Supraorbital craniotomy by fracture of the anterior orbital roof

Technical note

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The authors describe a new and rapid method to safely perform a supraorbital craniotomy. This technique can be used when tumor does not invade the orbital roof. Previous descriptions of the supraorbital craniotomy involved exposure of the frontal sinus by removing its anterior wall and using the Gigli saw to separate the orbital roof. This new approach avoids removal of the anterior frontal sinus wall and separates the supraorbital bone flap from the calvaria by fracturing the anterior orbital roof forward. In addition, a method for harvesting a laterally based pericranium and muscle pedicle that contains a section of contralateral temporalis muscle is described. This vascularized pedicle can be used for repair of cerebrospinal fluid leaks or bone defects along the anterior fossa floor and orbit.

KEY WORDS • supraorbital craniotomy • orbit • frontal sinus • anterior fossa • pericranium • operative technique

SUPORBITAL craniotomy provides wide surgical access to the anterior fossa floor and orbit with minimal brain retraction. Although surgeons can make a glabellar burr hole to perform this craniotomy, the supraorbital approach described by Jane, et al., eliminates the necessity for this midline forehead burr hole by removing the anterior wall of the frontal sinus as a single plate (Fig. 1). A burr hole is then made through the posterior wall of the frontal sinus and also at the keyhole. The supraorbital rim and the anterior orbital roof are resected together as part of a frontal bone flap using a Gigli saw. This approach is ideal when the site of interest involves the orbit, anterior fossa, or suprasellar region. Supraorbital craniotomy is also routinely used by many neurosurgeons for access to anterior communicating artery aneurysms.

Supraorbital craniotomy can usually be performed without using the Gigli saw or removing the anterior wall of the frontal sinus. This craniotomy is carried out using a keyhole burr hole, craniotome, and osteotome. The frontal bone flap that incorporates the supraorbital rim is separated from the calvaria by carefully fracturing the thin anterior orbital roof away from the anterior fossa floor. This modified method of exposure is recommended only when the orbital roof is free of tumor.

The purpose of this paper is to describe this safe and more rapid method of performing a supraorbital craniotomy. In addition, we describe a new method of harvesting a vascularized pericranium and muscle pedicle for repair of defects within the frontal sinus, anterior fossa floor, and orbit.

Surgical Technique

After induction of general anesthesia, surgical positioning requires the patient's neck be extended with the head above the heart level. The head is turned 0° to 15° toward the side opposite to the site of craniotomy and is secured in position. A bicoronal incision is then made beginning less than 1 cm anterior to the tragus at the level of the zygoma. The skin flap is dissected in the subgaleal plane with the pericranium and temporalis muscles remaining on the underlying frontal bones. This skin flap is reflected anteriorly exposing the ipsilateral supraorbital rim.

On dissection of the pericranium located above the orbital rim, the supraorbital foramen with its nerve and artery is usually encountered. Preservation of this nerve and artery can easily be accomplished (Fig. 2). Frequently, the foramen is incomplete anteriorly and the
FIG. 1. Illustrations showing the procedure for a supraorbital craniotomy. After a keyhole burr hole and an additional hole through the frontal sinus are made, an osteotome or craniotome is used to cut the zygoma near the frontozygomatic suture (A). The Gigli saw passer is introduced between the burr holes (B), and the anterior orbital roof is cut with the Gigli saw (C). The craniotome is then used to complete the frontal craniotomy (D and E). (Reproduced from Jane JA: Frontal approach to orbital and parasellar structures, in Wilson CB (ed): Neurosurgical Procedures: Personal Approaches to Classic Operations. Baltimore: Williams & Wilkins. 1992, p 13, with permission.)

FIG. 2. Illustration showing the method of preserving the nerve and artery by breaking the surrounding anterior bone with a small osteotome if a supraorbital foramen is encountered during dissection of the pericranium located above the orbital rim.

nerve and artery are dissected freely with pericranium. However, if the supraorbital foramen is complete, then the nerve and artery can be dissected free by breaking the surrounding anterior bone with a small osteotome (Fig. 2). The supraorbital nerve and artery can then be reflected anteriorly with the pericranium.

Harvesting a pericranial flap at the time of scalp-flap development is often easier than at closure. A pericranial flap should be made when obliteration of the frontal sinus or repair of bone and dural defects along the floor of the anterior fossa is anticipated. A large laterally based vascularized pericranial graft that distally incorporates a piece of contralateral temporalis muscle can be harvested prior to the supraorbital craniotomy (Fig. 3). The pericranium is cut along the bicoronal skin incision and anteriorly 1 to 2 cm superior to the supraorbital rims. The pericranium along with temporalis muscle is also incised below the contralateral superior temporal line. This pericranial and contralateral temporalis muscle pedicle is then carefully dissected away from the calvaria using a periosteal dissector. In
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addition, the ipsilateral temporalis muscle attachment to the frontal bone is separated by the periosteal dissector down to the level of the sphenoid wing. The remaining pericranium left on the superior orbital rims can later be used to secure the laterally based pericranium and muscle flap, and to obliterate an opened frontal sinus. Until time of closure, the harvested pericranium and muscle flap are kept moist and protected by wrapping the pedicle in a saline-soaked sponge.

The ipsilateral supraorbital rim and frontozygomatic process are exposed by carefully elevating the remaining pericranium. It is important to emphasize that the pericranium along the supraorbital rim is contiguous with the periorbita. With meticulous dissection, the supraorbital rim and orbital roof can be exposed by leaving both the pericranium and periorbita intact. If the periorbita is violated, fat will rapidly interfere with the exposure of the orbital rim. Bipolar coagulation of the cumbersome periorbital fat can minimize this problem.

Prior to performing the supraorbital craniotomy, a burr hole is placed at the keyhole (Fig. 4). If a large supraorbital craniotomy is contemplated, then an additional burr hole may be placed in the posterior frontal region behind the hairline. The frontozygomatic process is then cut using the craniotome. The craniotome is also used to cut a frontal bone flap that originates from the keyhole burr hole, extends posteriorly along the roof of the sphenoid bone, and ends at the medial edge of the supraorbital rim. Although the lateral frontal sinus is frequently opened with the craniotome, it can easily be obliterated at the time of closure with the previously harvested pericranial graft.

With the periorbita and orbital contents protected by a brain spatula, the cut along the medial orbital rim is extended to the thin anterior orbital roof using a craniotome or side-cutting bit (Fig. 5). The lateral anterior orbital roof is fractured through the keyhole using a mallet and osteotome. This supraorbital bone flap containing the frontal bone, frontozygomatic process, supraorbital rim, and anterior orbital roof is then carefully fractured forward and removed from the surgical field. Following surgical resection of a tumor or successful clipping of an anterior communicating artery aneurysm, the supraorbital bone flap can rapidly be secured back into position with suture or tantalum plates for an aesthetically pleasing result (Fig. 6).

Discussion

Supraorbital craniotomy is a simple and effective method to approach the anterior fossa and orbit without applying extensive frontal lobe retraction. This craniotomy can be safely freed from the calvaria by dissecting the periorbita away from the superior orbit and fracturing forward the thin orbital roof. The use of the
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prevents the surgeon from injuring the contents of the optic foramen and superior orbital fissure when performing the supraorbital craniotomy because it is difficult to fracture and can be as thick as 3 mm. Since the anterior roof is thin and fragile, the orbital fracture is most easily made anterior to this thick lesser sphenoid wing.

Anterior fossa defects and dural tears can be repaired with a vascularized pedicle of pericranium. Harvesting the pericranium prior to craniotomy is easier than at closure. If a large graft is required with a thick distal pedicle, then a laterally based pericranium and temporalis muscle flap is ideal. In procedures that require orbital exenteration, the pericranium and temporalis muscle flap can also be used to fill the orbit for a more aesthetically pleasing result.

References

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Fig. 6. Illustration showing the supraorbital craniotomy secured in position with suture or tantalum plates for an aesthetically pleasing result. If the frontal sinus is violated, a pericranial flap can be used to separate the sinus from the supraorbital bone flap.

Gigli saw to cut the anterior orbital roof is only required when this bone is invaded by tumor. Cutting the orbit with the Gigli saw is also recommended when the surgeon desires an extensive resection of the superior and lateral orbital rim as seen in the modified supraorbital craniotomy.

Fracturing forward the orbital roof is possible because the anterior region is markedly thin. The roof of the orbit is triangular in shape and formed by the frontal bone and lesser sphenoid wing. When examining a skull, the orbital roof appears thin, delicate, and translucent. It frequently has depressions and ridges on its cranial surface that correspond to the gyri and sulci of the frontal lobe. In elderly patients, the bone along the anterior orbital roof may resorb, causing the periorbita to be in direct contact with the anterior fossa dura. The lesser wing of the sphenoid forms the roof of the posterior orbit, and the superior surface of the optic foramen and superior orbital fissure. This area of bone

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