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Management of benign epithelial salivary gland tumors

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ABSTRACT

The salivary glands stand out as the tissue with probably the most diverse pathology in the human body. Salivary gland tumors are abnormal cells growing in the ducts that drain the salivary glands. Benign tumors are more common with the major glands. This review highlights management of benign epithelial salivary gland tumors. This covers various types of parotidectomy and techniques of submandibular gland excision. Endoscopic approaches and sialendoscopy are the recently used modalities. The key to surgical success is early identification of the facial nerve, meticulous dissection, and eradication of all disease at the time of initial surgery.

Introduction

The treatment of choice for most salivary gland neoplasms is complete surgical excision. Because most parotid tumors occur in the region of the tail of the gland and are superficial to the facial nerve, parotidectomy with identification and preservation of the facial nerve is diagnostic and curative in most cases.

Parotid Gland

The benign tumor is treated by excision of the " lobe " containing the tumor. When the superficial lobe is the site of the tumor a superficial lobectomy, leaving the facial nerve intact, is appropriate;the deep lobe tumor is managed by total parotidectomy preserving the facial nerve. Tumor size and the special relationship of the tumor to the facial nerve may also increase the complexity of parotid surgery.

Submandibular Gland [1]

The benign tumors are managed by excision of the gland, leaving the entire surrounding areas stripped absolutely clean of all fascia [1].

Minor Glands

The benign tumors of minor glands should be excised with a margin of normal tissue. In the palate it is probably safe to leave the underlying bone stripped bare especially if the defect, allowed to heal spontaneously or grafted, can subsequently be watched carefully.

Parotidectomy

Parotidectomy can be separated into four distinct parts:

1. Skin incision and exposure of the gland – This part of the procedure is common to all the resection procedures unless skin is being excised because it is involved by tumor.
2. Identification of the facial nerve – The nerve can be identified either proximally as the main trunk before it enters the gland, or distally as it branches after it has left the gland.
3. Tumor resection – Depending on the pathological problem this can take several forms:

a) Superficial lobectomy

b) Total parotidectomy with preservation of the facia

c) Radical parotidectomy with or without neck dissection in continuity

4. Reconstruction-This is required only if skin has been resected and is usually provided by flap cover [1].

Superficial parotidectomy

Superficial parotidectomy entails the removal of the lateral portion of the parotid gland with preservation of the facial nerve. It is the standard operation for the masses that arises in the portion of the parotid gland lateral to the facial nerve, particularly when the histopathologic nature of the mass has not been confirmed. Superficial parotidectomy is adequate treatment for benign tumors of the superficial parotid gland, such as pleomorphic adenoma [2].

Superficial parotidectomy with partial deep lobe resection

This is commonly performed for benign tumors of the central deep parotid gland, such as pleomorphic adenoma involving the gland deep to the facial nerve. The surgeon may not always be able to predict the relationship of the tumor to the peripheral nerve preoperatively, and the decision to resect the deep gland may evolve during the operation after dissection of the superficial gland [2].

Surgical Technique

The surgery is typically performed under general anesthesia with oral intubation. The endotracheal tube should be secured to the opposite side with the patient's head rotated laterally toward the contralateral shoulder. The skin should be prepared and draped to expose the ears, the corner of the mouth, the lateral canthus, and the neck to allow for observation of facial twitching during the dissection. A reverse Trendelenburg position aids in minimizing blood loss [3].

Incision

The parotidectomy incision must achieve three essential requirements: adequate exposure of all of the parotid region, with the possibility of extending the incision to allow neck dissection, and leaving a minimum of cosmetic sequelae.

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The incision is drawn with a skin pencil and takes into account the natural skin folds of the face and neck, classically forming a bayonet-shaped incision comprising three segments [4] (figure 1):

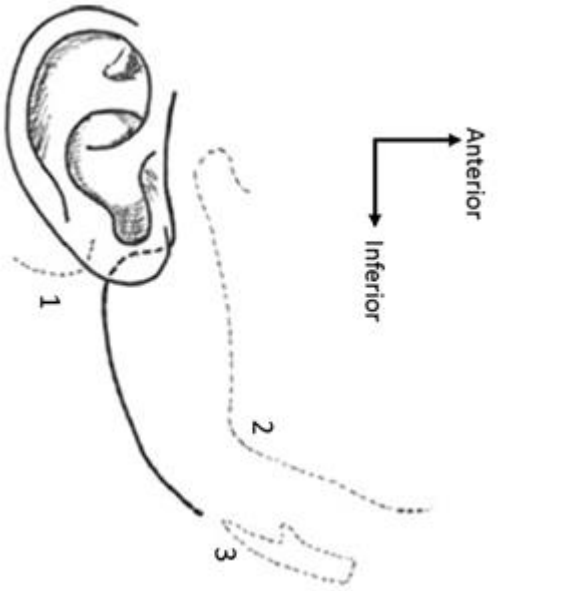

Figure 1. Elongated S-shaped incision.

1) projection of the tip of mastoid
2) projection of the angle of the mandible
3) projection of the greater cornu of the hyoid bone

• a vertical preauricular segment in the pretragal sulcus from the crus of the helix to the lobule;
• an intermediate, horizontal or slightly upward curved segment, flush with the insertion of the lobule and ending at the anterior border of the mastoid;
• a vertical segment that descends along the anterior margin of the sternocleidomastoid muscle (SCM), joins the superior cervical flexion fold and descends two fingers below the anterior border of the mandible to end about 2 to 3 cm anterior to the angle of the mandible [4]. The junction between these various segments must be curved, avoiding any acute angles, especially in the region below the lobule, which predispose to skin necrosis. Numerous modifications, to varying degrees, of this basic incision have been described, generally corresponding to cosmetic rather than oncological concerns. A first variant is designed to conceal the first segment of the incision in the external acoustic canal, by using the intertragic notch on the posterior surface of the tragus, and then in the intertragolobular groove. A second variant is designed to conceal the third segment of the incision in the scalp, by using a facelift incision. These variants must never compromise the quality of exposure of the parotid gland and the extent of tumour resection [4].

The modified Blair incision is commonly used for routine parotid surgery (figure 2). The incision should follow the crease just anterior to tragus and curve gently below the ear lobule before it becomes almost horizontal in the upper neck about 2 cm below the mandibular angle, preferably along a skin crease. The incision in the preauricular region may be modified to endaural design to conceal scarring. Cross-hatching the incision with a blade or using intradermal dye markings may aid in alignment of the incision during closure. The dissection is carried through the subcutaneous tissues to the parotid fascia while avoiding entering the gland or the tumor mass.

The assistant should exert a constant upward and anterior traction of the skin flap while the surgeon maintains countertraction in a posterior direction [5].

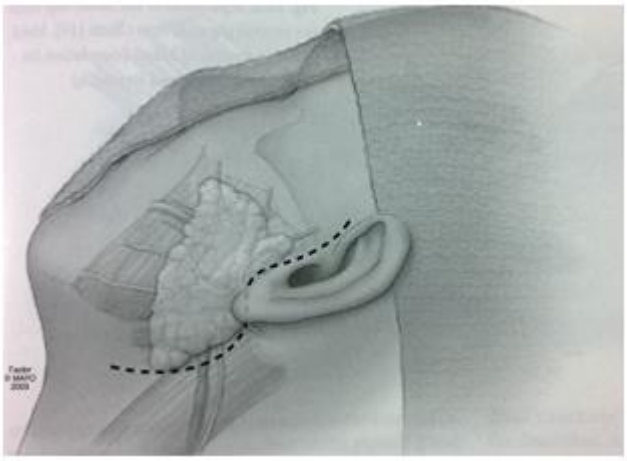

Figure 2 - Parotid incision

The flap may be raised to the anterior border of the parotid gland by creating tunnels parallel to the course of the branches of the facial nerve. At this point, only blunt dissection should be done and the masseter muscle fascia should be identified (figure 3).

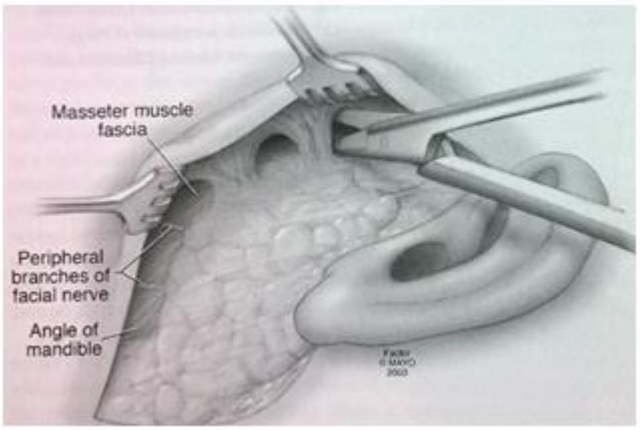

Figure 3-Separation of the facial flap from parotid gland

Failure to dissect beyond the gland anteriorly will make it difficult to remove the gland later on. The tail of the parotid and the key inferior landmarks are then exposed by identifying the sternocleidomastoid muscle (SCM). The fascia overlying the muscle provides a safe plane to elevate the tail of the gland. The greater auricular nerve (GAN) and the external jugular vein (EJV) will be encountered. Some surgeons advise against ligating the EJV early in the dissection to avoid edema and venous congestion in the gland. The GAN is a sensory nerve that provides sensation to the skin overlying the parotid gland, the mastoid area, and the pinna of the ear. The GAN travels deep to the SCM, then turns and runs along its superficial surface before entering the inferior surface of the parotid. This nerve is divided as close to the gland as possible in an attempt to save sensory branches if possible, and to serve as a potential nerve graft if needed. Preserving the posterior branch of the GAN may result in less sensory loss [5].Then, the posterior border is dissected off the cartilaginous ear

canal down to the level of the cartilaginous pointer. The posterior belly of the digastric muscle must be identified and dissected [5].

Identification of the facial nerve trunk (FNT) [3] (figure4)

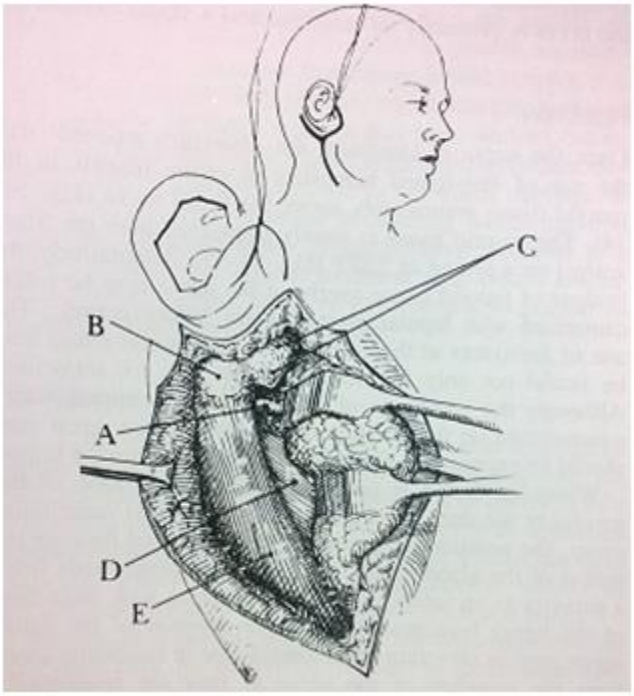

Figure 4 - Anatomic structures used in identification of (A) Facial nerve are (B) Mastoid tip, (C) Tragal pointer, (D) Posterior belly of digastric muscle and (E) Sternocleidomastoid muscle.

Multiple anatomic landmarks have been described for identifying the location of the FNT.

- Tragal pointer

The main trunk of the facial nerve is located 1 cm anteroinferior and 1 cm deep to the tip of the tragal cartilage.

- Digastric ridge

The main trunk is just superior to the attachment of the posterior belly of the digastric muscle to the digastric groove. This landmark also marks the approximate depth of the facial nerve.

- Stylomastoid foramen

The base of the styloid process is 5 to 8 mm deep to the tympanomastoid suture line. The facial nerve can be identified as it exits the stylomastoid foramen and passes over the posterolateral aspect of the styloid process.

- Tympanomastoid suture line

The nerve lies 6 to 8 mm deep to the inferior end of the tympanomastoid suture line.

- Mastoid

For revision cases, extensive tumors or, as a last resort, a mastoidectomy can be performed to locate the vertical segment of the facial nerve, which can then be followed as it exits the mastoid [3].

The facial nerve may also be identified in a retrograde fashion by tracing a terminal branch proximally. Several key relationships are helpful in identification of one or more terminal branches. The cervical branch of the facial nerve is just lateral to the posterior division of the retromandibular vein. The marginal mandibular nerve courses along the inferior border of the parotid gland and passes superficial to the retromandibular vein. The buccal branch travels with the parotid duct and usually lies just superior to the duct.

The temporal branch crosses the zygomatic arch midway between the tragus and lateral canthus, anterior to the superficial temporal artery and vein. After the main trunk of the facial nerve is localized, the pes anserinus is exposed and followed as it branches into the zygomaticotemporal and cervicofacial divisions. Each terminal nerve branch should be traced meticulously in a contiguous fashion, as skipping sections of nerve increases the likelihood of nerve injury [6]. Every attempt should be made to spare the facial nerve and its terminal branches. However, resection of the nerve may be indicated for direct tumor involvement or encasement of the nerve. The decision to preserve or sacrifice the nerve must frequently be made intraoperatively. The use of intraoperative facial nerve monitoring, an operating microscope, or a nerve stimulator may aid in the intraoperative localization and preservation of nerve branches. Although the use of intraoperative monitoring may provide useful feedback intraoperatively, its routine use is controversial given increased cost and operating time without clear improvement in outcomes [3].

The parotid gland is then grasped and retracted with Allis clamps, while a fine curved clamp is used to carefully dissect each branch of the facial nerve from the gland parenchyma [7] (figure 5).

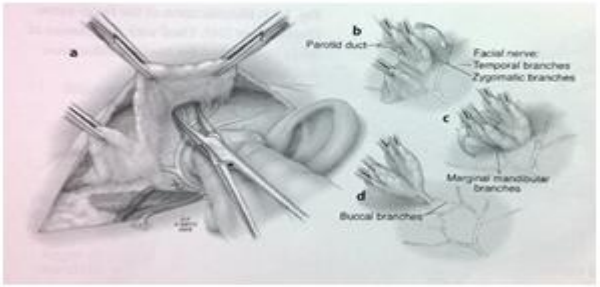

Figure 5 - Dissecting the facial nerve from the superficial gland

The superficial lobe is separated from the deep lobe in a similar fashion. The superior margin of the gland is then dissected free, taking care to avoid injury to the zygomatic and temporal branches [8]. Near the terminal fibers of the buccal branch, Stensen's duct is identified and ligated. After removal of the gland, hemostasis is achieved using a bipolar cautery. A small drain, usually a Jackson-Pratt, is placed in the cervical portion of the wound. The incision is closed using nylon sutures in the preauricular area and a standard layered closure in the neck. A pressure dressing is sometimes placed to prevent hematoma and seroma formation[9].

Submandibular gland excision

Submandibular gland (SMG) is commonly indicated in patients with neoplasms.

Classification of approaches to the submandibular gland [10]

- Open
- Transoralapproach
  Externalapproach

- Lateral transcervical
- Retroauricular
- Submental

➢ Endoscopic

❖ Endoscopy assisted

- Transoral
- Submental
- Lateral transcervical

❖ Completely endoscopic

Robot-assisted approach

Open techniques

Lateral transcervical approach

The lateral transcervical approach is the standard and time tested means of surgical access to the submandibular gland (figure 6). Indications for excision via this approach

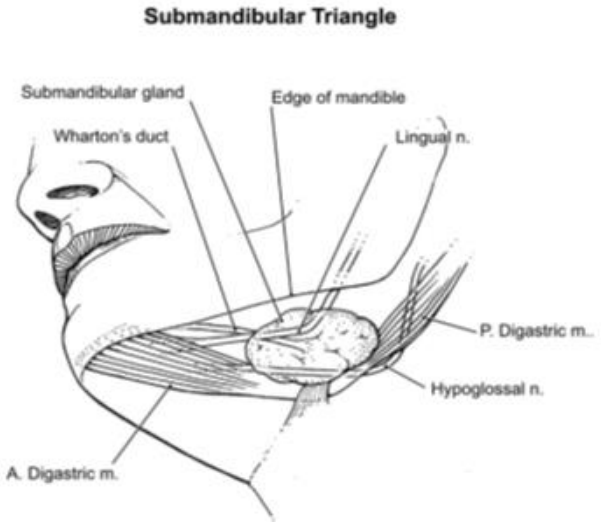

Figure 6 - The lingual nerve loops under the duct running a lateral to medial course and then travels deep and superior to the submandibular gland. The hypoglossal nerve lies inferior and medial to the lower third of the gland under the posterior belly of digastric muscle.

Include neoplasm of the submandibular gland. Lateral transcervical submandibular resection is most commonly performed under general anesthesia. Criteria for gland excision under local anesthesia include a clinically mobile mass without features of malignancy based on fine needle aspiration biopsy (FNAB) in patients who prefer local anesthesia or are at high risk with general anesthesia [10].

Surgical technique

- A 4–6 centimeter incision in placed in lateral neck crease approximately 2 to 3 centimeters below the lower edge of the mandible .
- Subplatysmal skin flap is developed and the marginal mandibular nerve is identified and protected.
- The facial vein is identified and ligated at the inferior border of the gland and reflected superiorly with the fascia over the submandibular gland. This maneuver exposes the submandibular gland and ensures protection of the marginal mandibular nerve.
- The facial artery is ligated or may be preserved by ligating only the branches of the facial artery to the gland.
- Blunt dissection then continues towards the superiomedial surface of the gland at which point the mylohyoid muscle must be retracted anteriorly to complete the dissection.

•Posterior and inferior traction on the gland facilitates identification and differentiating Wharton's duct, the lingual nerve with its attachment to the submandibular ganglion, and the hypoglossal nerve.

•The submandibular duct is then ligated and divided close to its opening in the floor of the mouth.

The gland is liberated from the submandibular ganglion and removed preserving the lingual and hypoglossal nerves [10].

Submental approach

The submental approach provides access to the submandibular triangle via a midline horizontal incision just superior to the submental-cervical crease at the level of the hyoid bone.The location is patient dependent determined by pre existing neck creases, amount of submental fat and skin texture. The site of the incision is marked pre-operatively along the least prominent line of the submental area in the frontal and lateral views of the face and the neck. The submental approach allows quick access to the gland. The submandibular gland is bluntly dissected free of surrounding fascia in a subplatysmal plane. The dissection differs from the traditional approach in that the anterior free edge of the gland is first encountered (figure 7).

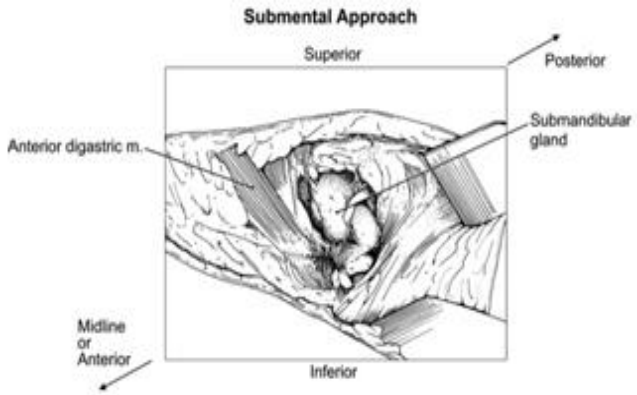

Figure 7 – Submental approach

Following this, the facial vein and artery are ligated and the gland is separated from the edge of the mylohyoid muscle. The submandibular ganglion is identified and separated from the gland. Finally the submandibular duct is ligated and the gland is delivered through the incision. A drain is placed within the incision and is removed on the second or third postoperative day.

Retroauricular approach

The incision is designed in the lower portion of the postauricular sulcus arching toward the middle to upper 1/3rd of the sulcus before transitioning across and downward into the hairline; the portion of the incision in the hairline is set ½ to 1 cm into the hair bearing area (figure 8). The main advantage is the improved cosmesis of the resultant scar. The main disadvantage of the retroauricular approach is the extent of the skin flap that must be raised to access the Wharton's duct proximally which can be 10 cm from the postauricular incision.

Figure 8. Retroauricular approach.

Transoral approach

- An incision is made in the floor of mouth from the submandibular papilla to the retromolar trigone.
- A cuff of mucosa on the gingival side is preserved to allow for tension free closure and to prevent limitation of tongue mobility due to scar contracture.
- The lingual nerve is identified and dissected free of its attachments to the submandibular duct and gland.
- The submandibular gland is bluntly dissected and delivered into the surgical wound by applying external pressure on the neck.
- The hypoglossal nerve is identified and preserved. Branches of the facial artery and vein are ligated with care not to disrupt the marginal mandibular branch of the facial nerve.
- The gland is removed and the wound bed irrigated [10].

Endoscopic approaches

Endoscopic-assisted transoral approach

Endoscopically-assisted transoral excision of the submandibular gland again is similar to its open counterpart[11]. The main advantage of the endoscopic assistance in addition to those that are natural to the transoral approach i.e. lack of a cervical scar and lower incidence of facial nerve palsy again are -

- Good visualization, magnification and illumination of the anatomical landmarks.
- A wider surgical field as compared to the conventional intraoral approach. The endoscopy assisted transoral approach has several *disadvantages* which are common to all endoscopic procedures and include:
- The cost of the endoscopic equipment
- The learning curve associated with the surgeon becoming familiar with the technique
- Increased operative and set up time [10].

Endoscopic-assisted submental approach

This procedure differs from the conventional submental approach in that a smaller incision (20–25 mm) is placed over the skin crease in the hyoid midline. Dissection is performed in a subplatysmal plane. The first assistant maintains an operative view using an endoscope and the second assistant maintains the working space with two retractors which lift up away from the skin. Vessels are ligated using Endoclips {Ethicon Endosurgery} and excision is performed in standard fashion using an ultrasound-activated scalpel). A drain is placed for drainage. The advantages of this approach include a smaller incision as compared to the standard submental approach. In addition, the use of an ultrasound-activated scalpel which does not transmit an electric current reduces the risk of thermal injury to the marginal mandibular nerve as compared to monopolar and bipolar electrocautery [10]. However, the disadvantages include those that are common to all endoscopic procedures as well as a significant increase in operative time as compared to the conventional submental approach [70 min, (50–120 min) vs. 41 min, (32–56 min).

Endoscopic transcervical approach

Access to the subplatysmal plane of dissection is achieved via two 15 mm incisions (one anterior and the other posterior), 10 mm below the submandibular area. A 4 mm diameter, 30-degree endoscope provides the surgical view when placed in the posterior incision. The operative pocket is created and maintained using trans-cutaneous sutures. The dissection is otherwise conducted in a usual fashion (figure 9) [12]. Extirpation of the gland is done through one of the incisions.

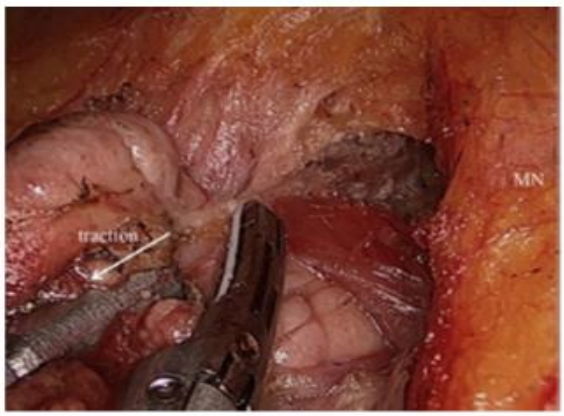

Figure 9. Dissection of the submandibular gland (SMG) using Harmonic curved shears during endoscope-assisted resection (EAR).

Endoscopic submandibular gland excision using co2 Insufflation

Monfared et al (2002) described an endoscopic approach to the submandibular gland in a porcine model using balloon dissection to create an operative pocket which was constantly maintained with low pressure (no more than 4 mm Hg) CO2 insufflation[13]. Three incisions were made. The central 14 mm incision accepts the 12 mm trocar which houses the endoscope while the two lateral incisions (6–7mm) were used to place the 5 mm operative trocars. The main advantage of the robotic-enhanced endoscopic surgery includes a virtual three dimensional vision projection system with an endoscopic arm and two operative arms that can be controlled by the surgeon from a remote console. In addition, the robotic arm permits use of a full range of articulated instruments which can reproduce surgical maneuvers in difficult to access locations. The disadvantages of robotic surgery are high cost and lengthy set up time [14].

Robotic sialoadenectomy of the submandibular gland via a modified face-lift approach

The robot-assisted technique could overcome the limitations of endoscopes, which are rigid and straight and which lack the ability to articulate or provide a

3-dimensional surgical view. In addition, the ergonomically designed robotic system is more convenient for the surgeon, allowing for the frequent collision of endoscopic instruments [15].

Procedure

The patients are placed in the supine position under general anaesthesia. The neck is extended, and the head turned away from the lesion. A 5–6 cm modified face-lift skin incision is made on the lesion side, 5 mm inside the hairline (figure 10) [16]. A supraplatysmal skin flap from the incision to the submandibular region is dissected using an electrical cautery under direct vision (figure 11). At the submandibular lodge, the gland is easily identified. At this point, the platysma is dissected to the level of the inferior margin of submandibular gland and the subplatysmal flap is elevated. Still under direct vision, the posterior pole of the gland is isolated.

At this point, if identified, the facial vein would have been cauterized or ligated with harmonic scalpel, also under direct vision[17].

A self-retractor is inserted through the skin incision and the flap is raised using a lifting device to keep a comfortable working space. The robotic system is set-up. A face-down 30-degree endoscope is inserted through the incision and the two instrument arms are located on both sides of the endoscope. The right arm is equipped with a harmonic scalpel, the left arm with a Maryland forceps (figure 12). The lingual nerve and hypoglossal nerve are identified and preserved endoscopically, and the gland (including the intraglandular mass) is removed [18].

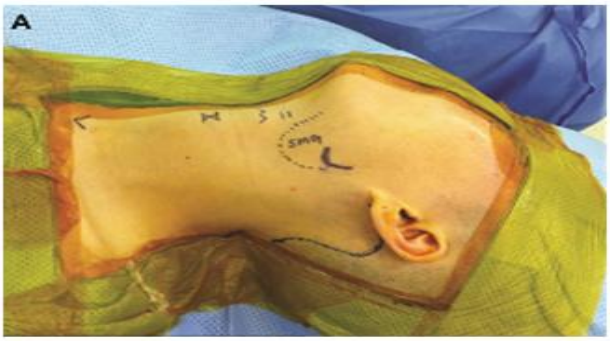

Figure 10. The patient is placed in the supine position under general anaesthesia. The neck is extended and turned away from the lesion. A 5–6 cm modified face-lift skin incision is made on the lesion side, 5 mm inside the hairline.

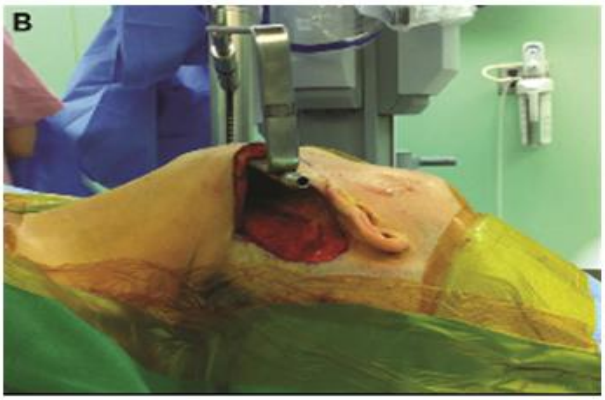

Figure 11. A supra-platysmal skin flap from the incision to the submandibular region is dissected using electrical cautery under direct vision. A self-retractor is inserted through the skin incision and the flap is raised using a lifting device to maintain a comfortable working space.

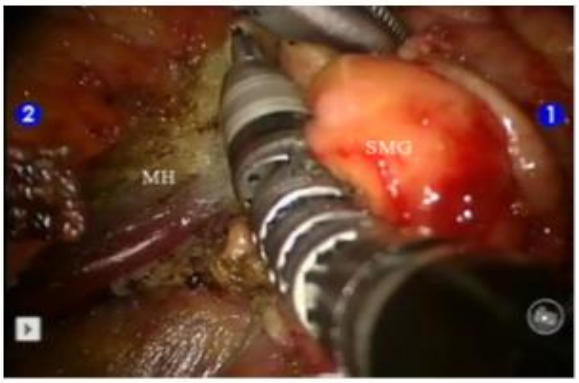

Figure 12 . Distal articulation of the maryland forceps and cautery. The multiangular movement of the robotic arms enables dissection of the superior and medial aspect of the submandibular gland.

Sialoendoscopy

The sialoendoscope is a small endoscope that can be introduced intraorally into the salivary gland using a major salivary gland duct. There are two mandatory components to a sialoendoscope, the optical fibers and an irrigation port. The optical fibers typically are encased in a semi rigid material. They come as a self-contained unit with irrigation or working ports, or they can be introduced into a sheath that contains irrigation or working ports.The diameter of the total unit is the limiting factor (figure 13). Generally, it is difficult to introduce a sialoendoscope without an incision into the duct when the diameter of the endoscope is 1.3 mm or greater. At the diameter of 1.2 mm, a stent must be introduced to prevent scarring caused by adhesion formation within the distal portion of the salivary duct [19].

Figure 13. Karl Storz sialoendoscope.

Technique

Before the introduction of the scope into the ductal system, the opening must be dilated. Lacrimal probes and dilators are needed to accomplish this aspect. Lacrimal probes are placed into the duct, starting at size 4–0, sequentially increasing in size to 8. If the probes are placed with excessive pressure, perforation of the duct into the surrounding tissues may occur. Once this occurs, it can be difficult to reintroduce the probes along the correct pathway, and extravasation of fluid into surrounding tissues is likely. Balloon dilation also can be performed within the distal portion of the duct using either salivary duct balloon

dilators or size 3or 4 Fogarty catheters [20]. Following successful dilation, the sialoendoscope is introduced into the gland opening; irrigation (normal saline or ringers lactate) is aprovided through one of the ports under pressure. This expands the duct and ductules away from the optical portion of the endoscope, allowing visualization of the duct and glandular tissues. The initial portion of the surgery is the most productive and visible portion. If there has been sufficient extravasation of fluid into the surrounding areas, the ducts are constricted by the surrounding engorged salivary tissue, and visualization becomes impaired. The types of surgery most conducive to pure endoscopic surgeries are: diagnostic sialoendoscopy, sialolithectomy, sialoendoscopic biopsy, and lysis of adhesions [19].

Conclusion

Parotid surgery presents special challenges to the surgeon, because most of the tumors removed are benign and patients commonly expect complete function of the facial nerve after surgery. The surgery may be further complicated by other factors including previous irradiation, infection, and previous surgery. Tumor size and the special relationship of the tumor to the facial nerve may also increase the complexity of parotid surgery.

The aim of surgery is to safely remove the tumor with normal adjacent parotid tissue margins while preserving the function of the facial nerve provided there is no direct nerve involvement. Superficial parotidectomy is the universally accepted method for removing benign tumors of the parotid. Partial superficial parotidectomy is similar to superficial parotidectomy with the exception that fewer branches of the facial nerve are dissected and less normal parotid tissue is removed.

For tumors involving submandibular gland, surgical excision is done. Ultimate treatment recommendations are based on histological grade, location, and extent of the disease. The key to surgical success is early identification of the facial nerve, meticulous dissection, and eradication of all disease at the time of initial surgery.

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