The Relationship of the Marginal Mandibular Nerve to the Mandibular Osseocutaneous Ligament and Lesser Ligaments of the Lower Face

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Abstract

**Background:** An in-depth understanding of the nuances of facial anatomy is the best means of preventing complications during facelift surgery. An appreciation of the operative details is complicated not only by the complexity of the anatomy but also by the variability in the nomenclature used.

**Objectives:** The authors have attempted to clarify these issues by detailing the relationships of the ligaments of the lower face both to each other and to the marginal mandibular nerve.

**Methods:** The mandibular ligament, the platysma mandibular ligament, and the marginal mandibular nerve were identified in 22 cadaver halves. The gonial angle, and the lower mandibular border were used as perpendicular reference lines.

**Results:** The mean length, height, and depth of the mandibular ligament and the platysma mandibular ligament were calculated. The mean distance of the mandibular ligament from the gonial angle along the mandibular border was also noted: it was always located superior to the platysma mandibular ligament. The marginal mandibular “danger zone” was identified a quarter of the length of the mandibular body along the lower jaw border. Finally, variability in nomenclature of the lower face ligaments was clarified.

**Conclusions:** A topographic map of the structures of surgical importance in the lower face was constructed in the hope that this will prevent surgical errors during facelift surgery.

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While controversial, one school of facelift surgeons believe that superficial musculo aponeurotic system (SMAS) release, SMAS repositioning, and fixation offers distinct benefits over superficial SMAS plication or SMAS-ectomy. However, if results are to be maximized and nerve injury is to be avoided, sub-SMAS surgery demands an intimate knowledge of the facial anatomy. To this end a number of recent articles have focused on detailing this anatomy of the upper face, the midface, and the lower face.

While the incidence of facial nerve injury during facelift surgery is variable, it is more likely to occur with more extensive sub-SMAS procedures. The marginal mandibular nerve (MMN) is perhaps the least likely branch to recover following facelift surgery because of its infrequent cross innervations. In fact only 15% of the MMN fibers crosslink with the buccal branches of the facial nerve; therefore recovery after complete transection is unlikely.

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Because of the probable permanence of the facial nerve deficit should MMN injury occur, we have chosen to revisit and detail this anatomy, to describe its relationship to contiguous structures, and to detail its variability in location in the lower face. Specifically we have attempted to describe the relationship of the MMN to the mandibular osseocutaneous ligament (MOCL), to the lesser known platysma mandibular ligament (PML), and to the mandibular septum.9 We have attempted to clarify inconsistencies in the ligament nomenclature. We also have defined potential “danger zones”—areas of increased risk for iatrogenic nerve injury—that may be encountered during facelift surgery. Finally we discuss when ligament release should be performed and at what level of dissection.

METHODS

Facial dissections were performed in 11 fresh cadavers (22 hemifaces) using ×2.5 magnifying surgical loupes. A skin flap was raised simulating the surgical dissection in facelift surgery in the subcutaneous plane. The mandibular osseocutaneous ligament (MOCL) and platysma mandibular ligament (PML) were identified as thick fibrous bands originating from the mandible with distinct dimensions and borders that could be separated from the surrounding subcutaneous and areolar tissue. The ligaments were sharply transected at the subdermal level and the skin flap dissection carried out beyond these structures cranially past the depressor anguli oris, medial to the level of the pogonion, and caudally at least 8 cm inferior to the mandibular border. The cut edge of each ligament was marked using brilliant green solution. The length (distance from proximal to distal end in horizontal plane), the height (distance from cranial to caudal end in vertical plane), and the depth (distance between osseous origin and end at the dermis) of the ligaments were measured on stretch using a ruler with an accuracy of 1 mm.

The MMN was identified by splitting the overlying SMAS and the depressor anguli oris muscle using a blunt dissector. The sub-SMAS course was then exposed along its entire length in retrograde fashion from deep to the depressor anguli oris muscle, then splitting the overlying SMAS to the facial artery (FA) and vein, and finally continuing deep to the parotidomasseteric fascia until its origin from the parotid gland was identified. Specific attention was paid to the superficial or deep course of the MMN to the FA and vein, the specific crossing point of the MMN and the FA, the branching points of the MMN in relation to the FA, and the distal course of the MMN in relation to the MOCL.

A measuring tape was pinned in place on the dissection plane conforming to the shape of the face from the gonial angle (point 0 mm) along the inferior mandibular border in a horizontal dimension. A second measuring tape was then placed from the gonial angle perpendicular to the first extending superiorly in a vertical dimension (Figure 1).

The distance of the proximal and distal ends of the MOCL and PML, as well as the crossing point of the MMN and FA from the gonial angle were then measured in the horizontal and vertical dimension using the rulers (1 mm increments) in place as reference. Using a separate ruler (1 mm increments) the shortest distance between the MOCL and PML, as well as the distance of the MMN to the origin and the midpoint of the MOCL in a vertical dimension, were measured.

To capture the entire course of the nerve we then placed tracing paper on the dissection planes of the fresh cadaver halves. We marked the gonial angle, the vertical and horizontal placed rulers, the course of the nerve, the nerve branch points, the FA, the MOCL, and the PML. We then scanned the tracings and performed a density analysis of the course of the MMN, and areas with the likelihood of nerve occurrence of <20%, ≥20% to 40%, and ≥40% were calculated.

Statistical analysis of the measurements was performed using the t-test (Stata, College Station, TX software). The mean, 95% confidence interval (CI), and standard deviation (SD) for the structures were calculated. A P value of less than 0.05 was considered significant.

RESULTS

The cadavers included 12 male and 10 female hemifaces with the mean age of 72.2 (range 55-85) years.

Retaining Ligaments; MOCL & PML

The MOCL was identified in all 22 hemifaces, while the PML was found only in 18 of 22 hemifaces (Figure 2). Within a 95% CI the mean proximal end of the MOCL was found to be 56.2 ± 3.1 mm from the gonial angle along the mandibular border and 9.1 ± 0.9 mm superior to it. The mean distal end was 67.8 ± 3.3 mm from the gonial angle along the mandibular border and 9.3 ± 1.6 mm superior to it. The length (distance from proximal to the distal end in the horizontal plane), the height (distance from cranial to caudal end in vertical plane), and the depth (distance between its osseous origin and end at the dermis) were 13.1 ± 1.4, 3.6 ± 0.1, and 5.4 ± 0.7 mm, respectively (Figure 3). There were no significant differences in length (P = .83), height (P = .82), or depth (P = .69) between male and female hemifaces. The distal fibers of the ligament were seen to intermingle with the depressor anguli oris muscle.

Within a 95% CI the mean proximal end of the PML was 48.5 ± 4.4 mm from the gonial angle along the mandibular border and 1.5 ± 0.8 mm superior to it. The mean distal end was 67.8 ± 5.4 mm from the gonial angle along the
mandibular border and 1.3 ± 0.8 mm superior to it. The length, height, and depth of the PML were 21.5 ± 2.2, 3.5 ± 0.4, and 5.6 ± 1.2 mm, respectively (Figure 4). Statistical analysis comparing male and female cadavers showed a significant difference in ligament length of 23.8 ± 2.5 mm in male hemifaces and 18.8 ± 3.6 mm in female hemifaces (P = .01). There was no statistical difference in ligament width (P = .65) or depth (P = .18) between male and female hemifaces. The MOCL was located on average 8.4 ± 1.6 mm superior to the PML (Figure 5).

Marginal Mandibular Nerve (MMN)

The course of the MMN was variable. Figure 6 demonstrates the density analysis, showing the areas with the likelihood of nerve being located in <20%, ≥20% to 40%,
and ≥40% of the time. In addition the 95% CI, as well as the mean course of the MMN, were calculated and shown in the diagram in relation to the FA and to the 95% CI of the retaining ligaments of the lower face (Figure 7). The nerve exited the parotid masseteric fascia to become sub-SMAS crossing the facial vessels at a mean distance of 23.1 mm from the gonial angle along the lower mandibular border and 3.1 mm superior to it in a sub-SMAS plane. This point equals approximately a quarter of the soft tissue mandibular length from the gonial angle to pogonian. Since this is a soft tissue measurement the actual boney measurement from gonial angle to pogonian will differ and is probably greater. This represents the masseteric fusion zone and is where potential injury to the facial nerve is most likely to occur during SMAS release (Figure 8). The nerve remains deep to the platysma/SMAS until it reaches the depressor anguli oris. The nerve had an average of 2.1 branches. The branch points were located proximal to the facial vessels in 21.1% and distal to the facial vessels in 65.8%. In 13.1% the branch point was identified directly at the point where the MMN crosses the facial vessels. The terminal branch was always cranial to the MOCL with a mean distance of 9.7 ± 1.2 mm (Figure 9). Proximal to the facial vessels 23.8% of the MMN branches were identified caudally, and 76.2% cranially to the inferior mandibular border, whereas 12.5% of those run initially caudally to the mandibular border but crossed and continued cranially to the mandibular border proximal to the FA. Distal to the facial vessels 19.0% of the MMN were located caudally to the mandibular border, but crossed eventually to continue cranially to the border, whereas 81.0% were located cranially to the mandibular border.

**DISCUSSION**

The importance of release of the retaining ligaments during facelift surgery is well recognized. Alghoul and Codner have recently reviewed the retaining ligaments of the face, and as they have noted the description of the location of these ligaments is variable depending on the authors cited. This can lead to confusion for the lesser experienced surgeon. For example, Mendelson located the mandibular ligament at the inferior most location of the inverted L created by the horizontally located zygomatic and inferiorly oriented masseteric cutaneous ligaments. Thus, Mendelson locates the mandibular ligament in vertical alignment with the masseteric ligaments and major zygomatic cutaneous ligament.

Stuzin (Figure 10) and Furnas (Figure 11), however, locate the ligament more medial than Mendelson at the parasymphyseal region and the anterior margin of the jowl, respectively. Further, the mandibular ligament has been described along both the superior aspect of the mandibular body and parasymphysis as well as 1 cm above the body. Furnas described the mandibular ligament as a series of parallel fibers with a second tier aligned 2 to 3 mm above the first, and this has been confirmed by others. Its depiction as a single structure, however, is understandable given that the two tiers are separated by a mere 2 to 3 mm. We identified the ligament with a length, width, and height of 13.1 ± 1.4, 3.6 ± 0.1 and 5.4 ± 0.7 mm, respectively. Our dissection findings are consistent with Stuzin, Furnas, and others with the ligament located in the parasymphyseal region 67.8 ± 3.3 mm from the horizontal line constructed from the gonial angle along the inferior border of the mandible (Figure 2) and more medial than the description by Mendelson.

We also demonstrate that the mandibular cutaneous ligament is in close proximity to the MMN in the sub-SMAS plane. The nerve consistently passes 9.7 ± 1.2 mm superior to the ligament (Figure 9).

The variability in ligament nomenclature adds to the confusion. Furnas described the aponeurotic connections between the anterior platysma and skin of the cheek as the platysma cutaneous ligament. Later Stuzin described these fascial condensations at the anterior border of the masseter and more aptly renamed these structures the masseteric cutaneous ligaments. As the masseteric cutaneous ligaments have no attachment to bone, he considered these “false” ligaments. Perhaps the most accurate and easiest way to describe the masseteric ligaments is as a fusion membrane between the SMAS and the masseteric fascia. As described by Mendelson this structure must be transected to release the SMAS during sub-SMAS facelift surgery.

Lesser-known ossecutaneous ligaments, which connect skin and soft tissue to bone, have also been described and have been given a variety of names. Feldman and others have depicted the PML running just lateral and inferior to the mandibular ligament along the inferior border of the mandible.

Ozdemir et al described ligamentous structures between the mandibular body and angle and named these fibrous attachments platysma cutaneous ligaments. They further noted that these structures represented septae rather than discrete ligaments and, finally, that they were present only in a minority (8 of 22) of their dissections.

More recently, Reece et al described the mandibular septum as a structure extending posteriorly from the mandibular ligament running horizontally and ending abruptly at the mandibular angle. They further demonstrated that the mandibular septum separated the inferior jowl compartment from the submandibular compartment and stated that the mandibular septum was critical to jowl formation. We clearly identified both the mandibular ligament and a parallel separate fibrous structure on average 8.4 ± 1.6 mm inferior to it extending for a length of 21.5 ± 2.2 mm, located on average 1.3-1.5 mm above the mandibular border (Figures 1, 2, and 7). We did not find a well-defined mandibular septum running as a direct posterior extension as described by Reece et al. Instead our findings mirrored...
Figure 5. Mean vertical distance between the mandibular osseocutaneous ligament (MOCL) and platysma mandibular ligament (PML) is noted.

Figure 6. Probability of marginal mandibular nerve (MMN) location in percent with blue <20%, yellow ≥20%-<40%, and red ≥40% chance of the nerve being located in a given area.

Figure 7. 95% CI, as well as the mean course of the marginal mandibular nerve (MMN), in relation to the facial artery (FA) and to the 95% CI of the retaining ligaments of the lower face.

Figure 8. The marginal mandibular nerve (MMN) passes sub-facial to the facial vessels approximately a quarter of the soft tissue length of the mandible from the gonial angle to the pogonion.
those of Feldman and others relative to the description of the PML. Whether the platysma mandibular ligament is what Reece et al called the mandibular septum is unclear.

However, the physiologic significance of this structure is the same, ie, to act as a hammock preventing further descent of jowl fat into the neck.

A variety of other ligaments have been described in the lower face. The paramedian platysma retaining ligaments define the lateral border of the submental area and the submental ligaments define the inferior border of the mental and the superior borders of the submental region. Therefore, jowl formation might best be described as follows: Laxity of the masseteric cutaneous ligaments leads to descent of jowl fat. Laxity in the PML determines the amount of descent of fat from the inferior jowl compartment. Further, descent of jowl fat is checked by the anteriorly located mandibular cutaneous ligament which fixes skin anterior to the mandibular ligament and serves as the structure defining the anterior-most border of the marionette lines. We have previously demonstrated that medially the mandibular ligament interdigitates with the inferior-lateral depressor anguli oris, forming the inferior most portion of the marionette line (Figure 12). Our clinical observations have demonstrated that the remainder of the marionette line is formed by vertically oriented filaments originating from the lateral portion of the depressor anguli oris.18

Figure 9. Mean vertical distance of marginal mandibular nerve (MMN) to mandibular osseocutaneous ligament (MOCL) in fresh cadaver.

Figure 10. Location mandibular ligament at the parasymphysis as described by Stuzin et al1 (reproduced with permission from Wolters Kluwer Health).
Figure 11. Description of the mandibular cutaneous ligament by Furnas\textsuperscript{16} as a two-tiered structure at the anterior margin of the jowl (reproduced with permission from Wolters Kluwer Health).

Figure 12. Prior cadaver dissection demonstrating the inter-digititation of the mandibular ligament with the inferior-lateral depressor anguli oris.

Figure 13. Intraoperative release of the mandibular osseocutaneous ligament at the subcutaneous level (arrow).
Figure 14. Pretreatment (A) frontal and (C) lateral views of 67-year-old woman. 5-year posttreatment frontal (B) and lateral (D) views following extended SMAS dissection with subcutaneous release of mandibular ligament and hairline browlift.
According to Owsley and Agarwal, the MMN emerges from the deep fascia at the inferior edge of the mid mandible to cross the facial vessels to enter the buccal space. Our study demonstrates that the crossing point of the MMN and the facial vessels was 23.1 mm from the gonial angle, which was equal to approximately a quarter the mandibular length from the gonial angle to soft tissue pogonion (Figure 8). At this crossing point the MMN is at greatest risk for injury and this can, therefore, be defined as the MMN “danger zone.” Sub-SMAS dissection in this area carries significant risk and should be done with caution.

Several of our findings may be of clinical importance. External marks on the skin of the lower face noting the location of the MOCL 56 mm from the gonial angle, the location of the MMN as it crosses the facial vessels, 23 mm from the gonial angle or a quarter the length of the mandible, and the distal MMN location 9 mm superior to the MOCL may be helpful to the lesser experienced surgeon. In particular, distal to the facial vessels the MMN continues to run superficial but still deep to the platysma. In this area the MMN is susceptible to injury even during subcutaneous dissection. This can occur via blind scissor dissection leading to inadvertent penetration of the platysma, by use of liposuction cannulas. Therefore, dissection under direct visualization using loupe magnification, sufficient lighting, and bipolar electrocautery in this area is suggested.

The mandibular ligament can be readily palpated as a tethering structure at the anterior-most location of the jowl/marionette lines.

Release of the MOCL during facelift surgery is controversial. Some surgeons release the MOCL routinely during facelift surgery while others do not. While the release of the MOCL is not necessary for excellent facelift results, there are occasions when its release can be beneficial. Whether or not this release may be indicated can be assessed in the operating room by placing superior lateral manual traction on the facelift flaps. Contour depression caused by ligament attachment suggests the release will be beneficial. Release of the ligament (Figure 13) allows mobilization of the distal submental skin and significant submental lift. This is similar to the manner in which major zygomatic cutaneous ligaments release allows mobilization of the distal mid face. Once released, further fibrous adherence may still be felt medial to the ligament. This may represent inadequate release of the MOCL, PML, or submental ligaments. Further dissection should be done only to allow adequate distal skin release. Due to the close proximity of the MMN to the mandibular ligament in the sub-SMAS plane if one decides to cut the mandibular cutaneous ligament to improve submental laxity or to optimize contour by redraping the distal submental soft tissue, it should be done in the subcutaneous plane. Release of the mandibular ligament in the sub-SMAS plane is not only unnecessary, but also ill advised as this risks injury to the MMN. Figure 14 demonstrates improvement obtained following extended SMAS release and release of mandibular ligament in the subcutaneous plane. Finally, releasing the mandibular ligament in conjunction with defatting or repositioning jowl fat corrects the pre-jowl sulcus.

Study limitations are acknowledged. The small number of fresh cadavers limits the conclusions that we can make regarding variability in anatomy. Further since only 12 male and 10 female cadaver halves were dissected, real anatomic differences between males and females may not have been realized.

CONCLUSIONS

Variability in nomenclature and location of the mandibular osseocutaneous ligament and lesser-known ligaments of the lower face can lead to confusion for the lesser experience surgeon. We have attempted to clarify both nomenclature and ligament location. Specifically we failed to identify the previously described mandibular septum but did clearly identify the platysma mandibular ligament. Further we identified the course of the marginal mandibular nerve as it travels across the “danger zone” passing through the masseteric fusion plane approximately a quarter of the distance from the genial angle to pogonion. Finally clinical correlation is addressed, suggesting when MOCL transection should or should not be performed and at what plane this should be done.

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