OPEN ACCESS ATLAS OF OTOLARYNGOLOGY, HEAD & NECK OPERATIVE SURGERY

MEDIAL SURAL ARTERY PERFORATOR (MSAP) FLAP

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The medial sural artery perforator (MSAP) flap is designed over the medial head of the gastrocnemius muscle. It is based on the perforators of the ***medial sural artery (MSA)***, which is a branch of the popliteal artery. It was first described by Hallock and Cavadas (2001) and has gained popularity as a reconstructive option for small-to-medium sized defects of the head and neck. It is a good intermediate option between radial forearm and anterolateral thigh flaps.

Advantages

- Thin and pliable
- Long pedicle (10-15cm)
- Low donor site morbidity
- Favourable functional and cosmetic donor site defect
- Favourable for simultaneous ablative and harvest surgery
- Can easily incorporate a chimeric muscular component

Disadvantages

- Longer harvest time than radial forearm free flap
- Steeper learning curve
- Requires meticulous dissection of small perforators

Surgical Anatomy

The ***medial sural artery (MSA)*** is a branch of the ***popliteal artery***, itself a continuation of the femoral artery. The ***popliteal artery*** begins at the level of the ***adductor hiatus*** in the ***adductor magnus muscle*** *(Figure 1)*. It continues into the popliteal fossa, posterior to the knee joint *(Figure 2)*. It then passes obliquely through the popliteal fossa and travels between the ***gastrocnemius*** and the ***popliteal muscles*** in the posterior compartment of the leg *(Figures 2, 3)*.

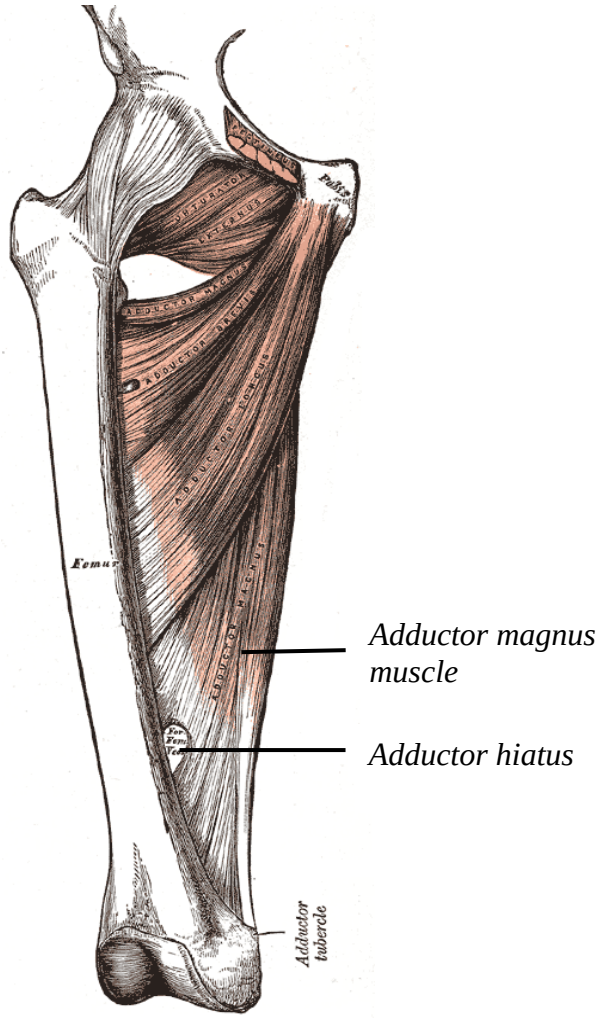

Figure 1: Adductor magnus muscle and adductor hiatus

It is at this point that the ***popliteal artery gives off its muscular branches*** to the gastrocnemius, soleus and plantaris muscles as the ***medial and lateral sural arteries*** *(Figure 2, 4)*. The popliteal artery terminates as the ***anterior and posterior tibial arteries*** at the inferior border of the popliteus muscle *(Figures 2,3)*.

The ***MSA*** runs longitudinally between the muscle fibers of the medial belly of the gastrocnemius before dividing into ***lateral and medial branches***, usually within the substance of the muscle *(Figure 4)*.

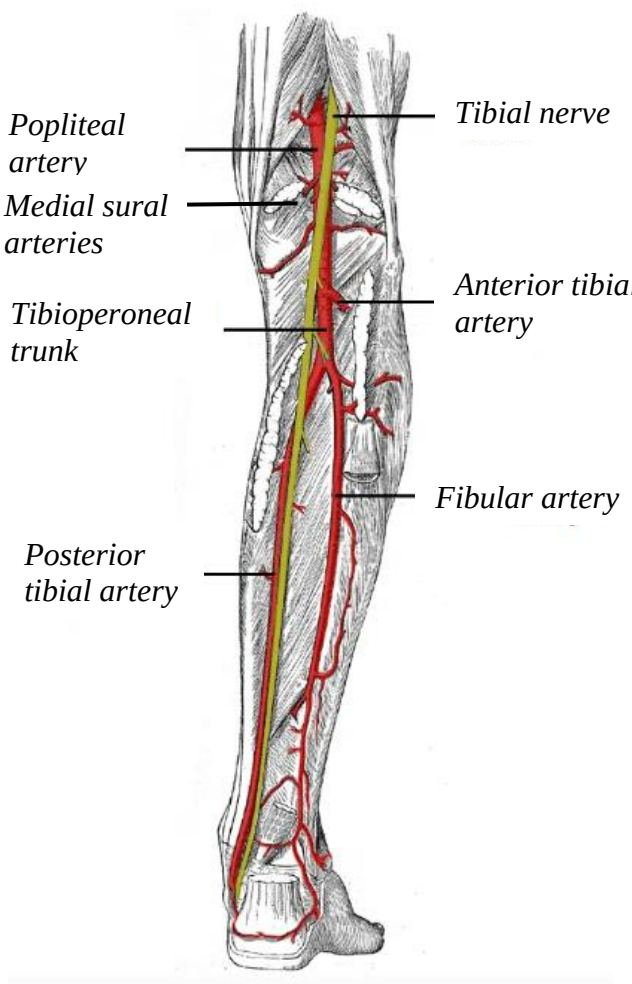

Figure 2: Popliteal artery emerges from adductor hiatus and crosses popliteal fossa and gives off the sural arteries between the gastrocnemius and popliteal muscles

After branching from the popliteal artery, the ***MSA*** courses 3-6cm before giving off ***perforators*** at intervals along the ***MSA*** or its branches to supply the skin overlying the medial calf. The perforators are frequently orientated along two vertical rows, one medial and one lateral. Most perforators arise in the proximal half of the medial gastrocnemius muscle bulk.

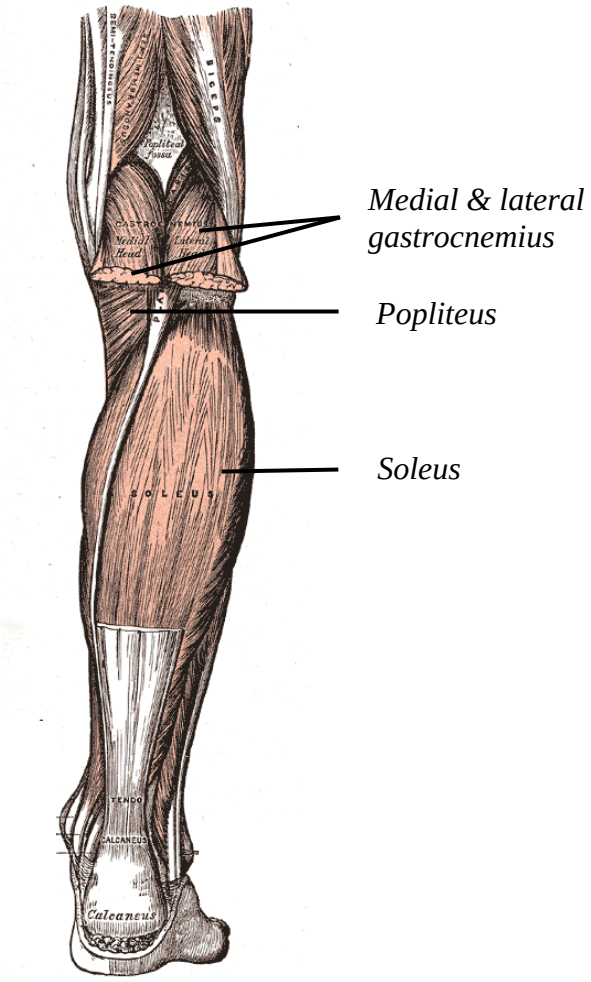

Figure 3: Gastrocnemius muscles (divided above) to expose soleus and popliteus

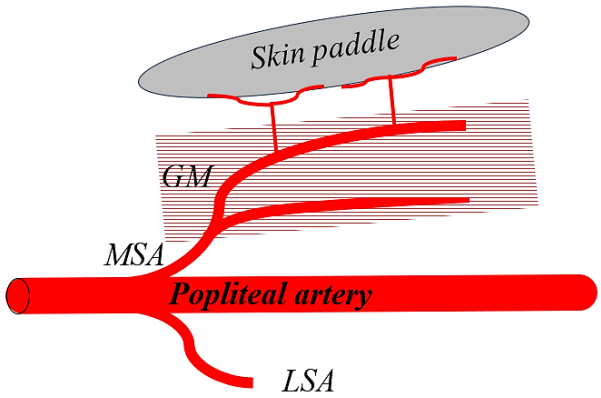

Figure 4: Schematic depiction of popliteal, and lateral sural arteries (LSA), with medial sural (MSA) and MSA perforator arteries to skin paddle traversing gastrocnemius muscle (GM)

Surgical Considerations

Choice of leg

- Take a careful history and note any previous lower limb fractures, risk factors or symptoms of peripheral vascular disease, varicose veins and prior varicose vein surery or deep venous thrombosis
- In the absence of any such risk factors, either limb may be used to harvest an MSAP flap
- CT-angiography can be helpful to assess the vascular anatomy and MSA variability/branching patterns of both legs, but is not essential

Tissue volume/quality

The colour and texture of the MSAP flap are comparable to the ALT and the radial forearm free flaps. An MSAP fasciocutaneous flap is generally thicker than a radial forearm but thinner than an ALT flap. A customisable volume of medial gastrocnemius muscle can be incorporated into the flap in a chimeric fashion.

Preoperative consent and counselling

The patient should be counselled about general complications of free flaps, particularly haematomas, seromas, poor cosmetic outcomes, flap failure, and scarring. Patients should also be counselled about the possibility of future procedures to help improve cosmetic and functional outcomes, such as flap debulking or flap revisions.

Patient Positioning & Setup

- A two-team approach to simultaenously harvest the flap and perform the ablation is possible with the MSAP flap *(Figure 5)*
- A tourniquet can be used if desired based on surgeon preference, although it is not required
- The donor leg is circumferentially prepped and draped
- The leg can be positioned in a frog-leg position or a cross-leg position *(Figure 6)*

Figure 5: The MSAP flap allows for simultaneous ablation and flap harvest with two teams

Figure 6: Positioning of leg in cross-legged fashion, with the leg prepped circumferentially

Skin paddle design

The skin paddle is designed around 1-2 dominant perforators (but more is possible). A maximum donor site diameter of about 7cms can usually be closed primarily. A flap length of up to 15cm can be achieved, although 10cm is the most commonly used.

- Draw a line from the medial malleolus to the midpoint of the popliteal fossa on the calf *(Figure 7)*

- Mark a point 10cm from the popliteal crease along this line, which is where most perforators are found *(Figure 7)*
- Identify and mark the perforators with the pencil doppler
- Ideally identify at least two perforators
- Design the skin paddle around these perforators

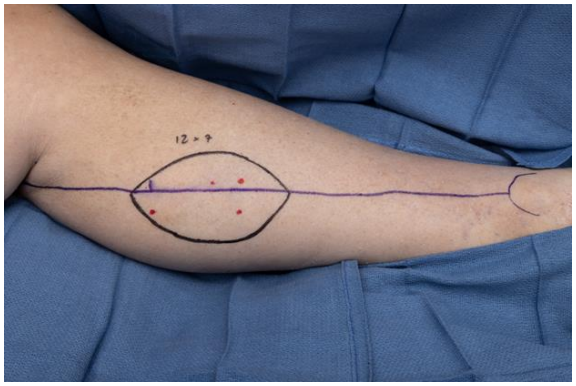

Figure 7: Line drawn from medial malleolus to midpoint of popliteal fossa. Perforators (red dots) identified 10cm from superior end of the line, with skin paddle designed around perforators

Surgical steps

Setup

- Position the patient as described above
- Identify the perforators with a doppler
- Design the skin paddle accordingly
- Placed a tourniquet around the mid-thigh (if being used)
- Circumferentially prep the leg
- Inflate the tourniquet to 300mmHg, +/- exsanguination (surgeon's preference)

Anterior dissection and identification of perforator(s)

- Start with the incision along the anterior edge of the skin paddle
- The great saphenous vein is frequently encountered, and is clipped, ligated, or dissected away from the flap *(Figure 8)*

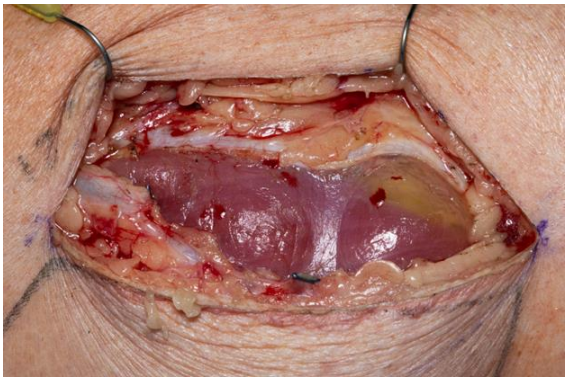

Figure 8: After the anterior cut is made, the great saphenous vein may be encountered. This can either be clipped, ligated, or dissected away from the flap. The incision is then carried through the deep fascia.

- Extend the incision through the deep fascia
- Dissect in a subfascial plane over the medial gastrocnemius with blunt dissection
- Note: a suprafascial dissection is also an option
- Identify the perforators, that are often small *(Figure 9)*

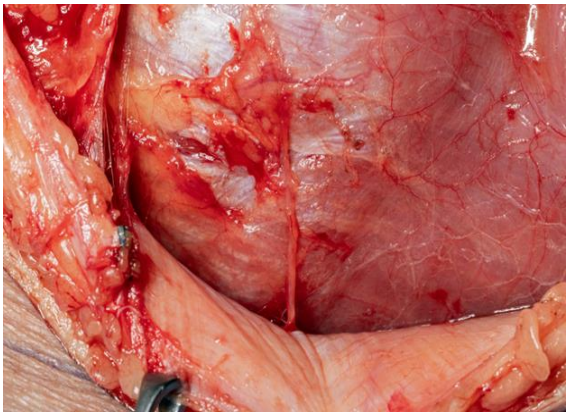

Figure 9: The perforators are identified after subfascial blunt dissection. They are frequently small

Perforator selection and dissection

- Once several perforators have been identified, select the largest perforator to base the flap on

- Divide the thick fascia that envelops the gastrocnemius to reveal the body of the muscle *(Figure 10)*

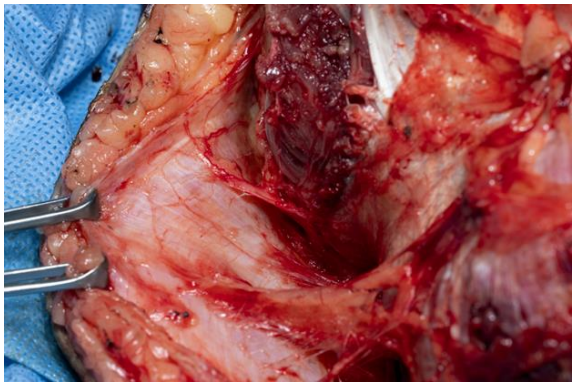

Figure 10: The fascia of the gastrocnemius muscle has been divided, revealing the muscle belly. The perforators can then be dissected through the muscle

- Carefully dissect the perforators proximally through the medial gastrocnemius muscle
- The perforators usually run 1-1.5cms below the muscle surface
- Dissect the perforators in a distal-to-proximal direction up to their origin from the medial sural artery branches
- The muscle fibres are very easily separated as their orientation is in line with the pedicle
- Ligate small intramuscular branches as they are encountered

Pedicle dissection

- Dissected the pedicle from the medial gastrocnemius muscle until sufficient length and caliber of vessels are obtained
- The pedicle can be traced all the way to the popliteal artery; the caliber of the artery is often significantly better closer to its origin from the popliteal artery *(Figure 11)*
- Ligate the distal end of the vascular pedicle *(Figure 12)*

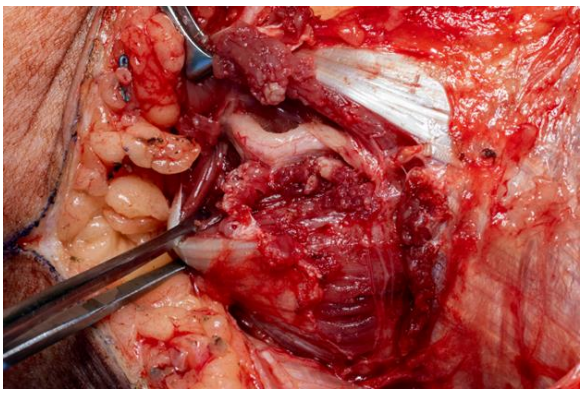

Figure 11: The perforators are dissected through the body of the gastrocnemius muscle. The caliber of the vessels improves towards the proximal end of the vascular pedicle

Figure 12: The distal pedicle is ligated. At this stage it is possible to harvest a cuff of muscle (if desired) under direct vision of the vascular pedicle

- Release the tourniquet to inspect for bleeding, and to properly inspect the pedicle while reperfused
- Check the perforator(s) again with a doppler applied to the skin

Incorporating a muscular component

- A muscular component may be incorporated for additional bulk
- This is best done after the pedicle has been dissected
- It is usually simplest to harvest a cuff of muscle centered around the distal vascular pedicle, as this can be done rapidly

under direct vision of the skin paddle perforators and vascular pedicle *(Figure 12)*

Posterior dissection and skin paddle/flap isolation

- The posterior skin cut of the skin paddle is now made and the flap is islanded
- The skin paddle can now be fully raised
- It can be helpful to excise the deep fascia from the internal aspect of the flap keeping the perforator in direct view
- With the flap fully islanded, again check the perfusion at the skin edges
- The proximal pedicle can be further extended with the flap fully islanded
- The vascular pedicle is prepared and fully isolated

Closure

- Ensure haemostasis
- Place a sealed suction drain
- A layered closure is performed
- The defect can usually be closed primarily
- Suprafascial undermining may assist with closure
- Skin graft the defect if required
- An elastic wrap bandage can be considered for patient comfort and for pressure to the wound

Postoperative care

- No mobility restrictions are required, and the patient is allowed to ambulate unless otherwise contraindicated
- The leg can be elevated for comfort/swelling
- An elastic wrap bandage can be applied as required

Other flaps described in *The Open Access Atlas of Otolaryngology Head & Neck Operative Surgery*

- *Pectoralis major flap*
- *Buccal fat pad flap*
- *Nasolabial flap*
- *Temporalis muscle flap*
- *Deltopectoral flap*
- *Paramedian forehead flap*
- *Upper and lower trapezius flaps*
- *Cervicofacial flaps*
- *Submental artery island flap*
- *Supraclavicular flap*
- *Latissimus dorsi flap*
- *Local flaps for facial reconstruction*
- *Radial free forearm flap*
- *Free fibula flap*
- *Rectus abdominis flap*
- *Anterolateral free thigh flap*
- *Thoracodorsal artery scapular tip (TDAST) flap*
- *Principles and technique of microvascular anastomosis for free tissue transfer flaps in head and neck reconstructive surgery*

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