

CASE REPORT GENERAL RECONSTRUCTION

Free gracilis muscle transfer with anastomosis of its major to minor pedicle for reconstruction of a popliteal fossa defect: a case report

Caitlin L O'Hare B Pharm MD, MS (Plast), B Pharm (Hons)  0000-0003-1120-7931,^{1a}

Harrison J Theile MBBS (Hons)  0000-0002-7522-4573,¹ Jonathan D Wiper MB ChB, FRCS (Plast), FRACS (Plast)  0000-0003-0377-3474¹

¹ Plastic and Reconstructive Surgery, Princess Alexandra Hospital, Woolloongabba, Queensland, AUSTRALIA.

Keywords: gracilis muscle, surgical flaps, microsurgery

Submitted: 16 August 2022 AEST Accepted: 18 January 2023 AEST

DOI: 10.34239/ajops.74140

Australasian Journal of Plastic Surgery

Vol 6, Issue 2, 2023

Background

The gracilis muscle is situated in the medial compartment of the thigh and is commonly utilised by the reconstructive surgeon due to its versatility and low donor site morbidity.¹ It is a type II muscle based on Mathes and Nahai's muscle flap classification system.² The muscle's dominant blood supply is from the medial circumflex femoral artery (MCFA), and minor vascular pedicles originate from the superficial femoral artery (SFA) and occasionally from the popliteal artery.³⁻⁵

The gracilis muscle may be used as a pedicled flap or for free tissue transfer to reconstruct a wide variety of defects.^{2,6} Popliteal defects are a complex region to reconstruct, with the literature showing overwhelming preference for local flap coverage.^{7,8} However, the gracilis muscle has been described for coverage of suprapatellar and anterior knee defects.^{9,10}

This case describes the utilisation of the gracilis muscle as a free muscle transfer to reconstruct a popliteal defect. Adding to the novelty of this case, the recipient vessel used for microsurgical anastomosis was the muscle's own minor pedicle—a technique which has not hitherto been described.

Case

A 20-year-old male was diagnosed with a left popliteal fossa clear cell carcinoma. He underwent neoadjuvant radiation prior to aggressive resection

in early 2021. Intraoperatively an 11 cm segment of popliteal artery and tibial nerve was resected and he required a saphenous vein graft and a sural nerve graft respectively for neurovascular reconstruction. The excision site was closed directly. Four months later, his wound became infected and dehisced, with nerve graft exposed. This required multiple debridements and ultimately resulted in a soft tissue defect within the irradiated popliteal fossa field (**Figure 1**).

Given the 11 cm segmental reconstruction of his popliteal artery, there were no suitable local reconstructive options and therefore required a free flap. An ipsilateral gracilis was raised on its major pedicle. During the flap raise, two minor pedicles were noted to be of significant calibre (approximately 2 mm diameter) (**Figure 2**). There were limited recipient vessels for microanastomosis due to popliteal artery reconstruction, therefore the major pedicle of the gracilis muscle was

^a Corresponding author: Caitlin O'Hare, B Pharm MD, MS (Plast), B Pharm (Hons); caitlin.ohare7@gmail.com



Fig 1 (left). Irradiated left popliteal fossa defect with exposed tibial nerve cable graft and popliteal artery graft reconstruction Fig 2 (right). (a) Gracilis muscle with two minor pedicles (yellow arrows) (b) Anastomosis of the free gracilis muscle to the most distal minor pedicle (yellow arrow).

anastomosed to its most distal minor pedicle to maximise pedicle length and allow the flap to reach the defect comfortably. A split-thickness skin graft was inset over the muscle.

The patient recovered well postoperatively and the flap healed without complication (**Figure 3**).

Discussion

This illustrates the first known case of the gracilis minor pedicle used as a recipient vessel for microsurgical anastomosis. The decision to utilise this vessel was based on two factors. Firstly, there was a lack of recipient vessel options given prior resection of popliteal artery and its branches, so novel options had to be explored by necessity. Secondly, the minor pedicle of the gracilis was of good calibre, approximately 2 mm in diameter. Anastomosis of the muscle to the most distal minor pedicle allowed the flap to sit comfortably within the defect.

The anatomy of the gracilis muscle minor pedicles has been investigated extensively.³⁻⁵ It is established that there is usually at least one minor pedicle distal to the dominant supply to the

muscle. This pedicle is usually from the superficial femoral artery and may be more than one vessel. Considerable variability can exist however, with minor pedicles also described as originating from the profunda femoris and obturator arteries.³

A technique described in the literature is the delay of the gracilis flap by raising the muscle on its minor pedicle and dividing its major pedicle to induce relative ischaemia and reliance on the muscle's minor pedicle.² This would then permit a favourable arc of rotation for a pedicled gracilis into the popliteal fossa. However, such a delay technique was not suitable in this case due to the exposed nerve graft and threatened exposure of the popliteal artery graft, which necessitated prompt coverage. There are descriptions of pedicled gracilis muscle flaps based on its minor pedicles for suprapatellar and anterior knee defects, although this requires both minor pedicles to remain intact.^{9,10} For more distal and posterior defects such as this case, length must be maximised and therefore this method is unsuitable.

Other studies have identified distal minor gracilis pedicles of similar calibre to our intraoperative



Fig 3. Two months post reconstruction of left popliteal fossa defect with free gracilis muscle flap and split thickness skin graft

findings of approximately 2 mm diameter.¹⁰ This is in contrast with Taylor and colleagues paper which described gracilis minor pedicles with a diameter of 1.1 mm.³ However, that paper looked at cadaveric studies, while Tiengo and colleagues paper and our findings were based on in vivo findings.¹⁰

The popliteal fossa is a difficult area for reconstruction, with limited case reports available describing strategies for soft tissue coverage.^{7,8} Previous examples of reconstructive options have included local reconstructive options, and regional options such as a pedicled anterolateral thigh or gastrocnemius muscle flaps.⁸ The gastrocnemius muscle particularly is a workhorse flap for locoregional reconstruction around the popliteal fossa and upper tibia. In our case, this was not a feasible option due to the prior segmental popliteal artery resection which sacrificed the vascular pedicle of the gastrocnemius muscle.

Conclusion

This case demonstrates an alternative novel technique for reconstruction of a popliteal fossa defect with limited locoregional options. As far as the authors are aware, this is the first case of successful anastomosis of a free gracilis muscle to its minor pedicle. Research has shown that the muscle's minor pedicle may be of acceptable calibre in-situ for microsurgical anastomosis.⁷ Thus it may be considered as a recipient vessel for microsurgery in the future, especially in a similar scenario in which there has been a vascular reconstruction otherwise limiting recipient vessels. Furthermore, using the minor pedicle of the gracilis muscle as a recipient vessel is located within the region of flap elevation and may reduce operative time and donor site.

Patient consent

Patients/guardians have given informed consent to the publication of images and/or data.

Conflict of interest

The authors have no conflicts of interest to disclose.

Funding declaration

The authors received no financial support for the research, authorship, and/or publication of this article.

References

- 1 Magden O, Tayfur V, Edizer M, Atabey A. Anatomy of gracilis muscle flap. *J Craniofac*. 2010;21: 1948–950. <https://doi.org/10.1097/SCS.0b013e3181f4ed81> PMID:21119464
- 2 Mathes SJ and Nahai F. *Clinical atlas of muscle and musculocutaneous flaps*. Missouri, C V. Mosby Company; 1979: pages 13–32.
- 3 Taylor GI, Cichowitz A, Ghee Ang S, Seneviratne S, Ashton M. Comparative anatomical study of the gracilis and coracobrachialis muscles: implications for facial reanimation. *Plast Reconstr Surg*. 2003 Jul;112(1): 20–30. <https://doi.org/10.1097/01.PRS.0000065909.86735.F7> PMID:12832872
- 4 Coquerel-Beghin D, Milliez PY, Auquit-Auckbur I, Lemierre G, Duparc F. The gracilis musculocutaneous flap: vascular supply of the muscle and skin components. *Surg Radiol Anat*. 2006;28: 588–95. <https://doi.org/10.1007/s00276-006-0150-8> PMID:17143568



CC-BY-4. This is an open access article distributed under the Creative Commons Attribution 4.0 International License (CC-BY-4) which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited. View this license's legal deed at <http://creativecommons.org/licenses/by/4.0> and legal code at <http://creativecommons.org/licenses/by/4.0/legalcode> for more information.

- 5 An, X, Yue B, Lee J, Lin C, Han S. Arterial anatomy of the gracilis muscle as determined by latex injection and glycerin transparency. *Clin Anat*. 2012;25: 231–34. <https://doi.org/10.1002/ca.21217> PMID:21744397
- 6 Lyones ME, Goldman JJ. Gracilis tissue transfer. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559046/>
- 7 Bharathi RR, Ramkumar S, Venkatramani H. Soft tissue coverage for defects around the knee joint. *Indian J Plast Surg*. 2019;52: 125–33. <https://doi.org/10.1055/s-0039-1688536> PMID:31456621 PMCID:PMC6664846
- 8 Filitis, DC, Fisher J, Samie FH. Reconstruction of a surgical defect in the popliteal fossa: a case report. *Int J Surg Case Rep*. 2018;53: 228–30. <https://doi.org/10.1016/j.ijscr.2018.10.070> PMID:30428437 PMCID:PMC6232581
- 9 Cavadas PC, Sanz-Giménez-Rico, Landin L, Martínez-Soriano. Segmental gracilis free flap based on secondary pedicles: anatomical study and clinical series. *Plast Reconstr Surg*. 2004 Sep 1;114(3): 684–91. <https://doi.org/10.1097/01.PRS.0000130965.99546.15> PMID:15318046
- 10 Tiengo BC Macchi V, Vigato E, Porzionato A, Stecco C, Azzena B, Morra A, De Caro R. Reversed gracilis pedicle flap for coverage of a total knee prosthesis. *J Bone Joint Surg (American Volume)* 2010;92: 1640–646. <https://doi.org/10.2106/JBJS.I.00195> PMID:20595571