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CASE REPORT

Gastrocnemius muscle flap of both heads on a single vascular pedicle

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Abstract

We present a case of a muscle flap of both heads of gastrocnemius on a single vascular pedicle for reconstruction of a tibial defect. The flap was based on the medial sural vessels alone. The vascular supply to the lateral head was achieved through the anastomotic vessels along the gastrocnemial raphe.

Key Words: *Gastrocnemius muscle flap, two heads on a single pedicle, anastomotic vessels, defects of the upper two-thirds of the tibia*

Introduction

Few options are available for reconstruction of the upper two-thirds of the tibia. The medial gastrocnemius myocutaneous flap is probably the most reliable choice of local flaps. However, skin grafts at the donor site and transsection of the saphenous nerve are no longer acceptable. In addition, the oedema that is usually observed at the periphery of this flap might cause trouble. The gastrocnemius myocutaneous flap is therefore less often considered as a first choice because its reliability does not outweigh its drawbacks [1]. The same disadvantages accompany local fasciocutaneous flaps. It should also be noted that although flaps of considerable size have been reported for reconstruction of defects around the knee, the adequacy of fasciocutaneous flaps for extensive, longitudinal defects of the tibia has not been reported. On the other hand, the consistency of the vascular pedicles of such flaps has been strongly disputed [2]. Local muscle flaps are inadequate for extensive tibial defects, unless a combination of flaps is used. Gastrocnemius and soleus muscles have been proposed for simultaneous reconstruction of the upper and middle third of the tibia, respectively. However, preservation of the soleus is always prudent. The soleus is the prime plantar flexor muscle of the ankle [3], whereas the substantial contribution of this muscle in the drainage of the lower leg cannot be overlooked [4]. Free flaps are therefore still the most reasonable option for reconstruction of extensive tibial defects.

Case report

A 78-year-old man was referred for cover of exposed bone of the upper thirds of his left tibia. A few days earlier he had had surgical debridement of chronic osteomyelitis of his left leg by orthopaedic surgeons. Debridement resulted in longitudinal soft tissue and bony defects of the upper two-thirds of the tibia, measuring 15×3 and 6×1 cm, respectively (Figure 1*a*).

The patient's medical history included treated hypertension and a single episode of deep vein thrombosis of his left lower extremity a few years previously. Physical examination showed mild oedema and no palpable pulsation of the major arteries of the left lower limb. Signs of infection around the edges of the defect were still evident. After wound swabs were sent for cultures and sensitivity tests, *Pseudomonas aeruginosa* was isolated. Angiography of the left lower limb showed high grade stenosis of the common iliac artery, but normal patency of all the distal major arteries and satisfying perfusion of

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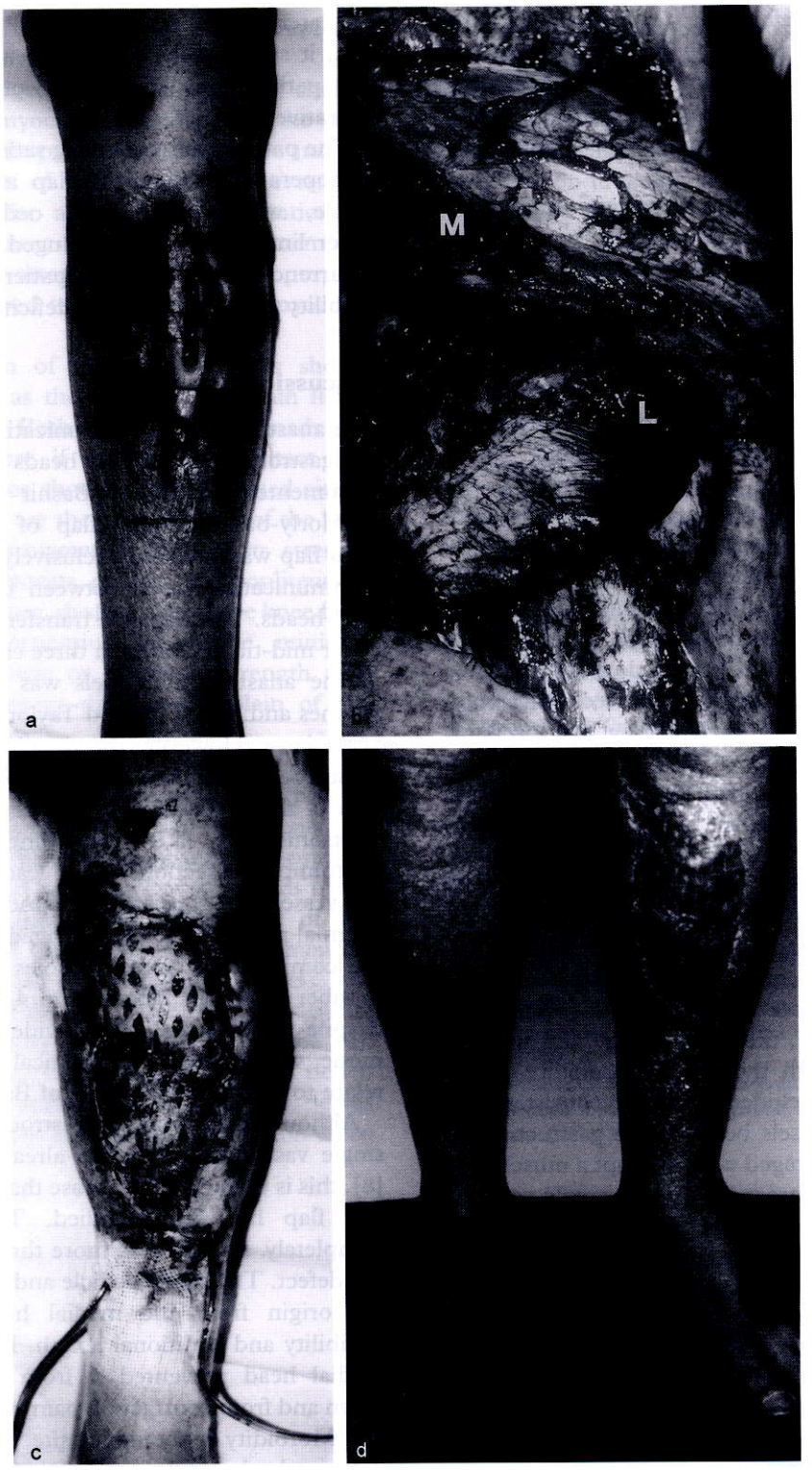

Figure 1. (*a*) Soft tissue and bony defects of the upper two-thirds of the left tibia, measuring 15 × 3 and 6 × 1 cm, respectively. The patient had had debridement of chronic osteomyelitis a few days earlier. (*b*) After additional, aggressive debridement, a gastrocnemius muscle flap of both heads was raised. The flap was based on the medial sural vessels alone. The medial (M) and lateral (L) heads were transferred to the upper and middle third of the tibia, respectively. (*c*) Cover of the defect. The flap had been grafted with a skin graft. After the additional debridement the residual defect was far more extensive than the initial one (Figure 1*a*). (*d*) Postoperative result at 8 months. Both the flap and the graft were stable. There was no appreciable deformity in contour.

the entire leg. Therefore, our failure to palpate the arteries of the leg was probably because of stenosis of the left common iliac artery. Triplex examination showed organised thrombosis with limited restoration of the patency of the deep venous system of the left lower limb.

After control of infection with systemic and topical antibiotics, we decided to proceed to one-stage wound debridement and reconstruction. The only reconstructive option was a flap transfer. A gastrocnemius musculocutaneous flap was a reasonable choice; however, we considered that the lower limb on the same side might be adversely affected. The large fasciocutaneous component of the flap and the medial head itself that were going to be transposed would no longer contribute to the drainage of the leg, so the already impaired venous return of the limb would probably be aggravated. In addition, possible sacrifice of sensory nerves would render the limb more difficult to manage. For the same reasons, fasciocutaneous flaps were excluded as well. We also found it hazardous to design a sizeable and appropriately orientated fasciocutaneous flap. Given that such a long and probably pedicled flap was going to be fed by inconsistent vessels, survival of the flap was dubious. On the other hand, the presence of infection possibly required a muscle flap. We decided to leave the soleus intact because, in the presence of venous insufficiency, this 'muscle pump' of the lower leg [4] was thought to be more helpful if left undisturbed. Undoubtedly a free muscle flap transfer would be the most appropriate option for this particular defect. Nevertheless, the patient's age and medical history together with the uncertain quality of the recipient vessels precluded that. The consistency of the anastomotic vessels between the gastrocnemius muscle heads encouraged us to attempt a muscle flap of both heads of gastrocnemius on a single vascular pedicle. Because the flap was going to be based only on the medial sural vessels, the anastomotic vessels along the gastrocnemial raphe were expected to support the lateral head.

On the day of operation the wound was debrided aggressively. After transsection of the lateral sural vessels, we raised a gastrocnemius muscle flap on both heads. The flap was based on the medial sural vessels alone. The medial head was detached from its origin, while the corresponding motor nerves were transsected. When the clamps from the lateral sural vessels were removed temporarily, considerable retrograde bleeding was noted. The flap was comfortably transferred into the defect and subsequently skin-grafted (Figures 1*b*, *c*).

The postoperative course was almost uneventful. Although mild venous stasis at the periphery of the lateral head resulted in a 2×3 cm skin graft loss, it soon resolved. Healing was completed and the patient was discharged on the 18th postoperative day.

The patient was recovering satisfactorily 8 months postoperatively. Both the flap and the graft were stable, whereas the mild oedema of the left lower limb remained unchanged. No osteomyelitic recurrence was noted. The patient reported normal mobility and no functional deficit (Figure 1*d*).

Discussion

The anastomotic or communicating vessels between the gastrocnemius muscle heads have already been documented. In 1983, Bashir [5] described an inferiorly-based muscle flap of the medial head. This flap was supplied exclusively by the lowermost communicating vessel between the two gastrocnemial heads. The flap was transferred successfully to cover mid-tibial defects in three cases. The existence of the anastomotic vessels was also described by Mathes and Nahai [6] and Taylor and Pan [7] a few years later. However, the detailed anatomy of the vessels remained obscure. A more elaborate description of these vessels has been reported recently by Tsetsonis et al. [8,9]. According to these authors' anatomical dissections of 28 cadaveric specimens, the vessels are consistently found along the gastrocnemial raphe. They are arranged in bundles, which are composed of both arterioles and venules. The number of vessels ranges from 4–10. Nevertheless, despite the unquestionable evidence of the anastomotic vessels, the only clinical applications that relate to them are still those of Bashir [5].

Although a flap of both gastrocnemial heads on a single vascular pedicle has already been proposed [8], this is the first clinical case that we know of when this flap has been applied. The flap survived completely. Its bulk was more than enough to cover the defect. The single pedicle and the detachment of the origin from the medial head offered great flexibility and additional length. Denervation of the medial head prevented it from possibly breaking down and from contraction pain as a result of spasms [1]. Morbidity at the donor site was negligible.

It might be argued that this flap was a risky undertaking in this particular patient. However, after our personal experience of more than 70 anatomical dissections and after Bashir's successful cases, we felt quite confident that the heads of gastrocnemius could possibly support each other through the anastomotic vessels. Our only concern was the drainage of the lateral head because valves might have intervened. Although eventually this was

the case, venous stasis was mild and completely resolved in a few days.

This flap was judged to be an appropriate choice. A gastrocnemius myocutaneous flap was the only option in terms of the patient's medical state and the nature and extent of the defect. However, we thought that, as far as possible, elimination of morbidity of the lower limb was of utmost importance. The flap we attempted fulfilled this purpose and eventually proved to be superior to a myocutaneous flap.

Loss of function of the gastrocnemius should not be a concern, as the soleus is the main flexor of the ankle [3]. Both gastrocnemial heads are expendable therefore if the soleus is intact [6]. Function of the knee should not be affected either. Hamstring muscles are the prime flexors of the knee accounting for approximately 65% of its strength [10]. Given that sartorius, gracilis, and popliteus are also flexors of the knee, dysfunction of the knee from loss of the gastrocnemius should be minimal. Although no isometric or isokinetic strength tests were done, our patient did not complain of any functional loss.

If the reliability of the gastrocnemius muscle flap of both heads on a single vascular pedicle is illustrated by a considerable series of patients, we think that this flap might be established as a primary reconstructive option for the upper two-thirds of the tibia in selected cases. The consistency of the anastomotic vessels has been well documented. The versatility of the gastrocnemius vessels, the size of the flap, and the easy dissection, are definite advantages. Deformity of the contour of the calf from loss of muscle bulk and functional deficit should be of little importance. No sensory nerves are removed. This flap may be the only option when myocutaneous, fasciocutaneous, or free flaps are contraindicated (such as for degloving injuries and in debilitated patients). However, the indications of this flap are restricted only to extensive defects, whereas the flap should not be applied without consideration in young and athletic people.

References

[1] Pico R, Luscher NJ, Rometsch M, de Roche R. Why the denervated gastrocnemius muscle flap should be encouraged. Ann Plast Surg 1991;26:312–24.

[2] Shaw AD, Ghosh SJ, Quaba AA. The island posterior calf fasciocutaneous flap: an alternative to the gastrocnemius muscle for cover of knee and tibial defects. Plast Reconstr Surg 1998;101:1529–36.

[3] Tobin GR. Soleus flaps. In: Strauch B, Vasconez LO, Hall-Findlay EJ, editors. Grabb's encyclopedia of flaps. 1st ed. Boston: Little, Brown and Company; 1990. p 1706–11.

[4] Watterson PA, Taylor GI, Crock JG. The venous territories of muscles: anatomical study and clinical implications. Br J Plast Surg 1988;41:569–85.

[5] Bashir AH. Inferiorly-based gastrocnemius muscle flap in the treatment of war wounds of the middle and lower third of the leg. Br J Plast Surg 1983;36:307–9.

[6] Mathes SJ, Nahai F, editors. Reconstructive surgery: principles, anatomy, and technique. New York: Churchill Livingstone; 1997. p 1391–418.

[7] Taylor GI, Pan WR. Angiosomes of the leg: anatomic study and clinical implications. Plast Reconstr Surg 1998;102: 599–618.

[8] Tsetsonis CH, Kaxira OS, Laoulakos DH, Spiliopoulou CA, Koutselinis AS. The arterial communication between the gastrocnemius muscle heads: a fresh cadaveric study and clinical implications. Plast Reconstr Surg 2000;105:94–8.

[9] Tsetsonis CH, Kaxira OS, Laoulakos DH, Spiliopoulou CA, Koutselinis AS. The venous communication between the gastrocnemius muscle heads. Plast Reconstr Surg 2000;105: 1357–60.

[10] Markhede G, Stener B. Function after removal of various hip and thigh muscles for extirpation of tumors. Acta Orthop Scand 1981;52:373–95.