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Original Article

Muscle Damage After Total Hip Arthroplasty Through the Direct Anterior Approach for Developmental Dysplasia of the Hip

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ABSTRACT

Background: Total hip arthroplasty (THA) through the direct anterior approach (DAA) is known to cause less muscle damage than other surgical approaches. However, more complex primary cases, such as developmental dysplasia of the hip (DDH), might often cause muscle damage. The objective of the present study was to clarify the muscle damage observed 1 year after THA through the DAA for DDH using magnetic resonance imaging.

Methods: We prospectively compared the muscle cross-sectional area (M-CSA) and fatty atrophy (FA) in muscles by magnetic resonance imaging and the Harris hip score before and at 1-year follow-up after THA through the DAA in 3 groups: 37 patients with Crowe group 1 DDH (D1), 13 patients with Crowe group 2 and 3 DDH (D2 + 3), and 12 patients with osteonecrosis as a control.

Results: THA through the DAA for D1 displayed significantly decreased M-CSA and significantly increased FA in the gluteus minimus (Gmini), the tensor fasciae latae (TFL), and the obturator internus (OI). Patients with D2 + 3 group did not have decreased M-CSA in the TFL or increased FA in the Gmini. Postoperatively, a significant negative correlation was observed between the M-CSA and FA for the OI in patients with D1 and D2 + 3.

Conclusion: THA through the DAA for DDH caused the damage in the Gmini, the TFL, and the OI; severe damage was observed in the OI, showing increased FA with decreased M-CSA in patients with both D1 and D2 + 3.

Total hip arthroplasty (THA) through the direct anterior approach (DAA) was considered as minimally invasive THA depending on the anterior interval that had both the internervous and intermuscular planes [1–4]. Many reports have shown the benefits of this approach, which included decreased pain, rapid recovery, shorter hospital stay, lower risk of dislocation, and early gait improvement [1,5–7]. Meneghini et al [8] reported that THA through the DAA caused lesser muscle damage than other surgical approaches in a cadaver study.

Acetabular preparation in THA through the DAA was equal to that of any other surgical approach, whereas the femoral preparation was more technically demanding [9]. Several patients with osteoarthritis (OA) had severe deformities and a restricted range of motion depending upon developmental dysplasia of the hip (DDH) [10]. Some authors recommended releasing several external rotator tendons to elevate the proximal femur in difficult cases [6,8,9].

Magnetic resonance imaging (MRI) is recognized as a useful tool for the assessment of muscle volume and fatty atrophy (FA) [11,12]. It has been used to compare muscles surrounding the hip joints with mild and advanced degeneration [13] and assess muscle damage after primary THA [11].

Previous studies have shown that the short external rotator muscle and piriformis, which are repaired to the greater trochanter after THA through the posterolateral approach, showed increased FA or decreased muscle volume upon MRI 1 or 2 years after surgery [14,15].

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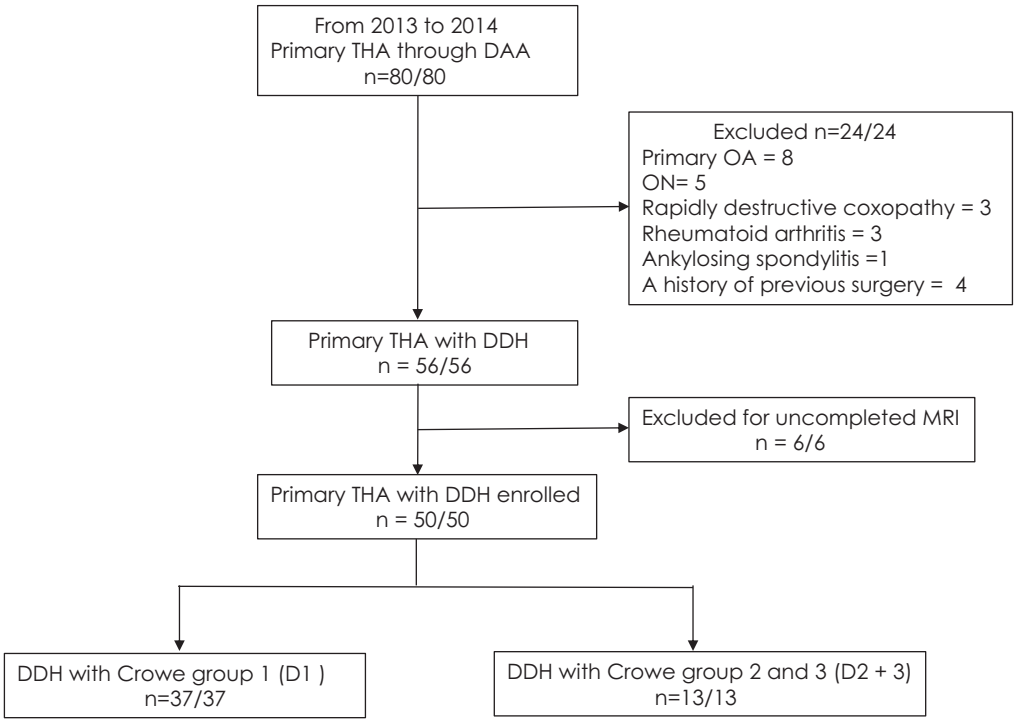

Fig. 1. Flowchart indicating objective (hips/patients) selection. THA, total hip arthroplasty; DAA, direct anterior approach; OA, osteoarthritis; ON, osteonecrosis; DDH, developmental dysplasia of the hip; MRI, magnetic resonance imaging.

Müller et al [16] reported that patients who underwent THA through an anterolateral approach (ALA) had FA of the anterior part of the gluteus medius (Gmed) and lesser compensatory hypertrophy in the muscle cross-sectional area (M-CSA) of the tensor fasciae latae (TFL) at 12 months after surgery. Unis et al [17] reported that 74% and 42% of patients who underwent THA through the modified ALA exhibited atrophy or hypertrophy of the TFL and fat replacement, respectively. Muscle damage due to THA through the ALA often depended on denervation injury of the superior gluteal nerve [16,17].

Bermer et al [18] retrospectively reported that THA through DAA produced fewer patients with FA of the gluteus minimus (Gmini) and the Gmed upon MRI than the transgluteal approach.

The purpose of this investigation was to clarify (1) which muscles surrounding the hip joint showed changes in the M-CSA and FA upon MRI after THA through the DAA for DDH, (2) whether the M-CSA and FA in the damaged muscles were correlated, and (3) whether MR findings of damaged muscles were reflected in the clinical scores.

Patients and Methods

From November 2013 to September 2014, a single surgeon (M.K.) performed primary THA through the DAA on 80 hips in 80 patients at our institution. Preoperative evaluation included detailed history of treatments, a radiographic examination (anteroposterior hip and axial view), and a blood test. OA depending on DDH was defined as a symptomatic hip joint that had a severe deformity, such as acetabular dysplasia or dislocation, and had radiographical evidence of changes in OA. Patients without DDH were excluded. Of the remaining 56 hips, we excluded 6 hips that were not completely evaluated by MRI. Fifty hips in 50 patients with DDH were included in this study and were divided into 2 groups, with group 1 (D1) having 37 hips and with groups 2 and 3 (D2 + 3) having 13 hips according to Crowe's classification [19] (Fig. 1). According to the Kellgren-Lawrence grading scale [20], D1

Table 1
Patients Demographics.

	D1	D2 + 3	Control	*P*
Number (patients/hips)	37/37	13/13	12/12	
Age (y)	66.8 ± 8.7	65.1 ± 7.9	59.1 ± 15.9	.09[a]
Gender (male/female)	4/33	1/12	7/5	<.05[b,c,d]
BMI (kg/m^2)	24.3 ± 3.9	23.5 ± 2.7	23.0 ± 2.8	.43[a]

BMI, body mass index; ANOVA, analysis of variance.
[a] Mixed-model ANOVA.
[b] Chi-square test.
[c] D1 vs control: $P < .05$.
[d] D2 + 3 vs control: $P < .05$.

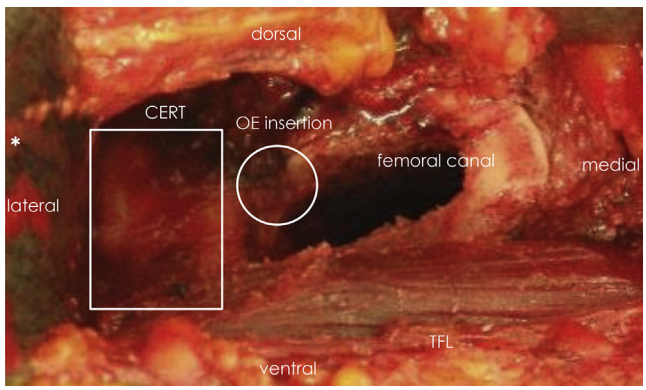

Fig. 2. Photograph showing femoral preparation in THA through the DAA. The greater trochanteric retractor was placed gently between the greater trochanter and the Gmini to elevate the proximal part of the femur. Generally, the conjoined external rotator tendon (CERT) and obturator externus (OE) insertion were not cut, but when femoral preparation was not insufficient, the posterior capsule was released along with partially releasing a dorsolateral soft tissue of the CERT. Standard broaching was performed with the final broach used being a short broach. The femoral component was inserted into the femoral canal. *Cranial side; quadrangle, CERT; circle, the location through which the OE was inserted to the greater trochanteric fossa.