Osteoarthritis and Cartilage 20 (2012) 1142–1146

Osteoarthritis and Cartilage

The reliability of musculoskeletal ultrasound in the detection of cartilage abnormalities at the metacarpo-phalangeal joints

A. Iagnocco †*, P.G. Conaghan ‡, P. Aegerter §, I. Möller ‖, G.A.W. Bruyn ¶, I. Chary-Valckenaere #, E. Filippucci ††, F. Gandjbakhch ‡‡, D. Loeuille #, E. Naredo §§, M.A. D'Agostino |||

† *Rheumatology Unit, Dipartimento di Medicina Interna e Specialità Mediche, Sapienza Università di Roma, Rome, Italy*
‡ *Division of Musculoskeletal Disease, University of Leeds & NIHR Leeds Musculoskeletal Biomedical Research Unit, UK*
§ *Department of Public Health, Université Paris Ouest-Versailles-Saint Quentin en Yvelines EA2506, Hôpital Ambroise Paré APHP, Paris, France*
‖ *Department of Rheumatology, Instituto Poal de Reumatologia, Barcelona, Spain*
¶ *Department of Rheumatology, MC Groep IJsselmeerziekenhuizen, Lelystad, The Netherlands*
# *Service de Rhumatologie, Hôpitaux de Brabois, Centre Hospitalier Universitaire de Nancy, Rue du Morvan, 54511 Vandœuvre-lès-Nancy Cedex, France*
†† *Clinica Reumatologica, Universitá Politecnica delle Marche, Ancona, Italy*
‡‡ *Division of Rheumatology, CHU Pitié-Salpêtrière, Paris, France*
§§ *Department of Rheumatology, Hospital Universitario Severo Ochoa, Madrid, Spain*
||| *Department of Rheumatology, Université Paris Ouest-Versailles-Saint Quentin en Yvelines, Hôpital Ambroise Paré APHP, Paris, France*

ARTICLE INFO

Article history:
Received 16 November 2011
Accepted 3 July 2012

Keywords:
OMERACT
OARSI
Ultrasound
Cartilage
Hand OA
Reliability

Key message:
Ultrasound is a reliable tool for detecting cartilage abnormalities in hand OA

SUMMARY

Objective: To assess the reliability of ultrasound (US) in detecting cartilage abnormalities at the metacarpo-phalangeal (MCP) joints in people with cartilage pathology.
Methods: Nine expert ultrasonographers initially achieved consensus on definitions and scanning protocols. They then examined the second to fifth MCP joints of the dominant hand of eight people with hand osteoarthritis (OA). US examinations were conducted in two rounds, with independent blinded evaluations of cartilage lesions. Global cartilage abnormalities were assessed by applying a dichotomous (presence/absence) score; in addition, the following lesions were evaluated using the same scoring system: loss of anechoic structure and/or thinning of the cartilage layer, and irregularities and/or loss of sharpness of at least one cartilage margin. Reliability was assessed using kappa (k) coefficients.
Results: Thirty-two joints were examined. Intra-observer k values ranged from 0.52 to 1 for global cartilage abnormalities; k values ranged from 0.54 to 0.94 for loss of anechoic structure and/or thinning of cartilage layer and from 0.59 to 1 for irregularities and/or loss of sharpness of at least one cartilage margin. Values of k for inter-observer reliability were 0.80 for global cartilage abnormalities, 0.62 for loss of anechoic structure and/or thinning of cartilage layer, and 0.39 for irregularities and/or loss of sharpness of at least one cartilage margin.
Conclusion: US is a reliable imaging modality for the detection of cartilage abnormalities in patients with cartilage pathology in the MCP joints. The analysis of specific cartilage measures showed more variable results that may be improved by modifying definitions and further standardization of US techniques.

Introduction

Osteoarthritis (OA) is the most common rheumatic disease, affecting most peripheral joints[1]. Pathologically the OA process involves multiple joint tissues, with predominant involvement of the hyaline cartilage, showing focal and diffuse degeneration with areas of progressive cartilage loss[1,2]. The hand is commonly involved representing a frequent reason for consultations in primary care.

Radiography is the traditional tool for imaging hand OA, and is valuable for detecting structural joint changes; however it is not able to directly visualize cartilage and employs a surrogate measure, joint space narrowing. Thus, the availability of imaging tools to directly assess cartilage would be of great value, especially in the early diagnosis of OA, where there may be paucity of symptoms and few clinical findings.

Musculoskeletal ultrasound (US) is a valuable imaging modality for detecting and quantifying a range of pathologies occurring in

* Address correspondence and reprint requests to: A. Iagnocco, Dipartimento di Medicina Interna e Specialità Mediche, Reumatologia, Sapienza Università di Roma, Policlinico Umberto 1°, Viale del Policlinico 155, 00161, Roma, Italy. Tel: 39-06-49974634; Fax: 39-06-49974642.
E-mail address: annamaria.iagnocco@uniroma1.it (A. Iagnocco).

1063-4584/$ – see front matter
http://dx.doi.org/10.1016/j.joca.2012.07.003

hand joints in inflammatory arthritis and in OA[3–5]. It has been demonstrated to be able to show early and late findings related to inflammation and structural damage, including cartilage lesions[3,4,6–9]. Particularly, the frequent involvement of MCP joints in OA has been previously reported by Keen *et al.* who demonstrated that those joints can be a target area in hand OA[4].

Importantly US can directly image certain components of articular cartilage. Normal hyaline cartilage is imaged by US as a homogeneously anechoic layer lining the bony cortex and having a superficial and deep margins that characteristically appear thin, sharp, continuous and regularly hyperechoic. In OA, a wide set of abnormalities are visualized, with evidence of loss of the anechoic texture, irregularities of the margins and progressive thinning. However, for the poor contrast between hyaline cartilage and synovial fluid that are both anechoic, it can be sometimes difficult to assess small focal defects of the articular cartilage by using US. In addition, while there is evidence in the literature concerning the ability of US to evaluate cartilage involvement in large joints[1,9–14] there is a paucity of data about cartilage assessment at hand joints[8,9,15]. Moreover, there is still the common perception in the medical community that US is a highly operator dependent technique.

The aim of the present study was to assess the intra- and inter-observer reliability of US in detecting cartilage abnormalities at metacarpo-phalangeal (MCP) joints level in patients with cartilage pathology.

Patients and methods

Patients

A total of eight patients, consecutively recruited from the outpatient Rheumatology Unit of Sapienza Università di Roma, were included in the study and underwent MCP joints US examination of the dominant hand. All patients met American College of Rheumatology (ACR) criteria for hand OA[16]. The presence of any other rheumatic diseases was an exclusion criterion from the study. Ethical committee approval was obtained and all patients gave their written informed consent.

US examinations

Nine rheumatologists from four countries, all expert in musculoskeletal US, participated in the study. They were members of the OMERACT US group and the OMERACT/OARSI US task force. Previously, a multistage process consisting of a number of different steps was undertaken. This started with a systematic review that was provided to the group prior to a Delphi exercise[17]. Subsequently the group participated in a Delphi exercise to reach consensus on which abnormalities and definitions they would recommend for testing the reliability of US in hand OA (Table I). Then, based on the suggestion to differentiate findings studying inflammation and those assessing structural damage, they firstly tested definitions for structural abnormalities in a patient-based exercise and an image-based reliability exercise. Hence, focussing particularly on cartilage lesions, they met 2 consecutive days, at first, to discuss the US protocol and scanning technique of the hyaline cartilage of the metacarpal heads and, subsequently, to perform the US intra- inter-observer reliability exercises. Indeed, previously to start the patients' sonographic examinations, the US methodology was clarified among ultrasonographers and a consensus was obtained both on scanning protocol and image interpretation of normal and pathological US findings; for this purpose, a training session on static images that had been previously collected by the same experts and randomly presented by the local organizer (AI) was performed on the same meeting.

Table I
Results of the Delphi exercise

High–good agreement (>80%) for including:

- Cartilage (90%)
- Cortical bone: Erosions (85%), Osteophytes (100%), Cortical irregularities (85%)
- Synovial membrane and synovial fluid (80%)

High–good agreement (>80%) for including:

- All those structures (80%)

High–good agreement (>80%) for including:

- Definitions (Cartilage abnormalities; Cortical bone lesions; Synovitis)

Poor–moderate agreement (<80%) for including:

- Ligaments and their changes (55%)

Suggestion to differentiate:

- Findings studying inflammation and those assessing structural damage

Patients were located in a confortable examining room with their dominant hand lying on an examination table. The single seats were placed at a distance that permitted a blinded and separate evaluation by the nine sonographers, each of whom was seated in front of a single patient. By keeping the joints in maximal flexion (more than 45°), from second to fifth MCP joints of the dominant hand were examined twice in two rounds, with independent evaluations of the various cartilage lesions. The time frame between the two rounds was 6 h. Global cartilage abnormalities at metacarpal heads were searched for, at first, by applying a dichotomous (presence/absence) score. In addition, during the same scanning session and using the same scoring system, the following basic lesions were evaluated: loss of anechoic structure and/or thinning of cartilage layer, and irregularities and/or loss of sharpness of at least one cartilage margin (Fig. 1). All joints were examined with a longitudinal dorsal scan, performed at the level of the median portion of the MCP joints, according with the technical observations that were agreed during the consensus meeting (Fig. 2). Particular attention was paid to keeping the probe perpendicular to the cartilage surface, which was obtained by performing slight sweeping movements with the transducer over the region of interest. All US examinations were performed by applying abundant amounts of gel to the skin to provide an appropriate acoustic interface.

Equipment

Eight identical MyLab 70 X-Vision Gold machines (ESAOTE Biomedica, Genoa, Italy), equipped with a multi-frequency (6–18 MHz) linear probe operating at a frequency of 18 MHz, were used. Previously to start the examination procedure, the same B-mode setting was recorded for all machines and was not modified during the study, including the positioning of the focus at the level of the region of interest and the application of 50% gain.

Statistical analysis

Intra-observer reliability and inter-observer reliability were assessed by using standard Cohen's kappa (k) coefficients[18]. While intra-observer coefficients were evaluated on pairs of measures performed by the same sonographer at each site, calculation of inter-observer coefficient was exclusively based on the first measure of those pairs. Global inter-observer reliability was