Section A-Research paper

Surgical Technique of Parotid Surgery and Great Auricular Nerve Preservation

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Abstract

In the realm of surgical approaches for salivary gland tumors, several techniques come into play depending on the nature and extent of the lesion. Extracapsular dissection involves tumor resection without facial nerve identification, utilizing a facial nerve monitor, and is typically employed for benign lesions other than pleomorphic adenoma. On the other hand, partial or superficial parotidectomy entails tumor removal with a margin of parotid tissue while carefully identifying and preserving the facial nerve. This approach finds application in cases of benign lesions and superficial lobe lymph node metastasis. For a more comprehensive procedure, total parotidectomy is opted for, involving complete gland removal while meticulously identifying and safeguarding the facial nerve. This method is reserved for aggressive malignant tumors, deep lobe tumors, sentinel lymph node excision located in the deep lobe, vascular malformations, or substantial tumors where distinguishing between superficial and deep lobes proves challenging.

Keywords: Parotid Surgery, Great Auricular Nerve Preservation

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In the realm of surgical approaches for salivary gland tumors, several techniques come into play depending on the nature and extent of the lesion. Extracapsular dissection involves tumor resection without facial nerve identification, utilizing a facial nerve monitor, and is typically employed for benign lesions other than pleomorphic adenoma. On the other hand, partial or superficial parotidectomy entails tumor removal with a margin of parotid tissue while carefully identifying and preserving the facial nerve. This approach finds application in cases of benign lesions and superficial lobe lymph node metastasis. For a more comprehensive procedure, total parotidectomy is opted for, involving complete gland removal while meticulously identifying and safeguarding the facial nerve. This method is reserved for aggressive malignant tumors, deep lobe tumors, sentinel lymph node excision located in the deep lobe, vascular malformations, or substantial tumors where distinguishing between superficial and deep lobes proves challenging **(1).**

In instances where preoperative facial paralysis is established or malignant tumors encompass the facial nerve, radical parotidectomy is considered, entailing the removal of the entire gland, including the facial nerve. In such cases, potential facial reanimation procedures or nerve grafting may be incorporated. Prior to surgery, patient counseling assumes significance, outlining the potential risks of temporary or permanent facial paralysis, the necessity of postoperative measures like suction drains and compressive dressing, as well as the likelihood of aesthetic contour irregularities at the surgical site **(2).**

Standard Operative Technique

Incision and Exposure

Among the array of incisions that have been formulated for this procedure. It commences within a skin crease just anterior to the tragus and follows the configuration of a Y, as illustrated. The posterior limb of the incision is extended over the mastoid process, directed caudally in approximate alignment with the underlying sternomastoid muscle, until it reaches a point situated about 1 cm below the angle of the mandible. Caution is advised to ensure that the angle of the Y does not assume excessive acuteness. The incision is then

conducted through the platysma muscle. Hemostasis is achieved using precise electrocautery techniques. The anterior skin flap is secured with small rake retractors, facilitating the substantial elevation of tissue within the plane just beneath the platysma. Upon exposure of the parotid gland's surface, the dissection is advanced through the utilization of small Metzenbaum scissors. Noteworthy is the presence of fibrous tissue attaching the parotid gland to the overlying tissue, resembling diminutive nerve fibers. It's essential to acknowledge that facial nerve fibers are not superficially positioned to the parotid gland. Hence, these individual fibers can be expediently divided **(3).**

In cases where a comprehensive superficial lobectomy is intended, the dissection is continued cephaladly, reaching the level of the zygomatic process, and anteriorly to the anterior margin of the parotid gland. However, it is crucial to avoid extending the dissection beyond the gland's anterior and inferior margins, as this could inadvertently jeopardize small facial nerve branches. This precautionary measure is particularly emphasized before the facial nerve's identification is accomplished. The intricacies of this approach underscore the imperative nature of meticulous anatomical awareness and precision within the context of parotid surgery **(4).**

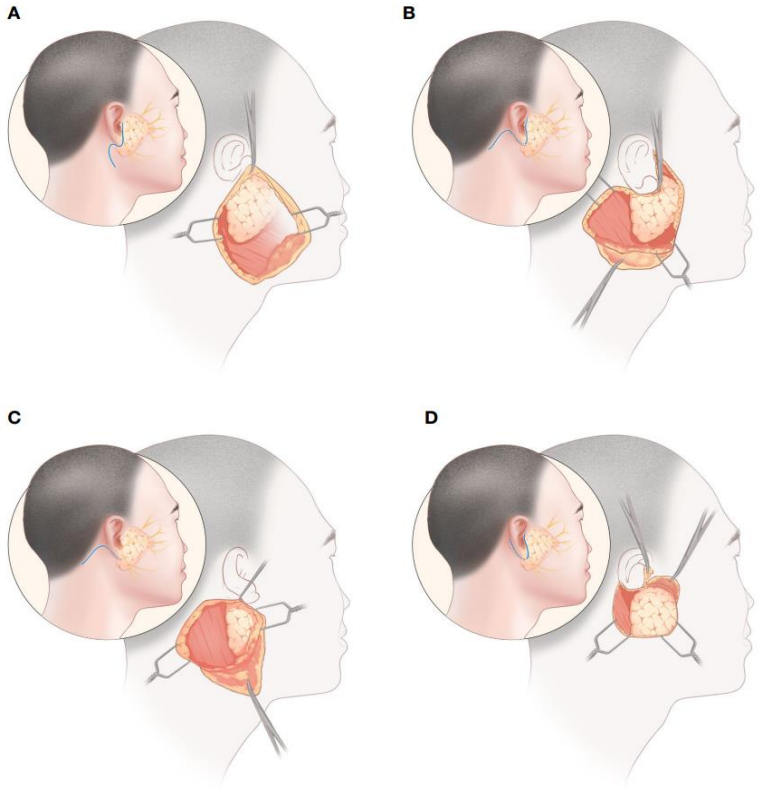

Fig (1): Parotidectomy via four incisions: (A) modified Blair incision, (B) modified facelift incision, (C) retroauricular hairline incision, (D) V-shaped incision **(5)**.

- **Locating the great auricular nerve**

The great auricular nerve is identified overlying the surface of the sternomastoid muscle, situated approximately 3–4 cm caudal to the mastoid process. The branch of the great auricular nerve entering the parotid gland is divided. In close proximity to this nerve, the external jugular vein is typically encountered, which is also divided and ligated posterior to the parotid gland. The anterior border of the sternomastoid muscle is exposed, and the dissection proceeds in a cephalad direction towards the mastoid process. While separating the tissues from the anterior surface of the mastoid process, there might be instances of bleeding originating from branches of the superficial temporal vessels. Precise clamping or electrocautery can effectively manage such bleeding occurrences **(6)**.

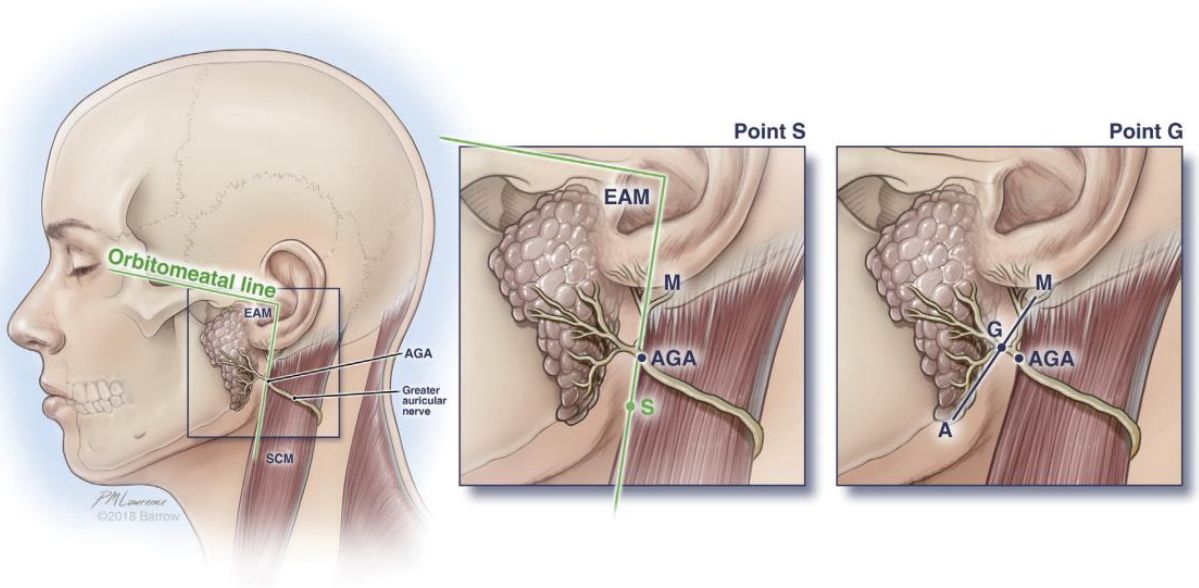

Fig (2): Artist's illustration showing the course of the greater auricular nerve and its relationship to adjacent landmarks. A, angle of mandible; AGA, anterior greater auricular point; EAM, external auditory meatus; G, intersection point of largest trunk of greater auricular nerve with the M-A line; M, tip of mastoid process; S, intersection point of a line perpendicular to orbitomeatal line projected from external auditory meatus with anterior border of sternocleidomastoid muscle; SCM, sternocleidomastoid muscle **(6)**.

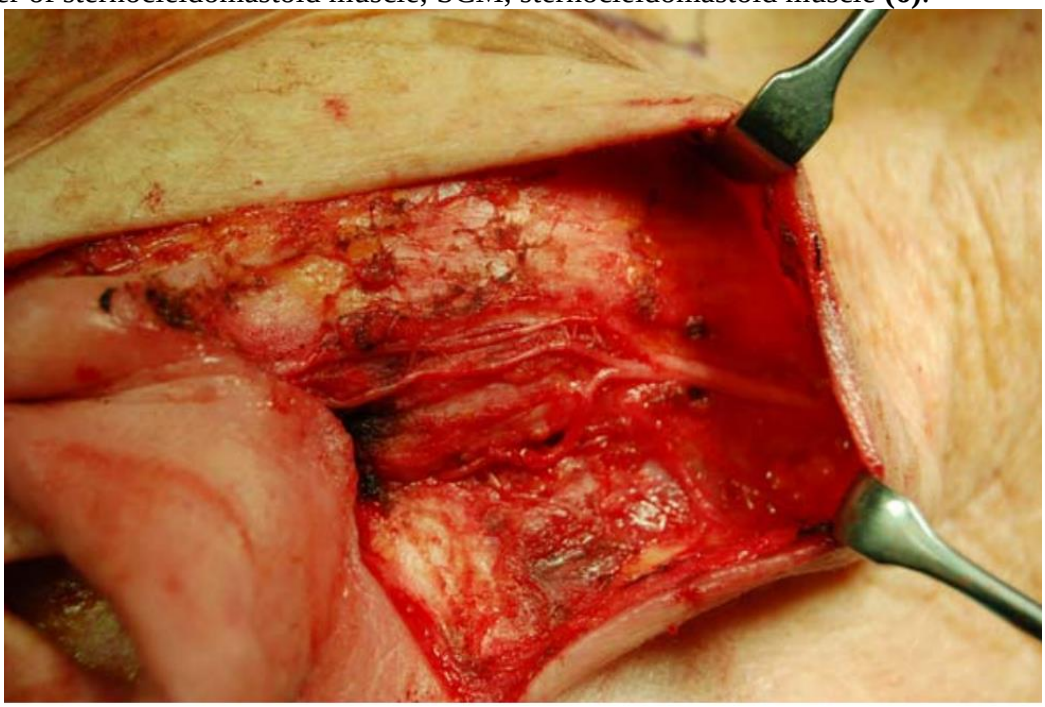

Fig (3): Intraoperative view of right parotid gland. Note the great auricular nerve main trunk dividing into three posterior branches lying on the posterolateral aspect of the gland (the anterior branch had already been divided).

Locating the Facial Nerve

Running from the tympanomastoid fissure to the parotid gland, a moderately dense layer of temporoparotid fascia is observed. This layer of fascia is elevated using a small hemostat or right-angle clamp, after which it is divided. The dissection continues in a deep manner along the anterior surface of the mastoid process. It's essential to keep in mind that the principal trunk of the facial nerve is situated within a 1-cm region anterior

to the tympanomastoid fissure and the upper half of the mastoid process, at a depth of 0.5–1.0 cm. An effort should be made to identify the minor arterial branch of the posterior auricular artery within this vicinity, followed by its division and ligation. In cases where inadvertent division occurs and precise clamping proves challenging, applying pressure for several minutes suffices to control bleeding **(7)**.

As the blunt dissection progresses using a hemostat, the posterior section of the parotid gland becomes retractable from the mastoid process. Continued separation and division of the fibrous tissue in this region eventually expose the primary trunk of the facial nerve. Typically oriented in a transverse direction from the mastoid process toward the gland, the nerve might occasionally assume an oblique course from the upper left area of the operative field towards the lower right portion as it enters the parotid gland. To gauge the requisite depth of the dissection needed for facial nerve exposure, observing the depth of the posterior digastric muscle's surface as it reaches its point of origin behind the mastoid process offers useful guidance. The nerve is positioned at the level of or just above this vessel **(8)**.

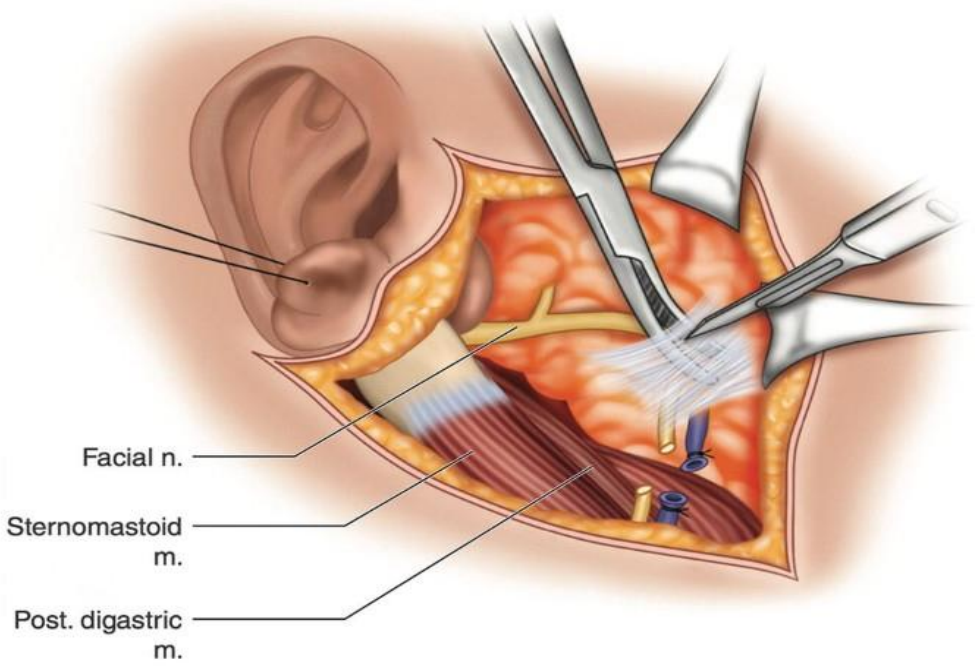

Fig (4): Facial Nerve Position and Depth of Dissection **(9)**.

- **Dissecting Facial Nerve Branches**

Traction is applied to the superficial parotid lobe using several Allis clamps or retractors. A small hemostat is inserted in the plane just above the facial nerve. An assistant is directed to divide the elevated fibrous tissue with the hemostat's guidance. The dissection is continued within this plane until each of the facial nerve's branches are separated from the overlying parotid tissue. Particular emphasis is placed on the cervical division and its marginal mandibular branch, facilitating the elevation of the lowermost section of the parotid gland. Upon reaching the anterior margin of the parotid gland, the identification of Stensen's duct is undertaken. The duct is ligated using 3-0 PG suture and subsequently divided. Following the identification of all nerve branches and the division of the duct, the removal of the superficial lobe of the gland is executed. During the nerve dissection phase, hemostasis is commonly achieved by applying gauze pressure. At this juncture of the dissection, meticulous identification of each bleeding point is performed, followed by clamping using a mosquito hemostat. Ligature is accomplished using 4-0 or 5-0 PG suture. Importantly, areas in close proximity to the nerve should avoid the use of electrocautery **(10)**.

- **Removing Deep Lobe of Parotid Gland (When Indicated)**

To initiate the removal of the deep lobe of the parotid gland, the initial step involves the excision of the superficial lobe as detailed earlier. Subsequently, the lower division of the facial nerve is meticulously separated from the underlying tissue. By retracting one or more of these divisions, the mobilization of the deep lobe is initiated. Identification of the posterior facial vein is undertaken. The marginal mandibular nerve

branch is carefully isolated from the vein. Subsequently, the posterior facial vein is divided and ligated using 4-0 PG suture. Moving forward, the superficial temporal artery and vein are divided. The lower border of the gland is elevated, and the external carotid artery is divided and ligated. Subsequent to this, the internal maxillary and transverse facial arteries are also divided and ligated at the gland's anterior border. This series of steps culminates in the successful removal of the deep lobe. **(11)**

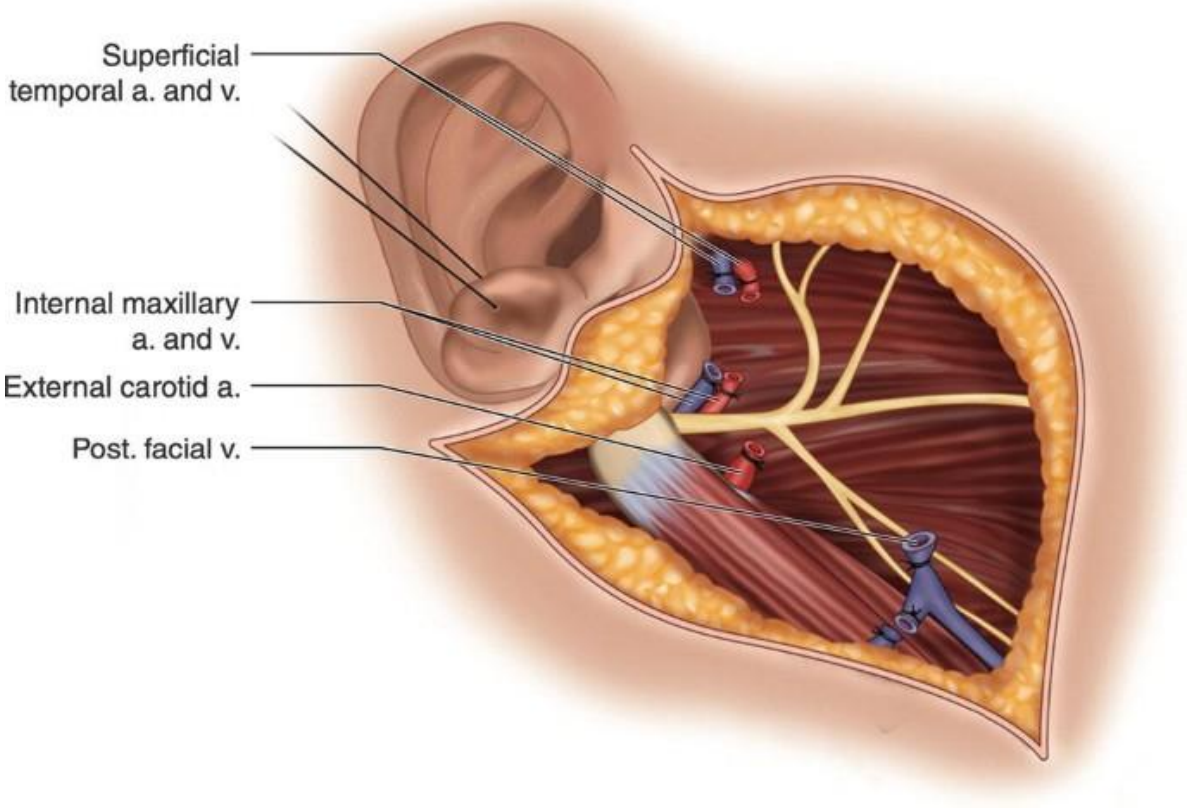

Fig (5): Operative Field After Deep Lobe Removal **(9)**.

- **Drainage and Closure**

A small Silastic closed suction drain is inserted through a puncture wound positioned posterior to the incision. The incision is closed utilizing interrupted 5-0 PG sutures for the platysma and subcutaneous fat, while the skin is closed with interrupted 5-0 nylon sutures. The closed suction drain is retained until drainage substantially diminishes, typically spanning 3–4 days postoperatively **(12)**.

Complications of Parotid Surgery

Hematoma occurs at a rate of 0.9%, with meticulous hemostasis being crucial for prevention and potential surgical reintervention for bleed control. Facial paralysis, often attributed to stretching when anatomically identified and with intact branches, is more common in total parotidectomy than in superficial parotidectomy. Transient paralysis has an incidence of 16.6% to 34%, typically recovering within 1 month, although it can persist for up to 18 months. Preventive measures to avoid exposure keratitis, such as ophthalmic drops, ointments, consultations with ophthalmologists, gold weights, and botulinum toxin, should be considered based on the evaluation of eye closure capability. Seroma can be managed through needle aspiration and compression dressing. Surgical site infection risk varies; while prophylactic antibiotics are debated, more extensive procedures with neck dissection and free flap reconstruction have higher infection risks and benefit from perioperative antibiotics. In standard parotidectomy, intraoperative antibiotics usually suffice for most patients **(13)**.

Another complication is Frey's syndrome more accurately referred to as gustatory sweating. Patients report facial swelling and sweating at the site of the parotidectomy in occurrence with meals. Etiology is believed to be aberrant innervation of the sweat glands with branches emerging from the auriculotemporal nerve after their division during surgery. This provides parasympathetic innervation to the normally

sympathetic-innervated sweat glands. Diagnosis is usually based on patient history, however if there is any doubt an iodine-starch test (Minor test) will confirm the diagnosis, where iodine starch placed on the affected area turns blue signaling sweat secretion. The incidence historically has been reported as high as 50 to 100%, though, with modern techniques and the use of SMAS flaps and thicker skin flaps at the time of initial elevation, this is greatly reduced and is now quite rare. Should this develop, surgical treatment options can be disappointing, with the best results obtained using SMAS and superficial temporal artery flaps as a barrier between the surgical site and the skin. Gold standard treatment now is botulinum toxin injection. Relief of symptoms is obtained for 6 to 36 months. It works at the pre-synaptic level of the neuromuscular and neuroglandular junction by blocking the release of acetylcholine **(14)**.

First bite syndrome (FBS); a painful spasm in the parotid region occurring at the first bite during mastication and decreasing afterward. This pain accompanies each meal usually. It is a unique complication of surgeries targeting the deep lobe of the parotid gland, the parapharyngeal space, and the infratemporal fossa. Presumed etiology is the loss of sympathetic innervation of the parotid gland, which will lead to relative parasympathetic overstimulation, resulting in the contraction of parotid myoepithelial cells. This is supported by the fact that Linkov, *et al*., only had one case of FBS when the entire parotid gland was removed. This case had ectopic parotid tissue left in place. Leaving the superficial lobe in place was found to carry a higher risk of FBS. Treatment is often challenging and begins with carbamazepine, which must be titrated. Most patients report improvement with time but never complete recovery. This is thankfully exceedingly rare, and really only encountered in extensive parotidectomy and extended neck dissections that violate the deep fascia of the floor of the neck, traumatizing the superior cervical ganglion **(15)**.

Frequent occurrence of sensory loss around the ear, particularly the lobule, is noted, with substantial yet incomplete improvement expected within a year. Recovery acceleration can be achieved through preservation of the posterior branch of the great auricular nerve. In cases where the GAN is transected, amputation neuroma can arise, necessitating treatment through simple excision. Surgical site depression corresponds to the extent of tissue resection; reconstruction options include SCM flap, although it creates a neck defect, and autologous fat graft. Trismus, characterized by mild and transient inflammation of the masseter muscle, can occur. Sialocele or salivary fistula, arising from salivary duct or gland communication with the skin, results in saliva excretion through the wound. Incidence ranges from 4% to 14%, and management entails frequent drainage, compressive dressing, and possibly reduced oral intake or completion parotidectomy. Botulinum toxin injection offers effective treatment by halting salivary flow **(16)**.

- ***Complications related to the Sacrifice of the Great Auricular Nerve***

When the great auricular nerve (GAN) is frequently sacrificed during parotidectomy, several complications can arise that impact both sensory function and the patient's overall quality of life: **(17)**.

- **Numbness and Sensory Disturbances:** The GAN serves as a critical sensory nerve, supplying innervation to the postero-inferior section of the auricle, the mastoid region, and the lower parotid-masseteric region. Sacrificing the GAN can result in numbness, tingling, and altered sensation in these areas. Patients may experience a lack of sensitivity, making them less aware of touch, pressure, and temperature changes. This can affect daily activities, as individuals might have difficulty detecting pain or discomfort in these regions **(5)**.
- **Discomfort and Functional Impairment:** Numbness and altered sensation can lead to discomfort and functional impairment. Patients might find it uncomfortable to wear earrings due to the absence of normal sensation. Shaving or performing routine tasks that involve contact with the affected areas could cause discomfort. Functional impairment can extend to routine activities like touching or washing the skin, impacting the patient's ability to engage with their surroundings comfortably **(18)**.
- **Potential Neuroma Formation:** The disruption or injury of nerve fibers can sometimes lead to the formation of neuromas. Neuromas are abnormal nerve growths that can generate localized pain, tingling, and heightened sensitivity. These growths can exacerbate discomfort and contribute to the altered sensory experience in the affected regions **(19)**.
- **Aesthetic Concerns:** Compromised sensation due to GAN sacrifice can result in altered perceptions of appearance. Patients might notice unusual sensations or discomfort that affect their self-perception.

This could lead to concerns about aesthetics and body image, adding a psychological dimension to the physical challenges they face.

- **Neurotic Excoriation:** Altered sensation can trigger a response known as neurotic excoriation, wherein patients persistently scratch or rub the affected area due to discomfort or unfamiliar sensations. This behavior can lead to skin damage, irritation, and even infections, further exacerbating the overall discomfort experienced by the patient.

The recognition of these potential complications has spurred discussions around the importance of preserving the GAN during parotidectomy. While the sacrifice of the GAN might facilitate surgical maneuvers, preserving this nerve can help maintain sensory function and mitigate the aforementioned challenges **(5)**.

Preservation of GAN during Parotid Surgery; The Procedure

The surgical procedure for Preservation of GAN during Parotid Surgery includes the following; Surgical initiation involves the marking of the ear-to-mouth (e-m) line and an incision line to guide the procedure. In cases where Warthin's tumors are situated in the parotid gland tail, a C-shaped subauricular incision is employed. For other cases, a modified S-shaped incision, originating from the tragus's top, passing through the intertragus notch and anterior cheek skin-border, and connecting with the C-shaped incision, is used. Due to the delicate nature of the lobular branch and its susceptibility to early-stage procedural injuries, a cautious approach is taken during skin incision and flap elevation. The skin incision around the lobule is performed shallowly, limiting subsequent steps to the superficial subcutaneous layer without attempting to expose the branch. Identification of the GAN trunk is a critical step, determining its location within a 5 mm radius from the e-m line under the incision. Following identification, the trunk is traced upward, preserving branches except for the anterior branch, which is sacrificed. The skin flap is then elevated by cutting the superficial subcutaneous layer exposed from the nerve and the layer along the incision line **(20)**.

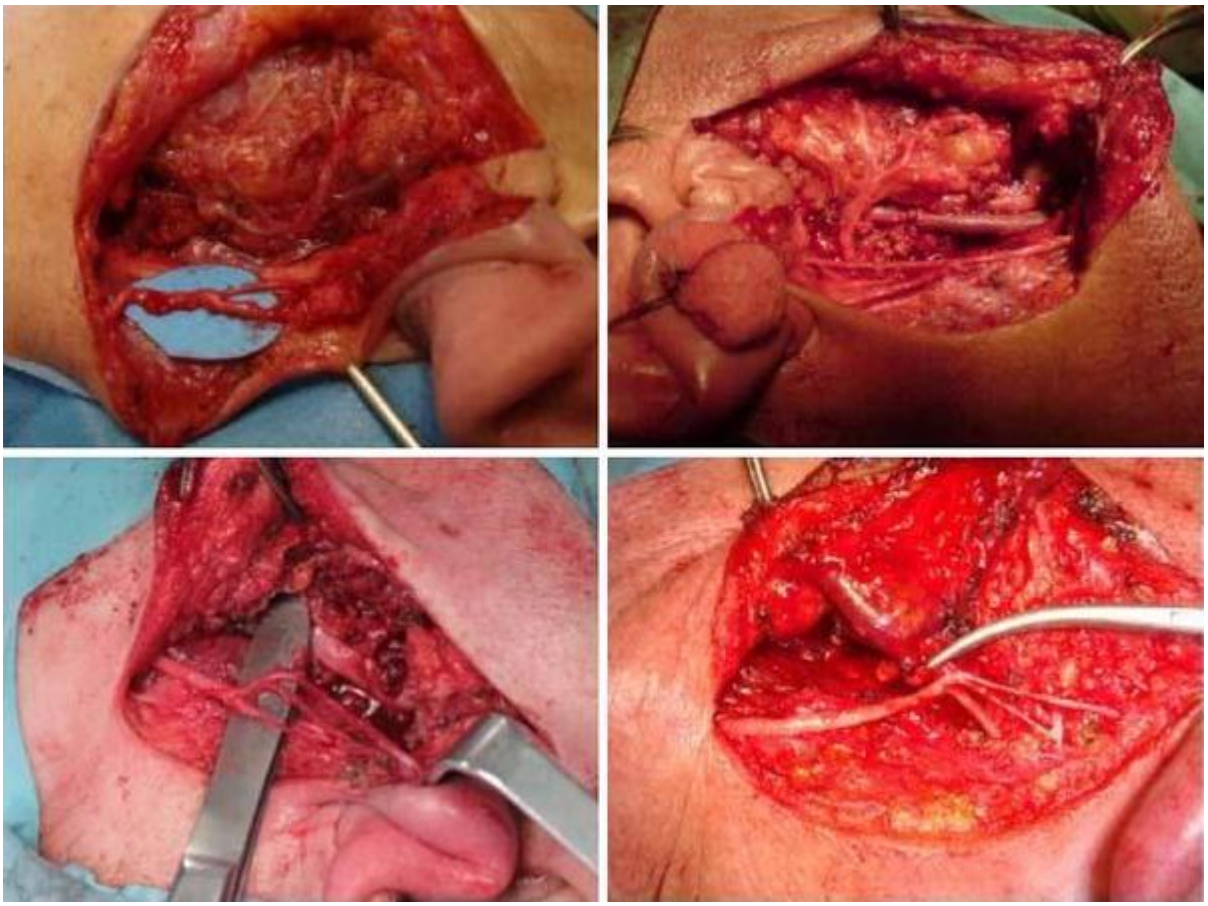

Fig (6): Preservation of the lobular and posterior branches of the GAN. Different anatomical presentations **(21)**.

Further dissection involves the isolation and separation of the nerve, encompassing the trunk and the lobular branch, up to its insertion in the lobule. The nerve is retracted posteriorly, freeing it from the surgical field This isolation and retraction continue through the tumor extirpation process until the repair of the parotid capsule is performed to prevent Frey's syndrome The relationship between GAN preservation and surgical outcomes highlights the evolving understanding of techniques that balance functional preservation and successful tumor management **(17)**.

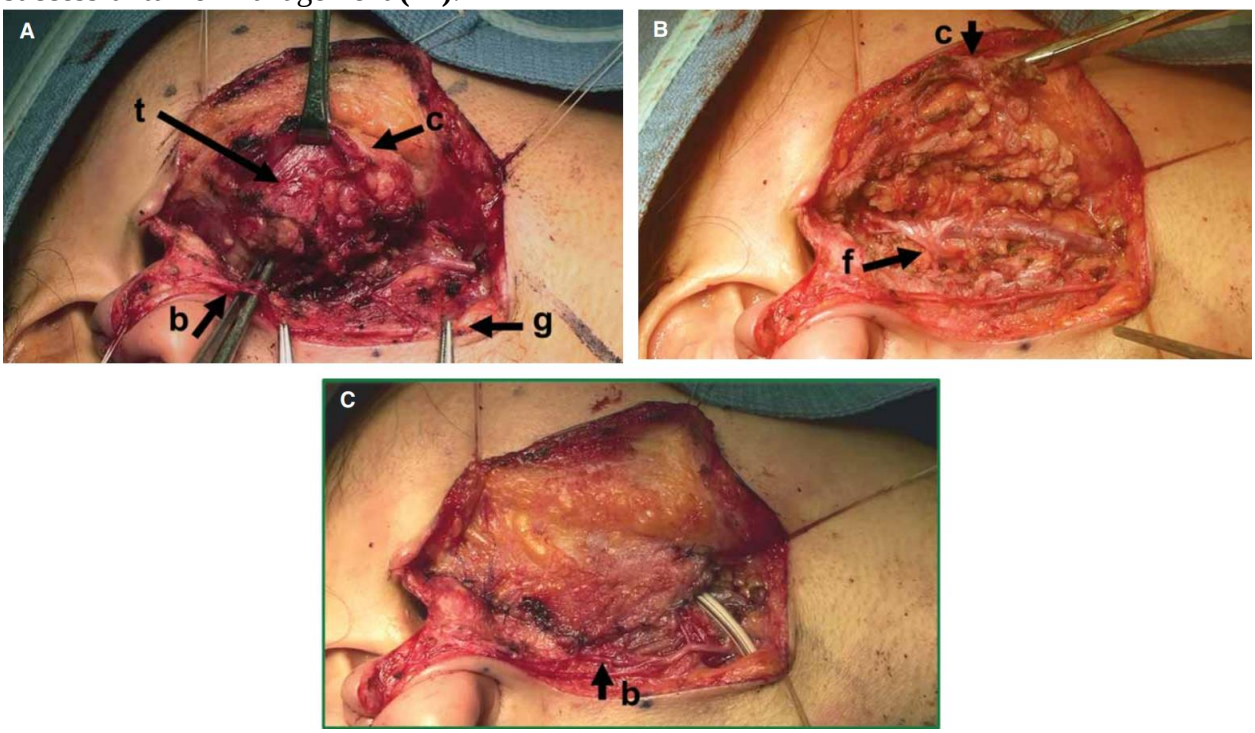

Fig (7): Protection of the great auricular nerve (GAN) during parotidectomy. (A, B) The preserved nerve, consisting of the trunk (g) and the lobular branch (b), is retracted and fixed posteriorly using small forceps in order to free the surgical field. Tumor (t) is removed while conserving the parotid capsule (c) and the facial nerve (f). (C) The parotid capsule is then reconstructed carefully to prevent injury of the nerve. b, the lobular branch **(22)**.

- **Outcomes**

The preservation of the great auricular nerve (GAN) during parotid surgery holds implications for patient outcomes that encompass sensory function, postoperative comfort, and overall quality of life. This approach aims to mitigate the potential complications associated with sacrificing the GAN, including numbness, altered sensation, discomfort, and aesthetic concerns. By opting for GAN preservation, patients may experience improved sensory outcomes in the regions innervated by the nerve. Retaining sensation in the postero-inferior auricle, mastoid region, and parotid-masseteric region can lead to enhanced patient comfort during daily activities such as wearing earrings, shaving, and interacting with their environment **(5)**.

Furthermore, the preservation of the GAN has the potential to mitigate neurotic excoriation—a response triggered by altered sensation that leads to persistent scratching or rubbing of the affected area. This can prevent skin damage, infections, and the associated discomfort. Aesthetic concerns stemming from altered sensations can also be addressed, potentially positively impacting patients' self-perception and body image. By avoiding complications related to GAN sacrifice, patients undergoing parotid surgery might experience improved overall satisfaction with their appearance and well-being **(23)**.

To fully comprehend the outcomes of GAN preservation during parotid surgery, ongoing research endeavors are essential. Long-term studies evaluating sensory recovery, patient-reported outcomes, and quality of life measures can provide a more comprehensive understanding of the benefits and effectiveness of this surgical approach. As medical knowledge advances, GAN preservation has the potential to emerge as a key factor in optimizing the overall surgical experience and outcomes for patients undergoing parotid surgery **(19)**.

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