Chapter 25

Surgical rejuvenation of the aging neck

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Introduction

A variety of procedures have been described for rejuvenation of the aging neck, which is often, but not invariably, performed in conjunction with that of the face [1]. This chapter focuses primarily on the surgical options available for neck contour restoration and puts it in the overall context of cervicofacial rejuvenation.

Numerous non-surgical treatments have been advocated for neck lifting including the use of Botulinum toxins [2], injectable fillers [3, 4], photodynamic therapy, pulsed light and lasers [5-7]. Although a discussion of these alternatives is beyond the scope of this chapter, occasionally they are combined with surgery.

Methodology

This chapter is a review of the literature on the surgical aspects of neck rejuvenation, of which there are numerous techniques. Lists of articles were accessed through the PubMed search engine using the following key words and terms: 'neck rejuvenation', 'cervical rejuvenation', 'platysmaplasty', 'neck lift', 'face lift' and 'cervicoplasty'. The relevant articles, along with the senior author's own experience, were then compiled into a review of this common aesthetic challenge.

The aging neck and an aesthetic 'ideal'

Numerous factors contribute to the loss of shape and contour which are characteristic of the aging neck [8]. The anatomical appearances are a consequence of changes occurring in all tissue layers of the neck, from skin through to the bone of the cervical spine. These changes include loss of collagen and dermal elastic fibres with subsequent sagging of the skin and ptosis of the soft tissues in the neck and chin. Attenuation of Stuzin's retaining ligaments, which hold the platysma against the deep cervical fascia, causes the appearance of platysmal bands and obliquity of the cervicomental angle [9] **(III/B)**. In addition to the banding of the platysma muscles, there is elimination of the anterior sternocleidomastoid border. With age there is also increased fat deposition and submandibular gland

Table 1. Options for surgical rejuvenation of the neck. *Adapted from Nahai F. The Art of Aesthetic Surgery, Principles & Techniques, 2005* [12].

Liposuction alone	a) Suction-assisted lipectomy (SAL) b) Ultrasound-assisted liposuction (UAL)
Submental lift (open neck lift)	
Endoscopic neck lift	
Short scar face and neck lift	a) With a submental incision b) Without a submental incision
As part of a full face lift	a) With a submental incison: i) through and through dissection ii) unconnected/interrupted b) Without a submental incision

protrusion. Furthermore osteoporosis causes bone resorption of the mandible and cervical spine. The latter causes shortening of the cervical spine [10].

It is important to pay special attention to specific external anatomical areas in order to optimise the surgical outcome from neck rejuvenation. These are the cervicomental angle, definition of the mandibular border, prominence of the labiomandibular fold (jowling), mental prominence and neck width. Changes to these areas can have significant effects on the appearance of the neck. In 1980, Ellenbogen and Karlin described the visual criteria that have been widely adopted as a means of focusing the surgeon's attention upon attaining specific anatomical features of the youthful neck **(III/B)**. These criteria are:

- A distinct mandibular border.
- A visible subhyoid depression.
- A visible thyroid cartilage bulge.
- A visible anterior sternocleidomastoid.
- A submental sternocleidomastoid line angle of 90° or a cervicomental angle of 105-120° [11].

Options for surgical rejuvenation of the neck (Table 1)

There are many surgical procedures used in rejuvenating and recontouring the neck. Each patient must be assessed carefully and the correct technique(s) selected in order to optimise the outcome.

Liposuction

Cervicofacial rejuvenation using liposuction is well described [13-24]. This technique is best suited to patients with excessive adipose tissue in the lower face and neck and normal skin quality (usually younger patients). It improves the contour by removal of the fat, skin redraping to the altered underlying framework, and skin contraction. Excellent skin quality is therefore essential for optimal results. The ideal candidate for liposuction alone has good skin elasticity and general skin quality [21] **(IV/C)**, may manifest early signs of facial aging in the lower face, but with minimal skin redundancy, and no platysmal banding (Figure 1). The midface should not show evidence of significant signs of facial aging that would warrant a rhytidectomy. One way to determine

Figure 1. A 39-year-old woman with a fatty neck and good skin quality. Note the obtuse cervicomental angle and generalised pre-operative adiposity. Rejuvenation of the neck was achieved by UAL alone, to the neck and submental area. There is significant improvement of the neck-jaw angle and reduction of early jowling. Note that excellent skin quality was essential for redraping. The jowls are reduced and the patient looks thinner.

whether there is excess skin redundancy and poor elasticity is to perform the Ilouz test. The distance between the earlobe and chin tip is measured, the skin is then pulled away from the face, and a second measurement of the distracted distance is made. If the distraction distance exceeds the initial measurement by 15% or less, a lipectomy technique should suffice; if it is 20% or more, a rhytidectomy is indicated. Neck skin is more amenable to redraping and redistribution than facial skin. Hence, skin excision is not necessary in most cases to achieve excellent cosmetic results.

The effect of volume reduction in patients with an obtuse cervicomental angle will be to sharpen this angle (Figure 1). It is possible that removal of excess adipose tissue may subsequently reveal significant signs of facial aging that were being masked, such as platysmal bands, prominent digastric muscles, redundant skin or ptotic submandibular glands. This highlights the importance of very careful pre-operative surgical assessment and planning. Patients with obtuse cervicomental angles must, therefore, be warned of the possibility of having a staged rejuvenation procedure. Alternatively they should be advised pre-operatively that an open neck lift or face lift is more appropriate. In general terms, younger patents with good skin elasticity are excellent candidates for this technique. Liposuction of the neck can either be undertaken with suction-assisted lipectomy (SAL) or ultrasound-assisted liposuction (UAL).

Suction-assisted lipectomy (SAL) [13-23]

Courtiss demonstrated that following submental liposuction there was sufficient redraping and recontouring of the submental skin without redundancy. The patients, however, had to have normal skin quality and elasticity [20] **(III/B)**.

Technique

Cervical contouring by liposuction involves the removal of pre-platysmal fat while relying on skin contraction to tighten the neck skin. It is important to leave at least 5mm of fat on the skin flaps in order to disguise any underlying irregularities. Liposuction cannot reliably or safely deal with subplatysmal fat and this needs to be dealt with by open fat excision via a submental incision.

Liposuction can be performed either under local or general anaesthesia. Stab access incisions are made in the submental area and occasionally behind each ear lobe (for jaw line and lateral neck). The area is infiltrated with a standard liposuction solution. The suction is then undertaken using either a flat 2-3mm cannula (with the holes always facing the deep tissues) or a 2.3 or 3mm Mercedes cannula staying at least 5mm deep to the skin. The suction should be judicious with only 1-2 passes per tunnel to avoid over-suction and postoperative irregularities.

Mechanism of action

Liposuction exerts some of its effect via a simple volume reduction through extraction of fat. Another important mechanism is the creation of tunnels in the subcutaneous plane. The tunnels heal through a fibrous contractile process, which, in effect, retracts the subcutaneous tissue. The elastic properties of the overlying skin allow it to redrape over the subcutaneous framework with a net result of skin retraction [25-32] and skin redraping, reducing the ptotic appearance. The removal of this superficial layer has been described as being more evenly accomplished through emulsification with ultrasound-assisted lipectomy, compared with suction-assisted lipectomy [12, 24] **(IV/C)**.

Ultrasound-assisted liposuction (UAL) [12, 24]

Ultrasound-assisted liposuction has been found to be effective in neck rejuvenation [24] (Figure 1). It emulsifies the supraplatysmal fat making it easy for evacuation and contouring. Ultrasonic energy itself stimulates skin retraction through a different mechanism. It seems that the fibrous framework supporting the skin undergoes an inflammatory reaction in response to the exposure to ultrasonic energy. This framework subsequently contracts, resulting in retraction of the skin. The use of ultrasound-assisted liposuction carries with it a potential risk of thermal injury. In order to avoid this risk it is important that the probe is in constant motion, and a wet environment is necessary. It is also important to lower the amplitude (25-50%) and the emulsification time (2-3 minutes) in order to avoid marginal mandibular nerve palsy [12, 24].

Lipectomy (open fat excision): en bloc/piecemeal

Despite the popularity of suction-assisted lipectomy for removal of cervical fat, some authors advocate an alternative excisional approach, that can either be en bloc or piecemeal [33, 34]. Proponents of this approach describe a more anatomical dissection that facilitates removal of greater amounts of fat with superior redraping of the cervical skin. Unlike liposuction this approach can be used to deal with the subplatysmal fat.

The fat excision can, therefore, be supraplatysmal and/or subplatysmal. It is performed under direct vision and therefore can be more precise. In contrast to liposuction, excisional lipectomy is usually undertaken in conjunction with rhytidectomy [35]. It facilitates management of the platysma muscle and therefore overlaps with the submental/open neck lift. Open fat excision is indicated in the difficult neck [33, 34], but as an isolated procedure has largely been superceded by liposuction or the submental lift as part of a face lift procedure.

Submental neck lift

This procedure involves a submental incision, undermining of the neck skin, followed by modifications of the fat (supra, inter, and sub-platysmal), platysma muscle and sometimes deeper structures under direct vision. Adequate visualisation is possible using a lighted retractor or a headlight and narrow Deaver retractor.

It is rarely undertaken in isolation (Figure 2), usually preceded by liposuction or pre-tunnelling, and often in conjunction with a face lift (short scar or long scar). It is indicated in patients with platysmal bands at rest, or bands visible on animation. In an isolated submental lift the extent of lateral undermining depends upon whether or not any skin redundancy persists or not. Any remaining contour irregularities are smoothed out either by liposuction or by direct fat excision. Drains are routinely used for this procedure.

Figure 2. A 57-year-old man with isolated aging of the neck. He has heavy skin with true skin excess. An open submental necklift with minimal liposuction, midline platysma plication and short scars around the ear lobes for skin excision were used to rejuvenate the neck. Note the well redraped skin, acute cervicomental angle and visible thyroid cartilage bulge postoperatively [11].

Managing the platysma (platysma modification)

Open surgical rejuvenation of the aging neck usually includes some form of platysma modification. The numerous methods by which the platysma muscle is dealt with in neck rejuvenation [36-47] suggest that no one single approach suits all cases.

Aging causes attenuation of the cervical support for the platysma allowing the anterior borders of the platysma to descend inferiorly thus causing prominence of the platysmal bands [36, 37]. Other contributory factors to platysmal band prominence include muscle hypertrophy with age and shortening of the bow-stringed platysma [9]. Descent of the platysma muscle also contributes to the obliquity of the neck and creation of an obtuse cervicomental angle. The central or medial aspects of the platysma muscles separate in the midline, and frequently, medial bands appear, perhaps owing to vertical shortening of the corresponding muscular fibres [9].

The platysma needs to be approximated in the midline (anterior edge to edge approximation with or without trimming of any excess) and occasionally division of the bands. This inferior transection myotomy is designed to release and lengthen the muscle and allow superior redraping of muscle, better definition of the neck and recreation of the youthful acute cervicomental angle (Figure 2). Platysmaplasty has taken on many forms, including lateral plication [42], sectioning and flap rotation [43], simple midline suturing [44, 45], progressively tensioned midline sutures [44], muscular Z-plasty [45], resection of muscular 'bridles' [46], and suspension sutures. Other descriptions which incorporate a combination of these principles, include Feldman's 'corset platysmaplasty' [46] and the 'hammock platysmaplasty' as described by Fuente del Campo [38] **(III/B)**. Feldman's corset platysmaplasty not only improves the submental contour and jawline but also eliminates platysmal bands [46]. Del Campo's double breasting of the platysma muscles in the midline, entirely through a submental approach enables excellent platysmal suspension and neck recontouring with no need for posterior traction of the platysma muscle or peri-auricular incisions.

Suspension sutures designed to improve the jaw line and neck-jaw angle were first described by Guerrero-Santos in 1983 [37] and have since been popularized by Giampapa and Di Bernardo [17]. The principle behind this method is to create a permanent artificial 'ligament' under the mandible, thereby correcting the deformities of the aging neck. The procedure is carried out through submental and post-auricular incisions. The neck is undermined (varied depending on the degree of ptosis and laxity), followed by plication of the platysmal edges medially. Subsequently, an interlocking, permanent suture is secured under the angle of the mandible before it is sutured onto the mastoid fascia. Specifically, one end of the interlocking suture creates the loop, and the other end passes through the loop. Only the first end is secured on the sternocleidomastoid muscle with two 'bites' on its fascia (less than 1cm apart). They then both get secured to the mastoid area. The long-term efficacy of suture suspension techniques in improving and masking abnormalities deep to the platysma has been questioned by Nahai [48].

Commonly used platysmaplasty techniques are shown in Table 2.

Endoscopically-assisted neck lift

The Emory University Hospital group has demonstrated that all the steps of a neck lift can be accomplished through minimal-access incisions. The incision behind the ear can be avoided if no skin excision is required [49]. The endoscope facilitates wide undermining of the neck skin and achievement of haemostasis. It has no particular advantages over the submental neck lift [12].

Neck lift as part of a face lift

Almost all facelifts have a rejuvenating effect on the neck, in particular the jaw line (and the jowls). This is especially so with face lifts incorporating the superficial musculo-aponeurotic system (SMAS) lift or plication. In the senior author's experience only a minority of face lifts achieve effective improvement of the neck without submental liposuction or without opening the neck **(IV/C)**. Most face lift patients' necks are rejuvenated with an open neck lift (involving a submental incision) and modification of the platysma.

Table 2. Commonly used platysmaplasty techniques.

Platysmaplasty	Technique	Advantages	Disadvantages
Standard plication [37]	Lateral or medial edge of platysma sutured to SCM* or to itself (medial)	Technically simple	Could result in 'bunching' effect
Corset platysmaplasty [46]	Suture down, up and down the full length of platysma	Contour definition	
Suture-suspension methods [17, 37]	Numerous methods using absorbable or non-absorbable sutures	Allow careful adjustment of the desired outcome	Scarring could result in tethering of skin to platysma. Requires very careful skin redraping
'Anterior only' approach [50]	Direct anterior skin excision with platysma & Z plasty	Good if elderly and wouldn't tolerate a big operation	Scarring of anterior neck.

* Sternocleidomastoid muscle

The results are more spectacular with through and through subcutaneous dissection of the neck. The face lift's retro and pre-auricular incisions allow better or more excision of the loose cervical skin, better redraping of the neck, in addition to very wide access for platysma plication, SMAS-platysma lift/ suspension and elimination of the jowls.

Short scar face and neck lift

This is indicated in patients with no excess neck skin with jowls and aging of the neck-face interface. The incision is entirely in front of the ear (pre-auricular) and extends superiorly below the side burn (pre-hairline). The MACS lift and the short scar lateral SMASectomy are such examples [51, 52].

Full scar face and neck lift

This is similar to the short scar technique but includes retro-auricular incisions. It is indicated in patients with aging changes of the face and neck, especially the neck-face interface, with inelastic skin and excess lower and posterior neck skin [12]. True skin excess is present if the neck wrinkles extend below the thyroid cartilage or laterally beyond the sternocleidomastoid muscles. Poor quality or sun-damaged skin is inelastic and will not contract sufficiently postoperatively; it thus requires excision (Figure 3).

Skin excision

In patients with significant skin laxity and redundancy, excision of skin is mandatory. This is usually incorporated into the standard peri-auricular facelift incisions; however, numerous authors have described a direct skin excision from an 'anterior only' procedure [53, 54]. The anterior incision is usually incorporated into a Z-plasty [55]. This approach is probably only acceptable in the elderly population that would be willing to accept the scar trade off for a less involved operation and faster recovery.

Figure 3. A 63-year-old lady with severe aging of the neck and face underwent a full facelift including endoscopic brow lift, open cervicoplasty and through and through submental dissection.

Table 3. Procedures deep to the platysma.

◆ Fat excision: open excision
◆ Tangential excision of the anterior bellies of the digastric muscles
◆ Intracapsular removal of the superficial lobe of the submandibular gland
◆ Release of the suprahyoid fascia (indicated for high hyoid)

Technical fine points

As previously mentioned there are specific anatomical sites that warrant special consideration. These areas have undergone further refinement over the years following improvement in surgical techniques, contributing to better aesthetic outcomes. Giampapa *et al*, in 2005, recently provided an excellent approach to the technical fine points involved in improving outcomes [10].

Depth of cervicomental angle

A number of options exist for enhancing this point. Firstly, if an interlocking suture method has been used (Giampapa) [17], then careful adjustment of the tension on this suture allows for adjustment of the depth of the angle. Additionally, defatting of the supra- and subplatysmal fat can also enhance the angle or help it remain soft. It is vital not to 'over correct' the neck, which occurs if too much tension is applied to the suspension sutures or if too much fat is removed from the supraplatysmal or subplatysmal plane.

Suturing of the digastric muscles together can further enhance the angle and help create a more concave or flat submental triangle [56, 57]. Finally, transection of the platysmal muscle borders has been popular; however, this is usually reserved for those with extremely thick platysmal bands or severe medial redundancy.

Modification of subplatysmal structures [12, 48, 57]

Connell demonstrated that even better neck contour (beyond that achieved with submental liposuction and corset platysmaplasty) could be obtained by removing the bulging caused by fat, the digastric muscles and the submandibular glands **(III/B)** (Table 3).

The fat between the platysma (interplatysmal) and deep to it (subplatysmal) cannot be dealt with by liposuction as it is difficult to access blindly, and it is dangerous to attempt to do so. Therefore, this is done by direct/ open excision under direct vision. The anterior bellies of the digastric muscles can be excised tangentially [57] or totally. Rarely, they may be plicated in the midline.

Mandibular border definition

Liposuction both above and below the border of the mandible while leaving a strip of subcutaneous fat along the bony mandibular border for highlighting of the border itself will contribute significantly to defining this border.

Additional techniques that can be used with good effect here are fat grafting along the border of the mandible during the primary platysmaplasty, or the use of long-term fillers. Finally, some have utilised alloplastic implants with good results [58]. However, the risks associated with alloplastic implants discourage their widespread use.

Mandibular angle definition

If the suture suspension method is used, correct placement and tensioning will help enhance this angle. Additionally, fat grafting into the masseter muscle has resulted in even more defined mandibular angles. Similar results have been reported with the use of long-term fillers and with alloplastic augmentation.

Labial mandibular fold prominence

The labial mandibular fold is considered above the neck proper; however, it contributes directly to an overall youthful appearance of the neck. Suctioning of this area from below via a submental incision and/or from a postauricular incision flattens the labiomandibular fold. Camouflage fat grafting around the labiomandibular area can also markedly help to decrease the deformity. Dissection of the depressor labii muscle through a small intra-oral incision and subperiosteal dissection allows the muscle component of the fold to be released and helps to alleviate the downward turned corners of the mouth. Finally, an extended skin ellipse with a postauricular skin excision can further correct skin redundancy when prominent jowling is present.

Mental prominence

A naturally prominent chin projection adds considerably to the overall length and beauty of an aesthetically balanced neck. It also helps keep skin from becoming redundant in the submental area, but can easily be overlooked. A number of techniques for augmenting a deficient chin prominence exist and predominantly focus upon alloplastic implants and the use of sliding genioplasties with or without wire/plate fixation. The latter can be technically challenging and require significantly more time and effort with more potential complications. Fat grafting and long-term fillers have also been used, but results with them are more modest and await validation.

Anterior neck width

In many patients, the neck width is markedly increased with aging. As discussed earlier, this increase is mainly attributable to muscle laxity, collapse of the cervical spine, and an increase in subcutaneous and submental fat deposits. The creation of an aesthetically pleasing, thin neck can be accomplished by a number of techniques including resection of the redundant midline platysmal muscle and reconstitution of the muscle at the midline, by imbrication, or by a combination of both [59].

Algorithmic approach to surgical rejuvenation of the aging neck (Figure 4)

Categorising the problem and choosing the right technique

The ideal procedure for patients with aging of the lower face and neck is a cervicofacial rhytidectomy. However, within this population is a subgroup whose goals can be met by a lesser procedure that focuses solely upon the neck, with no change in the midface. This sub-group of patients has been described as falling into three broad categories:

- Patients with an obtuse cervicomental angle and good skin elasticity (who may be treated with liposuction alone).
- Patients with subplatysmal fat or mild to moderate skin and muscle laxity (these patients may be best treated by anterior lipectomy/liposuction and platysmaplasty).
- Patients with marked skin excess or severe skin laxity (best treated by procedures which excise skin).

Simply put, the young, the middle-aged and the elderly require different surgical techniques or approaches [50].

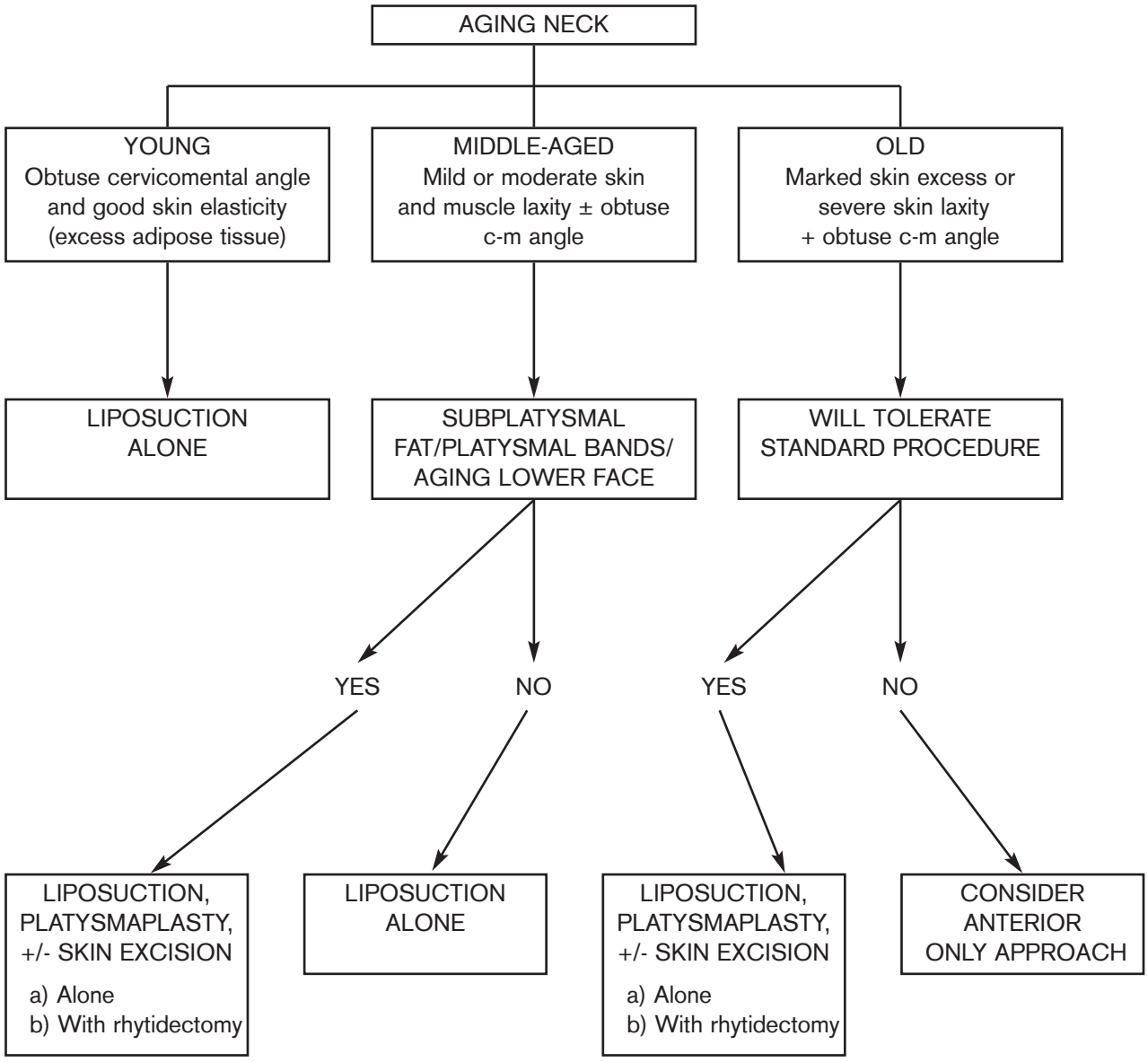

Figure 4. Algorithm for surgical rejuvenation of the aging neck.

Conclusions

Rejuvenation of the ageing neck highlights a frequently recurring principle in surgery that no single approach suits all. It presents the plastic surgeon with an aesthetic and technical challenge that requires a structured approach in order to achieve a successful outcome. The evidence base outlined here aims to provide a framework through which consistent results can be achieved (Figure 4).

Recommendations	Evidence level
◆ Attention to specific anatomical landmarks improves the surgical outcome from neck rejuvenation.	III/C
◆ SAL alone can be effective treatment in the young patient with excellent skin quality.	III/B
◆ UAL has extended the role of SAL and is more efficacious.	IV/C
◆ Numerous techniques are described in managing platysma, the utilisation of which depends upon the patients requirements and surgeons skill and familiarity with each.	IV/C
◆ In patients with significant skin laxity and redundancy, excision of skin is mandatory.	IV/C

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