Gluteus Maximus Advancement Flap Procedure for Reconstruction of Posterior Soft Tissue Deficiency in Revision Total Hip Arthroplasty

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The current study describes the surgical technique and early outcomes of a gluteus maximus advancement flap procedure for the treatment of posterior soft tissue insufficiency among patients with complex revision total hip arthroplasty. This retrospective case series was conducted with a prospective, single-institution arthroplasty registry. Patients who underwent a gluteus maximus advancement flap procedure in the setting of revision total hip arthroplasty between January 2012 and January 2016 were eligible for inclusion (N=7). Primary indications for the gluteus maximus flap procedure included periprosthetic infection with persistent wound breakdown (n=4), persistent symptomatic aseptic pseudotumor in the setting of adverse local tissue reaction after unsuccessful operative debridement (n=2), and abductor insufficiency with recurrent hip instability after unsuccessful placement of a constrained liner (n=1). All patients who underwent a gluteus maximus advancement flap procedure for chronic periprosthetic infection or adverse local tissue reaction had healing of the wound and were infection-free at the last follow-up. In the early postoperative period, 2 patients had recurrent wound infection that required flap elevation. The patients remained infection-free after the subsequent procedure. No patient had repeat instability, and no complications of flap necrosis or nerve palsy occurred. The gluteus maximus advancement flap procedure provides a diverse range of soft tissue coverage options for patients with recalcitrant periprosthetic joint infection, adverse local tissue reaction with pseudotumor, or recurrent instability. [Orthopedics. 2017; 40(3):e495-e500.]

Chronic soft tissue deficiencies of the abductor musculature, posterior capsule, and fascia encountered during revision total hip arthroplasty (THA) remain a significant challenge. Most studies of soft tissue deficiency in revision THA have focused on reconstruction of chronic abductor deficiency.1-11 In limited series, the use of allograft tissue for abductor reconstruction, including Achilles tendon allograft or extensor mechanism allograft, has been successful.4,11 Muscle transfers, including the vastus lateralis and gluteus maximus, also have been described and avoid the risks of disease transfer, the requirement for storage, and the cost of allograft tissue.1,2,4-7

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Local transfer of the vastus lateralis muscle on its vascular pedicle to the intact abductors proximally has been described in distal irreparable abductor tendon tears.\(^4\)\(^-\)\(^7\) Another promising reconstructive technique is the gluteus maximus muscle transfer as described by Whiteside.\(^1\)\(^,\)\(^2\)

Abductor deficiency is a challenging aspect of revision arthroplasty. Posterior capsular and fascial deficiencies also can adversely affect revision outcomes, and few studies have focused on these complex problems.\(^8\)\(^-\)\(^1\(^0\)\(^-\)\(^1\(^4\)\) One technique that has been described uses an Achilles allograft sling around the greater trochanter to augment the posterior capsule and provides compressive forces across the hip articulation in at-risk leg positions for recurrent posterior instability.\(^8\)\(^,\)\(^1\(^0\)\)

Chronic infection and pseudotumors as a result of adverse local tissue reaction also create significant soft tissue deficiency, and failure to address the soft tissues can lead to chronic seroma or hematoma cavities with fluid accumulation, impaired eradication of infection, and incisional breakdown. The ideal procedure for soft tissue reconstruction in revision THA would provide soft tissue coverage of the proximal femur in the setting of fascial defects, reduce dead space for fluid accumulation for patients with seroma or hematoma, and reconstitute the posterior soft tissue envelope, including the abductor musculature or posterior capsule.

The current study described the surgical technique and early outcomes of the gluteus maximus advancement flap procedure in the setting of posterior soft tissue insufficiency in complex revision THA. To the authors’ knowledge, this is the first study to illustrate the versatility of this muscle transfer technique in the setting of fascial insufficiency secondary to persistent periprosthetic joint infection or adverse local tissue reaction, seroma or hematoma cavity, and posterior capsular insufficiency.

**MATERIALS AND METHODS**

The current report describes a retrospective case series that used a prospective, single-institution arthroplasty registry. Patients undergoing a gluteus maximus advancement flap procedure in the setting of previous revision THA between January 2012 and January 2016 were eligible for study inclusion (N=7) (**Table**). Mean follow-up was 17 months (range, 6-37 months). All gluteus maximus flap procedures were performed by a single surgeon (L.B.G.) with fellowship training in plastic and microvascular surgery.

All gluteus maximus flap procedures were planned before the surgical date, and no procedures were emergent. Primary indications for the gluteus maximus flap procedure included periprosthetic infection with persistent wound breakdown in the setting of a seroma or hematoma cavity (n=4); persistent symptomatic aseptic pseudotumor in the setting of adverse local tissue reaction with previous unsuccessful operative debridement, with or without abductor insufficiency (n=2); and abductor insufficiency with recurrent hip instability after unsuccessful placement of a constrained liner (n=1).

Preoperative diagnoses included chronic periprosthetic infection (n=4), adverse local tissue reaction with pseudotumor (n=3; 1 also had chronic periprosthetic infection), placement of a constrained liner for recurrent

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**Table**

<table>
<thead>
<tr>
<th>Patient No./Sex/ Age, y</th>
<th>Body Mass Index, kg/m(^2)</th>
<th>Diagnosis</th>
<th>Surgical Indication</th>
<th>No. of Previous Revisions</th>
<th>Concomitant Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/58</td>
<td>29</td>
<td>Adverse local tissue reaction</td>
<td>Chronic abductor insufficiency</td>
<td>1</td>
<td>No; previous revision of both components</td>
</tr>
<tr>
<td>2/M/66</td>
<td>29</td>
<td>Adverse local tissue reaction</td>
<td>Persistent pseudotumor</td>
<td>1</td>
<td>Yes; head and liner exchange</td>
</tr>
<tr>
<td>3/M/67</td>
<td>37</td>
<td>Adverse local tissue reaction and chronic prosthetic joint infection</td>
<td>Fascial defect and wound breakdown</td>
<td>2</td>
<td>No; irrigation and debridement</td>
</tr>
<tr>
<td>4/M/58</td>
<td>30</td>
<td>Chronic prosthetic joint infection</td>
<td>Fascial defect and wound breakdown</td>
<td>8</td>
<td>Yes; spacer placement</td>
</tr>
<tr>
<td>5/F/58</td>
<td>34</td>
<td>Chronic prosthetic joint infection</td>
<td>Fascial defect</td>
<td>4</td>
<td>Yes; spacer placement</td>
</tr>
<tr>
<td>6/F/38</td>
<td>26</td>
<td>Chronic prosthetic joint infection</td>
<td>Wound breakdown</td>
<td>2</td>
<td>No; girdlestone</td>
</tr>
<tr>
<td>7/F/69</td>
<td>28</td>
<td>Recurrent dislocation</td>
<td>Chronic abductor insufficiency</td>
<td>5</td>
<td>Yes; femoral revision and liner exchange</td>
</tr>
</tbody>
</table>

Abbreviations: F, female; M, male.
instability (n=2; 1 also had chronic periprosthetic infection), abductor deficiency with inability to abduct against gravity preoperatively (n=3; n=2 in the setting of adverse local tissue reaction), and periprosthetic fracture (n=1).

Periprosthetic Joint Infection

All patients with chronic periprosthetic infection (n=4) had persistent wound breakdown and drainage despite previous revision attempts before the gluteus maximus flap procedure. In addition, 3 patients had immune disorders preoperatively (dermatomyositis on chronic steroids, n=1; lupus on chronic steroids and immunosuppressive medication, n=1; hepatitis C, n=1). The mean number of previous revision surgeries was 4 (range, 2-8). These included irrigation and debridement alone (8 cases, 4 patients), placement of an antibiotic spacer (3 cases, 3 patients), resection arthroplasty (1 case, 1 patient), open reduction of spacer dislocation (1 case, 1 patient), placement of a constrained liner for recurrent instability (2 cases, 1 patient), aseptic revision THA with debridement (1 case, 1 patient). All patients had a polymicrobial infection. Organisms isolated included methicillin-resistant and -sensitive *Staphylococcus aureus*, methicillin-resistant *S epidermidis*, coagulase-negative *Staphylococcus*, Klebsiella species, *Proteus* species, anaerobes, and *Mycobacterium avium*.

Adverse Local Tissue Reaction

Of the patients who had a primary diagnosis of persistent aseptic pseudotumor (n=2), 1 had a preoperative diagnosis of type II diabetes mellitus. Both patients had persistent lateral swelling and trochanteric pain on examination because of recurrent pseudotumor, and 1 also had concomitant abductor deficiency. The mean number of previous revisions was 1 and consisted of revision of the primary implant to a ceramic-on-polyethylene bearing surface with debridement of the pseudotumor.

Recurrent Hip Instability

The patient who had a primary diagnosis of recurrent instability had 5 previous revision attempts as a result of recurrent instability. These included revision of an acetabular component, placement of a constrained liner, and placement of a dual mobility bearing. The patient had mild concomitant abductor deficiency but was able to abduct against gravity.

Surgical Technique

The patient is placed in the lateral decubitus position with standard patient positioning devices. During skin preparation, care is taken to allow exposure proximal to the iliac crest and as posterior as possible. The first step is to expose and mobilize the gluteus maximus muscle. A curvilinear incision, similar to that performed with a posterolateral approach to the hip, is marked over the gluteus maximus, extending onto the lateral aspect of the proximal thigh as it courses inferiorly. The incision is carried down to the gluteus maximus fascia proximally and the iliotibial band distally. A soft tissue flap superficial to the gluteus maximus fascia is developed posteriorly, exposing the muscle belly. This flap can be carried all the way to its insertion posteriorly and distally. To begin muscle advancement, the fascia is then incised with monopolar electrocautery on the posterior aspect of the muscle in line with its superolateral border (Figure 1). This incision is performed perpendicular to the vector of advancement. The interval between the gluteus medius and the gluteus maximus is developed proximally, creating a free edge of the gluteus maximus muscle. The superolateral free margin of the muscle is undermined and mobilized. The sciatic nerve is identified to minimize the risk of dissection injury and obviate compression when advancing the gluteus muscle. For additional excursion, the distal insertion and the superior insertion are partially released if necessary. In the setting of infection, adverse local tissue reaction, or recurrent instability, careful debridement of the seroma cavity lining is necessary to reduce fluid accumulation and encourage tissue healing (Figure 2).

The next step is to advance and inset the muscle. The origin and insertion are left intact, and the mobilized free margin of the muscle is advanced (Figure 3). To reduce dead space, the muscle can be rolled into the periarthroplasty defect (Video). Additionally, the muscle can be advanced through the posterior aspect of the greater trochanter through drill holes, and the free
end is sutured to help support the posterior capsule (Figure 4). Alternatively, the muscle can be sutured to the vastus lateralis through drill holes to help support abductor function (Figure 5). The muscle is repaired to the femur with nonresorbable suture. The remaining closure is an imbricating layer of the gluteus maximus to the tensor fascia lata anteriorly to further support abductor function in the setting of instability and complete dead space closure and reestablish soft tissue coverage over the femur in the setting of fascial defect. The superficial fascia is closed with 0 absorbable sutures, the deep dermal layer is closed with 2-0 absorbable sutures, and the skin is closed with either a subcuticular absorbable barbed suture or an over-and-over monofilament suture.

Postoperative trochanteric precautions and toe touch weight bearing for a minimum of 6 weeks were recommended for all patients. Subfascial and subcutaneous large-bore drains were removed once output was less than 30 mL/d for at least 2 consecutive days (usually 1-3 weeks). Patients were progressed to full weight bearing by 3 months (governed by the requirements of the arthroplasty).

RESULTS

Chronic Periprosthetic Joint Infection

All patients who underwent a gluteus maximus advancement flap procedure for chronic periprosthetic infection had healing of the wound and were infection-free at the last follow-up. Because of multiple treatment failures, 3 of the 4 patients received maintenance therapy with long-term oral suppressive antibiotics. All patients ambulated with assistive devices at the last follow-up.

Two patients underwent reoperation after the initial gluteus maximus flap procedure. One patient had recurrent drainage from the incision 3 months after surgery. The flap was elevated and had excellent viability, and the patient underwent irrigation and debridement, with readvancement of the flap an additional 5 cm to improve coverage of the proximal femur. The patient remained infection-free after this second procedure. The second patient also had recurrence of drainage 3 months after the initial gluteus maximus flap procedure. A 1-stage exchange of the prosthesis with irrigation and debridement was performed, with readvancement of the flap. The patient remained infection-free after this procedure despite reelevation of the flap and recurrent wound closure over the flap.

Adverse Local Tissue Reaction

Of the patients undergoing a gluteus maximus flap procedure for recurrent aseptic pseudotumor, both had healing of the wound and neither had recurrence of lateral swelling. Neither patient had further reoperation. In both patients, abductor lurch improved but was still present. Trochanteric pain improved and was rated as mild at the last follow-up. Abductor strength improved by 1 strength level (i.e., able to abduct against gravity, or 3 of 5, from unable to abduct against gravity, or 2 of 5) in the patient who had concomitant abductor deficiency.

Recurrent Hip Instability

Intraoperatively, the patient with recurrent instability had a large seroma cavity and no posterior capsule in addition to a partial chronic tear at the abductor insertion. This patient underwent extensive debridement of the seroma cavity, con-
comitant revision of the femoral component to increase femoral anteversion, and exchange of the constrained liner at the time of the gluteus maximus flap procedure, with no recurrence of hip instability.

**Discussion**

Soft tissue loss in the setting of chronic periprosthetic infection, pseudotumor, or chronic recurrent instability can result in posterior capsular insufficiency, fascial defects, abductor tears, and seroma or hematoma cavities. The current study showed the versatility of the gluteus maximus advancement flap procedure and provided examples of its use in scenarios in which previous conventional revision options were unsuccessful. This technique offers numerous advantages. First, no functional impairment occurs with this technique because it does not disrupt the origin, insertion, and innervation of the gluteus maximus muscle. Second, the advanced tissue is thick but pliable, well suited for inset because of its overlying fascia, and well vascularized. Therefore, it functions as both an obliterator of dead space and a means of transferring an antibiotic-carrying blood supply directly to the site. Third, it can help to assist abductor function.

Chronic soft tissue deficiency with wound breakdown is a devastating complication of chronic periprosthetic infection and impairs successful eradication of infection. Current surgical management consists of 1- or 2-stage exchange of the prosthetic components with antibiotic therapy tailored to isolated organisms.\(^\text{15,16}\) Some studies report greater than 90% success with eradication of infection with a similar range of protocols.\(^\text{15}\) However, a study by Gomez et al\(^\text{16}\) suggested that failure of reimplantation after spacer placement, secondary procedures, and overall morbidity in these patients may be higher than appreciated. Providing a vascularized muscle bed to cover the proximal femur and reducing the potential space for fluid collection may improve antibiotic penetration into the peritrochanteric region and allow more effective skin healing. Other studies described the successful use of pedicled vastus lateralis and rectus abdominis flaps in cases of recalcitrant periprosthetic hip infection.\(^\text{17,18}\) The current study showed successful wound healing and infection control with the gluteus maximus flap procedure as an adjuvant to conventional treatments. In 2 patients, the flap had to be elevated within 3 months of surgery because of persistent drainage. The flap showed excellent viability, with subsequent infection control after repeat irrigation and debridement.

Pseudotumor caused by metal-on-metal or modular THA corrosion remains a challenging problem, and high rates of infection and dislocation have been reported after revision THA.\(^\text{19,20}\) Recurrent massive fluid collections provide a favorable environment for bacterial growth, result in wound breakdown, and can create symptomatic lateral thigh pain as a result of fluid pressure. Elimination of this seroma or hematoma cavity may help to reduce the incidence of infection. Posterior capsular deficiency and abductor deficiency are common in this setting, and the gluteus maximus flap can be tailored to help support a deficient posterior capsule or serve as abductor reconstruction in addition to its role in reducing dead space.

Use of the gluteus maximus as a reconstructive option for abductor insufficiency was described previously by Whiteside\(^\text{1,2}\) and Whiteside et al.\(^\text{3}\) Of 10 patients, 9 regained the ability to abduct the hip against gravity in the setting of abductor insufficiency after THA with a technique involving a split transfer of the gluteus maximus and tensor fascia lata to the greater trochanter.\(^\text{2}\) In the current study, patients with abductor deficiency had improved lateral pain and some improvement in abduction against gravity, but the primary goals were to address capsular deficiency and reduce dead space in the posterior soft tissues. Reapproximation of the posterior capsule and external rotators substantially reduces the rate of dislocation after the posterior approach for THA, and reconstruction of these structures may assist prosthetic and bone procedures during revision for recurrent instability.\(^\text{21}\) The senior author (L.B.G.) has used a modification of this technique that is similar to that of Whiteside et al\(^\text{1,2}\) for primary abductor reconstruction in the setting of isolated native hip chronic abductor tears, but this is outside the scope of the current study.

**Limitations**

Limitations of this study include its small size and the short follow-up period. This technique was reserved for use as a salvage option when conventional revision techniques were unsuccessful, limiting the number of patients who could be included. Although follow-up in this study was short, the patients had continuous wound problems, fluid collections, or recurrent dislocations that subsided only after the flap procedure. The current findings suggested that at least in the short term, the repetitive revision cycle was broken. Long-term follow-up is needed to examine the durability of the results.

**Conclusion**

The gluteus maximus advancement flap procedure offers a diverse range of benefits in revision THA, including soft tissue coverage of the proximal femur in the setting of fascial deficiency, volumetric reduction of seroma or hematoma cavities, and reconstruction of the abductor and posterior capsule.

**References**


3. Whiteside LA, Nayfeh T, Katerberg BJ. Gluteus maximus flap transfer for greater tro-


