The Mastoid Crevasse and 3-Dimensional Considerations in Deep Plane Neck Lifting

Aesthetic Surgery Journal
2024, Vol 44(2) NP132–NP148

https://doi.org/10.1093/asj/sjad321
www.aestheticsurgeryjournal.com

OXFORD UNIVERSITY PRESS

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Abstract

Background: Advances in face and neck lifting involve release of tethering points along the superficial musculoaponeurotic system–platysma complex to freely manipulate the deep natural glide plane in the face and neck.

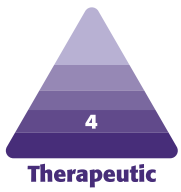
Objectives: The aim of this article was to determine a combination of deep plane techniques for addressing the face and neck and to elucidate, for the first time, a measurable endpoint for the gonial angle. Analysis of deep plane tethering and decussation zones was also undertaken.

Methods: Extended deep plane surgery performed in 79 patients (158 hemifaces; age, 30-75 years; 95% female), over a 3-month period, was reviewed. Patients were followed for 1 year. Measurements were performed systematically during deep plane face and neck lifting.

Results: Before intervention, the mean [standard deviation] gonial depth was 9.4 [3.6] mm on the left and 8.3 [2.7] mm on the right. The mean depth created below the gonial angle when measuring the traditional suspension to the anterior mastoid was 15.8 [3.3] mm on the left and 13.7 [2.5] mm on the right. The distance postoperatively when measuring the gonial depth after performing the crevasse technique was 23.2 [2.2] mm on the left and 22.5 [2.5] mm on the right. This represents a mean increase in the advancement of 7.4 mm on the left and 8.8 mm on the right (average, 8.1 mm) which was demonstrated to be statistically significant bilaterally ($P < .0001$).

Conclusions: The deep plane techniques described here aid manipulation of the deep plane and deep neck space, while also providing measurable endpoints and more effective modes of fixation by utilizing the mastoid crevasse. The use of techniques that release tension and allow redrape produce the most natural and well-balanced results.

Level of Evidence: 4



Editorial Decision date: September 20, 2023; online publish-ahead-of-print September 28, 2023.

In the authors' experience, recent advances in deep plane face and neck lifting, using extended modified deep plane techniques, have demonstrated superior results for midface volumization and neck contour improvements with less reliance on fat grafting, implantation, or other ancillary measures.[1,2] In line with recent discussions in the literature,[3,4] we have found that liberation and manipulation of the cervicofacial gliding plane, termed the deep plane, permits a greater level of lifting in both the face and neck with

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less resistance and entanglement of underlying structures. More importantly, the neck and face are treated and lifted as a single unit, providing a more uniform, natural, and durable result.[5-7] Nevertheless, certain regions remain untreated and unmastered in select patients with more challenging anatomy.

Various resistant anatomic attributes have spurred debate and discussion over proper diagnosis and treatment.[8-11] The most complex aspects for surgeons appear to include the approach to anterior digastric fullness, submandibular gland prominence, deepened prejowl sulci, and a low or anterior hyoid and larynx.[9] This article seeks to provide additional insight and reasoning as well as a methodical algorithm to address these challenges. We will also introduce modifications of existing techniques along with novel approaches to the submandibular triangle, parotid gland, and gonial angle that will provide clear and substantial improvements in the appearance of the anterior and lateral neck.

Proper deep plane release of the platysma in the submentum allows direct visualization and assessment of the midline deep fat and lymphoid tissue, anterior digastric muscles, submandibular glands, position of the hyoid bone, as well as the prehyoid and perihyoid soft tissues.[2,12-14] Each of these items may be assessed and treated appropriately prior to closure of the platysma by plication methods.[2,3,7] In this article we will provide our approach to each individual component and describe proper manipulation of the anterior platysma to help avoid surgical failures. For the lateral neck we will review the aging and prominence of the parotid gland which commonly coincides with loss of definition around the gonial angle. Release of the muscular-fascial decussation zones in the face and neck allow free manipulation of this region, permitting use of the mastoid crevasse technique discussed in this article.

The introduction of this technique provides a better conceptual understanding of vectorial aging of the neck, proper vectorial lifting of the neck, recompartmentalization of ptotic and bulging cervical triangles, and a measurable endpoint to determine the success of gonial angle improvements intraoperatively. These new techniques may be easily implemented and added to the surgical arsenal of any superficial or deep plane surgeon.

METHODS

The surgical techniques used to treat the anterior neck, lateral neck, and face will be reviewed in this study along with several endpoints used to determine success. Various intraoperative measurements were performed during extended deep plane face and neck lifting surgery in a total of 79 patients, providing 158 hemiface measurements. These patients were treated in a routine fashion over a 3-month period from August 2021 through November 2021 in the practice of the primary author (B.T.). Patients were followed for 12 months following the procedure and were seen postoperatively at 1 week, 3 weeks, 6 weeks, 3 months, 6 months, and 12 months at minimum. The remaining 72 Patients underwent a modified extended deep plane face and neck lift, like those previously described by the primary author, while using the more novel advances and will be the focus of this article.[1,2] Intraoperative measurements were taken during routine surgery for the primary author and no experimental studies were performed on patients, in accordance with the Declaration of Helsinki. One patient undergoing an isolated neck lift required a minor revision to treat banding at the cervical angle. A total of 200 surgeons were surveyed regarding routine measurement of the gonial angle in their practice. The survey was administered orally at a meeting by show of hands.

Analytic endpoints of our study include the following intraoperatively and postoperatively: persistence vs absence of anterior digastric fullness; prominence vs resolution of submandibular gland fullness; assessment of a smooth submentum vs indentations or defects; resolution of jowls and prejowl sulcus; laryngeal position; cervicomental angle and length; resolution vs persistence of cervical banding in one-quarter and three-quarter views; ear position and shape; parotid gland prominence and resolution; gonial angle depth and shape; and lifting provided to the lower neck and clavicular region. Written informed consent was obtained from all patients that their photographs could be used for research purposes. There were no complications to report. Inclusion criteria included any patient undergoing the technique proposed within that time point and granting consent for study.

Patient Selection

Indications for surgery included banding of the neck, overall drooping of the neck, submental fullness, obtuse neck with a low hyoid, jowling, and other causes of drooping or excess fullness in the neck. A total of 10% of cases were performed under local anesthesia and 90% using total intravenous anesthesia. Contraindications included propensity for bleeding and patients who would benefit equally from a noninvasive radiofrequency device. Patients who required submandibular gland reduction were placed under total intravenous anesthesia to avoid discomfort.

Patients without any facial complaints or skin excess underwent an internal neck lift, called the “weekend lift” (7/79), in our practice, while the remaining 72 underwent the Auralyft, which is a modified, extended deep plane face and neck lift. The “weekend lift” involves a submental incision with manipulation of the deep submental space and a platysmal plication combined with a postauricular incision to lift the lateral platysma to the mastoid crevasse. Skin is typically not excised, and a radiofrequency

treatment is performed on the face and neck with a Profound device (Candela Medical, Wayland, MA). Profound radiofrequency skin tightening was performed after crevasse measurements were taken. This tightening is isolated to the skin and dermis but does not have an effect on the deep crevasse and does not affect the measured depth as that is performed prior to the profound treatment, on the operating table. Ancillary procedures such as eyelid surgery were also performed on a large subset of patients, although these procedures would not have any effect on the neck measurements recorded in this study.

Surgical Technique

The surgical technique of the Auralyft (modified extended deep plane face and neck lift) will be detailed as performed by the primary author. The procedure typically takes 2 hours and is performed under local or total intravenous anesthesia in most cases. Local anesthetic is injected using a combination of 50 mL of 2% lidocaine, 50 mL of 0.5% bupivacaine, 250 mL of normal saline, 2.5 mL of 1:1000 epinephrine and 5 mL of sodium bicarbonate. The solution is then tinted with 2 mL of cyanocobalamin for safety and identification. Tranexamic acid in solution is avoided in large flap surgery due to the risk of cytotoxicity and vascular compromise but may be given intravenously without much concern.[15]

Platysmaplasty and Submental Contouring

Submental incision and platysmaplasty is performed in roughly 90% of patients. Submental work is performed in nearly all revision or secondary lifts, for patients with severe laxity and banding, exaggerated midline descent that would not be corrected with facelift alone, lengthening of the cervicomental distance, laryngeal setback, low hyoid position, and for submental volume contouring. Liposuction is rarely performed to avoid the contour irregularities, skin darkening, and worsening of platysmal banding seen with overaggressive fat removal. The submental incision is placed along the internal mandibular border rather than using a nearby crease. The incision is typically 2 to 4 cm in length depending on access and the length of the neck and may be curvilinear (Supplemental Figure 1). Placement in this location avoids the chance of migration of the incision to the neck or chin following facelift or chin implant placement.

An incision is made along the submental marking, and the supraplatysmal plane is opened with sharp dissection initially, then immediately converted to blunt dissection. Dissection is carried inferiorly to the thyroid cartilage and laterally as far as the dissection can reach easily. Excessive caudal skin delamination is avoided to maintain a healthy blood supply to the watershed zone of the skin around the cervicomental angle. The medial platysmal borders are pulled towards the midline to measure laxity. The

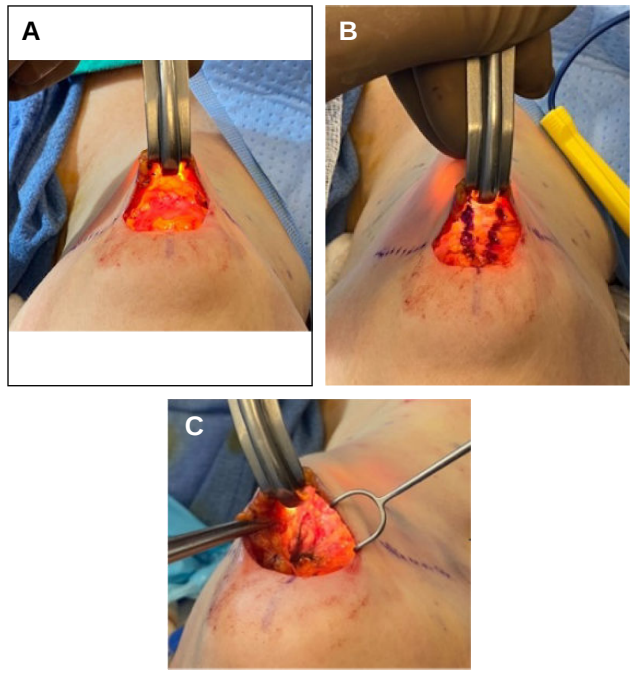

Figure 1. Neck dissection of a 42-year-old female. (A) Blunt elevation is completed, and fat is maintained attached to the skin above. (B) The medial edge of the platysma is marked on both sides for dissection and for future plication. (C) Next, each side is elevated, exposing the digastric on both sides and the glands.

borders of the platysma are then elevated by means of monopolar electrocautery followed by blunt dissection. There is no transition to the subplatysmal plane. The subplatysmal entry is as described with entry below the earlobe and anterior to about 6 to 8 cm. Caudal to the hyoid, care must be taken to avoid bleeding from anterior and accessory jugular vein laceration. Laterally, the dissection continues towards the lateral hyoid at the level of the lateral fascial sling of the digastrics. At this point the submental and submandibular triangle fullness is evaluated, looking at the anterior digastric muscles, submandibular glands, and fatty lymphoid tissue in Levels 1a and 1b (Figure 1). The sequence of reduction is of utmost importance. The central structures are more easily reduced and are more likely to be overreduced. When lying supine, the lateral compartments, such as the submandibular triangle, may appear much less ptotic than when sitting the patient upright. For this reason, the primary author strongly recommends beginning reduction with the lateral tissues and remaining more judicious with the medial or central tissues. The central submental compartment should always remain slightly fuller than the anterior digastrics and lateral triangles to avoid midline defects.

It is important to note that reduction of midline structures dictates the necessity to reduce lateral structures. Failure to do so may result in a relative appearance of ptosis of the lateral structures such as the submandibular glands.

Although the submandibular glands more often become ptotic than hypertrophic with age, there remains debate about whether or not to perform a submandibular gland reduction.[1,16-18] For simplicity, in our practice, a submandibular gland reduction is performed if the gland is pushing medially or inferiorly past the sling of the digastric, if the circumference of the neck at the hyoid appears too broad, if the gland is sitting inferior to the hyoid or mylohyoid, or if volumetric reduction is required when the platysma would appear too weak to suspend the submandibular contents (Figure 2). Sufficient reduction of the submandibular gland often requires resection of the deep lobe in addition to the superficial lobe. Although the primary concern with aging may be submandibular gland ptosis, elevation of the platysma alone may not correct the ptosis in some cases. The creation of dead space in the submandibular triangle and submentum may provide less resistance to central plication and lateral lifting. A reduction of roughly 30% to 50% of the gland is performed in 50% of our patients reviewed over the past 3 years. Reviewing photographs taken prior to adoption of submandibular gland or digastric reduction techniques would indicate that only 10% of our patients actually needed any sort of reduction to obtain an excellent result.

To perform reduction, the most medial and inferior portion of the gland is delivered from the capsule, injected with local anesthesia, atraumatically pulled medially, and partially resected by needle tip electrocautery for cutting and bipolar electrocautery for hemostasis (Supplemental Figure 2). Irrigation is intermittently performed to minimize heat dispersion to the surrounding nerves that may occur from cauterizing a fluid-filled gland. Reduction is performed until the bottom of the gland is level with the mylohyoid, cephalic to the hyoid, or deep to the mandible. The risk of bleeding increases with more lateral and cephalic dissection as the vessel caliber increases. It is important to note that resistance to mobilization of the gland is caused by the vessels within the gland and not due to any ligamentous attachments. In the 260 cases reviewed in the primary author's practice there have been no sialomas or subplatysmal hematomas without the use of neurotoxin, a subplatysmal drain, or gland imbrication. If more substantial gland resection is performed or large salivary cysts are present, a drain may be used. Although fluid collection may not occur, submental edema and submandibular gland fullness may ensue from reduction of the digastric or submandibular glands.

Fullness or bowing of the anterior digastric muscles may also occur in a subset of patients. This is likely more common in patients with hyperactive chin flexion caused by dental-alveolar prominence but may be present in any patient. Plication of the digastrics is avoided in almost all cases to avoid medialization of the submental contents, although this is a valid option to graft over a traumatic prior surgical defect when needed in rare cases. Complete resection should also be avoided to prevent any change in function or loss of support of the underlying mylohyoid muscles. Anterior digastric reduction is typically performed by strip excision of the outer half of muscle by means of bipolar electrocautery and trimming with scissors; a monopolar approach may result in excess bleeding and twitching of the surrounding muscles and nerve to the mylohyoid (Supplemental Figure 3).

Reduction of fatty lymphoid tissue in Levels 1a and 1b may also be performed. Complete excavation of Level 1a is generally avoided to prevent a midline defect and exaggerated prominence of the submandibular triangle and digastric muscles postoperatively. The midline submentum should remain slightly fuller than the paramedian submentum as the midline will tuck internally more easily following platysmal plication. Bipolar electrocautery is typically used to avoid bleeding from well-vascularized lymph nodes. If the lymph nodes are in excess or enlarged over 10 mm or darkened, they should be sent for biopsy. Caution must be taken with deeper dissection to avoid any trauma to the hypoglossal nerve or distal cervical branches to the platysma that may affect the smile. Dissection from medial to lateral all the way to the external jugular as the lateral border of the deep cervical fascia with partial myotomy and spreading with scissors will help avoid or identify these distal cervical branches in the dissection.

After the lateral volume has been addressed, the midline can be contoured. Midline banding and blunting of the cervicomental angle may be a consequence of platysmal descent or an obtuse line along the deep cervical fascia. To address the cervical angle, the submental deep cervical fascia is grasped and pulled towards the chin while a horizontal fasciotomy is performed across the prehyoid deep cervical fascia to expose the hyoid periosteum (Figure 3). This forms a discontinuity of the subhyoid and submental deep cervical fascia, permitting tighter approximation of the platysma during plication. In effect, banding is decreased while the cervicomental distance is lengthened and the cervicomental angle is sharpened. The horizontal fasciotomy is a very simple and powerful technique providing multiple immediate and long-term benefits. Caution must be taken to avoid excavating the prehyoid tissues in a patient with a prominent larynx and thyroid cartilage. Excessive removal of tissue may result in a prominent Adam's apple after lifting, causing an exaggerated contour defect in either sex or a masculinized appearance in women. If this occurs, a strip of fat may be transposed from the submentum into the suprahyoid or infrahyoid space into any deficit prior to platysmal plication to ensure the thyroid cartilage remains at the anterior level of the hyoid in the sagittal plane.

Platysmaplasty is then performed according to a classic platysmal plication technique.[19,20] The consequences of platysmaplasty on vertical facelifting must be considered.

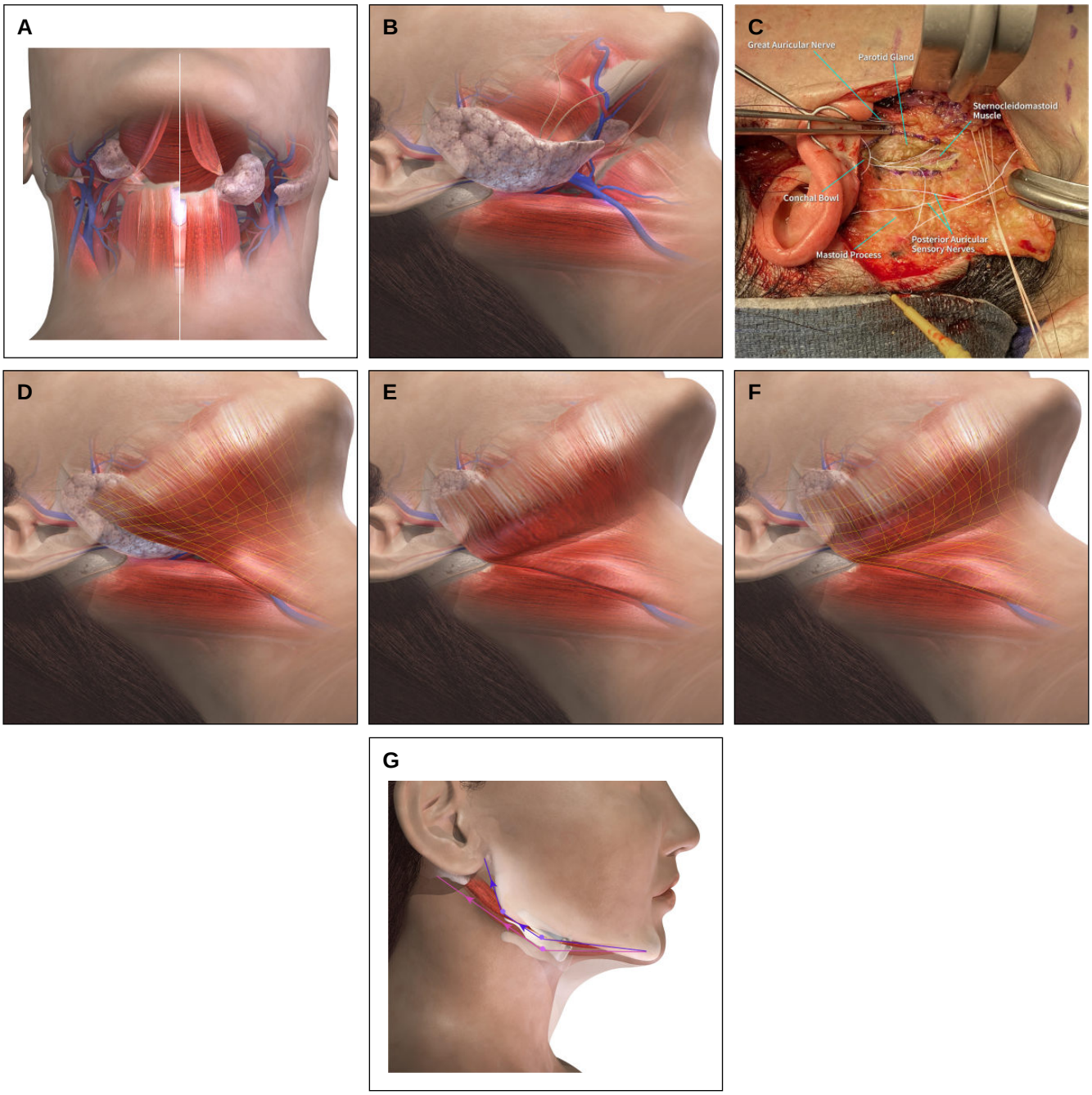

Figure 2. (A) Demonstration of neck dissection with digastrics and glands exposed on either side. (B) Overlay of relevant surgical anatomy prior to deep plane lift. (C) Additional overlay of relevant anatomy at the mastoid process and dissection of the parotid, highlighting the course of the greater auricular nerve and posterior auricular nerves in a 42-year-old female. (D) Vector and plane of tissues prior to surgical intervention. (E) Overlay of manipulated structures with inset of platysma at the mastoid crevasse. (F) Vector and plane of tissues after surgical intervention. (G) Demonstration of a lateral view of gonial angle before and after platysmal inset with overlay of pertinent anatomy and platysmal inset within the mastoid crevasse.

Cadaveric studies have demonstrated that plication platysmaplasty may limit the extent of vertical lifting in the face.[21,22] We believe that this effect is less exaggerated during submental platysmaplasty and more prominent as a consequence of infrahyoid platysmaplasty. The submental platysma naturally converges towards the chin, while the infrahyoid platysma diverges as it attaches to the clavicular heads. Hence, pulling the divergent platysma to the midline may medialize the body of the platysma and limit vertical lifting to a much greater degree (Figure 4).

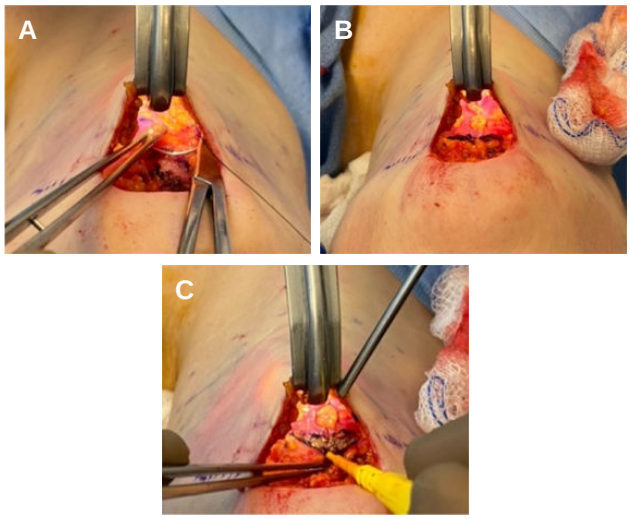

Figure 3. (A-C) Platysma closure and platysmal window of a 42-year-old female. The platysma is closed with buried figure-of-eight mattress sutures. If there is any midline platysmal banding after the platysma is closed, this is disrupted with a full or partial myotomy akin to a platysmal window less than 1 cm on each side. This must be caudal to the hyoid.

To perform the plication, the platysmal edges are pulled across the midline and minimal trim of the edges is performed only as needed. Suture plication is then performed with buried 3-0 nylon sutures beginning in front of the hyoid and then advancing towards the chin with 3 or 4 buried figure-of-eight sutures. Tacking to the prehyoid fascia must be avoided as this will tether the natural gliding separation of the deep plane and may alter the sensation of swallowing. If the platysma is tethered to the hyoid and larynx, the entire neck will move during deglutition and the patient may experience a choking sensation for an extended period of time.

The benefit of infrahyoid or prelaryngeal plication is that the thyroid cartilage and larynx can be repositioned posteriorly. This helps avoid prominence of the thyroid cartilage in patients requiring softening. Laryngeal setback can also have a profound effect on circumferential narrowing of the throat and neck while effectively lengthening the cervicomental distance. The benefits of laryngeal setback are quite profound, as it shortens the anterior-posterior dimension of the neck and makes the appearance of the entire larynx less broad and more delicate and defined. Cervicomental distance can be lengthened without the use of a chin implant, which also keeps patients more feminine and delicate. The benefits of laryngeal setback or prelaryngeal platysmal plication must be weighed against the drawbacks of limiting vertical facial lifting.

Once corset platysmaplasty is completed, the cervicomental angle is assessed with palpation to check for midline banding which may occur in some patients. If a band is palpated, it is transversely incised by performing a medial, oblique, partial myotomy bilaterally, caudal to the level of the hyoid (Supplemental Figure 3B, C). The platysma is then reinforced with interrupted 3-0 PDS sutures just distal and proximal to the angle only if needed. In some patients, the distance of travel of the platysma increases substantially after submental contouring is performed. The distance from the clavicle to the chin may be shorter in an obtuse neck than in a well-defined and angulated neck. In these patients, partial myotomies may be performed to lengthen the platysma. This is performed by pulling up on the platysma and gently incising the lower, medial third of the platysma with a Metzenbaum scissor while keeping the deeper platysmal fascial layer intact to envelope the vessels and deep neck contents. The lateral two-thirds of the platysma should not be interrupted to avoid loss of integrity of the lateral platysma during the vertical lifting portion. If any dehiscence of the platysma has occurred in the superior portions, running plication may be performed to void herniation of tissues after lifting.

Lastly, the mandibular ligaments and prejowl sulcus are analyzed. If there is a defect present in the sulcus, fat grafting can be performed at the beginning of the case or prior to dissection. The mandibular ligament is not a facial retaining or osseocutaneous ligament and has been erroneously described in the past. A more accurate description would demonstrate that the dense connections in this region occur between the platysma and bone. The appearance of tethering that occurs superficially is more likely a direct result of fat or superficial musculoaponeurotic system (SMAS) atrophy and collapse or simply tethering of the skin from platysmal plication and medialization. Hence, passing a 20G cannula using a subdermal fanning technique while grafting fat into superficial tunnels may reinflate and expand the collapsed region of the mandibular ligaments and obviate the need for comprehensive release or dissection. The shadow present in the prejowl sulcus is commonly a result of subdermal atrophy and changes in reflection of light, rather than simply shadowing caused by blockade of light. For this reason, volumetric grafting to the prejowl sulcus may brighten this area in a majority of cases. If vertical manipulation of the face demonstrates tethering in this region, subcutaneous release is performed only as needed. This must be performed judiciously with care to avoid trauma to the skin or overaggressive dissection, which could compromise the blood supply to the skin around the submental incision. Release is typically performed with a Metzenbaum scissor to push forward in a deep subdermal plane while placing tension with a double-prong skin hook. The tips of the scissor should push forward and not into the skin where they may compromise the dermal plexus resulting in clinical or subclinical ischemia. This region possesses several vascular arcades that may bleed following

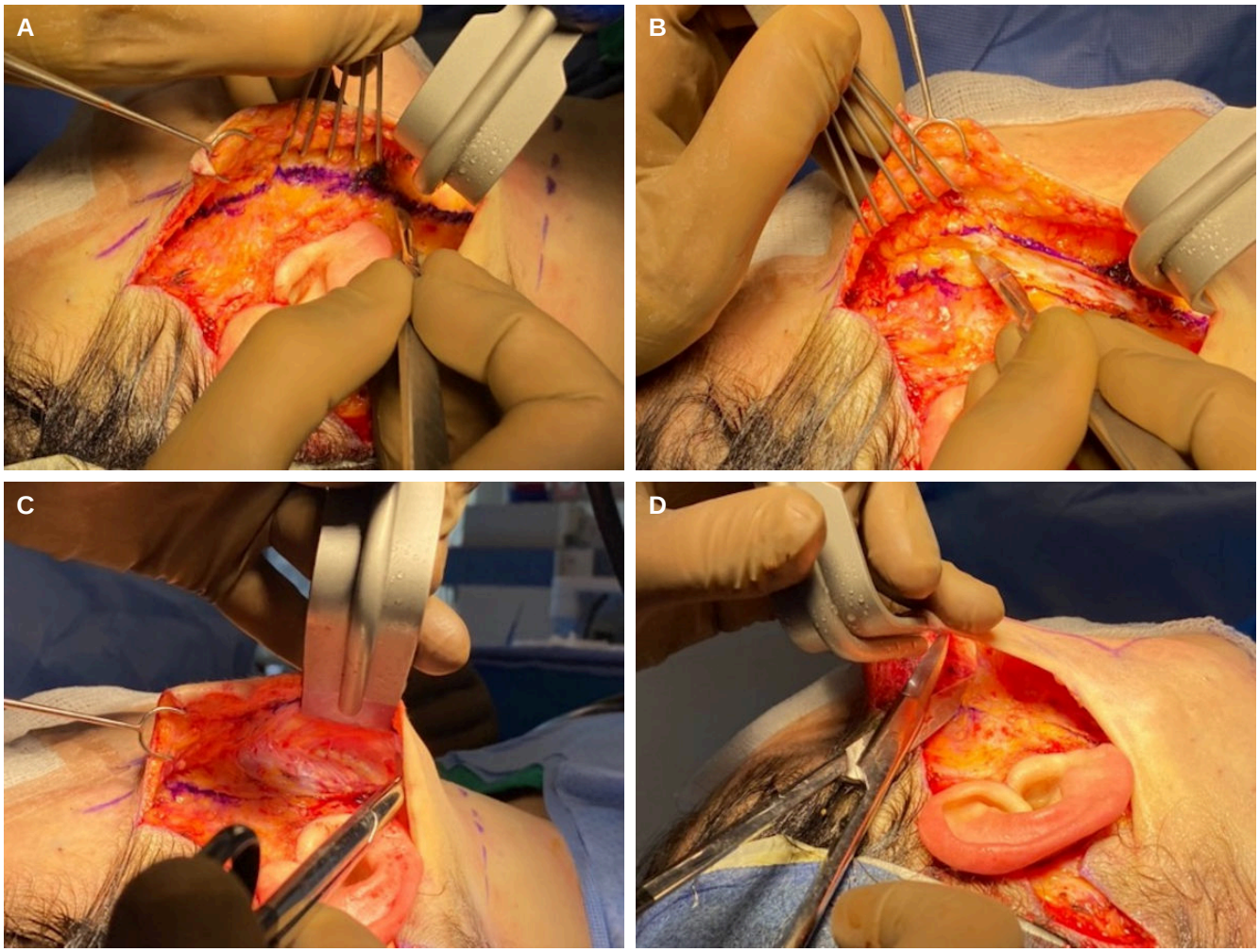

Figure 4. (A-D) Deep plane entry in a 42-year-old female. The deep plane entry line is incised. The platysma is elevated in the deep plane anteriorly to the level of the facial artery and inferiorly to release off the external jugular vein. The facial superficial musculoaponeurotic system is elevated off the zygomaticus muscles.

dissection. Cautery in the subdermis must be performed conservatively.

Vertical Face and Neck Lift

Incision markings are made followed by reference markings for the deep plane entry point and Pitanguy's line. The entry design in our practices has been modified using the "sailboat modification" to improve the positioning of the deep plane entry point (Supplemental Figure 8C). Assuming the platysma at the gonial angle will lift toward the pretragal line, an SMAS entry line is drawn to mirror the incision line roughly 2.5 cm away at a roughly 70° angle. This maximizes the composite area of the flap by minimizing the regions of skin-only dissection assuming the entry line will lift to touch the incision line or as close as possible, insetting like a puzzle piece. Limiting the amount of skin dissection may decrease ischemic effects on the distal flap including discoloration, decrease the amount of telangiectasias forming postoperatively, decrease operative dissection time, improve volume along the zygomatic arch and lateral flap, lower the chance of damaging the zygomaticus muscle complex, and make the SMAS thicker laterally providing easier entry and a better shelf for suspension (Supplemental Figure 5).

Incisions are made with a #10 scalpel around the temporal tuft following down the prehelical crease. The incision is placed in an immediate pretragal crease when present or in a retrotragal line when absent or in patients with poorer skin quality or previous scarring. Incision placement on each side is independent of the opposite side. The incision then follows around the earlobe directly in the crease following posteriorly in the postauricular sulcus and crossing to the hairline as the mastoid flattens. The posterior limb incision follows the occipital hairline around 2.5 to 3.5 cm in

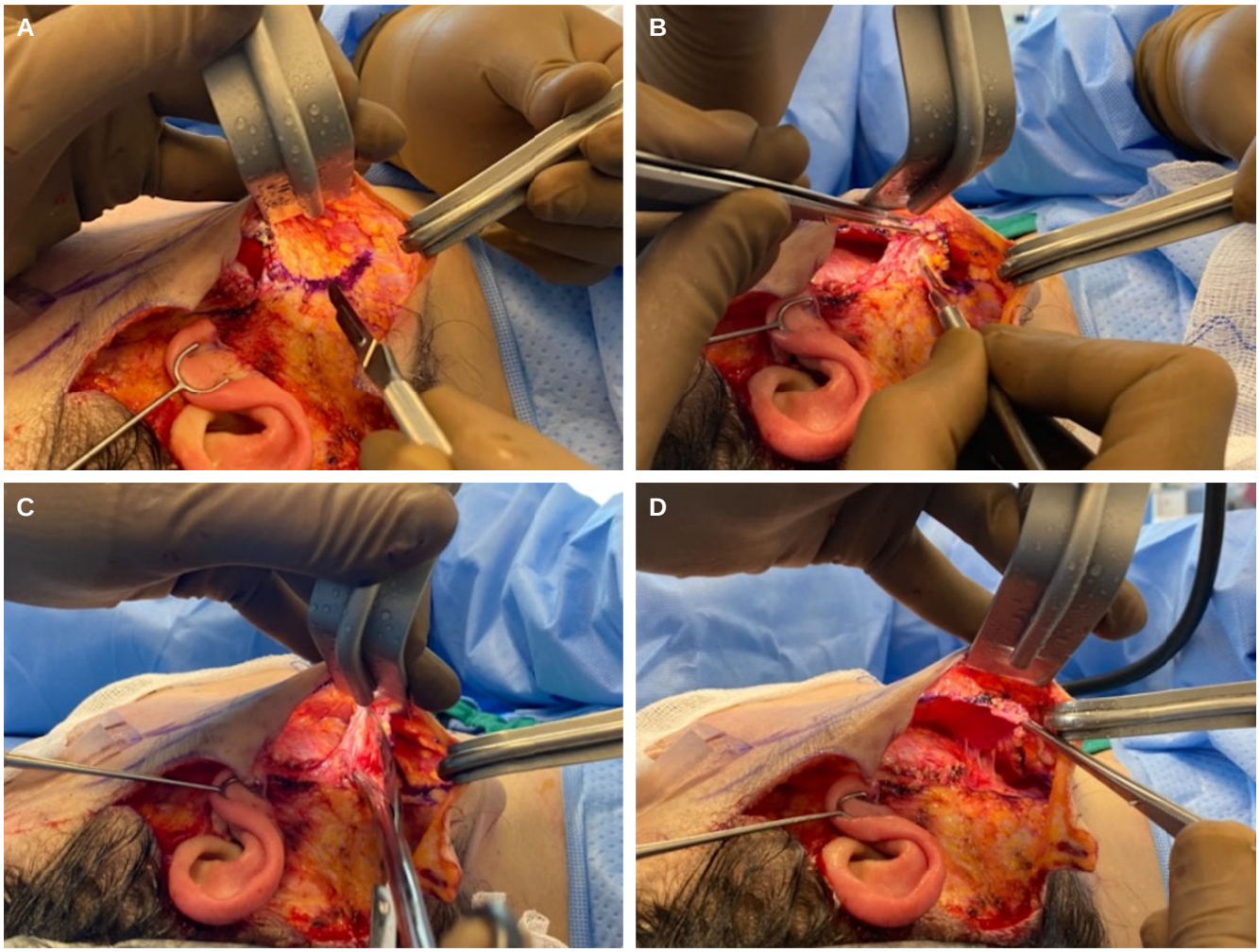

Figure 5. (A-D) Platysmal border in a 42-year-old female. The lateral border of the platysma is marked and incised through the cervical retaining ligament connections over the parotid capsule. The dense fibers terminate inferiorly over the external jugular vein. The fibrous attachments over the parotid are incised sharply then spread through bluntly to create the platysma flap.

most patients. Incisions extending into or tangential to the occipital hairline are avoided to prevent hairline distortion and limitations in vertical lifting and redistribution.

The skin flap is elevated in a subdermal plane, leaving hypodermal fat on the reticular dermis to avoid violating the dermal plexus. Elevation of skin is performed with a #10 scalpel followed by dissection with a microdissection scissor and tension using an Andersen bear-claw retractor and countertension provided by an assistant. The facelift flap is generally thought to be a random flap with the only axial blood supply being the perforator of the transverse facial artery, which is commonly transected, but may be preserved in some cases (Supplemental Figure 6). The postauricular skin is then elevated and connected to the facial skin dissection around the earlobe. The subcutaneous dissection then continues bluntly using a Steven's Kaye scissor to bluntly spread the supraplatysmal plane in the right hand while using a lighted facelift retractor in the left hand. The dissection is carried directly on the platysma until midline without violating the platysma. If a submental procedure was performed, the 2 cavities would be connected at this point.

Next, the "sailboat line" of the deep plane entry point is incised with a #10 scalpel with the right hand while the left hand retracts the flap upwards with an Andersen bear claw multiprong retractor. Superiorly, care is taken to avoid incision of the zygomaticus musculature by beveling the #10 scalpel in an upward direction. A thick flap should be created to avoid maceration of the deep plane shelf (Figure 5). The deep plane is then entered and elevated beginning at the lateral border of the facial platysma where risk of injuring nerve or deeper structures is low.[23] Typically, this is considered the fixed portion of the SMAS-platysma complex, where the lateral platysma is

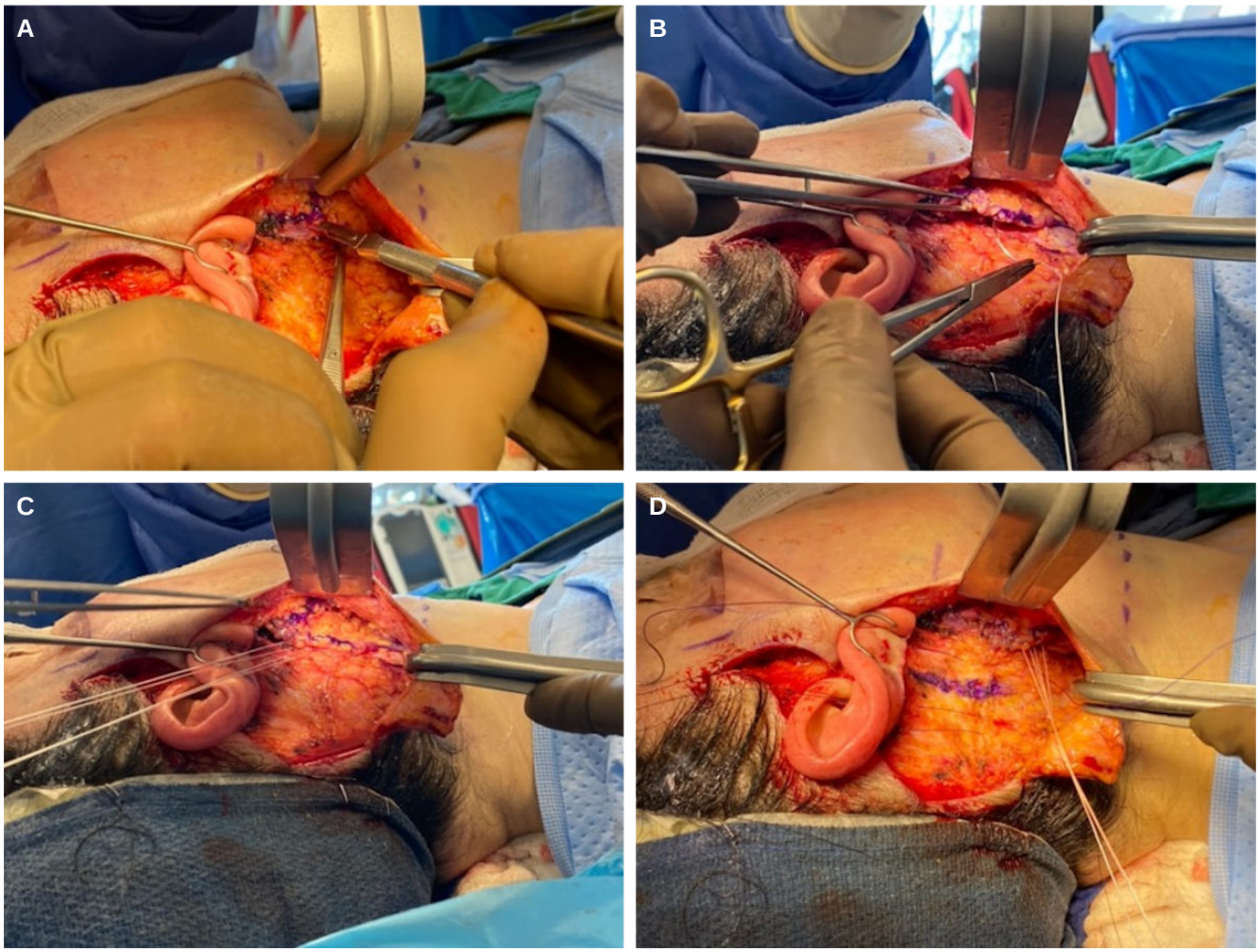

Figure 6. (A-D) Platysmal inset in a 42-year-old female. Myotomy is made in the shape of the gonial angle and then the platysma is redraped. Note the 3 marked structures in (D): the anterior mastoid line is marked in bold marker, and the great auricular and posterior auricular branches are marked with black monofilament.

overlying the parotid gland. Blunt dissection is performed with vertical spreads of the Steven's Kaye scissor in the right hand while holding the flap superiorly with facelift retractor in the left hand. Blunt dissection continues anteriorly over the masseter, which is considered the deep glide plane or mobile portion of the SMAS-platysma complex where the masseter and platysma muscles must move independently of each other without any connections. Dissection ceases at the anterior border of the masseter near the facial artery, then continues inferiorly into the neck. Retrodissection is performed from medial to lateral on the underside of the platysma to elevate it off the tail of the parotid inferior to the mandible and sternocleidomastoid (SCM) muscle, inferior to the tail of the parotid. The decussation plane of fibers that exists between the lateral platysma over the parotid tail fascia are referred to as the cervical retaining ligaments. These dense fibers are found over the parotid and not over the SCM as described in previous publications. Elevation of the cervical retaining ligaments allows for mobilization of the fixed platysma from off the parotid tail and provides a dense area of tissue to be utilized for suspension relative to the remainder of the weaker, more friable platysma muscle. A marking pen is then used to delineate the lateral border of the platysma and cervical retaining ligament from the tail of the parotid, extending inferiorly to the external jugular vein, where the retaining ligament terminates to a mobile plane again (Figure 6). The incision line is then scored with a long-handled #15 scalpel to score the outer portion of the platysma and retaining ligaments. Care must be taken to avoid damage to the greater auricular nerve which may lay over or lateral to the external jugular vein. Broad strokes are used to score the lateral platysmal border until reaching the underside of the deep fascia. Blunt dissection

performed by making vertical spreads with the Steven's Kaye scissor is then used from top down to release the cervical retaining ligaments from the parotid tail, continuing inferiorly over the SCM and external jugular vein where the mobile platysma elevates off easily. The dissection terminates medially at the level of the facial artery generally. A lateral approach to the submandibular gland is possible but is avoided in our practice to minimize trauma to the cervical facial nerve branches which penetrate the platysma and travel superficially at a more lateral point than the marginal mandibular branch. Great care is taken to avoid cervical facial nerve branch dissection and trauma.

The midface dissection is performed next. The "sailboat" modification to the deep plane entry point provides a thicker flap laterally that begins over the lateral extent of the zygomaticus muscles. Care must be taken to avoid transection of the lateral zygomaticus musculature, which may cause a strain and dimpling with smiling or smile block.[24] Although a primary concern of facelift surgery is to avoid nerve damage, muscle damage likely occurs more often and goes unrecognized. If partial or complete transection occurs, the muscles may be anastomosed with running absorbable sutures. Midface release is achieved by performing blunt dissection to enter the sub-SMAS plane directly on top of the zygomaticus and orbicularis musculature. Although there is often no defined SMAS at this level, entry at this point guarantees dissection into the sub-SMAS plane. The orbicularis overlaps the zygomaticus muscle slightly at the point where the SMAS layer thins and tapers off over the orbicularis. Dissection is carried in an inferomedial vector while suspending the face using a lighted facelift retractor in the left hand with blunt vertical spreads in the right hand created with the Steven's Kaye scissor. Tactile feedback aids in maintaining the proper plane of dissection as the SMAS release continues towards the nasolabial fold, terminating before arriving at the fold. At this point, the buccal decussation zone is the only remaining area that needs to be released to connect the sub-SMAS pockets of the neck and midface. The lateral extent of the zone has been referred to as McGregor's patch or the zygomatic cutaneous ligaments.[25] This is a dense region of osteocutaneous fibers extending from bone to skin and anteriorly along the maxilla. Although release of this zone may occur at the level of skin or deeper along the bone, we believe the most effective release to occur at the level of the deep plane, allowing mobilization and repositioning of the SMAS and superficial malar fat pad. Incision is performed with strong retraction of the left hand and facelift retractor while turning the scissor tips flat and sharply incising through roughly a 1 cm × 1 cm patch until palpable release of the reticular fibers is achieved. The transverse facial artery perforator exits somewhere around this region or anterior and inferior to the patch in 1 to 2 branches in most cases. This artery provides a segmental blood supply to an otherwise random facelift flap and is difficult to preserve in most cases. If it is transected, we recommend bipolar cautery to avoid facial hematoma. Elevation then continues anteriorly along the line of the parotid duct, through the buccal decussation plane. The buccal decussation zone contains interweaving fibers of SMAS and platysma at their junction point. These fibers must be released off the buccal capsule to permit full mobilization of the midface flap. Dissection typically terminates at the anterior extent of the buccal capsule, where platysmal fibers are seen diving deep and inserting into the SMAS. If the buccal fat is protruding or proptotic, it may be reduced and reinserted into the buccal space. If the buccal fat is transposed or left to hang freely outside of the capsule, it may cross the deep plane and tether to the SMAS and skin layers. This may cause a bulge and irregular movement with facial animation. A small shelf is then made along the sailboat entry line, typically 5 to 7 mm deep, to provide a ledge for suspension. At this point the cavity is irrigated with a dilute antibiotic and sodium hypochlorite solution followed by hemostasis using bipolar electrocautery.

The facial flap is then repositioned and suspended along the shelf of the SMAS-platysma complex. Then 5 to 6 sutures are placed, typically 3-0 nylon along the lateral platysma, 4-0 nylon at the central flap, and 5-0 nylon sutures along the upper midface sailboat flap. A large variety of suture materials may be used for the deep plane suspension. The sutures are positioned towards the individual patient's vector of greatest distraction or elevation, opposing the vector of aging for that particular patient. In primary facelifts, the average vector of suspension is around 70% from the Frankfort horizontal plane, and all the sutures lift at nearly the same angle. Horizontal mattress sutures are then placed through the flap shelf and suspended to a secure location in Lore's fascia, also referred to as the temporal parotid and tympanoparotid fascia (Supplemental Figure 6).[26-29]

The sutures must be tied down consecutively and free of tension. Placing tension in dermal or SMAS sutures may cause vascular compression of the dermal plexus and compromise both proximal and distal to the suturing point. Once the facial flap has been suspended, we continue with the lateral platysma manipulation. It has been our observation that proper 3-dimensional (3D) vectoring is more important and powerful than the metric of lateral distraction of the platysma. A great deal of focus is placed on creating depth around the gonial angle, while giving the greatest amount of lift and recompartmentalization to the submandibular triangle and lower neck. The cervical retaining ligament patch is moved vertically, posteriorly, and deep to maximally manipulate and restore neck contours. The average vectors of lift of the platysma are greater than the facial SMAS lift, typically ranging between 80° and 95° relative to the Frankfort horizontal plane. Classically, the platysmal

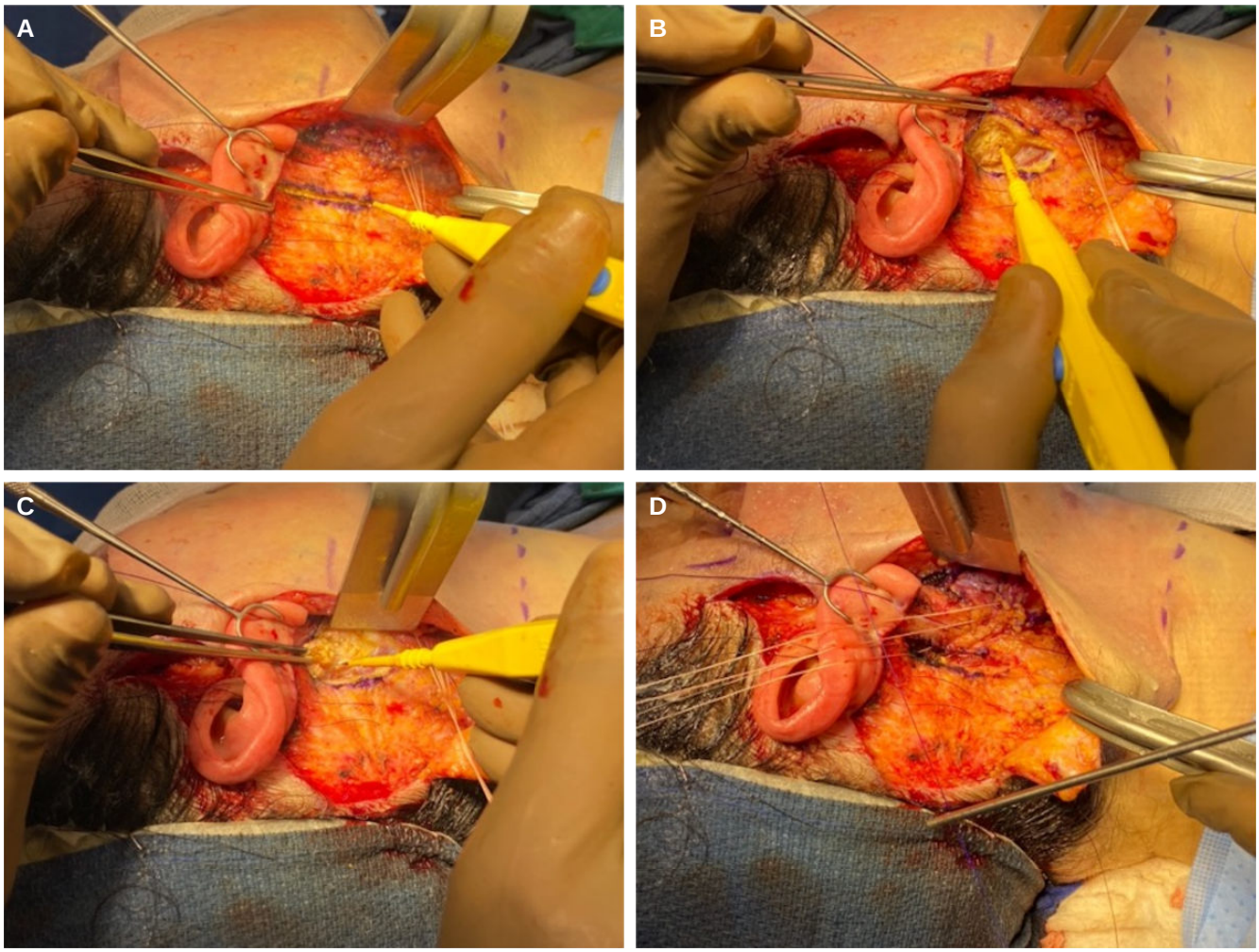

Figure 7. (A-D) Mastoid crevasse in a 42-year-old female. Here we have exposed the parotid tail and sternocleidomastoid muscle, which sit on the anterior and inferior border of the mastoid tip, respectively. The line may continue to elevate the conchal bowl. The parotid tail may be excavated under the parotid fascial capsule containing the great auricular nerve and the capsule is left intact. The platysma is then inset vertically into the crevasse, following an angle with respect to the Frankfort horizontal line shown.

flap is elevated and overlapped onto the lateral mastoid fascia using a myotomy or transposition flap. Although this may provide a strong area for fixation, it may blunt the gonial angle in patients with a broad mastoid bone and fail to fully restore the submentum as it most often will provide a less-vertical vector than needed (Figure 7). To overcome the structural limitations of lifting over the mastoid, the primary surgeon has developed a technique named the mastoid crevasse which has substantially improved surgical outcomes in a large variety of patients. The mastoid crevasse is formed by making a vertical incision by needle tip monopolar electrocautery along the anterior mastoid line. An incision is made down through the mastoid fascia to expose the anterior wall of the mastoid tip (Figure 8). The mastoid tip is bordered by the parotid tail anteriorly, conchal bowl and ear canal superiorly, and the SCM inferiorly. Anteriorly, this dissection frees the parotid tail from the mastoid, allowing the parotid and surrounding tissues to be compressed back into the deep pharyngeal space. Superiorly, the conchal bowl can be elevated very slightly to enable a more vertical repositioning of the platysmal cervical retaining ligaments, allowing a more substantial correction of the inferior neck and submandibular triangle. Inferiorly, the dissection stops at the SCM to avoid greater auricular nerve damage.

If parotid hypertrophy is present, a minor tail of parotid reduction may be performed at this point to reduce the tail of the parotid, although this may introduce a minor risk of sialoma and should only be performed as needed. The fascia overlying the parotid tail is elevated along with the great auricular nerve contained in that fascia. A minor amount of parotid tail tissue can safely be excavated from underneath the retracted fascia. The primary author limits parotid excision to the anterior border of the great

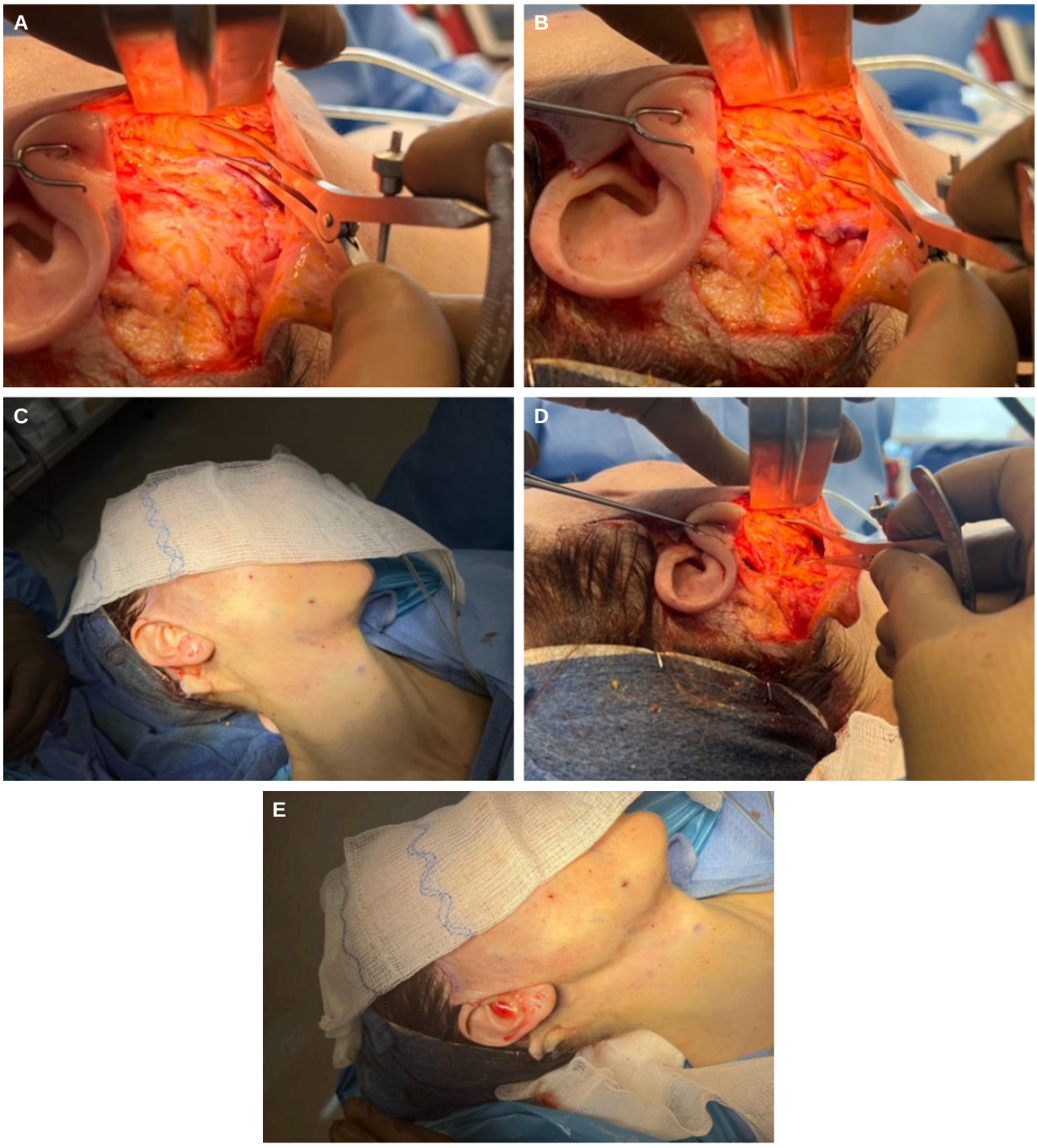

Figure 8. Mastoid crevasse creates more depth at the gonial angle than mastoid sutures (A-D). Here we demonstrate the study measurements in a 42-year-old female. (A) The depth of the gonial angle is measured at 6 mm before anything has been done; (B) the mastoid suture technique deepens the gonial angle to 11 mm, with the corresponding exterior image of the jawline improvement (C). (D) After the crevasse technique, the depth is 22 mm, with a corresponding improvement of the exterior appearance with improved definition of the gonial angle (E).

auricular nerve while avoiding any excision deep to the mastoid tip to avoid any heat dispersion to the facial nerve as it exits the skull at the stylomastoid foramen. A minor removal provides increased collapsibility of the parotid and provides less resistance to platysmal lifting and inset of the parotid tail into the deep pharyngeal space. The fascia should remain intact to lessen the risk of parotid gland exposure and potential sequelae. If the tail of the parotid reduction is performed, netting sutures are placed over the mastoid line following skin closure and left in place for 3 to 4 days.

Exposure of the anterior mastoid line allows inset of the platysma into the anterior mastoid rather than onlay over the mastoid. This provides a better position of fixation with substantially improved gonial angle depth and vertical platysma movement. The increase in gonial angle depth typically necessitates a greater surface area or distance of travel of the platysma around the gonial angle. To lengthen this area or relieve compression around the angle, a partial or full myotomy may be performed.[30] The primary author prefers performing partial myotomies or fasciotomies to maintain the integrity of the platysma and the cervicomental angle suspensory ligament.[30] It is important to maintain continuity and integrity of the inframandibular platysma, which directly elevates the hyoid and submental contents. This also aids in better encapsulation of the parotid gland and tail, giving the face a much more delicate appearance from frontal views, which is invaluable in patients with parotid hypertrophy. The partial myotomy is performed by pulling the lateral platysma flap superiorly and deep while scoring the shape of the gonial angle and mandible to retain the SMAS-platysma complex volume on the mandible while allowing the inframandibular platysma to inset and mobilize in a superior, deep, and posterior vector. In patients with a tall ramus, myotomy should be avoided and the platysma should only be scored as needed following suspension. This will help maintain the structure and integrity of the inframandibular platysma, which exerts its support on the submentum and submandibular triangles. The cervical retaining ligament zone of the lateral platysma is then engaged with two 2-0 Mersilene or silk sutures. The sutures are then placed on the anterior mastoid wall in a horizontal fashion to avoid inadvertent deep travel of the suture and needle. The placement should be as vertical as possible, possibly extending deep to the conchal bowl. This vertical movement performed deep to the mandibular angle exerts a much greater force of elevation on the hyoid and submandibular contents. This maneuver has a major mechanical advantage over standard mastoid suspension techniques, by forming a pulley system (Figure 2G). The inframandibular platysma is tethered deep to the gonial angle, which serves as a lateral pulley or fulcrum, which has a secondary movement against the lateral hyoid and tertiary pull against the chin. The goal is to affect a movement roughly 1 cm in the *x* axis, 1 cm in the *y* axis, and 1 cm deep in the *z* axis as opposed to trying to move 2 to 3 cm in a superolateral axis. This results in a more substantial elevation of the hyoid as it now swings vertically to or above the level of the chin and mandibular border. With the hyoid in a more internal and superior position, a greater correction of anterior digastric slope and bowing is achieved, with restoration of the submandibular triangle contents towards the floor of mouth, resulting in a negative submentum submentum.

The sutures are tied sequentially, insetting the platysma into the anterior mastoid tip. Any excess fat in the infragonial region is trimmed as needed. At this point, the gonial angle depth may be analyzed and measured to assess proper positioning and success. Gonial angle depth should be a routine measurable endpoint in face and neck lift surgery. At this point there should exist a contiguous line from the hyoid to the mastoid that is narrower and deeper than the line of the chin to the mandible. The facial platysma should lay comfortably with no tethering or tension around the gonial angle, the inframandibular platysma should wrap around the infragonial region tucking in the parotid tail and suspending the contents of the submentum and submandibular triangles, and the cervical platysma should have elevated the medial platysmal bands superolaterally while relieving lower ptosis of platysma and skin over the clavicles. Limiting skin dissection in the neck actually improves the gains achieved in skin quality relative to techniques that utilize greater dissection (Figure 5D). There should be no tension on or around the soft tissues of the ear, ensuring prevention of pixie ear or inappropriate rotation of the ear postoperatively.

At this point the suspension is complete and excess skin is trimmed without any tension or tacking sutures. A tension-free closure at all points helps ensure minimization of scarring (Supplemental Figure 7). Dermal sutures are avoided, if possible, to limit ischemia that may be caused by constriction of the dermal plexus. A #10 French round drain may be placed in the neck bilaterally overnight and 5-0 nylon netting sutures may be placed in the neck to avoid any minor fluid accumulation (Supplemental Figure 8). The suction tubing is mainly used to aid in redistribution of skin rather than in prevention of hematoma. Netting sutures are only placed in the noncomposite areas of the neck where skin was elevated, and they are removed after 72 hours. A soft headwrap is placed overnight with great care to avoid compression at the cervicomental angle.

RESULTS

Standard measurements of the depth below the gonial angle were taken intraoperatively in 72 patients (68 female,

Table 1. Average Gonial Angle Depth and Rate of Parotidectomy

	Preoperative (mm)	Postoperative 1 (mm)	Postoperative 2 (mm)	Parotidectomy (n, %)
Left (n = 78)	9.4 [3.6]	15.8 [3.3]	23.2 [2.2]	12 (15%)
Right (n = 78)	8.3 [2.7]	13.7 [2.5]	22.5 [2.5]	15 (19%)

Measurements are mean [standard deviation]. Post 1 is measuring the depth after traditional fixation of platysma to outside of mastoid fascia, post 2 is after creation of the mastoid crevasse and inset onto the anterior medial border of the mastoid.

4 male) treated in a 3-month period from August 2021 through November 2021 in the primary author's practice. The patients ranged in age from 32 to 72 years (although the primary surgeon has performed deep plane neck lifts on patients between 25 and 85 years old in his practice). All patients had follow-up at 1 week, 6 weeks, 3 months, and 12 months. Gonial angle depth was defined as the difference in height of the lower posterior border of the mandible to the deepest point 10 mm caudal to that point with the patient in supine position. The positions of the anterior and posterior auricular nerve branches were also measured relative to the position of the anterior mastoid line to assess safety. These measurements were routine, and no experimental studies were performed on patients, in accordance with the Declaration of Helsinki. A Castroviejo caliper was used to measure the gonial angle depth in 3 different positions. Position 1 was taken prior to elevation of the SMAS-platysma flap. Position 2 was taken following full deep plane release as described earlier along with partial myotomies, followed by standard suspension overlay on the mastoid fascia. Position 3 was measured following creation of the mastoid crevasse and inset of the platysma into the anterior mastoid. In total, 237 data points were acquired from the 79 patients bilaterally with an angled Castroviejo 40 mm graded caliper. For measurement acquisition, the upper arm of the caliper is placed directly at the inferior posterior border of the mandibular angle, while the lower caliper is placed at the deepest point within 10 mm of that to most accurately assess the gonial angle depth. If the tail of the parotid was reduced, this was recorded.

The mean [standard deviation] gonial angle depth of the 79 patients included in our database following primary suspension and platysma-mastoid onlay on the left side was 15.8 [3.3] mm while the mean depth after performing the crevasse technique with deeper platysmal inset was 23.2 [2.2] mm. Twelve patients (15%) received left-sided parotid tail reductions. The mean gonial angle depth after primary suspension onlay on the right side was 13.7 [2.5] mm, whereas the mean gonial angle depth after mastoid crevasse inset was 22.5 [2.5] mm. Fifteen patients (19%) received right-sided tail of parotid reductions (Table 1, Supplementary Table 1). In no patients was the gonial angle depth identical and symmetric.

Across the 79 patients included in the database, the average increase of gonial angle depth from traditional suspension of the platysma on the anterior mastoid was 5.9 mm, while the overall average gain in gonial angle depth after utilizing the suspension and inset of the platysma into the mastoid crevasse was 14.0 mm (Table 2). The gain in gonial angle depth with the mastoid crevasse technique was 8.1 mm ($P < .0001$). Changes in the hyoid position and submentum from position 2 to position 3 were universally observed but not recorded in this study (Supplemental Figure 10A, B).

Measurements of the auricular branches were also taken (Figure 2C). The great auricular nerve most often was found to travel in the plane of the SCM fascia as a single branch anywhere from 8 to 12 mm anterior to the anterior mastoid line. Between 2 and 3 posterior branches were typically found traveling along the mastoid posterior to the base of the lobule. In 99% of cases, the branches traveled from 4 to 12 mm posterior to the anterior mastoid line. In 1% of cases a minor branch was noted over the anterior mastoid line and was easily avoided with proper retraction. The main trunk of the facial nerve was absent along the anterior mastoid dissection in 100% of cases. Postauricular facial nerve motor branches could be found at the superior extent of the anterior mastoid line and were preserved.

In addition, 200 surgeons were surveyed in person at an international interdisciplinary conference. The only question of the survey was: "Do you measure the gonial angle or have a method of measuring the gonial angle during face or neck lifting surgery?" One of the 200 (0.5%) of the surgeons claimed they had assessed the depth of the gonial angle, demonstrating the lack of assessment of this important, measurable endpoint.

The patients' results and outcomes were reviewed retrospectively over 12 months of follow-up (Figure 9). Submental and submandibular ptosis and fullness were treated appropriately in 99% of patients. One patient required revision. One patient had temporary paresis lasting longer than 2 weeks around the lower mouth unilaterally, which resolved by 2 months. There were no cases of skin slough or epidermolysis. Three patients demonstrated an ischemic reperfusion response on the postauricular mastoid skin flap as diagnosed by visualization of minor vesicles and surrounding erythema after postoperative day 2. These resolved spontaneously with no sequelae. No facial hematomas occurred. Three minor cervical unilateral hematomas formed and were treated with drainage and netting sutures.

Table 2. Average Differences Between Techniques

	Traditional technique, postoperative 1 vs preoperative (mm)	Crevasse, postoperative 2 vs preoperative (mm)	*P*-value	Average gain (mm)
Left	6.4	13.8	<.0001	7.4
Right	5.4	14.2	<.0001	8.8
Overall	5.9	14.0	<.0001	8.1

Post 1 is measuring the depth after traditional fixation of platysma to outside of mastoid fascia, post 2 is after creation of the mastoid crevasse and inset onto the anterior medial border of the mastoid.

One seroma formed and was treated with drainage and netting sutures. There were no submandibular or parotid salivary leaks, and there was no incidence of gustatory sweating or first bite syndrome. There was zero incidence of ear rotation or pixie ear deformity. Representative before and after (12-month follow-up) photographs are shown in Supplemental Figures 9 and 10.

DISCUSSION

This article provides an advanced deep plane surgical technique detailing a novel approach to increasing definition and depth around the gonial angle; there are, to the authors' knowledge, no published articles describing the technique discussed herein. This technique simultaneously provides more effective vectors of lift to improve hyoid, digastric, and submandibular gland elevation, and suspension as well as improvements to the skin of the inferior neck and clavicle without reliance on skin delamination. This is the first article to recommend intraoperative analysis of gonial angle depth as a measurable endpoint and goal in face and neck lift surgery. Our results have been improved substantially by focusing on proper vectorial lifting of the platysma with inset into the anterior mastoid rather than onlay over the mastoid as classically performed.

Our measurements of primary suspension techniques over the mastoid fascia have demonstrated that patients with a shallow or atrophic mastoid tip with less lateral projection obtain better gonial angle depth than patients with broader, larger, or more lateralized mastoid tips. The mastoid crevasse technique overrides anatomic variations by allowing inset of the platysma to the anterior wall of the mastoid, which increases the depth of the gonial angle substantially. This technique also provides release of the parotid tail, which sits on the anterior mastoid in all patients. Release of the parotid gland and capsule allows the gland to be compressed easily into the deep pharyngeal space, correcting for the protrusion and widening associated with aging or hypertrophy. Performing platysmal scoring or partial myotomies of the outer platysma at the gonial border rather than a full myotomy helps to maintain platysmal integrity along the gonial angle and lateral neck. This technique improves definition and delicacy around the gonial angle by tucking in the parotid gland around the ramus of the mandible (Supplemental Figure 10). This is especially helpful in patients with parotid hypertrophy, including Asian patients and patients with thyroid eye disease who commonly display glandular hypertrophy. Minor parotid tail reduction can safely and easily be integrated into the surgical plan as well when needed without cause for unnecessary facial nerve dissection in a healthy patient.

Suspension to the anterior mastoid periosteum also provides a more secure suspension point for the platysma in a more effective vertical vector. Vertical lifting of the platysma into the anterior mastoid is generally performed in the range of 85° to 90° relative to the Frankfort horizontal line, utilizing mechanical advantages akin to using a pulley system. This provides a more appropriate lift of the submental platysma, anterior digastric muscle, hyoid bone and submandibular glands (Figure 2, Supplemental Figure 7D). This also allows the surgeon to sling the inframandibular platysma around the gonial angle to obtain a negative vector submentum where the submental and submandibular contents are located above the horizontal plane of the mandible.

This study also demonstrates safety of dissection along the anterior mastoid regarding motor and sensory nerves as well as gland function and complications. In the near future additional studies will help provide the average angle or vector of lift of the facial SMAS, facial skin, and cervical platysmal suspension using this approach. These studies help establish a baseline and at least 1 anatomic benchmark, analyzing gonial angle depth following mastoid crevasse inset, for measuring outcomes in the lower face and neck. We hope that this helps demystify outcomes-based research in lower face and neck rejuvenation procedures.

CONCLUSIONS

Modified extended deep plane face and neck lifting techniques focus on release and redraping of soft tissues rather than pulling, tightening, or stretching. Elevation off of the mimetic musculature avoids dynamic changes and alterations in facial muscle function and appearance while decreasing tension in lifting and closure. Incorporation of the mastoid crevasse technique provides a deeper and more secure point of fixation. Extension of the mastoid crevasse under the conchal bowl also makes a more vertical lift possible. Vectorial concepts are demonstrated and improve the surgeon's ability to analyze the neck and make improvements that come from narrowing the diameter around the hyoid and the curve towards the mastoid around the neck, relative to the dimensions of the mandible. Limitations in lifting

Figure 9. (A-J) Before-and-after photographs of a 59-year-old male before and 12 months after a comprehensive Auralyft. This included fat grafting, corner lip lift, and brow lift. His Auralyft involved bilateral submandibular gland reduction, bilateral digastric reduction, perihyoid fat pad reduction, and interrupted netting sutures. He also underwent an upper blepharoplasty with fat removed from bilateral nasal pads and injected into the right lateral brow. His lower blepharoplasty involved fat repositioning, fat grafting, double canthopexy, skin excision, and carbon dioxide laser treatment.

based on anatomic variants of the mastoid tip are overcome by utilizing this technique which also provides a more appropriate suspension of the submental platysma, digastrics, hyoid bone, and submandibular glands. The necessity for skin delamination is decreased by increasing the surface area of skin travel caused by 3D deepening of cervical contours. Limitations based on parotid gland hypertrophy are also better overcome with this technique. Analyzing a measurable endpoint at the gonial angle with the mastoid crevasse technique will aid practitioners in obtaining better results in the anterior and lateral neck and jawline, while leaving less to chance.

Supplemental Material

This article contains supplemental material located online at www.aestheticsurgeryjournal.com.

Disclosures

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

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