Clinical Imaging 39 (2015) 128–132

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: http://www.clinicalimaging.org

Impact of osteoid osteomas of the hip on the size and fatty infiltration of the thigh muscles☆

Salima Ladjeroud [a], Sébastien Touraine [b,]*, Cédric Laouénan [c,d], Caroline Parlier-Cuau [b], Valérie Bousson [b], Jean-Denis Laredo [b]

[a] Radiologie Ostéo-Articulaire, Hôpital Bichat-Claude Bernard, AP-HP, 46 rue Henri, Huchard, 75018 Paris, France
[b] Radiologie Ostéo-Articulaire, Hôpital Lariboisière, AP-HP, 2 rue Ambroise Paré, 75475 Paris Cedex 10, France
[c] Service de Biostatistique, Hôpital Bichat-Claude Bernard, AP-HP, 46 rue Henri, Huchard, 75018 Paris, France
[d] INSERM, UMR 738, Université Paris Diderot, Sorbonne Paris Cité, Paris F-75018, France

ARTICLE INFO

Article history:
Received 16 April 2014
Received in revised form 13 June 2014
Accepted 12 July 2014

Keywords:
Osteoid osteoma
Hip
Thigh
Muscle atrophy
Muscle fatty infiltration

ABSTRACT

We aimed to assess the impact of osteoid osteomas of the hip on the size and fatty infiltration of the muscle thigh in 42 patients. The thigh circumference, cross-sectional areas, and fatty atrophy of four anterior muscles were assessed on magnetic resonance axial T1-weighted images. A significant fatty atrophy was found in the studied muscles of the ipsilateral thigh except for the rectus femoris. No significant association was demonstrated with pain duration suggesting that muscle atrophy may rather be related to the locoregional inflammation than subsequent to the disuse of the limb.

1. Introduction

Osteoid osteoma (OO) is a benign bone tumor mostly diagnosed between the age of 7 and 25 years with a male predominance [1]. OOs account for approximately 13% of benign bone tumors [2]. Pathologically, the tumor is composed of osteoid and bone at various stage of maturation within a highly vascularized connective stroma [3]. As an inflammatory bone lesion, OOs are responsible for chronic inflammatory pain and may be associated with joint effusion and/or synovitis in case of intracapsular or juxtaarticular locations [4,5]. The hip is the most frequently affected joint [2,6]. OOs are preferentially located in the inferior cortex of the femoral neck, the trochanters, and the intertrochanteric crest and line [7]. An intracapsular location is less common and accounts for less than 10% of OOs around the hip [8,9]. Typically, an OO is diagnosed when a nidus is identified at conventional radiography or cross-sectional imaging [magnetic resonance (MR) imaging and computed tomography (CT)]. The nidus is typically a well-delineated round or oval lacuna of less than 20 mm in its maximal dimension with a central calcification [10,11]. The nidus is usually surrounded by reactive bone sclerosis and bone marrow edema at MR [12]. A nutrient vessel is usually visible in the surrounding bone [13] and the nidus exhibits an arterial kinetic pattern of enhancement on dynamic postcontrast MR imaging [14]. Clinically, the OO of the hip is likely to be responsible for recurrent limping, which may be a diagnostic challenge in children [15]. Additional clinical findings are reported in some cases of the English literature and include limb deformity [16], bone overgrowth [17,18], muscle weakness, and diminished deep tendon reflexes of the affected limb [19,20], which may stand for a neurological condition. In these pseudoneurological manifestations, the muscle atrophy may be reported in addition to the groin pain and gait disturbance [19]. To the best of our knowledge, no previous study focused on objective evidence of the thigh muscle atrophy in OOs of the hip. However, the assessment of the muscle atrophy may be interesting in a better understanding of the pathophysiology of OOs. To test the hypothesis that OOs of the hip may result in a significant muscle atrophy of the ipsilateral thigh in comparison with the contralateral limb, we retrospectively assessed, on MR images, the thigh circumferences as well as the cross-sectional areas and degree of fatty infiltration of muscles of the anterior compartment of the thigh. This work was conducted on 42 patients with pathologically proven OOs of the hip.

☆ Salima Ladjeroud and Sébastien Touraine's contribution to the manuscript is equivalent.

* Corresponding author. Radiologie Ostéo-Articulaire, Hôpital Lariboisière, 2 rue Ambroise Paré, 75475 Paris Cedex 10, France. Tel.: +33-1-499-586-99; fax: +33-1-499-591-06.
E-mail addresses: salima.ladjeroud@hotmail.fr (S. Ladjeroud), sebastien.touraine@lrb.aphp.fr (S. Touraine), cedric.laouenan@inserm.fr (C. Laouénan), caroline.parlier@lrb.aphp.fr (C. Parlier-Cuau), valerie.bousson@lrb.aphp.fr (V. Bousson), jean-denis.laredo@lrb.aphp.fr (J.-D. Laredo).

http://dx.doi.org/10.1016/j.clinimag.2014.07.006
0899-7071/

2. Materials and methods

2.1. Patient selection

Institutional review board approval was obtained for this retrospective study. The informed consent of patients was obtained for the anonymous use of their clinical and imaging data, in the interests of research. From January 2006 to December 2012, 372 patients with a clinical and radiological diagnosis of OO were treated in our institution by interstitial laser ablation (ILA). In 93 cases, the OO was located at the hip (femoral head and neck and acetabulum). Patients who met the following criteria were included in the study: a pathologically proven OO on the bone biopsy obtained immediately prior to ILA, the availability in our central database of the MR scans of both hips allowing a bilateral comparison of T1-weighted axial images, no recurrent OO, no previous fracture of a bone of a lower limb, or other medical condition responsible for a prolonged immobilization of a lower limb. Fifty-one patients were not included because of the lack of axial T1-weighted images (n=46), a unilateral MR examination (n=4), or a negative/noncontributory histopathology (n=1). Forty-two patients were finally included.

2.2. Clinical parameters

The indication of ILA treatment was confirmed during a pretherapeutic consultation (CPC, VB, JDL). The clinical examination looked more particularly for an inflammatory pain, relieved by salicylates or other nonsteroidal antiinflammatory drugs, a limitation of the range of motion, a limp or modification of the gait, and a muscle wasting of the thigh that was not clinically quantified. The review of the medical records and imaging files aimed to identify the nidus of the OO. The following parameters, obtained during this consultation, were recorded: sex, age, and pain duration. In order to assess the pain duration, the patients were asked to define the year and month of the onset of pain. The date of the first medical consultation at which analgesics were prescribed helped the patients to confirm this date. The duration of pain was calculated between the estimated date of the onset of pain and the date of the MR examinations.

2.3. Image analysis

Nidus size and calcification were assessed on CT images, obtained as part of the ILA procedure, from a single CT unit, a 64-detector-row CT scanner (Somatom Sensation, Siemens, Erlangen, Germany) with the following acquisition parameters: 120 kV, rotation time of 1.0 s, slice collimation of 0.6 mm, pitch factor of 0.90, 512×512 matrix, a 8- to 10-cm field of view adapted to each location, and mAs set between 120 and 150 mAs. CT images were reconstructed with 1.0 mm slice thickness, 1.0 mm interval, and a medium-sharp reconstruction algorithm (B50s kernel, Siemens Healthcare, Germany). All images were automatically sent to our database. In one case among the 42 patients, the CT images were not available. The nidus size (mm) was measured in two orthogonal planes on CT images with bone window settings (window width, 3500 HU; window center level, 400 HU). The highest measure was recorded. The nidus calcification was noted as present or absent.

The MR exams were performed as part of the diagnostic assessment. They were obtained from a 1.5 MR imaging scanner (Magnetom Avanto, Siemens Healthcare, Erlangen, Germany). For each patient, the T1-weighed axial image through the middle of both lesser trochanters was selected for comparative analysis. This image level was selected because it was a reproducible marker, close to the hip. Muscles were large and numerous at that level. Each patient was imaged using the combination of body and spine matrix coils. The same axial T1-weighted turbo spin-echo sequence was used with the following parameters: repetition time, 662 ms; effective echo time, 15 ms; turbo factor, 4; number of excitation, 2; bandwidth, 100 Hz/Px; field of view, 400 mm; matrix, 448×448 for a voxel size of 1×1×4 mm. Slices were contiguous with a slice thickness of 4 mm (distance factor of 10%).

Two readers (SL and ST, with respectively 5 and 11 years of experience in interpreting MR images), blind to the clinical data, laterality, and morphological characteristics of the OO, analyzed the MR images in a random order using the same workstation (Carestream Vue PACS version 11.3, Carestream Health, Inc., Rochester, NY, USA). They independently assessed the following parameters on both thighs (ipsilateral to OO and contralateral):

(1) Circumference (cm) of both thighs measured using the mouse by delineating the superficial aspect of the subcutaneous fat (Fig. 1).

(2) Cross-sectional muscle area (mm^2), obtained by delineation of the muscle contour. This area was measured for the iliopsoas (IP) muscle [inferior ends of psoas major and iliacus (IL)] and three muscles of the anterior thigh compartment: rectus femoris (RF), vastus lateralis (VL), and vastus intermedius (VI). The area of each of these four muscles was measurable on

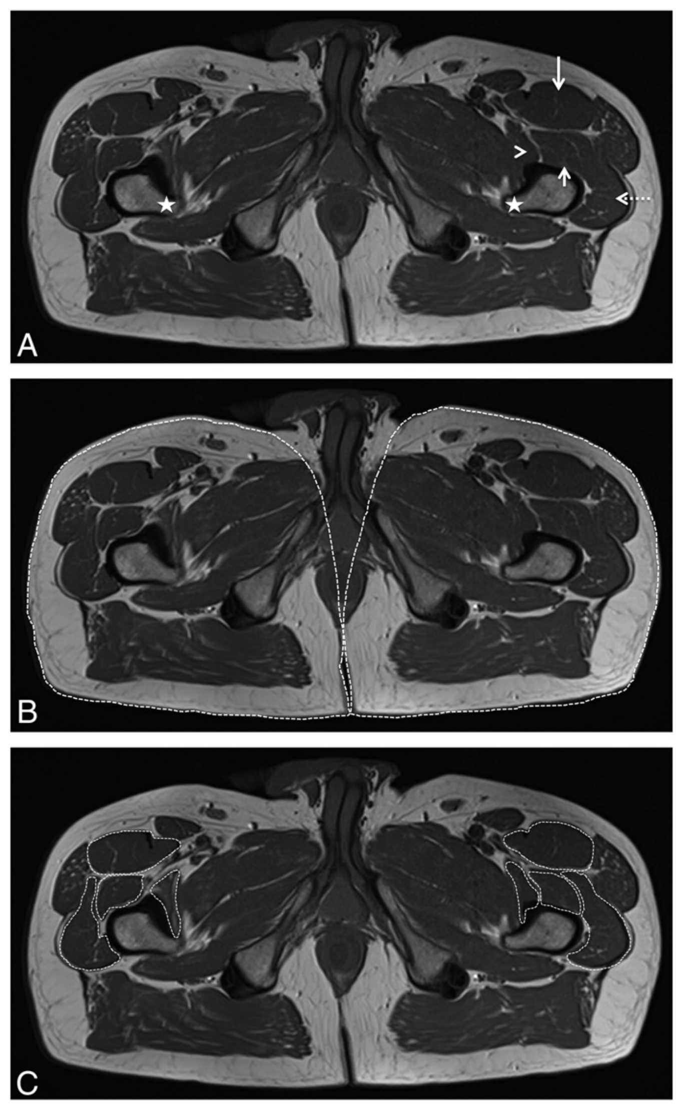

Fig. 1. A 25-year-old man with an OO of the right femoral neck: anatomy, thigh circumference, and muscle contours on axial T1-weighted images through lesser trochanters. (A) The axial MR section through lesser trochanters (stars) allows us to analyze the following muscles: RF (long arrow), VL (dashed arrow), VI (short arrow), and IP (arrow head). (B) Bilateral measurement of the thigh circumference by the delineation of the superficial aspect of the subcutaneous fat (dashed lines). (C) Bilateral contouring of muscles (RF, VI, VL, IP) allows the measurement of their cross-sectional areas.