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GRACILIS MICROVASCULAR FREE FLAP – SURGICAL TECHNIQUE

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The gracilis flap can be used either as a pedicled flap, or more commonly as a free flap in the head and neck. It may be harvested as a muscle-only flap or with skin. when used as an innervated flap with a functioning muscle it is the ***gold standard for dynamic facial reanimation.***

Advantages

- Easy dissection
- Good reliability
- Moderately thin skin
- Minimal donor site morbidity
- Option of compound flap with skin
- A two-team approach is possible
- Gold standard for dynamic facial reanimation

Disadvantages

- Narrow skin flap
- Moderate-to-short pedicle length
- Skin component can be precarious

Surgical Anatomy

Gracilis muscle

The gracilis muscle adducts, flexes and medially rotates the hip, and flexes the knee. It originates from the *symphysis pubis* and inserts distally into the medial surface of the proximal tibia *(Figure 1)*. Distally it passes between the sartorius muscle anteriorly and the semitendinosus muscle posteriorly *(Figure 1)*. The muscle is broad at its origin and tapers distally *(Figure 2)*, and has an average length of 30cm.

Vascular anatomy

The gracilis flap has a Type II vascular supply, with one dominant and several minor vascular pedicles that are anatomically relatively consistent. *(Figure 2)*. The flap is usually raised on the ***dominant vascular pedicle***, which is a ***branch of the medial femoral circumflex artery*** or may ***branch off the profunda femoris artery*** *(Figure 2)*. The vascular pedicle ranges from 6 - 8cm in length and is generally 2mm in diameter

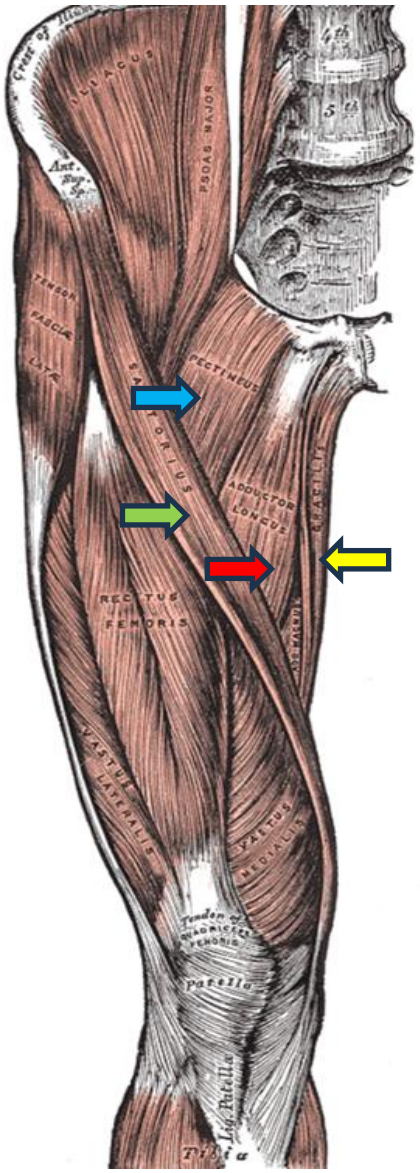


Figure 1: Gracilis muscle (yellow arrow) courses medial to adductor longus (red arrow), and sartorius muscle (green arrow) and crosses the knee. Pectineus muscle is indicated by the blue arrow

(1.5 - 3mm). The vascular pedicle usually enters gracilis 10cm inferior to the pubic tubercle. Several minor pedicles may arise from the superficial femoral artery and enter the muscle distal to the main pedicle.

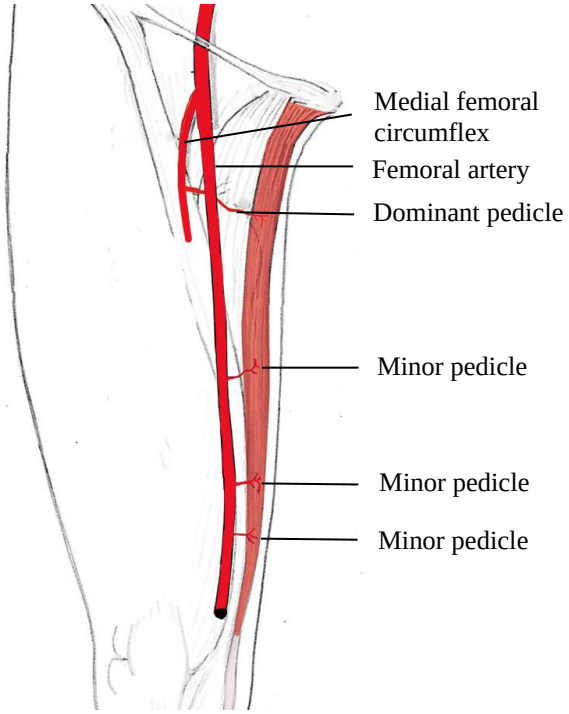


Figure 2: Arterial anatomy (Adapted)

Neurological anatomy

Gracilis is supplied by a single motor nerve, the ***anterior branch of the obturator nerve***, making it ideal for dynamic facial reanimation *(Figure 3)*. The nerve has a consistent anatomical course and is located near to the main vascular pedicle. The obturator nerve emerges at the obturator foramen and immediately divides into anterior and posterior branches under the pectineus muscle *(Figure 3)*. The anterior branch courses between the adductor longus *(Figure 3)* and brevis muscles before entering gracilis close to the dominant vascular pedicle. The nerve courses more obliquely than the vascular pedicle. It is generally 7-8cm in length; greater length can be achieved by dissecting it back all the way to the obturator foramen.

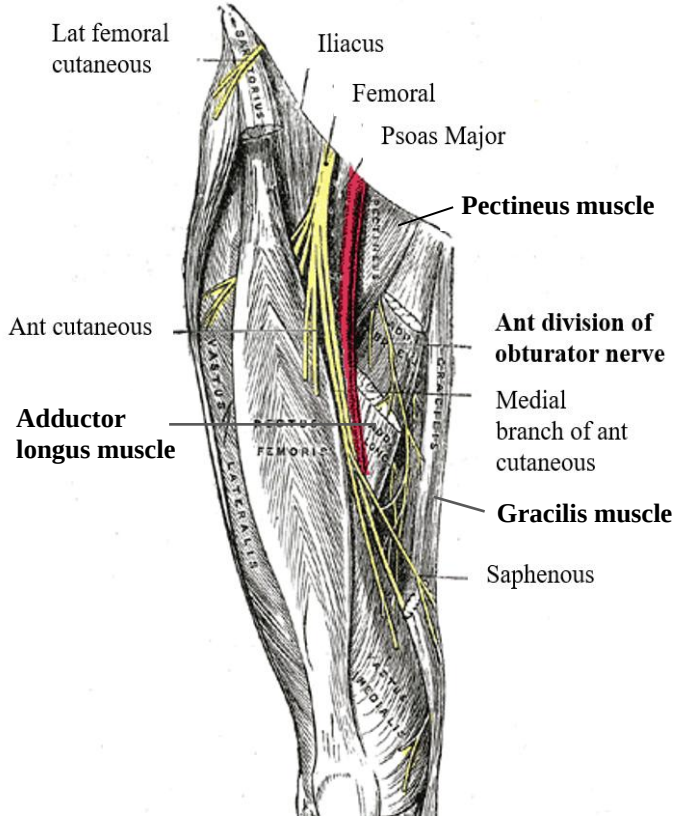


Figure 3: The gracilis is supplied by a branch from the anterior division of the obturator nerve

Surgical Considerations

Choice of leg

- Take a careful history and note any previous lower limb trauma, risk factors or symptoms of peripheral vascular disease, varicose veins, varicose vein procedures or deep venous thrombosis
- In the absence of any such risks, either limb may be used to harvest a flap

Tissue volume/quality

The colour and texture match of the skin is comparable to an anterolateral thigh (ALT) free flap. The gracilis flap has a large muscle component that can be useful to cover large soft tissue defects, although the shape of the muscle may not be as favorable as other free flaps for large wounds. The skin paddle may not be as reliable as other flaps

and the blood supply to its distal component can be tenuous. Including the fascia between the gracilis and the adductor longus muscle can improve perfusion to the skin.

Preoperative consent and counselling

The patient should be counseled about general complications related to free flaps e.g., hematomas, seromas, flap failure, poor cosmetic outcomes, and scarring. Patients should be counseled about the possibility of future procedures to improve cosmetic and functional results, such as debulking or revising the flap.

Patient Positioning & Setup

- A two-team approach to simultaneously perform an ablation and to harvest the flap is possible *(Figure 4)*

Figure 4: The gracilis flap allows for simultaneous ablation and flap harvest by two teams

- Position the patient supine with legs in a frog-legged position by abducting the hips and flexing the knees; a sandbag may be placed under the contralateral hip
- Alternatively, place the legs in stirrups for better exposure of the proximal, medial leg
- A tourniquet is not used
- Hair removal may be required
- Prep and drape the donor leg circumferentially

Flap design

- Draw a line from the pubic tubercle to the medial femoral condyle; this line roughly marks the orientation of the gracilis muscle *(Figure 5)*

Figure 5: A line is drawn from the pubic symphysis to the medial femoral condyle, and roughly marks the location of the gracilis muscle. A skin paddle can be designed over the proximal third of the flap

- For a muscle-only flap, the skin incision is placed 2-3cm posterior to this line
- The incision should be centered on the vascular pedicle, 10cm distal to the pubic tubercle
- The length of the incision depends on the amount of muscle required
- Extension of the incision into the groin crease should be avoided
- If a skin paddle is required, it is designed over the proximal third of the muscle for greatest reliability
- The skin paddle can be designed in a longitudinal or a transverse axis
- Dimensions of up to 35x19cm have been reported. Longitudinal skin paddles should be limited to 30cm in length and 8-10cm in width

Surgical steps

Setup

- Position the patient as described above
- Prep the entire lower limb and drape the leg from the inguinal crease distally
- Draw the skin markings from the pubic symphysis to the medial femoral condyle
- Palpate the gracilis muscle and mark it out on the skin
- Design the skin paddle accordingly

Muscle-only flap

- Start the skin incision proximally, and extend it down to gracilis muscle *(Figure 6)*

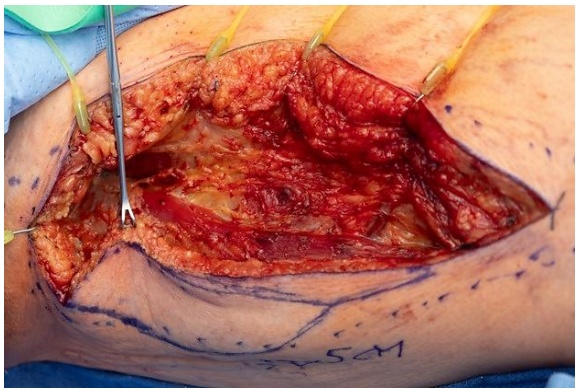


Figure 6: The anterior incision is made first, and the dissection is carried down to gracilis

- The gracilis can be identified as the most superficially located adductor, and lies posterior to the great saphenous vein
- The gracilis may be distinguished from the adductor longus (anterior) and adductor magnus (posterior) by flexing and extending the knee: gracilis is the only of these muscles to cross the knee joint
- With gracilis identified, carefully dissect around the muscle belly
- The dominant vascular pedicle is easily identified as it is the largest, lies most proximal and is associated with the motor nerve *(Figures 7, 8)*

Figure 7: The dominant pedicle is identified roughly 10cm from the pubic symphysis and enters the anterior surface of gracilis

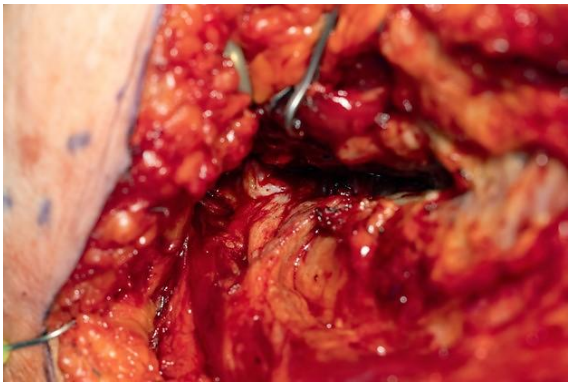


Figure 8: The nerve to gracilis is identified in close relation to the vascular pedicle and runs in a more oblique direction than the artery and vein

- If the flap is used for functional purposes e.g. dynamic facial reanimation, the motor nerve should be identified at this point *(Figure 8)*
- It can be helpful to identify and confirm the motor nerve early
- The adductor longus is retracted to enable dissection of the pedicle
- Dissection of the pedicle commences distal to proximal

- With the dominant pedicle identified, secondary pedicles that branch off the femoral artery may be divided
- Muscular branches of the vascular pedicle to the adductor longus are carefully divided *(Figure 2)*
- The pedicle can be followed up to the branching from the profunda femoris
- The motor nerve is then dissected proximally as far as is required
- The muscle is then divided proximally through the same incision used for the pedicle
- The muscle can be accessed and divided distally by elongating the skin incision or using a separate incision close to the knee

Functional gracilis flap for dynamic facial reanimation

- If a gracilis transfer is done for dynamic facial reanimation, a smaller segment of gracilis is harvested as the entire muscle is too large and results in a very bulky appearance *(Figures 9, 10)*
- Additional muscle bulk may be included e.g. following cancer ablation
- Firstly, measure the required length of muscle in the face
- Identify and isolate the vascular and nerve pedicles

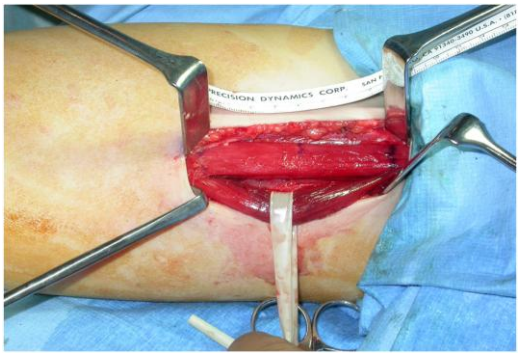


Figure 9: Small segment of gracilis harvested for facial reanimation (From Surgical reanimation techniques for facial palsy (paralysis)

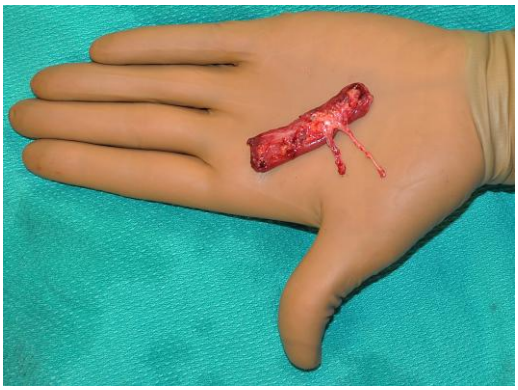
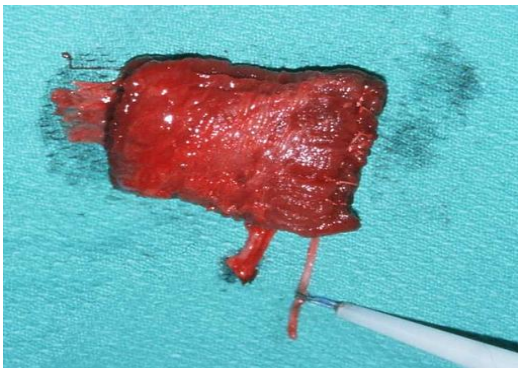


Figure 10: Small segment of gracilis with nerve and vascular pedicle for facial reanimation (From Surgical reanimation techniques for facial palsy (paralysis))

- Position the neurovascular pedicle in the center of the muscle segment, and add 1cm on either end *(Figure 11a)*



Figures 11a,b: Gracilis with nerve and vascular pedicle uncontracted (a); and contracted (b) (From Surgical reanimation techniques for facial palsy (paralysis))

- The posterior third of the muscle can be discarded to reduce muscle bulk, as the vascular pedicle enters the muscle from medially
- In the face, the muscle can be divided into separate strips and sutured with proline or Vicryl into the orbicularis oris near the modiolus, just lateral to the oral commissure to replicate the smile on the contralateral side; this can be carried all the way to the midline if required *(Figure 12)*
- Proximally it is sutured to the zygoma, orbital rim or deep temporalis fascia *(Figure 13)*
- One may need to resect buccal or subcutaneous fat to accommodate the bulk of the muscle and to achieve a normal facial contour
- Nerve coaptation is then done to either to the facial nerve, or to the nerve to masseter, or contralateral facial nerve for a cross-face graft *(Figures 13, 14)*
- It is imperative that nerve coaptation is tension free (exceeding 10% of the resting length of a peripheral nerve decreases blood flow to the nerve by 50%)
- Epineural approximation has comparable results to fascicular repair
- Sutureless nerve coaptation techniques can also be used

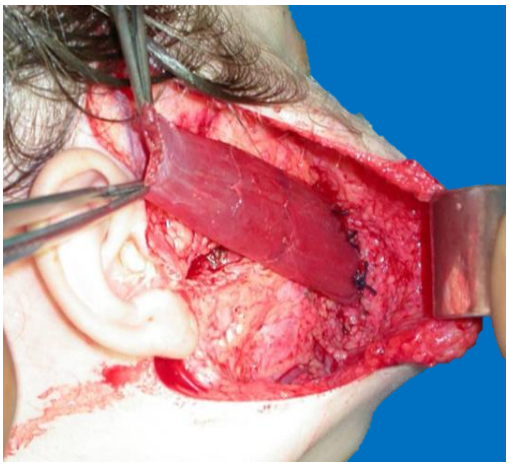


Figure 12: Inset into orbicularis oris (From Surgical reanimation techniques for facial palsy (paralysis))

Figure 12: Gracilis sutured to deep temporalis fascia (From Surgical reanimation techniques for facial palsy (paralysis))

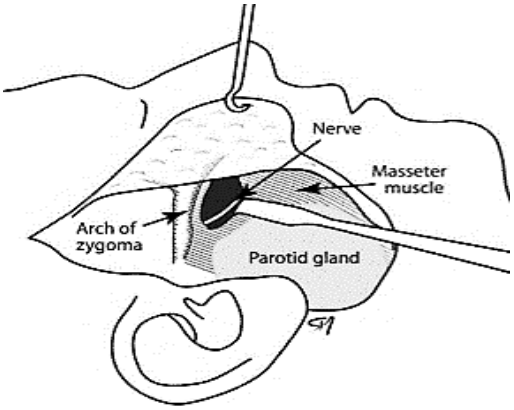


Figure 13: Nerve-to-masseter

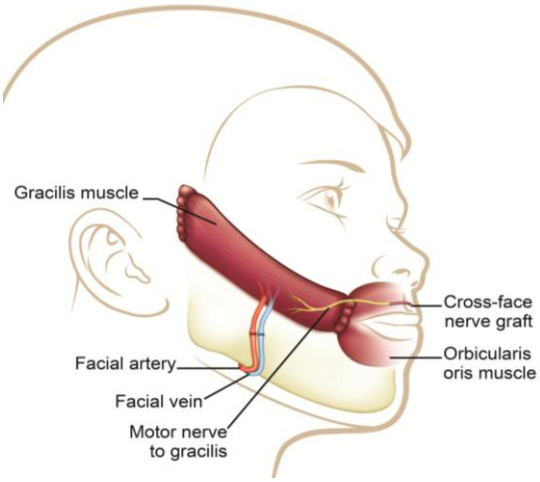


Figure 14: Gracilis flap with vascular anastomosis and CFNG (From Surgical reanimation techniques for facial palsy (paralysis))

Composite muscle and skin flap

- There are two main variations of skin paddle designs with the gracilis flap: ***longitudinal or transverse***
- ***Longitudinal*** skin paddles should be designed to be centered on the main vascular pedicle *(Figures 11a, 15)*
- Maximum dimensions of 30x10cm are described, and should include harvest of the surrounding fascia with the muscle to maximize its reliability
- The ***transverse flap*** is known as the ***transverse upper gracilis musculocutaneous flap (TUG)***
- The TUG flap is mostly used in breast reconstruction, but occasionally is used for head and neck reconstruction
- The TUG flap is orientated transversely over the proximal third of the gracilis (location of dominant perforator) and can extend from the femoral vessels anteriorly to the middle of the thigh posteriorly
- TUG skin paddles of up to 25x10cm have been used, with primary closure of the donor site being the limiting factor

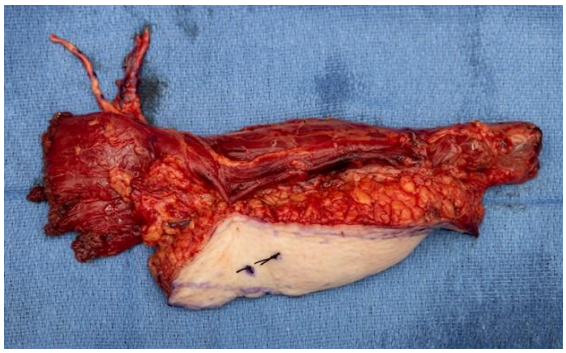


Figure 15: Musculocutaneous gracilis flap with a longitudinal skin paddle; the vascular pedicle and nerve are arising from the superomedial aspect of the muscle

Closure of donor site

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

Postoperative care

- Elevate the leg for comfort/swelling
- No mobility restrictions are required, and patients are allowed to ambulate unless otherwise contraindicated

Recommended reading in *Open Access Atlas:* Sainsbury DCG, Borschel GH, Zuker RM. Surgical reanimation techniques for facial palsy (paralysis)

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

- *Pectoralis major flap*
- *Cervicofacial flaps*
- *Deltopectoral flap*
- *Buccal fat pad flap*
- *Buccinator myomucosal flap*
- *Nasolabial flap*
- *Temporalis muscle flap*
- *Submental Artery Island flap*
- *Supraclavicular flap*
- *Upper and lower trapezius flaps*
- *Latissimus dorsi flap*
- *Paramedian forehead flap*
- *Local flaps for facial reconstruction*
- *Radial free forearm flap*
- *Anterolateral thigh (ALT) free flap*
- *Rectus abdominis flap*
- *Free fibula flap*
- *Thoracodorsal artery scapular tip (TDAST) flap*
- *Medial sural artery perforator (MSAP) flap*
- *Gracilis microvascular flap*
- *Principles and technique of microvascular anastomosis for free*

tissue transfer flaps in head and neck reconstructive surgery

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