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Anatomic Variability And Distribution Of Facial Nerve Posing Surgical Challenge In Parotidectomy: Lesson Learnt From 106 Cases

Asif Maqbool, Hira Ashraf, Talat Waseem

IMPORTANCE Functional and anatomic preservation of facial nerve and its terminal branches is a major challenge faced by surgeons during parotid gland surgery. Extra-temporal segment of facial nerve can be injured due to trauma, laceration or iatrogenic causes. Surgical procedures of parotid gland, submandibular gland, temporomandibular joint and face lift are commonly associated with complication of facial nerve palsy. Since iatrogenic injury is quite common, knowledge about relation of facial nerve with parotid gland and facial muscles is essential for competent surgical approach. The rationale for conducting this retrospective study was to identify variations in the course of facial nerve which may lead to better understanding of the surgeon while dissecting it.

PATIENTS AND METHODS We have analyzed records of 106 patients undergoing parotid surgery. In this retrospective study special attention is paid to operative trunk distance, type of peripheral branching pattern and interconnections of facial nerve branches.

RESULTS Greatest variation is observed in upper division of the five-level branching pattern. The frequency of peripheral pattern of facial nerve was type I (31.1%), type II (17.9%), type III (21.6%), type IV (24.52%), type V (2.8%), and type VI (1.88%). This study shows that type I is the most common branching pattern, followed by type IV, type III and type II, respectively. Marginal mandibular branch was found below the mandibular border on live cervicofacial dissections in half of the included cases.

CONCLUSIONS The conclusions are confirmative that extra-temporal course of facial nerve is extremely variable. Distinct knowledge of anatomic variation and distribution of facial nerve is essential for surgeons to enable safe dissection particularly during parotid surgery.

KEYWORDS Facial nerve, Parotidectomy, Variations, Anatomy of Parotid Region

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Neoplastic lesions of parotid gland commonly require parotidectomy. Functional and anatomic preservation of facial nerve and its terminal branches is a major challenge faced by surgeons during parotidectomy [1]. Extra temporal segment of the facial nerve can be injured due to trauma, laceration or iatrogenic causes. Surgical procedures of parotid gland, submandibular gland, temporomandibular joint and face lift are commonly associated with complication of facial nerve palsy. Post-operative facial nerve deformity can cause legal issues for surgeons [2]. Hence, knowledge about distribution and anastomosis of facial nerve branches is crucial for surgeons.

Since terminal branches of facial nerve are closely related to parotid gland, preservation and protection of these branches is vital for successful parotidectomy. Terminal branches of facial nerve can be injured during parotidectomy, especially in deep lobe dissection [3]. Two commonly employed techniques used for preservation of the extratemporal part of the nerve are antegrade and retrograde approach. However, antegrade approach is the standard procedure [1]. It is used by trainees to avoid the commonest complication of parotidectomy. It involves use of tympanomastoid suture, tragal pointer or digastric muscles' posterior belly as landmarks for identification of facial nerve trunk [4]. Yet, the localization becomes a difficult task in obese patients. Since the advent of peri-operative nerve monitoring, preference of antegrade approach has increased among surgeons [5]. While, retrograde approach requires soft tissue landmarks. Facial nerve stimulator aids in identifying these landmarks [6].

Extracranial portion of facial nerve exits stylomastoid foramen and supplies stylohyoid, posterior belly of digastric and auricular muscles. Facial nerve runs ventrally lying 5cm deep to the skin, splitting in upper (temporofacial) and lower (cervicofacial) divisions at posterior edge of parotid gland [7]. It divides parotid gland in superficial and deep lobes. Several branches arise from these divisions and exit the gland in a plexiform fashion forming pes anserinus. Pes anserinus supplies the superficial muscles of head, face and

upper neck. Branching of these divisions have several variations [8]. However, temporofacial division usually gives off temporal, zygomatic and buccal branches, while, cervicofacial division gives off marginal mandibular and cervical branches [7]. Since iatrogenic injury is quite common, knowledge about relation of facial nerve with parotid gland and facial muscles is of key importance.

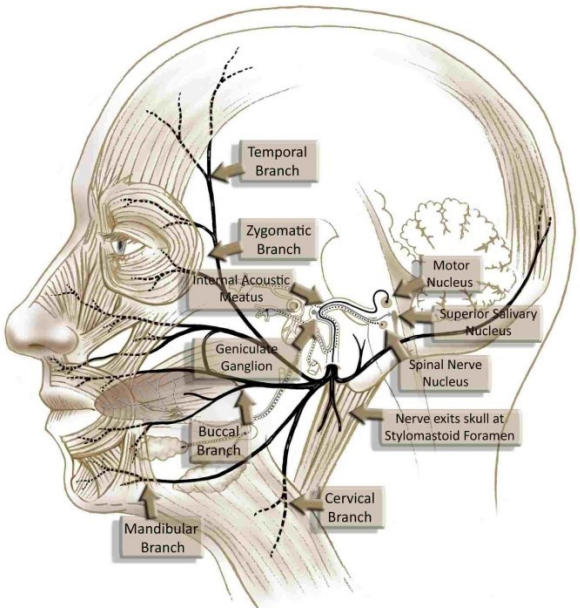

Figure 1: Facial nerve and its extra-temporal branches

Incidence of facial nerve injury during parotidectomy and rhytidectomy can be reduced by using anatomical landmarks. Facial nerve trunk passes superficial to retromandibular vein to enter substance of the gland and gives temporofacial and cervicofacial divisions [9]. Hence, retromandibular vein can be used for localization of facial nerve. Pre-operative localization of parotid gland tumors can reduce surgical complications. Retromandibular vein can be used as landmark in MRI, CT and sonography to localize the parotid tumors [10]. Course of retromandibular vein can be traced to localize the nerve trunk. Retromandibular vein and superficial temporal vein serve as landmarks in superficial parotidectomy and mandibular condyle fracture reduction. While, mastoid process, tragus, tympano-mastoid suture line and digastric muscles' posterior belly serve as important landmarks in intra-parotid facial nerve localization [10,11].

Injury to anastomosing terminal branches is less likely to cause permanent paralysis [12]. However, temporo-facial and mandibular branch of facial nerve rarely anastomose and are related to lesser subcutaneous tissue making these prone to injury in temporal flap and face lift procedures [2]. Thorough knowledge, good exposure, and reliability of surgical dissection can reduce the incidence of facial nerve injury. The rationale for conducting this retrospective study was to identify variations in the course of facial nerve which may lead to better understanding of the surgeon while dissecting it.

PATIENTS AND METHODS

Records of 106 patients undergoing parotidectomy are analyzed in this retrospective study. Special attention is paid to operative trunk distance, type of peripheral branching and interconnections. In all 106 cases antegrade approach is used. Antegrade approach is employed in all cases to identify facial nerve trunk using landmarks and then follow its course to identify the peripheral branching pattern. In addition, antegrade approach is also used in revision parotidectomy, limited superficial parotidectomy, traumatic nerve injury and obese patient. Parotidectomy of either side of the face is included. Both male and female patients are included in this study. All cases had regular follow-up for reporting post-operative facial nerve weakness.

RESULTS

A total of 106 cases of parotidectomy are included in this article. All cases had antegrade parotidectomy. In this study parotidectomy of either side of face is included. Difference in branching pattern is not seen to have any association with gender. Post-operative facial nerve weakness at one week and at 6 months is not reported in any of the case. Branching pattern categorized by Davis et al is used to classify the variations observed in all 106 cases [8]. Davis et al categorized patterns of facial nerve branching based on anastomosis amongst branches of each division and amongst divisions [8].

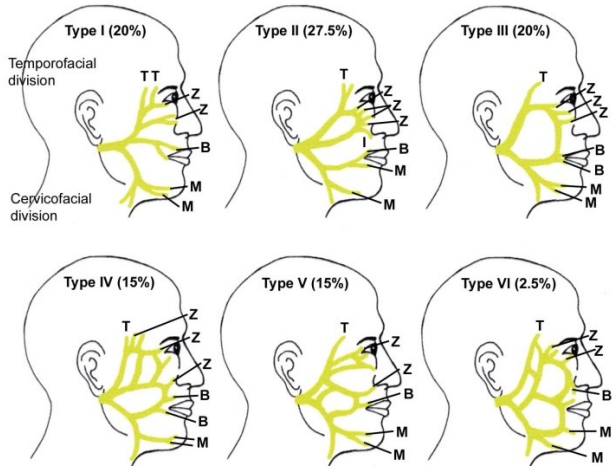

Figure 2: Various Branching Patterns previously classified by Davis et al[8] (Courtesy: Davis et al)

Type of branching	Anastomosis	Anastomosing branches
I	Absent	No anastomosis among temporo-facial and cervicofacial branches
II	Present	Among branches of temporo-facial division
III	Present (Single anastomosis)	Among branches of temporo-facial and cervicofacial division
IV	Present	It is a combination of type II and III
V	Present (Double anastomosis)	Among temporo-facial and cervicofacial division
IV	Present (Multiple anastomosis)	Among the two divisions. Buccal branch receives fibers from both, cervicofacial division and mandibular branch.

Table 1: Basic facial nerve branching pattern according to Davis et al[8] is given in Table 1 (Courtesy: Davis et al).

Antegrade approach is used in all cases owing to proficiency, decreased incidence of nerve morbidity, and technical ease. Nerve stimulator is not used intra-operatively in any of the case. Greatest variation is observed in upper division of the five-level branching pattern. Marginal mandibular branch was found below the mandibular border on live cervicofacial dissections in half of the included cases.

The frequency of peripheral pattern of facial nerve was type I (31.1%), type IV (24.52%), type III (21.6%), type II (17.9%), type V (2.8%), and type VI (1.88%). In every distinctive type subsequent subtype is also included.

Our study shows that type I is the most common branching pattern, followed by type IV, type III and type II, respectively. The least common branching types encountered are type V and type VI.

Branching type	Number of patients	Percentage
I	33	31.1 %
II	19	17.9 %
III	23	21.6 %
IV	26	24.52 %
V	3	2.8 %
VI	2	1.88 %

Table 2: Basic facial nerve branching patterns observed in this study.

Figure 3: Various representative Facial Nerve Variations observed during the study

Findings of our study are in contrast to the percentage reported by Davis et al [8]. Percentages reported by Davis et al[8] in their study are type III 28%, type IV 24%, type II 20%, type I 18%, type V 9%, and type VI 6%. Henceforth, the most common pattern reported by them was type III, followed by type IV, type II and type I. However, the least reported types by them were also type V and type VI.

In our study, marginal mandibular branch was found below mandibular border in half of the cases (53 cases). Several studies have shown that majority cases have this branch above the mandibular border [13–17]. However, our data implies that injury to this branch can be avoided by making incision below the mandibular border.

DISCUSSION

Facial nerve injury is a significant cause of morbidity associated with parotidectomy. Conventional approach used by majority surgeons for resection of parotid tumors is antegrade technique. Using this technique meticulous resection of the tumor is performed following identification of facial nerve trunk.

Parotidectomy is challenged by variation in peripheral branching pattern and distribution of facial nerve. Functional and anatomical knowledge about the peripheral branching pattern and distribution is hence vital for the operating surgeon. Peripheral branches are superficial and correlation between them and surgical interventions of this area require thorough description. A successful parotidectomy requires not only the removal of pathological tissue but also the functional and anatomical preservation of facial nerve. Surgical landmarks help in accurate localization of facial nerve trunk and peripheral branches, thereby reducing the incidence of nerve morbidity.

We studied the different presentations of facial nerve in order to protect and isolate the branches during parotidectomy. We employed antegrade approach in all cases owing to reduced incidence of nerve morbidity, proficiency and technical ease. However, some studies have shown no difference in incidence of nerve morbidity between antegrade and retrograde approach [18]. Nerve monitoring devices are not used in this study. Nerve monitoring has increased interest in retrograde approach and is also essential for this approach due to technical difficulties in localization and identification of peripheral branches [18–20]

Conventionally, complete superficial parotidectomy is performed for benign lesions. However, alternate techniques such as extracapsular dissection, limited superficial parotidectomy and selective deep lobe parotidectomy are encouraged in order to minimize iatrogenic facial nerve damage [1]. Antegrade approach is the standard technique practiced during training owing to reliable localization of the nerve using anatomical landmarks. However, the operative time is more than retrograde approach due to extensive resection. In United Kingdom 87% of the OMF and ENT surgeons use antegrade approach, while, 4% use retrograde approach [20]. Even though, antegrade approach is the standard approach, interest in retrograde technique is renewed due to its conservative approach and introduction of nerve monitoring devices [1].

In conclusion, the extra-temporal course of facial nerve is extremely variable. Knowledge about anatomic variation and distribution of the facial nerve is crucial for surgeons to avoid facial nerve injuries.

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