Clinical and MRI results in 67 patients operated for gluteus medius and minimus tendon tears with a median follow-up of 4.6 years

K.G. Makridis a,⁎, M. Lequesne b, H. Bard c, P. Djian d

a Clinique Nollet, 23, rue Brochant, 75017 Paris, France
b 33, rue Guilleminot, 75014 Paris, France
c 4, rue Léon Vaudoyer, 75007 Paris, France
d Cabinet Goethe, 23, rue avenue Niel, 75017 Paris, France

1. Introduction

Refractory tendon tears of the gluteus medius and minimus cause painful, functional disability that is as severe as the one associated with advanced hip osteoarthritis [1]. In addition, these tears are often missed [2]. Bunker et al. [3] and Kagan [4] first described these tears about 15 years ago. Since then, published studies on this topic have included case reports, diagnostic imaging studies using ultrasonography [5] and especially MRI [6–10], along with anatomic descriptions [11]. Surgical tendon repair has only been described in a few studies with a limited number of patients [4,10,12], although a recent Australian study included 72 patients [13].

The various diagnostic tools available differ in their diagnostic value [12]. Our team has been using a validated clinical testing protocol with good sensitivity and specificity [14]. Various repair techniques have been proposed, ranging from suture repair to use of synthetic ligaments [15]. But the results of these techniques are highly variable.

We hypothesized that gluteus medius and minimus tears can be repaired effectively with an open double-row technique. The goals of this retrospective study were to determine:
• if functional improvement can be obtained;
• if the repairs are continuous based on MRI, and;
• which factors determine success.

2. Material and methods

2.1. Patients

Seventy-three patients were operated on between 2003 and 2010. Patients were included in the study if they met the following criteria:

• spontaneous partial or complete tendon tears with chronic greater trochanteric pain refractory to conservative treatment for at least 6 months, and;
• tendon tears confirmed through positive clinical and imaging tests.

Patients meeting any of the following criteria were excluded:

• tendon tears due to trauma;
• patients with a systemic inflammatory disease or serious co-morbidities, and;
• history of surgery on the ipsilateral hip joint.

2.2. Surgical technique

All the procedures were performed under general anesthesia by a single surgeon (PD) using a lateral longitudinal approach (8–10 cm) centered over the greater trochanter. After opening the fascia lata and glutaeus maximus aponeurosis, the glutaeus medius bursa was excised and the torn gluteal tendons were identified. Two anchors were needed to reattach the anterior fibers of the glutaeus medius. One or two anchors were used in the glutaeus medius and one in the glutaeus minimus. Two different types of non-resorbable suture anchors were used: GII (DePuy, Mitek, USA) and TwinFix AB 5.0 (Smith & Nephew, Andover and Mansfield, MA, USA). The anchors were inserted into the greater trochanter where the gluteal muscles insert. The sutures from these anchors were then used to reattach the tendons to bone. All of the torn tendons were repaired with a double-row technique. The suture anchors used for the double-row repair were initially non-resorbable GII anchors (DePuy, Mitek, USA) and then absorbable Footprint ultra PK anchors (5.5 mm, Smith & Nephew, Andover and Mansfield, MA, USA). The fascia lata and glutaeus maximus aponeurosis were closed with absorbable suture without a surgical drain.

In the postoperative period, immediate passive motion with small active movements of the hip joint in flexion (20°–30°) and adduction (10°–20°) were allowed. No adduction and no active abduction were allowed for the first 6 weeks, during which only very light, touch-down weight bearing was allowed. Full weight bearing was allowed after 6 weeks. Muscle strengthening was initiated three months after the surgery.

2.3. Assessment methods

Physical examination included a walking analysis to look for limping and asking the patient stand on one leg for 30 seconds. With the patient’s hip flexed at 90° and externally rotated, the surgeon attempted to elicit pain during resisted internal rotation. An abduction test was performed with patients lying on their side [14]. The Trendelenburg sign and pain level when the leg is externally rotated with the hip flexed at 90° were also evaluated. Functional evaluations before the surgery and at review consisted of pain using the Visual Analog Scale (VAS), Lequesne pain and function index [16], the Harris Hip Score [17] and the degree of disability, which comprised the last steps in the verbal scale from significant to very significant [18]. During the review period, if patients were unable to visit the clinic, they were questioned by phone about their pain levels.

Magnetic resonance imaging (MRI) of the pelvis and involved hip (T1, T2 and fat-sat sequences) was obtained before the surgery to evaluate the type of tear, presence of fatty degeneration (FD) and muscle atrophy. MRI was repeated at least 12 months after the surgery. The MRI was performed and read by experienced radiologists. Tendon detachment or tear was detected based on the presence of a T2-weighted hypersignal with more or less blurred edges where the glutaeus minimus and/or medius tendons were located. This T2 hypersignal in all three planes was used as an indirect sign of the tear (Fig. 1a–c). It could mask a disruption in the tendon image itself and/or tendon retraction. Fatty degeneration was evaluated on T1-weighted images [19] using the classification system described by Goutallier et al. [20]. Muscle atrophy in the involved hip was evaluated on T1-weighted images and compared to the uninvolved (healthy) side. The contours of the gluteal muscles were outlined on each slice. The outlined areas on each slice were then added up and multiplied by the slice thickness (typically 4 or 5 mm).

2.4. Statistical analysis

Data were collected and then analyzed statistically using Student’s t-test and Pearson’s Chi² test. Continuous variables were expressed as the median (min, max) for age and BMI, and as mean ± standard deviation for the others. The significance level was set at P < 0.05 with 95% confidence intervals. The effects of independent variables (age, BMI) and other variables (muscle condition, number of torn gluteal tendons) on pain (VAS), the Lequesne index and the Harris Hip Score were evaluated. The effect of age was evaluated using two groups of patients above and below 68 years of age (median value) and the effect of BMI using two groups of patients with BMI above or below 24.9 (median value). All tests were performed using the software Pack SPSS Inc. for Windows, (version 17.0.1, SSPS, Chicago, IL, USA).

3. Results

Seventy-three patients were initially included in the study. Six (8%) were lost to follow-up, leaving 67 patients for analysis. The average follow-up was 4.6 years (range 1 to 8 years). There were 62 women (92.5%) and 5 men (7.5%). The median patient age was 68 years (range 25–87) and the median BMI was 24.6 (range 20.4–32). The average duration of symptoms before the procedure was 2.8 years (range 6 months to 10 years). Three patients were operated on both sides resulting in a total of 70 hips (37 left, 33 right). Twenty-one patient could not be examined at our clinic, so they were assessed by telephone; these patients had had either minimal or no pain. All the patients underwent a pre-operative MRI and 56 patients (83.6%) had an MRI at the follow-up visit.

Before the surgical procedure, 62 of patients (93%) had pain within 30 seconds of standing on the involved leg. Immediate, distinctive pain was triggered in 65 patients (97%) during the resisted internal rotation movement. Pain induced by resisted abduction was present in 60 patients (89%) and Trendelenburg’s sign was present in 23 patients (34%). At the review, all parameters of the functional and disability scores (walking, going up stairs) had significantly improved (P < 0.001) (Table 1). Of the 46 patients reviewed in person (68.6%), the number of patients with a positive Trendelenburg sign had decreased from 23 (34%) to 2 (3%) and those with pain when standing one a single leg had decreased from...
minimus pain. disability Harris cases (Evaluated were muscle was gluteus operative (16%, mean 1.77 11.5%, mean Table (16%))

Cannot walk > 1 km

87.9 ± 15.5 P < 0.001

Pain during stair climbing

63 patients (94%) 4 patients (6%) P < 0.001

Significant disability [18]

56 patients (83%) 8 patients (11.5%) P < 0.001

Harris Hip Score [17]

50.4 ± 8.0

P < 0.001

Lequesne Index [16]

12.3 ± 2.6

1.7 ± 2.7

P < 0.001

Pain (VAS)*

8.7 ± 1.1

P < 0.001

*Evaluated in 67 patients (except for stair climbing); VAS: Visual Analog Scale for pain.

Grade III and 2 at Grade IV) and 14 other hips (20%) displayed muscle atrophy. Conversely, 42 hips (60%) had no signs of either FD or muscle atrophy. When compared to the 42 hips with normal muscle appearance, the 14 hips with FD resulted in no significant changes in the postoperative functional abilities (Table 4), while the 14 hips with muscle atrophy had significantly lower functional scores (Table 5).

Of the 70 hips, 66 (94%) had a tear in the anterior fibers of the gluteus medius and 23 (33%) also had a gluteus minimus tear; the gluteus minimus tear never occurred in isolation. In the four other cases (6%), the main tendon (posterior fibers) of the gluteus medius was torn. Patients with single- or dual-tendon tears had similar mean values in their pain and functional scores after surgery: VAS (1.77 vs 1.89, P = 0.925), Lequesne index (3.43 vs 3.89, P = 0.886), Harris Hip Score (90.7 vs 88.6, P = 0.776), stair climbing (10.5% vs 11.5%, P = 0.927) and disability (4.8% vs 5.2%, P = 0.953).

There was no evidence of an age or BMI effect. The pre- and postoperative mean values for the functional and disability parameters were similar between the two age groups (Table 2) and BMI groups (Table 3).

On the pre-operative MRI, 14 hips (20%) had fatty degeneration relative to the healthy contralateral side (9 at Grade II, 3 at

Fig. 1. a: MRI axial slice: large area of T2 hypersignal indicates inflammation around the detached and retracted lateral fibers of the gluteus medius (GMe) and the subgluteus minimus bursa; b: coronal slice: GMe tendon tear and bursitis; c: sagittal slice: the main (posterior) tendon of the GMe is intact.

Table 1
Pre-operative and postoperative (at follow-up) values of the various functional and disability parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain (VAS)*</td>
<td>8.7 ± 1.1</td>
<td>1.7 ± 2.7</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Lequesne Index [16]</td>
<td>12.3 ± 2.6</td>
<td>4.0 ± 4.0</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Harris Hip Score [17]</td>
<td>50.4 ± 8.0</td>
<td>87.9 ± 15.5</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Significant disability [18]</td>
<td>63 patients (94%)</td>
<td>4 patients (6%)</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Pain during stair climbing</td>
<td>56 patients (83%)</td>
<td>8 patients (11.5%)</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Cannot walk &gt; 1 km</td>
<td>47 patients (70%)</td>
<td>10 patients (15%)</td>
<td>P &lt; 0.001</td>
</tr>
</tbody>
</table>

62 patients (93%) to 7 (10.4%) (P < 0.001). There were 11 failures (16%) with persistent pain, including four patients with significant muscle atrophy and poorly-defined tendons on MRI. Two cases of re-rupture were successfully treated surgically. In the 56 cases with an MRI at follow-up, the T2 hypersignal areas had disappeared and the continuity of the tendon had been restored (Fig. 2).

Fig. 2. MRI at the review (18 months): the GMe tendon’s continuity has been restored and bone anchor is stable.
Table 2
Pre-operative and follow-up values as a function of age. The age effect was evaluated on two groups of patients, one above 68 years of age and one below.

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age (min, max)</td>
<td>60 (25–67)</td>
<td>60 (25–67)</td>
</tr>
<tr>
<td></td>
<td>33 hips</td>
<td>33 hips</td>
</tr>
<tr>
<td>Pain (VAS)</td>
<td>8.85 ± 0.76</td>
<td>1.58 ± 2.28</td>
</tr>
<tr>
<td>Lequesne Index</td>
<td>11.67 ± 2.5</td>
<td>3.95 ± 4.1</td>
</tr>
<tr>
<td>Harris Hip Score</td>
<td>12.64 ± 2.6</td>
<td>87.15 ± 17</td>
</tr>
<tr>
<td>Stair climbing</td>
<td>82%</td>
<td>13%</td>
</tr>
<tr>
<td>Significant disability</td>
<td>85%</td>
<td>6%</td>
</tr>
</tbody>
</table>

P*: P value for differences based on age; VAS: Visual Analog Scale for pain.

Table 3
Pre-operative and follow-up values as a function of BMI. Two groups of patients with BMI above or below 24.9.

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median BMI (min, max)</td>
<td>23.5</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>(20.8–24.9)</td>
<td>(20.8–24.9)</td>
</tr>
<tr>
<td></td>
<td>38 hips</td>
<td>38 hips</td>
</tr>
<tr>
<td>Pain (VAS)</td>
<td>8.8 ± 1</td>
<td>1.58 ± 2.3</td>
</tr>
<tr>
<td>Lequesne Index</td>
<td>12.25 ± 2.7</td>
<td>3.88 ± 4.4</td>
</tr>
<tr>
<td>Harris Hip Score</td>
<td>50.69 ± 6.3</td>
<td>88.84 ± 15.6</td>
</tr>
<tr>
<td>Stair climbing</td>
<td>84%</td>
<td>8%</td>
</tr>
<tr>
<td>Significant disability</td>
<td>97%</td>
<td>5%</td>
</tr>
</tbody>
</table>

BMI: Body Mass Index; VAS: Visual Analog Scale for pain; *P: P value for differences based on BMI.

Table 4
Pre-operative and follow-up values as a function of fatty degeneration (FD).

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD</td>
<td>Normal muscles</td>
<td>FD</td>
</tr>
<tr>
<td></td>
<td>14 hips</td>
<td>14 hips</td>
</tr>
<tr>
<td></td>
<td>8.59 ± 1</td>
<td>1.27 ± 1.9</td>
</tr>
<tr>
<td>Lequesne Index</td>
<td>12.45 ± 2.7</td>
<td>3.85 ± 3.7</td>
</tr>
<tr>
<td>Harris Hip Score</td>
<td>50.6 ± 7.9</td>
<td>89.8 ± 13.5</td>
</tr>
<tr>
<td>Stair climbing</td>
<td>75.4%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Significant disability</td>
<td>91.4%</td>
<td>0%</td>
</tr>
</tbody>
</table>

P*: P value for differences based on muscle appearance on MRI; VAS: Visual Analog Scale for pain.

4. Discussion

This study included 67 patients (70 hips) who had been experiencing hip pain due to tears in the gluteus medius tendon, either alone or in combination with the gluteus minimus. These tears created severe functional deficits according to the test results collected here and previously described by others [1,21,22]. Our hypothesis that an open double-row suture repair of these tendons would significantly improve the outcomes was confirmed. With an average follow-up of 4.6 years, all the pain and functional outcomes (Lequesne index, Harris Hip Score, disability, walking, stair climbing) had improved significantly (P<0.001). There were 11 failures (16%) including two repeat tears that were reoperated successfully. Existing, validated clinical signs of greater trochanter pain syndrome [14] were very useful in making the diagnosis. Pre-operative MRI was also very useful; the signs of tendon rupture defined by radiologists (Fig. 1a–c) were used to confirm the surgical indication. The leading published studies that include pain assessments are shown in Table 6.

The current study has several limitations:

- this is a retrospective study, but it is also one of the largest single surgeon studies published (Table 6);
- twenty-one patients (31%) could not be reviewed in person, but these patients were not lost to follow-up; they were contacted by telephone and stated that their pain had greatly decreased;
- conversely, six patients were lost to follow-up;
- the quality of early MRI examinations was often not sufficient; as a result, the pan-pelvis views were only useful in evaluating the appearance of the muscles on T1 sequences. Only unilateral MRI with a small field of view provides enough definition to precisely analyze the lesions.

To our knowledge, this is the first study to have evaluated prognostic factors for the outcome of the surgical treatment of gluteus

Table 5
Pre-operative and follow-up values as a function of gluteal muscle atrophy.

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrophic</td>
<td>14 hips</td>
<td>14 hips</td>
</tr>
<tr>
<td>Lequesne Index</td>
<td>8.21 ± 1.1</td>
<td>3.07 ± 2.9</td>
</tr>
<tr>
<td>Harris Hip Score</td>
<td>51.2 ± 10.5</td>
<td>75.7 ± 19.7</td>
</tr>
<tr>
<td>Stair climbing</td>
<td>78.6%</td>
<td>21%</td>
</tr>
<tr>
<td>Significant disability</td>
<td>90.5%</td>
<td>21%</td>
</tr>
</tbody>
</table>

VAS: Visual Analog Scale for pain; *P: P value for differences based on gluteal muscle atrophy.
medius and minimus tears. Advanced age, high BMI and the number of tendons ruptured did not negatively affect the prognosis. However, the condition of the muscle must be carefully evaluated on MRI: the results were significantly worse in patients with muscle atrophy, whereas low-grade fatty degeneration did not have a negative effect.

To conclude, in cases of chronic greater trochanteric pain that are refractory to at least 6 months of conservative treatment and that have a well-justified surgical indication based on validated clinical signs and high-performance MRI, surgical double-row repair of ruptured gluteus medius and minimus tendons leads to highly satisfactory, medium-term results.

Disclosure of interest

Patrick Dijan has no conflict of interest relative to this study but acts as an educational consultant for Smith and Nephew. Hervé Bard has no conflict of interest relative to this study but has received honorariums from Rottapharm-Madaus, MSD, Abbott, Pfizer, Genzyme and Amgen that are unrelated to this study. Michel Lequesne and Konstantinos Makridis have no conflict of interest relative or outside of this study.

References