Radiologic classification of knee joint destruction in juvenile chronic arthritis

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Abstract. A new radiologic classification of juvenile chronic arthritis (JCA) of the knee joint is presented. Osteoporosis, epiphyseal enlargement, erosions, subchondral cyst formation and deformity of the joint surfaces are expressed in terms of a score. No attention is paid to the joint space or soft tissues. Thirty knee joints in 15 patients with JCA were evaluated according to the radiologic classification. There was a good correlation between the radiologic score and the clinical findings. The inter- and intraobserver variation was low. The classification system is proposed as a valuable tool for measuring the degree of knee joint destruction in evaluation of the natural course or results of treatment in JCA.

In JCA the knee joint is an important target area for the arthritic destruction [1]. During the last decades several new pharmacological and surgical techniques to prevent destruction of the joint have been tried with varying success. To evaluate the efficacy of the treatment given, it is important to be able to quantify the joint destruction, but hitherto no sensitive and objective method for such quantification exists. This paper presents a radiologic classification of the arthritic destruction of the knee joint in JCA, using a scoring system.

Material

The material consists of 15 patients with JCA, consecutively admitted to the Center for Joint Diseases in Children at the University Hospital of Lund, Sweden. There were five boys and 10 girls, with a mean age at diagnosis of 5 (1–13) years, and a mean age at the present examination of 11 (4–21) years. Nine of the patients had polyarticular and six had oligoarticular disease. In all patients both knee joints were affected, the mean duration of arthritis of the knee joint being 7 (1–19) years.

In the present study the 30 knee joints had a thorough clinical examination as well as a conventional radiologic examination including frontal and lateral views of the knee joint, and an axial view of the patello-femoral joint.

Method

The femoro-tibial and patello-femoral joints were individually assessed. Each of the bones participating in the articulation of the knee was examined for signs of osteoporosis, enlargement, erosions, subchondral cysts and deformity of the joint surface. The presence or absence of each of these parameters was allotted 1 or 0 points, respectively. An example of the scoring is given in Figure 1. Thus, each bone got a score of 0 to 5 points, giving a total score of the joint that could theoretically vary between 0 and 15 points (Table 1).

The clinical examination included assessment of pain at rest, pain upon weightbearing, swelling, atrophy of the extensor muscles of the knee, extension and flexion contracture, deformity and instability. These parameters were alotted 0–3 points, 0 point denoting a normal clinical finding, 1 point mild abnormality, 2 points moderate and, 3 points severe abnormality. Thus, the clinical score theoretically could range between 0 and 24 points.

All radiographs were individually examined by the two authors on two different occasions. The radiologic and clinical score in each joint were matched, and the scores obtained by the two authors as well as by the same author at the two different occasions were compared. The mean and SD for the intra- and interpersonal scoring differences were calculated.

Result

The radiologic score varied between 0 and 13 points with a mean of 8.9 points.

The clinical score varied between 1 and 14 points with a mean of 8.2 points.

The correlation found between radiologic and clinical score is illustrated in Figure 2. The correlation coefficient was 0.78 ($p < 0.001$).

The mean for interobserver scoring differences was 0.8 (SD 1.1) and the mean for intraobserver scoring differences was 0.4 (SD 0.6).

Table 1. Radiologic classification of the degree of joint destruction in JCA

	Femur	Tibia	Patella
Osteoporosis	0–1	0–1	0–1
Enlargement of epiphysis (or patella)	0–1	0–1	0–1
Erosion	0–1	0–1	0–1
Subchondral cyst formation	0–1	0–1	0–1
Deformed joint surfaces	0–1	0–1	0–1
Score	0–5	0–5	0–5
Total score 0–15			

Fig. 1 a–c. Girl, 14 years, JCA with knee affection since aged 10 years. a AP, b lateral view of the knee and c axial view of the patella. Osteoporosis (3 p.), enlargement (3 p.), tibial erosion (white arrow) (1 p.), patellar and femoral subchondral cysts (black arrow and arrowhead, respectively) (2 p.), femoral joint surface deformation (1 p.). Total joint score is 10 p

Discussion

Radiologic changes in JCA may be described verbally, giving an overall view of the morphologic changes in a joint. However, for scientific purposes and for follow-up studies of treatment there is need for some form of staging or scoring, thereby giving the possibility of a numerical analysis of the degree of joint destruction. Several suggestions for such a classification have been published, but all have been directed towards changes in rheumatoid arthritis in adults. Thus Steinbrocker et al. [10] proposed a standardized evaluation of rheumatoid arthritis based on four stages, but the sensitivity of that system was low, and the vague description of the changes qualifying for each stage also ment a low reproducibility [4, 6] Kellgren et al. [3] published an atlas of standard radiographs of arthritis, using standard reference films.

However, several pathologic changes could develop between two examinations, without the joint qualifying for progression from one stage to the next and thus the sensitivity was low. Sharp et al. [8] designed a scoring system for erosions and joint space narrowing in the hand and wrist, but never took into consideration other changes in the arthritic joint.

Larsen et al. [4, 6] presented a six-graded staging system, based on standard reference films. This system is today the most often used, and it is also recommended by the European League against Rheumatism (EULAR). This system has proven to be of high reproducibility [5, 9], but it has some disadvantages: the correlation between the radiologic and clinical stages is not convincing, and several changes may occur between two examinations, without the joint qualifying for an increase in stage.
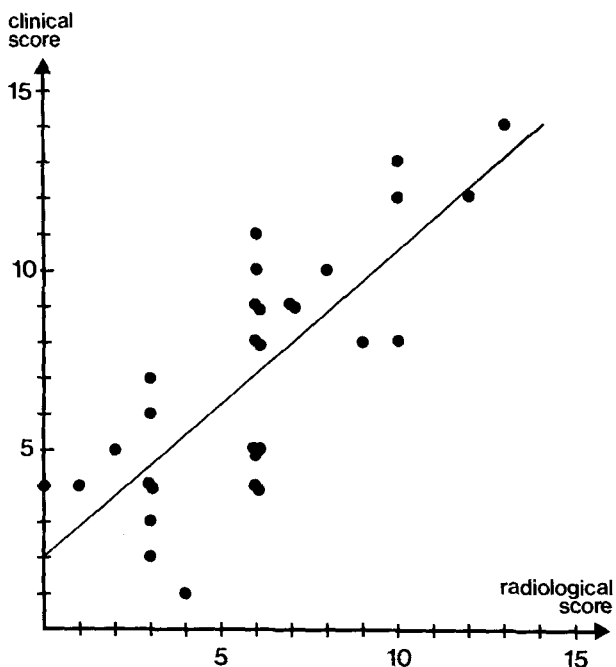
None of the above systems is designed for the

Fig. 2. Correlation between clinical and radiologic score. The correlation coefficient is 0.78 ($p < 0.001$)

changes specific for JCA and no other optimal radiologic assessment seems to have been published.

A radiologic evaluation, suitable for thorough assessment of the destruction in JCA should fulfill the following criteria:

1. It should be objective, with high reproducibility and accuracy.

2. The changes considered should be relevant for long-term progession or regression of the arthritic disease, and should be independent of acute exacerbation.

3. There should be a good correlation between the clinical status of the joint and the radiologic assessment.

4. The changes should be expressed numerically.

5. Each parameter included should be recorded individually, as well as the sum of parameters in a single joint or in a group of joints.

6. The method should be based on standard projections on plain films so as to be usable in multicenter studies.

The present classification, based exclusively on skeletal changes, fulfills the criteria given above.

There are many subgroups of JCA, with radiologic differences between them. However, the radiologic changes chosen may appear both in polyarthritic and oligoarthritic JCA as well as in juvenile adult-onset rheumatoid arthritis, and represent the progression of the arthritis.

In the present system no attention is paid to the loss of joint space. The reason is that estimating the joint space in the knee in children is hazardous; there ist an obvious difficulty for the child to put

weight upon a painful knee joint, and measurement of the joint space in the unloaded joint is of doubtful significance. Moreover, the arthritic knee joint often has a flexion and/or valgus deformity giving a false impression of joint space loss due to projectional error. Also, joint space loss is not such a prominent feature in JCA as in rheumatoid arthritis in the adult. Signs of soft tissue swelling and widening of the joint space caused by synovitis and effusion have been excluded. These signs, although early appearing, also are signs of acute exacerbation and thus unreliable parameters in assessment of the chronic destruction.

The present classification has a good correlation with the clinical status, a high accuracy and reproducibility and a low intra- and interobserver variation. It is based on the same principles as that designed by Pettersson et al. [7] for the hemophilic arthropathy. This system has proven to be of great value in that patient group [2] and therefore the present classification should be useful for the staging of the knee joint in the clinical situation, as well as for long-term follow-up in JCA. A study of the effect of synovectomy of the knee joint in JCA using this system is in progress.

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