European Journal of Radiology 85 (2016) 489–497

Contents lists available at ScienceDirect

European Journal of Radiology

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

MR arthrography of the hip with and without leg traction: Assessing the diagnostic performance in detection of ligamentum teres lesions with arthroscopic correlation

Florian Schmaranzer[a,b,*], Andrea Klauser[c], Michael Kogler[d], Benjamin Henninger[c], Thomas Forstner[e], Markus Reichkendler[f], Ehrenfried Schmaranzer[g]

[a] Inselspital, University of Bern, Department of Orthopaedic Surgery, Freiburgstrasse, 3010 Bern, Switzerland
[b] Medical University Innsbruck, Department of Radiology, Anichstraße 35, 6020 Innsbruck, Austria
[c] Medical University Innsbruck, Department of Radiology, Anichstrasse 35, 6020 Innsbruck, Austria
[d] District Hospital St. Johann in Tyrol, Department of Radiology, Bahnhofstraße 14, 6380 St. Johann in Tyrol, Austria
[e] Johannes Keppler University, Department for Applied Systems Research and Statistics, Altenbergerstraße 69, 4040 Linz, Austria
[f] District Hospital St. Johann in Tyrol, Department of Orthopedic Surgery, Bahnhofstraße 14, 6380 St. Johann in Tyrol, Austria
[g] District Hospital St. Johann in Tyrol, Department of Radiology, Bahnhofstraße 14, 6380 St. Johann in Tyrol, Austria

ARTICLE INFO

Article history:
Received 9 October 2015
Received in revised form
15 November 2015
Accepted 22 November 2015

Keywords:
Hip joint
Magnetic resonance imaging
Arthrography
Traction
Ligamentum teres

ABSTRACT

Objectives: To retrospectively assess the diagnostic performance of hip MR arthrography with and without traction in detecting ligamentum teres (LT) lesions with arthroscopic correlation and to evaluate the effect of traction on the imaging appearance of the LT.
Methods: 73 MR arthrograms (73 consecutive patients, mean age, 34.5 years; range, 14–55 years) obtained without and with leg traction (application of 15–23 kg, use of a supporting plate for the contralateral leg) were included. Two blinded readers independently evaluated LT lesions on MR arthrograms on separate occasions: coronal images without traction; coronal images with traction; a multiplanar traction protocol. MR findings were correlated with arthroscopic records. Sensitivity/specificity of traction and non-traction imaging was compared on coronal images with the exact McNemar test. Imaging appearance of the LT with and without traction was assessed in consensus and compared on coronal images using McNemar and McNemar–Bowker tests. ($p < 0.05$, * corrected for type I error).
Results: With arthroscopy 29 (40%) LT lesions were identified in 73 patients. Sensitivity was 72%/90% (without traction/with traction; $p = 0.25$*), specificity was 89%/77% ($p = 0.25$*) for reader 1 in assessing coronal images and for reader 2 sensitivity was 59%/86% ($p = 0.044$*) and specificity was 93%/82% ($p = 0.25$*). Alterations in fiber orientation, signal intensity, surface, dimension, fiber continuity after application of traction were observed in 33/73 (45%, $p = 0.002$*), 6/73 (8%, $p = 0.223$), 9/73 (12%, $p = 0.36$*), 6/73 (8%, $p = 0.031$) respectively 9/73 (12%, $p = 0.003$) cases. Traction-related alterations in at least one criterion were observed in 41/73 (56%) cases.
Conclusion: Application of traction can considerably alter the imaging appearance of the LT and resulted in higher rates of true-positive and false-positive findings compared to conventional MR arthrography.

Abbreviations: LT, ligamentum teres; FLASH, fast low-angle shot; FISP, fast imaging with steady-state precession; LCEA, lateral center edge angle; FAI, femoroacetabular impingement.

* Corresponding author at: Inselspital, University of Bern, Department of Orthopaedic Surgery, Freiburgstrasse, 3010 Bern, Switzerland.
E-mail addresses: forian.schmaranzer@insel.ch (F. Schmaranzer), andrea.klauser@i-med.ac.at (A. Klauser), kogler@khsj.at (M. Kogler), benjamin.henninger@i-med.ac.at (B. Henninger), thomas.forstner@jku.at (T. Forstner), praxis@doc-reichkendler.at (M. Reichkendler), schmaranzer@khsj.at (E. Schmaranzer).

http://dx.doi.org/10.1016/j.ejrad.2015.11.027
0720-048X/

1. Introduction

The role of the ligamentum teres (LT) in the complex biomechanics of the hip has been subject of increasing interest recently but is still unclear [1–4]. Lesions of the LT can cause groin pain and are frequently found in patients undergoing joint preserving surgery for correction of femoroacetabular impingement (FAI) [5–7]. Knowledge on the current status of the LT is important to fully understand the clinical presentation of patients with groin pain and also led to the introduction of a dedicated clinical test [5]. Direct magnetic resonance (MR) arthrography is considered the modality of choice for preoperative assessment of intraarticular lesions [8]. In contrast to labral and chondral lesions, imaging studies on the LT are sparse in the literature and have only recently been in focus [7,9–13]. Due to the tight anatomy of the hip, application of traction has been used to improve visualization of intra-articular structures [13–15]. First results of MR arthrography under axial traction in detection of LT lesions are promising [13].

The authors are not aware of any studies on traction and conventional MR arthrography of the hip in the assessment of LT lesions, certainly not with arthroscopic correlation. The aim of this study was to retrospectively assess the diagnostic performance of MR arthrography of the hip with and without traction in detection of LT lesions in correlation to arthroscopy and further to evaluate the effect of leg traction on the imaging appearance of the LT.

2. Material and methods

2.1. Patients

Over a period of 10 months 150 consecutive patients with clinical presentation of FAI underwent MR arthrography for assessment of FAI-deformities and associated collateral lesions with and without traction according to the institutional routine protocol. This study was conducted under a general waiver for institutional review board approvals for retrospective studies which was issued in accordance to Austrian law by the ethics committee of the Medical University of Innsbruck. Inclusion criterion was subsequent hip arthroscopy. Exclusion criteria were: lateral center-edge angle (LCEA) <25°, previous surgery, interval exceeding 6 months between imaging and arthroscopy and no availability of arthroscopic records on the LT. Hips with borderline dysplasia (LCEA <25°) were excluded because the traction approach was not standardized for these patients at that time. 101 MR arthrograms (98 patients) were followed by hip arthroscopy. After exclusion, 73 MR arthrograms of 73 patients remained in the study group (Fig. 1).

Mean age of the study cohort was 34.5 years (range, 14–55 years): 45 men (mean age, 34.2 years; range, 14–55 years) and 28 women (mean age, 35 years; range, 16–54 years). Mean interval from MR arthrography to arthroscopy was 14 weeks (range, 1–26 weeks).

2.2. MR arthrography

MR arthrography with and without traction was conducted as described previously [14,15]. Intraarticular injection was performed from an anterolateral approach, under fluoroscopic guidance and at 5–10° of flexion in the affected hip joint. A 21 G needle was used. 1–2 ml of iodinated contrast agent (iopamidol, 200 mg/ml; Iopamiro 200; Bracco, Milan, Italy), 2–5 ml of local anaesthetic (ropivacaine hydrochloride; 2 mg/ml; Ropinaest; Gebro Pharma, Fieberbrunn, Austria) and 15–20 ml of diluted MR contrast agent (gadopentetate dimeglumine, 2 mmol/l; Magnevist; Bayer Healthcare, Berlin, Germany) were injected (a total of 18–27 ml). A 1.5T scanner (Magnetom Symphony; Siemens Med-

Table 1
MR Arthrography sequencing parameters.

Sequence	Repetition time (ms)	Echo time (ms)	Matrix	Field of view (mm)	Flipangle	Section thickness (mm)	Intersection gap (mm)	Bandwidth (Hz/Px)	Traction
Coronal FLASH T1-w FS	475	9.8	448 x 224	180	60	3	0.6	70	no
Axial-oblique FLASH T1-w FS	524	9.8	448 x 224	180	60	3	0.6	70	yes
Axial-oblique 3D true FISP	4.66	2	256 x 256 x 256	200	70	0.8	0.016	501	yes
Sagital FLASH T1-w FS	475	9.8	448 x 224	180	60	3	0.6	70	yes
Coronal spin echo T1-w	450	12	448 x 224	180	90	3	0.6	130	yes
Coronal FLASH T1-w FS	475	9.8	448 x 224	180	60	3	0.6	70	yes

Note: FS = fat suppressed, FLASH = fast low angle shot, FISP = fast imaging with steady processing, : "Reproduced from: Schmaranzer F., Klauser A., Kogler M., et al. (2015) Diagnostic performance of direct traction MR arthrography of the hip: detection of chondral and labral lesions with arthroscopic comparison. Eur Radiol 25:1721–30." [15].