Acta Orthopaedica et Traumatologica Turcica xxx (2017) 1–5

Contents lists available at ScienceDirect

Acta Orthopaedica et Traumatologica Turcica

journal homepage: https://www.elsevier.com/locate/aott

Assessment of hip abductors by MRI after total hip arthroplasty and effect of fatty atrophy on functional outcome

Emrah Kovalak [a, *], Hanife Özdemir [b], Cenk Ermutlu [c], Abdullah Obut [c, d]

[a] Süleyman Demirel University, Faculty of Medicine, Department of Orthopaedics and Traumatology, Süleyman Demirel Caddesi, Isparta, 32260, Turkey
[b] İstanbul Education and Research Hospital, Department of Radiology, İstanbul, Turkey
[c] İstanbul Education and Research Hospital, Department of Orthopaedics and Traumatology, Istanbul, Turkey

ARTICLE INFO

Article history:
Received 8 February 2017
Received in revised form
11 September 2017
Accepted 12 October 2017
Available online xxx

Keywords:
Total hip arthroplasty
Fatty atrophy
Hip abductor muscles
Magnetic resonance imaging
Functional outcome

ABSTRACT

Objectives: The aim of this study was to evaluate how fatty atrophy (FA) of the hip abductors in operated and non-operated hips affected the functional outcome following arthroplasty.
Methods: Forty-four hips of 22 patients (8 males and 14 females; mean age: 60 ± 14.4 (range: 24–84)) who matched the inclusion criteria and willing to participate in the study were retrospectively evaluated. The mean follow-up was 13.8 ± 2.3 (range: 10–18) months Magnetic resonance imaging (MRI) and Harris Hip Score (HHS) were used to evaluate muscle degeneration and functional outcome after unilateral THA through a posterolateral approach. The FA grade was evaluated using Goutallier grading system. Non-operated hips of subjects were used as the control. Age, duration after the operation, gluteal muscle FA, and the relationships with HHS were evaluated.
Results: FA was more evident in the operated hip ($p < 0.05$), and was more in the gluteus minimus than in the gluteus medius in both hips ($p < 0.05$). Patients' age was not correlated with gluteal muscle FA in the operated hip ($p > 0.05$), whereas there was a positive correlation with the contra-lateral hip ($p < 0.05$). Duration after surgery did not affect gluteal muscle FA in the operated hip. Older age and FA of either the operated or healthy hip resulted in poorer HHS ($p < 0.05$). HHS had the strongest correlations with patient age ($p < 0.001$) and FA ($p = 0.026$) of the gluteus minimus of contralateral hip.
Conclusion: Following THA, there was marked FA in the operated hip compared to that in the contra-lateral hip. In these cases, degree of FA in the replaced hip did not correlate with patients' age. Fatty atrophy of the gluteus minimus precedes that of gluteus medius. FA of the contralateral gluteus minimus and patient age are strongly correlated with lower HHS. Level of evidence: Level IV, diagnostic study.

Introduction

Coxarthrosis is a major health issue in the modern aging society.[1] Total hip arthroplasty (THA) is a frequently utilized treatment option and it is one of the most successful and cost-effective interventions in medicine.[2–4] Patients' expectations are high, with emphasis on pain reduction and prompt return to daily activities.[3,5] Integrity and strength of abductor musculature are crucial to achieve a successful functional outcome following surgery.[6] As fatty degeneration of gluteal muscles progresses, patients' satisfaction declines and functional outcome deteriorates, especially in the elderly.[7,8] A strong correlation exists between presence of symptoms and degeneration of the gluteus medius muscles following THA.[9]

Fatty atrophy (FA) may be observed in gluteal muscles post-hip implant surgery. In addition, degeneration associated with osteo-arthritis may be progressive.[1,10,11] As coxarthrosis progresses, certain changes such as disruption of pelvic balance during walking and fatty degeneration or atrophy of hip abductors may occur, depending on the stage of the disease.[11] Of these, changes in gluteus medius muscle are of particular concern since they are shown to influence disease progression.[1,10,11] In addition, a relation between arthritic hip and contralateral gluteus medius muscle atrophy was reported, where muscle degeneration in the healthy limb was associated with arthritis in the contralateral hip.[11] Not

This study was presented in 25th National Orthopaedics and Traumatology Congress November 27th-October 1st 2015, Antalya.

* Corresponding author. Süleyman Demirel University, Faculty of Medicine, Department of Orthopaedics and Traumatology, Süleyman Demirel Caddesi, Isparta, 32260, Turkey.
E-mail address: emrahkovalak@yahoo.com (E. Kovalak).

Peer review under responsibility of Turkish Association of Orthopaedics and Traumatology.

[d] Yenişehir State Hospital, Atatürk Caddesi, No: 60, Yenişehir, Bursa, Turkey.

https://doi.org/10.1016/j.aott.2017.10.005

surprisingly, patients with coxarthrosis have lower muscle strength compared to normal individuals in the same age group.[11]

Magnetic resonance imaging (MRI) with optimized conventional pulse sequences and metal artifact reduction sequences (MARS) is a useful modality in the diagnosis of periprosthetic fractures, bone resorption and osteolysis, postoperative hematoma, disruption of the pseudocapsule, synovitis caused by polyethylene wear and adverse local tissue reactions, periprosthetic masses and neoplasms, bursitis, tendinopathy and tendon tears, and neurovascular compromise.[12] The metal artifact reduction sequences are optimized for reduction of metal artefact by using the following three strategies; 1) the section-selection gradient and increased radio-frequency (RF) bandwidth and a relatively narrow section thickness, 2) the increased read gradient, 3) view angle tilting. Each of these three strategies contributes about equally to reduction of metal artifact.[13] Several clinical and cadaveric studies on fatty degeneration and atrophy of hip abductors revealed that magnetic resonance imaging (MRI) is a suitable imaging modality to assess changes in gluteal musculature following THA.[2,8,9,14,15] In these studies, Goutallier classification was the most frequently used grading system to assess changes in the gluteal muscles with strong inter-observer reliability.[9,10] The focus of these studies was the effect of different surgical approaches on hip abductors.[2,8,9,14]

To the best of our knowledge, no study in the literature compared FA of both the operated and non-operated hip following hip arthroplasty, or evaluated their effect on functional outcomes. Only 2 prior studies reported the changes in contralateral hip following hip replacement; however, without assessing the correlation between functional outcome and gluteal atrophy of the non-operated limb.[2,15] In this study, we aimed to evaluate how FA of the hip abductors in both the operated and non-operated hips affected the functional outcome following arthroplasty.

Patients and methods

Patients who underwent primary THA through a posterolateral approach for unilateral primary coxarthrosis between 2010 and 2013 were enrolled in this retrospective study. After the approval of the Institutional Ethical Review Board (no: 525/5.9.2014), patients matching the inclusion criteria were called to participate in the study. Written informed consent was obtained from all patients. Inclusion criteria were; 1) age older than 18 years, 2) history of surgery for unilateral primary coxarthrosis, and 3) minimum follow-up of 6 months. Exclusion criteria were; 1) American Society of Anesthesiologists (ASA) physical status score of IV–VI, 2) higher grade of dysplasia (≥Crowe Type 2), 3) bilateral coxarthrosis, 4) lower extremity osteotomies, 5) history of hip surgery, 6) inflammatory arthritis, any mental or physical disabilities or lumbar disc pathology, and 7) contraindications for MRI.

All patients underwent unilateral primary THA through a posterolateral approach using collarless uncemented titanium stem and uncemented press-fit titanium cup (Biomet® Orthopedics, Inc., USA).

The same post-operative rehabilitation protocol was used for all patients. Quadriceps and gluteus maximus isometric exercises, heel slide, ankle pump, 30° active assisted or passive hip and knee flexion, and hip abduction exercises were begun immediately after surgery under the supervision of a physiotherapist. At post-operative day 1, patients were mobilized with a walker for 5–10 min. For the following 2 days, the patients were allowed to walk as much as they felt comfortable. Patients were discharged at post-operative day 5. Routine follow-ups were done at 6, 12, 24 weeks, and 1 year post-operatively. Patients used walker for 6 weeks, after which they were encouraged to use single crutch until 12 weeks postoperatively.

Patients enrolled had MRI scans of their both hips performed at the last follow-up of the current study. Harris Hip Score[16] (HHS) was used to assess the functional outcome. Two observers (E.K. and A.O.) carried out the clinical analysis.

Magnetic resonance imaging

All MRI scans were performed on a 1.5 T MR system (Signa® HDxt 1.5 T, General Electric Company) by metal artifact reduction sequences (MARS). To reduce metal artifacts maximum RF bandwidth and high matrix values were used. Pelvis protocol with axial T1-weighted turbo spin-echo sequences (repetition time-TR/echo time-TE of 640/9 ms, 3.5 mm slice thickness and, 1 mm slice spacing, 400 × 400 mm field of view (FOV)) and coronal T1-weighted turbo spin-echo sequences (TR/TE 540/3 ms, 5 mm slice thickness and, 1 mm slice spacing, 400 × 400 mm FOV) were used. FA of the gluteus medius and minimus muscles was assessed on the transverse T1-weighted images at the lower 1/3 of the distance between the iliac crest and the tip of the greater trochanter.

Image evaluation

FA of the gluteal muscles was evaluated by a radiologist at the PACS (Picture Archiving and Communication System) workstation (Neorad®, Teleradiology & 3D, Serman med. Ltd. Şti., Turkey). The grade of FA was scored separately for the gluteus medius and gluteus minimus muscles bilaterally on axial T1-weighted MR images according to the Goutallier grading system[17]; grade 0: normal muscle, grade 1: muscle contains some fatty streaks, grade 2: fatty infiltration, but still more muscle than fat, grade 3: equal amounts of fat and muscle, grade 4: more fat than muscle (Figs. 1 and 2).

The operated hips were assigned to group A whereas the contralateral hips were used as control and were assigned to group B. Age, duration after the operation, FA of the gluteus medius and minimus muscles, and the relationship of these findings with HHS were evaluated.

Statistical analysis

Data were statistically analyzed using SPSS software (v. 15.0; SPSS Inc. Chicago, IL, USA). Mean and standard deviation were determined for continuous variables. Independent variables were compared with Mann–Whitney's U test and dependent variables were compared with Wilcoxon's test. Parametric nominal variables were compared with Pearson's correlation analysis and non-

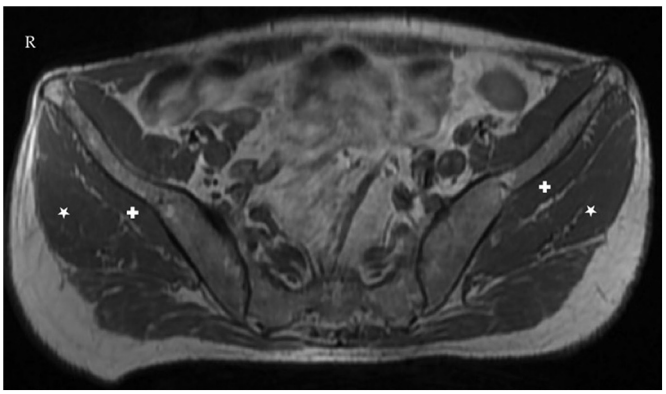

Fig. 1. In the axial T1 weighted images, the prosthesis is seen at the right hip. At the left hip in gluteus medius muscle (star) and in gluteus minimus muscle (cross) grade 1 fatty atrophy and at the right hip in both gluteus medius (star) and minimus (cross) muscles grade 2 fatty atrophies are seen.

Please cite this article in press as: Kovalak E, et al., Assessment of hip abductors by MRI after total hip arthroplasty and effect of fatty atrophy on functional outcome, Acta Orthop Traumatol Turc (2017), https://doi.org/10.1016/j.aott.2017.10.005