

McCraw and Arnold's Atlas of Muscle and Musculocutaneous Flaps



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Global-HELP
Publication

TEMPORALIS MUSCLE

ANATOMICAL CONSIDERATIONS

Surface Markings

The anterior margin of the temporalis muscle can be palpated by clenching the jaws. The superior margin of the muscle cannot be palpated, but it lies at a point halfway between the upper margin of the ear and the vertex of the skull. The insertion is palpable and visible near the mid-point of the zygomatic arch.

Origin and Insertion

The temporalis muscle originates from the temporal fossa and inserts into the coronoid process of the mandible. It functions in forceful posterior bite and in moments of extreme surgical anxiety. Because of the redundancy of the jaw muscles, it is a readily expendable muscle.

Adjacent Muscles

The temporalis muscle incorporates the pericranium on its deep surface and is surrounded by the galeal and frontalis fascia layers in its course to the coronoid process. The proximity of the galea is important because the galea has a completely independent vascular supply from the extracranial vessels. This prevents the temporalis muscle from forming a standard myocutaneous flap since there are no perforating vessels passing directly from the muscle to the scalp skin.

Vascular Pattern

The temporalis muscle is supplied by two deep temporal branches of the maxillary artery. These two vessels penetrate the under surface of the muscle just above its insertion and straddle the motor nerve to the muscle. The robust blood supply of the galea, which overlies the temporalis muscle, arises separately from the superficial temporal and occipital vessels. It is the dense arborization of these four extracranial vessels which usually allows the entire galeal layer to be raised on any single vessel and provides a consistent blood supply to the majority of the ipsilateral scalp skin. For this reason the temporalis muscle cannot be employed as a standard myocutaneous flap without the inclusion of the galea. This compound flap of scalp skin and temporalis muscle, in fact, represents a muscle flap and a separate fasciocutaneous flap.

Motor Nerve

Deep temporal nerve.

Sensory Nerve

Fifth cranial nerve.

USES

The temporalis muscle is an unusual muscle to employ only because it is overlooked. It is exceptionally useful for certain coverage problems contained within a radius of eight centimeters in any direction from the coronoid process. This includes the majority of the oropharynx, the mandible, and the mastoid area. The traditional application of the temporalis muscle flap has been for obliteration of the orbit. Its broader uses include the correction of mastoid, cheek, pharyngeal, and palatal defects because of its proximate rotation point. When it is necessary to correct massive intraoral defects, both temporalis muscles can be retrieved through a coronal incision. The two temporalis muscles can be used to reconstruct the palate, the entire floor of the mouth, or the posterior pharyngeal wall. This should not be surprising if it is recognized that the tonsillar fossa lies but a mere three centimeters away from the temporalis muscular insertion into the coronoid process. An even more obvious application is for coverage of the adjacent exposed dura or cranial bone. This broad range of applicability salvages the useful temporalis muscle flap from its present relegation to the rare need to obliterate an orbit.

REGIONAL FLAP COMPARISONS

This is certainly the most accessible muscle flap for "high" areas of coverage, extending from the body of the mandible and the mastoid bone inferiorly and to the orbit and forehead superiorly. Flap elevation is simple, and its transfer is certainly less complicated than that of the major chest wall flaps. Unlike the pectoralis and latissimus myocutaneous flaps, access to the neck is not required and bulk is not a problem. Because the intraoral muscle flap rapidly becomes re-epithelized, it is not necessary to skin graft a temporalis muscle flap which is transposed into the mouth. The temporalis muscle can also be used to transfer living "split" cranial bone to the middle and lower face.

DISADVANTAGES

There is no functional loss from the use of this muscle. However, if the muscle is left innervated, it will forcibly contract with chewing. This problem can be avoided by denervating the muscle at the time of its elevation. Because the pericranium is incorporated on the undersurface of the temporalis muscle flap, the exposed temporal

bone must be covered with either galeal or scalp flaps. The donor site is generally good, but the loss of the temporalis muscle leaves an area of depression behind the lateral orbital rim.

ADVANTAGES

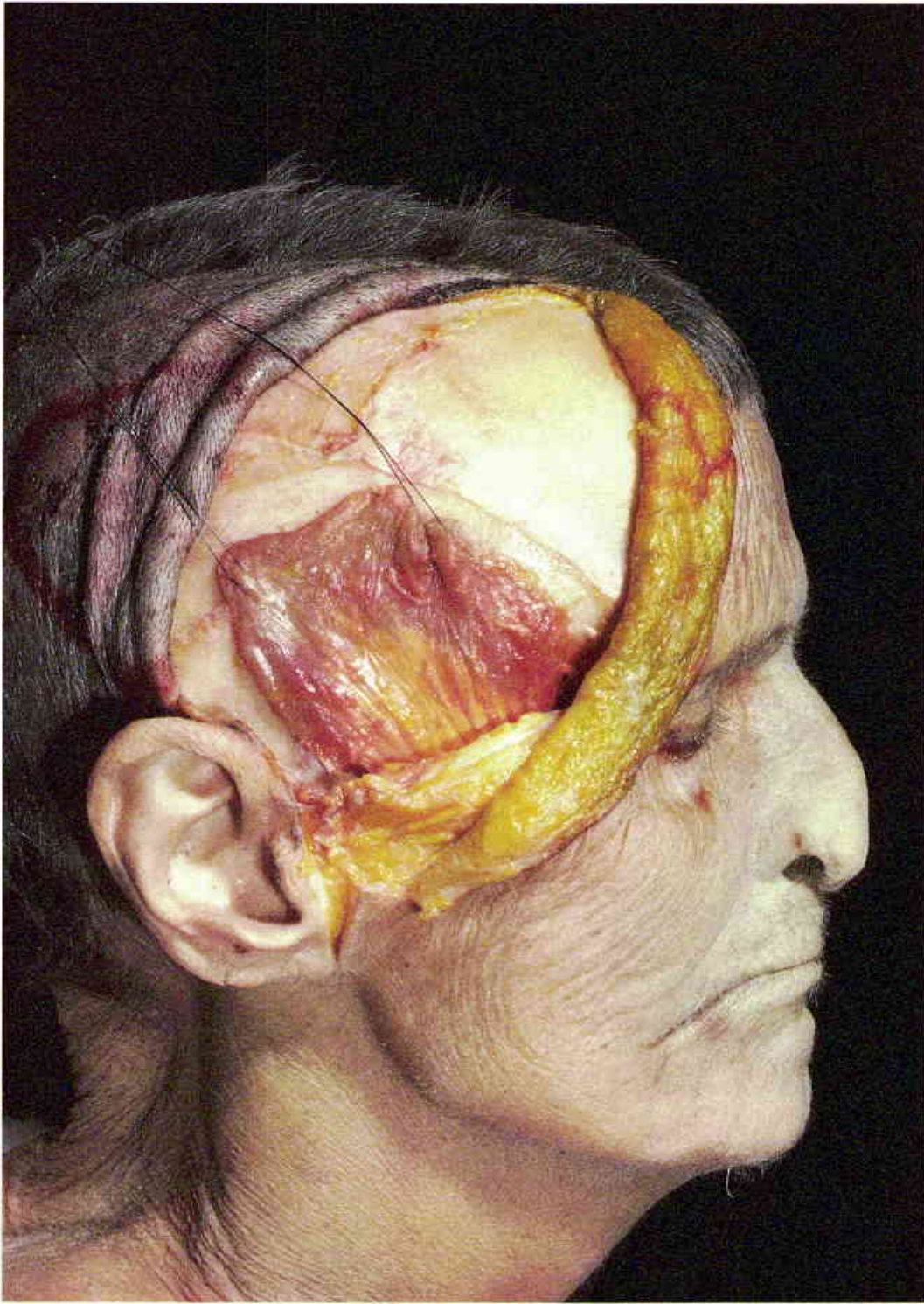
The temporalis muscle is simple to elevate and causes no functional loss. Its ability to replace the palate, the floor of the mouth, and the posterior pharynx is remarkable. One should not be surprised by this arc of rotation if the distance between the coronoid process and the upper margin of the muscle is "mentally" transposed to these inferior levels of inset. The great advantage of this muscle in intraoral applications is that it does not require skin grafting because it promptly re-epithelizes with local epithelium. The temporalis muscle can also be combined with either a galeal fascial flap or a galeal fasciocutaneous scalp flap because of their distinct and separate blood supplies. This unusual combination of a temporalis muscle flap and a galeal fasciocutaneous flap adds significantly to the versatility of their individual coverage capabilities. Acland has recently clarified our generic understanding of the galea. He describes two fascial layers overlying the temporalis muscle. The deep temporal fascia is densely adherent to the temporalis muscle and is supplied by the deep temporal vessels. The dense fascial layer, which he designates as the superficial temporal fascia (A.K.A. galea), lies between the temporalis muscle and the scalp skin. This superficial layer of fascia is contiguous with the galeal and frontalis fascial layers and is supplied by the superficial temporal vessels.

COMPLICATIONS, PITFALLS, AND DONOR SITE

The viability of the temporalis muscle flap should never be questionable, providing the dominant vessels are not harmed. When it is desirable to include skin with the temporalis muscle flap, the extracranial vessels and the galea must be separately elevated. The limits of this galeal fasciocutaneous extension are not completely known at this point. It is obvious that the fasciocutaneous flap margins can be extended much further than the demonstrated case presentations.

The primary pitfall one encounters is to leave the motor innervation intact in a visible site of inset. In this case the muscle can cause an undesirable "twitch." Should this occur, it is difficult to return safely to the previous operative area and denervate the muscle, but it can be done. After a period of several weeks, the neurovascular bundle and the muscular insertion can be completely divided without causing necrosis of the muscle flap, provided it has an adequate bed of inset.

To protect the seventh nerve, the galeal and temporal fascial layers should be elevated separately. Although it would be difficult to injure, the main trunk of the fifth nerve lies just deep to the insertion of the temporalis muscle. Temporary removal and later replacement of the zygomatic arch facilitates a safe dissection of all of these neurovascular structures. Some contour deformity results from the loss of the temporalis muscle bulk beneath the scalp. It also creates a significant area of depression behind the lateral orbital rim and beneath the adjacent sideburn area.



1
Temporalis muscle exposed through a coronal incision. The galea is retracted with the skin. Note the bony margins of the temporal fossa.

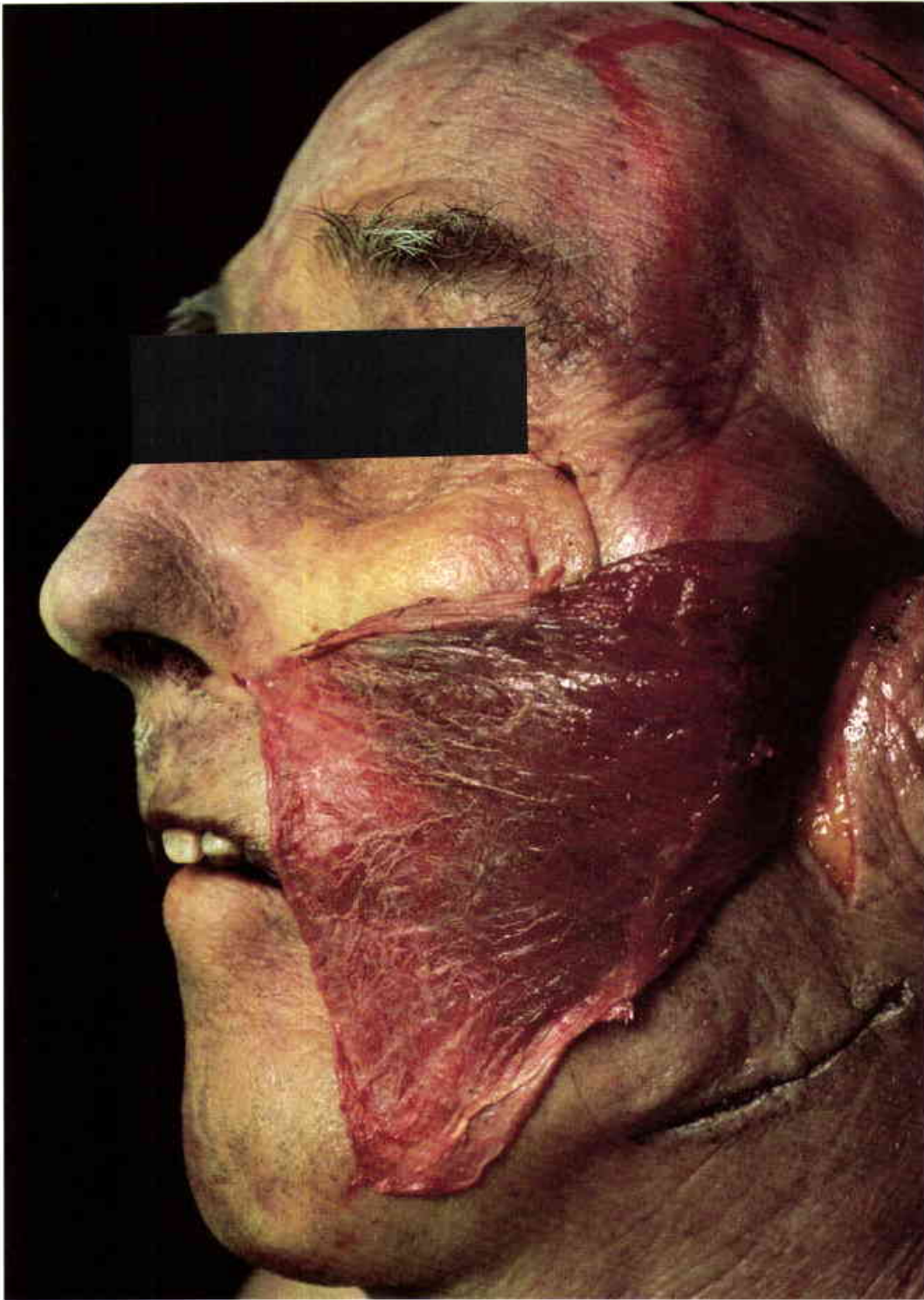


2
Exposure of the lateral orbital rim and the zygomatic arch.



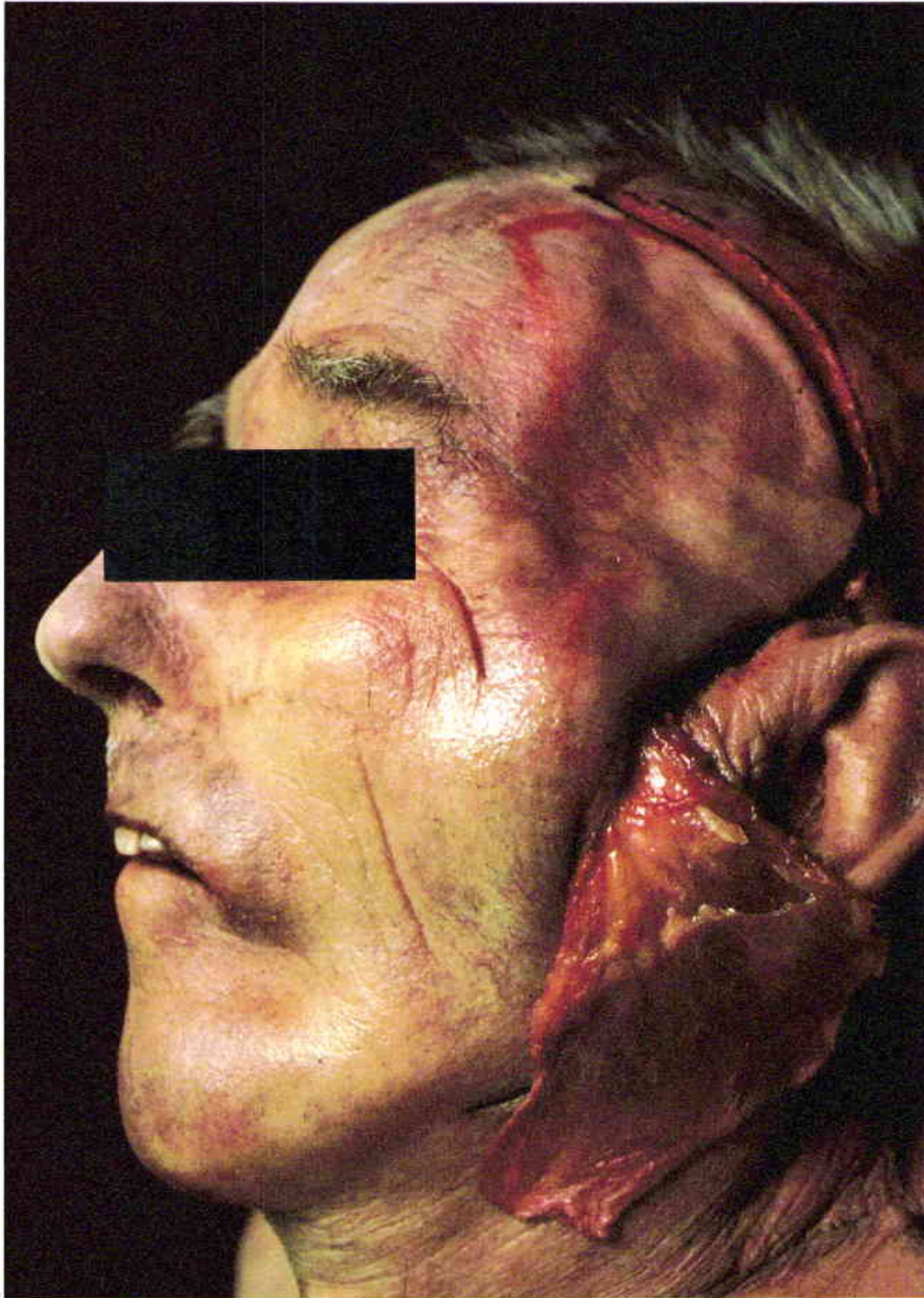
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Temporalis muscle transposed into an orbital defect.



4

Temporalis muscle passed beneath the zygomatic arch. The proximity of the coronoid process allows the muscle to reach both the palate and the cheek.



5

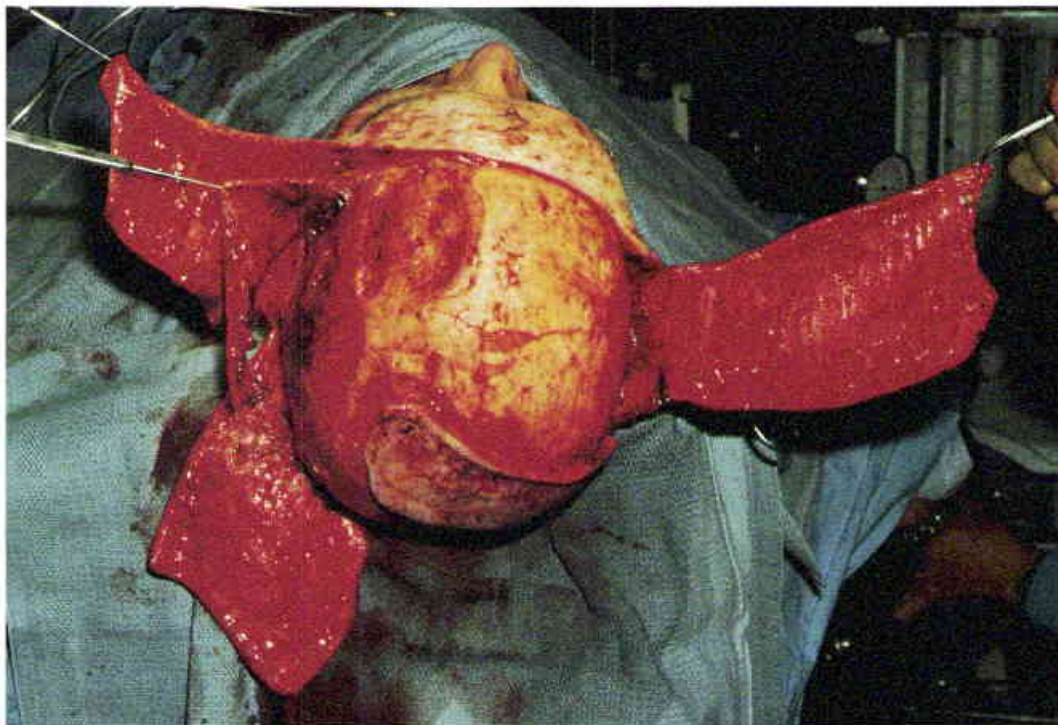
Downward extension of the temporalis muscle. Inferiorly, the muscle can be used to cover the mastoid process or the lateral pharyngeal wall.

**6**

Seventy-four-year-old male with a recurrent basal cell carcinoma of the scalp. He had previously been treated with irradiation and later by a wide excision and a rotation scalp flap. (Case of P.G. Arnold)

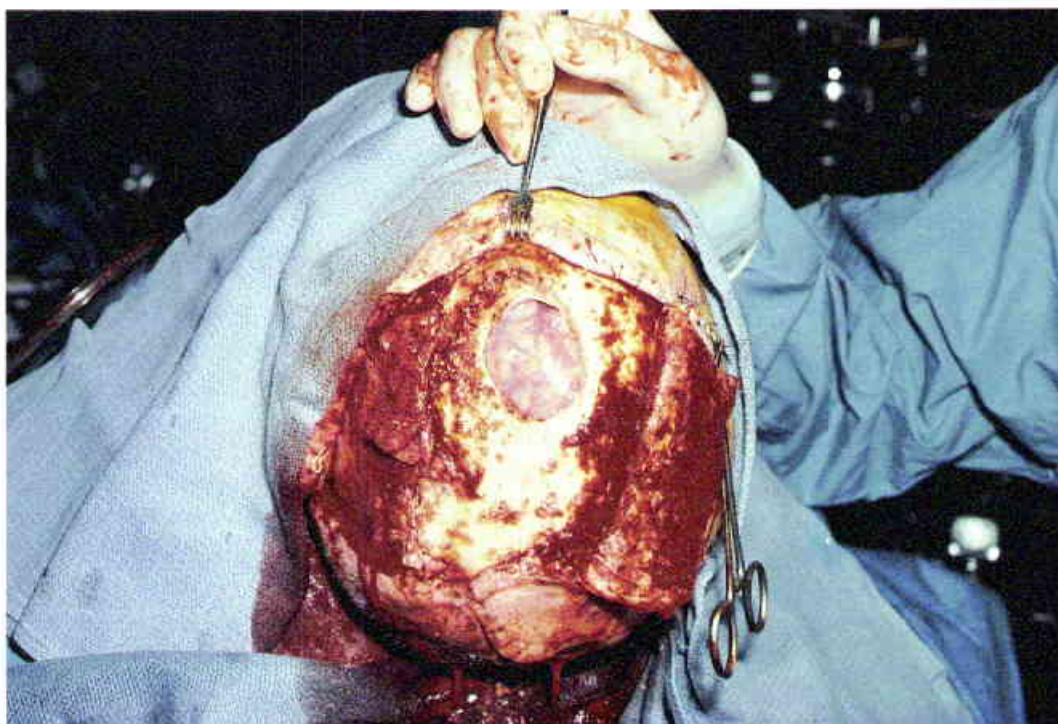
**7**

The outer table of the skull is excised and sent for pathological examination.



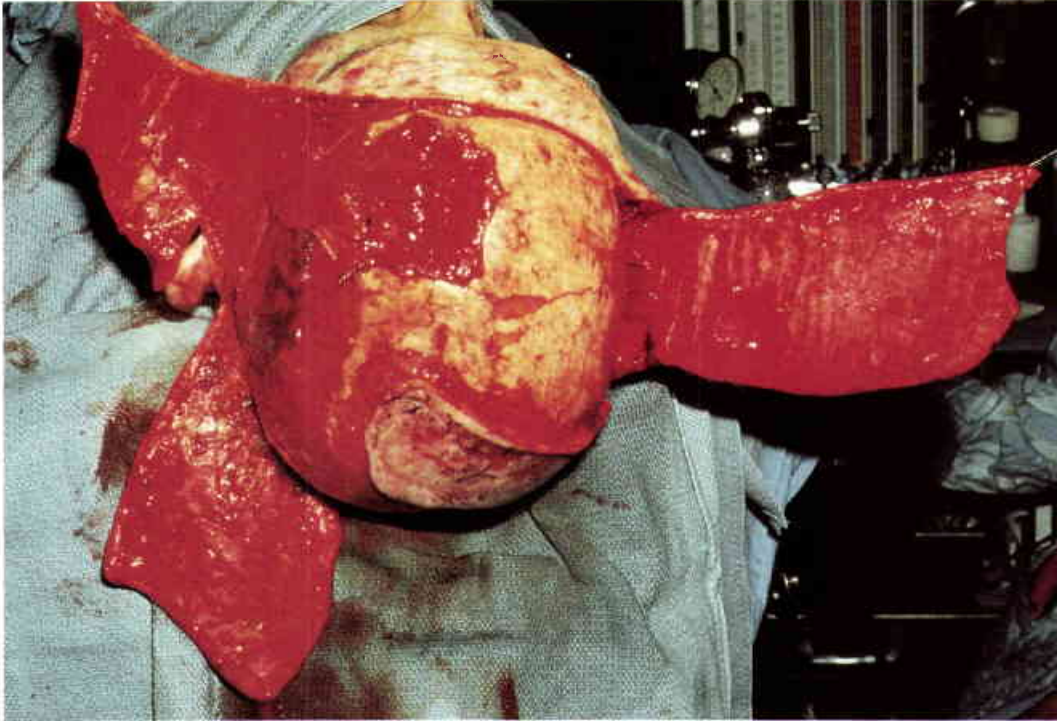
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Three Orticochea flaps are elevated. The previous skin graft of the posterior scalp has not been disturbed.



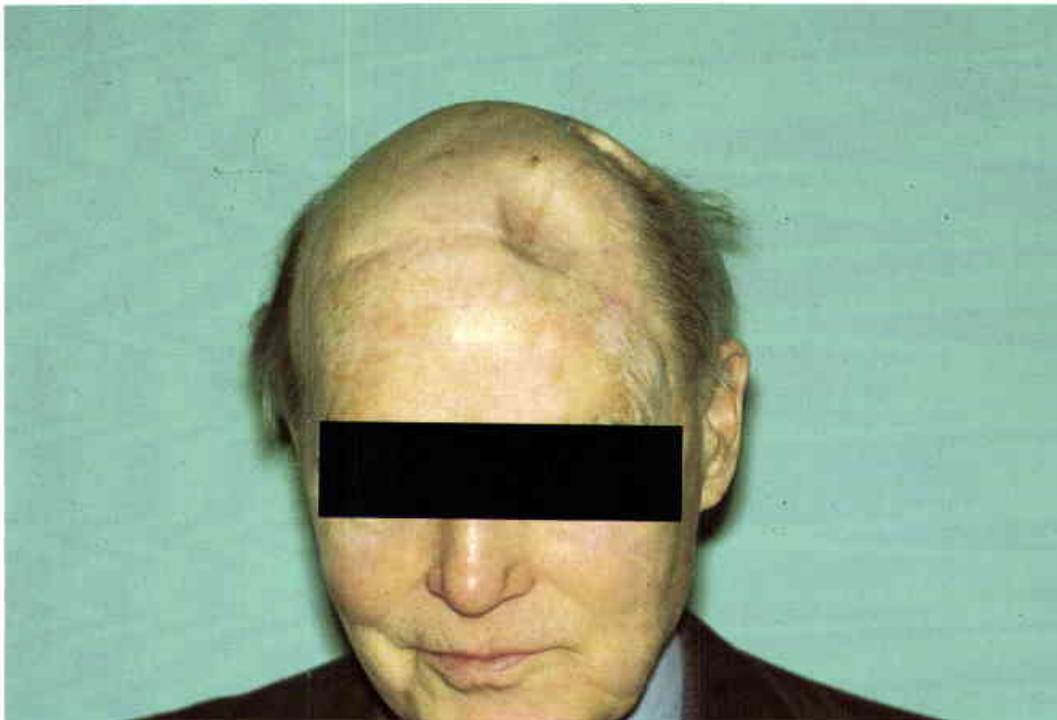
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Pathological examination demonstrated tumor involvement of the inner table of the skull, but not the dura. Nevertheless, the dura was excised and replaced with cadaver homograft.



10

The dural homograft is covered with a temporalis muscle flap. The Orticochea flaps will be used for scalp closure.



11

Postoperative appearance at four months. Bony reconstruction was temporarily deferred in the face of this aggressive tumor.



12, 13

Fifty-eight-year-old male with benign seborrheic keratoses of the temporal area. The confluent lesions were excised for esthetic reasons. (Case of J.B. McCraw)



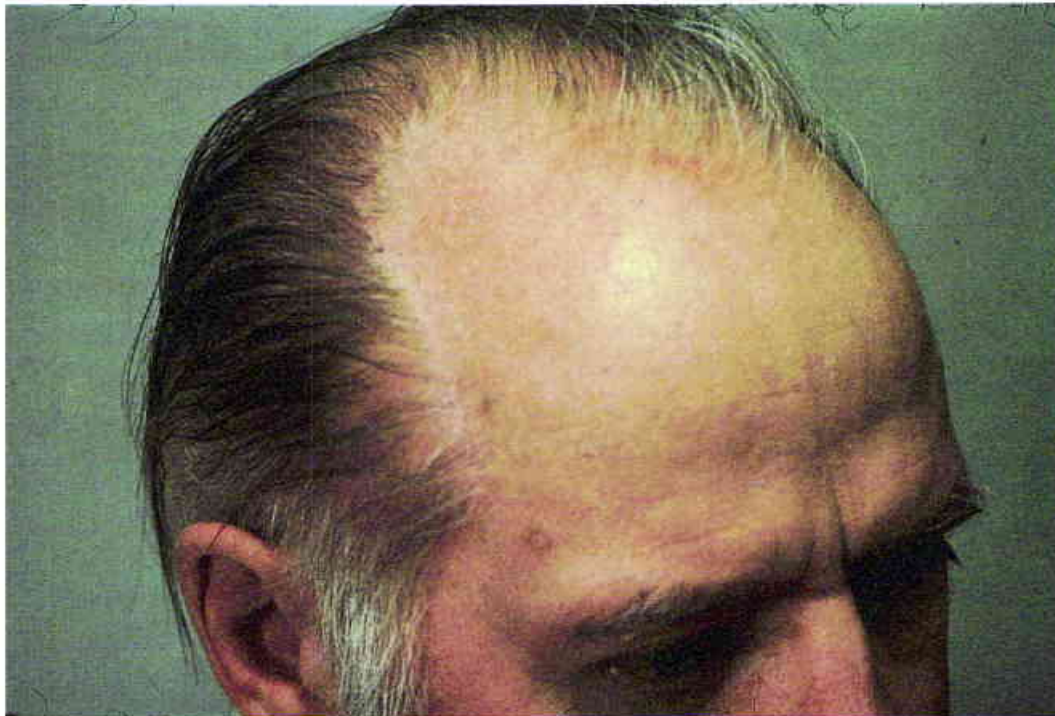
14, 15

Elevation and rotation of a galeal fascio-cutaneous flap from the central scalp. The temporalis muscle was not included with the flap.



16

Ninety degree rotation of the flap and primary closure of the donor site.



17

Postoperative result at six years. The hairline has been completely reconstituted.



18

Fifty-three-year-old male with an unsightly skin graft taken from the thigh. A level II melanoma had been excised ten years earlier. (Case of J.B. McCraw)



19

Rotation of a non-hairbearing galeal fasciocutaneous flap from the central scalp to the forehead. Note the fluorescence of the flap.



20

The scalp donor site was primarily closed with a rotation scalp flap.



21

Healed scalp donor site at four years.



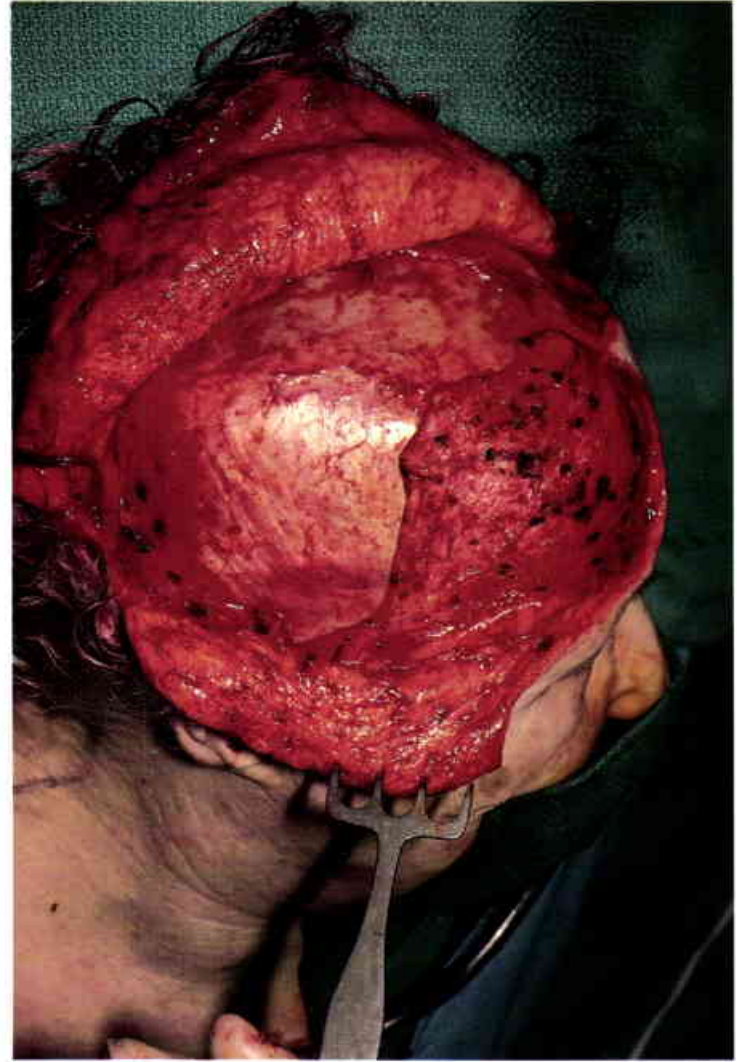
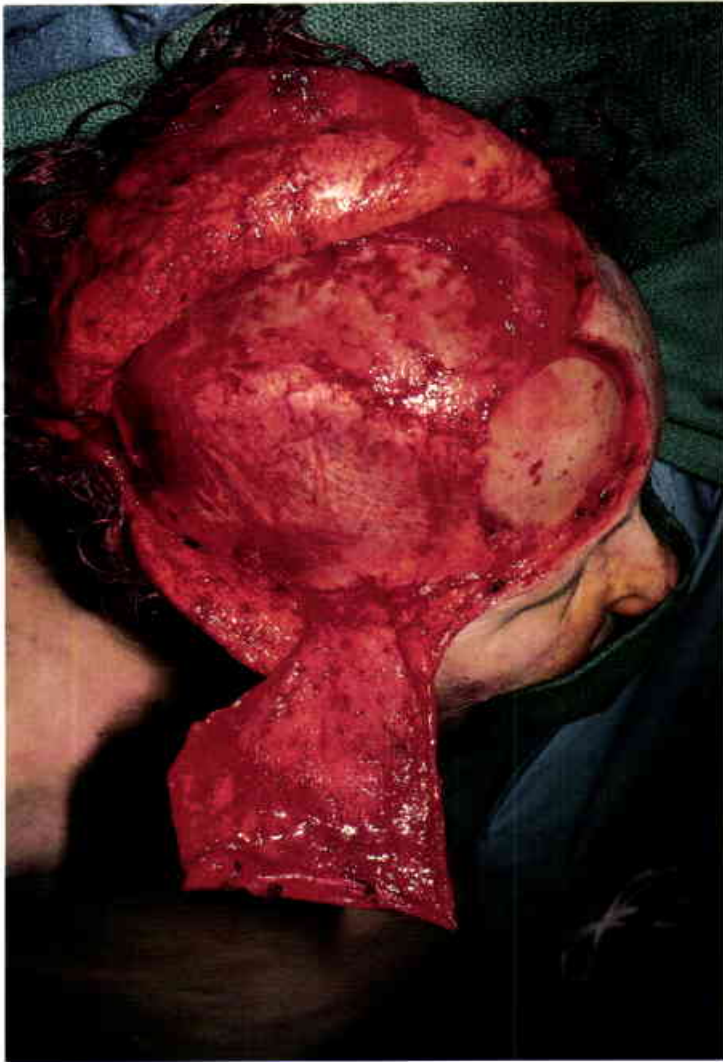
22, 23

The color match and contour of the forehead skin were nicely reconstructed by the fasciocutaneous flap.



24, 25

Recurrent squamous cell carcinoma of the forehead in an elderly patient. The tumor excision was adequate with the removal of just the periosteum of the frontal bone. (Case of J.B. McCraw)



26, 27

A galeal flap is elevated on the superficial temporal vessels. Note the undisturbed temporalis muscle. The fascial flap is rotated onto the forehead to resurface the periosteal defect of the frontal bone.

**28, 29**

Inset of the galeal flap into the forehead defect. The anterior margin of the remaining scalp flap did not fluoresce and was excised (blue mark). The extensive removal of the galea apparently devascularized this portion of the scalp.



30, 31

Immediate skin grafting was not successful. A “delayed” skin graft is always recommended because of the paucity of small vessels in the galea. The eventual contour restoration of this difficult area was good.



32

Wide excision of a recurrent, invasive squamous cell carcinoma of the right temple in a forty-three-year-old male.
(Case of G. Irons)



33

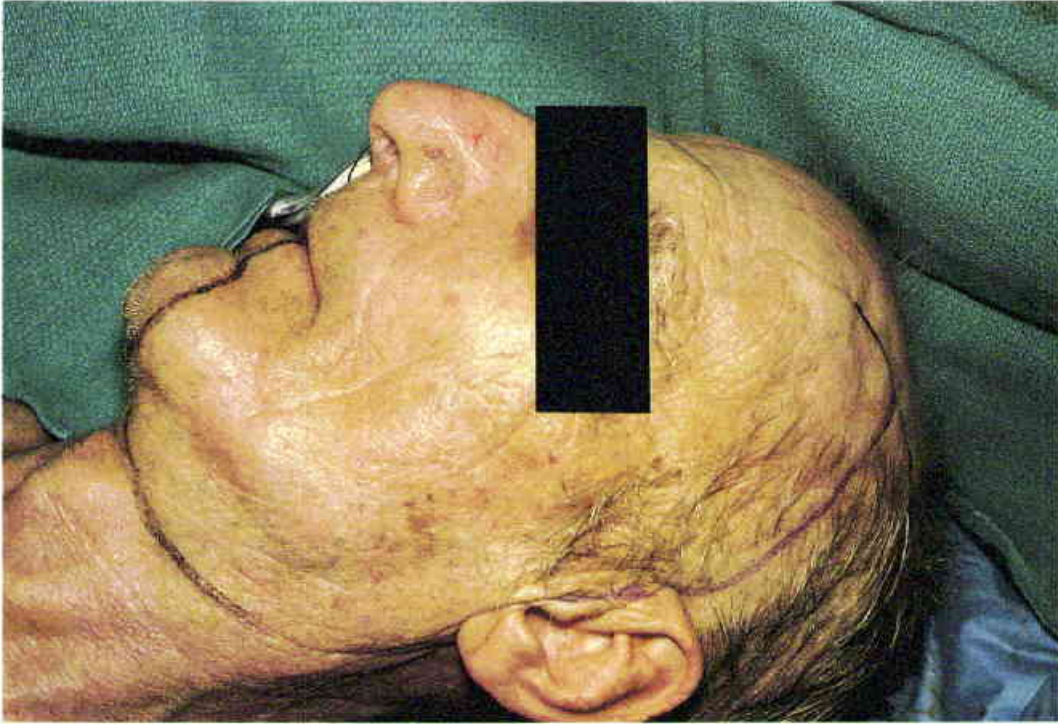
Anterior rotation of a temporalis muscle flap to cover the lateral orbital rim and the zygomatic arch.



34
The temporalis muscle flap was immediately grafted.

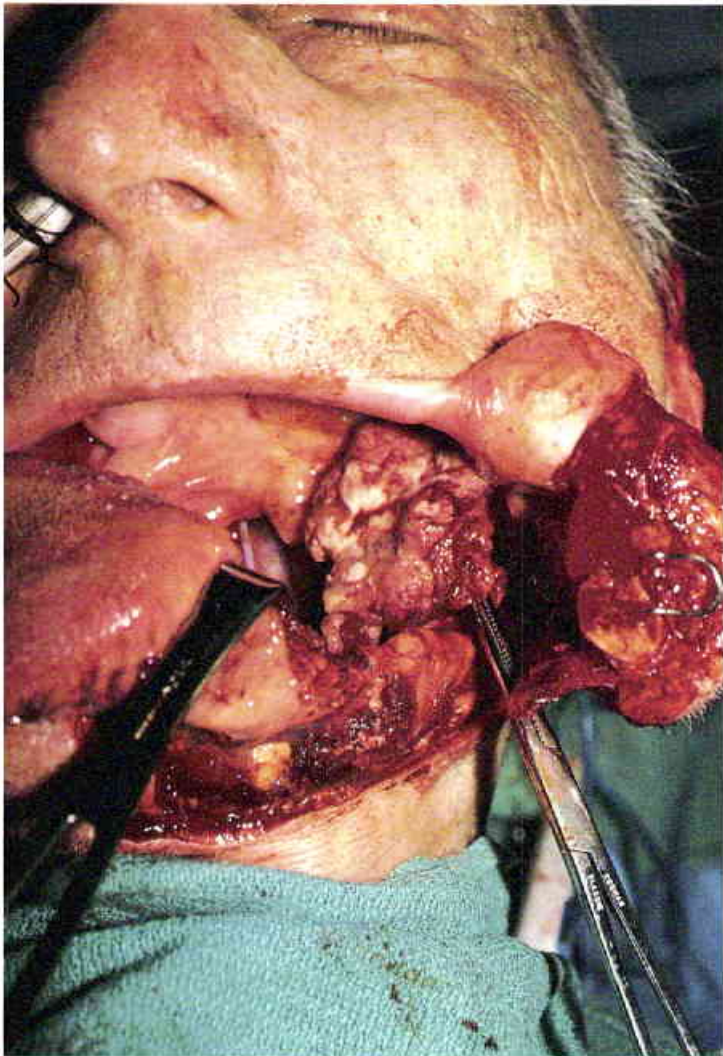


35
Appearance at five years.



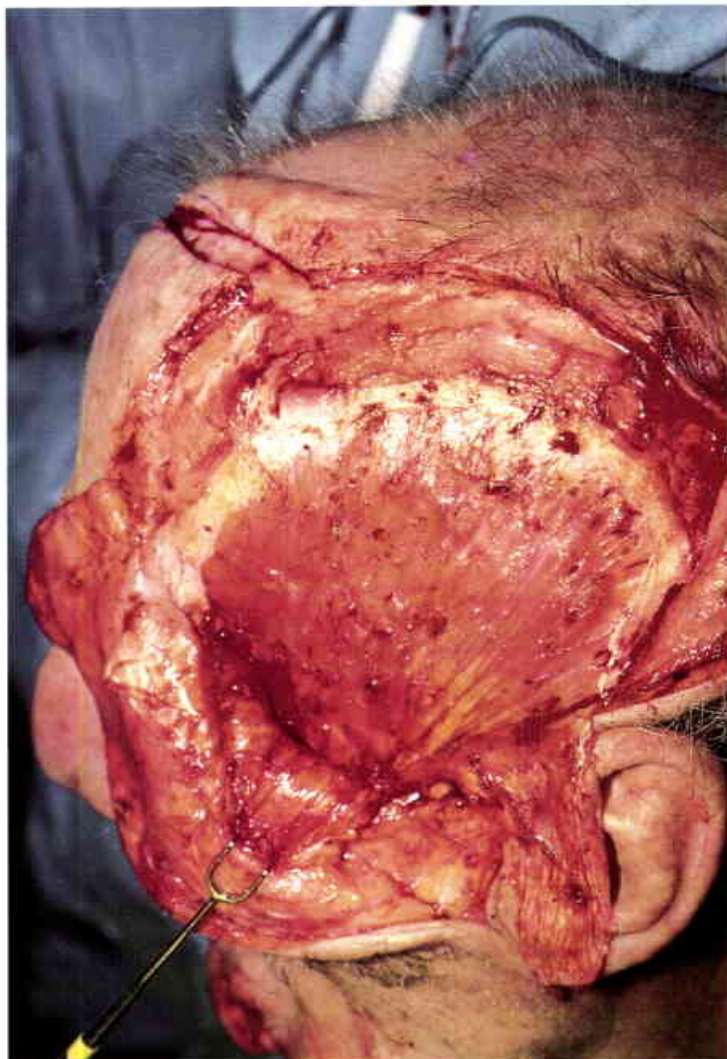
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Low grade tonsillar carcinoma in a seventy-six-year-old man. Incisions are outlined for the retrieval of a temporalis muscle flap. (Case J.B. McCraw)



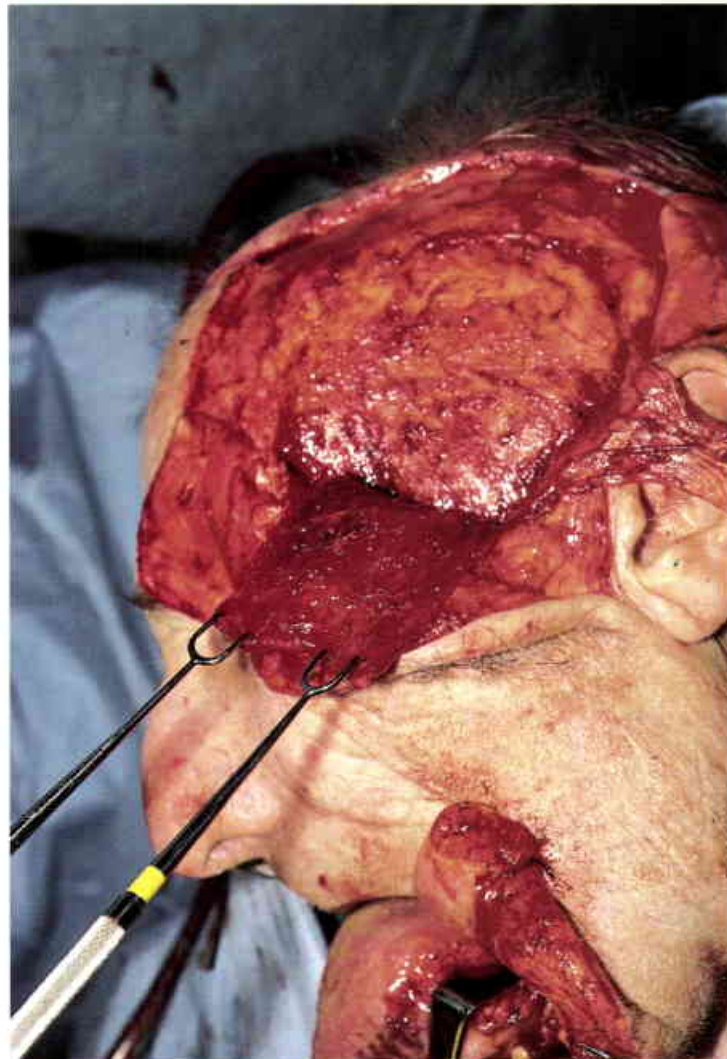
37

The massive tonsillar carcinoma is approached through a mandibular splitting incision.



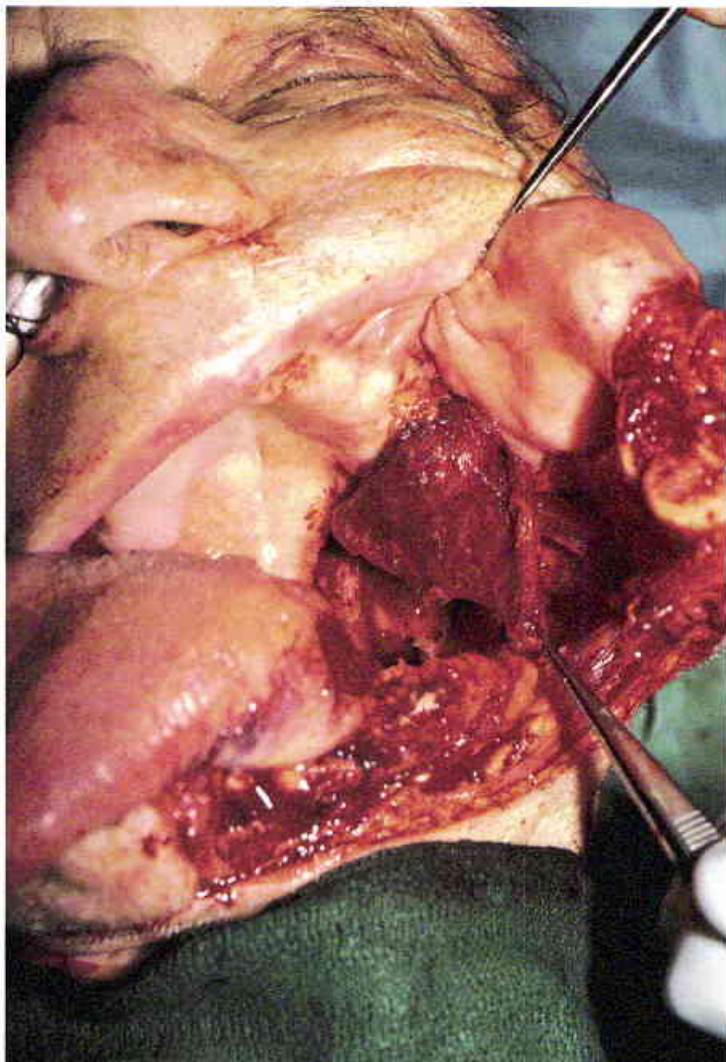
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Exposure of the temporalis muscle. A rim of deep temporal fascia is left with the muscle for retention of sutures.

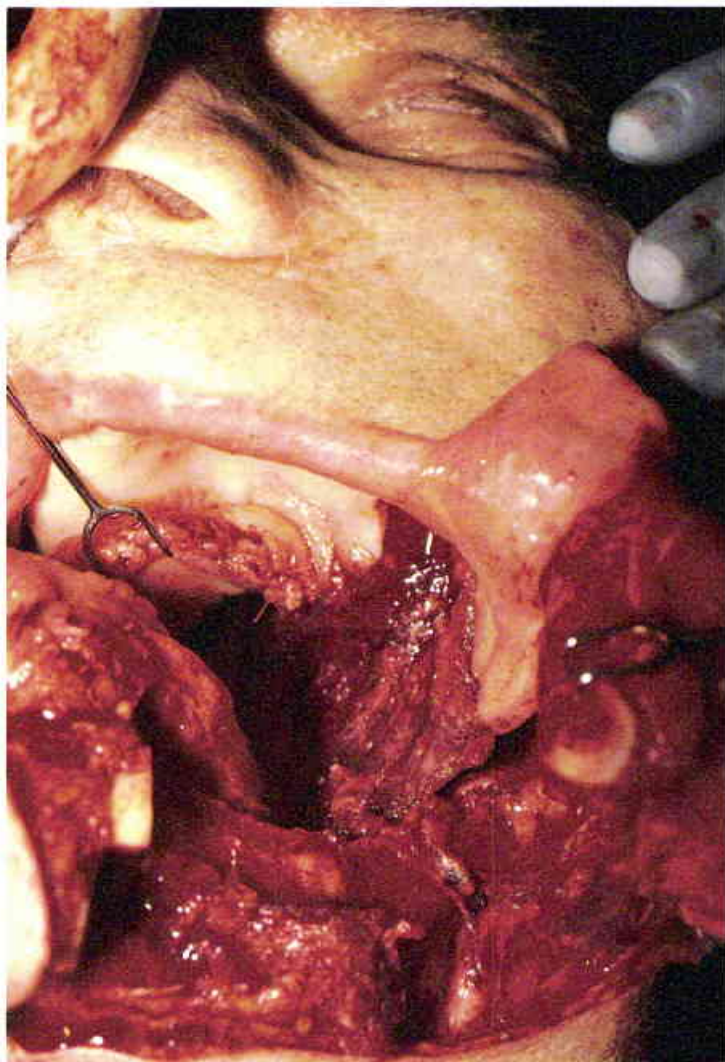


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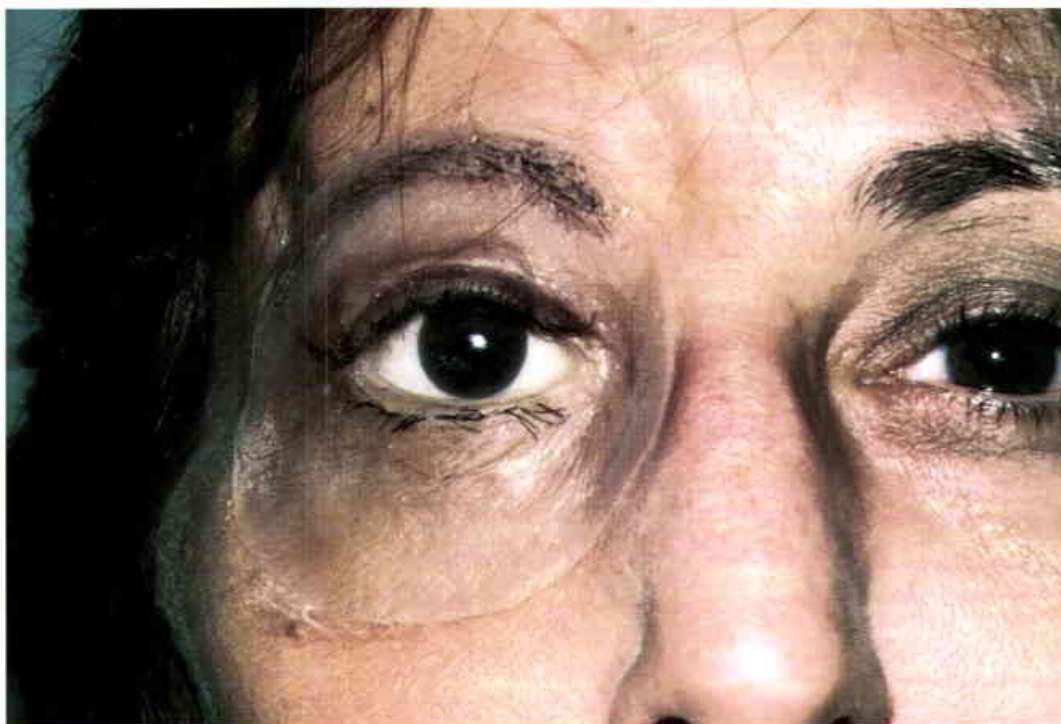
The temporalis muscle is passed beneath the zygomatic arch, which was temporarily removed and replaced.



40
The temporalis muscle flap (held with forceps) is introduced into the tonsillar defect.



41
Flap inset. Skin grafting was not required. The flap was well healed three weeks following surgery when the patient died suddenly from a stroke.



42, 43

Forty-year-old female two years following a temporalis flap to an orbital exenteration wound. The technique used in this case was identical to the cadaver dissection (fig 1-3). The wound has remained healed for five years. (Case of P.G. Arnold)

TEMPORALIS

- Abul-Hassan, H.S., Ascher, G., and Acland, R.D. "Surgical anatomy and blood supply of the fascial layers of the temporal region." *Plast. Reconstr. Surg.* 77: 17, 1986.
- Antonyshyn, O., Colclough, R.C., Hurst, L.N., et al. "The temporalis myo-osseous flap: an experimental study." *Plast. Reconstr. Surg.* 77: 406, 1986.
- Avelar, J.M. and Psillakis, J.M. "The use of fascial flaps in craniofacial deformities." *Ann. Plast. Surg.* 6: 464, 1981.
- Bakamjian, V.Y. "A technique for primary reconstruction of the palate after radical maxillectomy for cancer." *Plast. Reconstr. Surg.* 31: 103, 1963.
- Bakamjian, V.Y. and Souther, S.G. "Use of temporal muscle flap for reconstruction after orbito-maxillary resections for cancer." *Plast. Reconstr. Surg.* 56: 171, 1975.
- Bosniak, S., Sachs, M., and Smith, B. "Temporalis muscle transfer: a vascular bed for autogenous dermis-fat orbital implantation." *Ophthalmology* 92(2): 292, 1985.
- Bradley, P. and Brockbank, J. "The temporalis muscle flap in oral reconstruction." *J. Maxillofac. Surg.* 9(3): 139, 1981.
- Brent, B., Upton, J., Acland, R., et al. "Experience with the temporoparietal fascial free flap." *Plast. Reconstr. Surg.* 76: 177, 1985.
- Campbell, H.H. "Symposium on maxillo-facial surgery: surgery of lesions of the upper face." *Am. J. Surg.* 87: 676, 1954.
- Campbell, H.H. "Reconstruction of the maxilla." *Plast. Reconstr. Surg.* 3: 66, 1984.
- Conley, J. "Use of composite flaps containing bone for major repairs in the head and neck." *Plast. Reconstr. Surg.* 49: 522, 1972.
- Cramer, L.M. "Surgical management of recurrent periorbital tumors." *Plast. Reconstr. Surg.* 29: 14, 1962.
- Curioni, C., Toscano, P., Fioretti, C., and Salerno, G. "Reconstruction of the orbital floor with the muscle-bone flap (temporal muscle with coronoid process)." *J. Max. Fac. Surg.* 11: 263, 1983.
- Cutting, C.B., McCarthy, J.B., and Berenstein, A. "Blood supply of the upper craniofacial skeleton: the search for composite calvarial bone flaps." *Plast. Reconstr. Surg.* 74: 603, 1981.
- Deitch, R.D. and Callahan, A. "Temporal muscle transplant for tissue defects about the orbit." *Am. J. Ophth.* 58: 849, 1964.
- Dupuis, A., Princ, G., and Gitton, E. "Palatal reconstruction using a sternocleidomastoid flap with an upper pedicle." *Ann. Chir. Plas. Esth.* 30: 251, 1985.
- Edgerton, M.T., Tuerk, D.B., and Fisher, J.C. "Surgical treatment of Moebius syndrome by platysma and temporalis muscle transfer." *Plast. Reconstr. Surg.* 55(3): 305, 1975.
- Gillies, H.D. In *Plastic Surgery on the Face*, Frowde, H. (Ed.) London: Oxford University Press, pp. 54-55, 1920.
- Gillies, H.D. "Experiences with fascia lata grafts in the operative treatment of facial paralysis." *Pro. Soc. Med.* 27: 98, 1934.
- Golovine, S.S. "Procede de cloture plastique de l'orbite apres l'estenteration." *Arch. Ophth.* 18: 679, 1898.
- Gould, J.F. "Shortening of the temporalis tendon for hypmobility of the temporomandibular joint." *J. Oral Surg.* 36(10): 781, 1978.
- Hallock, G.G. "Reconstruction of a lower eyelid defect using the temporalis muscle." *Ann. Plast. Surg.* 13(2): 157, 1984.
- Harn, S.D. and Shackelford, L.S. "Further evaluation of the superficial and deep tendons of the human temporalis muscle." *Anat. Rec.* 202(4): 537, 1982.
- Hauben, D.J. and van der Meulen, J.C. "Use of a temporal musculoperiosteal flap in the treatment of craniofacial abnormalities: experimental study." *Plast. Reconstr. Surg.* 74: 355, 1984.
- Holmes, A.D. and Marshall, K.A. "Use of the temporalis muscle flap in blanking out orbits." *Plast. Reconstr. Surg.* 63(3): 336, 1979.
- Horton, C.E., et al. "Tumors of the maxilla and orbit." In *Symposium on Cancer of the Head and Neck*. Gaisford, J.C. (Ed.) St. Louis: C.V. Mosby Co., p. 293, 1969.
- Howowitz, J.H., Persing, J.A., Nichter, L.S., Morgan, R.F., and Edgerton, M.T. "Galeal-pericranial flaps in head and neck reconstruction: anatomy and application." *Am. J. Surg.* 148(4): 489, 1984.
- Jones, R.W. "The repair of skull defects by a new pedicle bone-graft operation." *Brit. Med. Jnl.* 780, 1933.
- Konig, F. Quoted from Garre, Kuttner, and Lexer. *Handbuch der Praktischen Chirurgie*. Ed. 6 Stuttgart Enke, 1: 1106, 1926.
- Longmore, R.B. and McRae, D.A. "Middle temporal veins — a potential hazard in the Gillies' operation." *Br. J. Oral Surg.* 19(2): 129, 1981.
- McCarthy, J.G. and Zide, B.M. "The spectrum of calvarial bone grafting: introduction of the vascularized calvarial bone flap." *Plast. Reconstr. Surg.* 74: 10, 1984.
- McGregor, I.A. and Reid, W.H. "The use of the temporal flaps in the primary repair of full thickness defects of the cheek." *Plast. Reconstr. Surg.* 38: 1, 1966.
- McGregor, I.A. and Reid, W.H. "Simultaneous temporal and delto-pectoral flaps for full-thickness defects of the cheek." *Plast. Reconstr. Surg.* 45: 326, 1970.
- Naquin, H.A. "Exenteration of the orbit." *Arch. Ophth.* 51: 850, 1954.
- Naquin, H.A. "Orbital reconstruction utilizing temporalis muscle." *Am. J. Ophth.* 41: 519, 1956.
- Rambo, J.H. "Musculoplasty: a new operation for suppurative middle ear deafness." *Transactions of the American Academy of Ophthalmology* 62: 166, 1958.

TEMPORALIS

- Ranney, D.A. and Furness, M.A. "Results of temporalis transfer in lagophthalmos due to leprosy." *Plast. Reconstr. Surg.* 51(3): 301, 1973.
- Reese, A.B. "Exenteration of the orbit: with transplantation of the temporalis muscle." *Am. J. Ophth.* 43: 386, 1958.
- Reese, A.B. and Jones, I.S. "Exenteration of the orbit and repair of transplantation of the temporalis muscle." *Am. J. Ophth.* 51: 217, 1961.
- Renner, G., Davis, W.E., and Templer, J. "Temporalis pericranial muscle flap for reconstruction of the lateral face and head." *Laryngoscope* 94(11 Part 1): 1418, 1984.
- Savage, R.C. "Orbital exenteration and reconstruction for massive basal cell and squamous cell carcinoma of cutaneous origin." *Ann. Plast. Surg.* 10(6): 492, 1983.
- Send, D.K. "Temporalis transplantation for paralytic lagophthalmos." *Br. J. Ophthalmol.* 54(10): 680, 1970.
- Sevel, D. "Exenteration of the orbit using a frontal periosteal flap." *Head Neck Surg.* 4(2): 154, 1981.
- Smith, R.A. "The free fascial scalp flap." *Plast. Reconstr. Surg.* 70: 204, 1982.
- Van der Meulen, J.C.H., Hauben, D.J., Vaandrager, J.M., and Birgenhager-Frenkel, D.H. "The use of a temporal osteoperiosteal flap for the reconstruction of malar hypoplasia in Teacher Collins syndrome." *Plast. Reconstr. Surg.* 74: 687, 1984.
- Verge, P., Raynaud, S., and Peri, G. "The use of the temporofrontal musculocutaneous flap in the reconstruction of the oropharynx after cancer." *Ann. Chir. Plas. Esth.* 30: 369, 1985.
- Webster, J.P. "Refrigerated skin grafts." *Ann. Plast.* 120: 431, 1944.
- Webster, J.P. "Temporalis muscle transplants for defects following orbital exenteration." *Tr. Internat. Soc. Plast. Surg.* 1: 291, 1955.
- White, T.P., Faulkner, J.A., Markley, J.M., Jr., and Maxwell, L.C. "Translocation of the temporalis muscle for treatment of facial paralysis." *Muscle Nerve* 5(7): 500, 1982.
- Wise, R.A. and Baker, H.W. "Orbital support." In *Surgery of Head and Neck*, Year Book Medical Publishers. 1st Ed., 1958. 2nd Ed., 1968.