Titolo rivista/libro: Scandinavian journal of rheumatology

Titolo articolo/sezione: sonographic evaluation of femoral condylar cartilage in osteoarthritis and rheumatoid arthritis

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ISSN: 0300-9742

DOI:

Anno: 1992

Volume: 21

Fascicolo: 4

Editore:

Pag. iniziale: 201

Pag. finale: 213

Sonographic Evaluation of Femoral Condylar Cartilage in Osteoarthritis and Rheumatoid Arthritis

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Iagnocco A., Coari G., Zoppini A. Sonographic Evaluation of Femoral Condylar Cartilage in Osteoarthritis and Rheumatoid Arthritis. Scand J Rheumatol. 1992; 21: 201–203.

Employing a real-time sonographic scanner with a 5 MHz linear probe, the articular cartilage of the knee was studied in four groups of subjects: normal subjects aged 18–36 years and 50–63 years, patients with rheumatoid arthritis (RA) and patients with osteoarthritis (OA). Cartilage thickness was diminished both in RA and in OA knees compared to the two groups of normal joints, even if in RA the reduction was less. The cartilage surface appeared irregular more frequently in OA than in RA. Our survey suggests that the sonographic technique is a useful, non-invasive diagnostic method to study the articular cartilage of the knee.

Key words: sonography, articular cartilage, rheumatoid arthritis, osteoarthritis.

In the last few years sonography has been used to study joints and especially the knee. Compared to other diagnostic methods, such as arthrography, arthroscopy, CT, and MRI, this technique is inexpensive, rapid, non-invasive, readily accepted by patients, and it does not use ionizing radiation (1). Sonography of the knee makes it possible to study the anatomical details of this articulation, such as synovial membrane, intra-articular fluid, articular cartilage, ligaments and tendons, menisci, possible popliteal cysts, their dimensions and localization.

In many rheumatic diseases it is very interesting to study these structures and their alterations.

Employing a real-time sonographic scanner we studied the articular cartilage of the knees evaluating the structure of cartilage surface in normal subjects, in patients with osteoarthritis (OA) and with rheumatoid arthritis (RA).

Materials and Methods

A 5 MHz linear probe with interposition of a gel spacer (Kitecko-3M) was used. The subjects were examined supine and with the knees held in maximum flexion (about 120°). The superior margin of the patella and the centre of the intercondylar groove were used as landmarks (1). Thickness was measured at specified points with the transducer oriented first transversely and then longitudinally with respect to the leg. 3 measurements were taken just above the superior margin of the patella, one two-thirds from the intercondylar notch to the lateral margin of the lateral condyle, another over the intercondylar notch, and a third two-thirds of the way from the intercondylar notch to the medial border of the medial condyle. The cartilage physiologically thins out just as it reaches the condylar apices. The measurements were repeated 2 cm above the superior margin of the patella. A magnified picture allowed an accuracy of 0,1 mm. Surface regularity was studied and changes such as blurring or obliteration of sharp edges were detected (Fig. 1, 3).

4 groups of subjects were examined:

1) 15 normal subjects aged 18–36 years, 6 men and 9 women;
2) 15 normal subjects aged 50–63 years, 8 men and 7 women;
3) 48 RA patients aged 24–45 years, 18 men and 30 women;
4) 60 OA patients aged 52–75 years, 27 men and 33 women.

The diagnosis of RA was confirmed by the new ARA criteria of 1988 (2). The disease had been present at least for 5 years and a clinical involvement of the knee for at least 2 years. RA subjects aged more than 45 years were excluded because of the possibility of a contemporary OA of the knee. The clinical involvement of the knee in OA patients was characterized by pain, deformity, enlargement of the joint, and limitation of motion.

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Received 27 June 1991
Accepted 3 February 1992

Table I. Mean value (mm) and standard deviations of cartilage thickness in the four groups examined.

	Mean value of sonographic measurements		
	laterally (mean + DS)	centrally (mean + DS)	medially (mean + DS)
30 normal controls (18–36 years)	2.10±0.71	2.50±0.39	2.07±0.63
91 RA knees	1.15±1.02	1.55±1.12	1.21±1.06
30 normal controls (50–63 years)	1.87±0.70	2.20±0.81	1.77±0.56
114 OA knees	0.99±0.81	1.35±1.02	0.94±0.85

The differences in each point of measurements as compared with controls are statistically significant ($p < 0.01$) both in RA and in OA.

Moreover, radiologic features of OA were present.

All knees that could not be bent at least 120° were excluded. In 3 cases where an abundant effusion prevented complete flexion, the sonographic examination was made after arthrocentesis.

In each joint six measurements of articular cartilage were taken just above the superior margin of the patella: two laterally, two medially and two centrally, and the mean value of each couple of results was calculated. The same measurements were taken 2 cm above the patella and the calculation repeated.

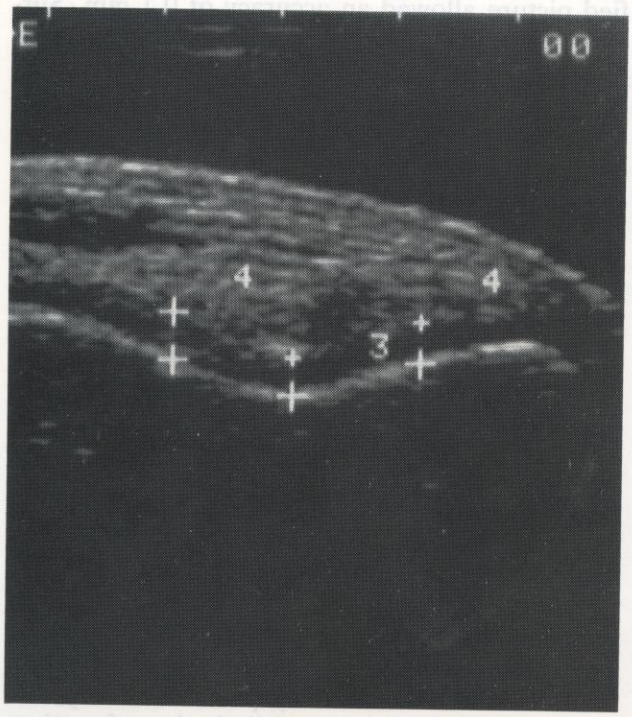

Fig. 1 Normal articular cartilage of the knee.

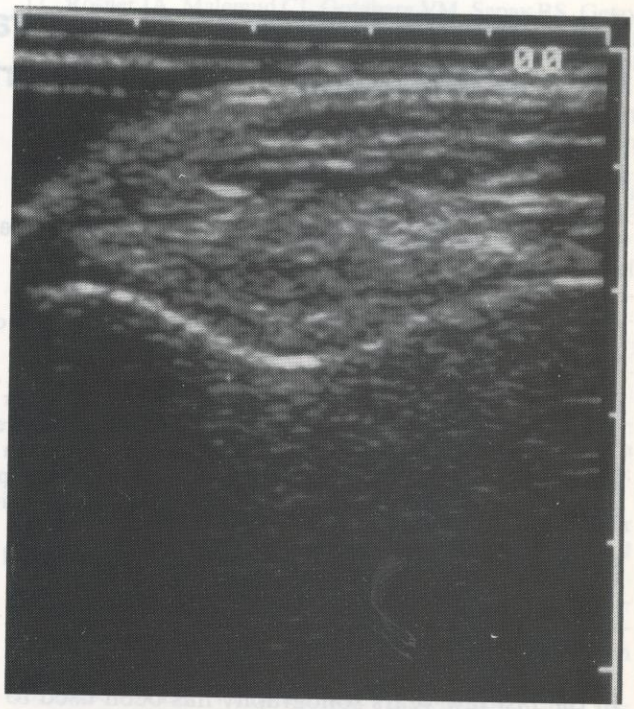

Fig. 2 Thinning of articular cartilage in a patient with OA.

In each one of the four groups we calculated the mean value of the individual results. Student's t-test was used for statistical analysis.

We also studied the quality of cartilage surface, classifying it as either regular or irregular, and calculated the frequency of irregularity in the pathologic articulations.

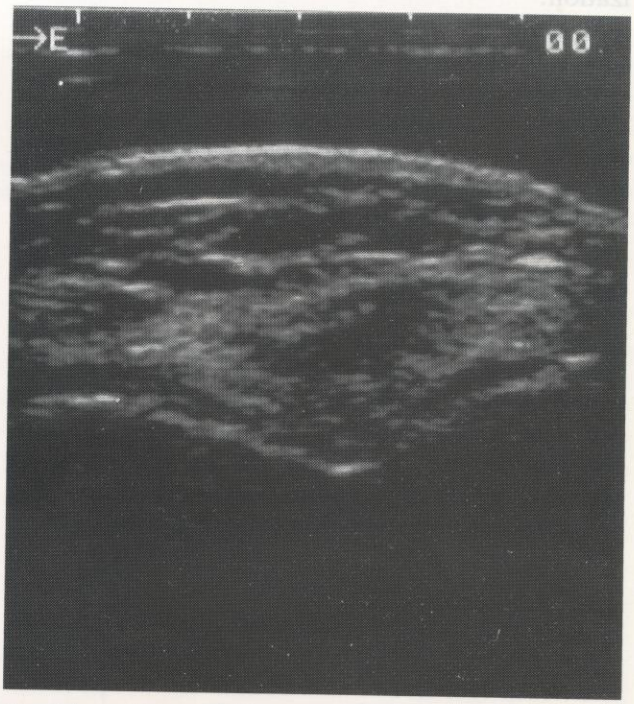

Fig. 3 Irregularity and blurring of sharp margins.

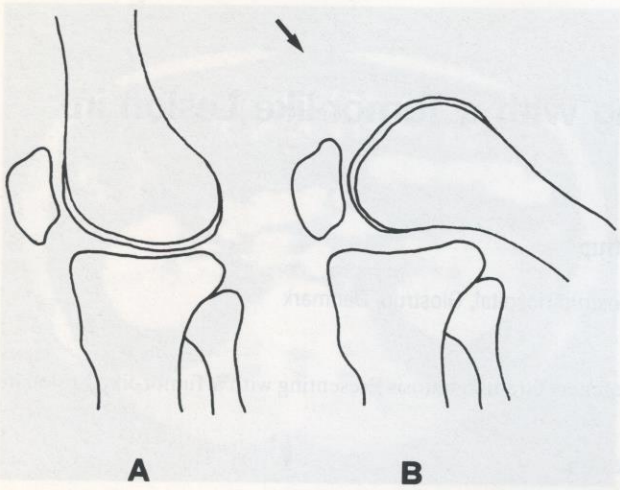

Fig. 4 Articular cartilage, which is under the patella when the knee is extended (A), can be studied by sonographic beam (arrow) when the articulation is fully flexed (B).

Results

Results of the measurement of cartilage thickness obtained by longitudinal and transversal scannings were similar, both in normal and pathologic knees. In normal articulations the mean value of cartilage thickness was between 1,8 mm and 2,5 mm; these results are in accordance with Hammer's work (1).

In all of the four groups of subjects examined the cartilage thickness was always greater at the centre of the intercondylar notch than on lateral and medial condyles (Table I).

Cartilage thickness was diminished both in RA and in OA knees compared to the two groups of normal controls (Table I), even if the reduction was less in RA.

The cartilage surface was irregular in 95 knees with OA out of 114 (83%) and in 61 RA cases out of 91 (67%).

Discussion

In 1984 Aisen (3) described a sonographic technique to measure the thickness of femoral condylar cartilage. Articular cartilage of the knee produces a sonolucent image whenever the sonic beam is perpendicular to its surface. Moreover, when the knee is fully flexed, it is possible to expose significant portions of the weight-bearing surface (Fig. 4), i.e. the cartilage area that more often is affected by rheumatic diseases.

Sonographically the femoral cartilage appears as a hypoechoic band with sharp margins, situated between a hyperechoic line (representing bone surface) and soft tissues (Fig. 1).

If articular cartilage is damaged by any pathogenetic factors, it is subject to some alterations (4) which cause narrowing of the hypoechoic band (Fig. 2) and blurring and irregularity of normally sharp edges (Fig. 3).

In our study the thickness of articular cartilage of the knee was measured by Aisen's sonographic technique. Because this method had been used by some authors (5, 6) in only a few cases, we examined the condition of articular cartilage in two of the most common rheumatic diseases that involve the knee: OA and RA.

Measurements taken in each one of the two groups of patients were compared to those taken in normal subjects.

There was no difference between results obtained by longitudinal and transverse scannings and we take this as evidence of the accuracy of the method.

In the four groups of subjects examined, the cartilage thickness was greater on the condylar notch than on the medial and lateral condyle, probably because the intercondylar notch is less weight-bearing than the condyles. No difference was found between the two condyles.

The aspect of cartilage surface appeared irregular more frequently in OA knees (83%) than in RA cases (67%).

Our survey of a large number of knees shows that it is possible to obtain useful information about articular cartilage of the knee and its alterations by means of sonography. Since sonography is non-invasive and cheap it makes it possible to follow the evolution of cartilage damage and to evaluate therapy efficacy.

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