A Handy Landmark (Triangle Technique) for Identification of the Facial Nerve during Parotid Surgery

Islam MA[1]*, Rahman MM[2], Mohammad T[3], Kazi MM[4], Chowdhury NH[5] and Khan MAM6

[1]Professor & Head of Otolaryngology-Head & Neck Surgery, Bangladesh Medical college Hospital, Bangladesh

[2]Associate Professor & Head, Ad-Din Bashundhara Medical College, Bangladesh

[3]ENT, Popular Medical College, Bangladesh

[4]Assistant registrar, ENT, Bangladesh Medical College Hospital, Bangladesh

[5]Assistant Professor, ENT, Bangladesh Medical College, Bangladesh

[6]Assistant professor, ENT, Cumilla Medical College, Bangladesh

*Corresponding author: Md. Ashraful Islam MBBS, FCPS, FICS, FACS, FRCS (Glasgow), Professor & Head of Otolaryngology-Head & Neck Surgery, Bangladesh Medical College Hospital, Bangladesh, Email: ashrafis123@yahoo.com

Abstract

The parotid glands are paired major salivary glands located in front of the tragus and below the ear lobule at the retromandibular area (behind the mandibular ramus and in front of the mastoid process of the temporal bone) on each side of the upper neck. The facial nerve is one of the most important structures encountered during parotidectomy. The neurovascular structures that pass through the parotid gland from lateral to medial are facial nerve, retromandibular vein, external carotid artery, superficial temporal artery and maxillary artery. Branches of the great auricular nerve enter the gland from the neck and remains superficial. Parotid surgery is indicated in certain pathological conditions namely benign and malignant neoplasm, chronic inflammatory diseases, sialolithiasis, intra-parotid cysts/sinuses and lymphadenopathy; and many more. The importance of the facial nerve and methods of identification are enumerated by the multiple anatomical landmarks during parotidectomy. The triangle landmark is one of these anatomical landmarks considering the base of the styloid process, tragal cartilage to tragal pointer and the origin of the posterior belly of the digastric muscle at the mastoid tip.

Facial Nerve and the Parotid Gland: The intra-temporal facial nerve exits from the stylomastoid foramen slightly posterior to the styloid process and anteromedial to the mastoid process. The main trunk is approximately 1.3 cm in length enters into the parotid gland and divides into cervico-marginal and zygomatico-temporal branches; and of course, buccal branches (upper and lower buccal) remain common in both the divisions. The cervico-marginal branches supply the muscles of the mouth and neck; and zygomatico-temporal branches supply the muscles of the forehead and eye. The facial nerve arbitrarily divides the gland into superficial and deep lobes.

Aim of the Study: The aim of this study was to locate the facial nerve trunk (FNT) very easily. Quickly and accurately at the point where the long axis along the tragal pointer from the tragus and posterior belly of the digastric from the mastoid tip meets over the styloid process.

Patients and Methods: This prospective study was conducted between January 2012 to December 2022 at Tertiary care hospital. It included 117 patients: 74 (63%) males and 43 (37%) females with a mean age of 42.52 ±16.63 years. Patients presented with pleomorphic adenoma (70), chronic sialectasis (05), parotid cyst (02), parotid sinus (01), mucoepidermoid carcinoma (21) adenoid cystic carcinoma (02) and squamous cell carcinoma (01) were subjected to superficial parotidectomy and total parotidectomy. Outcome was evaluated regarding clinical success of facial nerve identification by a handy landmark-triangle technique.

Results: All 117 patients underwent superficial and total parotidectomy. Facial nerve trunk was successfully identified in all the patients with no intra-operative complications. Operative time ranged from 50 to 180 minutes with a mean time 90.70 ±15.68 minutes. Facial nerve deficit of the marginal mandibular nerve (MMN) was noted in 4 patient (3.4 %), 02 had difficulty in eye closure (1.7%). No patient reported with surgical site infection, skin flap necrosis and hematoma in all the patients.

Conclusion: A handy landmark-triangle technique described here facilitates the identification of facial nerve trunk during superficial parotidectomy with relative ease, safety and accuracy. This can be a very useful method to minimize the facial nerve injury during parotid surgery.

Keywords: Facial Nerve Trunk (FNT); Identification Triangle; Technique Parotid Surgery

Introduction

"He who devotes himself to surgery must be versed in the science of anatomy. Those who lack a good grasp of anatomy are prone to serious and even fatal mistakes."Al-Zahrawi (936-1013 A. D.).

The preservation of the facial nerve is one of the most important aspects of a successful parotid surgery because of its critical functions and intimate relation with the parotid gland [1-6]. It requires great precision because the surgeon has to locate and operate around these important structures. Although there are several ways to locate the facial nerve such as antegrade approach with the identification of the main trunk and the retrograde approach with the identification of its branches to reach the main trunk [7]. Nevertheless, detection of the facial nerve becomes a crucial point in parotid surgery. The following anatomical landmarks are the key to locate the facial nerve trunk (anterograde) [8].

- Tragal pointer (TP): The nerve lies approximately 1.0–1.5 cm deep and slightly anterior and inferior to the tip of the tragal cartilage
- Posterior belly of the digastric muscle (PBDM): The nerve lies approximately 1.0 cm deep to the medial attachment of the posterior belly of the digastric muscle to the digastric groove of the mastoid bone
- Tympanomastoid suture (TMS): Facial nerve trunk is situated 3 mm inferior to suture to the stylomastoid foramen
- Styloid process (SP): The nerve trunk is found inferolateral to it.

Retrograde approach of the nerve trunk through one of the branches of the facial nerve [9].

- Marginal mandibular branch: it courses the deep surface of the tail of the parotid and often reliably found at the angle of the mandible.
- Buccal branch: it runs parallel to and 1 cm below the arch of the zygoma traveling toward the corner of the mouth.
- Zygomatic branch: any one of the ophthalmic branch where they cross the arch of the zygoma near the upper anterior corner of the gland.
- Retromandibular vein: This vein is also used as a landmark when evaluating imaging studies, as this vein marks the division of the deep and superficial lobes. This relationship is important as it approximates the depth of the facial nerve which lie superficially.

Besides all those described above, the following points are also considered for facial nerve identification.

- Parotid-mastoid fascia (PMF): The fascia is incised as the final step before identifying the trunk of the facial nerve. The nerve is found within fat deep to the parotid-mastoid fascia and localized employing the landmarks noted above [9,10].
- The facial nerve stimulator/monitor helps to localize the nerve through stimulation with observation of facial movement [11].
- Partial removal of the mastoid process is done by chisel, rongeur, or drill to identify nerve in mastoid [12].
- Gamma probe: It is used to identify a sentinel lymph node (Tc ^{99} injection done several hours before). The sentinel node was overlying the lower division of the facial nerve, warranting identification and preservation of the

Islam MA, et al. A Handy Landmark (Triangle Technique) for Identification of the Facial Nerve during Parotid Surgery. Otolaryngol Open Access J 2022, 7(1): 000232.

Copyright© Islam MA, et al.

nerve [11-13].

It is evident from the published literature that there are so many landmarks used to identify the facial nerve trunk because of its variable and inconsistent position. So parotid surgeons yet to reach to a consensus regarding the safety and reliability of each of these landmarks [14].

Material and Methods

- **Design:** Prospective study
- **Duration:** January 2012 to December 2022
- **Setting:** Tertiary care hospital
- **Study number:** 117 patients with different parotid diseases underwent parotid surgeries.
- **Landmarks:** A triangle was made from (a) the tragus to the mastoid tip anteriorly, (b) along the long axis of the tragus to the styloid process and (c) from the mastoid tip crossing the insertion of the posterior belly of the digastric muscle to the styloid process.
- **Facial nerve trunk identification:** The three most easily identifiable and anatomically constant landmarks were selected and their respective distance from the styloid process was measured. The facial nerve trunk was identified at the point of convergence of the lines from the tragal pointer and mastoid tip across the PBM to the styloid process.
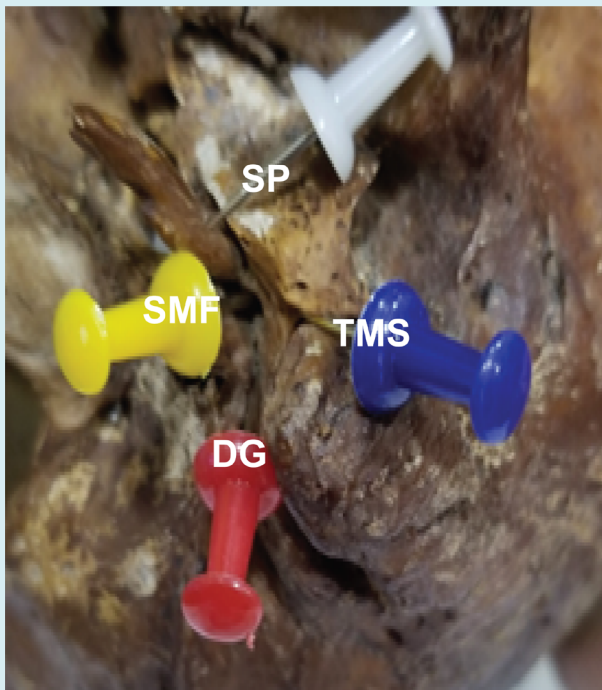

Figure 1: SP= Styloid Process, SMF = Stylomastoid foramen, TMS=Tympanomastoid suture DG=Digastric Groove.
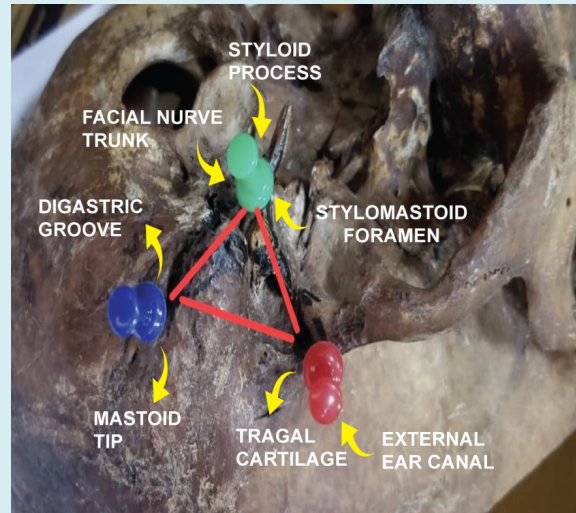

Figure 2: Facial nerve trunk.

Surgical Technique

a.   A modified cosmetic incision was made starting 1 to 2 cm above the tragus approaching to the neck behind tragus in the external auditory canal making a sinuous curve.

b.   The approach to the trunk of the facial nerve involves 3 steps.

➢ First step, the 3 anatomical landmarks were identified.

➢ The first landmark was at the center of the tragal cartilage.

➢ From that, a line was traced to the tip of the MP that was the second landmark.

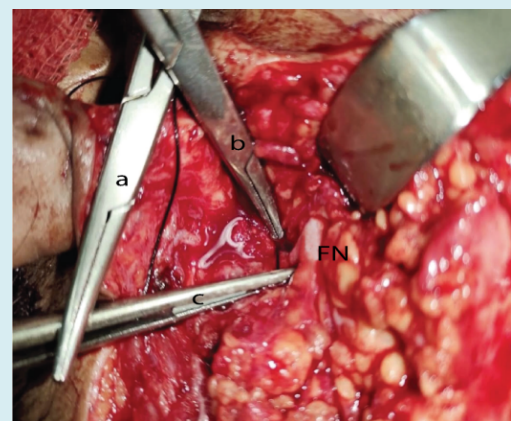➢ The third landmark was the SP, and the reference triangle was delineated

Figure 3: a. Tragal cartilage to mastoid tip b. Tragal cartilage to styloid process c. Mastoid tip to styloid process. FN= Facial nerve

The second step was to make an surgical triangle that started along the long axis from the center of the tragal

Islam MA, et al. A Handy Landmark (Triangle Technique) for Identification of the Facial Nerve during Parotid Surgery. Otolaryngol Open Access J 2022, 7(1): 000232.

Copyright© Islam MA, et al.

cartilage crossing the TP to the SP and the third step started from the MP to SP crossing the PBDM that was marked the convergent point at the SP. The predicted position of the facial nerve was located at the reference angle of the surgical triangle lateral to the SP. All references were chosen by means of dissection and palpation; not by objective measurements. Once identified, the facial nerve was freed until its trunk and its major 2 divisions were individualized.
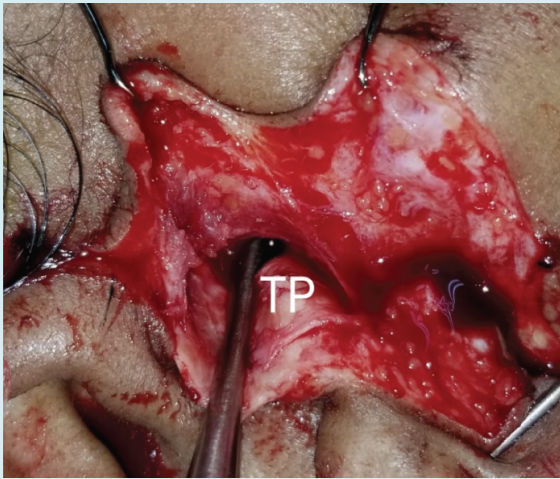

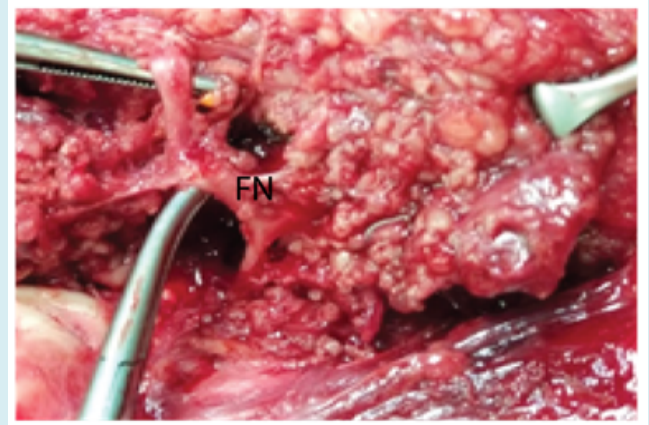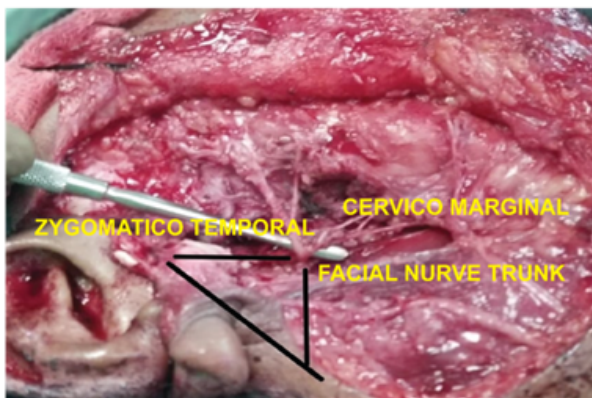**Figure 4:** TP= Tragal Pointer, RMV= Retromandibular Vein.

Figure 5: FN=Facial Nerve.

Results

The facial nerve trunk was located at the site of convergence in all 117 patients that is shown in Table 1.

Tragal cartilage to Mastoid tip	9.5±1.5 mm
Tragal pointer to styloid process	17.5±1 mm
Posterior belly of digastric from mastoid tip to styloid process	7.5±1.5 mm
Tragal pointer to facial nerve trunk	13±1.2 mm
Posterior belly of digastric to facial nerve trunk	6.5±0.5 mm

Table 1: Shows the distance of the facial nerve trunk from TP, MT and PBDM.

It has been observed in this study that the facial nerve exited the skull through the stylomastoid foramen for a length of 1.3 cm approximately; and divide in 2 main divisions cervico-marginal and zygomatico-temporal branches; and of course, buccal branches (upper and lower buccal) remain common in both the divisions within the parotid gland in all 117 patents. A triangle was made from tragal cartilage to mastoid tip with a mean distance of 9.5±1.5 mm. The mean distance between tragal pointer to styloid process was 17.5±1 mm, posterior belly of digastric from mastoid tip to styloid process was 7.5±1.5 mm, tragal pointer to facial nerve trunk was found 13±1.2 mm and posterior belly of digastric to facial nerve trunk was 6.5±0.5 mm. The facial nerve was located at the exact convergence between the tragal pointer to styloid process and posterior belly towards styloid process.

Facial nerve trunk was successfully identified in all the patients with no intra-operative complications. Operative time ranged from 50 to 180 minutes with a mean time

Islam MA, et al. A Handy Landmark (Triangle Technique) for Identification of the Facial Nerve during Parotid Surgery. Otolaryngol Open Access J 2022, 7(1): 000232.

Copyright© Islam MA, et al.

90.70 ±15.68 minutes. Facial nerve deficit of the marginal mandibular nerve (MMN) was noted in 4 patient (3.4 %), 02 had difficulty in eye closure (1.7%). No patient reported with surgical site infection, skin flap necrosis and hematoma in all the patients.

Discussion

Facial nerve trunk exits from the stylomastoid foramen and travels for a short distance of approximately 1.3 cm enters into the parotid gland [8,15] and divides into upper zygomatico-temporal and cervico-marginal branches with a common buccal branch to supply the ipsilateral face, eye, forehead, temporal region and upper neck. This nerve is arbitrarily but not anatomically dividing the parotid gland in to superficial and deep lobes [16].

The shortest FNT and its branches are intimately related with the parotid gland so facial nerve injury is the most common complication of parotid surgery [17]. The paramount importance is the identification of the facial nerve during parotidectomy is a paradigmatic procedure [15,17]. Both the main trunk and peripheral branches must be identified and preserved to prevent permanent aesthetic sequelae and medico-legal actions related to facial paralysis [18]. In this study facial nerve trunk identified with relative ease, safety and accuracy.

There are different ways of identification of the facial nerve such as anterograde, retrograde, facial nerve monitor/ stimulator, gamma probe etc [8,9,10-13]. The most common and easy technique to identifying the FNT at its point of exit from the stylomastoid foramen till its division in the entry point of parotid gland is the preferred method of getting the facial nerve which correlates with this technique [19].

Anatomically, a very constant landmark for facial nerve is the stylomastoid foramen (SMF) situated posterolateral to the styloid process but it is very difficult to find this foramen as it is mainly a palpatory landmark and most importantly because it remains surrounded by thick fascia which is continuous with the periosteum of skull base [20]. In this study the styloid process was taken as a very handy landmark to locate the FNT from the SMF.

Although tragal pointer (TP) is considered a very popular landmark and the nerve usually lies approximately 1.0–1.5 cm deep and slightly anterior and inferior to the tip of the tragal cartilage (TC) [21,22]. The only drawback of the tragus is that it is a cartilaginous structure which is mobile, asymmetrical having a blunt and irregular tip. In this study styloid process was considered as a robust landmark with the SMF, TC and TP.

In this study mastoid process was considered mainly a palpatory landmark, the process lies deep to the insertion of the sternocleidomastoid muscle (SCM). Posterior belly of the digastric muscle (PBDM) lies medial to SCM. The FNT lies approximately 1.0 cm deep to the medial attachment of the posterior belly of the digastric muscle to the digastric groove of the mastoid tip which is easily identifiable by drawing a line from the MT along the PBDM to the styloid process which corresponds to the other published literature [21,23,24].

The present study set out to locate the ease and accuracy of facial nerve identification using the triangle formed by the tragal cartilage, the mastoid tip and the styloid process. The FNT was accurately and quickly found at the point of convergence of the long axis from the TP to SP and from MT across the PBDM to styloid process. For easy and prompt identification of the nerve trunk, the surgeon needs to systematically look for the anatomical landmarks.

Recommendations

The proposed surgical triangle and the angle at the point of convergence inferolateral to the SP was practically the anatomical orientation that could make surgery around the parotid region safer and quicker. This approach offers substantial advantages when compared with other methods described in the published literature so far. It evaluates nerve position accurately; the 3 anatomical landmarks are easy to identify by palpation during surgery and are not distorted by the pathologic conditions.

Conclusion

The handy landmarks using triangle technique described in this article allowed a fast and safe identification of the facial nerve and may be of significant help during parotid surgery. Operative identification of the facial nerve trunk is a step-by-step procedure in which identification of the anatomic landmarks is highly advisable. The final success of the operation depends to a vast extent on the safe handling of the facial nerve and its branches as well as the use of bipolar diathermy during the surgical procedure.

Acknowledgement

Conflict of Interest

No conflict of interest.

References

1. Alexander de Ru J (2001) Landmarks for parotid gland surgery. The Journal of Laryngology & Otology 115: 122–125.

2. Somnath S, Pal S, Sengupta M, Chowdhury K, Saha VP Mondal (2014) Identification of Facial Nerve during Parotidectomy: A Combined Anatomical & Surgical Study. J Otolaryngol Head Neck Surg 66(1): 63-68.

3. Al-Qahtani KH (2020) A new landmark for the identification of the facial nerve during parotid surgery: A cadaver study; Laryngoscope.

4. Janes RM (1940) The Treatment of Tumours of the Salivary Glands by Radical Excision. Can Med Assoc J 43(6): 554-559.

5. Pereira JA, Merí A, José Potau JM (2004) A Simple Method for Safe Identification of the Facial Nerve Using Palpable Landmarks. Arch Surg 139(7): 745-747.

6. De Ru Javan, Bley B, Lubsen RL, Hordijk GJ (2001) Landmarks for parotid gland surgery. J Laryngol Otol 115(2): 122-125.

7. Lathrop FD (1949) Technique of exposing the facial nerve as an aid to surgery of the parotid gland. Surg Clin North Am 29: 673- 677.

8. Conley J (1978) Search for and identification of the facial nerve. Laryngoscope 88: 172-175.

9. McCabe BF, Work WP (1968) Parotidectomy with special reference to the facial nerve. Otolaryngology 4(3): 37-53.

10. Lydiatt DD (2003) Medical Malpractice and Facial Paralysis. Arch Otolaryngology Head Neck Surg. 129: 50-53.

11. Stennert E, Wittekindt C, Klussman PJ, Arnold G, Guntinas-Lichius O (2004) Recurrent Pleomorphic Adenoma of the Parotid Gland: A Prospective Histopathological and Immunohistochemical Study. The Laryngoscope 114: 158-163.

12. Redaelli de Zinis LO, Piccioni M, Antonelli AR, Nicolai P (2008) Management and prognostic factors of recurrent pleomorphic adenoma of the parotid gland: personal experience and review of the literature. Eur Arch Otorhinolaryngology 265(4): 447-452.

13. Makeieff M, Pelliccia P, Letois F, Mercier G, Arnaud S, et al. (2010) Recurrent Pleomorphic Adenoma: Results of Surgical Treatment. Ann Surg Oncol 17(12): 3308-3313.

14. Witt RL, Weinstein GS, Rejto LK (2005) Tympanomastoid suture and digastric muscle in cadaver and live parotidectomy. Laryngoscope 115(4): 574-577.

15. Holsinger FC, Bui DT (2007) Anatomy, function, and evaluation of the salivary glands; in Myers EN, Ferris RL (eds): Salivary Gland Disorders. Berlin, Springer pp: 1-16.

16. Wang SJ, Eisele DW (2007) Superficial parotidectomy; in Myers EN, Ferris RL (eds): Salivary Gland Disorders. Berlin, Springer pp: 247-246.

17. Joseph ST, Sharankumar S, Sandya CJ, Sivakumar V, Sherry P, et al. (2015) Easy and Safe Method for Facial Nerve Identification in Parotid Surgery. J Neurol Surg B Skull Base 76(6): 426-431.

18. Saha S, Pal S, Sengupta M, Chowdhury K, Saha VP, et al. (2014) Identification of facial nerve during parotidectomy: a combined anatomical & surgical study. Indian J Otolaryngol Head Neck Surg 66(1): 63-68.

19. Borle RM, Jadhav A, Bhola N, Hingnikar P, Gaikwad P (2019) Borle's triangle: A reliable anatomical landmark for ease of identification of facial nerve trunk during parotidectomy. J Oral Biol Craniofac Res 9(1): 33-36.

20. Owusu JA, Parker NP, Rimell FL (2013) Postoperative facial nerve function in pediatric parotidectomy: a 12-year review. Otolaryngol Head Neck Surg 148(2): 249-252.

21. Hogg SP, Kratz RC (1958) Surgical exposure of the facial nerve. Arch Otolaryngol 67: 560-561.

22. Kratz RC, Hogg S (1958) Surgical exposure of the facial nerve. J Laryngol Otol 72(11): 902-905.

23. Byars LT (1952) Preservation of the Facial Nerve in Operations for Benign Conditions of the Parotid Area. Ann Surg 136(3): 412-419.

24. Janes RM (1957) Tumors of the parotid gland. Ann R Coll Surg Engl 121(1): 1-20.

Islam MA, et al. A Handy Landmark (Triangle Technique) for Identification of the Facial Nerve during Parotid Surgery. Otolaryngol Open Access J 2022, 7(1): 000232.

Copyright© Islam MA, et al.