Innervated Gluteus Maximus For Huge Thigh & Groin Defects
A Rahoma, P Sengupta, K Pan

Citation

Abstract
Gluteus maximus is a bulky muscle with three sources of blood supplying also a skin flap that extends from iliac crest down to the popliteal fossa. The myocutaneous flap has been used long time ago, as an insensate flap, to cover defects in the buttocks. In this study we use this muscle as a sensate flap keeping sensory and motor nerves, to cover major defects in the buttocks and groin. This study included seven cases with different indications. The technique depends upon full mobilization of the muscle based on two main vascular pedicles to maintain adequate vascularity and nerve supply of the transposed flap.

AIM OF THE STUDY
This study demonstrate the importance of keeping sensation and motor function of the gluteus maximus muscle during moving it with the overlying skin to repair large defects around the upper part of the lower limb.

ANATOMY OF GLUTEUS MAXIMUS
The muscle originates from the posterior aspect of dorsal iliac bone, posterior superior iliac crest and posterior inferior aspect of sacrum and coccyx and sacrotuberous ligament.

It is inserted in fascia lata at the iliotibial band and in the gluteal tuberosity on posterior femoral surface. It is innervated by lower gluteal nerve only, formed by L5, S1 and S2 roots and reaching the gluteal region below the pyriform muscle.

The muscle is supplied by triple sources of blood, the superior gluteal artery, inferior gluteal artery; and branches of femoral system coming from the cruciate anastomosis around the femur. The muscle is the major extensor of hip joint.

Figure 1
Figure 1: Gluteus maximus
The muscle belongs to type III according to Mathes-Nahai classification of free vascular flaps.

### Type | Description
--- | ---
I- | Single vascular pedicle as tensor fascia lata
II- | Dominant vascular pedicle and a minor one as gracilis muscle
III- | Two dominant pedicles as gluteus maximus muscle
IV- | Segmental vascular pedicles as sartorius
V- | Single dominant vascular pedicle and secondary segmental pedicles as latissimus dorsi
Innervated Gluteus Maximus For Huge Thigh & Groin Defects

Figure 6
Figure 5: Type I

Figure 7
Figure 6: Type II
Figure 8
Figure 7: Type III

Figure 9
Figure 8: Type IV
Innervated Gluteus Maximus For Huge Thigh & Groin Defects

Figure 10

Figure 9: Type V

And it belongs to type C of regarding the pedicle type. 16, 17, 19, 21

Figure 11

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>direct cutaneous pedicle</td>
</tr>
<tr>
<td>B</td>
<td>septocutaneous pedicle</td>
</tr>
<tr>
<td>C</td>
<td>musculocutaneous pedicle (less reliable than type A and B)</td>
</tr>
</tbody>
</table>

Our patients had ulcer ranging from stage III and IV according the following classification of Pressure Ulcers 7, 9, 10, 12

Figure 12

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Erythema not resolving within 30 minutes of pressure relief</td>
</tr>
<tr>
<td>II</td>
<td>Partial skin thickness loss (epidermis and partial dermis)</td>
</tr>
<tr>
<td>III</td>
<td>Full thickness skin loss and extending into subcutaneous tissue.</td>
</tr>
<tr>
<td>IV</td>
<td>Deep tissue destruction extending to deep fascia involving muscle, bone, and joints</td>
</tr>
</tbody>
</table>

PATIENTS

Seven cases were operated utilizing the gluteus muscle:

Figure 13

<table>
<thead>
<tr>
<th>Type of ulcer</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacral bed sores</td>
<td>2</td>
</tr>
<tr>
<td>Ischial bed sores</td>
<td>2</td>
</tr>
<tr>
<td>Ischial bed sores with chronic femoral osteomyelitis</td>
<td>1</td>
</tr>
<tr>
<td>Osteosarcoma of the anterior iliac crest</td>
<td>1</td>
</tr>
<tr>
<td>Greater trochanter ulcers</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
</tr>
</tbody>
</table>

Male to female = 6:1

METHODS

Two techniques, uni- pedicle and bipedicled gluteus maximus flap.

Figure 14

<table>
<thead>
<tr>
<th>Category</th>
<th>Technique</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Complete muscle and skin dissection based on its vascular pedicles</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>Upper part of the muscle and skin overlying</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>Muscle mobilization with simple skin closure</td>
<td>2</td>
</tr>
</tbody>
</table>

CASE I: HUGE SACRAL BED SORE

A 35-year-old male, paraplegic following a road traffic accident three years ago developed an ulcer one year prior to admission to the hospital in late August 2004. The ulcer was clean, measuring 35 cm by 30 cm overlying the sacrum and eroding down to bone.

OPERATION

The patient was given epidural anesthesia, then placed in prone position. The ulcer was excised with debridement which included the sacrum by osteotomy. The right gluteus maximus with the overlying skin was completely mobilized after being detached at its origin and insertion. The two pedicles namely superior vascular and inferior neurovascular pedicles were completely dissected and protected. Lower pole of the muscle and skin overlying were mobilized backwards and superiorly to the midline. The upper part of the left muscle was also rotated to meet the right one in an S shaped line. The right greater trochanter which was exposed following mobilization of the insertion of gluteus maximus was dealt with by osteotomy and covered by tensor fascia lata rotation flap and skin graft. Wound was closed in layers with two vacuum suction drains. Three blood units were transfused to compensate blood loss.

Post-operatively, epidural anesthesia was continued for few days. The patient was nursed in the prone position over an
air mattress with physiotherapy for the lower limbs taking care of the pressure points. Ciprofloxacin and Ceftazidime were continued for 10 days. Drains were kept for one week. Sutures were removed on the 10th post operative day.

**Figure 15**
Figure 10: Defect is measuring 30 cm X 25 cm sacral sore.

**Figure 16**
Figure 11: Raising the muscle flap after freeing all sides showing the pedicles

**Figure 17**
Figure 12: Pointing to the superior gluteal pedicle

**Figure 18**
Figure 13: Trying to model the closure but still needs other muscle mobilization.
Figure 14: Closure after mobilizing the other muscle.

Figure 15: Final Closure

Figure 16: Post-operative view

Figure 17: Post-operative view

Figure 18: Post-operative view
CASE II: RECURRENT OSTEOSARCOMA OF THE LEFT HIP BONE

A 40 year-old patient had a past history of osteo-sarcoma affecting the left hip bone and iliac crest. The patient had been operated upon, two years before. A mass was excised using left rectus abdominus myocutaneous rotation flap to cover the defect.

The patient was presented with a recurrent huge fungating mass over the left thigh, groin and left lower abdomen. The patient was severely anemic from bleeding episodes. The mass measured 40 cm by 35 cm.

Radiological investigation revealed that the mass was replacing most of the left hip bone. Fig (24, 26)

Histopathology reported a poorly differentiated osteosarcoma with lung metastases, grade III and stage IV

OPERATION

Initial debulking of the tumor was done and the second surgery was done to arrest an attack of profuse bleeding one week after. The final operation was done two weeks later, for debridement and reconstruction. Reconstruction was done using the gluteus maximus myocutaneous flap. The muscle was freed superiorly and inferiorly. The insertion was also detached completely and rotated where the lower pole became postero-superiorly. The most anterior part of the wound was closed partially by undermining the lower abdominal wall. Osteotomy of the greater trochanter was done and simple closure of the incision posteriorly could be achieved where two suction drains were placed. Blood loss was estimated to be three litres. Six units of blood and six units of fresh frozen plasma were given to the patient.

POST-OPERATIVE CARE

Ciprofluxacillin and Ceftazidime were given intravenously for one week. Analgesia was given. Patient was nursed in the right lateral position. Drains were kept one week. Wound healed completely and patient was sent for radiotherapy two weeks later.

Figure 26
Figure 21: Antero-lateral view
Innervated Gluteus Maximus For Huge Thigh & Groin Defects

Figure 27
Figure 22: More lateral view

Figure 28
Figure 23: Down lateral view

Figure 29
Figure 24

Figure 30
Figure 25: After first debridement

{image:31}

{image:32}

{image:33}
OTHER CASES

Two cases with ischial bed sores (Paraplegic), both were closed after debridement with muscle mobilization and simple skin closure.

One case of sacral bed sore (10 cm in diameter) in a paraplegic patient with Pott's disease of the spine at the sacral region and she was on anti TB treatment.

A paraplegic young man with chronic osteomyelitis of the upper half of femur, and hip bone with very wide cavitated sore (40 cm X 50 cm). There was no hip joint and the femur was flail moving without control. He had several operations which were unsuccessful to treat the condition. Staged treatment for him was done by wide debridement of the ulcer. Closure was done by gluteus maximus muscle mobilization and simple skin closure over a drain. The ulcer healed completely but a track or sinus was still there with a tube drain getting copious pus from the osteomyelitic femur. The patient was advised to visit the clinic for follow up for more definitive treatment. The patient was readmitted again with a gluteal abscess after accidental removal of the drain. Abscess was incised and a new ulcer was developed at the old orthopedic incision.

RESULTS

Cases which were operated using this flap showed complete and sound healing. Patient number 7 developed a new gluteal ulcer at site of the old orthopedic incision. Definitive surgery was planned for this patient. Functionally, ambulating patients had no residual problems. The gluteus maximus flap function was compensated well, and ambulating patients could manage to walk properly.

Some paraplegic patients had some sensory function at the gluteal region, as the gluteus maximus was kept with its nerve supply.

DISCUSSION

Reconstructive techniques for back defects have been improved in the past few years because of better understanding of the vascular territories. The ideal technique of closure must be simple, safe, and easy to perform and must provide well-vascularized tissue that results in long-term durable coverage.

The indications include defects of the back which are caused by congenital or acquired problems.

Defects may be in the trunk or buttocks and can extend to the groin as well. Congenital causes include spina bifida which may be occulta and cystica. Spina bifida cystica further has the following 4 variants: meningocele, myelomeningocele, syringomyelocele, and myelocele. Acquired back defects result from trauma, infection, burns, radiation, tumor resection, postoperative wound dehiscence, or pressure ulcers.

Gluteus maximus is a type III flap with 2 dominant vascular pedicles (superior, inferior gluteal) that provides a reliable and durable coverage for back defects. It is used widely for reconstruction of these defects. Complete loss of gluteus maximus muscle function in ambulatory patient may result in significant hip instability. Harvesting the complete muscle is not advisable in ambulatory patients. In such circumstances, either the superior or inferior half of the muscle may be used. The entire muscle may be used in patients with paraplegia.

Gluteus maximus muscle provides an excellent source for covering major defects. It has been used successfully to reconstruct breast after mastectomy using non sensate and sensate free myocutaneous flap by Allen, and Blondeel.

Baran et al described a new partial thickness myocutaneous flap based on perforating vessels from superior and inferior gluteal arteries. One of the main advantages of this flap is the preservation of most of the gluteus maximus function in an ambulatory patient.

Sliding gluteus maximus musculocutaneous flap is commonly performed for coverage of sacral ulcers in patients without paraplegia when the structural integrity of the muscle is preserved. Create triangular skin islands overlying the corresponding muscles. Elevate the muscle and skin en bloc and advance them to the mid line. Close the donor site in a V-Y fashion.

Segmental muscle flaps: The muscle can be split and only
Innervated Gluteus Maximus For Huge Thigh & Groin Defects

the superior or inferior half of the muscle elevated as a flap. This can be performed either by transposition or by V-Y advancement.

Scheflan \textsuperscript{35} used an island flap to cover the sacral sore. This island depends either on superior gluteal or inferior gluteal arteries.

Superior gluteal muscle flap is used successfully in complex lumbosacral wounds in nonparalyzed patients. This flap is used to cover the fourth and fifth lumbar regions and the sacral region. Identify the superior gluteal artery with a Doppler probe. It is located approximately three cm lateral to the mid line and 5 cm inferior to the posterior superior iliac spine (PSIS).

Superior gluteus maximus myocutaneous turnover flap: use a de-epithelialized turnover superior gluteal island flap to patch the dural defect and simultaneously reconstruct large lower midline defects.

Bilateral latissimus dorsi and gluteus maximus musculocutaneous flaps: Ramirez and colleagues described a technique in which they used both latissimus muscles along with bilateral gluteus maximus muscles for large lumbosacral defects. The flaps are based on the thoracodorsal and superior gluteal vessels and the intervening thoracolumbar fascia. They performed en bloc advancement of these muscles without lateral relaxing incisions. This flap provides tension-free, durable, and viable soft-tissue coverage over the dural repair.\textsuperscript{16,20,22,23}

The use of gluteus maximus myocutaneous flap is not without certain disadvantages as increased blood loss, increased operation time, and some muscle function loss.\textsuperscript{24,26,28,32}

Using the whole muscle was described by many authors with different techniques.\textsuperscript{22,25,27,28,33}

Ohjimi et al\textsuperscript{26} and also Park\textsuperscript{30} could preserve the muscle in cases of small ulcers, making V-Y advancement flap, but in cases of large defects, the technique needs more aggressive surgery.\textsuperscript{11,14,23,30}

Some studies suggested utilization of fasciocutaneous flaps covering the muscle only, but the recurrences of bed sores, would be very high especially in trochanteric and ischial types.\textsuperscript{18,29}

Verpaele\textsuperscript{37} used the superior gluteal artery perforator flap while Higgins\textsuperscript{15}, Becker\textsuperscript{4}, and Rajacic\textsuperscript{31} used the inferior gluteal artery flaps for pressure sores.

Muscle splitting was used by some authors as Baran\textsuperscript{3}, Gould\textsuperscript{13}, and Rubayi\textsuperscript{3}. The use of split portion of gluteus maximus carries the disadvantage of being insensate in the upper segment. In case of use of lower segment will leave the upper segment insensate. So, this option is not good in our opinion.

Gluteus maximus muscle again is employed in our study, for treating gluteal and sacral and lateral groin defects. With a new technique we could maintain its nerve with its blood supply. Only the technique depends upon changing the direction of its fibers. The muscle action was unchanged too much, and it was compensated by the other surrounding muscles.

Again in most cases the patients were paraplegic, and in some patients the gluteus maximus was affected as well. The muscle was shown in this series to be easily mobilized in different directions to cover big defects and to long distances around the gluteal as well as sacral regions.

Presence of two major blood pedicles makes it easy to rotate the muscle up or down or to the sides. Skin covering the muscle can be extending down to the popliteal fossa, and can be utilized to reach far areas. Also it can allow for the use of fasciocutaneous flaps only if needed depending on any of the pedicles. Existence of anastomosis between superior and inferior gluteal arteries allow for more use of this skin and fascia with or without muscle mobilization partially or totally.

Bed sores carry a special consideration regarding the persistent pressure on the transposed muscle.\textsuperscript{7,9,10,12} If the muscle vascular territory is single and compressed, the flap can be compromised. In our technique there is a double blood supply and a good sensitive bulky muscle.

Estimated blood loss in the first case was about 800 ml, and the patient was given three units blood. The loss in the second case was around 3000 ml. The extensive invasion of the surrounding structures and dissection of the invading tumour resulted in extensive blood loss. The patient had a coagulation problem from the repeated blood transfusions. In addition he received six units of fresh froze plasma

CONCLUSION

Gluteus maximus muscle is useful in the repair of large lower limb, back of trunk and buttocks defects. Beside its
Innervated Gluteus Maximus For Huge Thigh & Groin Defects

use in reconstruction after total mastectomy, local rotation of the whole muscle provides an excellent way to cover adjacent defects keeping its normal function. The anastomosis between superior gluteal and inferior gluteal vessels provides a good blood supply enabling us to mobilize the muscle with a long sleeve of skin to cover huge defects.

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