Management of abductor mechanism deficiency following total hip replacement

Deficiency of the abductor mechanism is a well-recognised cause of pain and limping after total hip replacement (THR). This can be found incidentally at the time of surgery, or it may arise as a result of damage to the superior gluteal nerve intra-operatively, or after surgery owing to mechanical failure of the abductor muscle repair or its detachment from the greater trochanter. The incidence of abductor failure has been reported as high as 20% in some studies. The management of this condition remains a dilemma for the treating surgeon. We review the current state of knowledge concerning post-THR abductor deficiency, including the aetiology, diagnosis and management, and the outcomes of surgery for this condition.

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Deficiency of the abductor mechanism secondary to tears of the gluteus medius and minimus tendons is a well-recognised cause of hip pain and limping following total hip replacement (THR).1-3 These abductor tendon tears could be present pre-operatively or develop either intra- or post-operatively.

Symptomatic tears of the abductor tendons without prior surgery usually form part of greater trochanteric pain syndrome (GTPS), which encompasses a spectrum of disorders, including chronic degeneration and tendinopathy of the gluteal tendons, trochanteric bursitis and iliotibial band disorders.4-8 Conventional treatment for these patients is initially analgesia, non-steroidal anti-inflammatory drugs (NSAIDs), steroid injections and physiotherapy.6-8 Surgical repair is usually reserved for few patients who do not respond to conservative measures.9,10

Some patients undergoing THR can also develop abductor mechanism deficiency as an iatrogenic complication. The two most common causes are inadvertent damage to the superior gluteal nerve intra-operatively and failure of repair or rupture of the abductor tendon insertion from the greater trochanter.1,3,11-13 The incidence of abductor deficiency after THR has been reported in various studies to be between 0.08% and 22%.14

Although the management of GTPS is well described, there is little in the literature regarding management and outcome of abductor deficiency following THR.

This paper reviews current understanding regarding the incidence, demographics, diagnostic tests and treatment of abductor deficiency in patients after THR.

Literature search

This review follows the guidelines set by the Cochrane Organisation.15 Any patients reported to have clinical features of hip abductor deficiency following THR, irrespective of the surgical approach (apart from trochanteric osteotomy) or the type of implant used, were included. Abductor repairs performed after revision arthroplasty, proximal femoral replacement for tumour or metastases were excluded. We did include any repair of the abductor tendons in clinically or radiologically diagnosed abductor-deficient patients following THR but single patient case reports were not included. We were particularly interested to note the proportion of patients who had a persistent limp after repair. We also noted if pain was reported, the Harris hip score (HHS),16 the result of the Trendelenburg test, use of mobility aids, patient satisfaction and any instability. Incidence, association with surgical approach, superior gluteal nerve palsy, age, gender, socioeconomic status, previous hip pathology, various diagnostic tests and the effect of the timing of the surgery were also reviewed.

‘repair abductor mechanism’ associated with ‘total hip arthroplasty’ and/or ‘total hip replacement’ were incorporated into the search. The references in the retrieved articles were also checked to find further relevant publications. Finally, the published proceedings of recent scientific meetings and conferences such as the British Hip Society, European Hip society, American Academy of Orthopaedic Surgeons annual meeting and The Hip Society were followed, along with a manual search of various current orthopaedic and trauma textbooks.

**Results**

A total of 99 citations were identified as potentially relevant but subsequent scrutiny led to the exclusion of 80, leaving 19 studies to be retrieved. The majority of the excluded studies were either case reports, case series reporting abductor repair in revision arthroplasty, proximal femoral replacement for tumour or metastases settings. Of the retrieved studies, there were no randomised controlled trials and all the studies were relatively small cohort studies. There were five patient series comprising a total of 58 patients who underwent various surgical interventions to correct the deficiency (Table I).\(^1\),\(^3\),\(^1\),\(^1\),\(^1\) The remaining studies assessed the incidence and use of various imaging modalities in the diagnosis of the condition.

**Incidence and surgical approach**

The incidence of asymptomatic gluteal tendon tears diagnosed at the time of surgery has been reported to be between 11% and 20%\.\(^4\),\(^5\) The occurrence of abductor weakness after THR has been reported to be higher in women than in men\.\(^1\),\(^2\),\(^1\) Hendry, Biant and Breusch\(^1\) reported a significantly higher incidence of abductor tears in elderly women. Similarly, the majority of the 58 pooled patients who underwent surgical repair of the abductor tendon were women\.\(^1\),\(^3\),\(^1\),\(^1\)

Abductor weakness has commonly been associated with surgical approaches that involve the release of the of abductor insertion from the greater trochanter, including the direct lateral, anterolateral or transgluteal approaches\.\(^2\),\(^3\),\(^1\),\(^1\) However, Jolles and Bogoch\(^2\) found no significant difference in terms of positive Trendelenburg tests between posterior and direct lateral approaches. Post-operative limping secondary to abductor weakness ranged from 4% to 20% after lateral or anterolateral approaches, and from 0% to 16% after a posterior approach\.\(^1\),\(^1\) Weber and Berry\(^1\) recorded an 0.08% incidence of abductor weakness using the anterolateral approach. In a retrospective series of 2657 THRs, Lübbeke et al\(^1\) found a 0.7% incidence of abductor weakness using lateral approach. Svensson et al\(^1\),\(^1\) used radio-opaque metal markers on either side of the abductor reconstruction site after THR and noted an incidence of up to 50% of separation of these markers, suggesting either elongation or rupture of the tendons up to one year post-operatively. However, only 6% of those with a separation > 3 cm were symptomatic and had a positive Trendelenburg test.

The exact incidence of superior gluteal nerve palsy after THR is not known but it is observed in the in the immediate post-operative period in up to 77% of patients and tends to improve spontaneously over time\.\(^2\) In a cadaver study, Baker and Bitounis\(^1\) found that the nerve follows an oblique course within gluteus medius and lies 3 cm to 5 cm proximal to the tip of the anterior part of the greater trochanter. Therefore, there is the potential for damage to the nerve when the fibres of the glutei are split in order to improve surgical access. Khan and Knowles\(^1\),\(^1\) reported a 6.8% incidence of superior gluteal nerve injury at the time of surgery with a direct lateral approach. In a clinical evaluation supported by electromyography (EMG) studies, Baker and Bitounis\(^1\) noted a significantly higher incidence of superior gluteal nerve palsy two weeks after surgery in patients who underwent a direct lateral approach as opposed to a modified lateral or posterior approach. However, three months post-operatively there was no difference between the groups. Based on these findings, the authors concluded that there is a high incidence of intra-operative traction neuropraxia to the superior gluteal nerve when the

<table>
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<th>Author/s</th>
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<th>Male/female</th>
<th>Mean age (yrs)</th>
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<th>Mean follow-up (mths)</th>
<th>Indication (n)</th>
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* immediate post-operative period

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Table I. A summary of studies associated with abductor tendon repair. All the studies were of a cohort design with no control group.
direct lateral approach is used, but this usually resolves spontaneously.12

Clinical evaluation
A history should be sought regarding the onset, location and duration of hip pain and limp, and any episodes of trauma, subluxation or dislocation. The surgical approach used, any intra-operative untoward events and post-operative recovery should be noted. A physical examination assessing the gait, limb length discrepancy, range of movement and abductor strength should be performed. The Trendelenburg test is a sensitive way of evaluating hip abductor weakness, provided it is carried out properly.24,25

Investigations
Plain radiographs can provide valuable information about the positioning and orientation of the implant, leg length, offset and any signs of loosening, all of which could be associated with abductor weakness. Reduced offset after THR is a potential cause of hip abductor weakness.26 Ultrasoundography has not been extensively used in the diagnosis of this condition, but Garcia, Picado and Nogueira-Barbosa27 noted an overall incidence of 20.6% of abductor tendon tears one year after THR using this technique. However, only 11.7% of their patients were clinically symptomatic and had a positive Trendelenburg test. Of the eight patients who had clinical abductor weakness, only four had positive ultrasonography. Based on these findings, the authors concluded that ultrasonography could play a role in the diagnosis of abductor tendon tears, although it remained highly operator dependent.27

In a retrospective study of 33 patients, Ylinen et al28 observed that all 14 patients with positive arthrographic findings were known to have gluteal tears intra-operatively. However, none of the 19 patients with negative arthrograms had similar findings at surgery, meaning that this test had low specificity, which makes it unattractive especially as it is invasive and risks introducing infection.

MRI is considered to be the most useful tool in the diagnosis of abductor tendon tears. In a prospective study of 64 THRs (25 asymptomatic and 39 symptomatic) one year after surgery, Pfirrmann et al29 found a significantly higher incidence of tears of gluteus minimus and medius. There were signal changes and fatty atrophy of the gluteus medius tendon in symptomatic patients. Müller et al30 in a prospective study of 38 patients subjected to either a modified lateral approach or an anterolateral minimally invasive approach, noted a 50% incidence of abductor tendon tears and fatty atrophy at one year post-operatively that did not correlate with the clinical findings, reported levels of pain, degree of satisfaction or Harris hip scores. Although MRI appears to be a very sensitive but not very specific investigation, the results should be interpreted with caution and must relate to relevant clinical findings.

Management and outcome
In patients with superior gluteal nerve palsy it seems to be safe to adopt a ‘wait and see’ approach, as spontaneous recovery is reported in up to 95% of patients by 24 months after THR.22 Serial EMG can be used in the diagnosis and to assess recovery in these patients. If the abductor tendon is known to be ruptured there appear to be no studies that report the natural history of the condition.

Various surgical techniques that reconstruct the damaged abductor tendon have been described, with mixed results (Table 1). In all, there were 58 pooled patients from five studies who underwent surgical interventions for abductor deficiency repair and in whom the effect of repair on the limping was assessed post-operatively. Of these, 40 patients had direct transosseous repair,1,2,11 11 had transfer of anterior gluteus maximus to the greater trochanter,17 and seven had teno Achilles allograft reconstruction.3 In terms of outcome, 27 patients reported no limp after repair, 18 patients had a slight to moderate limp and 13 continued to have a severe limp post-operatively.

In the direct transosseous repair group (40 patients), 16 patients reported no limp, 13 had mild to moderate limp and 11 reported severe limp post-operatively. From the gluteus maximus transfer group (11 patients), nine had no limp, one reported slight to moderate limp and one reported severe limp. In the teno Achilles allograft reconstruction group of seven patients, two reported no limp, four a slight limp, and one reported severe limp post-operatively.

A total of four of the studies recorded post-operative pain relief. A study of 12 patients who underwent direct transosseous abductor repair reported an improvement in pain post-operatively in all patients, without further quantification.2 In all, there were 34 patients from three studies where post-operative pain was measured, 27 of whom had a direct transosseous repair and seven a teno Achilles allograft reconstruction.1,3,11 Of the 34 pooled patients, 23 reported no or mild pain post-operatively, nine had moderate pain and two had persistently severe pain.1,3,11 The Trendelenburg test was reported in 36 patients out of four studies,1-3,17 and of these, 26 patients had a negative test, six were weakly positive and four had a strongly positive test post-operatively. All the patients with a strongly positive Trendelenburg test belonged to the direct transosseous repair group.

Only two studies (a total of 25 patients) reported the HHS.3,11 In the direct transosseous repair group (18 patients), four recorded a significantly better HHS, seven had a marginally improved score and seven scored poorly post-operatively.11 In the teno Achilles allograft reconstruction group (seven patients), six had a significantly better HHS and the other patient was marginally improved.3

General patient satisfaction was recorded post-operatively for 39 patients, all from the direct transosseous repair group.1,2,11 Overall, 29 patients were satisfied and the remaining ten were dissatisfied.1,2,11
Only two studies (16 patients) recorded the use of mobility aids post-operatively. From the nine patients in the direct transosseous repair group, three mobilised without any walking aids and six occasionally required assistance when walking long distances. In the tendo Achilles allograft reconstruction group three of the seven patients mobilised without assistance and two occasionally required walking devices; the other two regularly required a walking device.

Instability was reported only in the gluteus maximus transfer group, where one of the three patients who underwent this procedure for recurrent dislocation continued to have similar symptoms post-operatively. In a retrospective review of 2657 THR, Lübbecke et al found no significant difference in the body mass index (BMI) of patients with abductor weakness requiring surgical repair of the gluteal tendon compared with the control group of THR patients without abductor weakness. However, in a different study, Miozzari et al reported better outcomes of abductor repair in patients with low BMI (≤ 30 kg/m²).

Timing of remedial surgery
Weber and Berry did not find any correlation between functional outcome and the time from THR to abductor repair. In their series of nine patients who underwent direct transosseous repair with or without incorporation of the fascia lata, the mean interval between THR surgery and abductor repair was 17 months (2 to 39). Of these, four patients had excellent to good results, two had fair and three had poor results. The authors concluded that after THR, one year of rehabilitation is usually sufficient, after which further diagnostic measures possibly leading to surgical exploration should be considered.

Lübbecke et al in a series of 19 patients with direct transosseous repair, included 11 patients who had early repair (one to 14 months after THR) and eight who had late repair (≥ 20 months after THR). They found improvements in post-operative limping and HHS in the patients who had early abductor repair. Miozzari et al in their series of 12 patients with direct transosseous abductor repair with a mean interval from THR to repair of 4.8 years, reported failure of the repair in four based on the post-operative MRI scan, although 75% of the patients in the series were satisfied post-operatively. Based on these findings, the authors concluded that earlier identification of the dehiscence and repair before muscle and tendon degeneration is established may improve the results.

Conclusions
In conclusion, abductor deficiency after THR is a difficult problem to treat. However, contrary to popular opinion, there is no clear evidence that the incidence of abductor weakness is higher in lateral than posterior approaches. Assessment of hip abductor weakness following THR should incorporate a clinical history, examination including a Trendelenburg test, and a review of plain radiographs. Further investigation should include MRI, which needs to take the clinical picture into account when evaluated. In cases where the abductor mechanism is known to be intact, one should consider further investigation of the superior gluteal nerve through serial EMGs.

The natural history of this condition when treated conservatively remains unclear but there seem to be far fewer patients presenting for surgical treatment than the numbers initially presenting with the condition following THR. This might be largely as a result of spontaneous improvement, modification of lifestyle, or the reluctance of the clinician or the patient to consider further surgery.

Most authors have reported some improvement in symptoms post-operatively after surgical repair. However, the outcomes with regard to limping and the Trendelenburg test are inconsistent. There appears to be slight evidence in favour of early repair. Apart from Weber and Berry who did not report very favourable outcomes with direct transosseous repair, the results with either direct transosseous repair or augmentation with either auto- or allograft were similar. Anterior gluteus maximus transfer may have a role, particularly in patients who have severe destruction of the hip abductor mechanism. Surgical repair for patients who have an unsatisfactory outcome after a year of conservative management offers a reasonable chance of improvement, and approximately 75% of patients are reasonably satisfied with the outcome.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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References