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The course of ultrasonographic abnormalities in knee osteoarthritis: 1 year follow up

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SUMMARY

Objective: Imaging of (peri)articular structures and inflammation with Ultrasonography (US) during the course of osteoarthritis (OA) might contribute to knowledge about early diagnosis of OA, prognosis and possibly the effect of disease modifying drugs. Our goal was to identify the prevalence of distinct patterns (stable vs fluctuating) in a set of US features in a cohort of patients receiving standard multimodal treatment for knee OA at $T = 0$, $T = 3$ months and $T = 12$ months.

Design: This was a prospective, explorative study including 55 patients fulfilling the American College of Rheumatology clinical criteria for knee OA. Six US features were investigated including: effusion, synovial proliferation, infrapatellar bursitis, meniscal protrusion, Baker's cyst and cartilage thickness at three time points during 1 year. A composite inflammatory score was composed. Overall prevalence was assessed as well as individual patterns which were appointed as stable or unstable.

Results: Inflammation like effusion and synovial hypertrophy does occur in over 40% of patients at some time in the year of follow up and shows a fluctuating pattern. Meniscal protrusion and Baker's cyst however are more stable features.

Conclusions: Our study gives insight in the prevalence and course of US abnormalities in patients with knee OA and contributes to the knowledge on the possible role of this imaging modality in research.

Introduction

Osteoarthritis (OA) is a common joint disorder, with the knee being one of the most frequently involved sites. It is characterized by degradation of cartilage and other (peri)articular structures and causes pain and stiffness, which can lead to considerable disability and in turn to decrease of quality of life and work impairment[1,2].

So far no disease modifying drugs for OA are available, mainly due to the fact that pathophysiology and relation with subsequent signs and symptoms are not completely understood. OA is not merely a disease of bone and cartilage but it affects the entire joint including soft tissue structures like menisci and synovium[3]. Visualizing these (peri)articular structures during the course of OA might contribute to knowledge about early diagnosis of OA and prognosis. Besides, knowledge about the natural course of the disease through imaging might contribute to evaluating the effect of possible disease modifying drugs[4].

Among the available imaging tools in OA, Ultrasonography (US) has a very attractive profile. It is, in contrast to conventional radiography, able to visualize (peri)articular soft tissue structures. In addition, US in knee OA has shown good construct validity[5,6] and moderate to good interobserver reliability[7,8]. Compared to Magnetic Resonance Imaging (MRI) which also produces images of soft tissue structures, it is relatively safe, inexpensive and less time consuming.

Prior research focussed mainly on cross sectional associations of US abnormalities with knee pain or progression to knee replacement[9–14]. Little is known however, about the course of soft tissue pathology visualized by US in time and thus about the course and behaviour of soft tissue structures in the osteoarthritic knee[5]. In theory, inflammatory aspects like effusion and synovial proliferation are likely to fluctuate in time. Mechanical features (e.g., meniscal protrusion), however, are expected to be more permanent and progress over time. This is of importance, because

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heavily fluctuating features are less likely to be useful for long-term prediction. The limited number of previous US follow up studies suggest that Baker's cyst is a relatively stable feature which tends to persist up till 3 years whereas synovial effusion is more momentary and tends to diminish 6 months after hyaluronic acid injection[15–17]. Evidence from MRI studies shows a very gradual decrease in cartilage thickness and increase in meniscal pathology over time with follow up data up till 36 months[18,19]. Little is known about the follow up of inflammatory changes on MRI in knee OA[20].

Therefore, in this explorative study we assessed a set of US features in the course of time in order to identify the ones which might be more eligible candidates for long term prediction. Our goal was to identify the prevalence of distinct patterns (stable vs fluctuating) in a set of US features in a cohort of patients receiving standard multimodal treatment for knee OA at $T = 0$, $T = 3$ months and $T = 12$ months.

Patients and methods

Study design

This prospective, study was carried out in the framework of a specialized knee- and hip-OA outpatient clinic. All patients were treated according to a multimodal treatment protocol comprising education, physical therapy, step up analgesics (acetaminophen, non steroidal anti-inflammatory drugs (NSAID), tramadol) and intra-articular injection with triamcinolonacetate and advice on weight reduction if indicated[21]. In this protocol, patients were followed up every 4 weeks in the first 3 months, after that, out-patient visits were planned yearly. The local Medical Research Ethics Committee, region Arnhem-Nijmegen (The Netherlands) approved the study design (study number 2009/095).

Patients

A total of 55 consecutive consenting patients fulfilling the American College of Rheumatology clinical criteria for knee OA[1] were included in our study. The symptomatic knee was appointed as index joint. If patients had bilateral knee OA the most symptomatic knee was selected. Exclusion criteria were: other rheumatic or severe orthopaedic diseases leading to inflammatory arthritis or secondary OA, co-morbidity exceeding the complaints or limitations of the knee OA, orthopaedic procedures planned within the next 3 months and cognitive or sensorimotor problems interfering with filling out questionnaires.

Data acquisition

On inclusion knee X-rays were collected. Weight bearing fixed flexion posterior–anterior radiographs were graded using Kellgren and Lawrence systematics (K&L)[1]. The patient was in standing position, knee flexed in 20–30°, and feet internal rotated 10°. At three time points (T_0 = inclusion, $T_1 = 3$ months, $T_2 = 12$ months), the US investigation was performed. At baseline clinical, demographic data and data on pain and analgesics were collected. Pain was assessed using a Numerated Rating Scale (NRS) from 0 to 10. The Knee injury and Osteoarthritis Outcome Score (KOOS) (Likert scale version)[22] was used as an instrument to assess the patients' opinion about their knee associated problems. KOOS scores were transformed in a way that 0 indicates no complaints and 100 indicates maximum complaints.

US

US was performed by a rheumatologist (KB) and a post-doc physician, who were trained in musculoskeletal US and previously involved in inter reader reliability research of the applied US protocol. Both investigators performed US on T_0 and T_1 (evenly distributed). For practical reasons (acceptance job offer elsewhere second investigator) KB performed all investigations on T_2. The protocol is based on results of previous US studies (especially the Outcome Measures in Rheumatology (OMERACT) definitions) and pathophysiologic concepts of knee OA[5,6,10,23]. It focuses on two domains, comprising inflammatory (synovial hypertrophy, effusion and bursitis), and mechanical aspects (medial meniscus protrusion, Baker's cyst and cartilage thickness). In a previous study, the protocol showed moderate to good interobserver reliability for all items except synovial hypertrophy[7]. To improve our results on synovial hypertrophy, we performed renewed calibration sessions in five patients with both investigators. Thereafter, 23 patients were blindly investigated by both assessors and interobserver agreement was calculated, yielding a new kappa value for synovial hypertrophy of 0.65. Overall, we managed to improve our interobserver agreement as new kappa values ranged from 0.59 for meniscal protrusion to 1.00 for Baker's cyst and effusion. For cartilage thickness, the minimal correlation coefficient was 0.74 (95% confidence interval (CI): 0.57–0.92) with difference of 0.12 (95% CI limits of agreement: −0.67–0.91 mm). Clinical evaluation and US examination were obtained on the same day. The investigator performing US was unaware of clinical and radiographic results. The ultrasound machine used in this study was a MyLab 25 gold (Esaote Biomedica, Genoa, Italy) with a 35 mm linear transducer (frequency 8–15 mHz). The complete US investigation took about 10 min per patient. The US protocol comprised the following items:

(1) Effusion: $a \geq 4$ mm hypoechoic or anechoic intra-articular material that is displaceable and compressible in the suprapatellar recess, evaluated using a longitudinal scan with the leg in passive full extension[9].
(2) Synovial hypertrophy: an abnormal hypoechoic intra-articular tissue that is nondisplaceable and poorly compressible of ≥2 mm in the suprapatellar recess, measured with the leg in full extension with a longitudinal scan[9].
(3) Meniscal protrusion: protrusion of meniscal tissue out of the joint space >3 mm from the joint line, evaluated at the medial joint space with the knee in full extension with a longitudinal scan (Fig. 1)[10].

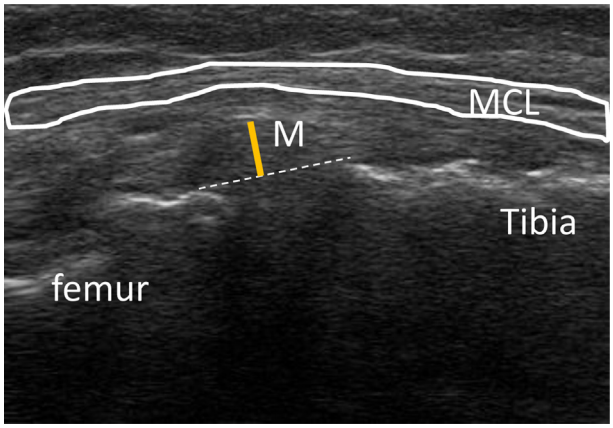

Fig. 1. Meniscal protrusion (M). Measured between the medial collateral ligament (MCL) and the joint space (dashed line).