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Exposure of the facial nerve within the facial canal: A technical report☆

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A R T I C L E I N F O

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A B S T R A C T

Background: The facial canal lies in the petrous part of the temporal bone and contains the facial nerve. The facial canal and nerve are divided into three segments: the labyrinthine, tympanic and mastoid segments, which travel in different planes. These segments are closely related to the structures of the middle- and inner-ear, so pathology of the intracranial facial nerve is often evident in cochlear implant users. The facial canal and nerve are of great concern to otologists during electrode placement for a cochlear implant, as any damage to the nerve may result in untreatable facial paralysis. Few studies have been conducted on a cadaveric population, with most carried out on CT images of the cochlea and facial nerve. Thus, there is no standard or straightforward methodology to visualise the facial canal and nerve directly. We propose a detailed dissection technique to bridge this gap in research.

Method: Four cadavers were used, and both the left and right facial canals were dissected. After the exposure of the cranial floor, the internal acoustic meatus and the facial canal were dissected out using drilling tools to remove the surrounding temporal bone and expose the facial nerve within the facial canal.

Results: This technique allowed for morphometric analyses and observations of the facial canal in relation to the middle- and inner-ear.

Conclusion: Knowledge of the facial canal may assist otosurgeons in safely dissecting the region without injuring vital structures within this area.

1. Introduction

The facial nerve, the nerve for facial expression, is the seventh cranial nerve (CN VII) originating at the brainstem. The facial nerve has a rather complex interosseous path within the temporal bone – travelling through the internal acoustic meatus and the facial canal [1,2]. Along this pathway, the nerve gives off several motor branches to supply the muscles of the face, parasympathetic secretomotor fibres to several glands (lacrimal, submandibular and sublingual salivary glands) and taste (special sensations) to the tongue, thus classifying it as a mixed nerve [1,2].

The intratemporal part of the facial nerve, can be divided into the portion travelling through the internal acoustic meatus (intracanalicular portion) and the portion within the facial canal [3]. The facial canal demarcates an integral part of the facial nerve as the nerve gives off most of its branches within the canal [3–5]. The facial canal has two distinctive turns (genu) in its course, and as a result, the facial canal and facial nerve running within it, can be subdivided into three segments, namely, the labyrinthine, the tympanic, and the mastoid segments. The geniculate ganglion is located at the first genu between the labyrinthine and tympanic segments and the second genu is located between the tympanic and mastoid segments [3–5].

The labyrinthine and tympanic segments travel along a horizontal plane, with the mastoid segment on a transverse plane. This makes it challenging to identify the entire length of the facial nerve lying within the facial canal in two dimensions [3,6–8]. Additionally, there is a lack of cadaveric studies on the intracranial portion of the facial nerve, and no references could be found in the literature to document a detailed method for dissection. The few studies that have reviewed the facial canal through dissection provide vague references to a method that is not repeatable [4,9]. One researcher elaborates on identifiable bony landmarks [9], though there is still a lack of information such as the

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Table 1
A comparison of the morphometry of the facial canal from the current study to that available in the literature, reported as the mean (±SD).

Study	n	LS (mm)		TS (mm)		MS (mm)		Angle 1 (degrees)	Angle 2 (degrees)
		l	w	*l*	w	*l*	w		
[9]	25	–	–	9.28 (±1.13)	–	13.7 (±1.45)	–	–	107.6 (±8.79)
[4]	35	3.14–5.27[a]	–	10.25 (±0.75)	–	13.78 (±1.12)	–	48–86[a]	–
[18]	50	4.1 (±0.6)	–	9.34 (±1.12)	–	12.8 (±1.8)	–	–	–
[8]	80	3.06 (±1.35)	0.91 (±0.41)	10.23 (±2.14)	0.94 (±0.33)	14.64 (±3.82)	1.58 (±0.51)	63.1 (±23.6)	–
Current study	8	L: 3.86 (±0.26)[b] R: 3.02 (±0.43)[b]	2.80 (±0.98)	10.88 (±0.95)	1.46 (±0.28)	12.74 (±0.88)	1.56 (±0.11)	63.44 (±16.22)	134.05 (±6.05)

l = length, L = left, R = right, SD = standard deviation, w = width.
[a] only the range was provided in the study.
[b] $p < 0.05$; thus, data could not be collated.

it is important to note that only the external morphometric properties of the canal can be analysed with this method. A full retrograde dissection would be possible using the new technique described in this study. However, it should be highlighted that the tympanic segment would have a slightly superior course, or inclination from the second genu in a retrograde dissection. Identifying the greater petrosal nerve and, thereby, the geniculate ganglion would still be a beneficial landmark to the dissector in identifying the origin of the tympanic segment and having a better understanding of the direction it is coming from.

The disadvantage of this technique is that it is destructive to the bone surrounding the facial canal, and thus, this method is solely for cadaveric use. If a comparative analysis between imaging modalities and this dissection technique were to be conducted, it would be advisable to scan the head first and then proceed with the dissection. Lastly, the dissection is time-consuming and, on average takes 1.5 h to complete per temporal bone. The quality of the facial canal exposure depends on the care and skill with which the dissection is conducted, and with more experience, the time of completion may be reduced.

Few limitations have been identified for this study. In terms of the dissection method, the lack of a dissection microscope for improved visualisation could affect the precision of the dissection as well as the time of completion. A further limitation is that the statistical analysis was performed on a small sample size; thus, a greater sample size would be required to quantify variability accurately.

With the increasing need to study the facial nerve for the application in three-dimensional computational models of the cochlea, and research into the incidence of facial nerve stimulation and the contribution of the facial nerve to resultant Bell's Palsy in COVID-19 incidences, the benefits of this technique to analyse the morphological properties of the facial nerve outweigh the minor challenges presented. Furthermore, this effective method is accessible to any laboratory with the basic equipment used in this study, unlike the equipment or scanning methods described by other studies [4,6,8,9].

In conclusion, this dissection technique was successful in exposing and preserving the facial nerve using standard equipment and may prove useful to anyone who requires a three-dimensional understanding of the facial nerve's course in relation to the middle and inner ear that is otherwise difficult to capture in textbooks.

Ethical declaration

Ethical clearance for the use of cadaver tissue was obtained from the Faculty of Health Sciences Research Ethics Committee (545/2021). All dissections, measurements, and observations were in accordance with the Declaration of Helsinki.

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CRediT authorship contribution statement

Shavana Govender: Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Tania Hanekom:** Writing – review & editing, Supervision, Funding acquisition. **Rene Human-Baron:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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