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HOW I DO IT - NEUROSURGICAL TECHNIQUES

How I do it. The pedicled temporoparietal fascia flap for skull base reconstruction after endonasal endoscopic approaches

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Abstract

Background Endoscopic endonasal approaches (EEA) are an alternative for removing challenging nasopharyngeal or skull base lesions. In some cases, a nasoseptal flap (NSF) is not always available and such complex procedures may lead to carotid arteries exposition and/or dura mater (DM) wide opening. Meticulous carotid coverage and DM reconstruction are crucial for preventing early and delayed complications.

Method We propose a step-by-step description of the pedicled temporoparietal fascia flap (TPFF) technique, with a focus on its pitfalls, advantages and limits.

Conclusion The TPFF is a reliable flap for skull base reconstruction when other pedicled flaps are not available.

Key points

1. Reliable flap even for irradiated patients
2. CT angiography with 3D reconstruction as pre-operative imaging

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3. Doppler ultrasound probe to draw the artery's trajectory on skin
4. TPFF elevation concomitantly to the endoscopic procedure
5. Hemicoronal incision sufficient to harvest the TPFF
6. Superficial dissection in a plane just beneath the hair follicles
7. Dissection plane deep to the fad pad to preserve the frontal branch of the facial nerve
8. Surgical corridor wide enough to avoid any compression of the pedicle
9. Double visualization to avoid any twist and Doppler control of the STA patency
10. Close follow-up, toilet in clinics

Relevant surgical anatomy

TPFF transposition was first reported in 2007 for repair of endoscopic expanded endonasal approaches (EEA) [1]. The TPFF is formed, from superficial to deep, by the subcutaneous tissue, the temporoparietal fascia (TPF) and the loose areolar tissue that separates the TPF ("superficial temporal fascia") and the temporalis muscle fascia ("deep temporal fascia"). The latter is formed by the fusion of a deep and a superficial layer (separated by a fat pad) approximately 2 cm above the zygomatic arch.
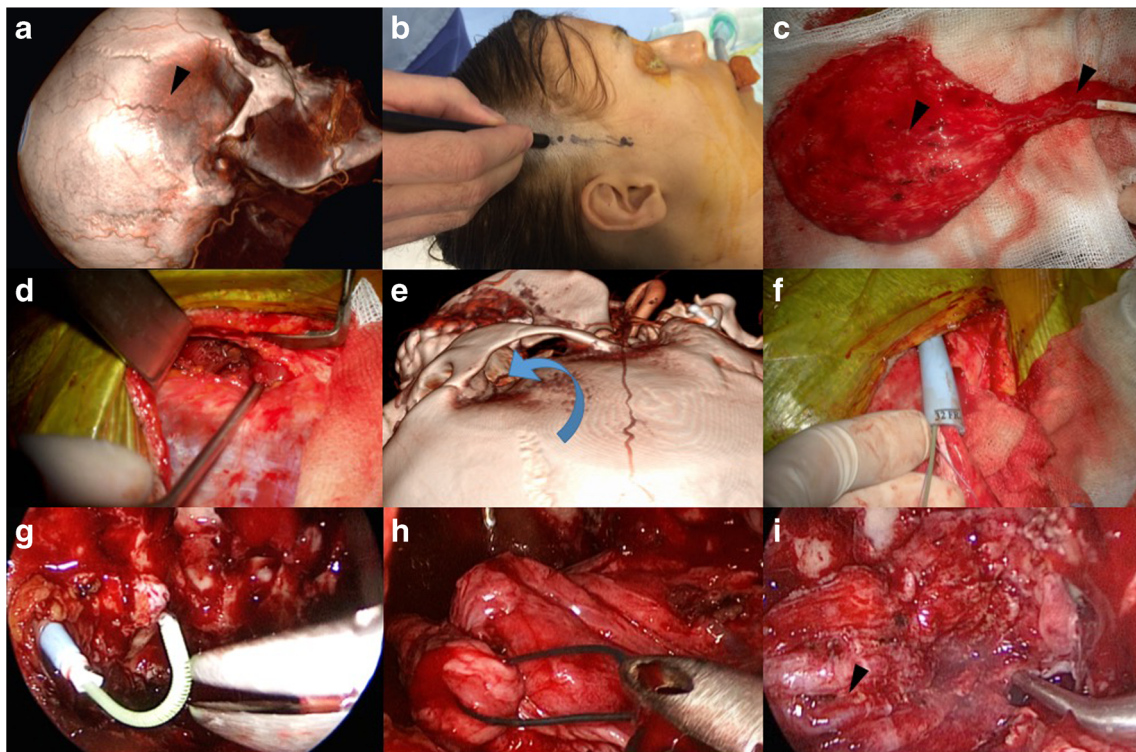
The TPFF is vascularized by the main branch, anterior (frontal) or posterior (parietal) of the superficial temporal artery (STA), which divides usually just above the zygomatic arch (Fig. 1a). The frontal branch of the facial nerve

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Fig. 1 Illustration of the different steps of the procedure. Superficial temporal artery (STA, *black arrowheads*). **a** STA demonstrated on the preoperative angio-CT; **b** Doppler localization of the STA; **c** temporoparietal flap harvested; **d** temporal muscle incision; **e** usually runs at the same depth than the superficial temporal artery [2, 3].

tunnelization trajectory shown on a 3D angio-CT reconstruction; **f** tunnelization with a "blue rhino"; **g** Blue rhino tip and guide crossing the PPF seen from inside the nose; **h** Gentle pulling the TPF flap with a forceps; **i** TPF flap covering the operating field

Description of the technique

Side of the fascia temporalis

The "donor" side of the fascia temporalis depends on two main criteria: (1) the quality of the feeding STA (size and length), (2) the side of the transpterygoid approach.

Positioning

The patient is placed in supine position. Shaving of the scalp along the skin incision is performed after the main trunk of the STA has been spotted by Doppler (Fig. 1b). The surgical team performing the endoscopic resection usually stands on the right side of the patient's head. When possible, the head is positioned in a horseshoes headrest so that it may be rotated freely according to the side of the fascia temporalis and the side of the transpterygoid approach. To harvest the flap, the surgeon must be seated on the side of the scalp incision:

both surgical teams can therefore work at the same time only if the flap is harvested on the left side.

Skin incision

Two main incisions are used:

1) A linear incision if the posterior branch of the STA is the main feeder of the flap: the incision is following the artery until or beyond the midline in the parietal region.
2) An arciform frontotemporal incision if the anterior branch is the main feeder.

A minimum length of 15 cm is mandatory to achieve most reconstructions. Some defects of the craniocervical junction may need longer flaps: in this case the midline can be crossed to obtain a taller flap. The scalp is infiltrated using Xylocaine only to avoid any spasm.

Flap harvesting

The initial incision is made using a Colorado microneedle (Stryker, Inc.). The superficial dissection must be initiated in a subcutaneous plane over the STA trunk then laterally

immediately below the hair follicles to avoid long-term alopecia. According to the main branch, two different situations are encountered:

1) Parietal branch is dominant: the dissection is made over the midpoint of the STA branch, which is then followed distally and proximally. Then the fascia is dissected subcutaneously from the STA to the front and then to the back along the incision.
2) Frontal branch is dominant: the skin incision is semicircular and the dissection starts from the common trunk of the STA. Fascia and anterior STA are then dissected from underneath the scalp.

The distal width of the flap is adapted to the size of the defect taking account that the flap will shrink in the acute and healing stage, whereas the proximal part of the flap that will go through the temporalis muscle, infratemporal fossa (ITF) and pterygopalatine fossa (PPF) needs to be narrow to prevent any external compression of the STA.

When the whole surface of the flap (along with its pedicle) is exposed, it can be incised at its distal part, starting from the subcutaneous layer to the periosteum (distally) and the deep temporal fascia (proximally), which are preserved. At this point, the flap is pedicled on its proximal part, centered on the STA just above the zygomatic arch (Fig. 1c). The flap is kept in a warm compress with papaverine to prevent any spasm.

Preparation of the corridor

The corridor starts under the zygomatic arch, and passes through the temporal muscle, the ITF, the PPF, and finally the bone window in the posterior wall of the maxillary sinus. To create a wide opening and avoid any compression of the pedicle, the temporal fascia should be incised widely (Fig. 1d). Then, the tunnel in the ITF is created using a percutaneous tracheostomy kit (Fig. 1e, f), the advantage being to use dilators to progressively enhance the size of the corridor, especially in its depth portion [1].

Tunnelization and placement of the flap

We attach one suture at the distal part of the TPFF and then place the distal part of the flap in a shortened tracheostomy dilatator to guide its passage through the corridor in the ITF (Fig. 1g). Both tube and flap are gently pulled through the tunnel. Attention is given to avoid any traction or torsion of the pedicle (Fig. 1h). Once in the nasal cavity, the TPFF is positioned to cover the defect (Fig. 1i). Patency of the STA is controlled in the nasal cavity using Doppler. Fibrin glue and Surgicel are used for nasal packing.

Indications

The TPFF is useful for the reconstruction of large defects following EEA with dura-mater opening or uncovered ICA [4], when local pedicled flaps (as nasoseptal flap [5] or inferior turbinate flap [6]) are no longer available, either because their pedicle has been sacrificed for oncologic reasons or during previous surgeries, or because the vascularization of the nasal mucosa has been altered by radiotherapy.

Limitations

There are few contraindications to the TPFF: arteritis, temporal muscle malformation or hypotrophy, major temporal traumatism, or previous surgery with STA sacrifice.

How to avoid complications

There are various anatomic variations in the fascial depth of the facial nerve. However, it is always superficial to the fad pad that separates the deep and superficial layers of the deep temporal fascia after its division: an efficient way to avoid any incident is therefore to remain deep to this fat pad during the dissection.

Specific perioperative considerations

Preoperative assessment of the STAs and their branches with an angio-CT proved to be very efficient for choosing the side and the feeder of the TPFF: anterior versus posterior branch of the STA.

For postoperative care, we recommend generous humidification of the nasopharynx. Otherwise, the flap may dry and lead to necrosis. Close endoscopic follow-up (at least every 2 weeks) is mandatory to check the vitality of the flap until complete reepithelialization.

Specific information to give to the patient

Risks of alopecia, wound-healing problems, and injury of the frontal branch of the facial nerve should be explained.

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