Facial Nerve in Foetal Cadavers: An Anatomical Study with Clinical Relevance

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Abstract: Introduction: Facial nerve paralysis is a major complication of parotid surgery and is widely reported. Little attention is paid to the facial nerve trunk in children. The facial nerve trunk in children and infants can be easily injured since they lie close to the surface. The present study therefore intends to describe the variability in the facial nerve trunk and its branching pattern in foetuses. Methods: The study was done bilaterally in 30 formalin-fixed foetuses (15 males, 15 females), age ranging from 21.0 to 35.5 weeks of gestation. The length of the facial nerve trunk was measured and bifurcation and trifurcation of the trunk was examined. Variability in the branching pattern was also noted. Results: The most common facial nerve trunk branching type was bifurcation (53.33%), followed by trifurcation (33.33%). Multiple branching of the facial nerve was also observed in 13.34% of the cases. Other variations related to the facial nerve were also noted. The mean length of the facial nerve trunk was 7.15 ± 2.12 mm. There was no significant difference between the right and left sides and in case of males and female foetuses. Conclusion: Facial nerve injury during parotid surgery is a major cause of paediatric facial paralysis. The length of the facial nerve trunk therefore must be accurately known in any surgical procedure planned in the area. The main bifurcation of the facial nerve should also receive special attention.

Key Words: Facial nerve, Foetus, Parotid gland, Anatomy

Introduction:
Paralysis of the facial nerve is a major complication of parotid surgery. The facial nerve is one of the most important structures encountered during surgical removal of parotid gland tumours, since these closely approximate the nerve. Damage to the facial nerve could result in paralysis of the muscles leading to loss of facial.(1) The facial nerve emerges from the facial canal via the stylomastoid foramen; it then passes forwards to enter the posterior surface of the parotid gland. Within the substance of the gland it branches into superior (temporofacial) and inferior (cervicofacial) trunks, usually just behind and superficial to the retromandibular vein. The trunks branch further to form a parotid plexus (pes anserinus). Five main terminal branches arise from the plexus, they diverge within the gland and leave by its anteromedial surface, medial to its anterior margin, to supply the muscles of facial expression.(2) Numerous microdissection studies have demonstrated that branching patterns and anastomoses between branches, both within the parotid and on the face, exhibit considerable individual variation.(3,4) The main trunk of the extra-cranial part of the facial nerve (FNT) is described as that part from its point of emergence from the stylomastoid foramen to its bifurcation into upper and lower branches.(5) Approximately, 80% of all salivary gland tumours originate in the parotid gland.(6) Parotid neoplasms are among the most complex and diverse group of tumours found in the region of the head and neck. During parotid surgery, in addition to removing the tumour, the surgeon must avoid damage to the facial nerve.(7) In order to accomplish this, accurate identification and precise location of the FNT are imperative. Knowledge of the branching pattern and other associated variations of the FNT are
The facial nerve trunk in children and infants can be easily injured since they lie close to the surface. The nerve may be affected during the trauma suffered at the time of childbirth resulting in facial nerve palsy. Although uncommon in children, however the frequency of malignant tumours is higher in children than in adults. Therefore the present study intends to describe the variability in the facial nerve trunk and its branching pattern in younger individuals like infants and children. As it is difficult to get cadavers of that age group, the present study was conducted on dead foetuses.

### Materials and Methods

The study was carried out in the department of Anatomy, Kasturba Medical College, Manipal. 30 formalin-fixed foetuses (15 females, 15 males), age ranging from 21.0 to 35.5 weeks of gestation were considered in the study. The spontaneously aborted and stillborn fetuses were procured from the department of Obstetrics and Gynaecology, Kasturba Hospital Manipal. Fetuses with any external deformity were excluded from the study. The fetuses were meticulously dissected and the facial nerve was identified. The length of the facial nerve trunk was measured from its emergence from the stylomastoid foramen to its point of furcation. Values were analysed separately for right and left sides and for male and female foetuses using image analyzer software- Image J 1.46. SPSS version 16 was used for the statistical analysis. Kolmogorov-Smirnov test was applied to check the uniform distribution of the data and Levene’s test for their homogeneity. The mean length of the facial nerve trunk in males and females foetuses were compared using unpaired t test and between right and left sides using paired t test. P < 0.05 was considered statistically significant.

### Results

Thirty foetuses (15 males and 15 females) were included in the study. The mean and standard deviations of the length of the facial nerve trunk were shown in Table 1. The average length of the facial nerve trunk was 7.15 ± 2.12 mm. The length of the facial nerve trunk varied from a maximum of 12.02 mm to a minimum of 3.34 mm in length.

![Figure 1](image1.png)

**Figure 1:** Showing the bifurcation of the facial nerve trunk (FN) and its different branching patterns. Black arrow indicates the position of the stylomastoid foramen and * denotes the point of bifurcation of the facial nerve. Figure 1a: The upper division of the facial nerve (FN1) provides the temporal (T), zygomatic (Z) and buccal (B) branches while the lower division (FN2) provides the marginal mandibular (MM) and cervical (C) branches. Figure 1b & c: The upper division (FN1) provides the temporal (T), zygomatic (Z) and the upper buccal (UB) branches while the lower division (FN2) provides the lower buccal (LB), marginal mandibular (MM) and cervical (C) branches. A communication is also observed between the upper and lower buccal branches in figure 1c. Figure 1d: The upper division (FN1) provides the temporal (T), buccal (UB) and lower buccal (LB) branches while the lower division (FN2) provides the marginal mandibular (MM) and cervical (C) branches.

<table>
<thead>
<tr>
<th>Length of the facial nerve trunk in foetuses</th>
<th>Males (N=15)</th>
<th>Females (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>7.48±2.35</td>
<td>5.98±1.71</td>
<td>7.48±2.12</td>
</tr>
</tbody>
</table>

Unpaired t test when applied to compare the means between males and females, no significant difference was observed in the length of the facial nerve trunk (p<0.05). Paired t test was applied to compare the means between right and left sides. There was no statistical significant difference found between the means of two sides indicating bilateral symmetry.

The most common branching type of the facial nerve was bifurcation (53.33%) (Figure 1), followed by trifurcation (33.33%) (Figure 2). Multiple branching of the facial nerve was also observed in 13.34% of the cases (Figure 3). Other variations related to the facial nerve were also noted. Interestingly, a communication between the cervical branch of facial and the great auricular nerves was also observed in the present study (Figure 4).

![Figure 2](image2.png)

**Figure 2:** Showing the trifurcation of the facial nerve trunk (FN) and its different branching patterns. Black arrow indicates the position of the stylomastoid foramen. Figure 2a: The upper trunk provides the temporal (T), zygomatic (Z) and upper buccal (UB) branches while the lower trunk provides the lower buccal (LB) and marginal mandibular (MM) branches. The cervical (C) branch arises separately from the facial nerve. Figure 2b: The temporal and zygomatic branches arise from the upper trunk of the facial nerve. The buccal branch arises separately and communicates with the zygomatic branch forming a loop (*). The marginal mandibular and cervical branches arise from the lower trunk of the facial nerve.
Figure 3: Showing the multiple furcation and varied branching pattern of the facial nerve trunk.

Figure 4: Showing a communication (indicated by *) between the cervical branch (C) of facial nerve (FN) and the great auricular nerve (GAN).

Discussion:
Facial nerve injury is the most common complication of parotid surgery as the two structures are intimately related to each other. The facial nerve along with the accompanying vessels creates a potential plane which lies in between the deep and superficial lobes of the parotid gland. Dissection in this plane is never possible until and unless the surgeon identifies the nerve and proceeds along the nerve and its branches. This clearly leads to the fact that parotid gland surgery is purely an anatomical dissection and sound anatomical knowledge sharpened further by cadaveric
dissection goes a long way in improving the surgical skill of a surgeon. (1) Holt referred to the difficult problem of dissecting the facial nerve trunk through the surrounding soft tissues. (12) The dissection of this segment becomes more difficult and risky when the normal anatomy is deformed by a tumor, a scar from previous surgery, or other pathological processes. (13) Salivary gland tumours in children are uncommon, but the frequency of malignant tumours is higher in children than in adults. All masses in children require thorough diagnostic evaluation. Benign masses of the parotid gland in children may be due to vasomotor abnormalities, cysts, inflammatory processes, or neoplasms. The most common intraparotid mass is the benign lymph node, as a significant number of lymph nodes are present in the parotid. The most common benign tumour in children is the hemangioma. Of the benign epithelial tumours, the mixed tumour (pleomorphic adenoma) is the most common. (14) In infants, the facial nerve trunk is located in a more superficial plane and is liable to injury during surgical incision and trauma to the retromandibular area. (15) The processus mastoideus is not yet developed in infants, and the facial nerve arising from the stylomastoid foramen is very close to the surface. The facial nerve trunk may therefore be vulnerable when using the forceps during difficult births. (16) Accurate knowledge of the anatomy of the facial nerve trunk is therefore essential for performing various surgical procedures on the mastoid process and parotid gland, for approaches to the cranial base, and for surgery aimed at facial nerve repair. (13, 17) Previous studies on foetal cadavers have reported that the most common facial nerve trunk type was bifurcation (81.25%), followed by trifurcation (18.75%). The length of the facial nerve trunk measured about 11.59 ± 2.80 mm. (18) However in the present study, the average length of the facial nerve trunk was 7.15 ± 2.12 mm. The most common branching type of the facial nerve was bifurcation (53.33%), followed by trifurcation (33.33%). Multiple branching of the facial nerve was also observed in 13.34% of the cases. Interestingly, in the present study a communication between the cervical branch of the facial and the great auricular nerves were also observed. Authors in the past have reported a case of communication of the anterior branch of the great auricular nerve with the cervical branch of facial nerve in an adult cadaver. They further postulated that the clinical importance of this variation is that during neck surgeries, the stimulation of a communicating nerve of the cervical plexus might result in tense oblique ridges in the skin of neck due to the contraction of platysma, and could potentially cause the operating surgeon to think that it was a branch of the facial nerve. (19) Preservation of the facial nerve during parotid gland surgery depends upon its being exposed and located without suffering damage. An accurate knowledge of the anatomy of the nerve and considerable perioperative care are essential if trauma is to be avoided. The surgeon must be acquainted with a range of techniques, since anatomical variations may make any specific approach difficult. (20) Facial nerve injury during parotid surgery is a main cause of paediatric facial paralysis. Therefore a thorough understanding of the anatomy of the facial nerve trunk is essential for performing any surgical procedure in the region. The present study therefore describes the variations in the length and furcation of the facial nerve trunk, the findings of which could be reliable in infants and premature babies, whose facial trunks can be easily injured since these lie close to the surface.

References