



Simple Technique Using an Additional Landmark to Reliably Identify the Trunk of Facial Nerve During Parotidectomy: a Cadaveric and Clinical Correlation Study

Roshan Verma¹ · Gontu Gopi Satya Sai Reddy¹ · D. N. S. Prakash¹ · Daisy Sahni²

Received: 11 November 2021 / Accepted: 19 April 2022 / Published online: 27 April 2022
© The Author(s), under exclusive licence to Indian Association of Surgical Oncology 2022

Abstract

The incidence of facial palsy in parotid surgeries is up to 50% transient and 17% complete facial palsy. Locating facial nerve trunk during parotid surgery can be tricky despite using the standard landmarks. During a cadaveric dissection, we came across a simple technique to identify the trunk of facial nerve which we have also tried to use it in clinical setting and found it to be useful. Parotidectomy was done in 12 cadaveric hemi-faces. The distance between the mastoid tip and the tympanic segment of facial nerve was measured. The distance of the facial nerve and mastoid tip and tympanomastoid suture and facial nerve was measured. The trunk of facial nerve was found to cross the tympanomastoid sulcus-mastoid tip at around 8–10 mm from the mastoid tip in 70% of the cases. We extrapolated this information in 5 cases of parotidectomy in operative setting. We were able to identify facial nerve trunk accurately in 4/5 cases. Imaginary line connecting the mastoid tip and tympanomastoid suture can be used to locate the probable position of the facial nerve trunk reliably during parotidectomy.

Keywords Parotid surgery · Tympanomastoid suture-mastoid tip line · Facial nerve trunk

Highlights • Difficult to identify facial nerve during parotid surgery.

- Posterior bellies of digastric and tympanomastoid suture are time-tested landmarks to identify the facial nerve trunk during parotid surgery. We have made an interesting observation during cadaveric dissection of the parotid gland which can be used as an additional landmark to identify the facial nerve trunk during parotidectomy.
- Our technique to identify the facial nerve using imaginary line connecting the mastoid tip and tympanomastoid suture can be used to identify the trunk of facial nerve reliably.
- This technique was first employed in cadaver dissection measurement recorded and then it was validated in 5 clinical cases.
- Trunk of facial nerve was found to cross line joining the tympanomastoid sulcus-mastoid tip line at around 8–10 mm from the mastoid tip in 70% of the cases.

✉ Roshan Verma
roshanverma@hotmail.com

¹ Dept. of Otolaryngology and Head and Neck Surgery, Postgraduate Institute of Medical Education and Research, Chandigarh 160012, India

² Dept of Anatomy, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Introduction

Parotid surgery is a challenging surgery because of the fear of injury to the facial nerve. Facial nerve paralysis has serious consequences and can significantly impact the quality of life, and hence, every effort should be made to identify and preserve the integrity of facial nerve during parotid surgery [1]. Most commonly and time-tested landmarks used for facial nerve identification during parotid surgery are tympanomastoid fissure, the cartilaginous part of the external auditory canal, the posterior belly of the digastric muscle and tragal pointer, the retromandibular vein, and the styloid process of the temporal bone [2]. In spite of good anatomical knowledge of the landmarks and meticulous technique, the incidence of transient facial nerve palsy is up to 50% and permanent facial palsy is 17% [3].

Search for newer landmark may help us predict reliably the position of trunk of the facial nerve even in difficult situation. During our cadaveric dissections, we came across an interesting observation that can be reliable to identify the facial nerve trunk. Facial nerve trunk was seen to divide the imaginary line connecting two bony anatomical landmarks from the tympanomastoid fissure to the mastoid tip consistently. We extrapolated this cadaveric finding into operative

setting and we were able to reliably identify facial nerve trunk during parotidectomy. In this article, we highlight our new approach to identify the facial nerve trunk consistently during parotidectomy.

Materials and Methods

Prospective anatomical dissection study and clinical observational study were done in collaboration with Department of Anatomy, Post Graduate Institute for Medical Institute and Research, Chandigarh, for a duration of 1 year between June 2018 and June 2019. The study protocol was approved by the Institute Ethics Board, vide: memo no. 11564/PG-Trg/2017. Fourteen sides from 10 frozen fresh cadaveric heads were used for this study. The specimens were derived from 8 males and 6 females with an age at death ranging from 30 to 65 years. Dissection was done in bright day light respecting the cadavers used for the study.

The cadaveric heads were fixed in lateral position using the surgical 3-pin holder. Cervico-mastoid-facial incision was made. The skin and superficial fascia was reflected back to expose the parotid gland and sternocleidomastoid muscle (SCM). The anterior aspect of the SCM was separated from the parotid capsule by blunt dissection and then, the SCM was removed distally. The posterior belly of the digastric muscle was separated from the posterior aspect of the parotid gland. The facial nerve trunk was identified using the following landmarks: the tragal pointer, the posterior belly of the digastric muscle, and the tympanomastoid suture.

The relationship of the trunk of the facial nerve and mastoid tip and tympanomastoid fissure was explored. We also measured the distance between the mastoid tip (at point of insertion of the posterior belly of the digastric muscle) and

tympanomastoid fissure (TMS-MP) and tympanomastoid fissure and facial nerve trunk (TMS-FN) and mastoid tip and facial nerve trunk (MP-FN). All measurements were made using calibrated vernier callipers. During dissection, high-definition images were taken to record the relationship amongst the facial nerve, external auditory cartilage, and mastoid tip. The average of the measured values in all 14 cadaveric hemi-faces was taken as the average distance between each landmark.

Clinical Setting

The observations were extrapolated in 5 cases of parotid tumour after prior informed consent. Patients underwent superficial parotidectomy for parotid tumours for the study, taken prior to the study. The distance between the mastoid tip and tympanomastoid fissure (Tm-MP) and tympanomastoid fissure and facial nerve trunk (TM-FN) and mastoid tip and facial nerve trunk (MP-FN) was measured. The ease of identification of facial nerve and difficulty encountered were recorded.

Results

This study had two components.

Cadaver Study

We dissected 14 cadaveric hemi-faces from 10 fresh frozen cadavers. Eight of them were male cadavers and 6 were female cadavers. During cadaveric study, we noticed an interesting finding. The facial nerve trunk was found to consistently cross a line joining two bony landmarks, the mastoid tip and

Fig. 1 Cadaveric dissection showing the trunk of the facial nerve showing reference landmarks and trunk of the facial nerve dividing TMS-MP line at approx. its midpoint

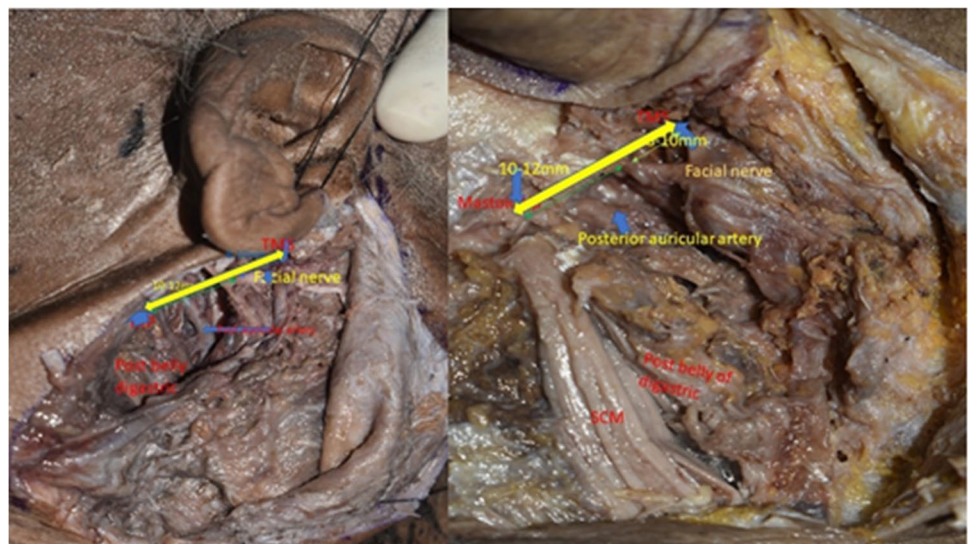
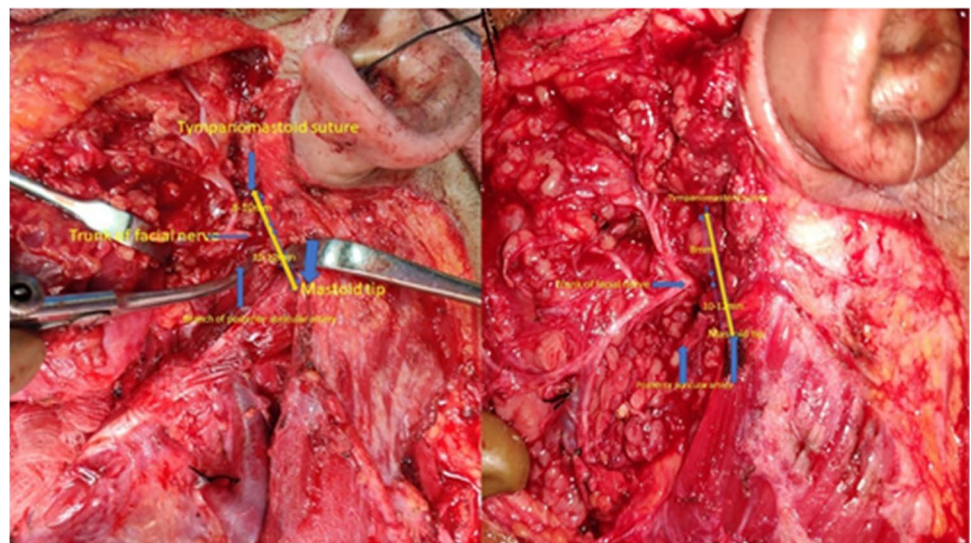


Table 1 Distances between trunk of the facial nerve, mastoid process, and tympanomastoid fissure

Cada S.no	TMS-MP (mm)	MFN (mm)	FPA (mm)	M-PA (mm)	TMS-FN (mm)
1	15	5	5	7	10
2	22	12	2	9	10
3	18	8	10	11	10
4	18	10	8	9	8
5	20	10	8	11	10
6	17	8	6	9	9
7	15	7	6	11	8
8	15	8	13	13	7
9	17	9	7	11	8
10	21	8	7	7	13
11	24	10	6	9	14
12	21	9	6	13	12
13	22	8	7	13	14
14	20	7	14	13	13
Average	18.92	8.5	7.5	10.42857	10.42857

Fig. 2 Operative dissection of parotidectomy showing trunk of the facial nerve dividing TMS-MP line at its midpoint



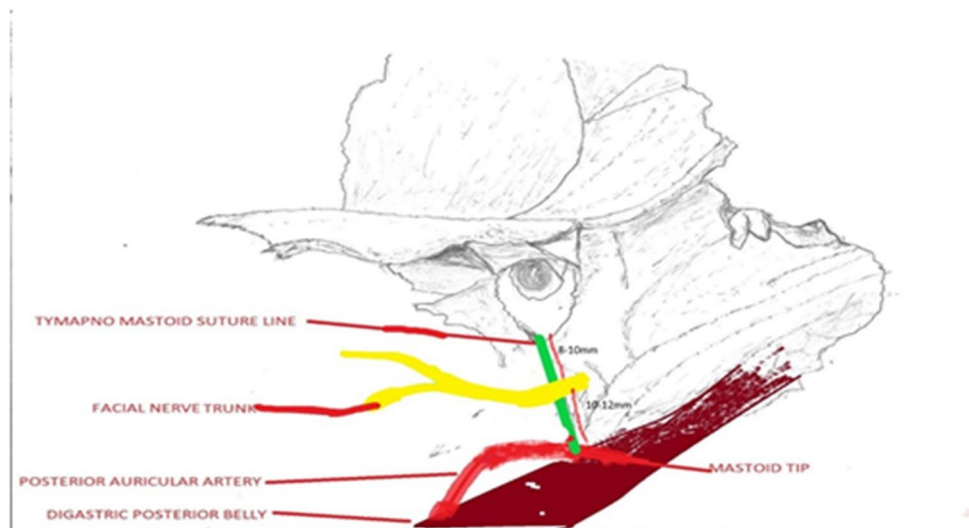
the tympanomastoid suture (TMS-MP line), in 12 dissected cadaveric specimens. In 2 cases (15%), facial nerve trunk was found to divide before the line and in them the lower cervico-facial branch was found crossing the TMS-MP line.

Measurement of distances from the tympanomastoid suture to mastoid tip (TMSMP), mastoid tip to facial nerve (MP-FN), and facial nerve to tympanomastoid suture (FN-TMS) was done using vernier callipers.

Table 2 The average distances between various landmarks and trunk of the facial nerve in operative setting

Patient	Age/sex	Side	Clinical diagnosis	TMS-MP (mm)	TMS-FN (mm)	MP FN (mm)	FPA (mm)
1	55/M	Left	Mucoepidermoid	15	7	8 mm	5
2	48/F	Left	Pleomorphic adenoma	22	4	10 mm	7
3	62/F	Right	Pleomorphic adenoma	18	8	15 mm	10
4	50/F	Left	Mucoepidermoid	21	7	10 mm	8
5	45/F	Left	Pleomorphic adenoma	17	10	12 mm	8

Fig. 3 Line diagram showing position of trunk of the facial nerve with respect to TMS-MP line



The average distance from the mastoid tip to the tympanomastoid suture (TMSMP) was 17.26 mm (12–26 mm).

The average distance between the mastoid tip and the tympanomastoid suture (TMS-MP) was found to be 17.24 mm (12–26 mm).

The average distance between the tympanomastoid suture and the facial nerve trunk (TMS-FN) was 5 mm (2–7 mm) (Fig. 1).

The trunk of the facial nerve was found to cross the TMS-MP line at distance of 10–12 mm from the mastoid tip in 70% of cadaver dissections (Table 1).

Clinical Study

A prospective clinical study was done to identify the trunk of the facial nerve using the above landmarks in 5 cases during parotidectomy. The average age of the patients was 55 years (50–65 years). Four patients were female and 1 was male. Four patients were operated on the left parotid gland and 1 was operated on the right parotid gland. Four patients had pleomorphic adenoma and 1 had mucoepidermoid carcinoma of the parotid gland. In 4/5 cases (90%), the nerve was easily identified using the TMS-MP line. In 1 patient, the nerve was dividing before the TMS-MP line and difficulties were encountered in identifying the main trunk of the facial nerve. None of the patients had complete facial paralysis whilst 1/5 had mild marginal mandibular nerve paralysis post-operatively (Fig. 2).

The average measured distances were recorded:

Mastoid tip to tympanomastoid suture (TMS-MP): 18.6 mm (15–22 mm).

Tympanomastoid suture to trunk of facial nerve (TMS-FN): 7.2 mm (4–10 mm).

Mastoid tip to trunk of facial nerve (MP-FN): 11 mm (8–15 mm).

The facial nerve trunk was found to cross the TMS-MP line at a distance of 8–10 mm from the mastoid tip in 3/5 (60%) patients during parotidectomy (Table 2; Fig. 3).

Declarations

Discussion Facial nerve paralysis is a daunting potential complication of parotid surgery. It can significantly impact the quality of life of the patient and also has medico-legal implications for the surgeon. Various studies have reported the incidence of transient facial nerve palsy up to 50% and permanent facial palsy up to 17% after parotidectomy [5]. It is difficult to predict the precise location of facial nerve during parotidectomy during surgery. The surgeons use a system of reference landmarks that help them to predict with safe margin the location of facial nerve. The most frequently and time-tested used landmarks for intra-operative localization of facial nerve are the retro-mandibular vein [6], the tympanomastoid fissure [7], the tragal pointer [8], the posterior belly of the digastric muscle, and styloid process of the temporal bone [9]. These landmarks are difficult to identify during surgery due to their deep location, small size, or variant anatomy in some clinical situations and there is a need to identify additional reference points that can be more useful in difficult situations during parotidectomy [10].

Our technique of identifying trunk of the facial nerve using the mastoid tip-tympanomastoid fissure line (TMS-MP) as reference landmarks has been found to be very useful. The average length of the tympanomastoid line was found to be 17.24 mm (12–26 mm) and in clinical dissection was 18.6 mm (15–22 mm). The facial nerve trunk is found to transect this line at a distance of 8–10 mm from the mastoid tip consistently in 12/14 (85%) cadaveric dissections and in three out of five (60%) clinical dissections during parotidectomy. The advantage of this reference line is that it connects two bony reference landmarks which is less likely to be displaced and this distance is found to be relatively consistent in most dissections.

We found that in 12/14 cadaver dissections, the facial nerve trunk was found to bifurcate after crossing this TMS-MP line, and in 2 cadaver dissections, we found the facial nerve trunk to bifurcate before crossing this TMS-MP line, whilst in **clinical setting** only in 1/5 cases we found the facial nerve trunk to bifurcate before crossing the TMS-MP line. Difficulties in identifying the facial nerve trunk were encountered in situation where the nerve was found to bifurcate before crossing the

TMS-MP line and in such situations other landmarks were also used to identify the facial nerve. It is also important to look for the facial nerve trunk at appropriate depth. The imaginary line is made at the level of the insertion of the post belly of digastric process to the mastoid tip. Plane of dissection is important to identify the facial nerve and we will miss the nerve if we are superficial or deep to this plane.

In the clinical setting, we may encounter bleeding from the posterior auricular artery and its branches which lies distance of 10.42 mm (7–13 mm) from the mastoid tip and 7 mm from the facial nerve trunk. This bleeding can be severe and surgeon may injure the facial nerve trunk inadvertently. We understand that the roles of the posterior belly of the digastric muscle and tympanomastoid suture are consistent landmarks to be used for the identification of facial nerve trunk during parotid surgery. However, our technique advocates tympanomastoid suture-mastoid tip (TMS-MP) line can be used as an additional landmark to identify the trunk of the facial nerve during parotidectomy.

This technique makes identification of facial nerve trunk easier and also faster, though our experience in [clinical setting](#) is small and further larger studies with greater sample and different operating settings are needed to further validate our reference landmark.

This material has never been published and is not currently under evaluation in any other peer-reviewed publication.

Competing Interests The authors declare no competing interests.

References

1. Kuriyama T, Kawata R, Higashino M et al (2019) Recurrent benign pleomorphic adenoma of the parotid gland: facial nerve identification and risk factors for facial nerve paralysis at reoperation. *Auris Nasus Larynx* 46:779–784
2. Saha S, Pal S, Sengupta M et al (2014) Identification of facial nerve during parotidectomy: a combined anatomical & surgical study. *Indian J Otolaryngol Head Neck Surg* 66:63–68
3. Pather N, Osman M (2006) Landmarks of the facial nerve: implications for parotidectomy. *Surg Radiol Anat* 28(2):170–175
4. Sood AJ, Houlton JJ, Nguyen SA, Gillespie MB (2015) Facial nerve monitoring during parotidectomy: a systematic review and metaanalysis. *Otolaryngol Head Neck Surg* 152(4):631–637
5. Kopuz C, Ilgi S, Yavuz S, Onderoglu S (1995) Morphology of the retromandibular vein in relation to the facial nerve in the parotid gland. *Acta Anat (Basel)* 152:66–68
6. Hogg SP, Katz RC (1958) Surgical exposure of the facial nerve. *Arch Otolaryngol* 67:560–561. Page 11 of 19 Skull Base For Peer Review
7. Robertson MS, Blake P (1984) A method of using the tympanomastoid fissure to find the facial nerve at parotidectomy. *Aust NZJ Surg* 54:369–373
8. Deru JA, van Benthem PP, Bleys RL, Lubsen H, Hordijk GJ (2001) Landmarks for parotid gland surgery. *J Laryngol Otol* 115:122–125
9. 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
10. Pereira JA, Meri A, Potau JM, Prats-Galino A, Sancho JJ, Sitges-Serra A (2004) A simple method for safe identification of the facial nerve using palpable landmarks. *Arch Surg* 139(7):745–747

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.