Anatomical Study of the Facial Nerve

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Abstract: The facial nerve is the seventh cranial nerve. It arises from the brain stem, it passes through the internal acoustic meatus, to pass through facial canal and leaves skull through stylomastoid foramen. It pierces the parotid gland, where it gives terminal branches to supply muscles of face. The materials consisted of ten cadavers (twenty sides of head and neck), they derived from dissecting room, Anatomy Department, Faculty of Medicine, King Abdel Aziz University. Careful dissection of the parotid gland to follow the branches of facial nerve in face. The results were recorded and photographed.

Results: The facial nerve divided inside the parotid gland into two main divisions, the upper (temporozygomatic) and the lower (cervicomandibular), to give five branches in the face as: temporal, zygomatic, buccal, mandibular and cervical branches.

Conclusion and Recommendation: These results are important to take in consideration during surgical intervention of superficial temporal artery, parotid duct and submandibular gland.

Key words: Facial nerve • Parotid gland • Temporal • Zygomatic • Buccal • Mandibular • Cervical • Parotid duct

INTRODUCTION

It has three nuclei of origin located in pons, two motor and one sensory nucleus: the axons of these cells carry special visceral efferent to supply the muscles of facial expression. Contain presynaptic parasympathetic neurons to supply the lacrimal and salivary glands. Containing gustatory afferents fibers from the anterior two third of the tongue [1].

The two roots, exit in the cerebellopontine angle between the Pons and the olive, medial to the exit of cranial nerve VIII.

The facial nerve travels through the petrous part of the temporal bone, in which four segment are described: metal, labyrinthine, tympanic and mastoid segments. The labyrinthine segment is the narrowest and shortest part (3.5-4mm). At the end of this part the nerve change direction and forming a genu that marks the location of the geniculate ganglion [2].

This nerve carries parasympathetic fibers from superior salivatory nucleus and make synapses in the pterygopalatine ganglion. The postganglionic fibers supply the lacrimal and nasal glands. The tympanic segment extends from the geniculate ganglion to the horizontal semicircular canal, (8-11mm in length), it then bend back and arches downward in vertical direction to the stylomastoid foramen (mastoid segment). Its length is approximately 10-14 mm.

Presynaptic parasympathetic fiber that synapse in the submandibular ganglion, then the postganglionic fibers supply the submandibular, sublingual and small salivary glands in the anterior two third of the tongue.

The nerve enters the parotid gland high up on its posteromedial surface and it passes forwards behind the mandibular ramus. Within the substance of the gland it branches into superior (temporo-zygomatic) and inferior (cervicomandibular) trunks, usually just behind and superficial to the retromandibular vein. The trunks branch further to form a parotid plexus, (pesanserinus) [3].

In the parotid gland forming the intraparotid plexus, from which the following branches are given: (Temporal, Zygomatic, Buccal, Mandibular and Cervical) for the muscles of facial expression [3]. The facial nerve emerges from the junction of the pons and medulla as two
divisions: the motor root and the Intermediate nerve (nervus intermedieus). The large motor root (facial nerve proper) innervates the muscles of facial expression and the smaller intermediate nerve carries taste, parasympathetic and somatic sensory fibers.

As the nerve of second pharyngeal arch, the facial nerve supplies the striated muscle derived from its mesoderm, mainly the muscles of facial expression and auricular muscle, it also supplies the posterior belly of digastric, stylohyoid and stapedius muscles. Facial nerve provider presynaptic parasympathetic fibers to the ptreygopalatine ganlion for innervation of the lacrimal, nasal, pharyngeal and patatine glands and to the submandibular ganlion for innervation of the sublingual and submandibular salivary glands. Some fibers from the geniculate ganlion supply a small area of skin close to the external acoustic meatus. Fibers carried by the chorda tympani join the lingual nerve to convey taste sensation from the anterior two thirds of the tongue and soft palate [4]. The aim of this study is to study the anatomical distribution of the branches of facial nerve in the face.

MATERIALS AND METHODS

Pathology: The facial nerve is affected by a wide variety of pathologies including congenital, traumatic, inflammatory and neoplastic conditions. Imaging plays a vital role in diagnosis of these pathologies [19]. Knowledge of complex functional and structural anatomy of the facial nerve is critical in the radiological evaluation of the facial nerve. CT and MRI of facial nerve represent important tools for diagnosis of facial nerve pathology and the structural information. That aids in preoperative and postoperative evaluation and represent important tools for the head and neck radiologist and surgeon alike [5].

Trauma to the facial nerve is the second most common cause of facial paralysis and can result in devastating consequences including ocular complications, impaired speech, feeding difficulties and inability to convey emotion through facial expression. It is critical that otolaryngologists and plastic surgeons have a thorough understanding of the principles of facial nerve trauma management because timing of treatment can have a significant impact on a patient’s chances and extent of recovery. The number of possible treatment options can be overwhelming to both patient and physician, including whether or not surgery is indicated and, if so, which operation should be chosen and at what point in time should it be performed [6].

Fig. 5: A photograph showing a vertical incision is done in front of the auricle beginning from the temporal region down to the neck.

The material of the present study were consisted of 10 adult human cadavers (20 sides of head and neck). The cadavers were derived from Department of Anatomy, Faculty of Medicine, King Abdulaziz University. The cadavers were fixed in 10% formalin solution. The fixed specimens are subjected to dissection of the face to identify the branches of facial nerve in the face. Vertical incision was done in the face in front of the auricle beginning from the temporal region to the neck. Reflection of the skin flap anteriorly, then identification of the parotid gland was done. Blunt dissection of subcutaneous tissue in the face was done to identify the branches of facial nerve arising at the anterior border of the parotid gland Fig (5). Careful dissection and removal of the parotid gland was done in one specimen to identify the main divisions of facial nerve inside the gland.

The posterior flap (PF) is reflected posteriorly and the anterior flap (AF) is reflected anteriorly. The parotid gland (PG) is identified. Blunt dissection of subcutaneous tissue is used to identify the branches of facial nerve arising at the anterior border of parotid gland. Note that: The cervical branch (C) of facial nerve is seen arising from lower pole of parotid gland, entering into deep surface of platysma muscle (PM). The mandibular branch (M) arises from anterior border of parotid gland and running below the base of the mandible (BM).

RESULTS

Dissection of the face in ten the fixed cadavers (20 sides) to identify the branches of the facial nerve in the face, revealed the following results:

Facial nerve inside the parotid gland: it was found that the facial nerve divides into two main divisions; the upper (tempororozygomatic) and lower (cervicomandibular)
Fig. 6: A photograph showing dissection of the facial nerve after removal of parotid gland.

Fig. 7: A photograph showing more magnification of the same specimen.

Fig. 8: A photograph showing the branches of facial nerve in the face.

Fig. 9: A photograph of the left side of the face in a cadaver that injected with red latex into the arterial system and blue latex into the venous system.

Fig. 10: A photograph of the right side of face showing the branches of facial nerve in the face in a cadaver which is injected with red latex in the arterial system.

divisions. The upper division gives temporal, zygomatic and upper buccal branches of facial nerve in the face. The lower division gives lower buccal, mandibular and cervical branches of facial nerve (Figures 6 and 7).

Temporal branch of facial nerve: it arose from anterior border of parotid gland close to its upper pole. It was seen running upward and forward, which is anterior and parallel to the superficial temporal artery. It was found that, it was formed of single branch in 14 sides of head and neck (Fig: 7, 10, 11, 13 and 14). It was formed of 2 branches in 6 cases (Figures 8, 9 and 12).

Zygomatic branch of facial nerve: it arose from the anterior border of parotid gland and was directed upward and forward toward the orbit. It was found to be formed of single branch in 12 sides of head and neck (figures 7, 12, 13 and 14). It was formed of 2 branches in 8 sides of head and neck (figures 8, 9 and 11).

Buccal branch of facial nerve: it was found to be directed from anterior border of the parotid gland and directed forward along the parotid duct. It was found to be formed of 2 branches in 10 sides of head and neck (figures 7, 9 and 13). It was found to be formed of 3 branches in 6 sides (figures 10, 11 and 14), 4 branches in 2 sides (figure 12) and 5 branches in 2 sides of head and neck (figure 8).

Mandibular branch of facial nerve: it was found to arise from anterior border of the parotid gland and was directed downward and forward toward the base of the mandible. It was found to be formed of single branch in 8 sides, that run just below the base of the mandible (figures 10, 12 and 14).

It was found to be formed of 2 branches in 8 sides: in 4 cases one branch ran along the mandibular base and other branch ran just below the mandible, (figures: 7 and 9); but in the other 4 cases the 2 branches of mandibular nerve ran below the mandibular base (Figure 11).
Cervical branch of facial nerve: it was seen running from the lower pole of parotid gland, was directed downward and forward entering into the deep surface of the platysma muscle. It was found to be formed of single branch in 8 sides (figures 7 and 12) and was formed of 2 branches in 12 sides of head and neck (figures 9, 10, 13 and 14).

The main two divisions of the facial nerve, the upper division is the temporozygomatic trunk (TD) and the lower division is the cervicomandibular trunk (CD). The temporozygomatic division gives off temporal (T), Zygomatic (Z) and the upper buccal (UB) branches of facial nerve in the face. The cervicomandibular division gives off the lower buccal (LB), mandibular (M) and cervical (C) branches of facial nerve.

The temporal branch (T) is seen running upward and forward in front and parallel to the superficial temporal artery (A). The parotid duct (PD) is seen running horizontally between the upper buccal (UB) and the lower buccal (LB) branches of facial nerve. The mandibular branch (M) is formed of two branches (M1 and M2), the upper larger one (M1) is seen running along the base of mandible (BM) and the lower smaller branch (M2) running below the base of mandible (BM). The cervical branch (C) is seen entering into the deep surface of platysma muscle. The retromandibular vein (V) is seen running vertically downward deep to the facial nerve.

The temporal branch (T) is seen running upward from the anterior border of parotid gland (PG). The superficial temporal artery (TA) is seen running parallel and behind the temporal branch (T) of facial nerve. Accessory parotid gland (A) seen along the parotid duct (PD) and between the upper buccal (UB) and lower buccal (LB) branches of facial nerve (the upper buccal is formed of 3 branches and the lower buccal is formed of 2 branches). The mandibular branch of facial nerve is seen formed of three branches,
the upper (M1) is seen running above base of mandible (BM) and the middle branch (M2) is seen running along the base of the mandible (BM) and the lower branch (M3) is seen running below the base of the mandible (BM).

PM: is platysma muscle.

The temporal branch of facial nerve is seen formed of two branches (T1 and T2), that are directed upward and forward in front and parallel to superficial temporal artery (A). The zygomatic branch of facial nerve is seen formed of two branches (Z1 and Z2) which are directed to the orbit.

The buccal branch of facial nerve is formed of two branches (UB and LB) that run above and below the parotid duct (PD). The mandibular branch of facial nerve is seen formed of two branches (M1 & M2) that run superficial to both facial artery (FA) and facial vein (FV). The upper branch (M1) is seen running along the base of the mandible (BM). The lower branch (M2) is seen running below the base of mandible (BM). The cervical branch is seen formed of two branches (C1 and C2) entering into platysma. The temporal branch (T) of facial nerve is seen running anterior to the superficial temporal artery (A). The zygomatic branch (Z) of facial nerve is seen cut as it is directed to the orbit. Two parotid ducts (PD) are seen arising from parotid gland (PG) running superficial to masseter muscle, piercing the buccinator muscle to enter the mouth. The mandibular branch of facial nerve is seen formed of three branches, the upper (M1) is seen running above the base of the mandible (BM), the middle branch (M2) is seen running along base of the mandible (BM) and the lower branch (M3) is seen running below the base of the mandible (BM). The cervical branch of facial nerve is formed of 2 branches (C1 & C2) arising from the lower pole of parotid gland and entering into deep surface of platysma muscle (PM).

The temporal branch (T) is seen running upward and forward, passing parallel in front of the superficial temporal artery (A). The zygomatic branch (Z) is formed of two branches (Z1 & Z2) are seen running upward and forward toward the orbit. The parotid duct (PD) is seen running horizontally between the upper buccal (UB) and lower buccal of facial nerve (LB); which is formed of 2 branches (LB1 & LB2). The mandibular branch (M) of facial nerve is seen running below the base of mandible (BM) and superficial to the facial artery (FA). The cervical branch of facial nerve is formed of 2 branches (C1 & C2) arising from the lower pole of parotid gland and entering into deep surface of platysma muscle (PM).

Table 1: Showing The Summry Of Reslutes

<table>
<thead>
<tr>
<th>Maine Branches of Facial Nerve</th>
<th>Sub Branch</th>
<th>Number of Cases</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Temporal</td>
<td>1</td>
<td>14</td>
<td>70%</td>
</tr>
<tr>
<td>2- Zygomatic</td>
<td>1</td>
<td>12</td>
<td>60%</td>
</tr>
<tr>
<td>3- Buccal</td>
<td>2</td>
<td>10</td>
<td>50%</td>
</tr>
<tr>
<td>4- Mandibular</td>
<td>1</td>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>5- Cervical</td>
<td>1</td>
<td>8</td>
<td>40%</td>
</tr>
</tbody>
</table>

Accessory parotid gland (A) is seen along the parotid duct (PD) and in between the upper buccal (UB) and lower buccal (LB) branches of facial nerve. The upper buccal is formed of two branches (UB1 & UB2). The lower buccal is also formed of two branches (LB1 and LB2). The mandibular branch (M) of facial nerve is seen running below the base of mandible. The cervical branch of facial nerve arising from the lower pole of parotid gland and entering into deep surface of platysma muscle (PM).

The temporal branch (T) is seen running upward and forward in front and parallel to the superficial temporal artery (A) and superficial temporal vein (V). The zygomatic branch (Z) of facial nerve is seen cut as it is directed to the orbit. Two parotid ducts (PD) are seen arising from parotid gland (PG) running superficial to masseter muscle, piercing the buccinator muscle to enter the mouth. The mandibular branch of facial nerve is seen formed of three branches, the upper (M1) is seen running above the base of the mandible (BM), the middle branch (M2) is seen running along base of the mandible (BM) and the lower branch (M3) is seen running below the base of the mandible (BM). The cervical branch of facial nerve is formed of 2 branches (C1 & C2) arising from the lower pole of parotid gland and entering into deep surface of platysma muscle (PM). The retromandibular vein (JV) is seen running vertically downward deep to the facial nerve.

The temporal branch (T) is seen running upward and forward in front of the superficial temporal artery (A). The zygomatic branch (Z) is seen running upward and forward toward the orbit. The buccal branches (UB and LB) of facial nerve seen running below the parotid duct (PD). The upper buccal is formed of two branches (UB1 & UB2). The mandibular branch of facial nerve is seen formed of two branches (M1 and M2), the upper one (M1)
runs above the base of the mandible (BM), the lower branch (B2) is seen running below base of the mandible (BM). The cervical branch of facial nerve is formed of 2 branches (C1 & C2) arising from lower pole of parotid gland and entering into deep surface of platysma muscle (PM).

DISCUSSION

In the present study, ten adult fixed cadavers were used to study the branches of the facial nerve in the face; dissection of the 20 sides was done. The intraglandular part of facial nerve was found to be formed of two main divisions, the upper (temporofacial) and the lower (cervico facial) branches. The upper division gives temporal, zygomatic and upper buccal branches in the face. The lower division gives the lower buccal, mandibular and cervical branches.

Several anatomical variations in the division of the intraglandular part of facial nerve were recorded; bifurcation, trifurcation and pleurifurcation [7].

As regard temporal branch of facial nerve, the present study showed that; it arises from anterior border of the parotid gland close its upper pole, ascending upward and forward to supply frontalis muscle. The frontal branch was found to be formed of single branch in most cases (80%) and two branches in 20% of cases. In all cases, the frontal branch was found to be anterior and parallel to the superficial temporal artery.

Previous studies reported injury of frontal branch of facial nerve as a complication of superficial temporal artery biopsy [8-10].

The present study showed that; the zygomatic branch was formed of single branch in most cases (60%) and two branches in 40% of cases. The zygomatic branch was found arising from anterior border of parotid gland and is directed upward and forward toward the lateral angle of the orbit (lateral canthus).

Brian LS, et al. [11], showed that temporal branch of facial nerve curved upward and forward with mean distance of 2.5 cm superior to the lateral canthus. The zygomatic branch was approximately at the skin crease extending laterally from the lateral canthus. The present study showed that; the buccal branch was found to be multiple in most cases; two branches were found in 50% of cases, 3 branches in 30% of cases and 4 branches in 20% of cases and they were arranged above and below parotid duct.

Anthony Pogrel MB et al. [12], showed that buccal branch of facial nerve consisted of one branch (85%), whereas 15% had two branches. In 75% of cases, the nerve was inferior to parotid duct. In 25% of cases, the nerve crossed the duct, usually from superior to inferior. They reported that; this relationship of the buccal branch to parotid duct is of importance in performing parotid gland surgery, parotid duct surgery and some facial cosmetic surgery [12, 6].

In another study, the buccal branch of facial of facial nerve was found to be consisted of 2-3 ramifications in about 90% of specimens. As the parotid duct had a constant surface landmark, the buccal branch coursed within the distance between 10.7 mm above and 9.3 mm below the parotid duct and innervated muscles of midface. The marginal mandibular branch of facial nerve coursed within the distance between 13.4 mm above and 4.8 mm below the lower border of the mandible, crossed superficial to the facial artery and innervated muscles of lower lip [13, 15].

The present study showed that, the mandibular marginal branch of facial nerve was formed of single branch in 40% of cases that run below the base of the mandible. It was found to be formed of 2 branches in 40% of specimens arranged around the base of the mandible. and was found to be formed of 3 branches in 20% of cases passing around mandibular base. The marginal branch of facial was found to cross superficial to the facial artery and facial vein.

Voltmann, et al. [14] measured the distance of mandibular marginal branch of facial nerve to the inferior margin of the mandible in order to determine the best and safest location of approach submandibular region. They found that the mandibular marginal branch of facial nerve consisted of 1-3 branches. The upper branch passed superior along the length the inferior border of the mandible. The lower branch passed below passed below the mandibular base by about 2 cm. They recommended an incision of about 3 cm below the inferior border of the mandible for submandibular approach to reduce risk of injury of the mandibular marginal branch of facial nerve [14, 5].

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REFERENCES