Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/bsg07y10

A NOVEL CLINICAL LANDMARK FOR JACOBSON'S NERVE: RAO'S POINTER

Dr. Santhanakrishnan Kaliavaradan[1], Dr. Poornima S. Bhat[2], Dr. Satyananda Rao Sutrave[3], Dr. Nisha M.[4*], Dr. Rahul Panwar[5], Dr. Shwetank Manjul[6]

[1]Professor, Department of ENT, Varun Arjun Medical College & Rohilkhand Hospital, Shahjhanpur, Uttar Pradesh, India.
[2]Associate Professor, Department of ENT, Varun Arjun Medical College & Rohilkhand Hospital, Shahjhanpur, Uttar Pradesh, India.
[3]Consultant ENT Surgeon, Shweta ENT Clinic, Bellary, Karnataka, India.
[4*]Assistant Professor, Department of ENT, AVMCH, Pondicherry, India.
[5]Postgraduate Resident, Department of ENT, Varun Arjun Medical College & Rohilkhand Hospital, Shahjhanpur, Uttar Pradesh, India.
[6]Postgraduate Resident, Department of ENT, Varun Arjun Medical College & Rohilkhand Hospital, Shahjhanpur, Uttar Pradesh, India.

***Corresponding Author:** Dr. Nisha M
*Assistant Professor, Department of ENT, AVMCH, Pondicherry, India.

ABSTRACT

Background: The tympanic branch of Glossopharyngeal nerve, also called as Jacobson nerve, is a useful landmark in identifying the anterior and posterior parts of the basal segment of the scala tympani of particular relevance in cochlear implantation. It is also sectioned in cases of Frey's syndrome. This study was conducted to assess the usefulness of handle of malleus (Rao' pointer) as a novel landmark for the identification of Jacobson's nerve over the promontory.

Methods: This prospective, cross- sectional observational study included the patients in the age group of 12- 70 years, with Chronic Otitis Media, inactive mucosal type with large to subtotal central perforation. Findings of were noted using otoscope and endoscope with special attention to Jacobson's nerve and its relationship with the Handle of malleus. The position of the nerve was marked, by plotting the otoendoscopy image to an imaginary clock position by considering the lateral process of malleus at 12' O clock position. Statistical analysis was performed using

Results: Out of the total 162 tympanic membrane perforations examined, in 110 patients with COM, the following findings were noted. In 11(6.69%) ears, Jacobson nerve was not visible on the promontory. In 143(88.27%) ears, Jacobson's nerve was visible on the promontory, parallel to the handle of malleus, along the imaginary 6'0 clock position (Rao's Pointer**).** In rest 8(4.94%) cases, it was slightly posterior, between the 6 o' clock - 7 o' clock on left side and 6 o' clock to 5 o' clock on right side, respectively.

Conclusion: Rao's pointer can be used as a valuable clinical landmark to identify this nerve in majority of the patients in various ear surgeries and also in undergraduate and postgraduate training. Further studies with intraoperative correlations and exact distance measurements are recommended.

Keywords: Jacobson's nerve; Tympanic branch of glossopharyngeal nerve; Frey's syndrome; Cochlear implant; landmark; Handle of malleus

INTRODUCTION

The Jacobson nerve, also known as the tympanic nerve, is a branch of the glossopharyngeal nerve that provides sensory and parasympathetic innervation to the middle ear, mastoid cells, Eustachian tube, and parotid gland. The parasympathetic fibers leave the plexus as the lesser petrosal nerve. The nerve is named after Ludwig Levin Jacobson**,** (1783-1843) a Danish anatomist.[1]

In the majority of cases the tympanic nerve arises from the inferior ganglion of the glossopharyngeal nerve traversing through the tympanic canaliculus into the middle ear. On the promontory it coalesces with sympathetic fibres from the carotid chain forming the tympanic plexus which has individual variability. Functionally, as well as giving off parasympathetic fibres to the parotid gland via the lesser petrosal nerve, it is a useful anatomical landmark for cochlear implantation. The surgical importance of the tympanic nerve is not only restricted to middle ear surgery; it also extends to salivary gland disorders.[2] In an anatomical study of the tympanic nerve, Tekdemir et al. examined ninety-six cadaveric temporal bones and reported that the nerve originates from the inferior ganglion, situated at an average distance of 11.3 mm from the genu (the knee-like bend). It consistently makes a 90-degree angle inferiorly at the genu as it proceeds toward the tympanic canaliculus.[3] The tympanic nerve and the inferior tympanic artery pass through the inferior tympanic canaliculus, a bony passage situated between the internal carotid foramen medially and the internal jugular foramen laterally. This canaliculus is located medial to the styloid process and the stylomastoid foramen.[4-7] The tympanic nerve emerges on the promontory of the middle ear, on its medial wall and anterior to the round window. The nerve divides on the promontory forming an anterior branch which courses up towards the Eustachian tube and a posterior branch that skirts the rim of the round window.[8,9] The two divisions of the tympanic nerve are often found running parallel to each other on the promontory.[10] On average the distance between Jacobson's nerve and the lip of round window niche is 2.1 mm with a range of zero to 3.2 mm.[11,12] It acts as a useful marker in identifying the anterior and posterior parts of the basal segment of the scala tympani of particular relevance in cochlear implantation.[4,11,13] Interruption of the efferent neuronal pathway at the level of the middle ear by sectioning the tympanic nerve as a theoretical approach to the management of Frey's syndrome. the procedure was later popularised by Golding-Wood who used it for the successful treatment of Frey's syndrome coining the term tympanic neurectomy to describe it.[14] Tympanic neurectomy has been considered useful in the management of otalgia with the proviso that other important causes of otalgia have been excluded.[15] Later Friedman added other important indications for tympanic neurectomy including parotid duct stenosis, salivary duct dilation (sialectasis) and parotid salivary fistula.[16] In more recent years the tympanic nerve has gained favour as a useful anatomical landmark in cochlear implantation where the classical approach to the scala tympani through the round window niche by way of facial recess is impossible. Successful intubation of the scala tympani in such instances utilises the anatomical proximity of the tympanic nerve to the round window and the cochlea.[4,11] It was noted during the vast clinical experience of the senior author (Dr. SRS), a positive correlation was noted between the Jacobson's nerve position over promontory and the Handle of Malleus, both during clinical examination as well as during middle ear surgeries. As per our systematic literature review, scarcity of literature was noted providing a useful and reliable clinical landmark for the Jacobson's nerve. The aim of this study was to evaluate the usefulness of the handle of malleus (Rao' pointer) as a landmark for the identification of Jacobson's nerve over the promontary. This novel landmark can help in locating the Jacobson's nerve for various indications, including difficult cochlear implant cases.

MATERIALS AND METHODS

This cross- sectional observational study was conducted by the Department of ENT of a tertiary care medical college & hospital, in the northern part of India, from April 2024 to September 2024, for a period of six months, after obtaining the clearance from the Institutional Ethics Committee. All the patients, from 12- 70 years, with Chronic otitis media, inactive mucosal type, with large to subtotal central perforation, who gave consent to participate in the study were included in the study.

Patients with active ear discharge, edematous middle ear mucosa, previous middle ear surgeries, acute otitis exerna, eroded handle of malleus and previous history of vasovagal attacks during ear cleaning/examination were excluded from the study.

After obtaining a written, informed consent, detailed history was collected and the patients were examined thoroughly using Otoscope followed by 0 degree, Hopkins rod endoscope. Findings of the Endoscopy were noted, with special attention to Jacobson's nerve and its relationship with the Handle of malleus. The position of the nerve was marked, by plotting the otoendoscopy image to an imaginary clock position by considering the lateral process of malleus at 12' O clock position**. (Figure 1)** And the Jacobson's nerve was noted as visible/ not visible and when visible, its position with respect to handle of malleus and Clock positions was noted. Sociodemographic details like age, gender, occupation was noted. Collected data was entered into the case proforma, and Microsoft Excel Sheets and Statistical analysis was done using EpiInfo 7.2.6.0 software.

RESULTS

110 patients were included in this study, who met the inclusion and exclusion criteria. Patients belonged to both the genders. Out of 110 patients, 62 (56.36%) were males and 48 (43.63%) were females. Out of the 110 cases, 52 (47.27%) patients had bilateral large/subtotal tympanic membrane perforations, amounting to 104 tympanic membranes. Rest of the cases 58(52.72%) patients had unilateral TM subtotal perforations. Out of these, 32 (29.1%) were right side and 26 (23.63%) were left side ears.

Out of the total 162 tympanic membrane perforations examined, the following findings were noted. **(Table 1)** In 11(6.69%) ears, Jacobson nerve was not visible on the promontory. In 143(88.27%) ears, Jacobson's nerve was visible on the promontory, parallel to the handle of malleus, along the imaginary 6'0 clock position (Rao's Pointer**) (Figure 2).** In rest 8(4.94%) cases, it was slightly posterior, between the 6 o' clock - 7 o' clock on left side and 6 o' clock to 5 o' clock on right side, respectively.

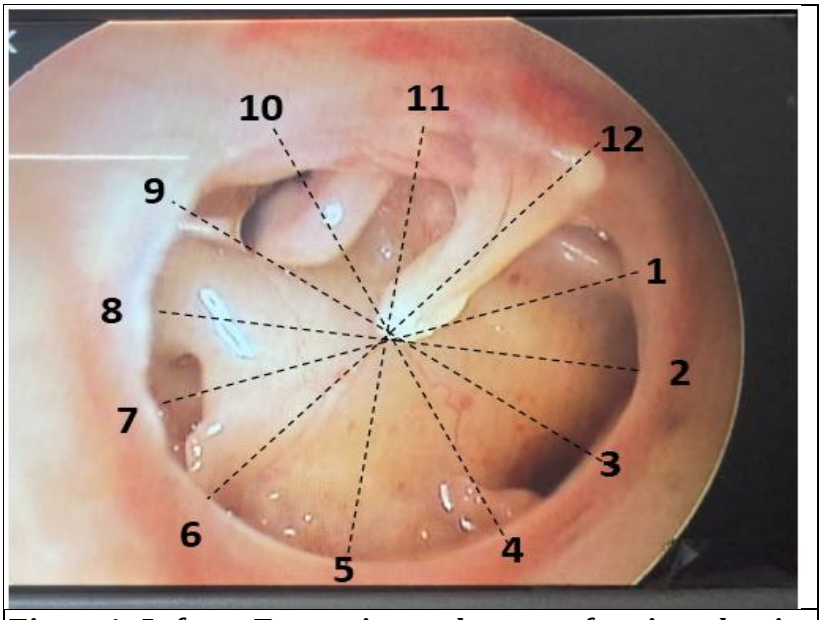

Figure 1: Left ear Tympanic membrane perforation, showing theplotting of imaginary lines over the tympanic membrane similar to clock positions., starting from lateral process of malleus at 12' O clock position

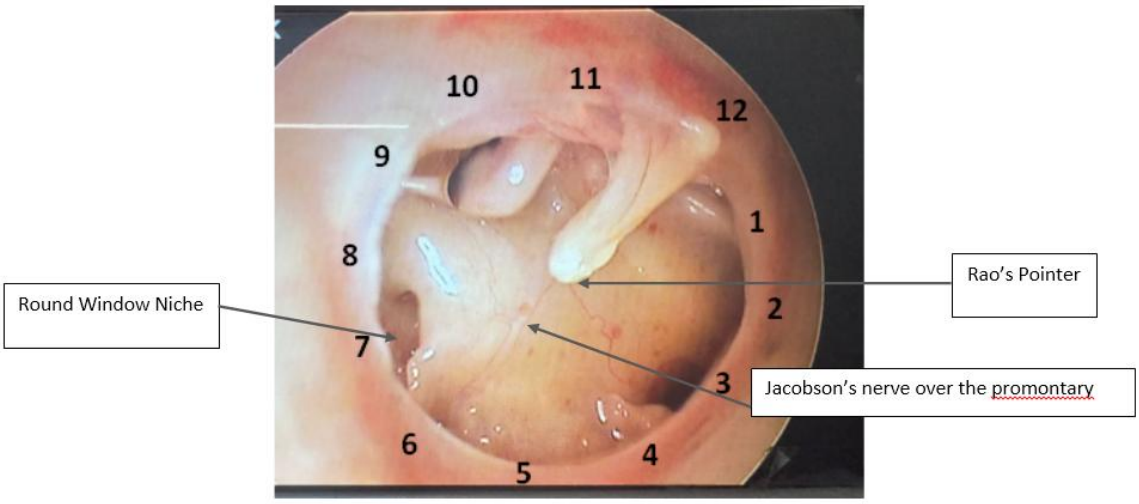

Figure 2: Handle of Malleus as Rao's Pointer, pointing towards the Jacobson's nerve at 6' o Clock position

Position of Jacobson's nerve using Rao's pointer	**Number (%)**
Not visualized	11(6.69%)
Visualized at 6'o clock position	143(88.27%)
Visualized between 6-7' o clock(Right side) or 5-6'o clock (Left side)	8(4.94%)
Total	162 (100%)

Table 1: Identification of position of Jacobson's nerve, with respect to Rao's pointer

DISCUSSION

Although no clinical studies have been conducted in the past correlating the postion of Handle of malleus with the Jacobson's nerve, several anatomical studies have been published in the literature, studying the course of this nerve.

Porto et al. in their a study of 20 specimens and Tekdemir et al. in a study of 96 specimens, both observed that the tympanic nerve was fully encased in bone along its entire length in 5% and 20% of their specimens, respectively.[3,6] In a study of 50 temporal bones, Donaldson found that in 6% of the specimens, the tympanic nerve traversed part or all of its middle ear course beneath the bone of the middle ear. Additionally, in these cases, the hypotympanic branch was absent.Another unusual finding was a unilateral duplication of the tympanic nerve.[7]

An aberrant course of the tympanic nerve where it coursed anteromedially within the bony septum before entering the middle ear anteriorly accompanied by the sympathetic branch from the internal carotid sympathetic plexus was reported in one of the specimens of a study.[6] These findings are similar to the findings of our study, in which among the total 162 middle ears examined, Jacobsn's nerve could not be identified over the promontory in 11(6.8%) cases. This may be attributed to the nerve being embedded deep underneath the bone over the promontory. Although we did not find any duplication of the nerve clinically over the promontory among the examined cases.

The round window niche is commonly used as a primary reference for cochleostomy during cochlear implantation, although there are instances where the niche is not visible. In such cases, Jacobson's nerve can serve as an alternative guide. The average distance from Jacobson's nerve to the edge of the round window niche is 2.1 mm, with a range from 0 to 3.2 mm. These distances were not found to be clearly related to either mastoid size or the orientation of the manubrium of the malleus. When the main trunk of Jacobson's nerve is visible on the promontory (which occurs in ≥95% of cases), it is within 3.3 mm of the round window niche with 95% certainty. Furthermore, the distances from Jacobson's nerve to the round window niche do not show any correlation with the

orientation of the manubrium as seen through the external ear canal or the degree of mastoid pneumatization.[11]

Although the tympanic nerve and plexus are typically located in open grooves (submucosally) on the promontory, in about 20% of cases, its branches are encased in bony canals of varying depths, which can make them challenging to identify.[12]

In our study, although the exact measurements were not performed, similar findings were noted, where in143 (88.27%) ears, Jacobson's nerve was visible on the promontory, along the direction of the handle of malleus, correlating with the imaginary 6'0 clock position (Rao's Pointer). In 8 (4.94%) cases, it was slightly posterior, between the 6 o' clock - 7 o' clock on left side and 6 o' clock to 5 o' clock on right side, respectively.

In another study involving 150 patients undergoing cochlear implantation in a tertiary medical center, during surgery, the round window electrode insertion was marked using 5 surgical landmarks: oval window, pyramid, fustis, round window membrane, and arborization of intracochlear blood vessels. They concluded that the round window electrode insertion can be precisely performed using these 5 surgical landmarks in straight forwards cases as well as in difficult cases.[17] As Jacobson's nerve was almost consistently found on the promontory, at 6'o clock position, in majority of the ears (88.27%) and between 6- 7'o clock position(right side) or 5-6' O clock position (Left ear) in 4.94% cases, with respect to the handle of maleus, this Rao's pointer can serve as an additional useful landmark during cochlear implantation.

Recent reports have highlighted instances of incorrect electrode array insertion into the hypotympanic or infralabyrinthine cell tracts. In these cases, the round window niche may be positioned posteriorly, obscured by bony growth, or sclerosed at the cochlear basal turn. As a result, the success of scala tympani intubation is largely dependent on the position of the round window niche and the openness of the basal cochlear turn. The Jacobson's nerve (JN) landmark has been utilized to guide cochleostomy, either by drilling anteriorly or directly through the nerve.[4] Rao's pointer can be a valuable clinical marker to identify Jacobson's nerve in such difficult cases of Cochlear implantation.

This pointer can also be used in various other indications of tympanic neurectomy. This can also be used widely in medical education for teaching the Undergraduate and post graduate students, about the middle ear anatomy and identification of Jacobson's nerve in cases of COM, as it is a common practice to describe the TM perforations, with respect to clock positions.

Merits of this study are that it is a novel clinical landmark for the Jacobson's nerve, being documented for the first time, which can be easily applied either during middle ear surgeries or difficult cochlear implantation procedures, as well as easily can be utilized in training of undergraduate and postgraduate medical students.

Limitation of this study is lack of exact measurements of the distance of the nerve. Further studies, correlating the intraoperative identification of Jacobson's nerve using Rao's pointer are recommended for more precise calculation of the exact distance of the Jacobson's nerve from the round window niche.

CONCLUSION

Jacobson's nerve is an important nerve in the middle ear, used in various procedures of tympanic neurectomy and also increasingly as a landmark in difficult cases of cochlear implantation. Rao's pointer can be used as a valuable clinical landmark to identify this nerve in majority of the cases and also in undergraduate and postgraduate training. Further studies with intraoperative correlations and exact distance measurements are recommended.

Ethical Considerations

A written, informed consent was obtained from all the participants. Institutional Ethics Committee approval was obtained before commencement of the study (IEC/VAMC/OTO/003/Mar2024).

Conflicts of Interest
All the authors declare that there are no conflicts of interest.

Funding
This study did not receive any grants or funds.

REFERENCE
[1] Lekakis G. Philipp Friedrich Arnold, Ludvig Levin Jacobson and Their Contribution to Head and Neck Anatomy. J Laryngol Otol 2003;117(1):28-31.
[2] Kanzara T, Hall A, Virk JS, Leung B, Singh A. Clinical anatomy of the tympanic nerve: A review. World J Otorhinolaryngol 2014;4(4):17-22.
[3] Tekdemir I, Aslan A, Tüccar E, et al. An anatomical study of the tympanic branch of the glossopharyngeal nerve (nerve of Jacobson). Ann Anat 1998;180:349-52.
[4] Goravalingappa R. Cochlear implant electrode insertion: Jacobson's nerve, a useful anatomical landmark. Indian J Otolaryngol Head Neck Surg 2002;54:70-3.
[5] Ozveren MF, Türe U. The microsurgical anatomy of the glossopharyngeal nerve with respect to the jugular foramen lesions. Neurosurg Focus 2004;17:E3.
[6] Porto AF, Whicker J, Proud GO. An anatomic study of the hypotympanic branch of Jacobson's nerve. Laryngoscope 1978;88:56-60.
[7] Donaldson I. Surgical anatomy of the tympanic nerve. J Laryngol Otol 1980;94:163-8.
[8] Townsend GL, Morimoto AM, Kralemann H. Management of sialorrhea in mentally retarded patients by transtympanic neurectomy. Mayo Clin Proc 1973;48:776-9.
[9] Sinha P Successful treatment of parotid fistula with tympanic neurectomy. Indian J Otolaryngol Head Neck Surg 2008;60:227-30.
[10] Frenckner P. Observations on anatomy of the tympanic plexus and technique of tympanosympathectomy. AMA Arch Otolaryngol 1951;54:347-55.
[11] Todd NW. Jacobson's nerve clues to the round window niche. Cochlear Implants Int 2009;10:63-9.
[12] Rosen S. Tic douloureux of the chorda tympani. AMA Arch Neurol Psychiatry 1953;69:375-37
[13] Schuknecht HF. Pathology of the Ear. 2nd edn. Philadelphia: Lea and Febiger 1993:40-1.
[14] Golding-Wood P. Tympanic neurectomy. J Laryngol Otol 1962;76:688-93
[15] Cook JA, Irving RM. Role of tympanic neurectomy in otalgia. J Laryngol Otol 1990;104:114-7.
[16] Friedman WH, Swerdlow RS, Pomarico JM. Tympanic neurectomy: a review and an additional indication for this procedure. Laryngoscope 1974;84:568-77.
[17] Fiky LE, Mostafa BE, Ibrahim SA, et al. Landmarks for Proper Round Window Electrode Insertion in Cochlear Implantation. J Int Adv Otol 2022;18(3):210-3.