Management of the Submandibular Gland in Neck Lifts

Indications, Techniques, Pearls, and Pitfalls

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KEYWORDS

• Submandibular gland • Neck • Neck lift • Face lift • Neck rejuvenation • Subplatysma • Mandibular nerve • Bleeding

KEY POINTS

- Patients who present for facial rejuvenation often choose to undergo treatment of cervical contour after the initial consultation.
- Physical examination and photographic analysis, including an upward view of the flexed neck, are important surgical planning steps in neck rejuvenation.
- Knowledge of subplatysmal anatomy is crucial for favorable results of neck rejuvenation. The authors introduce novel techniques for management of the submandibular salivary glands.
- The authors describe safety maneuvers to avoid and manage bleeding while treating structures in the subplatysmal region.
- If carefully planned and conducted, partial removal of the submandibular salivary glands is a helpful and safe technique in neck rejuvenation.

Video content accompanies this article at http://www.plasticsurgery.theclinics.com/.

INTRODUCTION

Deformities of the cervical region can exacerbate the appearance of facial aging.[1] However, patients who seek facial rejuvenation typically do not specify the neck as the primary concern. We have found that a thorough interview and examination of the patient—involving photographic analysis in various views—often has the effect of shifting the patient's chief concern to the neck. Adequate diagnosis and treatment of this area are paramount to achieve patient satisfaction.

The cervical region generally is regarded as a stratified structure comprising layers of skin, subcutaneous tissue, and platysma, much like the middle third of the face. However, findings of anatomic and surgical studies have indicated that subplatysmal structures, such as the digastric muscles, mylohyoid muscle, hyoid, subplatysmal fat, and bilateral submandibular salivary glands (SMSGs), affect the 3-dimensional shape of the neck (**Fig. 1**).[2] These structures may interfere with the criteria for a youthful cervical appearance, as described by Ellenbogen and Karlin[3]: a distinct inferior mandibular border, an identifiable subhyoid depression, a visible thyroid cartilage bulge, a discernible anterior border of the sternocleidomastoid muscle, and a cervicomental angle between 105° and 120° (**Fig. 2**). Furthermore, the neck is an articular region, which distinguishes it

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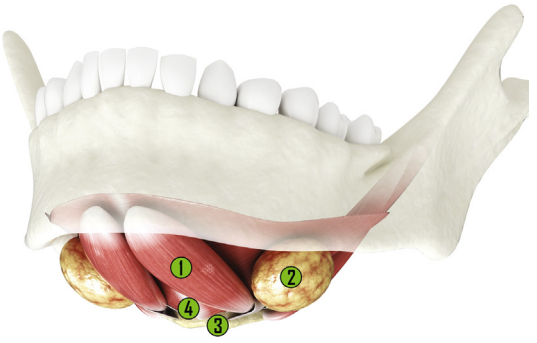


Fig. 1. Subplatysmal structures that affect neck contour. (1) Anterior belly of the digastric muscle, (2) submandibular salivary gland, (3) hyoid, and (4) mylohyoid muscle. Subplatysmal fat (not depicted) is distributed around these structures and also may contribute to contour deformities.

from the front and middle third of the face. Neck flexion may yield increased skin flaccidity and intensify the appearance of aging.

Herein, we describe a safe and effective subplatysmal technique of neck rejuvenation in which special attention is given to the SMSGs. We explain how to diagnose hypertrophy and ptosis of the SMSGs and how to determine whether partial resection is indicated.

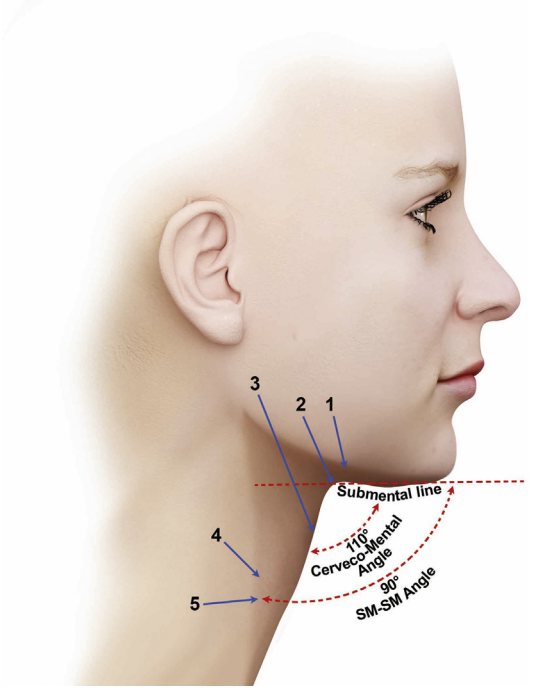


Fig. 2. Criteria for a youthful neck appearance, as described by Ellenbogen and Karlin[3]: (1) a distinct inferior mandibular border, (2) a subhyoid depression, (3) a visible thyroid cartilage bulge, (4) a visible anterior sternocleidomastoid border, and (5) a 90° sternocleidomastoid–submental angle and a cervicomental angle between 105° and 120°.

CONSULTATION

Patients who present for facial rejuvenation often indicate the eyelids and brows as the primary concerns. However, after surgical consultation with photographic analysis, the patient's primary concern frequently becomes the neck (our unpublished findings; **Table 1**).

Before consultation in our practice from April 2016 to September 2016, 98 patients were asked to specify whether the eyelids and brows, cheeks and nasolabial folds, or neck caused them to seek facial rejuvenation. Most (49.0%) chose the eyelids and brows as their chief concern, followed by cheeks and nasolabial folds (36.8%) and neck (14.2%; see **Table 1**). Patients then were photographed in 4 views: front, profile with neck in neutral position, profile with flexed neck, and upward view with flexed neck. When asked again, 53.0% of patients indicated the neck as the chief concern. We have found that a patient usually evaluates his or her face in frontal view, rather than in profile, which may explain these findings. We now routinely include photographic evaluation during the first consultation to ensure that patients' presenting concerns are addressed effectively.

PHYSICAL EXAMINATION

Palpation of subplatysmal structures is valuable for predicting intraoperative findings. Several maneuvers may help with determining the size and position of these structures (**Fig. 3**).

Table 1
Chief concern of patients before and after receiving consultation with photographic analysis

Chief Concern	Before Consultation, n (%)	After Consultation, n (%)
Eyelids and brows	48 (49.0)	28 (28.6)
Cheeks and nasolabial folds	36 (36.8)	18 (18.4)
Neck	14 (14.2)	52 (53.0)

Data represent a series of 98 patients who were evaluated from April 2016 to September 2016.

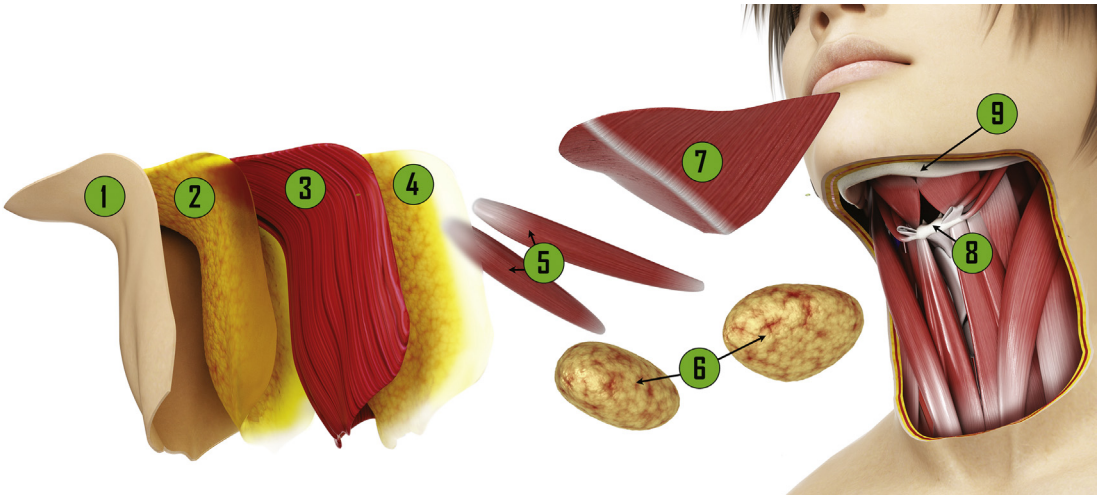


Fig. 3. Structures that contribute to an aging appearance of the neck that should be addressed on physical examination: (1) skin, (2) subcutaneous fat, (3) platysma, (4) subplatysmal fat, (5) digastric muscle, (6) submandibular salivary gland, (7) mylohyoid muscle, and (8) hyoid. The mandible (9) is also shown.

By pinching the submental region, the surgeon may be able to detect subplatysmal structures (**Fig. 4**). The density of interdigastric and subplatysmal fat and the width of the anterior belly of the digastric muscles also can be evaluated with this maneuver. With the patient's neck flexed, palpation of the submental area enables assessment of subplatysmal structures, including the SMSGs, the digastric muscles and the hyoid (**Fig. 5**), because this position relaxes the anterior aspect of the neck. Palpation also allows for evaluation of flaccidity of the platysma and skin and determination of dermal creases that need to be released during surgery (**Fig. 6**).

The SMSG is located in the submandibular triangle, the sides of which comprise the anterior and posterior bellies of the digastric muscle and the lower border of the mandible (**Fig. 7**). The size of the SMSGs varies among healthy individuals; patients who are 50 or more years of age—or sometimes younger—usually present with hypertrophy and ptosis of the SMSGs, which interfere with a pleasing contour of the neck.

Radiologic evaluation of the neck may be indicated based on the patient's medical history and physical examination findings.

PHOTOGRAPHIC ANALYSIS

Easy access to digital cameras has changed the way patients perceive and monitor their physical features. In our experience, patients who undergo

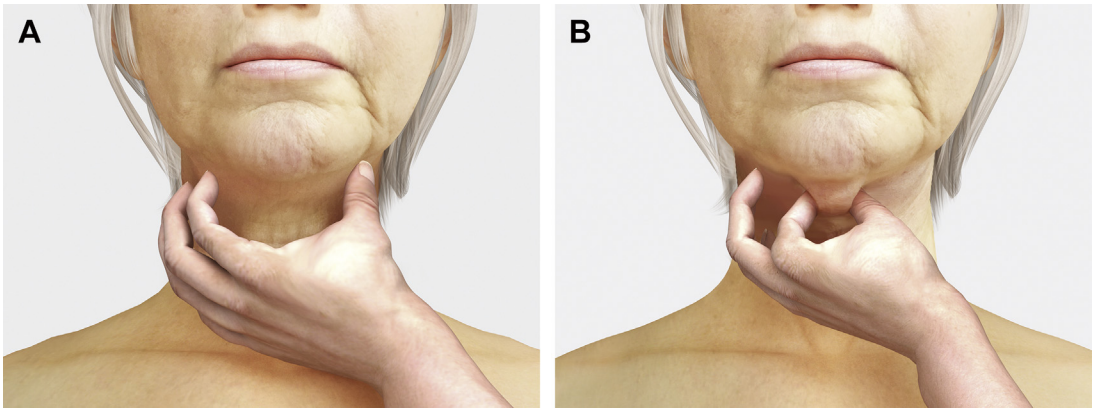


Fig. 4. Palpation of the submental region. (*A*, *B*) The bidigital pinch test allows the surgeon to assess the density of the interdigastric and subplatysmal fat and the width of the anterior bellies of the digastric muscles.

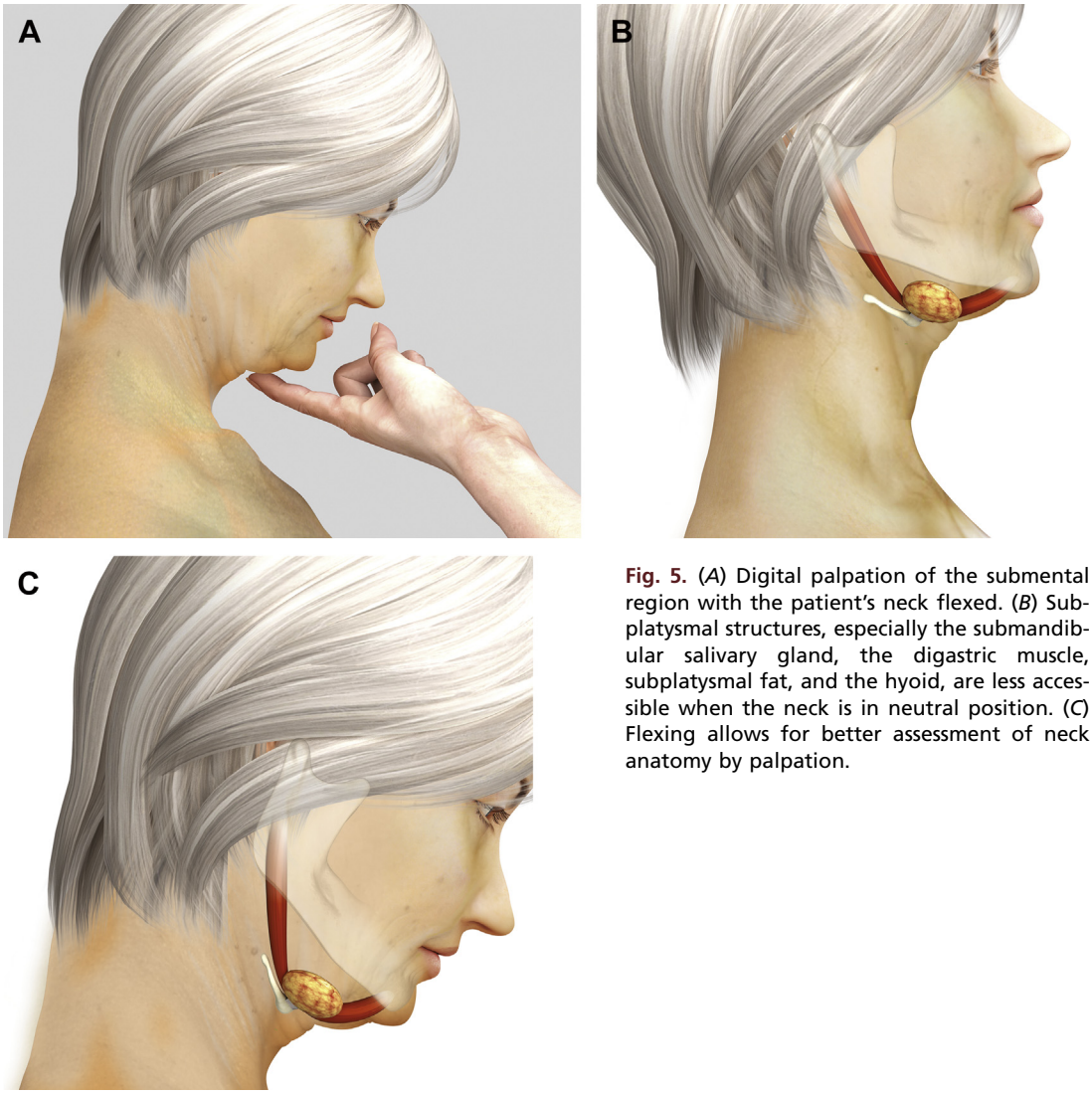


Fig. 5. (*A*) Digital palpation of the submental region with the patient's neck flexed. (*B*) Subplatysmal structures, especially the submandibular salivary gland, the digastric muscle, subplatysmal fat, and the hyoid, are less accessible when the neck is in neutral position. (*C*) Flexing allows for better assessment of neck anatomy by palpation.

facial rejuvenation often monitor postoperative recovery by taking photographs of themselves and comparing these images with those taken preoperatively. The surgeon should exercise care to obtain routine preoperative and postoperative photographs in numerous views: front, oblique, profile with neck in neutral position, profile with flexed neck, and upward view with flexed neck. These photographs should be referenced intraoperatively because anatomic structures may shift when the patient is in the Trendelenburg or supine position.

These authors determined recently that imaging in upward view with the patient's neck flexed helps the surgeon to identify submental structures, define the skin redundancy, and ascertain whether an open surgical procedure should be performed in the neck.[4] These photographs are obtained with flash and zoom features disabled. The camera is positioned approximately at the level of the xiphoid appendix and oriented upward. The patient is asked to flex the neck and look at the camera for the photograph (**Fig. 8**). Landmarks observable in an upward-view photograph are consistent with findings of the physical examination of the neck (**Fig. 9**) regarding interplatysmal, interdigastric, and subplatysmal fat; the SMSGs; the submental crease; the mandibular ligament; mental fat; and skin redundancy and creases. The submental crease is difficult to evaluate in

Fig. 6. Evaluation of the skin of the cervical region and platysma. (*A*) The neck in neutral position. (*B*) The neck in flexion allows for improved assessment of skin and platysma redundancies.

other photographic views, but is depicted well in an upward view. Patients who are younger tend to have a minimal crease or no crease; those who are older usually have a noticeable submental crease that extends to the submandibular ligament (**Fig. 10**).

INDICATIONS AND LEARNING CURVE

For neck rejuvenation involving submental access and treatment of subplatysmal structures, the surgeon should consider the patient's degree of concern with his or her neck as well as physical examination findings. Because the technique involves treatment of disparate structures, open surgical rejuvenation of the neck can be complex and challenging, but also rewarding. Feldman's textbook on neck rejuvenation offers an excellent and detailed description of this subject.[5] We have found that assisting in oncologic neck dissection and examining fresh cadavers are helpful to enhance the plastic surgeon's knowledge of neck anatomy. Surgeons who lack experience in neck procedures should start with patients for whom flaccidity of the platysma is the main indication and subsequently consider cases involving the digastric muscles. Treatment of the SMSGs should be undertaken only after significant experience has been gained.

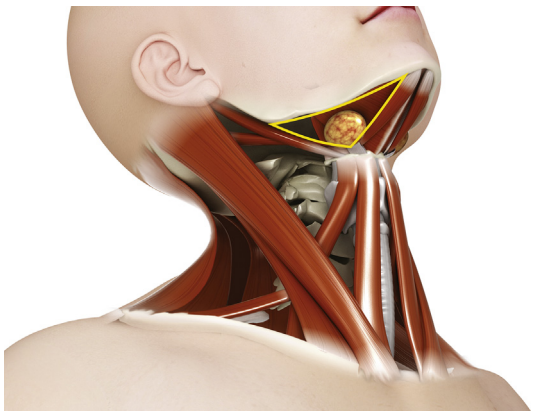


Fig. 7. The submandibular salivary gland is located in the submandibular triangle (depicted in *yellow*), which is defined by the anterior and posterior bellies of the digastric muscle and the lower border of the mandible.

TREATMENT OF THE SUBMANDIBULAR SALIVARY GLANDS

Treatment of the SMSGs involves resection of the bulging superficial lobe. Alternatively, repositioning may be considered for small ptotic glands. Dissection of the neck to the SMSGs should proceed in a specific sequence. Video 1 depicts an edited process of SMSG treatment. For this operation, general intravenous anesthesia with orotracheal intubation is achieved by means of remifentanil, propofol, and dexmedetomidine.[4,6] To improve pain control and facilitate skin

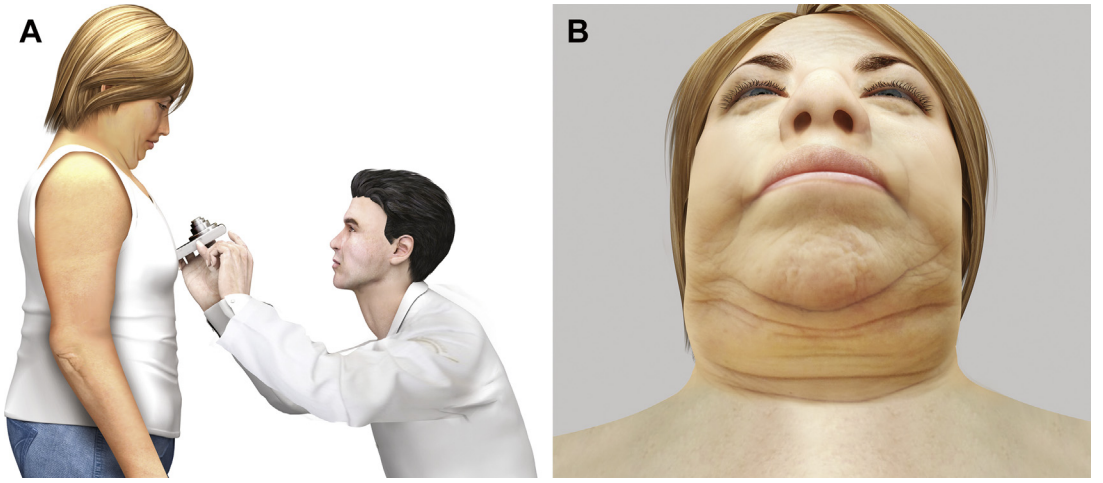


Fig. 8. Upward view of the flexed neck. (*A*) Photographs are taken from below, with no zoom and no flash and with the patient gazing down. The camera should be placed on the patient's chest at the level of the xiphoid appendix. (*B*) A photographic result.

dissection, tumescent local anesthesia is used (1 L of saline, 40 mL of 2% lidocaine, 20 mL of 1% ropivacaine, and epinephrine [1:1,000,000]). The following surgical instruments are necessary for this operation: a lighted retractor, long insulated forceps with delicate teeth, DeBakey forceps, long cautery tips, and a powerful Yankauer suction tip.

With the patient in Trendelenburg position, an incision is made 1.0 to 1.5 cm anterior to the hyoid to facilitate access to the submandibular triangle (**Fig. 11**).[1] The average distance from the midline of the incision to the most lateral part of each SMSG is 5.5 cm, and the average distance to the midline of the submental crease is 7 cm (personal communication, Dr T. Gerald O'Daniel). This incision placement allows for direct access to subplatysmal structures and brings the SMSGs close to the surgical field. In particular, visualization of the posterolateral portion of the gland's superficial lobe, which contains the central perforating artery, is facilitated with this approach.

NECK LAYERS AND THE SUBCUTANEOUS UNDERMINING

The surgeon should be comfortable identifying and dissecting the strata of the neck (**Fig. 12**). Initial subcutaneous undermining should be limited to the area in which the SMSGs are located (**Fig. 13**). This undermining may expose major veins, including the anterior jugular vein and its collaterals. Further dissection should be avoided at this stage because it may encourage bleeding. In addition, care should be given to prepare a skin flap with adequate thickness to avoid skin slough.

INTERPLATYSMAL AND INTERDIGASTRIC FAT RESECTION

Evaluation and resection of the interplatysmal and interdigastric fat proceed after undermining (**Fig. 14**). Enough fat should be removed to reduce the submental bulge and allow identification of the anterior bellies of the digastric muscles. The authors advise against liposuction in this step because the consistency of this fat typically is fibrous and difficult to suction and because liposuction may traumatize the skin flap. The platysma then is lifted by pulling its medial border and temporarily affixing it to the skin flap with a 5-0 nylon suture (**Fig. 15**). Gentle blunt dissection is performed to further detach the platysma from subjacent structures until the infrahyoid region is reached. At this point, the surgeon should be able to see the anterior belly of the digastric muscle.

CERVICAL TRIAD

The cervical triad comprises the anterior belly of the digastric muscle (and intermediate digastric tendon), the SMSG, and the hyoid (**Fig. 16**) and is an important reference for locating the SMSGs. The digastric muscle is identified and followed to the hyoid. The SMSGs are predictably positioned lateral to this junction.

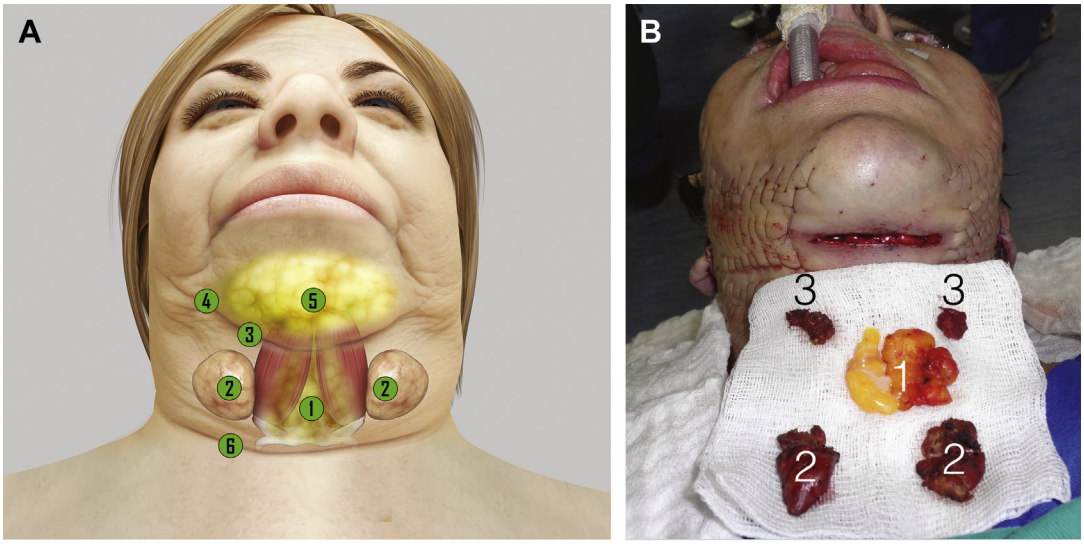


Fig. 9. Upward view of the flexed neck. (*A*) Structures that may be assessed on physical examination and in photographic analysis include (1) the interplatysmal and interdigastric fat and anterior bellies of the digastric muscles, (2) the submandibular salivary glands, (3) the submental crease, (4) the mandibular ligament, (5) the mental fat compartment, and (6) the cervical skin redundancy. (*B*) Intraoperative view with the following structures resected: (1) interplatysmal and interdigastric fat, (2) submandibular salivary glands, and (3) anterior bellies of the digastric muscles. (*C*) Preoperative views of this 53-year-old woman with the neck in neutral position (*left*) and on upward view with the neck flexed (*right*).

HYOID REPOSITIONING

After removal of interplatysmal and interdigastric fat, the surgeon should examine the deep investing cervical fascia and determine whether to reposition the hyoid. The superficial layer of the deep investing fascia is a whitish covering in the midline that envelopes the suprahyoid, perihyoid, and infrahyoid regions. The investing fascia extends posteriorly and attaches to several ligamentous and bony structures, including the cervical spine.[5,7] This fascia can be applied to reposition the hyoid. Specifically, the investing fascia is released and partially removed in the suprahyoid region to facilitate elevation of the hyoid. The anterior bellies of the digastric muscles then are approximated with 1 or 2 stitches in the adjacent area of the intermediate tendon and pulley tissues. In the infrahyoid region, the fascia is preserved. Plication of this fascia at the level of the hyoid and inferiorly repositions it more superiorly and posteriorly, thereby improving the contour of the neck (**Fig. 17**). The strong bony attachments of the fascia help to ensure the durability of the surgical result. Moreover, plication brings the SMSGs closer to the midline, which facilitates visibility and accessibility for resection.

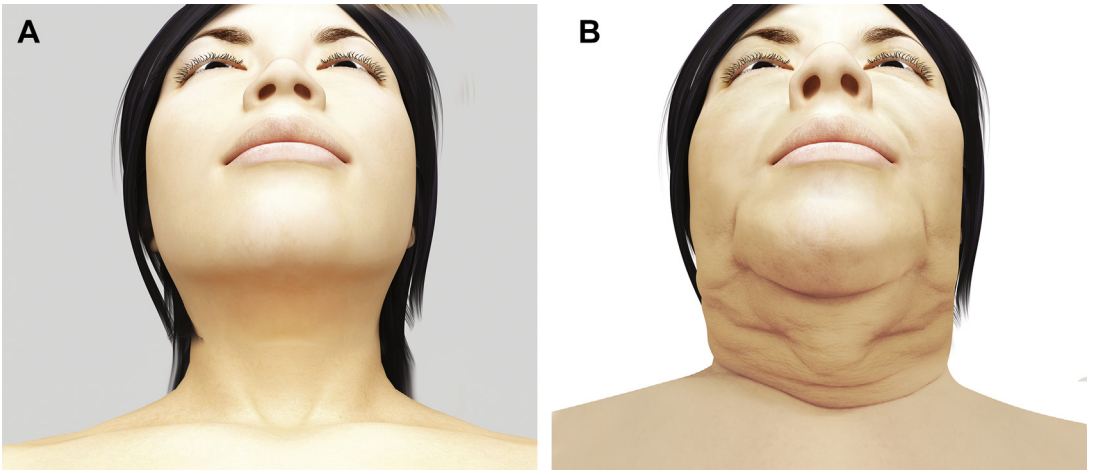


Fig. 10. Upward views of the flexed neck. (*A*) A young woman with a subtle submental crease. (*B*) An older woman with a deep submental crease and skin flaccidity.

PARTIAL RESECTION AND PLICATION OF THE ANTERIOR BELLIES OF THE DIGASTRIC MUSCLES

Hypertrophy of the anterior bellies of the digastric muscles can yield excessive submental volume. With the patient's neck flexed, the surgeon can identify these structures and estimate volume preoperatively by palpation. If hypertrophy is confirmed intraoperatively, wedge resection of 30% to 40% of the anterior bellies can be undertaken with a Mixter forceps and electrocautery. To manage the remaining anterior bellies and reshape the mouth floor, a digastric corset technique can be performed, as described by Labbé and colleagues.[8] We perform this procedure routinely (**Fig. 18**). The attachments of the mylohyoid muscle to the digastric muscle account for the strength and durability of this plication.

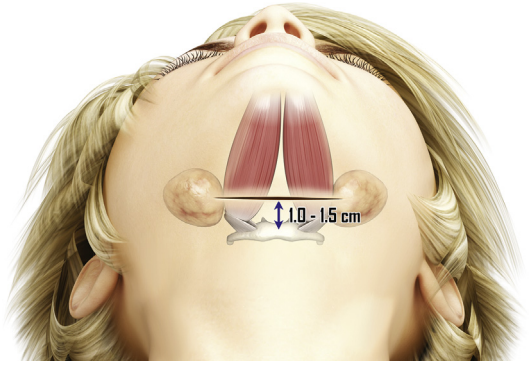


Fig. 11. For neck rejuvenation with a subplatysmal approach, incision placement is approximately 1.0 to 1.5 cm anterior to the hyoid; this method enables direct access to the submandibular salivary glands.

SUBMANDIBULAR SALIVARY GLAND CAPSULE AND THE MARGINAL MANDIBULAR NERVE

The SMSG is initially seen as a whitish aponeurotic structure because it is enclosed in a capsule that originates from the splitting of the investing fascia.[5] In neck rejuvenation, the capsule is opened by blunt dissection with Metzenbaum scissors, and the gland is detached; this step is a necessary precursor to partial resection of the superficial lobe. The gland then is released from its medial attachments and mobilized with fine-tip electrocautery (see **Fig. 18**). This region is devoid of crucial nerve structures, so release is relatively easy. Blood vessels encountered during the procedure should be progressively cauterized as the gland is freed. We advise expansion of the inferior capsule, especially if the surgeon determines that there is insufficient space to manipulate the gland (**Fig. 19**).

The marginal mandibular nerve is located superiorly and external to the capsule. Therefore, the nerve is not at risk of direct injury during release of the gland inside the capsule (**Fig. 20**). The authors have found transient weakness of the lower lip depressor muscle in 5.6% of patients who undergo this procedure, a similar rate observed by other surgeons.[4,5] The cause of this temporary weakness has not been ascertained, but may be attributed to the use of monopolar cautery, the narrow space for dissection, and/or direct

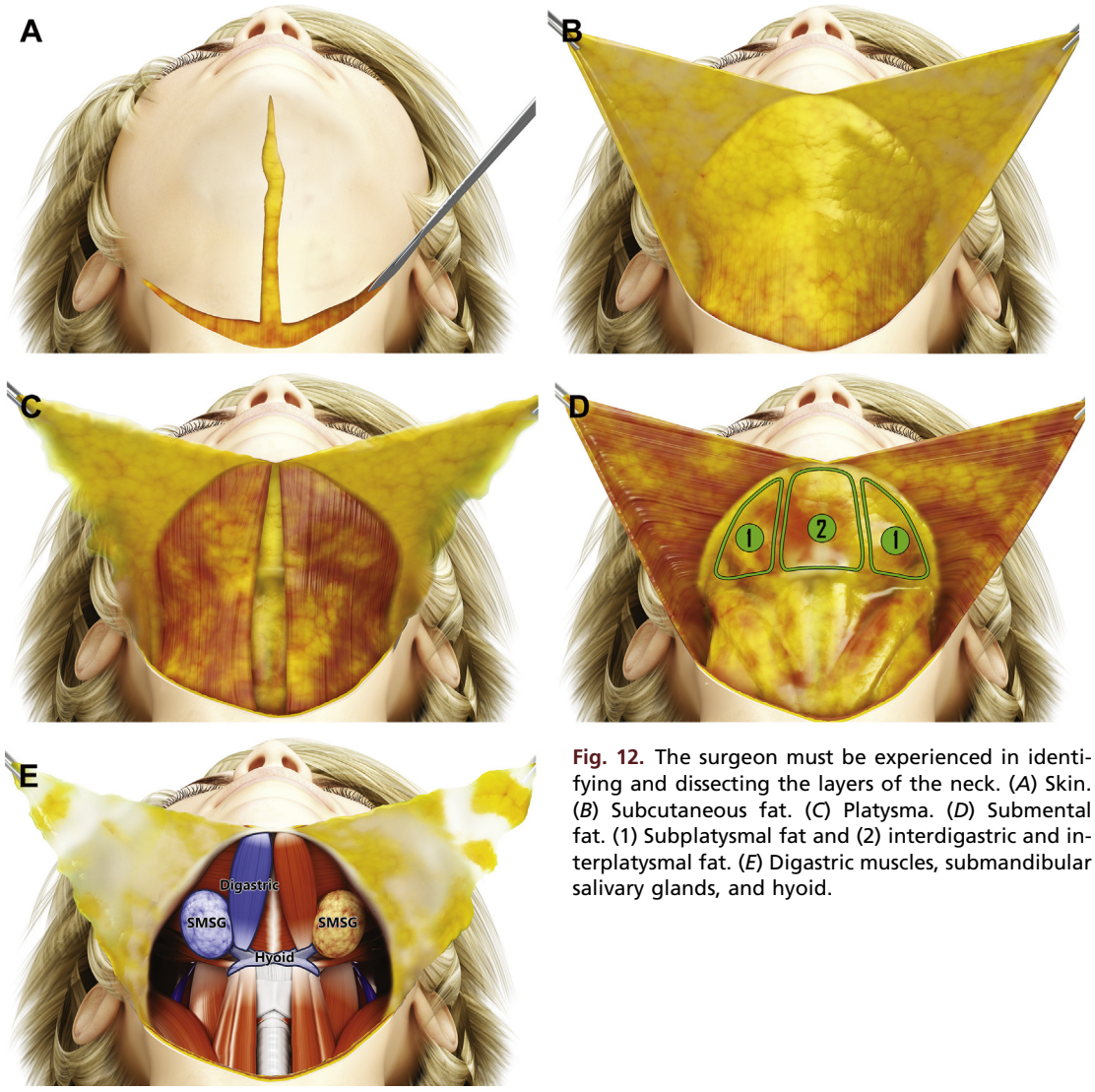


Fig. 12. The surgeon must be experienced in identifying and dissecting the layers of the neck. (*A*) Skin. (*B*) Subcutaneous fat. (*C*) Platysma. (*D*) Submental fat. (1) Subplatysmal fat and (2) interdigastric and interplatysmal fat. (*E*) Digastric muscles, submandibular salivary glands, and hyoid.

trauma by the light retractor. Bilateral injection of botulinum toxin in the lower lip depressor muscle can be offered to alleviate the patient's concerns regarding asymmetric movement of the mouth during the recovery period, which takes up to 90 days (Video 2).

PARTIAL REMOVAL OF THE SUBMANDIBULAR SALIVARY GLAND

With the SMSG freed, the surgeon should analyze whether its volume justifies partial resection. We suggest an anatomic parameter to help determine the resection volume. A line is drawn between the lowest point of the anterior belly of the digastric muscle and the inferior border of the mandible. The portion of each SMSG that bulges below this line is resected (**Fig. 21**).[4]

The most inferior and anterior portion of the superficial lobe of each SMSG is removed with fine-tip electrocautery and forceps (**Fig. 22**). Horizontal and vertical passes of the electrocautery device help to control bleeding. Two assistants should participate in this step. One assistant manages the light retractor and applies a hook to pull the chin upward. The other assistant handles the Yankauer suction tip. The gland should be removed in an oblique or transverse plane in relation to the mouth floor. The result can be refined by removing additional

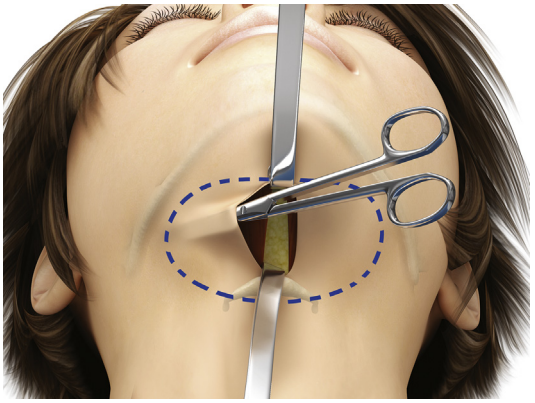


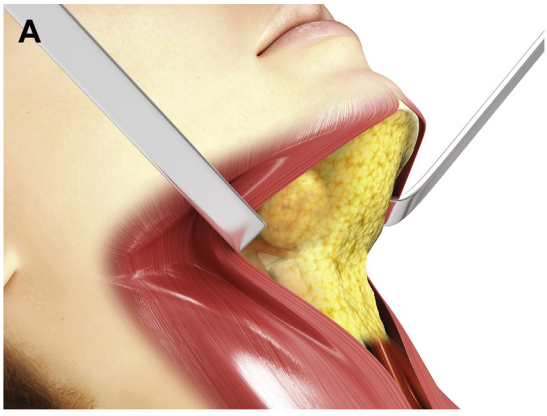
Fig. 13. Initial subcutaneous undermining should be limited to the area within the dashed line.

small portions of the gland. Subsequently, 1.5 mL of 0.75% ropivacaine is injected with a fine needle into the raw surface of the gland (**Fig. 23**) and into the anterior belly of the digastric muscle (Dr Ozan Sozer's personal recommendation). This technique has been found to greatly reduce postoperative pain. We also have found that injection of 5 U of botulinum toxin into the gland helps to diminish saliva production temporarily, which decreases the risk of salivary fistula.

After partial removal of the SMSG, improvement in neck contour can be confirmed by inspection, palpation, and analysis of the upward view of the flexed neck. For patients who undergo preoperative and postoperative radiologic imaging, we have found that the postresection volume of the gland is decreased postoperatively (**Fig. 24**).

RELATIONSHIP OF FACIAL ARTERY AND VEIN TO THE SUBMANDIBULAR SALIVARY GLAND

Hematoma is the most concerning intraoperative and postoperative complication of SMSG resection.[9] The surgeon should be prepared to manage additional bleeding upon accessing the subplatysmal region. The facial artery and vein enter the SMSG capsule in its posterolateral aspect and small branches of the facial artery penetrate the superficial lobe. The most significant branch is the central perforating artery,



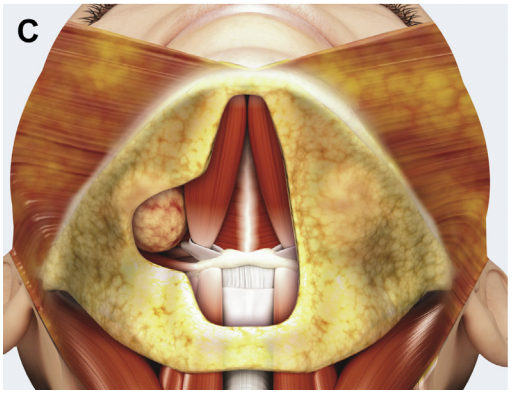


Fig. 14. Removal of interplatysmal and interdigastric fat. (*A*) After subcutaneous undermining, the interplatysmal and interdigastric fat can be examined in the submental area along the midline. (*B*, *C*) Typically, the surgeon must remove this fat to access the anterior bellies of the digastric muscles.

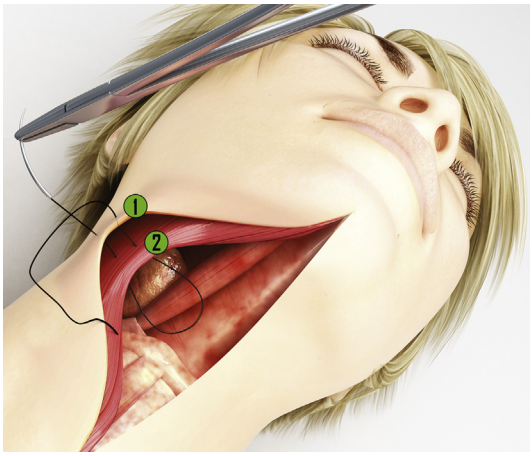


Fig. 15. The platysma (2) is lifted by pulling its medial border and temporarily affixing it to the skin flap (1). This maneuver retracts the platysma from the operating field.

which is located in the most posterior and lateral aspect of this lobe. The facial vein usually is found in the lateral portion of the superficial lobe; however, it is eventually seen in a more medial course over the gland (**Figs. 25–27**).[5,9,10] **Because of the lateral locations of the facial artery and vein, the surgeon should perform blunt dissection when releasing the lateral aspect of the gland.**

Manipulating the SMSG induces pain, which can increase the arterial blood pressure. The anesthesiologist should exercise caution to control blood pressure and pain during this step. In case of intensive arterial bleeding, 2 or 3 gauzes wet with cold saline solution should be applied to the SMSG, while the anesthesiologist ensures that arterial blood pressure is controlled. With a long forceps in one hand and the Yankauer suction tip in the other, the surgeon should try to locate and clamp the bleeding vessel so it can be cauterized by the assistant surgeon. Figure-of-8 sutures may be placed to stop arterial bleeding if cauterization alone is not effective.

If the bleeding originates from a vein, the patient should be moved to the reverse Trendelenburg position to lower the venous blood pressure in the head (**Fig. 28**). The vessel then should be located and cauterized (Videos 3 and 4).

Once bleeding is controlled, the surgeon should ensure complete closure of the raw surface of the gland by means of a continuous stitch with a 4-0 absorbable suture. The needle should be placed to encompass approximately 1 cm of the raw edges because the gland is friable. In addition, the thread must be pulled continuously to avoid bleeding owing to needle passage (**Fig. 29**).[4]

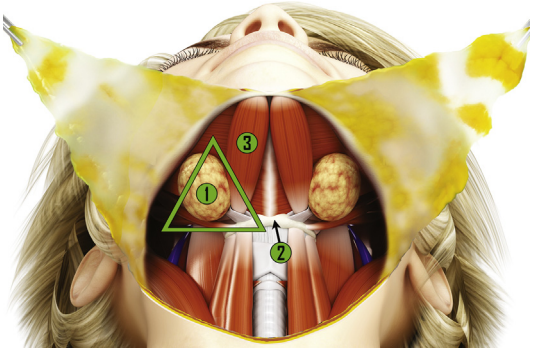


Fig. 16. Subplatysmal structures of the cervical triad. (1) Submandibular salivary gland, (2) hyoid, and (3) anterior belly of the digastric muscle. The submandibular salivary gland is found lateral to the junction of the digastric muscle and the hyoid.

INTERMEDIATE DIGASTRIC MUSCLE TENDON AND SUBMANDIBULAR SALIVARY GLAND REPOSITIONING

The intermediate digastric muscle tendon is a stable structure attached to the hyoid. The surgeon can anchor the SMSG to this tendon after partial resection of the gland or as a means to reposition a ptotic, nonhypertrophic gland. The hypoglossal and lingual nerves as well as the lingual artery and Wharton's duct are located posterior to the intermediate digastric muscle tendon (**Figs. 30** and **31**). Dr Fausto Viterbo has taught these authors a straightforward maneuver to locate the tendon. The assistant pulls the patient's chin upward, placing tension on the muscles of the mouth floor. The surgeon then uses an index finger to palpate the tendon (**Fig. 32**), which is rigid and cordlike. A suture is placed that encompasses the gland and the intermediate tendon (**Fig. 33**). Subsequently, the capsule surrounding each SMSG is closed with absorbable sutures. The platysma flap then is sutured over each SMSG with 1 or 2 stiches to further close the area and help to prevent the leakage of saliva.

PLATYSMA CORSET

Once the subplatysmal structures are treated, the surgeon may extend the subcutaneous dissection laterally to allow for plication of the

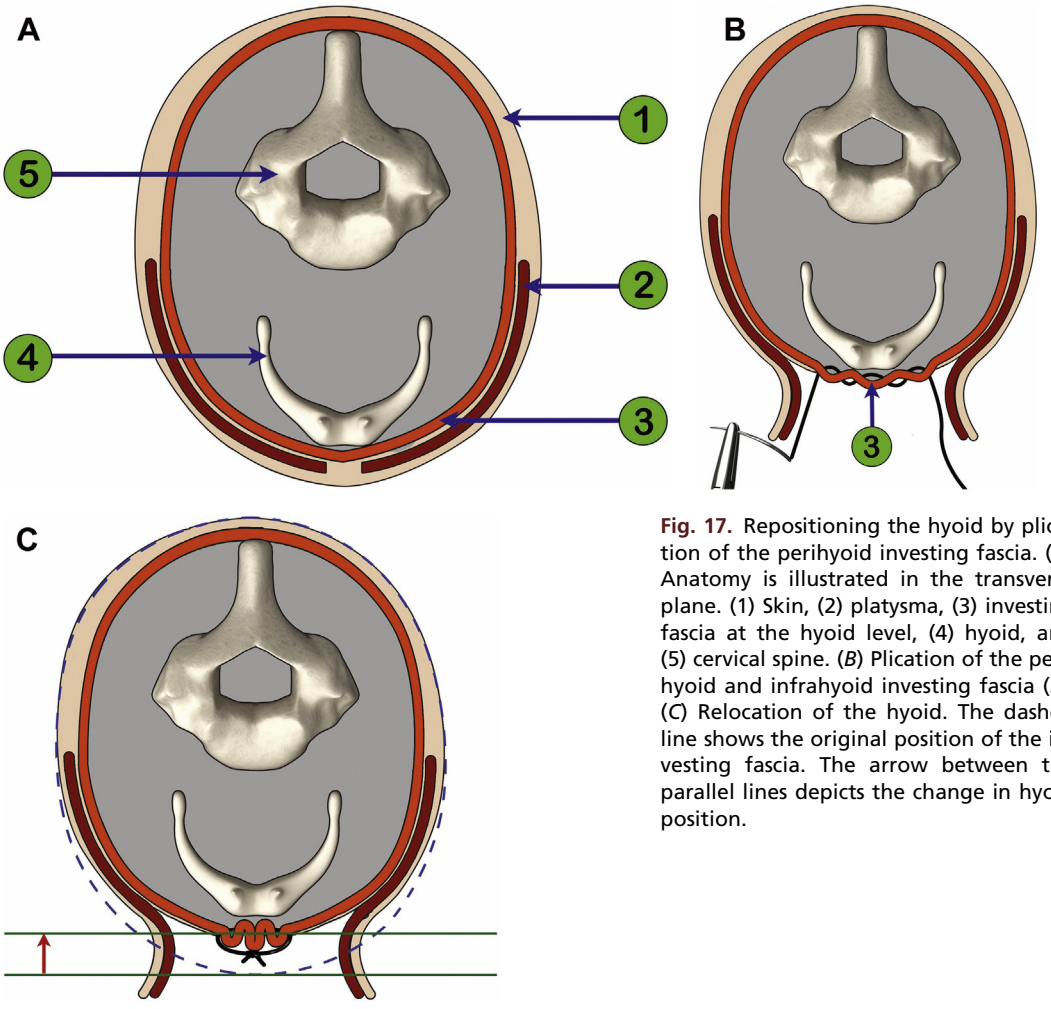


Fig. 17. Repositioning the hyoid by plication of the perihyoid investing fascia. (*A*) Anatomy is illustrated in the transverse plane. (1) Skin, (2) platysma, (3) investing fascia at the hyoid level, (4) hyoid, and (5) cervical spine. (*B*) Plication of the perihyoid and infrahyoid investing fascia (3). (*C*) Relocation of the hyoid. The dashed line shows the original position of the investing fascia. The arrow between the parallel lines depicts the change in hyoid position.

platysma. Plication is carried out by corset suture, preferably in 2 stages. The infrahyoid region is sutured in the first stage. Because the incision is placed close to the hyoid, it is possible to go as low as the sternal notch. In the second stage, the suprahyoid region is closed with a continuous suture that is stopped just before the submental crease. Tumescent infiltration is performed in the chin region to facilitate the release of the submental ligament with Metzenbaum scissors. This procedure enables access to the subcutaneous fat compartment of the chin. By detaching the submental crease, the surgeon also can manage the witch's chin (**Fig. 34**). Chin fat subsequently is trimmed and the platysma corset technique is completed (**Figs. 35** and **36**).

POSTOPERATIVE FINDINGS

Since 2011, the authors have performed subplatysmal neck rejuvenation on 711 patients; 523 of these patients underwent partial resection of the SMSGs. No patient experienced major hematoma from gland resection. Two patients had sialoma, and 1 had a salivary fistula. These complications resolved after treatment with needle aspiration, external compression, and botulinum toxin. We attribute the low incidence of complications to the fact that saliva drains by a pressure gradient. Our procedure involves placing a continuous hemostatic suture over each SMSG and closing each capsule; these steps force the saliva to drain into the mouth. We also apply botulinum toxin, which temporarily decreases saliva production

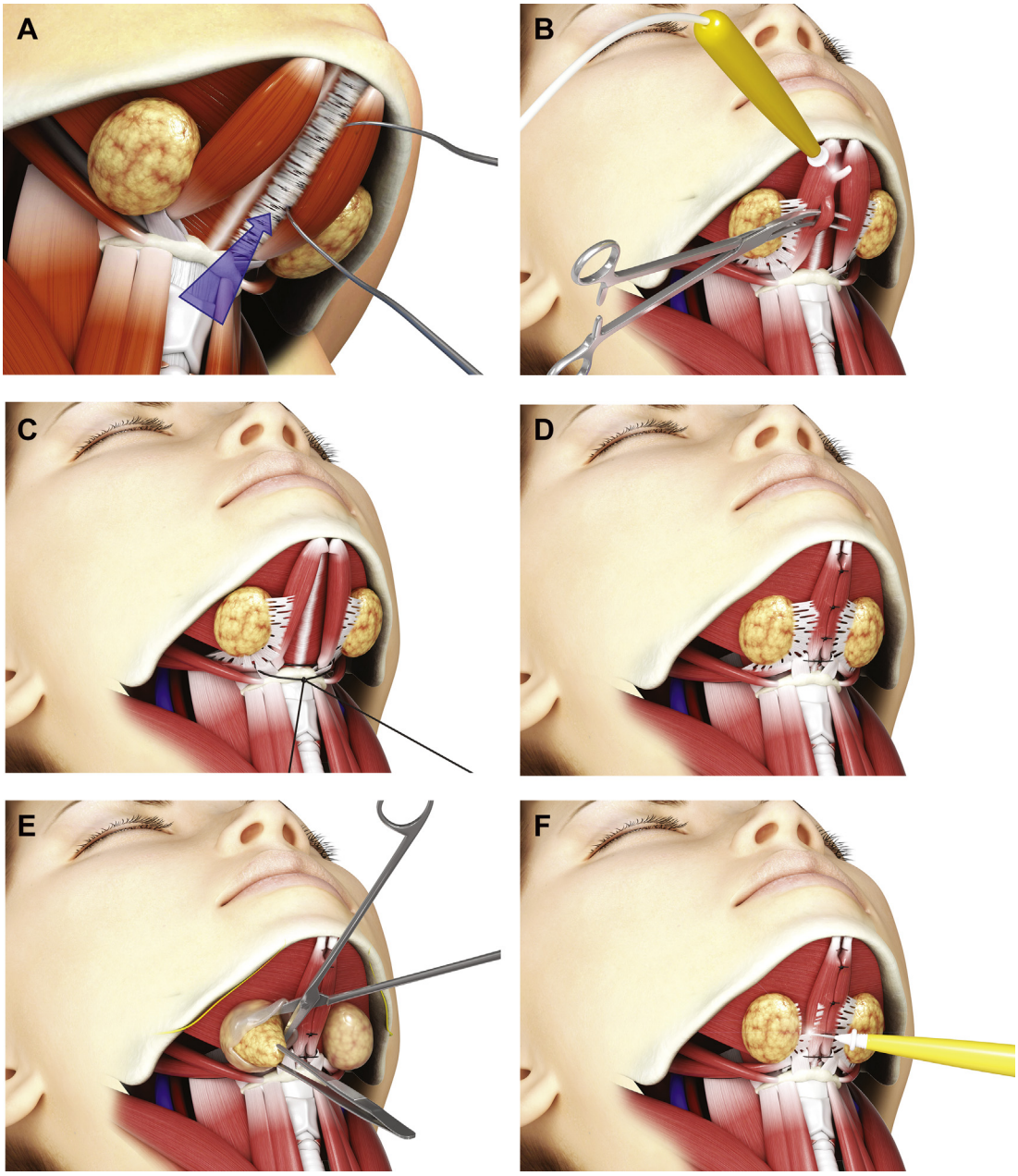


Fig. 18. (*A*) The strength and durability of digastric muscle plication as described by Labbé and colleagues[8] can be attributed to attachments of the mylohyoid muscle to the digastric muscle (*arrow*). (*B*) The anterior bellies of the digastric muscles are resected by 30% to 40% using a Mixter forceps and electrocautery. (*C*) The first stitch in plication of the digastric muscles is placed in the tendinous region of the tissue pulleys. (*D*) Corset plication of the anterior bellies of the digastric muscles. (*E*) Blunt dissection to open the submandibular salivary gland capsule. Freeing the submandibular salivary gland from its capsule is required for resection of the gland. (*F*) Medial gland adhesions are released by fine-tip electrocautery.

from the SMSGs. We do not drain the SMSG space. We have found that partial removal of the SMSGs does not yield dry mouth, as described previously in studies of large series of patients.[4,5]

In our experience, the position and aspect of the submental scar is acceptable to patients. The incision is made in an inconspicuous, shadowed area. In case of hypertrophic scarring, the patient can be treated with serial injections of

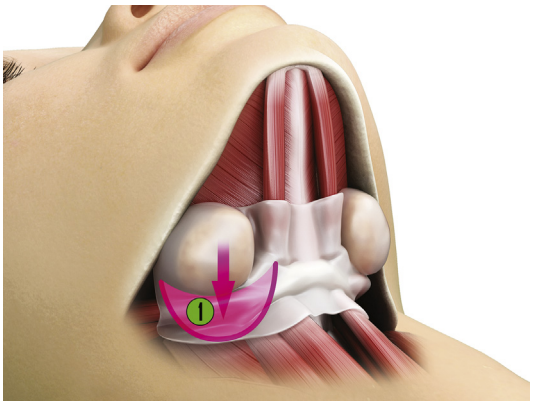


Fig. 19. The capsule is expanded inferiorly (1, *pink shaded area*) to enable manipulation of the gland.

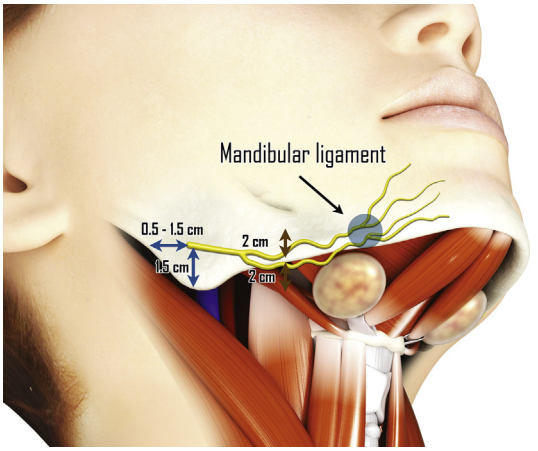


Fig. 20. Marginal mandibular nerve course. The nerve is external and superolateral to the submandibular salivary gland capsule and therefore is at low risk of damage during intracapsular gland dissection.

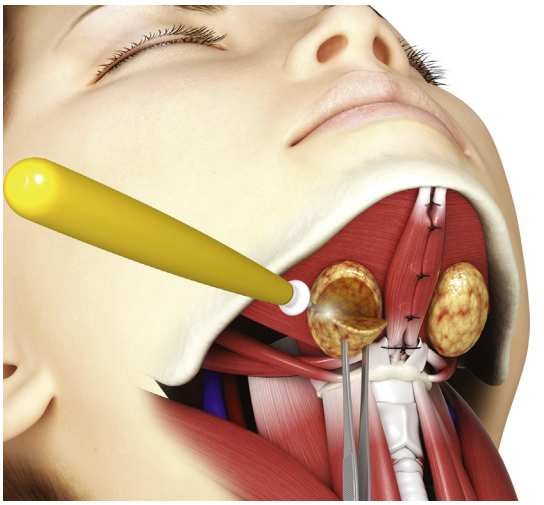


Fig. 22. Resection of the submandibular salivary gland with fine-tip electrocautery.

dexamethasone or 20% triamcinolone or by surgical revision. Fewer than 1% of patients require revision for hypertrophic scarring in our experience. We have found that subcutaneous or subplatysmal fibrosis occurs in approximately 5% of patients. This also may be treated with triamcinolone, but usually resolves by 1 year postoperatively.

A bulge in the neck contour owing to the SMSGs persisted in only 5 patients of the 523 who received gland resection (0.96%). Three of these patients underwent revision subplatysmal surgery to partially remove the gland.

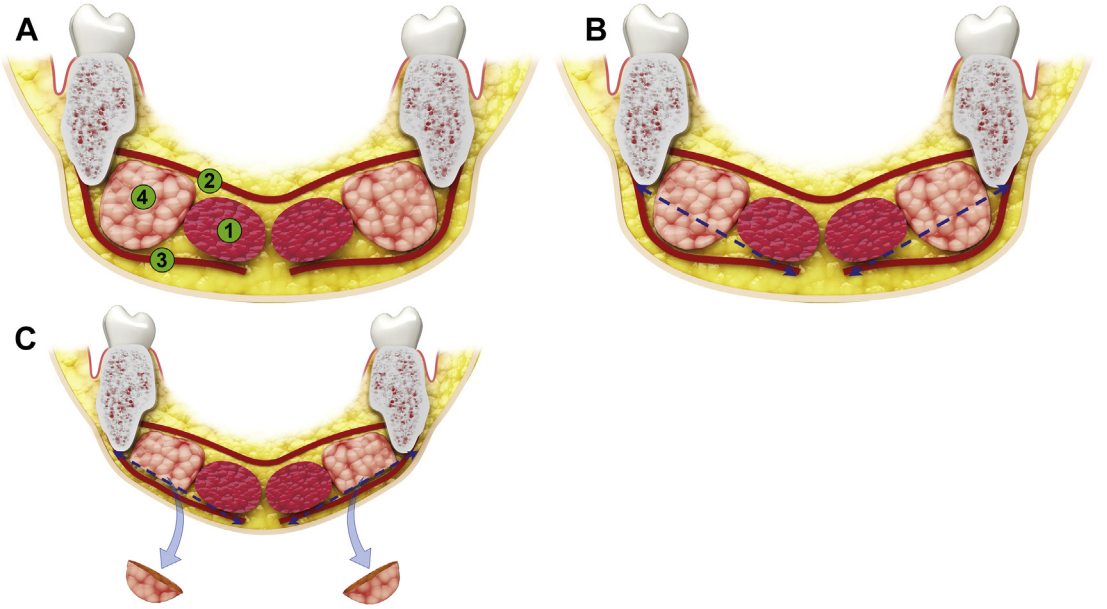


Fig. 21. (*A*) Submandibular anatomy depicted in the frontal plane. (1) Anterior belly of the digastric muscle, (2) mylohyoid muscle, (3) platysma, and (4) submandibular salivary gland. (*B*) The submandibular salivary gland area that bulges below a line drawn between the lowest point of the anterior belly of the digastric muscle and the inferior border of the mandible (*dashed arrow*) is considered for resection. (*C*) The submandibular salivary gland after resection.

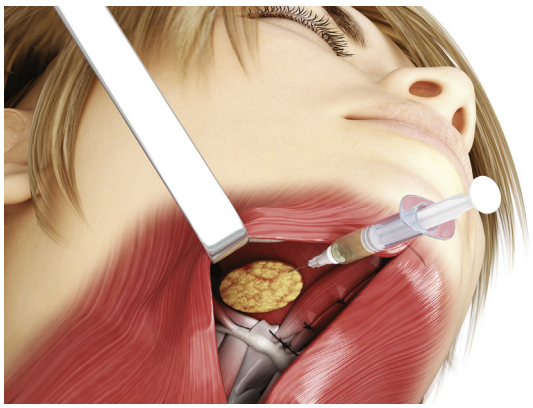


Fig. 23. Injection of a solution containing botulinum toxin and ropivacaine into the raw surface of the submandibular salivary gland. This maneuver reduces the likelihood of salivary fistula and helps to control pain in the early postoperative period.

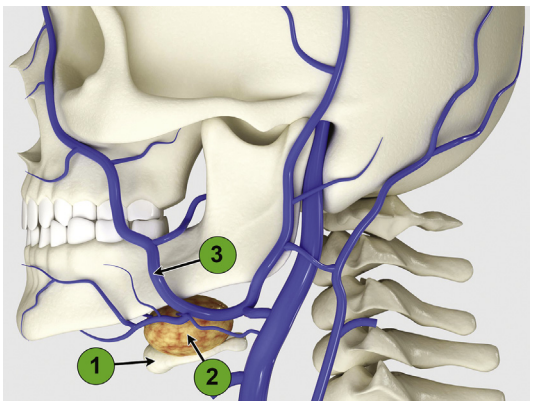


Fig. 25. Positions of submandibular structures and the facial vein and tributaries. (1) Hyoid, (2) submandibular salivary gland, and (3) facial vein.

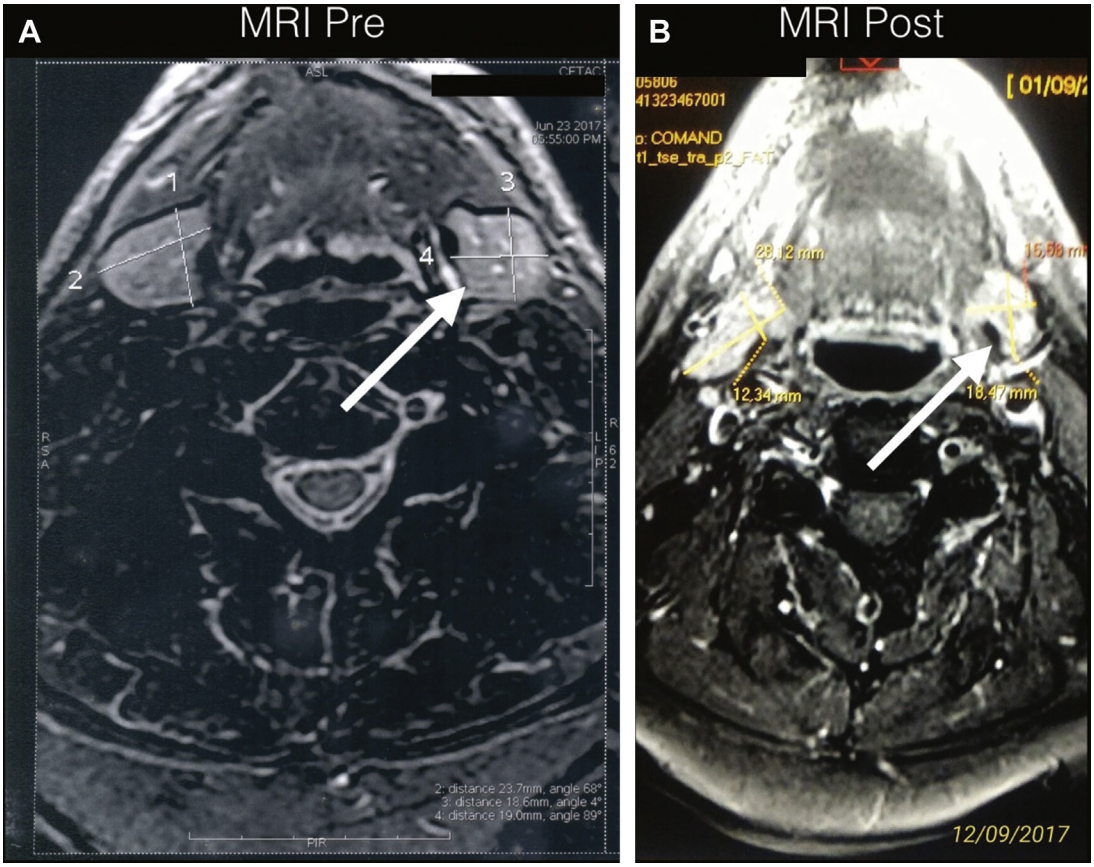


Fig. 24. MRI of the neck of this 48-year-old man who underwent surgical neck rejuvenation. (*A*) Preoperatively. (*B*) Six months postoperatively. Radiologic findings indicated an approximate volume reduction of 2.2 mL in the submandibular salivary gland (from 7.6 to 5.4 mL).

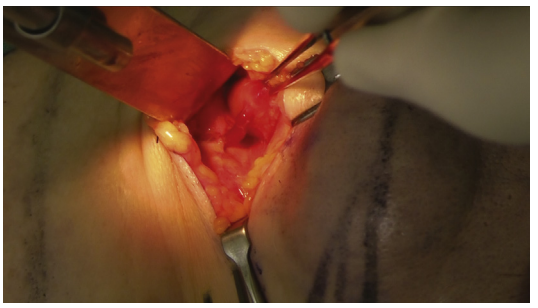


Fig. 26. Collateral vein on the medial aspect of the submandibular salivary gland at the superficial level. In the authors' experience, this occurs in approximately 8% of patients.

HEMOSTATIC NET

In open surgical rejuvenation of the neck, hematoma is a major concern.[11] Previously, we described closure of all dissected areas with the hemostatic net,[12] a series of columns of running sutures that encompass the skin flap and subjacent muscle (**Figs. 37** and **38**). Since its introduction in 2010, nearly 1000 patients have received the hemostatic net and no instance of hematoma has been recorded in the first 48 hours after surgery. The hemostatic net also has usefulness for skin redraping, especially for patients with severe skin redundancy.

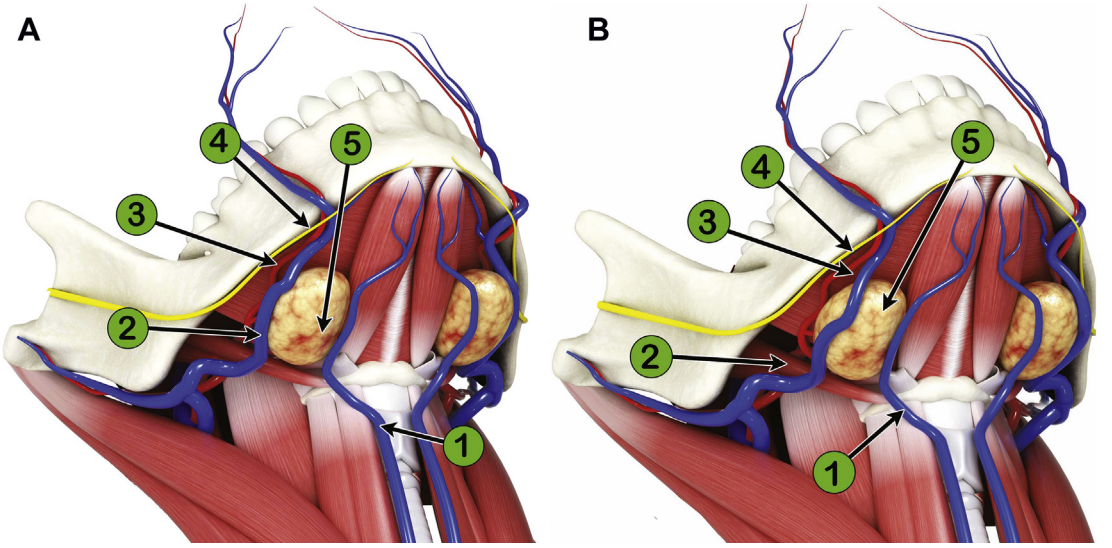


Fig. 27. (*A*, *B*) Circulatory anatomy in the submandibular area. (1) Anterior jugular vein, (2) facial vein, (3) facial artery, (4) marginal mandibular nerve, and (5) submandibular salivary gland. In most patients, the facial vein occurs lateral to the superficial lobe, as in (*A*). However, the facial vein has a more medial course over the gland in some patients, as in (*B*).

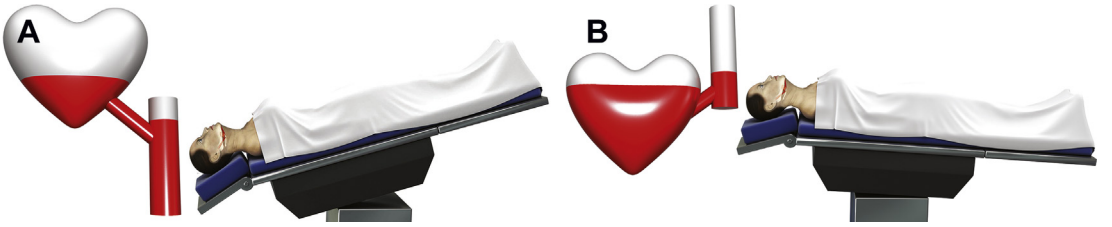


Fig. 28. (*A*) In neck rejuvenation surgery, venous blood pressure usually is high when the patient is in the Trendelenburg position. (*B*) Elevating the head may help to control bleeding.

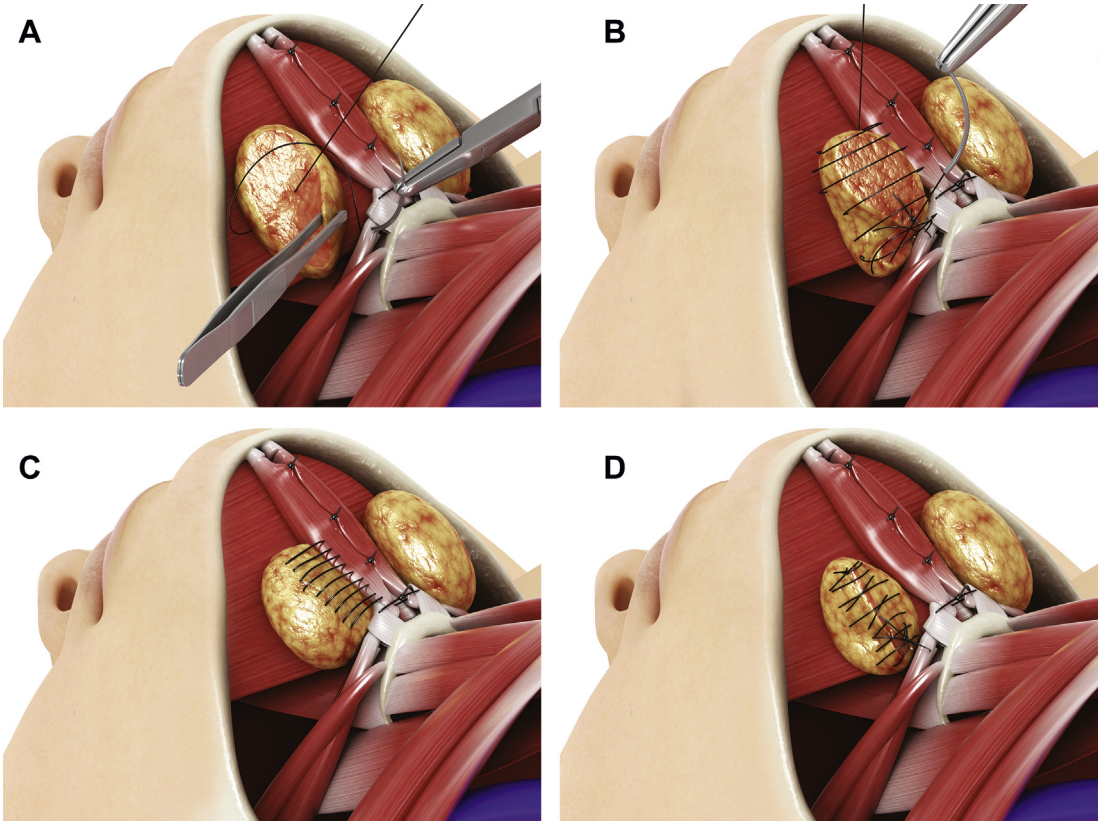


Fig. 29. (*A*, *B*) For hemostatic control, the raw surface of the submandibular salivary gland is closed. Continuous double-layer absorbable sutures are placed. (*C*) The submandibular salivary gland subsequently is sutured to the lateral portion of the anterior belly of the digastric muscle. (*D*) Affixing the submandibular salivary gland to the intermediate tendon of the digastric muscle helps to prevent ptosis of the gland.

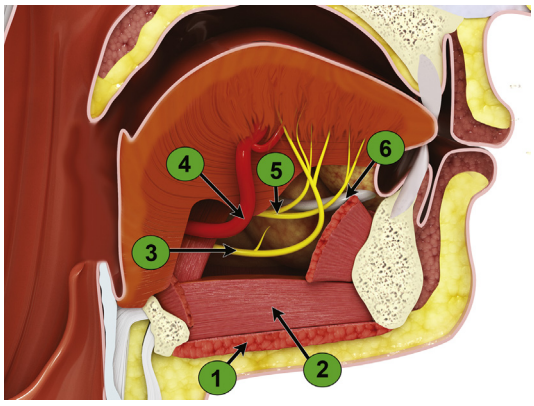


Fig. 30. Schematic anatomy of the subplatysmal region in the sagittal plane. (1) Platysma, (2) digastric muscle, (3) hypoglossal nerve, (4) lingual artery, (5) lingual nerve, and (6) Wharton's duct. When repositioning the submandibular salivary gland by anchoring it to the intermediate tendon of the digastric muscle, caution should be exercised to avoid damaging the hypoglossal nerve.

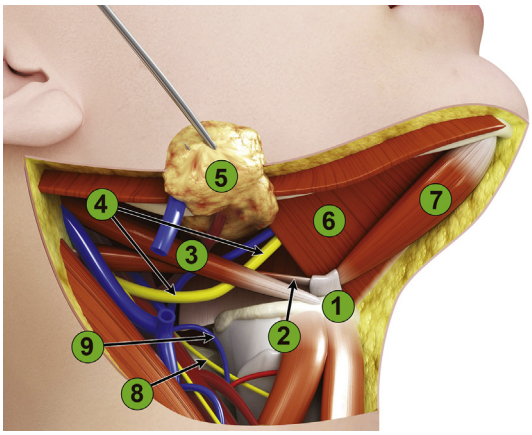


Fig. 31. Schematic anatomy of the subplatysmal region. (1) Hyoid, (2) intermediate tendon of the digastric muscle, (3) stylohyoid muscle, (4) hypoglossal nerve, (5) submandibular salivary gland, (6) mylohyoid muscle, (7) anterior belly of the digastric muscle, (8) superior laryngeal nerve, and (9) superior thyroid vein.

Fig. 32. Maneuver to locate the intermediate tendon of the digastric muscle. The assistant surgeon pulls the chin upward with a hook. The surgeon then locates the tendon either through blind palpation or direct vision. The tendon is rigid and cordlike.

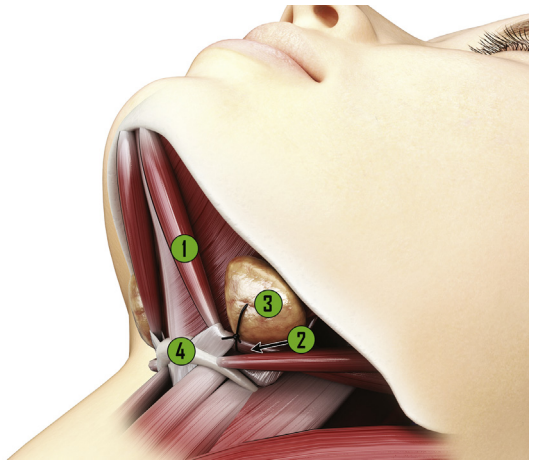


Fig. 33. The submandibular salivary gland may be repositioned by suturing it to the tendon. (1) Anterior belly of the digastric muscle, (2) intermediate tendon of the digastric muscle, (3) submandibular salivary gland, and (4) hyoid.

Fig. 34. The skin is undermined in the chin area after plication of the lower part of the neck by the platysma corset technique. This dissection allows for detachment of the submental crease in the treatment of the so-called witch's chin.

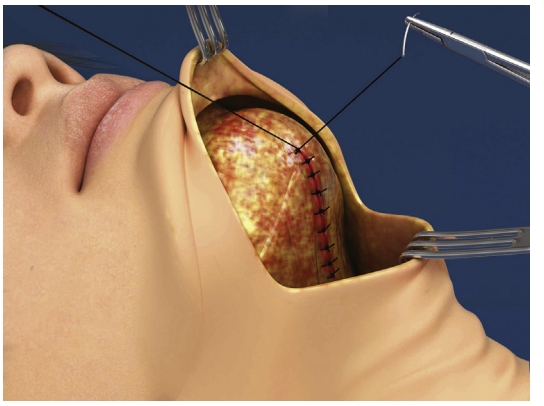


Fig. 35. Completed platysma plication over the chin.

Fig. 36. Suture placement on completion of subplatysmal neck rejuvenation.

Fig. 37. In neck rejuvenation, dissected areas can be closed with the hemostatic net, a series of columns of running sutures that encompass the skin flap and subjacent muscle. This closure maneuver helps to avoid hematoma.

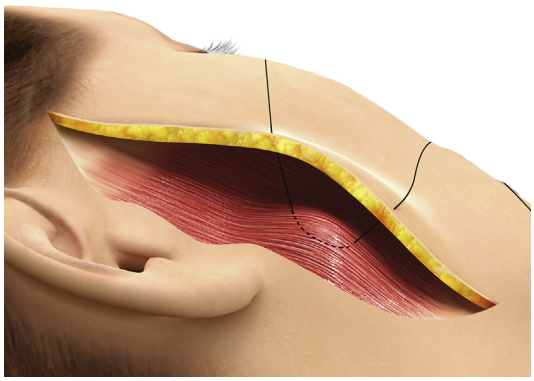


Fig. 38. Detailed depiction of the suture encompassing the skin and subjacent muscle during hemostatic net placement.

SUMMARY

For patients seeking facial rejuvenation, a thorough physical examination and photographic analysis (including of upward view of the flexed neck) allow for a precise determination of structures to be treated. Improving cervical contour frequently becomes the primary aim. Hypertrophy and/or ptosis of the SMSGs is a common cause of contour deformities. With advanced knowledge of neck anatomy and surgical expertise, the SMSGs can be resected safely and reproducibly to yield favorable results of neck rejuvenation.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.cps.2018.06.001.

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