



Piriformis muscle rupture during total hip arthroplasty using a muscle-preserving posterior approach

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Total hip arthroplasty via muscle-sparing approaches is advocated and performed with increasing frequency. However, performing total hip arthroplasty through muscle-sparing approaches may require a more forceful retraction, which in turn may damage the muscles which the less invasive approach intended to preserve. We report on the rupture of the piriformis muscle during primary total hip replacement performed through a posterior approach intended to preserve this muscle. The prevalence and effects of such iatrogenic injuries are currently unknown, although unrecognised muscle damage may be a potential reason why early postoperative gait analyses could not demonstrate the expected benefits of less invasive surgery. Surgeons should be aware of this potential complication when performing total hip arthroplasty through a less invasive posterior approach.

Keywords: less invasive surgery ; total hip arthroplasty ; piriformis muscle ; muscle rupture.

Over recent years there has been a trend towards less invasive surgery when performing total hip arthroplasty (THA). Although such muscle-sparing approaches are supposedly less traumatic than standard approaches, concerns about potential iatrogenic risks remain since more forceful retraction or limb manipulation may be required (8,11). Importantly, early postoperative gait analysis is yet to demonstrate benefits of less invasive surgery (14).

The posterior approach is one of the most commonly performed approaches for THA and is associated with a higher rate of dislocation than a lateral approach, which may be due to the detachment of the short external rotators from the greater trochanter (4,9,15). In an effort to reduce the dislocation rates, less invasive techniques that involve preservation of piriformis have been advocated (3,6,7). A recent study that investigated the elongation of piriformis during THA performed through a posterior approach suggested that, if not released from the greater trochanter, this muscle can be elongated up to its threshold to rupture during the procedure (11). To the best of our knowledge, there is no published

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report of intraoperative rupture or avulsion of the piriformis muscle during THA. As clinical practice has proven that the possibility of iatrogenic intraoperative piriformis rupture is real, the lack of reporting the issue is either an oversight or due to some surgeons rating the complication as minor. Unfortunately, a good understanding of this complication and its potential consequences cannot be accomplished without greater awareness, investigation and follow-up.

This paper presents two illustrative cases in which the attempt to preserve piriformis during THA resulted in the intrapelvic rupture of this muscle, and speculates about the potential clinical consequences of this complication. Two male patients (Case 1 : sedentary 88-year-old male, weight 80 kg, height 178 cm, diagnosis primary osteoarthritis ; Case 2 : actively working 53-year-old male, weight 100 kg, height 183 cm, diagnosis osteoarthritis secondary to Perthes disease) underwent primary hybrid THA through a posterior approach intended to be less invasive and preserve the piriformis trochanteric insertion. Apart from the intent to preserve piriformis, the posterior approach was otherwise classically performed in both patients. After femoral canal preparation, the tendon of piriformis was, in both cases, noticed to be 'buckled' close to its insertion, and, on further investigation the piriformis muscle was found to have ruptured or avulsed within the pelvis (Fig. 1a & b). As the intrapelvic rupture of piriformis was deemed to be irreparable, the denervated muscle was excised.

Postoperatively, both patients underwent an unmodified rehabilitation protocol and had an uneventful recovery. However, the older patient demonstrated abductor weakness clinically, a limp and a positive Trendelenburg test postoperatively, which persisted two years after surgery. This patient's Harris hip scores improved from 32 preoperatively to 88 at two years postoperatively and his Harris pain score improved from 10 to 40. His abductor strength was measured at 5/5 preoperatively and 4/5 at two years postoperatively (13). Despite the persistent limp, he was satisfied with the result. In the younger patient, the Harris hip score improved from 51 preoperatively to 92 at one year postoperatively and the Harris pain score improved from 10 to 40.

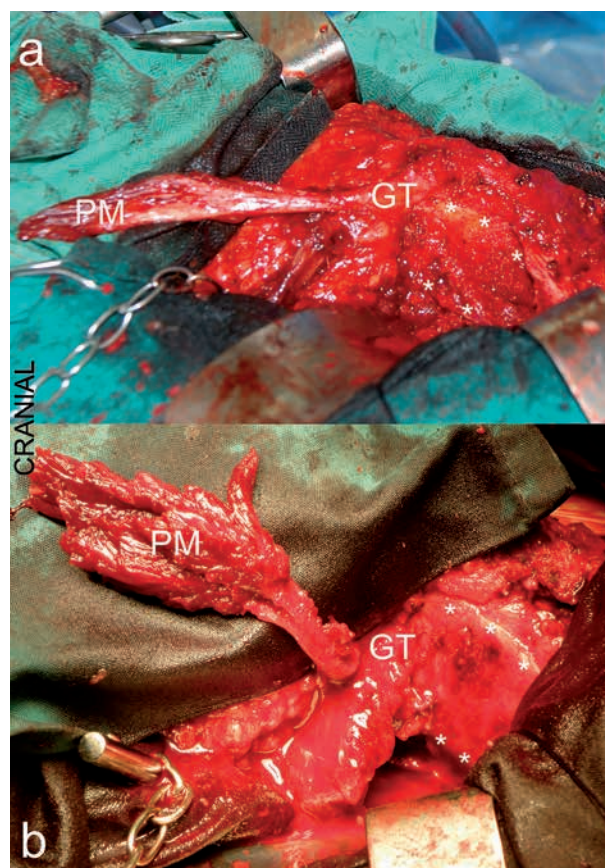


Fig. 1. — Intraoperative pictures illustrating the ruptured piriformis muscle (PM). a. Case 1 ; b. Case 2 ; GT, greater trochanter ; *, site of femoral neck osteotomy.

His abductor strength was measured at 3/5 preoperatively and at 5/5 at one year postoperatively. The Trendelenburg test was positive preoperatively but negative one year postoperatively. The patient mobilised with no limp and was satisfied with his result.

To further investigate Case 1's persistent postoperative abductor weakness and limp, magnetic resonance imaging (MRI, 1.5 Tesla AVANTO, Siemens, Germany) using a previously described protocol was performed at two years postoperatively (5). The MRI revealed that gluteus medius and minimus on both sides were symmetric in cross-sectional area and showed no signs of fat infiltration. The MRI also demonstrated that the posterior capsule and obturator internus had healed back onto the greater trochanter.

The cases illustrated in this paper highlight a specific complication that can occur during a muscle-preserving posterior approach to THA when the piriformis tendon is intended to be preserved at its greater trochanter insertion: an irreparable intra-operative rupture or avulsion of the piriformis within the pelvis. This observation confirms in clinical practice the findings of a laboratory study, which demonstrated that the positioning of the thigh during femoral preparation for a posterior approach THA can elongate piriformis above its threshold for rupture (11). One could argue that poor muscle quality might have played a role in the muscle rupture in Case 1, a sedentary 88 year-old patient, however, Case 2 was much younger and in otherwise good physical condition. In the presence of this complication, the intended benefit of the muscle-sparing approach with its reduced dislocation risk logically becomes redundant.

Although a definitive conclusion regarding the functional and clinical importance of the iatrogenic rupture of piriformis cannot be established based on the cases illustrated in this paper, some speculative observations can be made. One of the perceived advantages of the posterior approach to the hip when performing THA, over the lateral approach, is that patients have better postoperative abductor function and less limp. However, abductor dysfunction and limp has been reported after a posterior approach despite this approach preserving all hip abductors. Additionally, a Cochrane review could find no difference in the abductor function and limp when comparing THA performed through a lateral approach to THA performed through a lateral approach (2). In the absence of any gluteus medius and minimus release during a posterior approach postoperative abductor weakness can only be explained by iatrogenic injury to these muscles and/or their nerve supply by over or prolonged retraction or by dysfunction of other muscles affected by the approach.

Case 1 had persistent hip abduction weakness and an altered gait pattern postoperatively, which in the absence of morphologic and functional alterations in the regular hip abductors could be linked to the lack of piriformis function. Trendelenburg gait patterns are typically associated with significant

abductor weakness, but MRI investigations of this patient found no difference in cross-sectional areas of the abductors between the involved and non-involved sides. As an explanation of the observed gait pattern and abduction weakness seen in this patient, it is possible that the abduction component of the piriformis muscle is more important dynamically than previously thought. The anatomical orientation of the piriformis muscle suggests that its primary role is to externally rotate the hip, with abduction being a lesser function due to the almost horizontal alignment of the muscle fibres, the anterior sacral attachment and the small, proximal femoral attachment. However, the persistent nature of the post-operative gait dysfunction seen in Case 1 could suggest that the functional role of piriformis as a hip adductor might be underestimated. It is possible that the horizontal orientation of the muscle fibres results in compression of the femoral head into the acetabulum on early activation, stabilising the joint and allowing subsequent gluteus medius and minimus activation to pull the femur into a position of abduction (1,10). The absence of the piriformis in this stabilising role may go some way to explaining the findings in Case 1. In contrast to Case 1, good abductor strength was measured postoperatively in Case 2. It would be logical to surmise that a negative Trendelenburg test and gait requires that overall abductor strength falls below a certain threshold. In Case 1, a sedentary elderly man, the loss of the abductor function of piriformis might have brought his overall abductor strength below this threshold, while in contrast, in Case 2, a younger more active person, the loss of piriformis did not bring his overall abductor strength below such a threshold. It is recognised that further research in this area is required to prove or disprove these speculative observations.

Muscular damage due to retraction has been previously described and its extent will vary depending on patient factors (e.g. size, nutrition, muscle mass) and surgeon factors (e.g. surgical technique, skills) and may not be fully apparent at the time of surgery. As the repair of piriformis to the greater trochanter during a conventional posterior surgical approach for THA can fail and the current case reports have highlighted that failure to release piriformis from

the greater trochanter can lead to its partial or complete rupture in some cases, perhaps an alternative to these options might be the release of piriformis from its conjoint tendon with obturator internus, but preservation of its connection with gluteus medius as previously suggested (11,12). In this way, the continuity of the muscle to the greater trochanter is preserved through gluteus medius while allowing reduced tension during retraction for THA.

It is speculated that several factors could lead to an intrapelvic piriformis muscle rupture or avulsion during a THA performed through a posterior approach that aimed to preserve this muscle by not releasing it from the greater trochanter. Such factors could include the quality of the muscle, the amount of flexion, adduction and internal rotation applied to the femur and the amount of retraction applied to the muscle. The position of the femur during surgery and the amount of retraction applied to the muscle will depend on the complexity of the case and the amount of surgical exposure. The rupture of piriformis in two cases reported in this paper illustrates why surgeons should be cautious when attempting to preserve piriformis during a posterior approach to THA.

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