menisci. In the stage 3 group 95% of the articular cartilage, 85% of the medial, and 80% of the lateral menisci showed severe change, the extent of which is similar in both compartments. From these facts it can be seen that the change in the articular cartilage is almost symmetrical through all the stages.

Despite recent research little is known about the mechanism of the progression of cartilaginous and meniscal destructive changes in the rheumatoid knee

joint. As mentioned in the previous paper (Part 1), the degree and the localisation of synovial proliferation correlate closely with the pathological changes in these intra-articular components, which at least clinically begin from synovial tissue, the cartilage and menisci becoming its target. The findings that the change in the articular cartilage is a little ahead of that of the menisci in the early stage, but that the change of both compartments is almost the same in the advanced stage, are contrary to the report of Sakamoto⁵ of the findings at operation, in which the meniscal changes were much more severe than those of the cartilage. It appears that rheumatoid synovial tissues are macroscopically and microscopically much more invasive to the cartilage than to the menisci.

It is necessary to appreciate not only the pathological condition of the bones of the knee joints but also that of the intra-articular components to devise more careful programmes of treatment for rheumatoid knees. The changes in the bony component in plain radiographs do not always show the changes of the intra-articular components, especially in the early stages. To fulfil this purpose arthrographic and/or arthroscopic techniques are usually used, and the former are particularly beneficial for screening because the procedure is straightforward and can be repeated on an outpatient basis.

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