European Journal of Radiology 81 (2012) 2366–2369

Contents lists available at SciVerse ScienceDirect

European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

Value of modern sonography in the assessment of meniscal lesions

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ARTICLE INFO

Article history:
Received 14 July 2011
Received in revised form
14 September 2011
Accepted 17 September 2011

Keywords:
Ultrasonography
Knee
Meniscus
Meniscal injury

ABSTRACT

The aim of this prospective study was to assess the accuracy of modern ultrasonography in diagnostic imaging of meniscal tears. One hundred and sixty menisci were evaluated in 80 patients (42 females, 38 males, mean age = 36.2 years, range = 16–70 years). Inclusion criteria for the study were twofold: clinical suspicion of meniscal injury and clinical indication for arthroscopy. Knee examination was performed with the Voluson 730 Expert ultrasound system (General Electric). After sonographic examination, all patients underwent arthroscopic procedures within 1–4 days. The final diagnosis of meniscal tears was taken from surgical reports. The overall sensitivity, specificity, positive predictive value and negative predictive value of sonographic examination in the assessment of meniscal tears amounted to 85.4%, 85.7%, 67.3% and 94.4%, respectively. The statistical parameters were not statistically different in medial and lateral menisci. Age, sex, body mass index (BMI), weight, physical activity, mechanism on injury, and time lapse from injury did not have a statistically significant impact on the usefulness of ultrasonography.

The highest sensitivity (>90%) was obtained in medial menisci and in patients with a BMI > 25. The highest specificity (>90%) was obtained in lateral menisci, in patients after twisting injuries, in sports injuries, and in recent injuries (time lapse from the injury <1 month). The positive predictive value (PPV) of sonographic examination was higher than 90% only in recent injuries (<1 month), however, the negative predictive value of ultrasound is high, being less than 90% in males with lesions of lateral menisci and in sequelae of sports injuries.

1. Introduction

Meniscal tears are the most common injury of soft tissues [1]. The incidence of meniscal injuries reported in 1985 in the United States of America amounted to 61/100,000/year, with a clear male predominance (3:1) [2]. The incidence reported in Great Britain in 2008 amounts to 23 cases per 100,000/year [1].

Meniscal injury may occur due to sports trauma or from a trivial injury due to increased age and a degenerated meniscus. [3].

Although magnetic resonance imaging is currently the diagnostic method of choice in assessment of menisci [4], it is expensive, has a number of contraindications, and is not always readily accessible.

Ultrasound has been used for more than three decades in the assessment of the musculoskeletal system, and is the method of choice in the assessment of superficial structures, such as muscles, tendons, and nerves. However, its use in the assessment of menisci remains controversial, despite development of new sonographic techniques and dramatic improvements in the quality of sonographic images.

2. Objectives

The objectives of this study are: to evaluate the usefulness and value of modern ultrasonography in the assessment of meniscal injuries and to assess the impact of various characteristics of the injury (etiology of injury, sports activity, time elapsed from injury) and the patient (specifically, sex, age, weight, and BMI).

3. Material

Sonographic examinations of 85 knee joints in 85 patients (45 females, 40 males, mean age: 36.2 years, range 16–70 years) were performed in a two-year period from 2005 to 2007. The inclusion criteria for the study were: clinical suspicion of meniscal injury as stated by an orthopedic surgeon, and clinical indication for arthroscopy. Five patients, who despite clinical indication for arthroscopic surgery, did not undergo it and were excluded from the study. The final study population comprised 80 patients (42 females, 38 males). The etiology (mechanism) of injury, time

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doi:10.1016/j.ejrad.2011.09.013

elapsed from injury, sex, age, weight, BMI and physical activity of the patients were recorded.

Informed consent was obtained from all patients. Since sonographic knee examination is part of normal medical procedure for all patients referred for arthroscopic surgery with suspicion of meniscal tear, the study was waived from institutional board approval since it did not incur any additional health hazards for the patient nor did it breach patient confidentiality.

4. Methods

All sonographic examinations were performed by a single physician with 7 years experience in musculoskeletal ultrasound. Examinations were performed with the Voluson 730 Expert ultrasound system (General Electric), using a 6–12 MHz frequency probe, to allow automatic volumetric data acquisition. A variety of advanced techniques improving image quality were used (compound imaging, speckle reduction, and harmonic imaging). In each knee, both menisci were evaluated. The knees were examined in supine and prone positions in full extension and 30° flexion. Dynamic examinations aimed at showing displacement of the fragments of the meniscus were also performed during slight passive varus-valgus movements.

Following sonographic examination, criteria for the diagnosis of meniscal tear included: hypoechoic line extending to the surface of the meniscus, irregular outline, lacking sharp edge or presence of a meniscal cyst (Figs. 1–3).

All patients underwent knee arthroscopy within 1–4 days after sonographic examination. The surgical reports were reviewed and compared with the results of sonographic examinations.

5. Statistical evaluation

To compare the results of ultrasonography and arthroscopy chi-square test and Fisher exact test were used. Statistical significance level was set at $p < 0.05$. Sensitivity, specificity, positive predictive value, and negative predictive value of sonographic examination were calculated.

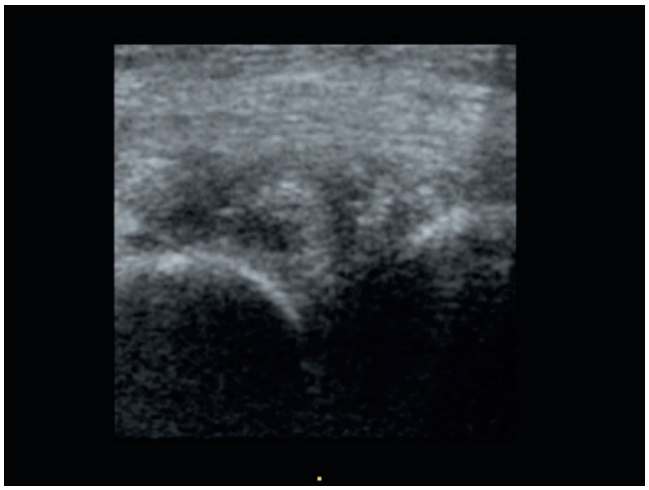

Fig. 1. A bucket-handle tear of the medial meniscus demonstrated on two-dimensional ultrasonography.

6. Results

A correct sonographic diagnosis was obtained in 35 (85,4%) meniscal tears and 102 (85.7%) intact menisci as seen on arthroscopy. The concordance of sonographic and arthroscopic diagnosis was statistically significant ($p < 0.05$). Detailed results are shown in Table 1.

The overall sensitivity, specificity, positive predictive value, and negative predictive value of sonographic examination in the assessment of meniscal tears amounted to 85.4%, 85.7%, 67.5% and 94.4%, respectively.

The results obtained in meniscal tears secondary to twisting injuries (sensitivity = 91.3%) were better than in meniscal

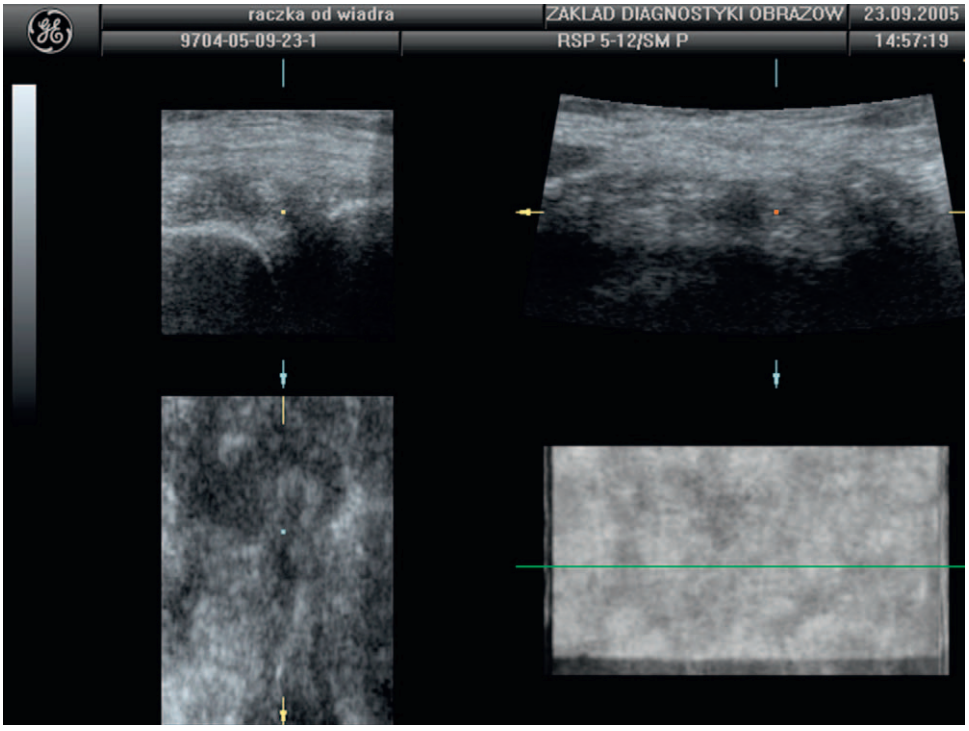

Fig. 2. A bucket-handle tear of the medial meniscus demonstrated on three-dimensional ultrasonography (multi-planar reformation).