Facial Nerve in Rhytidoplasty: Anatomic Study of Its Trajectory in the Overlying Skin and the Most Common Sites of Injury

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The anatomic study of the facial nerve is closely related to the prevention of nerve injury that may occur in facial surgeries. The purpose of this study is to analyze the most susceptible areas in the face regarding the probability of facial nerve injury, based on the demarcation of its trajectory in the overlying skin. Three hundred cadaveric hemifaces were dissected (172 male, 128 female) and the facial nerve trajectory was followed from the stylomastoids foramen to the mimic muscles. The trajectory of the facial branches was delimited in the overlying skin by six diverging lines, with the following reference points: the upper and lower portions of the tragus, the most cranial wrinkle of the frontal region, the lower facial wrinkle of the frontal muscle, the nasal midpoint, an imaginary point 1 cm caudal to the oral commisura, another imaginary point also caudal to the oral commisura at the lower margin of mandible, and the clavicle midpoint. The temporal branches have the highest probability of being injured, followed by the mandibular marginal and buccal branches. The areas with greater risk of injury are the temporofrontal region (between the hairline and the lateral limit of the frontal muscle), the area near the angle of the mandible, and the preparotid region.

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The anatomic study of the facial nerve is closely related to the prevention of nerve injury that may occur during rhytidoplasties and other facial surgeries. According to Guerrero–Santos,[1] the first procedures in face lifting started at the beginning of this century and were limited to elevation of smale skin. Castañares[2] analyzed the complications after rhytidoplasties and concluded that paralyzation of the face was rare, but injury of a single branch was more common because of surgical traumas, excessive tension during flap elevation, thermal injury by electrocautery, direct injury (sectioning) of the branch, and inflammatory response. Bernstein and Nelson[3] conducted a study in which the anatomy of the facial nerve was observed through the projection of the trajectories of its branches in the overlying skin. The objective of the current study is to analyze the most susceptible areas in the face regarding the probability of facial nerve injury, based on the projection of the trajectory of the facial nerve in the overlying skin.

Material and Methods

For this study 150 adult cadavers had their faces dissected bilaterally at the Federal University of São Paulo, Escola Paulista de Medicina, Morphological Department as indicated in the Table. The anatomy of the facial nerve was studied from the beginning of its extracranial territory, at the stylomastoid foramen, until the motor end plate at the muscles of facial expression, by the following:

1. Incision, from the upper temporal region anteriorly to the tragus to the angle of the mandible, making a curve toward the mental region, stopping at the symphysis. In the cervical region, a median incision was made from the symphysis to the external furcula.
2. Elevation of the skin flap through subcutane-

Cadaveric Characteristics

Ethnic Group	Gender		Total
	Male	Female	
White	40	26	66
Not white	46	38	84
Total	86	64	150

ous tissue to the internal canthal ligament and to the oral commissure.

3. Preauricular incision of the superficial fascia, and its elevation to the muscles of facial expression limits. Dissection of the muscles of facial expression, keeping them attached to the superficial fascia in their superficial and deep levels.
4. Incision of the parotid fascia, near the tragus, along the parotid gland, from its upper border to its lower portion. In the cervical region, incision of the platysma and superficial cervical fascia on its middle point.
5. Elevation of the parotid fascia to the point where the facial nerve branches emerge from the gland. In the cervical region, exposure of the deep structures to the cervical fascia (Fig 1).
6. Meticulous dissection of all facial nerve branches to the penetration in the muscles of facial expression (Fig 2).
7. Topical application of hydrogen peroxide for a period of 24 hours to effect better visualization of the branches: The facial nerve and its branches were analyzed according to their relationship with surrounding structures, territory of innervation, and number of branches. Also, a projection of the branches in the overlying skin was made.

Results

It was shown by the dissections that the branches of the facial nerve have their trajectory marked in the overlying skin through the following parameters: The temporal branches were the thickest, composed of a single branch (28%), two branches (32%), three branches (16%), or four branches (4%). They were in a region limited by two straight diverging lines. The first line begins at the upper portion of the tragus and ends at the most cranial wrinkle of the frontal region (Fig 3, line A). The second line begins at the lower portion of the tragus and extends to the lower wrinkle of the frontal region (see Fig 3, line B).

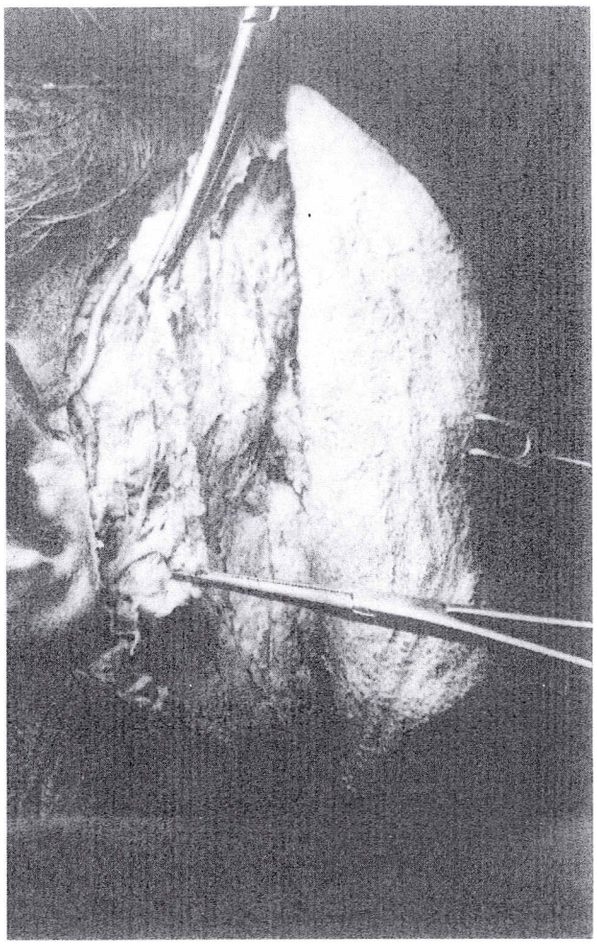

Fig 1. Subcutaneous flap elevated in the right hemiface of a cadaver, showing parotid fascia that was elevated, and exposing the facial nerve branches.

Temporal branches were anterior and caudal to the frontal ramus of the superficial temporal artery in 91% of the subjects. The corrugator muscle received branches between these two lines in 95% of the subjects, reached by the temporal branches alone in 76% and by the temporal and the zygomatic branches in 19%. The procerus muscle received temporal branches in 21% of the subjects. Cranial to the zygomatic arch, the tissue layer covering the temporal branches became very thin, increasing nerve damage risk.

The zygomatic branches were formed by two branches (9%), three branches (46%), four branches (40%), or five branches (5%) and were

Fig 2. All facial nerve branches. The branches formed a nerve plexus, receiving communicating branches from each other.

limited by two lines. The first line, superiorly, is line B in Figure 3, and the second line begins at the lower portion of the tragus and extends to the midpoint of the nose (see Fig 3, line C). The zygomatic branches passed below the orbicular muscle reaching both the procerus muscle in 96% and the corrugator muscle in 24%. All of them were between lines B and C in Figure 3. In all subjects the zygomatic branches began in the anterior portion of the parotid, were well protected by subcutaneous tissue and superficial fascia, and reached the lateral margin of the orbicularis muscle in a relatively short trajectory.

The buccal branches formed a nerve plexus, and in 26% of the subjects received an ascending branch from the marginal mandibular branch. They were limited between two straight diverging lines. The first one is line C in Figure 3. The second goes from the lower portion of the tragus to an imaginary point 1 cm caudal to the oral commissure (see Fig 3, line D).

The buccal branches become vulnerable at the anterior margin of the parotid gland, where they are very superficial. These branches, in a complex plexus, innervate the oral orbicularis, buccinator, and risorius muscles. In all subjects these branches innervated the cranial portion of the orbicularis, whereas in 49% of the subjects the same branches innervated the caudal portion of the orbicularis muscle.

The marginal mandibular branches were formed by two branches (21%), three branches (58%), or four branches (11%). Their innervation area was limited by two lines: above by line D in Figure 3 and below a line beginning 1 cm caudal to the tragus, extending to an imaginary point determined by crossing the line along the margin of the mandible (Fig 3, line E) and a craniocaudal line passing through the oral commissure. Posteriorly to this point 60% of the branches were caudal to the bone margin, and anteriorly all the branches were cranial to the margin. In 85% of the subjects the branches caudal to the bone margin crossed the margin near the facial artery. These branches innervate the mouth and the depressor of the lower lip, and the mental, risorius, buccinator, and the lower portion of the oral orbicularis muscles. Near the angle of the mandible these branches are covered by a thin layer of tissue and by the platysma.

The cervical branches were formed by two branches (28%), three branches (52%), or four branches (20%) limited by two lines: line E in Figure 3 and a line that extends 1 cm caudally to the tragus to the middle point of the clavicle. These branches innervated platysma in 85% of the subjects and were often connected with cervical transverse branches.

All terminal branches of the facial nerve were below the superficial musculoaponeurotic system (SMAS). The protection provided by the SMAS is variable, and the temporal branches are the least protected, particularly between the hairline and the lateral margin of the frontal muscle, where the SMAS is thin superficial fascia (Figs 4 and 5). Other regions of greater risk are the preparotid region and the region near the margin of the mandible (Fig 6).

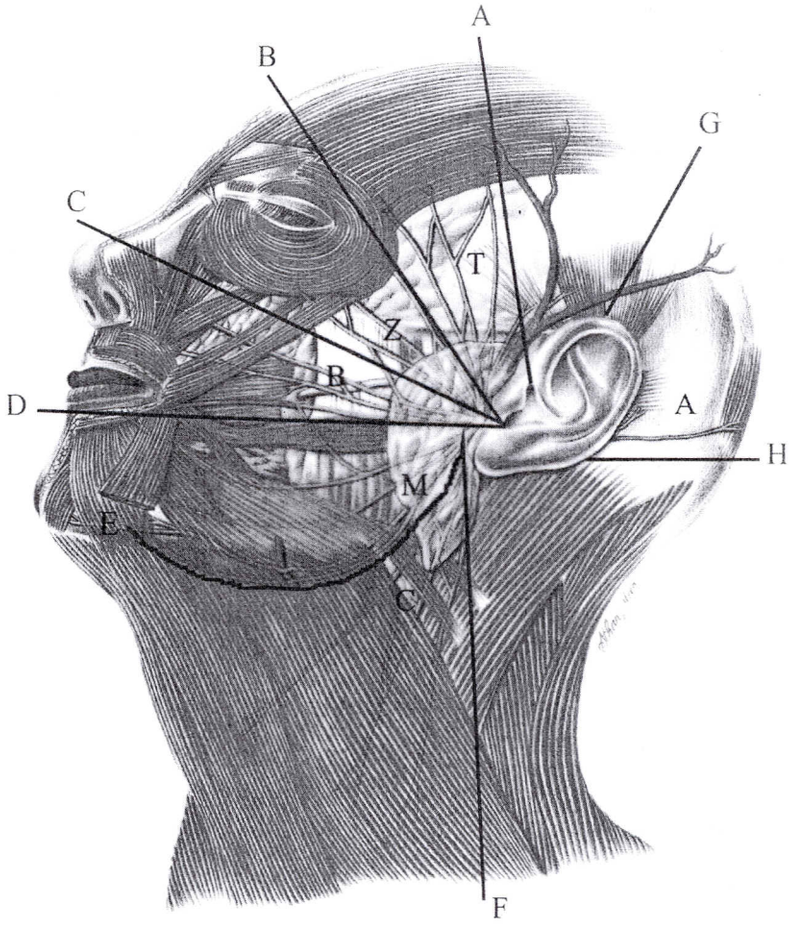

Fig 3. Lines in the overlying skin that mark the trajectory of the facial nerve branches. T = temporal; Z = zygomatic; B = buccal; M = marginal mandible; C = cervical; A = postauricular.

Discussion

In the literature, the distribution of the facial nerve branches remains controversial. Nelson and Gingrass[4] stressed the necessity of standardized studies on this subject for a better comprehension of the trajectory of the branches. The projection of the temporal branch in the current study is more accurate than suggested by others.[5–7] To prevent temporal branch injury during a rhytidoplasty, we suggest elevating the skin flap cranially to the zygomatic arch, above the superficial fascia, in the subcutaneous layer, not too thin, to prevent trophic skin lesions, as advocated by others [5,7–12] The facial branches that innervate the frontal muscle, corrugator, and procerus are usually more anterior and caudal to the frontal branch of the superficial temporal artery, so the risk of injury is very low when elevating the flap posterior to this artery. To prevent hair follicle injury, the flap may be elevated below the superficial fascia until the artery is seen. Elevation should be done in a more superficial layer to avoid injuring the branches.[5,7,13,14] The temporal branches are the most unprotected against injury because they are too superficial near the frontal muscle.

Often there is a difficulty in distinguishing the cervical branches from the marginal mandibular ones.[4,9,15] Dingman and Grabb[15] describe these branches above the mandibular margin in 81% of cases, and the other 19% were located not more than 1 cm from the bone margin. Nelson and Gingrass[4] described these branches below the margin in 100% of cases, and Baker and Conley[9] reported these branches 3 or 4 cm below the bone margin.

We observed that these branches follow a trajectory toward the margin and below it in 60% of subjects, and can be as much as 2 cm from the bone margin. Our study showed an intermediate result in comparison with other studies, probably because some of the fibers that innervate the platysma muscle run together with fibers that

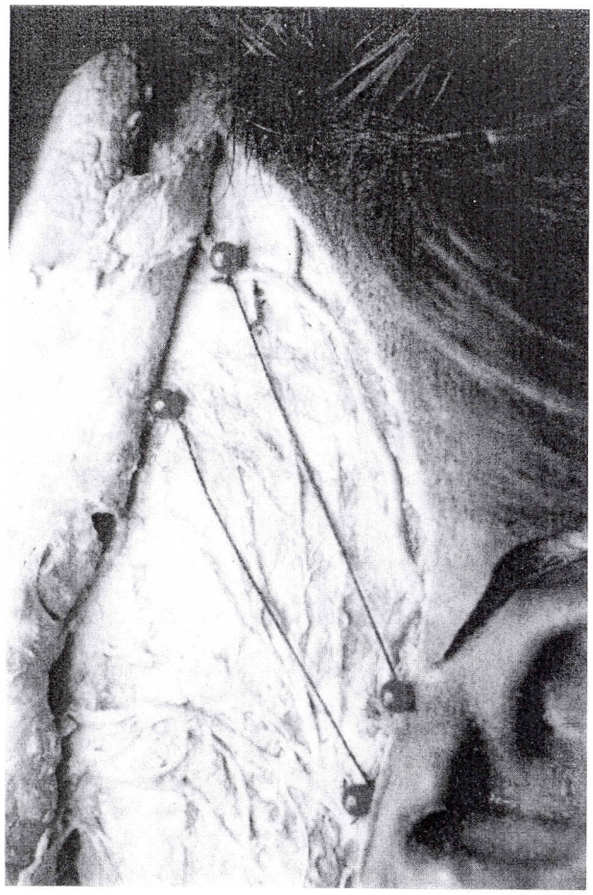

Fig 4. Temporal branches: least protected area that is limited by two lines where the superficial musculoaponeurotic system is a thin superficial fascia. The temporal superficial artery is superior.

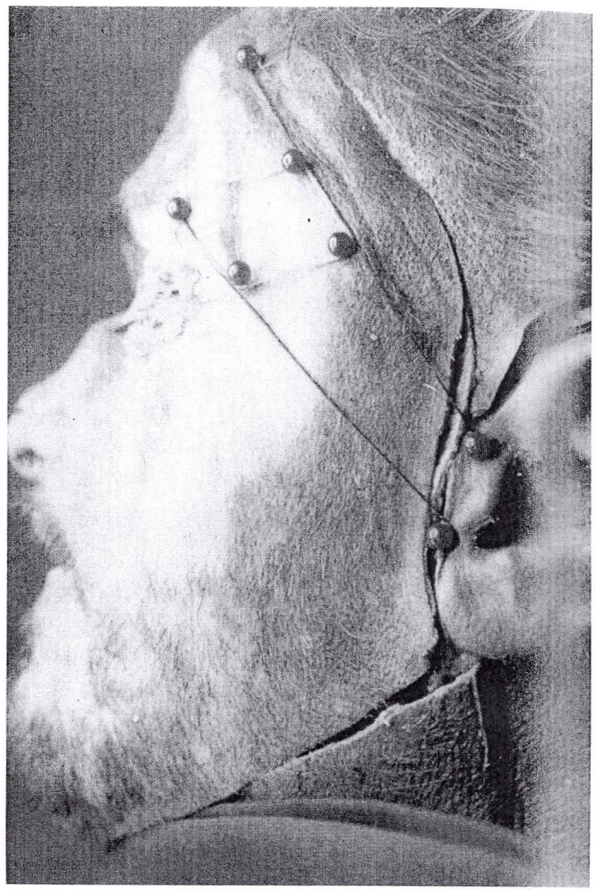

Fig 5. Limited area between the hairline and the lateral margin of the frontal muscle where the protection provided by the superficial musculoaponeurotic system is minimal, becoming the most important site of injury.

innervate the depressor of the lower lip muscle. Therefore, the cervical branches were misidentified in other studies, and were considered marginal of the mandible branches by a mistake.

The marginal branches are more unprotected when they are caudal to the bone margin, especially near the angle of the mandible. In patients with thin skin and a thin layer of subcutaneous tissue, the risk of injury is higher, especially when the fibers of the platysma are not well developed. To avoid injury of the marginal branches, dissection must be superficial to the platysma muscle, and the incision must be made more than 3 cm below the bone margin.[9,13]

The marginal branches may be injured when the surgeon goes deep to the platysmal fibers, often within the angular region or lower to the bone margin.

Baker and Conley[9] advocated that this branch is the most susceptible to injury during rhytidoplasty. The buccal branch can be injured in the masseter–parotid region, below the SMAS. After crossing the parotid, these branches become relatively superficial and are protected only by the subcutaneous tissue and the superficial fascia, until they reach specific muscles of the facial expression.[9,13,16]

Conclusion

During rhytidoplasties, the facial nerve branches are relatively protected by superficial pairs of the parotid and fascia within the limits of the parotid region. As the branches emerge from the gland, the SMAS, fascia, and subcutaneous tissue protect them. The trajectory of the facial branches can be delimited in the overlying skin according to six diverging lines: the upper and lower por-

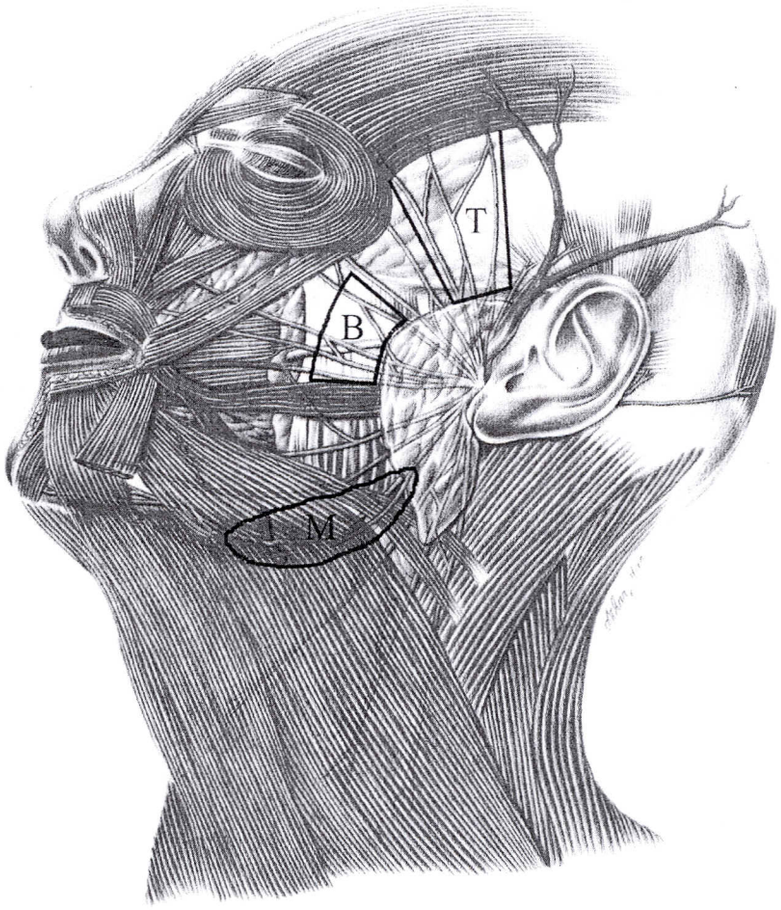

Fig 6: Areas where the branches are more unprotected. T = temporal; B = buccal; M = marginal mandible.

tions of tragus, the most cranial wrinkle of the frontal region, the lower facial wrinkle of the frontal muscle, the nasal midpoint, an imaginary point 1 cm caudal to the oral commissure, another imaginary point also caudal to the oral commissure at the lower margin of the mandible, and the clavicle midpoint.

The most unprotected branches are the temporal ones, followed by the mandibular margins and the buccal branches. The most important sites of injury are the temporofrontal region (between the hairline and the lateral margin of the frontal muscle), the region near the angle of the mandible, and the preparotid region.

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