

Pushing the Limits of Reach for the Pedicled Anterolateral Thigh Flap

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Summary: The pedicled anterolateral thigh flap, although tremendously versatile, may be limited in reach, especially in challenging clinical cases. Traditional methods to extend its reach may remain insufficient or unavailable. We describe two modifications to the conventional pedicled flap to extend its reach to the limits, namely (1) selecting a distal perforator supplemented by the nonsizable perforator harvest technique, and (2) the double-pivot technique adding an additional rotation to the flap à la propeller perforator flap. The increased reach not only improves reconstructive success, but also opens up new applications for this workhorse flap. (*Plast Reconstr Surg Glob Open* 2024; 12:e5727; doi: [10.1097/GOX.00000000000005727](https://doi.org/10.1097/GOX.00000000000005727); Published online 8 April 2024.)

MODIFICATIONS TO THE PEDICLED ANTEROLATERAL FLAP AND A CASE REPORT

The pedicled anterolateral thigh (ALT) flap is tremendously versatile.¹ Although its reach is considerable, much of the flap bulk is lost in transit, limiting availability at the defect. Variations in vascular anatomy also severely limit its length.² Surgical techniques exist to improve its reach.³ However, these measures may still prove insufficient or are unavailable in challenging clinical scenarios.

Herein, we describe our modifications to the flap that not only reliably ensure a long reach, but also push it beyond its normal limits to reach defects not traditionally considered possible. Our first modification is to raise the flap based on a distal perforator, which naturally allows for increased reach. Cadaveric studies by Yu and Lee showed the distal “C” perforator as the most common perforator location.^{4,5} Unfortunately, when these distal perforators are tiny or “nonsizable” (diameter <0.5 mm), common advice is to abandon the ALT flap. This is where our technique differs from other authors.

To circumvent the issue of nonsizable perforators, we previously published our technique of ALT flap harvest based on such perforators.⁶ This technique bypasses the limitations of perforator anatomy and allows for reliable flap harvest on distal perforators, ameliorating the need for preoperative scans to analyze perforator caliber and location. Pushing this to the extreme to maximize reach, we can even raise the flap on nonsizable perforators near the terminal branching of the pedicle, which occurs at 5–10 cm above the patella.⁷

Traditionally, there is a single pivot point at the pedicle origin upon which the flap rotates toward the defect. Our second modification is the double-pivot concept: we design the skin paddle with the perforator lying eccentrically and distally. The skin paddle is then rotated/pivoted about the perforator in the fashion of a perforator propeller flap (Fig. 1). This second pivot allows the tip of the flap to reach further than convention, akin to a crane’s folding arm. We first described this technique for pedicled medial sural artery perforator flaps.⁸ However, it has even greater relevance to the pedicled ALT flap, given its versatility, multiple perforators, and a long, ample skin paddle to take advantage of the second pivot.

Applying these two modifications is simple. Preoperatively, the terminal branching of the pedicle is marked 10 cm above the patella along the flap axis.⁷ Just proximal to that represents the most distal location possible for nonsizable perforator harvest. The skin paddle is designed eccentrically around this location and can be extended proximally for more reach during the double-pivot maneuver. If the distal perforator is sizeable, the flap is conventionally raised. If it is small, then our nonsizable perforator harvest technique is used. The proximal perforators are then occluded by vascular clamps. If flap

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perfusion remains adequate, they are ligated. If perfusion is poor, they are preserved and the flap is converted to a free flap, or the plan is abandoned and another flap is used instead. Thankfully, this has yet to occur in our experience. During the double-pivot maneuver, the direction of rotation is determined by the relative axes of the pedicle and defect. Care is taken to never rotate more than 180 degrees; any further and the flap should be pivoted in the other direction instead.

As proof of concept, we performed a cadaver dissection, raising a left ALT flap on a tiny distal perforator using the nonsizable perforator harvest technique. The flap was initially able to reach the right groin. With the double-pivot, length was increased significantly, and it reached the right iliac crest. Although only one cadaver dissection was performed, the result was highly encouraging, and we proceeded with surgery on a complicated clinical case that required expeditious reconstruction. A



Fig. 1. The skin paddle is rotated about the eccentrically placed perforator propeller-flap-style to increase the flap's reach.

Takeaways

Question: The pedicled anterolateral thigh flap is versatile but often limited or inconsistent in reach. We aimed to increase its reach reliably despite anatomical variations.

Findings: We describe two modifications to the flap. Firstly, to raise it on distal perforators, and if these are nonsizable, we use our previously published nonsizable perforator flap harvest technique. Secondly, we use the double-pivot maneuver, whereby the skin paddle is rotated upon the axis of the perforators à la propeller style, swinging the flap out for further reach.

Meaning: The pedicled anterolateral thigh flap often has a shorter reach than reported, but our two modifications can reliably extend its reach, improving its predictability and versatility.

9-year-old girl was run over by a truck, sustaining extensive soft tissue injuries over the left lower abdomen, hip, and thigh, with multiple visceral injuries and pelvic fractures (Fig. 2). When she was finally ready for reconstructive surgery, the huge defect included exposed pelvic bones and a long segment of femoral bypass graft. Locoregional options on the left were nonexistent, and vascular injury to the external iliac and femoral systems made free tissue transfer hazardous. Although this remained our backup plan, we first raised a right pedicled ALT flap with our



Fig. 2. Extensive soft tissue defect with vascular injuries that rendered regional and free flap reconstruction options unavailable.

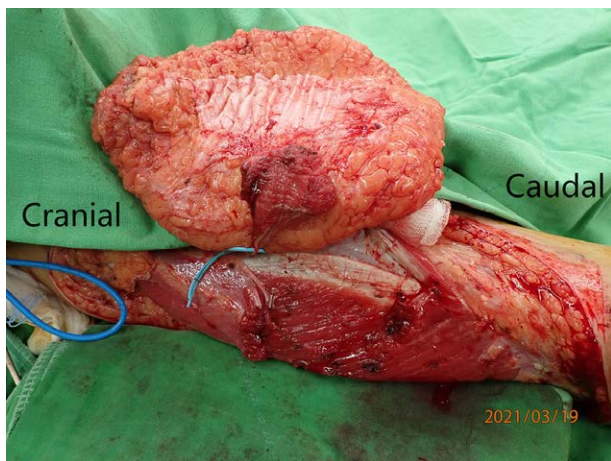


Fig. 3. A large ALT flap was raised using the nonsizable perforator technique incorporating a small cuff of vastus lateralis muscle. This allowed us to use the small distal perforators that, combined with the double-pivot maneuver, enabled the flap to reach the defect.



Fig. 4. The flap fully survived even to the furthest tip, and the patient went on to heal fully before undergoing rehabilitation.

two described modifications: the distal perforator was small, so we used the nonsizable perforator harvest technique, and we designed the skin paddle eccentrically for the double-pivot maneuver (Fig. 3). The flap was able to reach the contralateral iliac crest and trochanter to cover all critical defects. Additionally, we harvested split-thickness skin grafts from the flap to resurface the ALT donor site to maximize flap utilization. The flap survived fully, and the patient eventually healed well (Fig. 4).

DISCUSSION

Even with the prevalence of microsurgical expertise, pedicled flaps will always remain relevant and useful. Pushing the limits of the pedicled ALT flap's reach through our modifications is thus important for several reasons. Firstly, ensuring a flap reaches the defect adequately requires some guess work. Preoperative estimation may differ significantly from intraoperative circumstances, and insufficient reach can result in surgical failure. Having increased flap length provides additional margin for error arising from any intraoperative developments.

Secondly, the pedicled ALT flap may in reality have a shorter reach than is commonly reported in the literature. Studies reported that it is able to reach the costal margin, or 8 cm above the umbilicus.⁹ However, Tamai showed that only 28.3% of flaps could reach the umbilicus.¹⁰ These contradictory data suggest that isolated outliers aside, most ALT flaps have a much more modest length, and modifications are needed to ensure it can reach the defect reliably.

Thirdly, our modifications allow the flap to reliably reach locations hitherto unheard of, such as the contralateral iliac crest and trochanter, coccyx, or upper abdomen/lower chest, further expanding the flap's usefulness.

Thus, combining (1) a distal perforator selection supplemented by the nonsizable perforator harvest technique and (2) the double-pivot technique allowed us to push the limits of the pedicled ALT flap beyond the convention.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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