

## Special Article: Plastic Surgery

# The Evolution of Techniques in Neck Lifting / A 123 Year Review

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## Introduction

A review of the history of neck rejuvenation includes aesthetic minimally invasive, moderately invasive, and fully invasive procedures to reverse the signs of the aging neck. The goal is to provide a safe, reproducible, and aesthetically appealing result that addresses all of the anatomic components from the skin to the underlying bony skeleton.

## Early History of Neck Lifting

Reviewing the history of face lifting sheds very little light on attempts to rejuvenate the neck. Certainly, skin lifts provided minimal improvement in the aging neck and did not address any of the components of the aging neck except for minimal improvement in skin laxity posteriorly.

In fact, the first attempt at performing a facelift was in 1901 by dr. Eugen hollander. His procedure was a mere removal of an elliptical piece of skin from around the ear without an attempt to lift the structures of the mouth. The first facelift in which the skin was detached from the subcutaneous tissue and repositioned under tension was performed in 1916 by dr. Erich Lexer [1], a german surgeon. His surgery was the predominant type of facelift surgery for the next 60 years. Results were different than those obtained in later years by other surgeons.

Interestingly, very little was published regarding correcting the aging neck until millard [2] published the direct approach to submental lipectomy through a submental incision. Landmark publications that led to an evolution of technical maneuvers to

rejuvenate the neck can be legitimately attributed to Guerrosantos, Connell, Owsley, Aston, and De Castro [3-7]. As in any surgical procedure, a thorough understanding of the relevant anatomy is essential in the production of a safe approach to rejuvenation of the aging neck.

Ellenbogen and karlin published the criteria for a youthful neck [8], including a distinct inferior mandibular border, a visible sub hyoid depression, a visible thyroid cartilage bulge, a visible anterior sternocleidomastoid muscle border, a submental-sternocleidomastoid line angle of 90 degrees, or a cervicomenal angle f 105 to 120 degrees.

It was De Castro [9] who demonstrated in cadaver dissections, three anatomical variations of platysma anatomy: high decussation, suprahyoid decussation, and full-length decussation of platysmal muscle fibers (Figure 1,2).

• Before Exploring the Options in Rejuvenating the Neck, One Must Include all of the Following Components of the Aging NeckSkin

- Subcutaneous fat
- Hyoid bone position
- Platsma muscles (Figure 3)
- Interplatysmal fat
- Subplatysmal fat

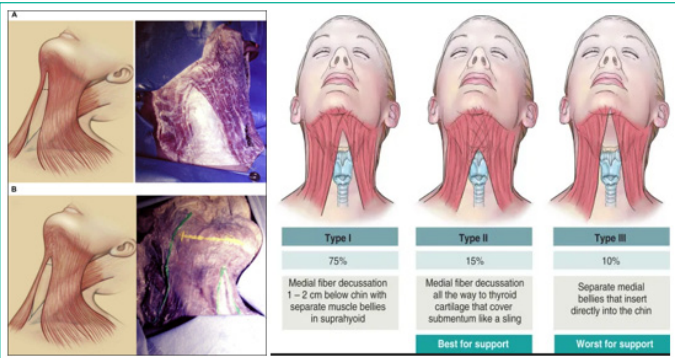


Figure 1 & 2: Platyisma Muscle Decussation Patterns.

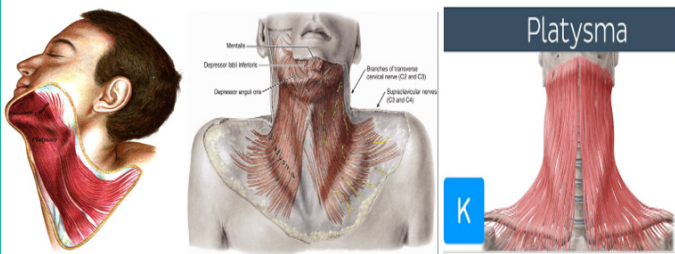


Figure 3: Platyisma Muscle Anatomy.

- Anterior digastric muscles (Figure 4)
- Submandibular glands (Figure 5)
- Mandibular anatomy / central, lateral, gonial angle
- Vascular perfusion of the neck (Figure 6)
- Sensory and motor innervation of the neck including the mandibular soft tissue (Figure 7,8)

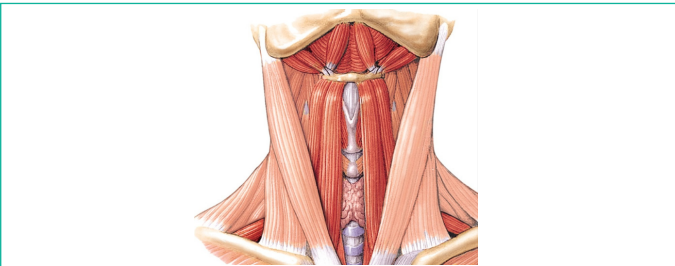


Figure 4: Digastric Muscles.

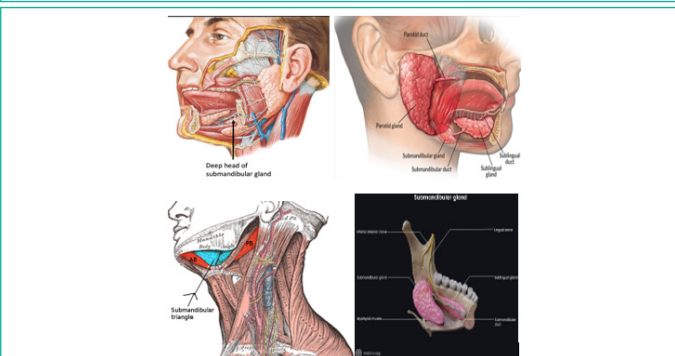


Figure 5: Submandibular Glands.

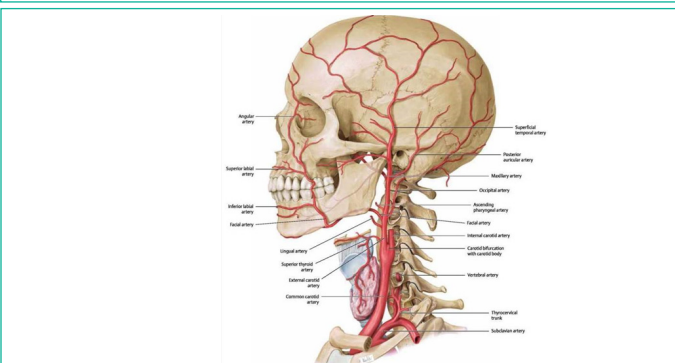


Figure 6: Vascular Perfusion of The Neck.

As mentioned above, early attempts at facial rejuvenation did not address the neck, rather, the neck contour was minimally improved with advancement of the skin and the later addition of smas/platysma flaps developed and tightened laterally.

Clearly, minimally, moderately, and fully invasive techniques emerged in attempts to address all components of the aging neck. For decades, only fully invasive techniques were available. The introduction of closed body liposuction by illouz was followed by suction lipectomy of the neck published by E. Courtiss [10], fillers (both autologous and non-autologous), silastic implants, porous polyethylene implants, bone grafts, neurotoxins, and energy based devices provided alternative and additive procedures to our armamentarium.

**Fillers**

Injectable fillers both autologous and non-autologous can be used to augment the chin / mentum instead of placing an alloplastic implant, fill in the pre-jowl sulcus while enhancing the mandibular border, and can augment the gonial angle.

Nano-fatgrafting can improve the skin texture and improve the transverse neck rhytids [11].

Silastic implants (augmentation in the third dimension) published by Terino [12] and porous polyethylene implants provided augmentation commonly performed in the mentum and less often in the gonial angle.

Bone grafts required more invasive procedures to harvest bone grafts and were mostly limited to craniofacial reconstruction indications.

Advancement genioplasty was a more invasive approach to improving the projection of the chin and could be combined with orthognathic procedures. Clearly, augmentation of the chin with any of the above methods could produce a more pleasing profile aiding in achieving an acute cervico-mental angle by improving the projection of the chin.

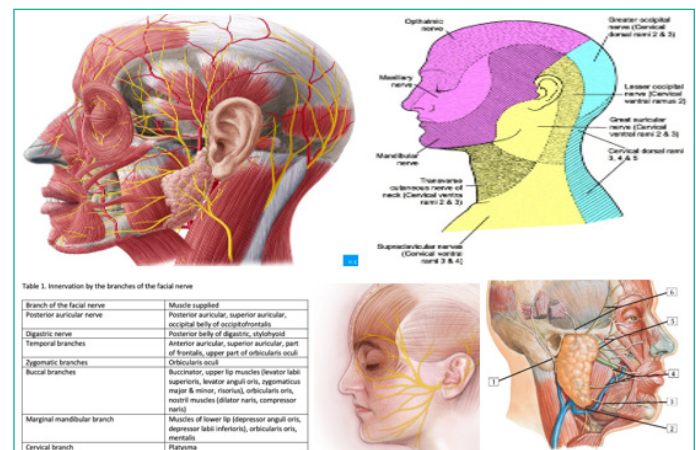


Figure 7 & 8: Sensory and Motor Innervation of The Neck.

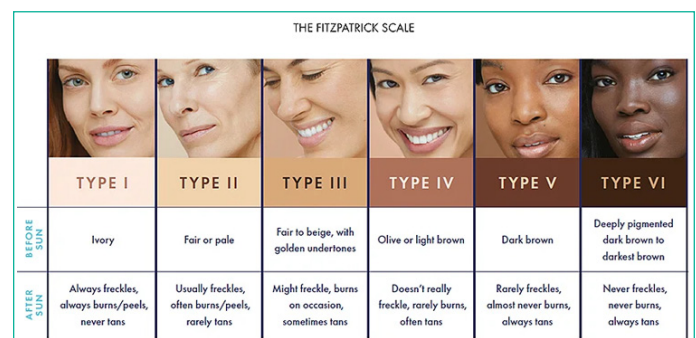
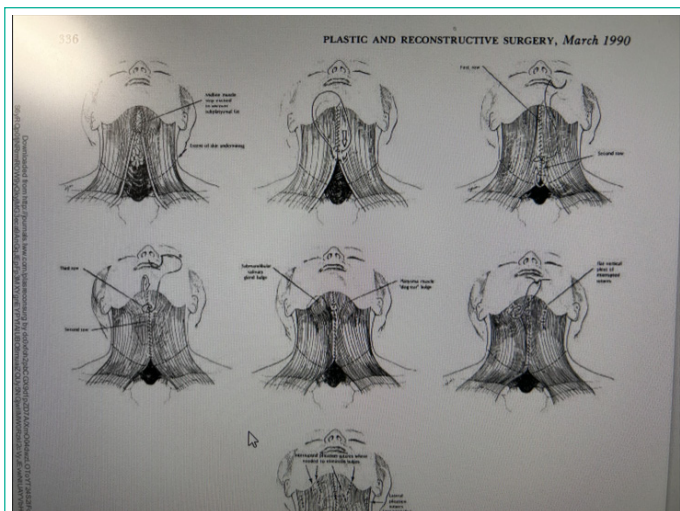


Figure 9: Fitzpatrick Classification.



**Figure 10:** Corset Platysmaplasty.

Neurotoxins can be injected to relax platysmal bands either as a primary treatment or to treat recurrent bands that appear after a necklift, but this improvement is temporary.

### Energy Based Devices

- Laser energy based devices for skin remodeling
- Radiofrequency energy devices for skin and soft tissue remodeling and tightening
- Ultrasonic energy for skin tightening
- J plasma and helium energy based devices for tissue tightening.

### Surgical Options in Neck Rejuvenation

As is true in all facial aesthetic surgical procedures, a complete examination that addresses all of the components of the aging neck is required to allow one to produce an aesthetically pleasing result.

### Quality of the Skin

Fitzpatrick classification (Figure 9), texture, pliability, presence of transverse rhytids.

- Laser resurfacing can produce improvement, but the absence of accessory skin appendages limits the application of laser based energy to the neck.
- Radiofrequency energy based devices can tighten the skin, remodel subcutaneous tissue, and improve the texture, but cannot be expected to improve the convex contour due to platysma muscle bands, a low hyoid, nor address the deep fat compartments of the neck.
- Botulinum toxin can be injected in small amounts intradermally to improve the appearance of transverse neck rhytids, but the improvement is temporary (usually lasting 3-6 month).

Liposuction, Introduced by illouz and fournier in the late 70's performed below the mandibular border can improve the fullness of the neck, and, as mentioned above, various energy based devices and injectables can also diminish the amount of subcutaneous fat.

Kybella, desoxycolate (allergan, irvine, ca) injections are approved for the reduction of submental fullness in the neck.

Interplatysmal and subplatysmal fat can only safely be contoured/reduced when an open submental approach is utilized.

Over resection of deep submental fat can lead to a cobra deformity which can be very difficult to correct, requiring fat grafting and possibly other maneuvers.

### Platysma Muscle Bands

A thorough understanding of the variation in platysma muscle anatomy is essential in selecting the proper procedure to improve the contour of the neck. As mentioned above, De Castro's cadaver dissections described three types of decussations of the platysma muscles. Regardless of the type of decussation, the platysma muscles have to be thoroughly examined and, although platysmal bands can be managed from the lateral approach [13], i do not believe that reproducible production of an acute cervico-mental angle can be produced from the lateral approach in patients who present with long bands that extend to the clavicles.

Attempts to improve the cervico-mental angle include the following surgical maneuvers:

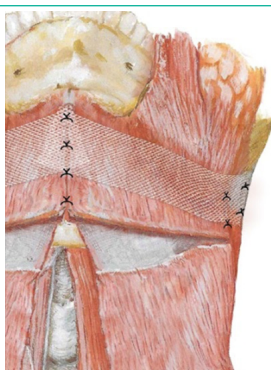
- Corset platysmaplasty [14] (Figure 10)
- Vest over pants platysmaplasty [15] (Figure 11)
- Composite platysmaplasty and closed percutaneous platysma myotomy: a simple way to [16].
- Pmid: 1982546 partial horizontal division or full division [17]
- Platysma myotomies (Figure 12)
- Suture suspension [18]
- Dursorb [19] (Figure 13) sling suspension
- Laser beam assisted platysmaplasty [20]
- Direct anterior excision of the "Turkey Gobbler" deformity [21] (Figure 14) in selected patients who do not want or cannot be medically cleared for a more invasive and longer procedure and will accept a central neck vertical scar interrupted with a z plasty or alternative skin flap redraping. This procedure is accepted by older men with thickly textured skin and the presence of horizontal rhytids.



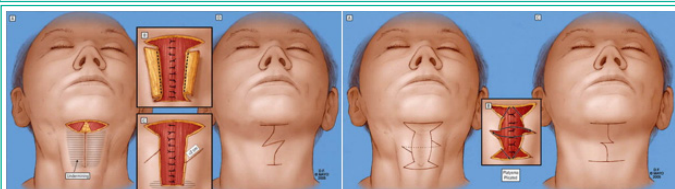
**Figure 11:** Vest Over Pants Platysmaplasty.



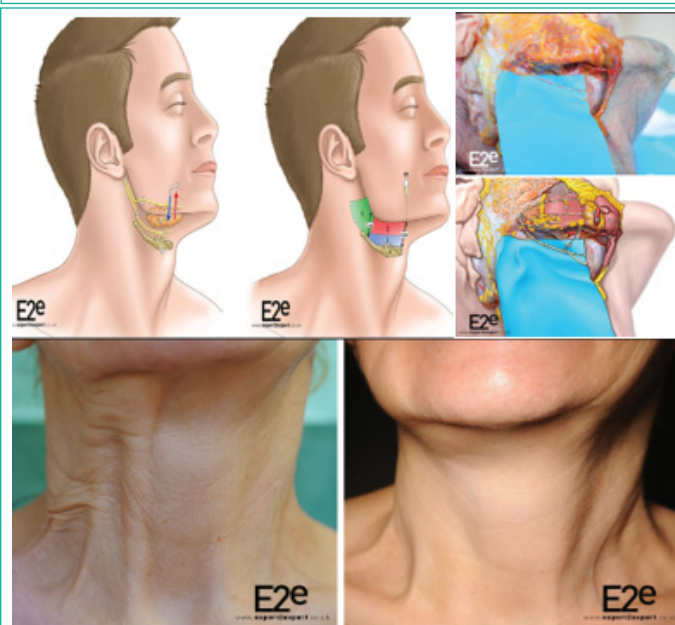
**Figure 12:** Platysma Myotomies.



**Figure 13:** Durasorb Neck Suspension.



**Figure 14:** Direct Anterior Neck Approach (Turkey Gobbler).



**Figure 15:** Denervation of the Cervical Branch of The Facial Nerve.

- Selective denervation of the cervical branch of the facial nerve monitored with a nerve stimulator [22] (Figure 15).

Ancillary procedures to improve the cervico-mental angle and produce a harmonious contour from mentum to the clavicles

When analyzing the submandibular central contour after platysma muscle modification, there are patients who show residual muscle bands which can be significantly improved with partial resection of the anterior bellies of the digastric muscles [23] (Figure 16).

The presence of lateral bulges below the mandible are frequently ptotic submaxillary glands. Partial resection has been promoted by many surgeons [24]. This procedure requires specific instruments and lighting as well as a thorough understanding of the vascular anatomy of the submaxillary gland. An interesting device has been designed to minimize the risk of excessive bleeding as the gland is partially resected. The surgilase (Figure 17) allows the use of bipolar radiofrequency energy to be applied for hemostasis as the gland is partially transected and removed. As an alternative to partial resection of the gland, injections of botulinum toxin in 5 locations within the gland have been shown to diminish the size of the gland (Figure 18) attempts to suspend the submaxillary gland with oblique / lat-

eral platysmaplasty sutures [14]. Various slings utilized to suspend the gland have mixed reviews.

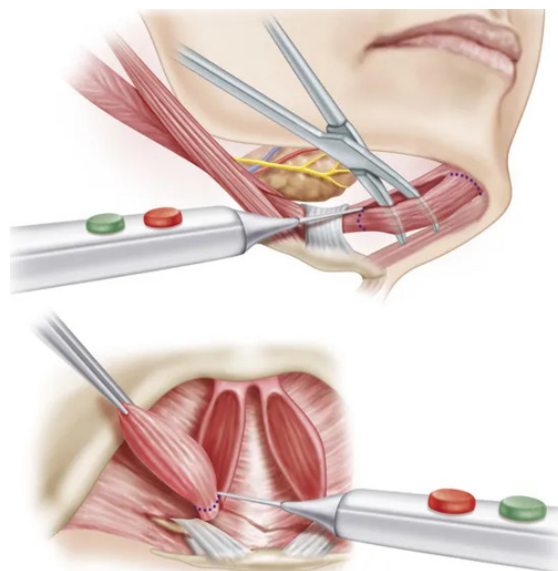
### Vascular Anatomy of The Face and Neck

Despite the rich vascular perfusion of the face and neck (Figure 6), vascular compromise, usually in the post-auricular area, but also in the preauricular area can occur and are more commonly seen in smokers who are advised to stop smoking at least 3 weeks before surgery. A rapidly expanding hematoma, left undrained, can also lead to perfusion compromise in front of and behind the ear. It is my belief that the effects of smoking on the microcirculation of the skin flaps is permanently altered and never returns to normal. The use of sequential dilators was introduced by Da Luz [25] (Figure 19) and allows the release of the skin of the neck from the platysma muscle fascia while maintaining the blood supply to the flap by preserving the fasciocutaneous perforators (Figure 20). This has allowed safe dissections even in recent smokers. The amount of skin detachment is less than in a full width undermining with less tightening of the neck as a result of limited undermining, but the safety outweighs the less-than-optimal result achieved in a smoker or a recent smoker. This maneuver eliminates the possibility of an expanding hematoma because the dilators produce tunnels similar to those achieved with liposuction, so, there is no large space in which a hematoma can form. In the author's experience in over 300 face and necklifts, easily drained small collections occurred behind the ear and only once it was required to open the posterior neck incision to control bleeding after performing a necklift (in a male patient who, despite medical management of his hypertension, presented with a systolic blood pressure of 180mm hg and a diastolic pressure of above 100mm hg).

### Sensory Nerve Supply to The Neck

The sensory nerve supply to the neck is rich (Figure 7) and, although patients may complain about numbness after a necklift, typically, sensory reinnervation occurs in 3-12 months depending on the extent of skin undermining.

A danger zone occurs over the sternocleidomastoid muscle 6.5 cm below the external auditory canal where the greater auricular nerve crosses the muscle below the superficial fascia (Figure 21). This is the most common sensory nerve that can be damaged during a necklift. If divided, the nerve should be repaired to prevent the formation of a neuroma.



**Figure 16:** Partial Excision of The Anterior Bellies of The Digastric Muscles.

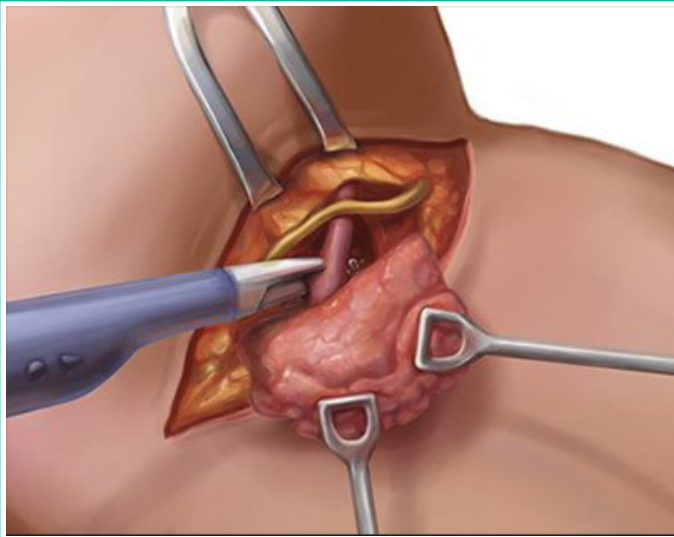


Figure 17: Surgilase.



Figure 18: Botulinum Toxin for Decreasing the Size of The Submaxillary Glands.



Figure 19: Da Luz Vascular Wands.

**Motor Nerve Innervation of the Neck**

Two principal facial nerve branches are at risk in open and closed aesthetic surgical and minimally invasive procedures: the marginal mandibular branch and the cervical branch (Figure 8).

A landmark study of the course of the marginal mandibular branch course was carefully described and was published by Dingman and Grabb [26]. This nerve is at risk in closed liposuction procedures that cross the mandibular border anterior to the facial artery. Certainly, this nerve is at risk in anterior dissections in the sub-platysma plane when the deep cervical fascia is violated laterally and the dissection becomes more superficial

as the nerve enters the deep surface of the depressor anguli oris muscle anterior to the inferior mandibular border. The mentalis and inferior labial nerves are at risk if the mandibular branch is traumatized. If this nerve is injured, reinnervation is common unless complete transection of the nerve occurs, but it can take weeks or months to completely return to normal function. During this time, the opposite depressor anguli oris muscle can be injected with botulinum toxin to provide symmetry to the smile.

The cervical branch can be transected when the platysma muscle is transected. Recently, a study of the safe line in performing safe subplatysmal dissections allowed the marking of the safety zone to avoid injuries to the mandibular and the cervical branches of the facial nerve [27] (Figure 22).

As mentioned above, trevedic has demonstrated that the selective transection of the cervical branch of the facial nerve monitored with a nerve stimulator resulted in complete absence of platysma bands followed over several months.

Fortunately, most diminished sensory and motor nerve functions are temporary neuropraxias. The temporary nature of these injuries does not lessen the strain on the patient and on the surgeon. Early motor injuries may require exploration to determine if a motor nerve has been caught in a suture, transected, or merely bluntly traumatized. Blunt trauma to a motor branch (seen more frequently after the closed liposuction of the jawline) should begin to resolve in 10-14days. Some motor nerve injuries can take up to 6 months to resolve which is a long time for patients to recover. The strain on the doctor/patient relationship can be severe.

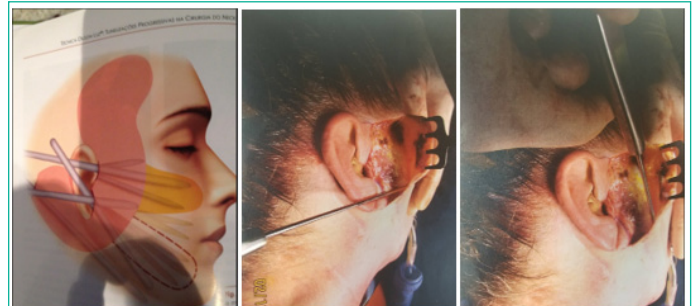


Figure 20: Vascular Wands Procedure.

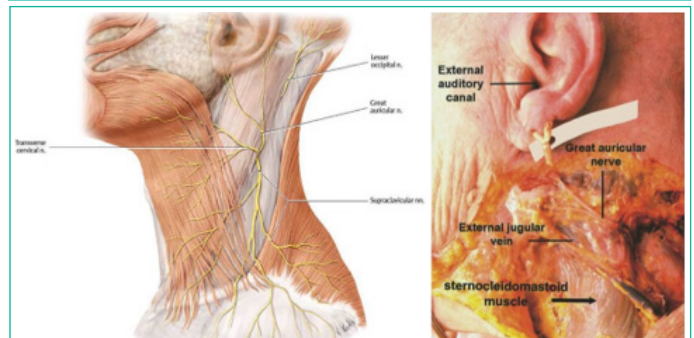


Figure 21: Greater Auricular Nerve.

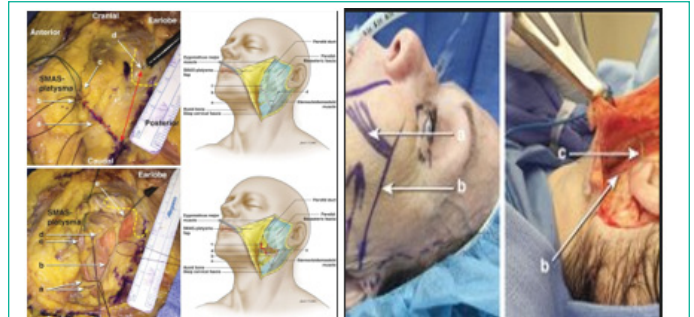


Figure 22: The C-Line.



**Figure 23:** Hemostatic Net.

#### Historical Management of Complications of Neck Lifting

The Complications of Neck Lifting Include All of The Following:

##### Improper Location of Incisions

- Submental incision (should be placed approximately 1 cm below the existing submental crease to prevent deepening of the crease which can result in a “witches chin” deformity)
- Post-auricular incision (should follow the natural curvature of the retroauricular sulcus)
- Posterior / scalp incision

##### Within the hairline in women

Along the inferior hairline in men depending upon how much skin will be shifted

##### Failure to examine the texture and laxity of the skin

Aggressive removal of subcutaneous, inter and sub-platysmal fat resulting in skin adhesions to the platysma fascia and a cobra neck deformity

Failure to determine the extent of paramedian platysma bands and their pattern of decussation

##### Incomplete undermining

##### Failure to obtain hemostasis

##### Failure to address all of the fat compartments in the neck

##### Failure to address the deep structures of the neck

##### Low positioned hyoid bone

##### Large anterior belly of the digastric muscles

##### Enlarged and/or ptotic submaxillary glands

##### Injury to the greater auricular nerve

##### Injury to the marginal mandibular nerve

##### Injury to the cervical branch

Failure to address hypertension pre, intra, and post-operatively

##### Improper flap tension and flap direction of redraping

##### Improper skin closure

Failure to immediately address expanding hematomas in the neck

#### Management of Complications of Neck Lifting

The immediate management of complications of aesthetic surgery of the neck principally involves treatment of an expanding hematoma which can result in a shift of the trachea with compromise of the airway. Small, non-expanding hematomas can be managed at the bedside, but expanding hematomas need a return to the operating room for hemostasis. Interestingly, the use of a hemostatic net [28-32] (Figure 23). Can be helpful in eliminating the formation of a hematoma and can be used after evacuation of a hematoma to close the dead space.

Failure to promptly address an expanding hematoma can result in skin necrosis, delayed healing, and contour deformities which are often difficult to correct.

Neuropraxia of the marginal mandibular branch of the facial nerve can be stressful to both the patient and the surgeon. Fortunately, this injury resolves within several weeks. During that time, the use of botulinum toxin on the normal side can improve the symmetry of the smile. However, as the injured nerve function returns, the side treated with botulinum toxin may show weak lip depression for a longer period of time.

The greater auricular nerve crosses the sternocleidomastoid muscle 6.5cm below the tragus and is the most common sensory nerve injured during a necklift. If transected, it should be repaired under magnification to prevent the occurrence of a painful neuroma as well as diminished sensation of the ear.

Recurrence of platysma bands is probably the most common occurrence and may be treated with injections of botulinum toxin, percutaneous platysma myotomies, or a second open platysmaplasty after several months have passed to allow for healing and softening of the tissues.

Frequently, ptotic and or hypertrophied submaxillary gland will become visible after neck defating with or without platysmaplasty. A second look with partial gland excision is an option, as is reducing the volume of the gland with botulinum toxin injections (25u per gland and perhaps a need to repeat every 4-6 months).

The improper location of the incisions can be difficult to correct and requires months of healing before revisions can be safely performed.

Cervical branch injuries are not as worrisome and, as mentioned above, selective cervical branch denervation may prevent recurrence of platysmal bands.

Skin necrosis requires conservative management with the expectation that scar revision(s) may be necessary to improve the final result.

Relaxation of the skin of the neck can occur from several factors including poor texture, sun and smoke damage, loss of elasticity with age, improper redraping, and tension on closure.

#### Certainly, The Most Common Complaints Regarding Neck Lift Procedures Are:

- Improper location of access incisions
- Recurrence of platysma bands
- Loose skin
- Visible anterior belly of digastric muscles
- Ptotic and or enlarged submaxillary glands

## Summary

The history of neck lifting dates back to over 100 years. However, management of all of the elements of the aging neck did not begin until the 1960s, years later. The description of the three varieties of platysmal bands, the introduction of liposuction, the options in platysmaplasty, and platysma partial or complete transection, the artistic location of necklift incisions (respecting the hairline in men and in women) the avoidance of skin tension after the realization that neck contouring should occur at a deep level and skin redraping should be without tension, the management of the anterior belly of the digastric muscles, and the partial reduction of the submaxillary glands. More recently, minimally and non-invasive energy based devices (lasers, ultrasound, radiofrequency, plasma/helium, etc.). Have been introduced to offer less invasive solutions to the aging neck including improving the quality of the skin as well as contouring the neck with fat reduction and collagen remodeling.

Providing a safe, reproducible, patient specific approach to neck rejuvenation results in an enormous benefit to both the patient and the surgeon.

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