

Abductor mechanism tears in primary total hip arthroplasty

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Abstract

Introduction Tears of the abductor mechanism of the hip are well recognized, but poorly understood. Little is known of the effect of demographics and pathology on prevalence of abductor mechanism tears or the impact on clinical outcome.

Methods This prospective study analysed the effect of age, gender, medical co-morbidity and social deprivation on prevalence of abductor mechanism tears of the hip in 835 consecutive patients undergoing total hip arthroplasty (THA) between 2003 and 2011. Effect on clinical outcome relating to presence of abductor mechanism tear was analysed in a subset at pre-op and at 1 year post-operation using the Oxford hip score (OHS).

Results The prevalence of abductor mechanism tears was 25.4 % ($n = 212$). Female patients ($p < 0.001$), older patients ($p = 0.001$) and those of lower socioeconomic status ($p < 0.001$) were significantly more likely to have a pre-operative abductor mechanism tear. In older socially deprived females the predicted rate of tear is 70.9 %. The aetiology of the hip disease ($p = 0.593$) or presence of any specific co-morbidity ($p = 0.085$ – 0.929) had no significant effect on the prevalence of abductor mechanism tears. In patients with protrusion or dysplasia there was an increased prevalence of tears ($p = 0.002$). There was no significant difference in pre-operative ($p = 0.775$) or post-operative ($p = 0.604$) OHSs regardless of the tears when the tears were recognized and treated at the time of THA.

Conclusions Tears are increasingly prevalent in women of advancing years and lower socioeconomic status which should be considered when planning operative approach in this demographic. When recognised and repaired there is no difference in the clinical outcome for those with abductor mechanism tears of the hip.

Keywords Abductor mechanism tears · Rotator cuff tears of the hip · Total hip arthroplasty · Deprivation

Introduction

The abductor mechanism of the hip is composed of the chief muscles of hip abduction; gluteus medius and gluteus minimus and the accessory abductors of the hip, tensor fascia lata and sartorius. The abductor mechanism is integral for gait and stability of the hip joint. Deficiency of the abductor mechanism in the presence of a native or prosthetic hip results in a Trendelenburg gait.

Tears of the abductor mechanism were recorded in a series of patients with a fracture of the femoral neck at surgery with a prevalence of 22 % [1]. The tears were considered similar to those of the better-known shoulder equivalent and therefore the term ‘rotator cuff tear of the hip’ was used. The appearances of tears seen in gluteus minimus and the anterior third of the insertion of gluteus medius with rolled edge appearances are analogous to those of large tears affecting supraspinatus and the anterior border of infraspinatus [2].

Howell et al. [3] investigated the prevalence of rotator cuff tears of the hip in a prospective population of osteoarthritis patients undergoing total hip arthroplasty (THA). Prevalence of tears was 20 % with increased frequency at

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advancing age and in women. Small tears were found in the gluteus minimus in younger patients and older patients had greater tears involving the gluteus medius. When THA was undertaken with a posterolateral approach, Cates et al. [4] found the incidence of tears to be considerably lower at 1.6 %.

Abductor mechanism tears of the hip have been observed in patients presenting with isolated lateral sided hip pain due to recalcitrant trochanteric bursitis [5]. In patients with symptomatic trochanteric bursitis abnormal signal within the tendon of gluteus medius has been found with magnetic resonance imaging. Following reattachment with bone sutures patients in one study were pain free [5] and in another had significantly improved clinical outcome scores at 1-year follow-up [6].

Abductor mechanism tears of the hip are a common finding that may be under recorded and therefore under repaired in THA patients. Predisposing factors and the potential effect of tears on the clinical outcome in a THA population are largely unknown. This prospective study was designed to assess the effect gender, aetiology, social deprivation and co-morbidities had on the prevalence of abductor mechanism tears of the hip, and assess whether presence of these tears affected the clinical outcome of patients undergoing THA when they were recognized and treated.

Patients and methods

Between May 2003 and December 2011, 880 patients had primary THA performed by or under the direct supervision of the senior author. In cases with bilateral THA both procedures were recorded separately. There were 308 (36.9 %) males and 527 (63.1 %) females with average age 69.5 years (range 33.4–89.8, 95 % CI 68.0–71.0). Patients with previous ipsilateral hip surgery or those undertaken via posterior approach, which was used mainly in young patients with developmental dysplasia of the hip (DDH) or congenital hip dislocation (CDH), were excluded ($n = 45$).

Patient demographics and co-morbidities were recorded at pre-operative assessment. Categories of co-morbidity included heart disease, hypertension, lung disease, vascular disease, neurological problems, stomach ulcer, kidney disease, liver disease, anaemia, depression, back pain, pain in other joints, obesity and diabetes. The aetiology of hip pathology, side and procedure details were obtained from operation notes.

The Carstairs index was used to assess the level of social deprivation [7]. This method has been used since 1981 to measure social deprivation in Scotland by giving each postcode sector a standardized deprivation score. The scores are assigned a categorical variable called the

Table 1 Classification of abductor mechanism tears

Degree of abductor mechanism tear	Grade
None (normal abductor mechanism)	0
Small tear in gluteus medius (up to 2 cm ²)	1
Tear in gluteus medius and anterior trochanter polishing ≥ 2 cm ²	2
Full thickness tear in gluteus medius and minimus	3
Full thickness tear in gluteus medius and minimus with defect in hip joint capsule (i.e. exposed femoral neck)	4

deprivation category (DEPCAT) ranging from one, most affluent to seven denoting the least affluent [8].

The patient was placed in the lateral decubitus position. Surgery was performed via a modified lateral Hardinge approach [9, 10]. An inspection of the abductor mechanism was undertaken and if a tear was identified, site and size of tear were recorded. Tears were categorized using the classification system outlined in Table 1. All patients received a cemented Contemporary polyethylene acetabular component (Stryker, UK) and an Olympia cemented femoral component (Biomet, UK) with the use of Palacos R&G bone cement (Palacos R&G, Heraeus Medical, Werheim, Germany). Any abductor tears present were repaired with transosseous refixation of capsule and vastoglutal sleeve as previously described [10]. A standard post-operative rehabilitation programme was followed for all patients.

All data were collected prospectively, but during the study period, the department started to collect pre- and post-op oxford hips scores (OHS) routinely from 2005. A subset of patients therefore had clinical outcome scores. 150 cases (18 %) had patient recorded outcome measures (PROMS) at pre-operative assessment and follow up appointments. The clinically validated OHS [11] (scored from 12 to 60, with 60 as the worst score) was recorded pre-operatively and at 12 months post-operatively. This subset was representative of the population with similar age (68.0 vs. 69.5), sex ratio (1:1.7 vs. 1:2.01), DEPCAT

Table 2 Frequency of each category of category abductor tears

Degree of abductor mechanism tear	Frequency cases (%)
None (normal abductor mechanism)	623 (74.6)
Small tear in gluteus medius (up to 2 cm ²)	97 (11.6)
Tear in gluteus medius and anterior trochanter polishing ≥ 2 cm ²	76 (9.1)
Full thickness tear in gluteus medius and minimus	33 (4.0)
Full thickness tear in gluteus medius and minimus with defect in hip joint capsule (i.e. exposed femoral neck)	6 (0.7)

Fig. 1 Intraoperative finding of mass Grade 4 tear with full thickness tear in gluteus medius and minimus through the joint capsule

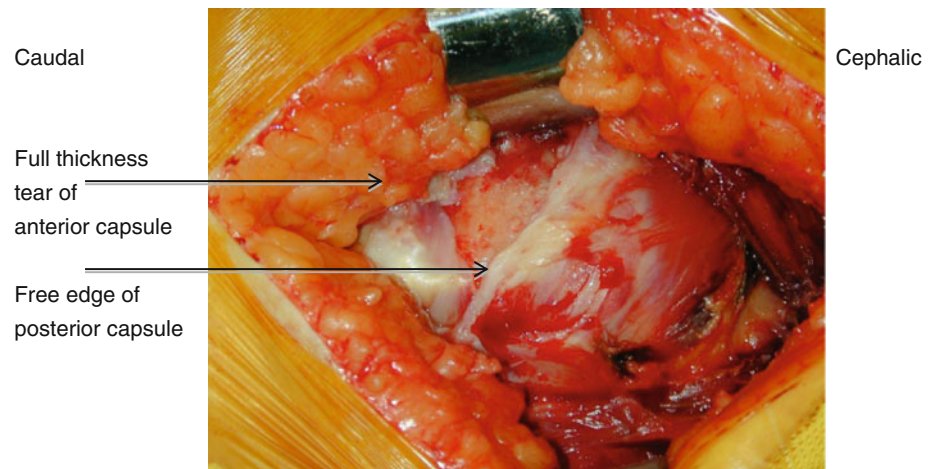


Table 3 Effect of comorbidities and demographics on presence of abductor mechanism tear

Demographic	Mean score		Statistical difference. (independent samples Mann–Whitney)
	Tear present	Tear absent	
Ischaemic heart disease	1.16	1.13	0.276
Hypertension	1.24	1.20	0.306
Lung disease	1.08	1.08	0.888
Peripheral vascular disease	1.03	1.02	0.632
Neurological disease	1.06	1.04	0.263
Diabetes	1.13	1.09	0.085
Duodenal ulcer	1.05	1.03	0.455
Renal disease	1.04	1.02	0.296
Liver disease	1.01	1.01	0.979
Anaemia	1.07	1.04	0.072
Depression	1.03	1.05	0.125
Back pain	1.27	1.24	0.375
Pain other joints	1.42	1.44	0.557
Obesity	0.3	0.3	0.949
DEPCAT	4.17	3.10	0.000*
Diagnosis	1.33	1.22	0.593
Protrusion	1.13	1.08	0.031*
Operation	1.45	1.26	0.02*
Sex	1.75	1.59	0.000*
Age	69.89	67.63	0.001*

score (3.40 vs. 3.25) and prevalence of abductor tear (25.4:24 %).

Analysis was performed using Statistical Package for the Social Sciences version 19.0 (SPSS Inc., Chicago, IL.) Due to small numbers of Grade 4 tears, when assessing for differences in grades of tears, Grade 1 and 2 tears were grouped together as ‘minimal tears’ with Grade 3 and 4 making up ‘large tears’. Using Shapiro–Wilk testing, the data were found to be non-parametric. Analysis was

undertaken with Mann–Whitney and Kruskal–Wallis H testing. Post hoc analysis for Kruskal–Wallis H testing used ANOVA with Tamhane test. A p value <0.05 was considered significant. Multiple logistic regression modelling was used to predict the presence of tear correcting for independent variables.

Results

The aetiology was primary osteoarthritis in 707 (84.7 %) patients, rheumatoid, inflammatory or psoriatic arthritis in 92 (11.02 %), and degenerative hip disease resultant of DDH in 17 (2.0 %), Avascular necrosis (AVN) in 19 (2.3 %). 79 patients had a protrusion pattern independent of aetiology (9.46 %). 708 cases (84.8 %) underwent THA. A further 19 (2.3 %) had THA with autogenous acetabular roof graft and 86 (10.3 %) had THA with autogenous acetabular floor graft. The 22 remaining cases had THA with impaction grafting (2.5 %). Abductor mechanism tears were found in 212 of 835 cases (25.4 %). The prevalence of each category of tear is outlined in Table 2 and an example of a Grade 4 tear seen in Fig. 1.

The prevalence of tears in women was 29.7 % compared to 17.5 % in men (Mann–Whitney, $p < 0.001$). Average age of patients with tears was 69.89 (95 % CI 68.4–71.4) years versus 67.6 (95 % CI 66.8–68.5) years in those without tears. The average DEPCAT score for patients with tears was 4.08 (95 % CI 3.88–4.27), compared to 3.17 (95 % CI 3.06–3.28) in those without tears. Socially deprived patients were significantly more likely than affluent patients to have a pre-existing abductor mechanism tear at THA (Kruskal–Wallis, $p < 0.001$).

Older patients were more likely to have a cuff tear (Kruskal–Wallis, $p = 0.001$). There were significantly greater female patients (Mann–Whitney, $p < 0.001$) with an abductor mechanism tear. There was no significant

Table 4 Demographics, operation and diagnosis for each grade of tear (0–4) and category of tear (no tear, minimal tear, large tear)

Grade of cuff tear	No tear 0	Minimal tear		Large tear	
		1	2	3	4
Age	67.64	70.80	68.41	70.07	73.02
Sex ratio (%)					
F	59.3	68.1	75	88	100
M	40.7	31.9	25	12	0
DEPCAT	3.17	3.92	4.17	4.36	3.83
Protrusion (%)	8.2	9.3	15.8	21.2	0
Operation (%)					
THR	87	80.4	76.3	72.7	100
THR with floor graft	8.2	16.5	15.8	21.2	0
THR with roof graft	2.4	1.0	2.6	3.0	0
THR with impaction	2.4	2.1	5.3	3.0	0
Diagnosis (%)					
OA	85.2	87.6	77.6	84.8	66.7
RA, inflammatory, psoriatic	9.5	12.4	21.1	9.1	33.3
DDH	2.6	0	1.3	0	0
AVN	2.7	0	0	6.1	0

difference in prevalence of specific co-morbidities with abductor tears (see Table 3 for individual *p* values.)

A significant difference was found between prevalence in tears and requirement of more complex primary THA (Kruskal–Wallis, $p = 0.002$). Further analysis showed a significant difference between standard primary THA and THA with floor graft, THA with roof graft and THA with impaction grafting (ANOVA post hoc Tamhane, $p = 0.005$).

OHS scores pre-operatively were 40.31 (95 % CI 37.52–43.09) in those with a tear compared to 40.39 (95 % CI 38.87–41.91) in those without. The 12 months OHS score for those with tear recognized at THA and treated was 20.42 (95 % CI 18.16–22.68) and 21.03 (95 % CI 19.37–22.69) for those without tears. There was no significant difference in OHS dependent on the presence of tear pre-operatively (Mann–Whitney, $p = 0.775$), 12 months postoperatively ($p = 0.604$) when the tear has been repaired and difference between scores ($p = 0.604$).

When tears are classified as none, minimal or large tear, significant differences in age are found between no tear and large tear (ANOVA post hoc Tamhane, $p = 0.03$). There are significantly more female than males between all categories of tears (ANOVA post hoc Tamhane, $p < 0.001$) (Table 4)

Using a multinomial regression model to predict the prevalence of tear (no tear, minimal tear or large tear), age, sex and social deprivation have a significant effect on predicting cuff tear presence ($p = 0.019$, PPV 61.7 %, NPV 92.6 %). When accounting for increased age (70–80 years), female sex and increased social deprivation (DEPCAT score 5 and 6) abductor mechanism tear was

70.9 % (Exp B 2.74). In younger patients (40–50 years), male gender with higher affluence (DEPCAT 1–2) predicted tear rate was 1.4 % (Exp B 0.005). Increasing decile of age increases predicted prevalence by a factor of 1.34 regardless of the size of tear. When controlling for independent variables the likelihood of having a minimal tear and being male is 15.1 % (Exp B 0.591) and 4.2 % (Exp B 0.166) for a large tear. More affluent DEPCAT scores (1–2) reduce prevalence of minimal tears (Exp B 0.53, 12.7 %) and large tears (Exp B 0.09, 2.3 %), with more deprived scores (DEPCAT 5–6) having increased predictive effect for minimal tears (Exp B 1.641, 41.8 %) and large tears (Exp B 2.577, 65.5 %).

Discussion

Little is known of the cause of abductor mechanism tears of the hip. Original work by Neer [12] suggested that rotator cuff tears at the shoulder were progressive, generated by impingement of the sub-acromial arch. Proponents of the alternative intrinsic theory suggest that shoulder rotator cuff tears result from progressive age related degeneration with tears in a relatively hypo-vascular zone [13]. Howell et al. [3] noted all hip rotator cuff tears in their series had their centre on an osteophyte and occurred at a vascular watershed. This, combined with observations from this study shows that increasing age relates to tear prevalence and increasing size of tear suggests tears are progressive and part of the natural history of the disease. This study is the first to demonstrate the role of deprivation, co-morbidities and different aetiologies on the prevalence of

abductor mechanism tears of the hip. The limitation of this study is lack of clinical outcome scores on all patients, therefore a subset of cases were used to determine clinical outcome with pre- and post-operative scores.

Like rotator cuff tears of the shoulder, the true prevalence of abductor mechanism tears may be underestimated. In asymptomatic patients of any age prevalence of rotator cuff of the shoulder on MRI is 34 % [14]. In our cohort, no difference was seen in pre-operative scores regardless of the presence of tear. With a prevalence of 25.4 % rotator cuff tears of the hip may be under recorded in clinical practice, and possibly under repaired. A significantly lower incidence of tears (1.6 %) was reported by Cates et al. [4] who used a posterolateral approach. This discrepancy is not surprising, as a cuff tear would only be evident intraoperatively if of full thickness. It seems reasonable to postulate that when using a posterior approach the vast majority of low grade of tears i.e. Grade 1–2 are not repaired, simply as these will not be identified.

We propose a simple classification of such tears as one does not exist, which may allow a basis for future studies and their comparison. The consequences of missing or not treating abductor mechanism tears is unknown. When considering that there is no reported difference in outcome, abductor hip strength or incidence in Trendelenburg test between posterior and direct lateral approach in the literature [15, 16], Grade 1 and 2 tears probably do not influence abductor function. However, it remains unknown whether these tears (if not repaired in posterior approach) continue to progress and whether any progression of such tears would then predispose to a higher incidence of late dislocation of the hip [17].

We have to expect an increased prevalence of tears in women, older patients and those of lower socioeconomic status and when considering an increased risk of dislocation in older female patients [18, 19], this may affect the surgeons' choice of surgical approach. Irrespective of demographic factors, rotator cuff tears of the hip when appropriately repaired do not seem to negatively impact on clinical outcome (scores) based on the limited data available so far. However, further studies with emphasis on the prevalence of pre- and postoperative lateral hip pain and possible correlations with cuff tears are required to enhance our current understanding of this condition.

Conflict of interest The authors' declare that they have no conflict of interest.

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