

# Free fibula flap and posterior peroneal flap

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Mini Review

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## Background

One of the most significant advances in reconstructive surgery in recent decades has been the introduction of microsurgical techniques for tissue transfer. The anatomy and physiology of the fibula, as it relates to the use as a free flap, is unlike that of muscle or soft tissue; this holds for other bone free flaps such as the iliac crest, rib, and the medial femoral condyle. The vascularized fibula free flap is the most commonly used in head and neck surgery for bone reconstructions. It is a free composite flap that contains bone and muscle, with or without skin, and that allows a safe reconstruction in a single step with excellent functional and aesthetic results. The fibular free flap has been described in an extensive number of procedures, it's versatily can be used for head and neck reconstruction surgeries, making it the most commonly used bone or osteocutaneous microvascular flap. The fibular free flap presents an excellent therapeutic alternative in the resolution of bone gaps with extensive skin defect.

**Keywords:** Fibula free flap.

One of the most significant advances in reconstructive surgery in recent decades has been the introduction of microsurgical techniques for tissue transfer, allowing the therapeutic options to be expanded by performing more refined and safe procedures, both from a functional and aesthetic point of view, thus providing solutions to many complex reconstructive problems.<sup>1,2</sup> The structural characteristics of the fibula, such as strength, shape, length, and limited donor site morbidity, make it an excellent tool for the reconstruction of large extremity bone defects.<sup>3</sup> The fibula is an important resource for reconstructive purpose when used as a source of vascularized bone in musculoskeletal surgery with the best indications being the fibular transposition (“fibula-pro-tibia,” “Huntington procedure”), reverse-pedicled myosseous flaps, but most importantly, fibula free flaps. The fibula is considered a relatively “expendable” bone, as it transmits only approximately 17% of body weight.<sup>4</sup> Historically, microvascularized free flaps had to be used almost always for large defects in the distal third of the leg, ankle, and heel; However, at present, the perforator flaps of the leg have gained superiority, because they avoid morbidity of the main vessels, they act on the same limb without generating morbidity in another donor area, and technically it can be performed without training in microsurgery. This flap

is used to cover any soft tissue defect in the distal third of the leg and in the proximal third of the foot, as long as the defect is large enough to be covered by the maximum size of the flap and can be reached by the pedicle. Possible secondary skin defects include pressure ulcers, venous ulcers, soft tissue trauma, osteomyelitis, burns, scars, coverage of oncological resections. The anatomy and physiology of the fibula, as it relates to the use as a free flap, is unlike that of muscle or soft tissue; this holds for other bone free flaps such as the iliac crest, rib, and the medial femoral condyle. The nutrient vessel entering the bone is not necessarily the main source of blood supply when used as a free flap, as the nutrient vessel is excluded from the harvested flap. This is especially true with the free fibula flap, where the blood supply to the bone (outer cortex through to the medullary canal) is supplied via small vessels that traverse the periosteum, which in turn develop into fine vessels that perforate the cortex and traverse the cortex to the intramedullary space.<sup>5</sup> For microvascular tissue transfer to the lower leg, consideration of which recipient vessel to utilize is critical. With significant trauma, the vessels to the lower leg can be injured, leading to issues of vascular access for microsurgical tissue transfer. If the dorsalis pedis and posterior tibial pulse are palpable at the level of the ankle, we feel that vascular studies are probably unnecessary. On the contrary, if both pulses are not

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palpable, we think it is prudent to obtain vascular studies. Arteriography is usually the best type of study to obtain, computed tomography angiography and/or magnetic resonance angiography may be acceptable depending on the expertise and skill of the local radiologists.<sup>6</sup>

### Fibula free flap

The vascularized fibula free flap is the most commonly used in head and neck surgery for bone reconstructions. It is a free composite flap that contains bone and muscle, with or without skin, and that allows a safe reconstruction in a single step with excellent functional and aesthetic results. The fibula free flap is an excellent option for the reconstruction of bone defects of 6 cm or greater, in the upper and lower extremities, regardless of the cause of the injury. Likewise, adding a skin island based on septocutaneous perforating branches of the peroneal artery increases its versatility, helping to cover skin defects, with exposure of deep tissues or osteosynthesis material. In the case of major defects, skin coverage can be used by means of a secondary sequential flap; the most frequently used is the anterolateral thigh. The deep inferior epigastric artery flap is a good option to cover more extensive defects.<sup>3</sup> Clinically, the free fibula may be used in the reconstruction of musculoskeletal defects associated with osteomyelitis (of various causes), trauma, tumors, congenital or acquired defects, as well as arthrodesis procedures.<sup>5</sup> In the lower extremity, the free fibula is indicated when a critical size intercalary bone defect is present, that is otherwise unable to be reconstructed by conventional means. Critical size is defined in respect to the area of reconstruction.<sup>7</sup>

### Posterior peroneal flap

The posterior peroneal flap is a fasciocutaneous flap whose main arterial source is the peroneal artery perforating vessels and secondary sources by perforating vessels of the posterior tibial artery, and venous drainage from the venocutaneous perforators of the small saphenous vein and neurocutaneous perforators of the sural nerve. Its main indication is the coverage of the lower part of the leg, the heel, and the proximal third of the foot.<sup>8</sup>

There are many imaging techniques to determine the location of perforators in the lower leg, but angiography is the most useful as it provides morphologic data that allows for safe visualization of the perforator arteries, their location, and distribution. It is the sensory nerve of the lateral portion, posterior part of the leg and the lateral aspect of the foot, it is universally located in the adult from 1 to 1.5 cm behind and posteriorly to the lateral malleolus, in 67%

it is formed by the union of the medial sural cutaneous nerve and lateral sural cutaneous nerve, branches of the tibial nerve and common fibular nerve, respectively. When there is no union, in 33% it is the extension of the medial sural cutaneous nerve.<sup>9</sup>

### Discussion

Reconstruction of bony and soft tissue defects of the lower extremity has been revolutionized by the advent of microsurgical tissue transfer. There are numerous options for reconstruction. Possibilities include transfer of soft tissue, composite (bone and soft tissue) tissue, and functional muscle. Many lower extremity reconstructions require staged procedures. Planning is of paramount importance especially in regard to vascular access when multiple free flaps are required. Soft tissue reconstruction of the lower extremity may be accomplished with muscle flaps such as the rectus femoris and latissimus dorsi covered with a skin graft.<sup>6</sup> One of the biggest challenges for the reconstructive surgeon is the coverage of complex defects in extremities, with exposure of deep tissues and sometimes with the absence of them. Since the advent of the microvascular era, perforator vessel flaps have been the best option for complex reconstructions to date.<sup>3</sup> The success of this posterior fibular flap is related to the type of patient and their lesion. It is higher in young, healthy patients and in whom the origin of the defect is traumatic. The fibula free flap is the most common source of vascularized bone for the reconstruction of complex, critical size bone defects in the lower extremity. These locations include the femur, tibia, calcaneus, and foot columns and midfoot. The free fibula may also be used in arthrodesis procedures. The free fibula may carry a skin island for flap monitoring, and when well designed, the skin island may provide coverage of defects of the soft tissue envelope.<sup>5</sup>

In complex trauma, damage control surgery takes a priority; fracture stabilization, vascular and bleeding control along with necrotic tissue debridement being the most important steps.<sup>10,11</sup> The fibular free flap has been described in an extensive number of procedures, it's versatility can be used for head and neck reconstruction surgeries, making it the most commonly used bone or osteocutaneous microvascular flap.<sup>12</sup> The fibular free flap presents an excellent therapeutic alternative in the resolution of bone gaps with extensive skin defect. Development of advance microsurgery and reconstructive surgery techniques calls for a more extensive evaluation of complex traumas.<sup>13</sup>

## Conclusion

Recent reviews concerning long-term results of microsurgical reconstruction of the lower extremity show good long-term results and reasonable rates of limb salvage. It is necessary to investigate new therapeutic alternatives as well as strategies to favor the percentage of success in the fibular free flap and posterior peroneal flap.

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## Conflicts of interests

The authors declare no conflicts of interests.

## References

1. Ozalp T, Masquelet AC, Begue TC. Septocutaneous perforators of the peroneal artery relative to the fibula: Anatomical basis of the use of pedicled fasciocutaneous flap. *Surg Radiol Anat.* 2006;28:54-8.
2. Sepúlveda S, Carolis FV, Andrades CP, Benítez SS, Danilla ES, Eranzo CC, et al. Reconstrucción con colgajos libres: experiencia de 33 años. *Rev Chil Cir.* 2013;65:502-8.
3. Miguel de la Parra-Márquez, Oscar Zorola-Tellez, Silvia Cardenas-Rodríguez, Jesus María Rangel-Flores, Gerardo Sánchez-Terrones. Versatilidad del colgajo microvascular de peroné en reconstrucción de extremidades. *Cirugía y Cirujanos.* 2016;84(3):213-219.
4. Lambert KL. The weight-bearing function of the fibula. A strain gauge study. *J Bone Joint Surg Am* 1971;53(3):507-13
5. Christopher Bibbo. The Free Fibula Flap for Lower Extremity Reconstruction. *Clin Podiatr Med Surg.* 2021; (38): 117-130
6. William C. Pederson, Luke Grome. Microsurgical Reconstruction of the Lower Extremity. *Semin Plast Surg.* 2019; 33(1): 54-58.
7. Malizos KN, Zalavras CG, Soucacos PN, et al. Free vascularized fibular grafts for reconstruction of skeletal defects. *J Am Acad Orthop Surg* 2004;12(5):360-9.
8. Diana Cruz, Brayan Loza, Marcelo Mackfarlane, Joaquín Pefauré. Reconstruction with posterior peroneal flap to cover defects in the distal third of the leg and the proximal third of the foot. *RACP.* 2020;26(3):121-126.
9. Keith E. Follmar, B.A. Alessio Baccarani, Steffen P. Baumeister, L. Scott Levin, Detlev Erdmann. The Distally Based Sural Flap. *Plast Reconstr Surg.* 2007;119(6):138e-148e.
10. Tosti R, Eberlin KR. Damage control hand surgery: Evaluation and emergency management of the mangled hand. *Hand Clin.* 2018;34(1):17-26.
11. Prasarn ML, Helfet DL, Kloen P. Management of the mangled extremity. *Strateg Trauma Limb Reconstruct.* 2012 Aug 1;7(2):57-66.
12. Tantry TP, Kadam D, Shenoy SP, Bhandary S, Adappa KK. Perioperative evaluation and outcomes of major limb replantations with ischemia periods of more than 6 hours. *J Reconstruct Microsurg.* 2013 Mar;29(03):165-72.
13. Ruiz RB, Treviño AIV, Mendoza FFG, Aceves RAM, Hernández RR, Alba IV, et al. Thoracic limb salvage by fibular free flap. *Int J Res Med Sci* 2020;8:351-4.