Preservation of the frontotemporal branch of the facial nerve using the interfascial temporalis flap for pterional craniotomy

Technical article

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The pterional craniotomy as described previously by the first author requires creation of a special flap over the temporalis muscle for increased visibility. Topographical variations of the course taken by the frontal branches of the facial nerve were studied and are described in this report.

Key Words • operative technique • facial nerve • pterional craniotomy

MICRONEUROSURGICAL procedures for intracranial aneurysms can be facilitated greatly by securing extra millimeters of surface exposure. Awkward angles created by limited exposure often cause undue problems in performing adequate aneurysm dissection and clip application. Maximum surface exposure and minimum brain retraction are the keys to successful surgery via the pterional approach. A technique involving an interfascial temporalis muscle flap for pterional craniotomies has been developed and used at the University of Zurich to maximally retract the temporalis muscle and increase visibility along the sphenoid ridge. The interfascial approach and removal of part of the orbital roof and sphenoid wing greatly increase the exposed area at the base of the surgical pyramid. These procedures have been described previously.6

Recently, a question was raised regarding injury to the frontotemporal branch of the facial nerve resulting from use of the interfascial temporalis muscle flap as described.1 Specifically, it was noticed at another institution that many of their patients had suffered frontalis nerve paralysis after undergoing surgery involving the technique described. We have since undertaken detailed studies of the course of the frontotemporal nerve and of the interfascial approach to help clarify this question. A description of the anatomy of the motor nerve and the use of interfascial temporalis muscle flap for pterional craniotomy are presented below.

Anatomical Description

The topographical location of the frontotemporal branch of the facial nerve overlying the temporal muscle is described in most anatomy texts. However, the various fascial planes in this region and the course of the individual nerve fibers in these planes are sometimes confusing. The thin fascial laminations and delicate nerve fibers are difficult to dissect and are of minor significance to anatomists, but they are of importance for surgeons operating in this area.

The anatomy of the soft tissues in the temporal region is more complex than that of the remainder of the scalp due to the temporal muscle, the various temporal fascia layers, and the zygomatic arch. The epidermis and the underlying connective tissue are very thin in this region. Immediately subjacent to the subcutaneous tissue is a multiple-laminated connective tissue layer, the temporal fascia. The temporal fascia is present from the origin of the temporal muscle along the superior temporal lines (where it is continuous with the galea) to the zygomatic arch.2-5

As the facial nerve emerges from the stylomastoid foramen, it lies within the fatty tissue approximately 1 to 2 cm deep to the middle of the anterior border of the mastoid process. It then courses anterolaterally over the ramus of the mandible into the substance of the parotid gland, where it divides into five main branches: cervical (platysma musculus), marginal mandibular...
(obicularis oris, risorius, and depressor anguli oris musculi), buccal (zygomaticus major, zygomaticus minor, levator labi superioris, levator labi inferioris, levator anguli oris, and alae nasi musculi), zygomatic (obicularis oris musculus) and frontotemporal (Fig. 1). The frontotemporal branch of the facial nerve is the branch that can be injured during craniotomy. The three twigs of the frontotemporal nerve exit the parotid gland to run in the subcutaneous tissue. The posterior branch has a very short course, innervating the anterior and superior auricular and tragus muscles. The middle and anterior branches continue their courses in a superficial manner over the zygomatic arch, within the subcutaneous tissue approximately 1 cm anterior to the superficial temporal artery. The middle branch courses anteroccephalad to innervate the ipsilateral frontalis muscle, and the anterior branch continues more directly anteriorly 1 to 2 cm above the zygoma to innervate the obicularis oculi and corrugator muscles. Either or both of these branches could be inadvertently divided during dissection for craniotomy with resulting postoperative deficits.

Operative Technique

The standard pterional approach for aneurysm surgery has been well described. Over the years, various methods have been used to incise and retract the temporalis muscle. Ideally, an attempt should be made to maximally retract the temporalis muscle from the temporal fossa without injuring the frontotemporal nerve. Subgaleal dissection of the skin flap with separate reflection of the temporalis muscle affords good exposure, but results in a 30% incidence of ipsilateral frontalis nerve paralysis. A combined skin and muscle flap virtually eliminates nerve injury, but at the expense of exposure. The bulky temporal muscle often blocks visualization along the sphenoid ridge. This creates awkward angles, and more retraction on the brain is required to dissect and clip the aneurysms. With the interfascial approach, a dissection plane through the laminae of the temporal fascia is utilized which protects the frontalis nerve, allows maximum retraction of the temporalis muscle from the temporal fossa, and increases exposure so that only minimal mechanical retraction on the brain is required.

The incision is the same as has been described previously. It begins approximately 1 cm superior and anterior to the auricle, behind the hairline and extends directly superior in a direction perpendicular to the zygomatic arch (Fig. 2A). Care is exercised during this initial part of the incision not to extend the incision too deeply and risk injury to the superficially and anteriorly placed superficial temporal artery and frontotemporal nerve. The incision continues superiorly to the temporal crest, then curves sharply anteriorly, ending just past the hairline and just short of the midline. The galea is then separated from the pericranium and the temporal fascia is exposed to within approximately 4 cm of the orbital rim, until the remaining fascial attachment constitutes a plane overlying the anterior one-fourth of the temporalis muscle. The scalp flap is reflected anteriorly toward the orbit. At this level the anterior part of the temporal fascia divides into two layers between which is consistently found a sickle-shaped layer of fat 5 to 6 mm thick.

As previously mentioned, the superficial and deep layers of the fascia attach to the lateral and medial borders of the zygomatic arch, respectively. The fat layer is dissected apart carefully with a scalpel and reflected with the superficial layer anterolaterally over the skin flap (Fig. 2B). The frontotemporal nerve is thus protected since it courses superficially along this fascial layer. When completed, this dissection reveals a sickle-shaped anterior quarter of the temporalis muscle, which is still covered by its fascia. This temporal fascia is then incised along its insertion to the medial surface of the zygoma and frontal zygomatic process (Fig. 2C). The incision is carried anterosuperiorly along the superior temporal lines releasing the temporal fascia, temporal aponeurotica, temporal muscle, and periosteum from the area of the origin of the temporalis muscle. A short anteriorly directed slit of frontal pericranium is re-
Facial nerve preservation in the pterional craniotomy

FIG. 2. Artist's drawings illustrating the operative procedure. A: Location of the incision for pterional craniotomy (broken line). B: Dissection of the fat layer (arrows) behind the zygomatic arch. C: The location and direction of the periosteum and temporalis fascia incision are indicated by broken lines and arrows. D: The incised pericranium is stripped away. E: The temporalis muscle is dissected out of the temporal fossa and reflected laterally.
reflected as a triangular flap toward the orbit. The incised peri- cranium above the superior temporal line is stripped away toward the line of the skin incision (Fig. 2D). Using a curved periosteal elevator, the temporal muscle and its adherent fascia and periosteum are dissected out of the temporal fossa to a point parallel to the zygomatic arch near the floor of the middle fossa. The temporalis muscle is then reflected and rotated inferoposteriorly along the plane of its remaining tendinous attachment (Fig. 2E). This exposes most of the temporal fossa revealing the pterion and a large portion of the squa- mous temporal, sphenoid, and zygomatic bones and, following craniotomy, allows excellent visualization along the sphenoid ridge into the middle fossa. The craniotomy is then performed as has been previously described.

Comment

This procedure was performed on a cadaver specimen; the facial nerve was then dissected from the parotid gland to demonstrate that it is not injured during the interfascial dissection (Fig. 3). This approach has been used routinely by one of us (M.G.Y.) for the past 20 years for basal aneurysms and tumors, selective amygdalohippocampectomy, and various other procedures. The exposure obtained by this approach is far superior to that achieved by previously used techniques, and the incidence of postoperative frontalis nerve paralysis at this institution has been negligible.

References


Manuscript received December 15, 1986.
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