

Vastus Lateralis Muscle Flap for High-Risk Patients Undergoing Orthopaedic Hip Surgery

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VIDEO 1



VIDEO 2

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None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Ms. Olsson, Ms. Amado, Dr. Fijany, Ms. Soleimani, Mr. Troia, Dr. Washington, Dr. Sanchez, Dr. Kurapati, and Dr. Pekarev.

JAAOS Glob Res Rev 2024;8: e23.00151

DOI: 10.5435/JAAOSGlobal-D-23-00151

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ABSTRACT

Introduction: Chronic infections and soft-tissue defects are serious complications after total hip arthroplasties (THAs) that may require hip disarticulation (HD). HD is a relatively high-risk procedure with poor long-term outcomes and survival. This is the first study to analyze the effect of an ipsilateral, pedicled vastus lateralis (VL) muscle flap in preventing HD in patients with recurrent complications after THA.

Methods: This retrospective case review analyzed the 6-month postoperative outcomes of 14 patients who underwent soft-tissue hip reconstruction with a VL muscle flap by a single surgeon.

Results: Most (86%) patients fully recovered after 6 months with preserved hip range of motion, no pain, and no weakness on ambulation. Two (14%) patients ultimately required HD despite introducing a VL flap.

Discussion: A VL muscle flap is an effective treatment of nonhealing THA and prophylactic intervention for patients at high risk for HD. The VL muscle is optimal because of its large size allowing reduction of soft-tissue dead space, its local anatomical location to the hip, and its exceptional vascularity. Additional prospective studies are necessary to determine the most appropriate population for this technique.

Chronic infections and soft-tissue defects are serious complications after total hip arthroplasties (THAs) that may require hip disarticulation (HD) if revision arthroplasties fail. The primary indication for revision after THA is periprosthetic joint infection (PJI).¹ PJI is commonly treated with surgical debridement, antibiotics, implant retention, and single-stage or multistage revisions.^{2,3} A single-stage revision includes implant removal and debridement. The multistaged modification consists of a single-stage correction in addition to resection arthroplasty or antibiotic-coated implantation on the prosthesis.¹ Management of PJI continues to be controversial,⁴ with failure rates ranging from 11% to 35%.⁵ Unfortunately, outcomes have not shown improvement over time,⁶ with poor quality of life and long-term joint function.⁷ Post-THA patients with chronic infection or inadequate wound healing are at risk of requiring HD.⁸

HD is a high-level amputation of the proximal hip performed by transecting all nerves and muscles that enclose the hip joint and then separating the entire leg from the pelvis. Indications for HD include advanced malignancy, soft-tissue defects, fulminant infection, and untreatable ischemia. This procedure is relatively high-risk, with complication rates as high as 60%⁹ and mortality ranging from 0% to 50%.¹⁰ After HD, patients are reported to have severely worsened quality of life, pain measures, and survival.¹¹ Using a muscle flap to cover the posterior hip joint after THA may reduce the risk of infections, poor perfusion, or instability.

Disruption of the hip abductor muscles after a THA or repeated THA revisions may result in instability. This places patients at an increased risk for hip dislocations or inflammatory processes that can compromise soft tissues.¹² Adding a local pedicled muscle flap improves soft-tissue density and bulk, supporting the affected region.¹³ This mitigates weakness and instability, promoting better healing of the hip joint with decreased risk of injury. Muscle flaps also introduce better vasculature and immune support to the recipient site, limiting risk of infection.¹³ The vastus lateralis (VL) flap is a native tissue with appropriate volume, adequate blood supply, and antibacterial potential, all of which aid in wound healing.¹⁴

This study intends to outline the use of a prophylactic VL muscle flap in post-THA patients at greater risk of requiring HD.

Methods

The Institutional Review Board at Texas Christian University approved this retrospective case series. To be included in this study, patients must have undergone soft-tissue hip reconstruction with a VL muscle flap by a single surgeon at MP Plastic Surgery. All patients included in this study were at postoperative month 6 or beyond. Patients who were less than 6 months post-operation were excluded to ensure adequate healing time and monitoring for osteomyelitis recurrence. Patients who underwent hip reconstruction without a VL muscle flap or who had a VL muscle flap elsewhere were also excluded from this study, ensuring the same reconstructive procedure was performed on all patients.

Any surgical complications within the first 6 months postoperation were recorded along with the necessary treatments. Final outcomes at 6 months postoperation were recorded with a healed and functional status indicating that the patient's hip joint has been successfully salvaged. Demographic information for each patient

was recorded as well. Descriptive statistics were used to analyze patient demographic information and postoperative outcomes.

All patients were involved in a complete discussion regarding the risks of HD, thrombosis, infection, and failed muscle flaps. Patients were informed of all alternative treatment options, including a second opinion and conservative care. Patient informed consent was obtained for the procedure and for this study.

When performing the surgery, excisional debridement of chronically infected, inflamed, or sclerotic tissues and scarring is performed. Then, the involved bone is débrided as necessary to ensure adequate bony vascularity. The area is thoroughly irrigated with normal saline, and hemostasis is achieved. To achieve soft-tissue reconstruction and cover the exposed joint, a pedicled VL flap is used. The incision at the hip wound is extended over the anterolateral thigh. The dissection is continued through the subcutaneous tissue into the fascia. The VL muscle is exposed widely and disconnected from its attachments distal to the descending branch of the circumflex femoral artery pedicle. The VL muscle is elevated from the inferior to superior direction until the pedicle on the posteromedial surface of the flap is encountered. Adequate blood flow in the pedicle is ensured. The muscle is rotated from the thigh to the lateral hip to obliterate all dead space and recreate an anatomic joint capsule (Figure 1 and Video 1).

The muscle flap is then covered with a negative pressure wound dressing to create granulation tissue and facilitate postoperative fluid reflux from the joint and surrounding tissue (Figure 2). Finally, a skin graft is placed over the flap 3 to 6 weeks later, and the wound is monitored as it heals (Figure 3).

Results

A total of 14 patients were included in this study. All patients initially presented with soft-tissue defects after repeated hip arthroplasty surgeries (Video 2). Seven patients (50%) had chronically infected wounds, four had nonhealing wounds (29%), and three had poorly healing wounds (21%) (Table 1). All the pedicled VL muscle flaps survived.

Two patients (14%) ultimately required HD despite the VL muscle flap. The indications for HD in these patients were recurrent implant infections and osteomyelitis. These two patients had irreversible osteomyelitis,

Figure 1

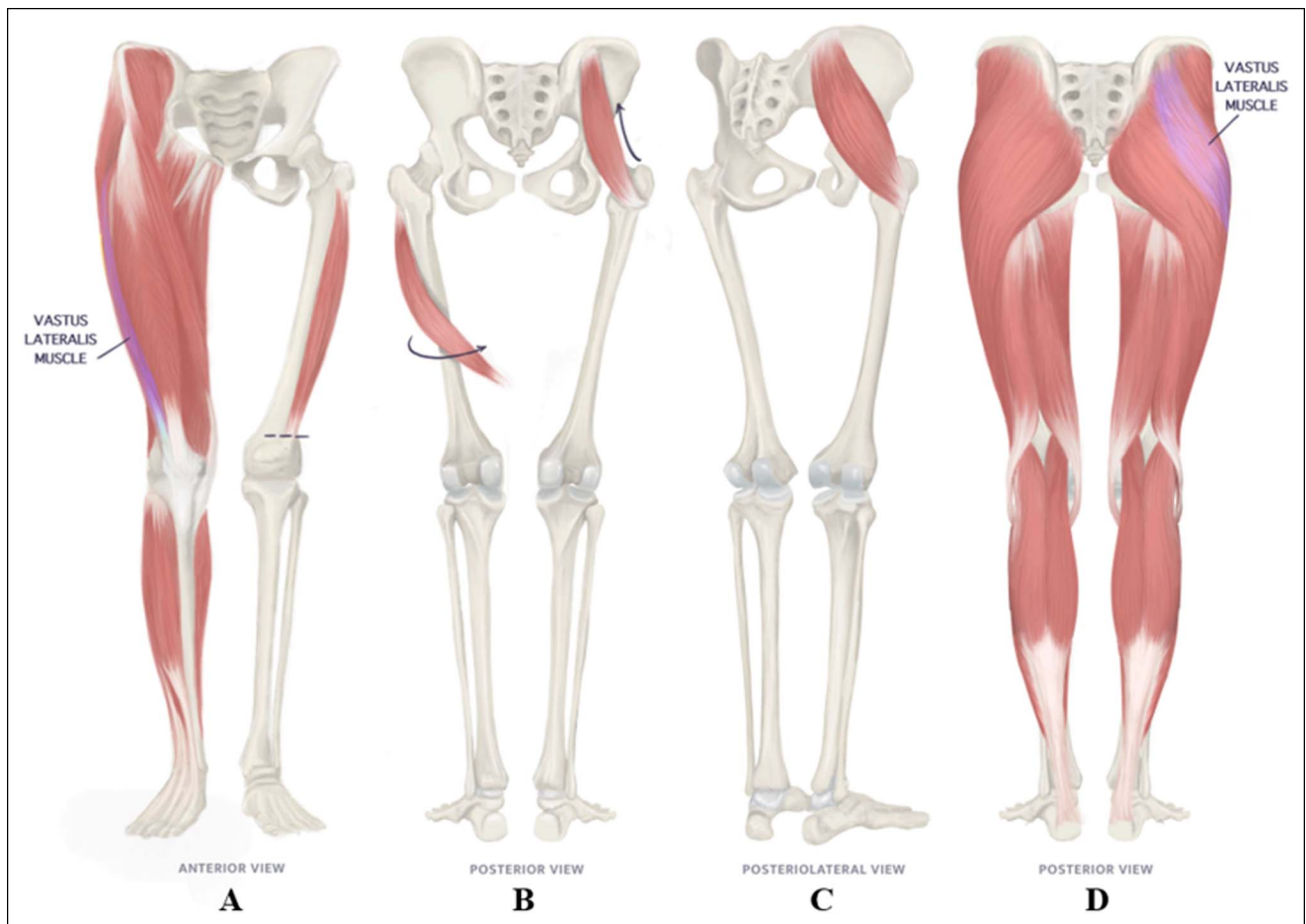


Image showing pedicled VL muscle flap for THA. **A**, Native location of the VL muscle and site of surgical detachment. **B**, VL elevation to hip. **C**, Native gluteus medius muscle naturally occupies a similar region with a similar muscle fiber direction to the VL flap. **D**, The outcome of VL muscle flap. THA = total hip arthroplasty, VL = vastus lateralis.

preventing adequate debridement and eradication of deep infected tissue. Although the hip was successfully reconstructed in both patients, the infections were too severe to obtain negative margins while preserving the pelvis or femur.

Twelve patients (86%) recovered after 6 months post-operation and had healed functional hip joints. These patients could walk without pain, and the range of motion at the hip was preserved. There was no reported weakness with ambulation or perceived difference in quadriceps function. Two patients (15%) had donor site seromas. This was treated with debridement, drainage, and split-thickness skin graft, which ultimately fully resolved.

Discussion

This study chose the ipsilateral VL as a pedicled muscle flap for patients with soft-tissue hip defects. It is the

only local flap with adequate tissue and bulk to reconstruct the hip region. The VL is frequently used for pedicled and free muscle flaps.¹⁵ Its large vessel diameter, long pedicle length, and minor donor site morbidity have made the muscle a valuable flap for lower limb reconstructions.¹⁵ The sheer size of the VL muscle also makes it capable of covering notable defects.¹⁶ The VL muscle flap has previously been shown to reduce acetabular dead space and improve blood supply as an interposition myoplasty after hip joint resection.¹⁷

The cohort studied presented with a wide variety of post-THA complications, which heightened their risk of HD. These included recurrent infections, nonhealing wounds, soft-tissue defects, and chronic hip dislocation. It has been reported that the most notable indications of HD include severe soft-tissue defects and osteomyelitis.¹⁸ The VL provided bulk and improved soft-tissue

Figure 2



Image showing VL muscle flap before (A) and after (B) negative pressure wound dressing placement. VL = vastus lateralis.

integrity, obliterated dead space, and increased immune support in the area. All patients experienced mild-to-moderate postoperative weakness which ultimately resolves by 6 months postoperation. This may be due to quadriceps muscle reconditioning or atrophy after limited muscle use for a prolonged period. Return to bearing weight and physical therapy led to complete resolution of the unilateral weakness which may either be a result of surrounding muscle compensation or restoration of strength to their preoperative state. Possibly because of less physical activity in elderly individuals, patients had no perceived effect of unilateral VL removal.

Most (n = 12; 86%) patients in this study adequately healed without indication of HD after a history of recurrent THA complications. This supports using an ipsilateral pedicled VL muscle flap in treating non-healing wounds after THA. Despite soft-tissue reconstruction, the two patients requiring HD had extensive osteomyelitis preventing adequate debridement. Although the hip reconstruction in these patients was successful, the deep infections could not be eradicated. The authors believe that infection recur-

rence and HD risk could have been reduced in these two patients with an earlier addition of a VL muscle flap.

Figure 3



Image showing healed donor site 4 years postoperation.

Table 1. List of Patients With Preoperative and Postoperative Outcomes

| ID | Age | Sex | Indication for Hip Reconstruction ^a | Postoperative Complications | Treatment of Complication | Outcome at 6 mo |
|----|-----|-----|--|--|--|------------------------|
| 1 | 66 | M | Poor healing | Chronic recurrent implant infections and osteomyelitis | HD | Healed disarticulation |
| 2 | 70 | F | Nonhealing wound | None | N/A | Healed and functional |
| 3 | 81 | F | Nonhealing wound | None | N/A | Healed and functional |
| 4 | 62 | M | Nonhealing wound | None | N/A | Healed and functional |
| 5 | 73 | F | Chronic infection | None | N/A | Healed and functional |
| 6 | 55 | M | Chronic infection | None | N/A | Healed and functional |
| 7 | 55 | F | Chronic infection | Recurrent osteomyelitis of the left femur | HD | Healed disarticulation |
| 8 | 63 | F | Chronic infection | None | N/A | Healed and functional |
| 9 | 71 | F | Nonhealing wound | None | N/A | Healed and functional |
| 10 | 57 | F | Chronic infection | Donor site seroma | Debridement and drainage | Healed and functional |
| 11 | 71 | F | Poor healing | None | N/A | Healed and functional |
| 12 | 71 | F | Poor healing | Donor site seroma | Debridement and split thickness skin graft | Healed and functional |
| 13 | 72 | F | Chronic infection | None | N/A | Healed and functional |
| 14 | 66 | M | Chronic infection | None | N/A | Healed and functional |

HD = hip disarticulation, N/A = not applicable.

^aAll patients had soft-tissue defects as an indication of hip reconstruction.

Infection after THA is commonly treated using incision and drainage, removal of implant, and introduction of an antibiotic-coated spacer.¹⁹ Once the joint is healed, painless, and with negative cultures, a new prosthetic is introduced 3 months postoperatively.¹⁹ The patient is then followed for at least 6 months to ensure healing and eradication of the infection.¹⁹ If the joint becomes reinfected, the process may be repeated, or the patient may require HD or femur removal depending on the extent and location of the infection.¹⁹ The patients in this study primarily underwent soft-tissue hip reconstruction after their second infection within the hip joint.

Outcomes may have been improved if a VL muscle flap had been introduced after the first infection to prevent future infections. This is due to the improved vas-

cularity and immunologic access to the joint after the introduction of a pedicled muscle flap. Multiple hip arthroplasties attempting to eradicate repeated infections cause hip muscle stiffness because of fibrosis from various incisions. This decrease in the pliability of the lateral hip puts patients at greater risk of hip dislocations. Soft-tissue reconstruction with the VL muscle strengthens the area, improves flexibility, and diminishes dead space within the joint capsule, mitigating the risk of hip dislocation. The extensive scarring and poor soft-tissue integrity also limit blood flow, causing poor wound healing and increasing the risk of dehiscence. Introducing a pedicled muscle flap improves blood supply to the area, allowing for minimal scarring.

Repeated hip joint arthroplasties result in soft-tissue deficiencies, leading to poor vascularity and hip

function. This increases the risk of complications, such as hip dislocation, poor wound healing, and recurrent infections. For best results, a VL pedicled muscle flap should be introduced at the first signs of soft-tissue deficiency rather than as a last resort. Soft-tissue reconstruction of the hip may improve outcomes of THA and reduce the risk of recurrent infections requiring repeated incision and drainage.

Maintaining soft-tissue integrity can improve THA outcomes, especially with early introduction of a pedicled muscle flap. There may be use for prophylactic VL muscle flaps introduced perioperatively for high-risk patients undergoing THA. Risk factors of complications after THA include smoking, diabetes mellitus, cardiac history, and vascular problems.²⁰ Prophylactic muscle flaps have previously been described in the setting of femoral vascular surgery.²¹ A prophylactic muscle flap was reported as a safe, effective method for improving bulk and increasing vascular access in high-risk patients undergoing groin surgery.²¹ This study used a VL muscle flap prophylactically in patients at increased risk of HD because of THA failure.

There are strengths to this study including its relatively large cohort of 14 patients and the use of a singular surgeon, eliminating the bias associated with variation between personal surgical preferences. An additional strength of the study is increased confidence in long-term patient outcomes because of the minimum of 6 months postoperation to be considered. There are also limitations to this study which must be addressed. A limitation is the exclusion of patients less than 6 months postoperation as it decreased the sample size. A notable limitation of this study is the lack of a control group. The retrospective nature of this study makes it prone to recall bias and subject to confounding variables. Causation cannot be determined, and temporal relationships may be difficult to assess. Future research would benefit from a double-blind, controlled, prospective study. The lack of categorizing variable presentations and severity of PJI and THA complications is another limitation of this study. Despite their high-risk status, it also could not be predicted whether a patient would ultimately require HD.

Conclusion

A prophylactic, pedicled VL muscle flap shows promise in preventing HD in patients suffering from post-THA soft-tissue defects, chronic infection, and poor wound healing. Additional prospective studies are necessary to determine the most appropriate population for this technique.

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