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Surgical Approaches of Traumatic Facial Nerve Paralysis

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Abstract:

Background: Traumatic facial nerve paralysis is a serious complication that may occur following accidental trauma, temporal bone fractures, penetrating injuries, or iatrogenic surgical interventions. The degree of facial nerve dysfunction ranges from partial paresis to complete paralysis and may significantly affect both functional and cosmetic outcomes. Surgical management remains challenging because the choice of the operative approach depends on the site and extent of injury, hearing status, and associated temporal bone pathology. Several surgical approaches have been described for facial nerve decompression and repair, including transcanal transtympanic, transmastoid, middle cranial fossa, combined transmastoid-middle cranial fossa, retrolabyrinthine, and translabyrinthine approaches. Early surgical intervention has been associated with improved recovery rates, particularly in patients with severe degeneration demonstrated by electrophysiological studies. Recent studies demonstrated favorable outcomes following decompression surgery, especially when performed within the first weeks after trauma and when guided by radiological and electrophysiological findings. This review discusses the different surgical approaches for traumatic facial nerve paralysis, their indications, operative techniques, advantages, limitations, and reported outcomes in the literature.

Keywords: Traumatic facial nerve paralysis; Facial nerve decompression; Temporal bone fracture; Transmastoid approach; Middle cranial fossa approach; Translabyrinthine approach; Facial nerve injury.

Introduction:

Traumatic (accidental or Iatrogenic) facial nerve paralysis is either partial (paresis) or complete paralysis of the facial nerve from trauma, surgical misadventure, or planned surgical resection of the nerve. The vast majority of these cases involve one side of the face. The facial nerve can be damaged intracranially, or within, or external to the temporal bone (1).

Accidental traumatic facial paralysis occurs relatively commonly. The trauma can be blunt (e.g., blow to the head in a motor vehicle accident), sharp (e.g., knife wound), or from a missile (e.g., gunshot wound). As the reader might expect, traumatic facial paralysis is more common in men than in women. It is less common in children and the elderly than in the young adult male population. Iatrogenic facial paralysis occurs at rates that vary with the type of surgical procedure, the experience of the surgeon, and the complexity of the practitioner's caseload. Rates of facial nerve paralysis can be relatively high at tertiary care centers where surgeons are referred patients with complicated medical and surgical problems, such as a patient with a recurrent parotid malignancy, necessitating complex surgical treatments. Overall rates of iatrogenic facial paralysis are somewhat difficult to determine, but literature exists for facial paralysis as a complication of numerous specific surgical procedures. Iatrogenic facial paralysis occurs most commonly at the hands of an otolaryngologist during neurotologic procedures, parotidectomies, neck dissections, otologic procedures, and rhytidectomies. Facial paralysis can also occur during mandibular surgeries, and neurosurgical procedures involving the posterior fossa and brainstem, and paresis has even been reported after the delivery of a child (2).

In some cases, the paralysis is temporary from infiltration of local anesthetic or from stretching or manipulating the nerve, while in others, the paralysis of either the entire nerve or specific branches of the nerve is permanent. Permanent paralysis from an iatrogenic cause is most often from transection of the facial nerve or one of its branches. In addition to facial paralysis from surgical or procedural related cases, the cause of facial paresis or paralysis can be misdiagnosed by the general practitioner and less commonly by the otolaryngologist (3).

SURGICAL APPROACHES OF TRAUMATIC FACIAL NERVE PARALYSIS

1-Transcanal transtympanic approach

The transcanal transtympanic surgical approach performed via either the endaural or the postauricular route offers limited access to the horizontal portion of the facial nerve above the oral window and stapes. Because of the limitations imposed by the size of the external auditory canal, access is necessarily limited and indications are few for exposure of the nerve by this route. The patient is placed supine on the operating table with the head turned so that the involved ear is uppermost. With the patient under premedication, 1% Xylocaine with epinephrine is injected in the routine stapes fashion and a large tympanomeatal flap is elevated. Some posterior superior bony currettage may be performed to afford greater visualization of the facial nerve, and the incus may be extracted to allow visualization of the nerve in this area. Limited decompression may be performed from the geniculate ganglion to the pyramidal eminence. Other surgical procedures upon the facial nerve are not feasible via this limited approach. Prior to replacement of the tympanomeatal flap, the incus is replaced, preferably transposed onto the head of the stapes, since this usually yields better hearing results than replacement in the anatomical position. The tympanomeatal flap is replaced and ointment or packing is placed in the external auditory canal (4).

2-Transmastoid approach

The postauricular transmastoid approach is utilized for surgical exposure of the facial nerve in its entire horizontal and vertical portion from the geniculate ganglion to the stylomastoid foramen. This approach is favoured when hearing and balance function are serviceable, for it allows maintenance of the normal anatomy and physiology of the ear. With the patient under general anaesthesia and after the postauricular incision is made in the usual fashion, a complete simple mastoidectomy is performed, the horizontal and posterior semicircular canals, digastric ridge, middle fossa dural plate, sigmoid sinus, and fossa incudis being identified. The posterior bony canal wall is thinned down and the facial recess developed; this is a triangular area of bone bordered externally by the chorda tympani nerve, medially by the upper half of the descending portion of the facial nerve, and superiorly by the bone that forms the fossa incudis . When this recess has been opened sufficiently, it is possible to see the pyramidal eminence, the oval and round windows, the stapes, and the horizontal process of the facial nerve as far anteriorly as the cochleariform process. Access to the facial nerve between the cochleariform process and the geniculate ganglion is obtained between the body of the incus, the horizontal semicircular canal, and the middle fossa dura superiorly. Care must be taken at this point to identify and preserve the ampullated end of the superior semicircular canal. Once the exposure of the facial nerve has been accomplished, the bone over the entire nerve accessible by this approach is thinned down to eggshell consistency with the diamond drill and constant suction irrigation. In order to gain maximal exposure of the nerve, bone is thinned down anterior and posterior to the nerve in its vertical course so it may be uncapped to its maximal diameter . This thin bone is then removed with a small dental excavator or sickle knife in the vertical portion and with a small sickle knife through the facial recess beneath the long process of incus in the horizontal section . After complete unroofing of the facial nerve from the geniculate ganglion to the stylomastoid foramen, a Von Grafe cystotome knife is used to open the descending portion of the facial nerve and a Ziegler needle knife to open the sheath of the horizontal and labyrinthine portion of the facial nerve .Upon completion of the intended procedure upon the facial nerve, the postauricular wound is closed with 3-0 interrupted catgut sutures subcutaneously without drainage (5).

3-Middle cranial fossa approach

The middle cranial fossa surgical approach to the facial nerve is indicated for exposure of the facial nerve in its course through the internal auditory canal and labyrinthine portions of the facial nerve. Utilization of this approach is indicated when serviceable hearing and vestibular function is present, and it may be used as the definitive procedure or in combination with the postauricular transmastoid approach for total decompression of the facial nerve (6).

The patient is placed upon the operating table in a supine position with the head turned slightly away from the side of operation. General anaesthesia is employed, a half head shave is performed, and the area draped. The skin is infiltrated with 1% Xylocaine with epinephrine, and an incision is made from approximately 2 cm in front of the tragus of the ear vertically and curving slightly posteriorly to end approximately 4 cm above the superior aspect of the helix. The plane between the skin and the temporalis muscle is developed by blunt dissection; the skin is reflected and held in place with self-retaining retractors. The exposed temporalis muscle is incised in the direction of the fibers, and the attachment of the temporalis muscle and temporalis fascia to the zygomatic arch is incised parallel to the zygomatic arch and at right angles to the direction of the fibers of the temporalis muscle (7).

This maneuver is very important if one is able to obtain access via the subtemporal approach. By limiting the incision to the muscle and fascia at the zygomatic arch, the ascending branch of the facial nerve can be avoided. The temporalis muscle is stripped from the underlying calvarium over an area approximately 4 by 4 cm (8).

A self-retaining retractor is then placed beneath the temporalis muscle, exposing the underlying bone. A rectangular temporal bone flap is removed by use of a dental drill and the microscope. It is important that the base of the bone flap approximate the level of the floor of the middle cranial fossa. The anterior-posterior dimensions of the bone flap should lie two thirds in front and one third behind the external auditory canal (9).

Following removal of the temporal bone flap, the dura is exposed and bleeding from the diploic bone of the skull is controlled with bone wax. Arterial bleeding from branches of the middle meningeal artery coursing over the surface of the dura is controlled by electrocoagulation. The House-Urban self-retaining dural retractor is inserted between the edges of the craniotomy incision. The dura is then carefully elevated from the floor of the middle cranial fossa, and the blade of the retractor is placed between the dura and bone floor. In elderly patients the dura may be quite thin and adherent to the bone floor and may be opened and is a basic landmark for all middle fossa surgery. Directly medial lies the thin tegmen of the eustachian tube. Lateral to the artery is the roof of the temporomandibular joint. With this focus firmly fixed, dural dissection is carried posteriorly to uncover the arcuate eminence and the ridge of the petrous pyramid. Slightly anterior to the arcuate eminence, and posterior and lateral to the middle meningeal artery, lie the greater and lesser superficial petrosal nerves as they enter the middle cranial fossa. The retractor blade is then withdrawn slightly and advanced posteriorly, where a second landmark, the arcuate eminence, is located. The dura is carefully elevated over the dome of the arcuate eminence, and the blade of the retractor is advanced so that it fits over the ridge of the bone that corresponds to the superior petrosal sinus. The dura is then dissected free between the arcuate eminence and the middle meningeal artery. This step must be performed very carefully, because if the bony covering of the geniculate ganglion is dehiscent, the ganglion may be injured (10).

By approaching from behind and stripping the dura away anteriorly, it is possible to find a third major landmark, the greater superficial petrosal nerve, without injury to the ganglion. The retractor blade is now placed medial to the geniculate ganglion and as near to the superior petrosal sinus as possible. The greater superficial petrosal nerve serves as a guide to the geniculate ganglion. Once this ganglion has been exposed, the position of the lateral end of the internal auditory canal is fixed . Here, the labyrinthine portion of the facial nerve is exposed as it runs from the geniculate ganglion medially to the lateral extent of the internal auditory canal (10).

In addition to running medially from the geniculate ganglion, the facial nerve runs posteriorly, displaced slightly in this direction by the basal turn of the cochlea. The bone is now removed over the facial nerve. Now the dissection can be carried medially toward the opening of the internal auditory canal into the posterior fossa by removing the usually thick bone covering the internal auditory canal (11).

Once the dura is exposed, the triangular piece of bone in the lateral extent of the canal is identified (Bill's bar), separating the anterior superior facial nerve compartment from the posterior superior vestibular nerve compartment. Once these landmarks have been identified, the dura is incised posteriorly over the superior vestibular nerve in order to make the incision away from the facial nerve and to leave an anteriorly based dural flap over the facial nerve to protect the structure (12).

Should this approach be combined with the postauricular transmastoid approach, bone lateral to the geniculate ganglion over the epitympanum may be removed, thereby connecting the two approaches and effecting total exposure of the facial nerve . Upon completion of the procedure, all bleeding points are controlled and a plug of free temporal muscle is placed over the internal auditory canal to prevent postoperative cerebrospinal fluid leakage. The dural elevator is removed slowly and the temporal lobe allowed to re-expand into its normal position in the middle cranial fossa. The previously created temporal bone flap is reinserted and the temporal muscle and temporalis fascia are brought together in layers. The skin and fascia are brought together with either subcutaneous 2-0 chromic catgut sutures or interrupted wire sutures. Drainage is not used; a dry sterile dressing is placed over the wound and the patient is observed in the intensive care unit overnight (13).

4- Combined Transmastoid-middle cranial fossa approach

This combination of surgical approaches is utilized when serviceable hearing and vestibular function are present and when total exposure of the facial nerve is required. With the patient under general anaesthesia, initially the transmastoid exposure is accomplished and then either by extension of the postauricular incision anteriorly and superiorly or by a separate incision the middle cranial fossa approach is used. Upon completion of the transmastoid part of the total exposure, it is helpful if a small perforation is made in the epitympanic tegmen just lateral to the geniculate ganglion. This perforation remains extradural, and upon elevation of the middle fossa dura during the second half of the operation this hole is readily identifiable from above, aiding considerably in more rapid clarification of landmarks (14).

5- Retrolabyrinthine approach

The retrolabyrinthine approach to the posterior fossa course of the facial nerve is useful when access to this area is required in a patient with useful hearing and balance function. The patient is placed supine on the operating table with the head turned so that the involved side is up. Under general anaesthesia an incision is made over the mastoid cortex. The skin and soft tissues are reflected off the mastoid cortex and adjacent lateral subocciput. With the self-retaining forceps in position and utilizing the operating microscope, the air drill, and constant suction irrigation, a complete mastoidectomy is performed and the bone over the lateral subocciput, sigmoid sinus, and posterior and middle fossa dura is removed as far medial as the posterior canal. The jugular bulb is skeletonized inferiorly and the middle fossa plate superiorly. The posterior bony external auditory canal is preserved and the facial nerve identified inferior to the lateral semicircular canal. An incision is made in the dura parallel to and anterior to the sigmoid sinus, thereby carefully preserving the endolymphatic sac, which is reflected anteriorly. The dura and endolymphatic sac are held in place with sutures fixed to the surrounding soft tissues . The subarachnoid space is then opened and cerebrospinal fluid is released from the lateral cystern. The cerebellum falls posteriorly, and usually minimal retraction is necessary to expose the exiting nerve roots in the cerebellopontine angle. The trigeminal nerve lies anterior and superior to the VII and VIII cranial nerves. The IX and X cranial nerves are seen inferior to the VII and VIII nerves. The brainstem and adjacent blood vessels are readily visualized. All bleeding must be controlled prior to closure of the dura with continuous silk suture. A free graft of temporalis muscle is used to plug the defect in the mastoid and to prevent cerebrospinal fluid leakage. The skin and soft tissues are brought together in one layer with 2-0 interrupted subcutaneous chromic catgut sutures or interrupted wire sutures without drainage. The patient

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is returned to the intensive care unit for observation overnight. The typical postoperative course is four to five days (14).

6- Translabyrinthine approach

The postauricular translabyrinthine approach for exposure of the facial nerve affords total exposure of the facial nerve from the posterior fossa proximally to the stylomastoid foramen distally. This approach affords through one incision maximal exposure of the facial nerve. However, because the vestibular labyrinth is exenterated, the procedure is reserved for patients without serviceable hearing or balance function. The patient is placed supine on the operating table with the involved side uppermost. The postauricular area is shaved and draped. Under general anaesthesia an incision is made approximately 1 to 2 cm (15).

behind the postauricular crease, extending from 1 cm. above the superior aspect of the helix to 2 cm. behind the tip of the mastoid. It is important not to incise too close to the postauricular crease, for it is more difficult to remove bone posteriorly through a more anteriorly placed incision. The skin is held in place with self-retaining retractors, and the plane between the temporalis fascia and the subcutaneous tissue is developed by blunt dissection. The soft tissues are stripped off the mastoid forward to the external auditory canal and posteriorly to the lateral subocciput. By use of a large cutting burr, air drill, and constant suction irrigation, a wide mastoidectomy is performed. The opening is extended forward above the external auditory canal into the epitympanum. The antrum is exposed and the middle ear identified. The facial nerve is skeletonized in its course through the mastoid to the stylomastoid foramen. The genu of the facial nerve is identified, and a thin layer of bone is left over the facial nerve at this point to protect the structure. Posteriorly the superior petrosal and sigmoid sinuses are exposed, again leaving a thin shell of bone over these structures for protection (16).

A labyrinthectomy is then carried out. The fibers of the superior vestibular nerve are identified as they enter the vestibule. The bony removal is then carried out along the superior vestibular nerve to the internal auditory canal. The entrance of the facial nerve into the internal auditory is exposed by careful removal of bone above the superior vestibular nerve with a diamond burr. A definite bar of bone (Bill's bar) lies between the superior vestibular nerve and the facial nerve. The facial nerve is then completely exposed from the posterior fossa to stylomastoid foramen with the diamond drill under constant suction irrigation. The incus and head of the malleus are removed in order to expose the facial nerve in the tympanic portion. However, the tympanic membrane is left intact. All bone is then removed with the diamond burr and constant suction irrigation from the internal auditory canal to the stylomastoid foramen. Access to the posterior fossa, if required, may be obtained by removing the layer of bone previously left over the sigmoid sinus and posterior fossa dura. Upon completion of the procedure, all bleeding must be carefully controlled. Abdominal fat or a temporalis muscle plug is used to fill the mastoid and epitympanum in order to prevent leakage of cerebrospinal fluid. The wound is then closed with 2-0 subcutaneous interrupted chromic catgut sutures without drainage. A mastoid dressing is applied and the patient is returned for observation overnight in the intensive care unit (17).

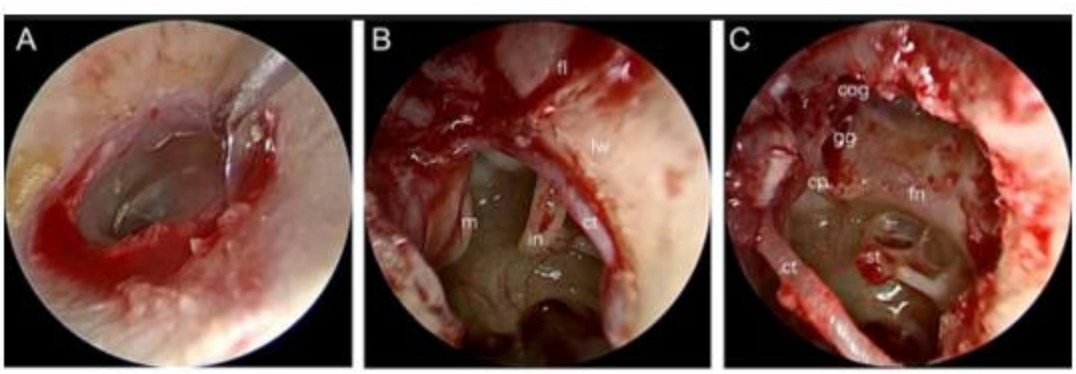

Figure 1: transcanal transtympanic approach (18).

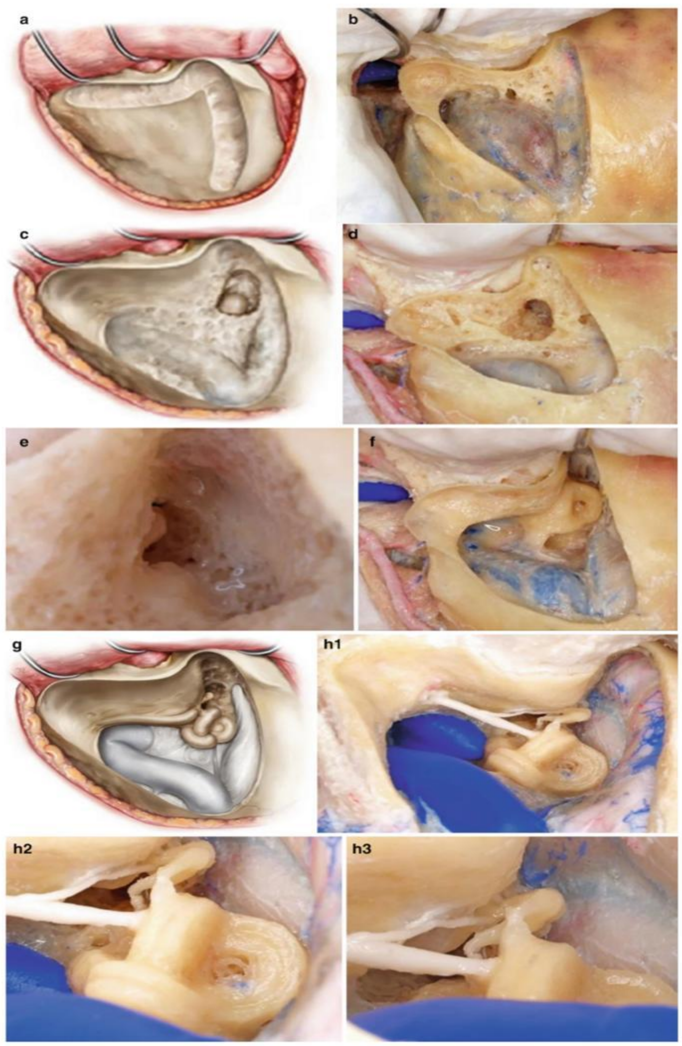

Figure 2: (a) (Left) The anterior and superior margins of the mastoidectomy; (b) (right) the mastoid air cells are removed anteriorly and superiorly to expose the middle fossa dura (temporal tegmen). (c–e) Exposing the mastoid antrum. (f, g) Exposing the semicircular canal and the transverse sigmoid sinus. Cadaver (left) and drawing (right).

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(h) Skeletonizing of the sigmoid sinus, jugular bulb, the fallopian canal, and the entire course of the facial nerve through the mastoid bone (19).

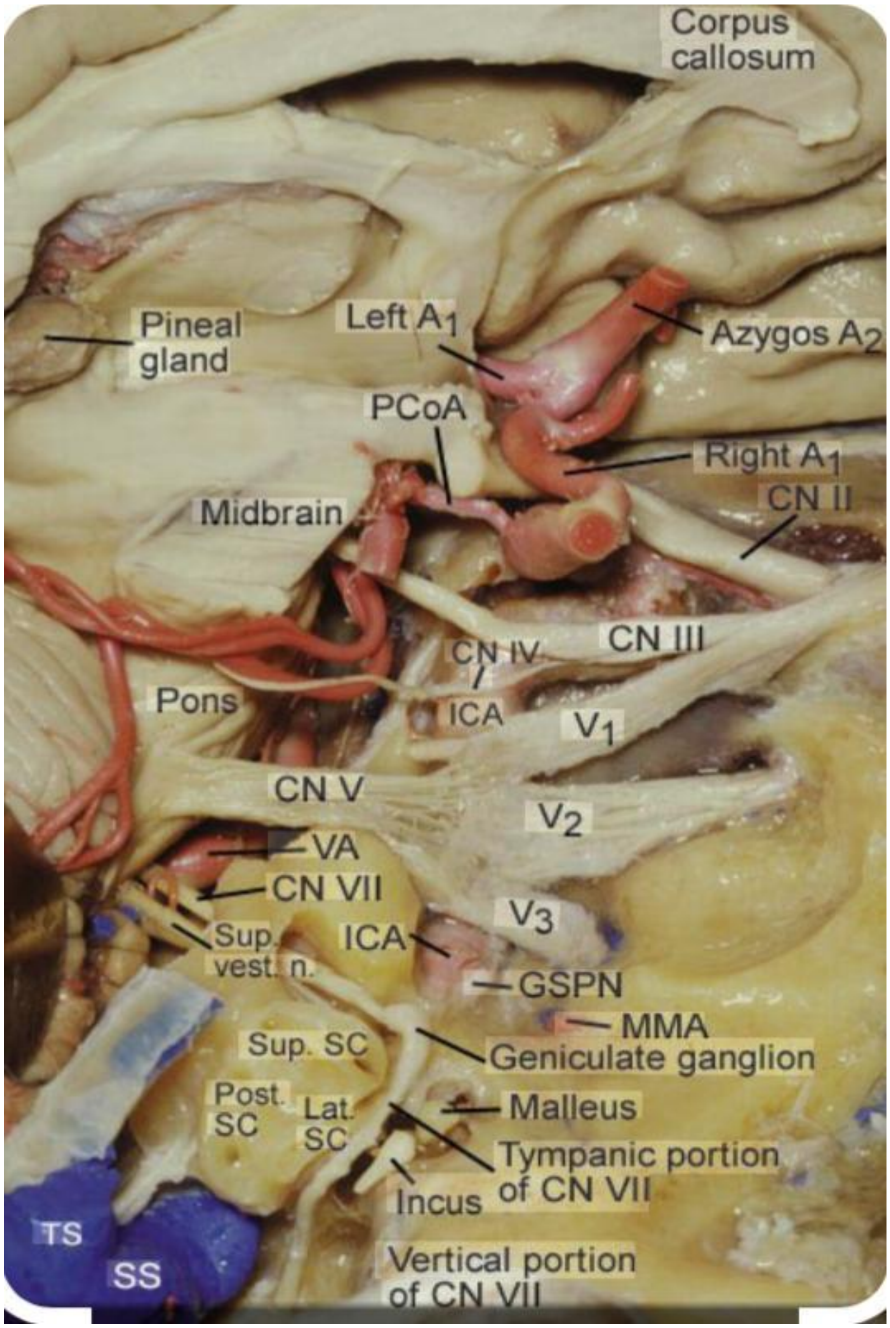

Figure 3: shows anatomical illustration of the middle cranial fossa approach to the internal auditory canal. It highlights key neurovascular structures and surgical landmarks, including: The internal carotid artery (ICA) and its branches, such as the left and right A1 segments and the azygos A2 artery variant (20).

Cranial nerves (CN) II, III, IV, V, and VII, showing their relationships within the skull base. Structures of the inner ear, including the malleus, incus, and superior, posterior, and lateral semicircular canals (SC). The midbrain and pons, central components of the brainstem (20).

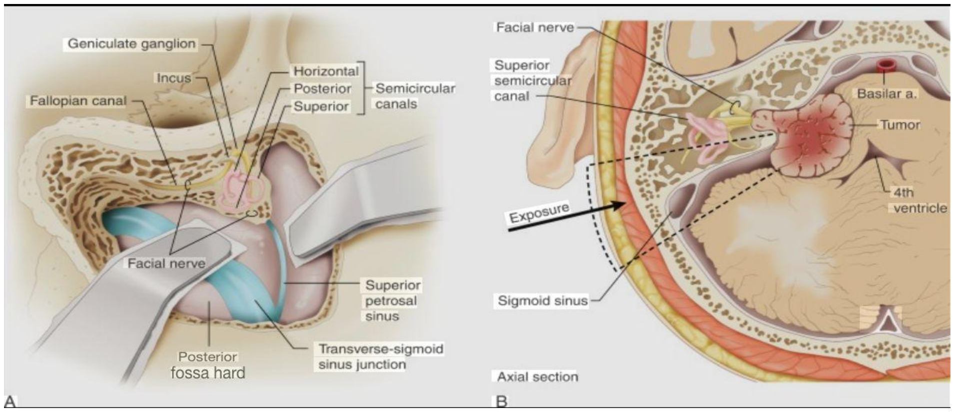

Figure 4: retro labyrinthine approach (20)

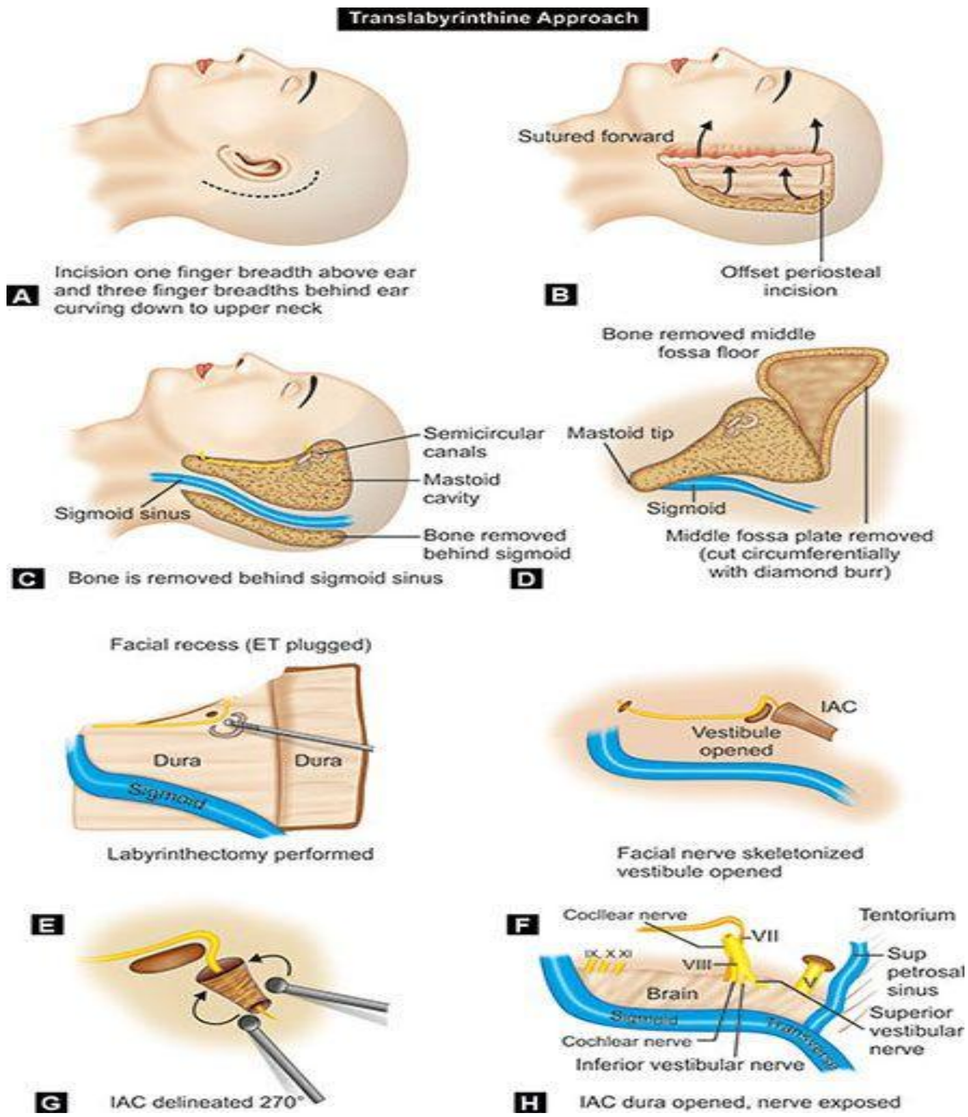

Figure 5: trans labyrinthine approach (21)

OUTCOME OF THE SURGICAL TREATMENT OF A TRAUMATIC FACIAL NERVE PARALYSIS

The mainstream view is that the earlier the surgical decompression is carried out, the greater the efficacy. In Fisch's opinion, surgical operation should be performed immediately in patients with neural degeneration of the facial nerve >90% by facial nerve electroneurography (the timing for performing electroneurography after temporal bone fracture should be defined) . Naohito Hato et al. indicated that the ideal time for facial nerve decompression surgery was within the first 2 weeks after the trauma. The reported rate of complete recovery was 85.7% (7).

Motor neuron cell bodies recover 21 days after damage; at that time, constructive metabolism is at its most vigorous. So if facial nerve decompression is performed at that time, the curative effect would be most beneficial. On the other hand, it is easier to locate the damaged position of the nerve at the early stage of onset, the nerve fibers are easier to exposed and have no tension. Too long a time after injury, the nerves are prone to shrink, or scars occur at the broken end, so neuromas are formed and the peripheral organs atrophy, which is not beneficial for functional recovery of the facial nerve (22).

Exploring the facial nerve after traumatic paralysis remains controversial. Further studies are necessary to resolve the issue over which patients should undergo decompressive surgery to recover facial nerve function. With non-penetrating trauma, the overall rate of good recovery (i.e., House-Brackmann grade 1 or 2) after decompression of the facial nerve is traditionally 50% (23).

Mc Kennan and Chole (1992) revealed that exploratory surgery and repair was performed on 14 patients with immediate-onset complete facial paralysis. Nerve transection was found in 8 patients. However, only 4 were monitored longer than 1 year after surgery. Of the 4 patients, 2 improved to moderately severe dysfunction (i.e. House-Brackmann grade 4), and the remaining 2 continued to have total paralysis (i.e., House-Brackmann grade 6) (24).

Irugu et al (2018) revealed that in the early decompression group , the preoperative status of the facial nerve was grade VI in nine cases (90%) and grade V in one case (10%). Postoperatively, it improved to grade II in eight cases (80%) and grade III in two cases (20%). In the delayed decompression group, the preoperative status was grade V in one case (7.70%) and grade VI in 12 cases (92.30%). After surgery, it improved to grade II in one case (7.70%), grade III in four cases (30.76%), grade IV in seven cases (53.84%), and grade V in one case (7.70%). Overall, postoperatively in both groups, nine patients improved to grade II (39.13%), six patients to grade III (26.08%), seven patients to grade IV (30.43%), and one patient to grade V (4.34%).Authors of small case series such as these that lack adequate follow-up questioned the utility of surgery among patients with nerve transection. Severe injuries, such as nerve transection, were thought to carry a poor prognosis irrespective of surgical intervention and repair. With this possibility in mind, the merits of surgical decompression need further evaluation, especially when the clinically significant risks and complications of an intracranial procedure are considered. Recent authors profess the utility of surgery in specific situations, especially when a severance of a nerve is suspected. Although the overall incidence of transection is low, the outcome is undoubtedly poor without intervention. For example, in a prospective case series of 10 patients with 11 temporal bone fractures, decision for surgical intervention was mainly based on high-resolution CT scan and lack of regeneration potentials on EMG. In this series, no nerve transections were encountered. After surgical exploration and decompression, 5 fractures recovered to House-Brackmann (HB) grade I, 4 patients recovered HB grade II, and 2 patients recovered HB grade III. In a retrospective study, Darrouzet et al (2001) examined 115 patients with posttraumatic facial paralysis. Patients with immediate and electrophysiologically severe facial paralyses with a clear fracture line on the fallopian canal on CT scans were treated with surgery as soon as possible. Patients with delayed or severe facial paralyses and a mixed electrophysiologic pattern were treated medically. Patients with severe facial paralyses without a clearly visible fracture line on CT underwent electrophysiologic and clinical monitoring with the option of late surgery if they did not recover. Of 65 patients who underwent surgery, 52 (80%) had immediate severe paralysis, 2 (3%) had delayed-onset paralysis, and 11 (17%) had unknown delay-associated paralysis. Nerve transection was found in 9 patients (14%). After 2 years of follow-up, 61 patients (94%) had a grade I-II HB recovery. A grade IV HB recovery was observed in 4 patients; no patients recovered to a grade V or VI HB level.Bodenez C et al; (2006) reported the functional outcome of 64 cases of facial paralysis following temporal bone fracture based on a decision algorithm combining CT scan findings and electroneuronography, 38 patients were given medical treatment and 26 underwent surgery. Normal or near-normal facial nerve recovery (HB 1-2) were obtained in 63% of medically treated patients and 39% of surgically treated patients. Grades III-IV HB were obtained in 13% of medically treated patients and 42% of surgically treated cases. In addition, the authors concluded that grade III is the best obtainable result after nerve anastomosis. In addition, data have also challenged the timing of surgery. Initial beliefs held that surgery should be performed within 2-3 weeks after injury. However, because most patients have multi-systemic trauma, surgery for facial nerve decompression within this window is not feasible (25).

Quaranta et al (2001) reviewed outcomes after late facial nerve decompression. All 9 patients satisfied traditional electrophysiologic criteria and were operated on 27-90 days after trauma. Normal or near-normal (HB I-II) facial function was achieved in 7 (78%) after more than 1 year of follow-up. The remaining 2 patients, operated on 3 months after trauma, obtained grade III HB recoveries. They concluded that, in patients who cannot undergo surgery early and who present at 1-3 months with more than 95% denervation on ENoG, facial nerve decompression may still be beneficial. However, studies such as this lack a control group; therefore, knowledge about the potential for recovery of such patients when treated medically or untreated is lacking. A study by Liu Y et al (2015) reported good outcomes from extended subtotal facial nerve decompression performed through the transmastoid approach in patients with facial palsy after temporal bone fracture, but indicated that such surgery should be performed within 8 weeks following the causative trauma. Of the 12 patients who underwent surgery within 8 weeks of trauma, 11 of them (91.7%) achieved complete or near-complete recovery from facial palsy, while of the six patients who underwent decompression between 9 and 14 weeks after injury, only four (66.7%) attained complete or near-complete recovery (5).

Ylikoski *J* (1988) reported two cases of facial paralysis resulting from temporal bone fractures that underwent exploratory operation 1 year after injury. The pathology showed considerable endoneural fibrosis, with only little nerve fiber surviving. Ylikoski believed that endoneural fibrosis is the main reason for nerve dysfunction, and it is endoneural hematoma that induces endoneural fibrosis. Early operation may remove compression of hematoma, prevent anabatic neurodegeneration, decrease inogenesis in the nerve, and stimulate nerve fiber regeneration and directional control. In addition, judging from the facial nerve edema, the earlier the surgery is given, the milder the nerve edema, and the facial nerve can obtain better recovery (26).

In Jie Han et al (2014) As a result, for the facial paralysis resulting from temporal bone fractures, the operative approach should be determined by the site of facial nerve injury as defined preoperatively. For patients whose facial nerve injuries are located before the geniculate ganglion, the middle cranial fossa approach is essential. The transmastoid approach has a limited surgical field and is inconvenient to perform, leading to an insufficient decompression range to the geniculate ganglion, even seriously influencing the aural comprehension. Of the 60 cases in their study, 48 cases were treated via the middle fossa approach, 8 cases by the transmastoid approach, and 4 cases by the transmastoid and middle cranial fossa approach. A 1-year follow-up period showed that 57 cases reached above H-B grade II, which suggests a satisfactory curative effect. A combined approach should be used in those patients whose temporal bone fractures are complicated, so that the best decompression effect can be achieved (27).

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