

Surgical repair of hip abductors. A new technique using Graft Jacket[®] allograft acellular human dermal matrix

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Received: 5 April 2012 / Accepted: 13 July 2012 / Published online: 8 August 2012
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Abstract

Purpose Avulsion of the abductors from the hip can be an infrequent but debilitating complication after total hip arthroplasty performed through a trans-gluteal approach. This can result in intractable pain, limp, Trendelenberg lurch and instability of the hip. There have been various methods described for repairing or reconstruction of this abductor muscle complex including direct trans-osseous repair, muscle transfers, muscle and tendon sling, bone tendon allograft reconstruction and endoscopic repair techniques.

Methods In a prospective study at our institution we evaluated the results of a surgical technique in 12 patients using a trans-osseous repair of gluteus medius and minimus insertions augmented by a Graft Jacket[®] allograft acellular human dermal matrix (Graft Jacket[®]; Wright Medical Technology, Arlington, TN) over the anterior and anterolateral aspects of the greater trochanter. Diagnosis of hip abductor avulsions was made by evaluation of the history of presenting complaint, clinical examination and confirmed by ultrasound or MRI scans.

Results Evaluation of results included pain scoring, gait evaluation, Trendelenberg test, and the Harris hip score. There was a significant improvement in pain (VAS mean values 8.25 to 2.33; p value <0.0001), limp and gait along with abductor strength. The Trendelenberg test became negative in all but one. At the mean follow up of 22 months Harris hip scores improved from 34.05 to 81.26 (p value <0.0001).

Conclusion Overall this procedure appears to be safe and associated with high patient satisfaction, without the morbidity of any tendon or muscle transfers.

Introduction

Abductor muscle deficiency of the hip joint can cause severe pain over the lateral aspect of hip, limp and instability of hip joint. There have been three distinctive groups of patients described by Lachiewicz [1] with hip abductor tears. The first group involves older patients with intractable lateral hip pain and weakness but without arthritis of the hip joint. These patients have degenerative or traumatic tears of the hip abductor tendons. These were described as rotator cuff tears of the hip joint by Kagan [2]. The second group with abductor muscle complex tears includes patients undergoing arthroplasty of hip either for osteoarthritis or fractured neck of femur and are asymptomatic. The third type of abductor dysfunction occurs with avulsion or failure of repair of abductor muscles following total hip arthroplasty performed through the anterolateral approach. These patients are symptomatic and need treating.

There have been several techniques described for repairing these abductor tears including direct trans-osseous repairs [3, 4], endoscopic repair techniques [5], Achilles tendon allograft [6], gluteus maximus muscle transfers [7] and vastus lateralis muscle transfers [8, 9]. The results have been unpredictable and often involve extensive recovery and rehabilitation periods. The aim of our study was to assess improvement in pain, limp and abductor strength in patients operated upon surgically for confirmed abductor avulsion using a modified trans-osseous repair and augmentation of repair with a Graft Jacket[®] allograft acellular human dermal matrix (Graft Jacket[®]; Wright Medical Technology, Arlington, TN).

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Methods

We conducted a prospective study with ethical approval of our institution. In this study we included 12 consecutive patients with hip abductor avulsions between 2008 and 2010. In 11 of them this followed a primary total hip arthroplasty through an Hardinge approach [10] for osteoarthritis and in one patient it followed a trivial trip while dancing. The total number of primary hip arthroplasties performed during that period at our institution was 1276 (Source: National joint registry—Online statistics for England and Wales for St. Richard's Hospital, South East England) [11]. There were eight female and four male patients with mean age of 68 years (range 62–84 years). All the patients presented with pain around lateral aspect of hip, and walked with a significant Trendelenberg limp using a crutch or a stick in the opposite hand. They all had a positive Trendelenberg test with weak abduction and were unable to do a single leg stance on the affected side. All 12 patients examined in the lateral decubitus position had weak abduction of hip against gravity according to the Medical Research Council muscle strength grading system, (grades 0 to 5, with grade 0—no muscle contraction to grade 5—normal power) grade power 2 in seven patients and grade 3 in five patients. The initial diagnosis of hip abductor deficiency was made on evaluation of the history of the presenting complaint and clinical examination, and the abductor muscle complex tear was confirmed on magnetic resonance imaging (MRI) scan in eight patients and on ultrasound scan in four patients. MRI scans showed separation of the gluteal tendon from the anterior aspect of the trochanter best seen on the T2-weighted fat suppressed coronal and transverse sequences (Fig. 1).

The ultrasound scan findings were of tendinous defects of the hip rotator cuff characterised by sonography as hypo echoic or anechoic focal areas and by the absence of a



Fig. 1 MRI scan. Left hip abductor complex tear with arrow showing atrophy and retraction of muscle belly

uniform fibrillar pattern of hip abductor musculature in the trochanteric region.

All these patients were counselled and offered surgery and mean time for surgical intervention was eight months (range six–14 months) from total hip arthroplasty or injury.

Surgical technique

The procedure was performed with the patient in a lateral decubitus position through the old scar as used for primary total hip arthroplasty in 11 patients and a new incision with direct lateral approach in one patient who had an abductor avulsion in the native hip. Avulsion of the aponeurosis of the gluteus medius and gluteus minimus tendon from the greater trochanter was found in all cases (Fig. 2). The torn aponeurotic tissue was always retracted from the bone, scarred, and largely avascular. This mass was mobilised by sharp dissection from the anterior superior joint capsule/pseudo capsule and the tensor fascia lata. The muscle fibres of gluteus medius and minimus were further mobilised from the distal bony bed on the ilium using a combination of sharp and blunt dissection to permit advancement onto the trochanter and closure of the gap with the least possible tension. Care was taken to avoid injury to the superior gluteal nerve. The insertion site on the greater trochanter was scarified to fresh bleeding bony surface. The limb was maintained in approximately 20° of abduction and neutral rotation with the leg and the flexed knee resting on a predetermined height of Mayo stand. Two-millimetre drill holes were made in the anterior aspect of the greater trochanter as close as possible to the normal insertion site dependant on the excursion of the glutei, then affixed to this area with No. 5 trans-osseous Ethibond suture (Ethicon, Somerville, NJ) and Krackow stitch [12] via three to five tunnels, depending on bulk of muscle and conjoint tendon. There remained a bare area of bone in all but two cases over the greater trochanter (Fig. 3). An on-lay augmentation of the osseo-tendinous

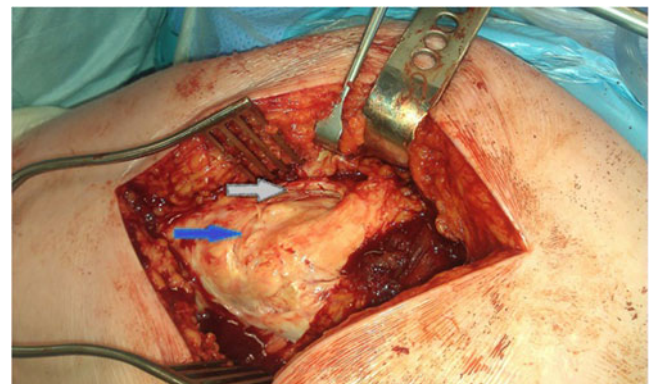


Fig. 2 Retracted combined tendon of gluteus medius and minimus tendon (grey arrow) exposing bare area of greater trochanter (blue arrow)

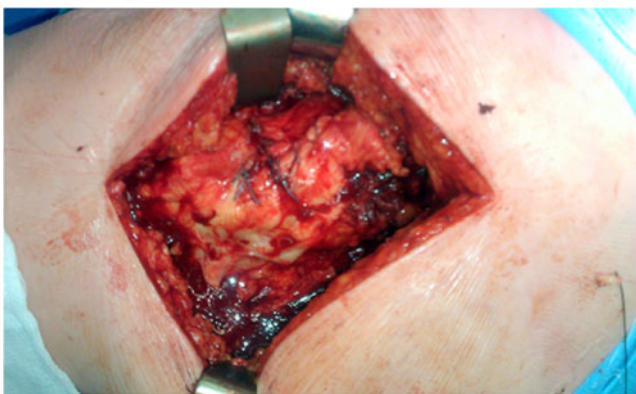


Fig. 3 The combined tendon of gluteus medius and minimus attached to the greater trochanter through the intra-osseous tunnels using a Krackow core stitch. Note the remnant bare area of trochanter. In spite of extensive mobilisation of abductor muscle it could not be reattached to its normal insertion site

junction with the proximal musculo-tendinous junction was performed using a Graft Jacket® matrix of 4 × 7 cm in size covering the gluteus medius, greater trochanter and inferiorly onto vastus lateralis. A continuous No.1 Vicryl absorbable suture (Coated Polyglactin 910 Vicryl; Ethicon, Somerville, NJ) was used to suture the Graft Jacket® matrix at its periphery in a fashion akin to securing a split skin graft (Fig. 4). After the augmentation, there were no bare areas of bone left over the trochanteric region. A careful closure of the fascia lata and rest of the superficial surgical wound was performed. An abductor wedge was applied whilst the patient was in the decubitus position and turned with help of five personnel.

Postoperatively patients were mobilised using two crutches, full weight bearing as tolerated. Active and passive abduction of the operated hip was avoided for six weeks. Following this for a further six weeks, patients were allowed passive abduction for functional activities of daily living and thereafter allowed active abduction strengthening exercises.

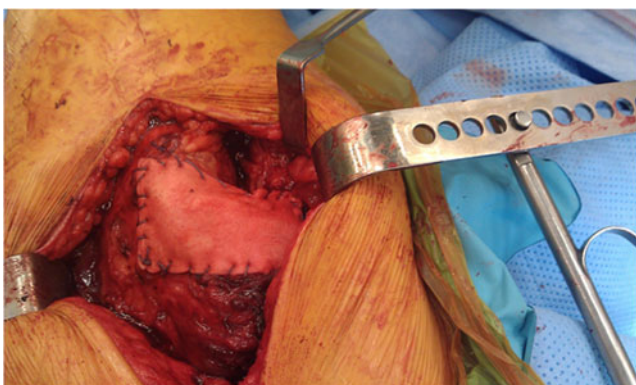


Fig. 4 The augmentation of intra-osseous repair with graft jacket matrix to cover the bare area of greater trochanter. Apart from providing biological scaffolding, graft jacket prevents any impingement of fascia lata on the bare area of the greater trochanter and the intra-osseous repair

The period of rehabilitation under the care of our physiotherapist was a minimum period of six months. Patients were followed up at six-week intervals for three months and then at three-month intervals.

Results were analysed using the VAS scores, Harris hip scores, abductor muscle strength using MRC grading and their improvement in gait. The mean and standard deviation were determined for VAS scores and Harris hip scores and statistical analysis was completed using Student's *t* test with *P* value of <0.05 accepted as being significant.

Results

At mean follow up of 22 months (range of 15–34 months), pain improved in all patients with mean VAS score (0—no pain to 10—worst pain ever) improving from 8.25 to 2.33 ($p < 0.0001$). All the patients had improvement in their abductor strength and were able to abduct against gravity in the lateral decubitus position with MRC (medical research council muscle strength grading system) grade 4 out of 5 in 11 patients and 3 out of 5 in one patient, who was previously grade 2. The Trendelenberg sign reverted to normal in all but one. The mean Harris hip score improved from 34.05 to 81.26 ($p < 0.0001$). All patients had improvement in gait and mild Trendelenberg lurch was noticeable in only one of the 12 patients. Eleven patients did not use any walking aids and one felt more secure using a walking stick in the contralateral hand. There was one postoperative haematoma which needed surgical drainage. There were no other complications.

Discussion

Total hip arthroplasty through lateral or anterolateral approach is popular in Europe and North America. Transgluteal approaches necessitate violation of the trochanteric attachment of the hip abductors. Although avulsion of hip abductors following hip arthroplasty is not common, it is nonetheless a debilitating condition. It can give rise to intractable pain, limp, inefficient gait pattern and lead to instability of hip and tiredness. True incidence of gluteus medius and minimus tears is yet unknown as a complication of total hip arthroplasty or in the general population. A prospective study by Bunker et al. [13] of 50 patients, average age of 83.5 years (range, 56–98 years), with fractures of the femoral neck revealed a 22 % incidence of tears of the gluteus medius and minimus treated with open repair. In a series of 7,444 total hips done through an anterolateral approach with release of gluteus medius insertion, Weber and Berry [14] identified only six (0.08 %) that needed repair of an avulsion. But this series underestimates the number of true avulsions as they included only patients who had surgical repair. Schuh

and Zieler [15] observed that abductor muscle avulsions were present in 3.5 % of 372 patients after primary total hip arthroplasty. In our series we found 11 confirmed partial abductor avulsions out of 1,276 (0.86 %) patients after hip arthroplasty that consented to surgical repair. We had a further three patients who did not wish to proceed with surgical repair and another four patients who were treated by other techniques. Our overall abductor dysfunction rate was therefore 1.48 %. We did investigate any patient presenting with lateral hip pain after total hip arthroplasty within the first year at least with an ultrasound scan so there were not many patients who could have been missed with symptomatic avulsions. There were no cases of trochanteric avulsions which may have been visible on plain radiographs.

There have been various techniques described for repair of the abductor avulsions. Trans-osseous repair using non-absorbable sutures to reattach the abductor mechanism to the greater trochanter seems to be the favoured option [3, 4, 14–16]. Results of these procedures are unpredictable. In a series of nine patients from Weber and Berry [14], only one patient had an excellent result, three had good results, two were fair and three patients were considered as failures. Miozzari et al. [3] in their series elaborated that only nine of their 12 patients were satisfied with the surgery. Four patients still walked with a limp and two patients had a positive Trendelenburg test. Davies et al. [16] described 24 patients (22 women, two men) with a mean age of 67 years with trans-osseous sutures or suture anchor repair of the glutei. In their series they reported that all but one patient had improvement in hip pain and muscle strength at a minimum two-year follow-up. This is the most encouraging series presented in literature than ever before.

The other options described for the vastus lateralis muscle transfers or slides [8, 9] and gluteus maximus muscle transfers [7, 17] appear to be more invasive procedures and theoretically are violating the other muscle groups. Moreover the results of vastus lateralis muscle transfer or slide are only from small series of 11 [8] and three [9] patients. Whiteside [17] has alluded to the technique of gluteus maximus transfer being very useful for complete loss of abduction. Endoscopic repairs [5] require extensive training and a long learning curve. The tendo Achilles graft reconstructions [6] are expensive and not readily available in centres without appropriate human tissue licensing arrangements in place. On other hand the use of Graft Jacket® matrix is readily available and technically easy to perform. This provides scaffolding for abductors to reattach, and by covering the repair or any bare area of greater trochanter it reduces the pain thought to arise from impingement of fascia lata and helps prevent development of trochanteric bursitis. The Graft Jacket® allograft acellular human dermal matrix has already been used successfully in rotator cuff repairs of shoulder [18–20] and has showed encouraging results. In a

case report Snyder et al. [21] evaluated histologically a biopsy specimen retrieved three months after rotator cuff augmentation with Graft Jacket® allograft acellular human dermal matrix. Histologically they found incorporation of the Graft Jacket® evidenced by cellular infiltration, alignment of collagen fibres, and blood vessel ingrowth and confirmed that this graft exhibits key biological factors of the remodelling process when used as an augmentation device in rotator cuff repair. The animal model studies on created rotator cuff defects in the shoulders of adult male Sprague–Dawley rats showed that within 12 weeks, the acellular dermal matrix graft was histologically incorporated into a structure resembling control specimen, i.e. rotator cuff tendon of a normal rat. Ide et al. [22] performed biomechanical testing in these rats and showed that the graft group had a greater mean ultimate force to failure. The other animal model tests done by Song et al. [23] on sheep tendo Achilles repairs have shown that Graft Jacket® enhances the tendon strength in comparison with non-augmented repairs.

Conclusions

Overall this procedure appears to be safe and associated with high patient satisfaction, without the morbidity of any tendon or muscle transfers. The Graft Jacket® matrix provides biological bridging between the hip abductors and their insertion into greater trochanter allowing cellular and vascular in-growth and constructive tissue remodelling. The described procedure appears to enhance the mechanical strength of repaired tendon immediately following surgery. The early success of this new procedure warrants further study with more patients, longer follow-up and possibly histological study of retrieved specimens.

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

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