Original Article:
Morphometry and Morphology of Extracranial Part of Facial Nerve – A Cadaveric Study.

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Citation

Submitted: Dec 3, 2016; Accepted: Dec 31, 2016; Published: Jan 31, 2017

Abstract: Introduction: Identification of the extracranial part of facial nerve with respect to bony landmarks is important to avoid injury to it. Purpose: To measure the length of the facial nerve trunk and its divisions and to measure the distance of the nerve trunk with the mastoid process and atlas. The variations in the divisions and branches were also noted. Methods: Twenty hemi-faces were dissected. The facial nerve was identified at the stylomastoid foramen and dissected meticulously through the parotid gland. The divisions and branches were identified and traced. The trunk was measured from the stylomastoid foramen to its point of bifurcation. The length of the two divisions were measured up to their branching. The distance from the nerve trunk to the mastoid process and atlas were measured. Results: Mean length of facial nerve trunk in centimetres was 1.380±0.082, length of upper division was 0.820±0.108 and length of lower division was 0.890±0.090. The mean distance in centimetres between the facial nerve trunk and mastoid process tip was 1.300±0.089 and the distance between facial nerve trunk and transverse process of atlas was 1.645±0.108. Conclusion: The above data may help in minimising injury to the facial nerve.

Key Words: Facial nerve, stylomastoid foramen, mastoid process, atlas.

Introduction:
The facial nerve (FN) gains its importance clinically in facial palsy which is of a great concern for the clinicians and for the patients. Iatrogenic injury to the facial nerve most often is seen after cervicofacial rhytidectomies, surgery of the parotid gland, acoustic neuroma resection, or tumor resection at any point along the passage of the facial nerve. If there is facial paralysis following surgery, post-operative investigation should be done (1). Hypoglossal-facial neurorrhaphy has been extensively used for reanimation of paralyzed facial muscles after irreparable injury of the facial nerve.(2) Facial nerve emerges from the stylomastoid foramen (SMF) and goes into the parotid gland through its postero-medial surface. It further furcates into an upper division (temporalfacial) and a lower division (cervicofacial), which further gives the five terminal branches. The segment of the FN between its point of appearance from the skull through the SMF and its furcation into upper and lower branches at the parotid area is known as the main trunk of the FN.(3) In infants, the FN trunk is in a more superficial plane and is liable to injury during surgical incision and trauma to the retromandibular area.(4) In the adults, this region is surrounded by soft tissue which poses difficulty in dissecting the FN trunk. Therefore, a thorough knowledge is necessary to know the exact location of the path of the FN, which would help the clinicians and surgeons in clinical diagnosis and in performing surgery.

Exploration of the various branches of the FN using anatomic landmarks is difficult because of high variability of the branching pattern. Soft tissue benchmarks are frequently used but they are usually mobile and are of inconsistent morphology. Bony benchmarks are more consistent but only few have been described in literature.(5) Hence this study was made to note the morphometric dimensions of facial nerve and its relation with transverse process of atlas and tip of mastoid process which was found lacking in the literature.

Materials and Methods
Twenty hemi-faces of unknown age and sex were dissected.

The FN was identified at the SMF and traced along its course through the parotid gland. The distance between the FN trunk from its exit to the tip of the mastoid process (FM) and the distance between the exit of the FN trunk to the transverse process of the atlas (FA) was measured using the Vernier calliper. The length of the FN trunk was measured from its exit to the point of its bifurcation into two divisions within the parotid gland (LOT). The length of the two divisions, upper division (LOUD) and lower division (LOLD), up to the emergence of the branches was measured. Gross variations in
the branches and the two divisions were also noted and photographed.

Results

The mean of
1. The length of the facial nerve trunk (LOT) was 1.380±0.082
2. The length of the upper division (LOUD) was 0.820±0.108*
3. The length of the lower division (LOLD) was 0.890±0.090*  

* - significant with Length of facial nerve trunk

![Image](image-url)

Fig 1. A: Facial nerve trunk of facial nerve immediately bifurcates into two divisions, the upper trunk gives temporal, zygomatic and buccal. There is communication between temporal, zygomatic and upper buccal (Type I).  

Fig 1. B: Trunk bifurcates into upper and lower division, the lower division gives the lower buccal branch, marginal mandibular and cervical. Upper division gives zygomatic and temporal and upper buccal (Type II).

Fig 1. C: There are two major trunks emerging from the parotid gland. Upper trunk divides into temporal, zygomatic and upper buccal. The lower trunk divides into lower buccal, marginal mandibular and cervical. The stylomastoid artery (A) emerges between the two trunks. There is communication marginal mandibular and lower buccal (Type III).

The mean of
1. The distance between facial nerve trunk and tip of the mastoid process (FM) was 1.300±0.089
2. The distance between the facial nerve trunk and transverse process of atlas (FA) was 1.645±0.108

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of Specimens</th>
<th>Percentage</th>
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<tr>
<td>Type I (Fig. 1. A)</td>
<td>2</td>
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</tr>
<tr>
<td>Type II (Fig. 1. B)</td>
<td>15</td>
<td>75%</td>
</tr>
<tr>
<td>Type III (Fig. 1. C)</td>
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<td>Type IV (Fig. 2. A)</td>
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<tr>
<td>Type V (Fig. 2. B)</td>
<td>1</td>
<td>5%</td>
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Table 1: Types of branching patterns

![Image](image-url)


Fig 2. B: Loop formation between two trunks. Absence of a single trunk, FN bifurcates before the gland. There is communication between LB and MM (Type V). Tr1 – First trunk, Tr2- Second trunk

Discussion

Conservative parotidectomy is the treatment for parotid gland tumors. A report on retrospective studies on 351 parotid gland surgeries suggests that post-operative facial nerve dysfunction occurs mainly in radical parotidectomy.(6) There is 1–4 percent likelihood of injuring the facial nerve during arthroscopic puncture during temporomandibular joint (TMJ) surgeries.(7) The styloloid process is used as a bony benchmark for recognition of FN for classical parotid gland surgeries, any variation in the styloloid process prevents it from being used as reliable landmark. Hence Dimitrov et al. used the insertion of posterior belly of digastic and tympanomastoid fissure as the landmarks for parotid surgery in 37 patients with good results.(8) In a study, which included 40 human cadaveric heads were dissected by a surgeon and anatomist using substantial landmarks to locate the FN trunk easily and swiftly. An incision was made in the middle of a triangle formed by temporomandibular joint, angle of mandible and mastoid process. Dissection was progressed till the main trunk of facial nerve was reached. The average distance between the expected and the real position of the nerve was 1.42 mm.(9)

In a previous study conducted by Pather et al on 40 cadaveric heads, the morphological association on the FN trunk to the surrounding structures was assessed. The distance of facial nerve in mm from the styloloid process was found to be 9.8, transverse process of the axis was 16.9 and mandible angle was 38.1. The length of the facial nerve trunk from its point of exit from the SMF to its bifurcation is 14.0. This study supports use of transverse process of axis as it is effortlessly felt as a consistent landmark and warrants least threat of damage to FN trunk.(3) Similar reference points were used in our study. We used the transverse process of atlas and tip of mastoid process as bony reference points, both the bony landmarks are easily palpable and appreciated. The mean distance in centimetres between facial nerve trunk and tip of the mastoid process (FM) was found to be 1.300±0.089 and the mean length between the facial nerve and atlas (FA) was found to be 1.645±0.108.

In a study conducted by Shin et.al. on 29 specimens, the direct distance from the mastoid process tip (MPT) to the SMF was found to be 14.1±2.9 mm. The distance from the MPT to the FN origin was 8.6±2.8 mm in the front and 5.9±2.8 mm above.(10) In a study of 45 parotid glands, the mean distance from the angle of mandible to FN was 28.8 mm. Communication between FN and auriculotemporal nerve was
seen in 93.3% cases. (11) Similarly, in the present study the communication between auriculotemporal nerve and facial nerve is seen one case (Fig. 2. A).

Dissection of 30 heads showed that mean depth of SMF from the exterior of the skin was 21.0 mm and distance of foramen from the bifurcation of FN is 13.0 mm. In the same study, buccal branches showed lot of patterns and accordingly were classified into different types. In type I (13.8% of cases), two main divisions of the trunk gave rise to the buccal branch. In type II (44.8% of cases), the two main divisions gave rise to buccal branch were interconnected with the zygomatic branch. In type III (17.3% of cases), buccal branch, which originated from the upper and lower divisions was interconnected to marginal mandibular branch. In type IV (17.3% of cases), buccal branch was interconnected to the branches from zygomatic and marginal mandibular. (12) In our study, in one case there is communication between temporal, zygomatic and upper buccal branches (Fig. 1. A). Also, a communication between marginal mandibular and lower buccal branches was observed (Fig. 1. C). In yet another case, a single trunk giving all the branches and establishment of communication between all the branches was observed (Fig. 2. A).

In a study with hundred cadaveric heads the MMB ran below the lower border of the angle of mandible with an average vertical distance of one centimeter. The divisions of the FN were in the area between the apex of the parotid gland and the Lateral palpebral line. The dividing configurations of the FN were categorized into six varieties. The least common (1%) was type I (absence of anastomosis), while type V, the complex pattern of branching (29%). Symmetrical branching pattern occurred in 30% of cases. (13) (Fig. 2. B) FN branching as seen in 20 cases of parotidectomy in 75% patients, the mean length of main trunk of facial nerve between 16 – 20 mm. In 60% patients, the distance of facial nerve from tympanomastoid suture was between 2.5-3 mm. (14) In the present study length of the facial nerve trunk was 1.380±0.082 mm.

In a study conducted on facial nerve pattern in 94 parotid gland tumour surgeries, bifurcation was seen in 76% and trifurcation was seen in 24% of cases, also the branching pattern was classified into 3 groups per the rebranching of the cervical and facial branches. (15) FN studied in foetal cadavers showed the maximum common branching type of the facial nerve was bifurcation (53.33%) shadowed by trifurcation (33.33%). Several divisions of the FN were also perceived in 13.34% of the specimens. Remarkably, a communication between the cervical branch of facial and the great auricular nerves was also detected in the study. (16) In our study bifurcation (Figs. 1. A & B) was seen in 90% of cases and single trunk was seen in 10% of cases (Fig. 2. A).

**Conclusion**

Precise understanding of the anatomy of the facial nerve trunk and its branching pattern along with its variation is thus vital for performing several surgical techniques on the mastoid process, parotid gland, temporomandibular joint and surgical procedure directed at facial nerve restoration.

**References**