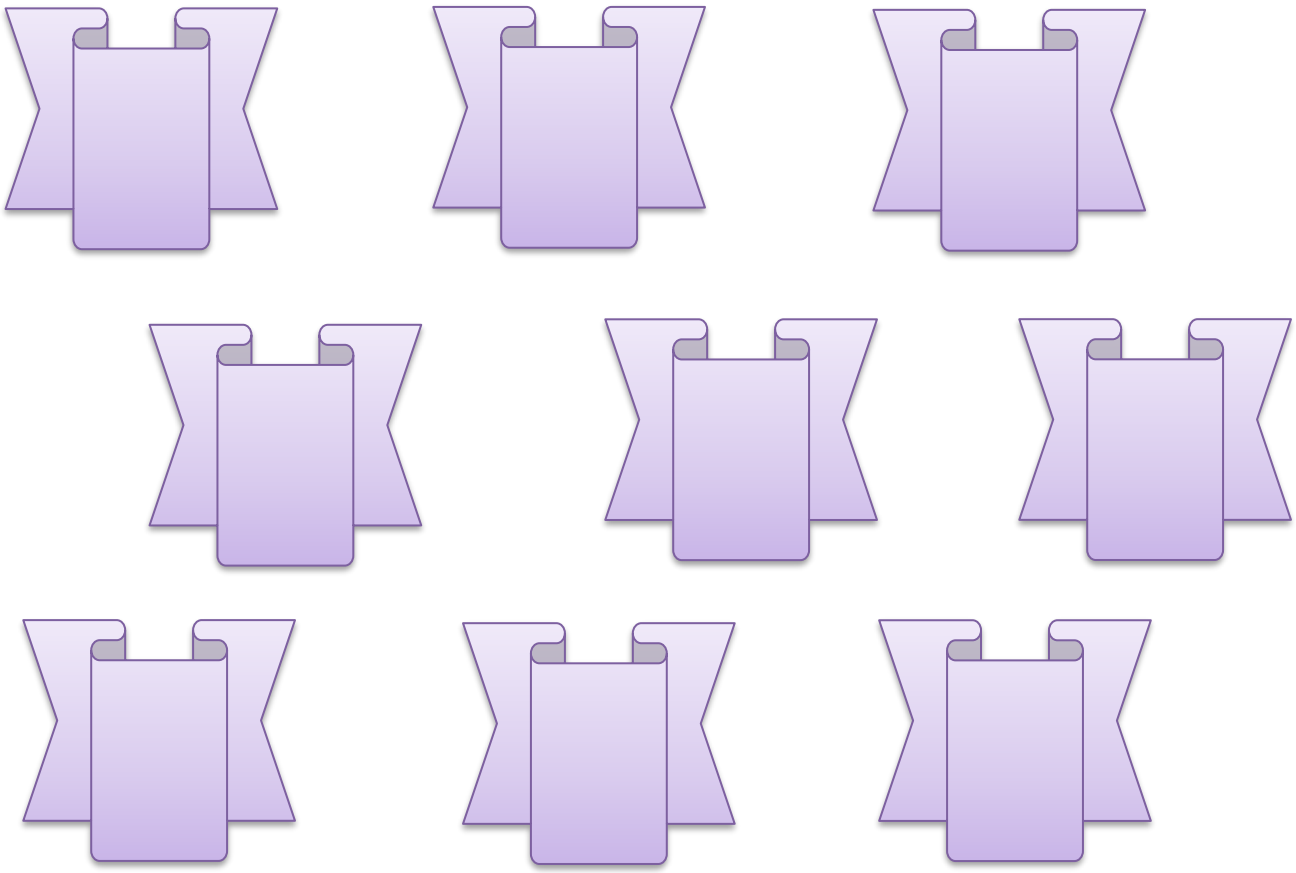
International Journal of Medical Arts

Volume 5, Issue 9, September 2023

https://ijma.journals.ekb.eg/



Print ISSN: 2636-4174

Online ISSN: 2682-3780

Available online at Journal Website
https://ijma.journals.ekb.eg/
Main Subject [Otorhinolaryngology]

Original Article

Chorda Tympani Nerve Injury during Tympanoplasty: Comparison of Endoscopic and Microscopic Methods

Mahmoud Allam *[1], Atef Abd-Allah Elmaraghy [2], Ahmed Hassan Mohamed [2]

[1] Department of Otorhinolaryngology, Hearing and Speech institute, Giza, Egypt

[2] Department of Otorhinolaryngology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Article information

Received: 07-10-2023

Accepted: 10-11-2023

DOI: 10.21608/IJMA.2023.241287.1830.

*Corresponding author

Email: mahmoudelnaghi28@gmail.com

Citation: Allam M, Elmaraghy AA, Mohamed AH. Chorda Tympani Nerve Injury during Tympanoplasty: Comparison of Endoscopic and Microscopic Methods. IJMA 2023 September; 5 [9]: 3663-3669. doi: 10.21608/IJMA.2023.241287.1830.

ABSTRACT

Background: The chorda tympani is frequently harmed during middle ear surgery. Surgery-related chorda tympani injury is rarely associated with impaired taste perception in patients. The use of microscopes marked the beginning of modern tympanoplasty techniques, and the endoscopic tympanoplasty approach is now described in terms of minimally invasive surgery.

Aim of the Study: The aim of the current study is to compare chorda tympani nerve [CTN] injuries occurring because of tympanoplasty performed using microscopic and endoscopic methods.

Patients and Methods: This prospective study was carried out on 50 patients from Al-Azhar University hospitals who suffered from chronic suppurative otitis media [safe type]. Patients were randomized equally using opaque sealed envelopes into two groups. Group A: 25 patients underwent transcanal endoscopic tympanoplasty with elevation of the tympamomeatal flap. Group B: 25 patients underwent microscopic tympanoplasty by postauricular incision.

Results: Chorda tympani nerve was with no injury in 24 [96%] cases in group A and 14 [56%] cases in group B, while 1 [4%] case in group A and 8 [32%] cases in group B had stretched chorda tympani nerve and 3 [12%] cases in group B had transected chorda tympani nerve. The Chorda tympani nerve was significantly less injury, less stretched in group A than group B, and more transected in group B than group A [P value=0.012].

Conclusion: In patients undergoing tympanoplasty, Endoscopic ear surgery provides superior visualization, reduces the necessity for extensive manipulation of the chorda tympani, and subsequently lowers the occurrence of CTN injury compared to microscopic ear surgery.

Keywords: Chorda tympani; Nerve Injury; Tympanoplasty.

INTRODUCTION

The chorda tympani transport specialized visceral afferent fibers that transmit taste signals from the tip of the tongue. Sublingual and submandibular glands are innervated by parasympathetic general visceral efferent fibers that travel from the ganglion of the submandibular nerve [1].

Immediately after branching off the facial nerve, the chorda tympani run through the posterior colliculus. After that, it moves over the tympanic membrane in the middle ear [2]. The chorda tympani pass through the space between the malleus and the incus, emerging again in front of the middle ear. It then travels medially through the petrotympanic fissure to the temporomandibular joint. After leaving the petrotympanic fissure in the infratemporal fossa, the chorda tympani connect with the lingual nerve [3].

The chorda tympani is frequently harmed during middle ear surgery. It is important to highlight, however, that chorda tympani injury typically has minimal long-term clinical significance. Consequently, CTN injury is not life-threatening and usually not permanent, however stretching or disconnection of the chorda tympani nerve during otologic surgery can lead to taste and salivary dysfunction, which affects patients' quality of life and therefore every effort should be made to prevent its injury [4, 5].

Surgery-related chorda tympani injury is rarely associated with impaired taste perception in patients. In addition, anesthesia of the chorda tympani nerve has no negative effects on taste, indicating that the taste system can make up for any input losses. Some cells in the nucleus of the tractus solitarius are thought to be disinhibited when the chorda tympani innervation is eliminated, leading to the phenomenon of taste constancy. This line of reasoning elucidates a study that demonstrated an augmentation in the perceived intensity of quinine on the circumvallate papillae when the chorda tympani nerve was subjected to anesthesia. This finding suggests that neuroplasticity may serve as a compensatory mechanism for the partial taste impairment resulting from chorda tympani nerve loss [6, 7].

The use of microscopes marked the beginning of modern tympanoplasty techniques, and the endoscopic tympanoplasty approach is now described in terms of minimally invasive surgery [8].

The aim of the current study is to compare chorda tympani nerve [CTN] injuries occurring because of tympanoplasty performed using microscopic and endoscopic methods.

PATIENTS AND METHODS

This prospective study was carried out on 50 patients from Al-Azhar University hospitals who suffered from chronic suppurative otitis media [safe type]. The duration of the study was 18 months, from March 2022 to September 2023. The study was approved by the Ethics Committee of the Faculty of Medicine, Al-Azhar University, Egypt. Informed written consent was given from relatives of children or adult patient. There were adequate provisions to maintain the privacy of participants and the confidentiality of the data. All data of patients was confidential with secret codes and private files for each patient, all given data were used for the current medical research only. Any unexpected risks that appeared during the course of the research were cleared to participants and the ethical committee on time. Patients were randomized equally using opaque sealed envelopes into two groups. Group A: 25 patients underwent transcanal endoscopic tympanoplasty with elevation of the tympano-meatal flap. Group B: 25 patients underwent microscopic tympanoplasty by postauricular incision. We included the patients according to the following criteria:

The Inclusion criteria were: Age: ranged from 12 to 45 years, Sex: both males and females were included, and Safe types of chronic suppurative otitis media with small, medium, and large perforations were included in the study.

The Exclusion criteria were: Patients with changes in taste sensation, unsafe type of chronic suppurative otitis media, previous ear surgery, diabetes mellitus, superimposed otomycosis and associated otitis externa

Data collection: All patients underwent the following; history taking, general examination, local nasal examination, Ear examination by otoscope and ear endoscope, and Oral cavity examination; Taste tests [regional chemical taste test and subjective evaluation] were performed

one week preoperatively and postoperatively [2-4 weeks and 6-9 months after tympanoplasty], routine laboratory investigations [complete blood count [CBC] , bleeding profile which includes prothrombin concentration [PC], prothrombin time [PT] and activated partial thromboplastin time [APTT], hepatitis markers, renal functions and random blood sugar], and Pure tone audiometry [PTA].

Surgical technique

The tympanoplasty procedures were performed under general anesthesia. In group A endoscopic approach an endoscopic system and rigid endoscopes were used. Following the de-epithelialization procedure on the margins of the perforation, a lateral incision was performed in the posterior and inferior regions of the external auditory canal, about 6 to 8 mm away from the tympanic membrane.

A tympanometry flap was elevated, and the middle ear cavity was visualized. The malleus peeled off the TM. A chondroperichondrial graft was extracted from the tragus and subsequently manipulated by stretching and pressing techniques. The resulting graft, referred to as the "underlay," was then positioned at a medial location relative to the malleus. Gel foam sponges were introduced into both the middle and outer ear canal [Figure 1].

In group B microscopic approach: The postauricular approach was used for tympanoplasty. The procedure was done by making a semicircular incision roughly one cm posterior to the auricle skin fold; the ear was folded anteriorly. This incision was carried down through the musculoperiosteum creating a musculoperiosteal flap, which was elevated towards the membranous ear canal, thereby entering the bony ear canal. The skin along the posterior aspect of the bony canal was elevated until we reached the tympanometry flap incisions. The TM perforation edge was freshened with scissors or cup forceps. The tympanomeatal flap was raised, and the middle ear could be entered. If the incudostapedial joint couldn't be visualized, the chordal crest, an area of bony tissue located near where the CTN enters the middle ear, was removed by curette. A piece of temporalis fascia or chondroperi-chondrial graft was taken from the tragus and was stretched and pressed and the "underlay" graft was placed medial to the malleus. Gel foam sponges were inserted into the middle and outer ear canal.

Care was taken to avoid damaging the chorda tympani in the posterior region when elevating the annulus of the tympanic membrane from its bony sulcus [Figure 2].

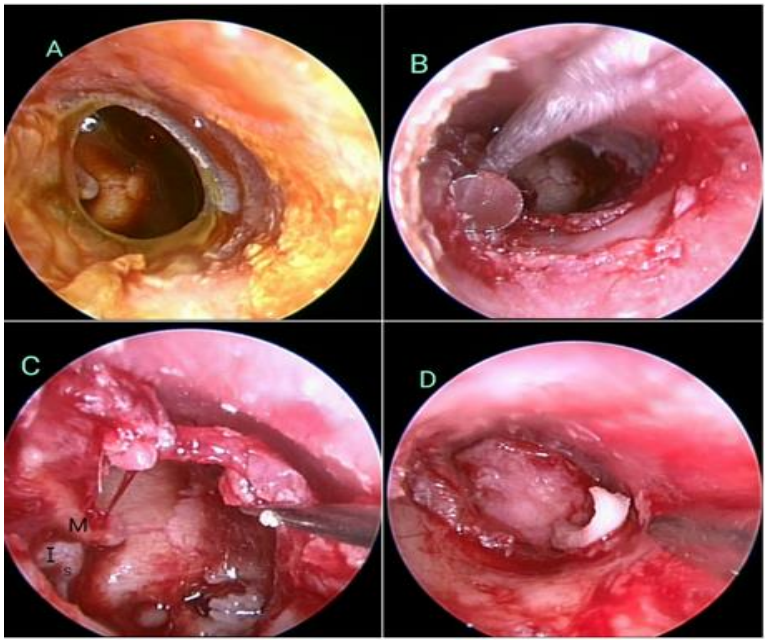


Figure [1]: Endoscopic myringoplasty showing A: large central perforation, B: showing incision in the posterior and inferior parts of external auditory canal, C: middle ear cavity after elevation of tympanomeatal flap [M: malleus, I: incus, S: stapes], CTN not manipulated D: reconstruction of perforation by chondroperichondrial graft

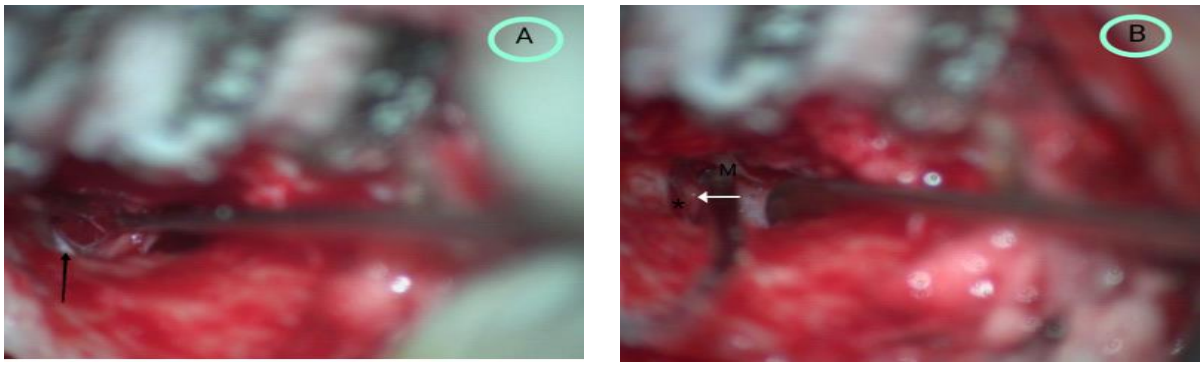


Figure [2]: Microscopic myringoplasty showing A: CTN was manipulated during elevation of annulus, [black arrow: CTN]. B: Middle ear cavity after the elevation of tympanomeatal flap, *: CTN, white arrow: incudostapedial joint, M: Malleus

Follow-up: Patients performed gustatory test scores 48 hours after the surgical procedure. Patients were requested to complete a questionnaire, inquiring about symptoms of CTN injury, at two to four weeks and six to nine months following the surgical procedure. Alterations in gustatory perception, paresthesia of the tongue, and xerostomia.

Gustatory testing

The chemical test involved the examination and identification of representative solutions representing the five basic taste qualities, namely sweet, sour, salty, bitter, and umami. Two concentrations were employed for each stimulus: a low concentration slightly above the recognition threshold, and a high concentration that was clearly supra-threshold. The solvent employed in the experiment was distilled water. Table 1 presents a comprehensive overview of the various chemicals employed, along with their respective concentrations. The lateral side of the front two-thirds of the extended tongue, on the same side as the ear operation, was cleansed using strips that had been soaked in various solutions.

The participants were provided with instructions to protrude their tongues outside of their mouths to prevent the dispersion of the solution throughout the entire oral cavity via the tongue. Participants were additionally instructed to clean their oral cavities with water subsequent to each administration. The test was conducted in ten repetitions, with each repetition involving the evaluation of both high and low concentrations of the five taste attributes. The participants were provided with a list of five descriptors, namely sweet, sour, salty, bitter, and umami, and were instructed to identify the flavor quality using a multiple forced-choice approaches. They were then asked to make a mark accordingly. Subsequently, the correct responses were incorporated to yield a cumulative score out of 10. The taste tests were conducted using a blind methodology, and the outcomes of the tests were recorded, organized, and subjected to analysis. The functionality of the CTN was deemed to be compromised when there was a reduction of 30% or greater in the postoperative score, relative to the patient's preoperative score.

Statistical analysis: The statistical analysis was conducted using SPSS v26, a software developed by IBM Inc. in Chicago, IL, USA. The quantitative variables were reported as the mean and standard deviation [SD] and were compared between the two groups using an unpaired Student's t-test. The qualitative variables were represented in terms of frequency and percentage [%] and were subjected to analysis using the Chi-square test. A two-tailed P-value less than 0.05 was deemed to be statistically significant.

RESULTS

A total of 50 patients were allocated equally between the two groups. The age of the studied patients ranged from 12 – 45 years with a mean [± SD] of 24.2 ± 9.87 years in Group A and 26 ± 11.91 years in Group B. There were 13 [52%] male and 12 [48%] female in Group A. 13 [52%] male and 12 [48%] females in Group B. Both age and sex were insignificantly different between both groups. Eight patients [32%] were of right side and 17 [68%] patients were of left side in Group A. Fifteen [60%] patients were of right side and 10 [40%] patients were of left side in Group B. Side was significantly different between both groups [P=0.047] [Table 2].

In relation to the removal of the chordal crest, it was seen that none of the patients in group A necessitated chordal crest removal, as the endoscopic technology provided complete visualization of the ossicular chain. Within group B, a total of 7 patients, accounting for 28% of the sample, underwent the procedure of chordal crest excision utilising a curette. This intervention was performed with the aim of facilitating the visualisation of the ossicular chain. The statistical analysis revealed a significant p-value of 0.004 associated with this procedure.

In terms of the CTN manipulation, it was manipulated during annulus elevation in 1 patient in group A [4%] and 4 patients in group B [16%] [P =0.348].

Chorda tympani nerve was with no injury in 24 [96%] cases in group A and in 14 [56%] cases in group B, while 1 [4%] case in group A and 8 [32%] cases in group B had stretched chorda tympani nerve and 3 [12%] cases in group B had transected chorda tympani nerve. The Chorda tympani nerve was significantly less injury, less stretched in group A than group B, and more transected in group B than group A [P value=0.012] [Table 3].

Regarding the chemical testing in group A, preoperative scores ranged from 8-10 with a mean ± SD of the 9.2 ± 0.71 while postoperative scores ranged from 6-10 with a mean ± SD the 8.4 ± 1.04. The postoperative score was significantly lower [P=0.003] with a 4% decrease. In group B, preoperative scores ranged from 8-10 with a mean ± SD in 9.4 ± 0.65 while postoperative scores ranged from 5-10 with a mean ± SD in the 7.5 ± 1.42. The postoperative score was significantly lower [P<0.001] with a 24% decrease. The postoperative scores in group A were significantly higher than the group B [P =0.016] [Table 4].

In this study, a total of 7 patients out of 50 [14%] were diagnosed with CTN affection, as determined through chemical testing. The incidence was found to be lower in group A [n=1] compared to group B [n=6] [p=0.042].

Altered sense of taste was the most common symptom, a metallic taste in the mouth was reported by 5 patients [10%]: 1 in group A [4%] and 4 in group B [16%] [p=0.349]. Ageusia/hypogeusia was reported by 2 patients [8%] in group B but none in group A [p=0.489]. Tongue numbness was reported by 1[4%] patient in group B but none in group A [p=1.00]. No patients had dry mouth in both groups [Table 5]. All the CTN symptoms such as change of taste and tongue numbness] in our study had resolved completely after 6 to 9 months post-operatively.

Table [1]: The substances and concentrations used for different taste qualities

Taste quality	Substance	Low concentration [mmol/L]	High concentration [mmol/L]
Sweet	Sucrose	20	146
Slaty	NaCl	20	85
Sour	Citric acid	1.3	5.2
Bitter	Caffeine	1.5	6.7
Umami	Monosodium glutamate [MSG]	10	80

Table [2]: Demographic data of the studied groups

		Group A [n=25]	Group B [n=25]	P value
Age [years]	Mean ± SD	24.2 ± 9.87	26 ± 11.91	0.563
	Range	12 - 45	12 - 45	
Sex	Male	13 [52%]	13 [52%]	0.998
	Female	12 [48%]	12 [48%]	
Side	Right	8 [32%]	15 [60%]	**0.047***
	Left	17 [68%]	10 [40%]	

Table [3]: Nature of chorda tympani nerve injury of the studied groups during tympanoplasty

	Group A [n=25]	Group B [n=25]	P value
No injury	24 [96%]	14 [56%]	**0.012***
Stretched	1 [4%]	8 [32%]	
Transected	0 [0%]	3 [12%]	

Table [4]: Gustatory test scoring of the studied groups

Gustatory test scoring		Group A [n=25]	Group B [n=25]	P value
Pre-operative	Mean ± SD	9.2 ± 0.71	9.4 ± 0.65	0.218
	Range	8 - 10	8 - 10	
48 hrs post-operation	Mean ± SD	8.4 ± 1.04	7.5 ± 1.42	**0.016***
	Range	6 - 10	5 - 10	
P value		**0.003***	**< 0.001***	
% of affection		4%	24%	

Table [5]: Chorda tympani nerve symptoms 2 to 4 weeks post-operative of the studied groups

2 to 4 weeks post-operative		Group A [n=25]	Group B [n=25]	P value
Change of taste	Metallic taste	1 [4%]	4 [16%]	0.349
	Ageusia or hypogeusia	0 [0%]	2 [8%]	0.489
Tongue numbness		0 [0%]	1 [4%]	1.00
Dry mouth		0[0%]	0 [0%]	--

DISCUSSION

To our knowledge, there is a lack of studies that compared the efficacy of using microscopic and endoscopic techniques in reducing the incidence of CTN injury during tympanoplasty operations. Therefore, the purpose of this study was to compare microscopic and endoscopic methods for evaluating CTN injury after tympanoplasty.

Fifty people were selected at random for this study, all of them suffered from chronic suppurative otitis media. The two study groups were matched for their age, and gender, which is similar to previous studies [9, 10]. Patients were given questionnaires to fill out between two and four weeks and six to nine months after surgery to check for signs of CTN damage, such as altered taste perception, numbness of the tongue, and dry mouth.

In our study, no patients in group A required chordal crest removal, because the ossicular chain could be fully visualized using the endoscopic system with regular irrigation and suction to decrease heat exposure from endoscopes. In group B, 7 [28%] patients underwent removal of the chordal crest using a curette to allow for visualization of the ossicular chain [P= 0.004]. These results are in agreement with **Lade *et al.*** [11].

Our study showed that the CTN was manipulated during annulus elevation in 1 patient in group A [4%] and 4 patients in group B [16%] [P =0.348], which is similar to the results reported by **Gulsen and Karatas** [12], who reported that CTN manipulation was required in 13 [34.2%] and 22 [64.7%] cases in endoscopic group and microscopic group, respectively [p<0.05]. Also, **Iynen and Dundar** [1] found that CTN was manipulated during annulus elevation in 8 patients in group 1 [32%], and none of the patients in the endoscopic group experienced CTN transaction whereas 3 patients [7%] in microscopic group experienced accidental transection of the nerve [p=0.28].

In our study, stretched CTN occurred in 4% of cases in group A and 32% cases in group B and 12% cases in group B had transected CTN. CTN was significantly less injury, less stretched in group A than group B and more transected in group B than group A. Based on the chemical testing, our results showed that the total number of patients who were identified as having CTN affection was 7 out of 50 [14%]. The incidence was lower in the endoscopic group [n=1] 4% than in the microscopic group [n=6] 24% [p=0.042]. This is in accordance with the findings of **Moneir *et al.*** [9], wherein it was observed that the overall percentage of patients diagnosed with CTN affection [as determined through chemical testing] was 18.2%. The incidence of the condition was notably lower in the group that underwent endoscopic procedures [n = 2] compared to the group that underwent microscopic procedures [n = 14] [p = 0.019].

In the present study, pre-operative gustatory test scoring was insignificantly different between both groups. 48 hours post-operation gustatory test scoring was significantly higher in group A [8.4 ± 1.4] than in group B [7.5 ± 1.42] [P =0.016], which is similar to the findings of **Moneir *et al.*** [9].

According to our results, the metallic taste was insignificantly different between group A [4%] and group B [16%]. 2 [8%] patients had Ageusia or hypogeusia with no significant

difference between both groups. 1 [4%] patient had tongue numbness in Group B, with insignificant difference between both groups, which is in agreement with two studies [1, 9].

The CTN symptoms such as change of taste and tongue numbness in our study had resolved completely after 6 to 9 months post-operatively. **Moneir *et al.*** [9], Reprted that all the patients were free from symptoms within 1–6 months [average: 2.5 months]. According to the findings of **Gopalan *et al.*** [13], it was observed that the symptoms associated with CTN injury demonstrated improvement within a timeframe of 4 to 8 months. According to **Michael and Raut** [7], it has been observed that a duration of 12 months is necessary for the complete resolution of symptoms.

The recovery of subjective taste can be clarified through various mechanisms. CTN recovery may potentially manifest subsequent to its injury. Other mechanisms encompass the compensation of alternative neural pathways and subjective adaptation. The central inhibition between the afferent inputs of the seventh and ninth cranial nerves has been demonstrated. As a result, the impairment of CTN function may result in heightened taste sensitivity via the glossopharyngeal nerve [14, 15].

Conclusion: In patients undergoing tympanoplasty, endoscopic ear surgery provides superior visualization, reduces the necessity for extensive manipulation of the chorda tympani, and subsequently lowers the occurrence of CTN injury compared to microscopic ear surgery.

Financial and non-financial relations and activities of interest: None

REFERENCES

1. Iynen I, Dundar R. Chorda Tympani nerve injury during tympanoplasty. Comparison of endoscopic and microscopic methods. Ann Ital Chir. 2021 Mar 2;10:S0003469X2102813X. Epub ahead of print. PMID: 33687346.

2. Ho ML, Juliano A, Eisenberg RL, Moonis G. Anatomy and pathology of the facial nerve. AJR Am J Roentgenol. 2015 Jun;204[6]:W612-9. doi: 10.2214/AJR.14.13444.

3. Shimotakahara R, Lee H, Mine K, Ogata S, Tamatsu Y. Anatomy of the lingual nerve: Application to oral surgery. Clin Anat. 2019 Jul; 32[5]:635-641. doi: 10.1002/ca.23361.

4. Rao A, Tadi P. Anatomy, Head and Neck, Chorda Tympani. 2023 Mar 4. In: StatPearls [Internet]. Treasure Island [FL]: StatPearls Publishing; 2023 Jan–. PMID: 31536194.

5. Choi N, Ahn J, Cho YS. Taste Changes in Patients With Middle Ear Surgery by Intraoperative Manipulation of Chorda Tympani Nerve. Otol Neurotol. 2018 Jun;39[5]:591-596. doi: 10.1097/MAO.0000000000001780.

6. von Molitor E, Riedel K, Hafner M, Rudolf R, Cesetti T. Sensing Senses: Optical Biosensors to Study Gustation. Sensors [Basel]. 2020 Mar 25;20[7]:1811. doi: 10.3390/s20071811.

7. Michael P, Raut V. Chorda tympani injury: operative findings and postoperative symptoms. Otolaryngol Head Neck Surg. 2007 Jun;136[6]: 978-81. doi: 10.1016/j.otohns.2006.12.022.

8. Emre IE, Cingi C, Bayar Muluk N, Nogueira JF. Endoscopic ear surgery. J Otol. 2020 Mar; 15[1]:27-32. doi: 10.1016/j.joto.2019.11.004.

9. Moneir W, Eladl HM, El-Okda MM, Ebada HA. Chorda tympani injury during endoscopic versus microscopic stapes surgery: a randomized controlled clinical trial. Eur Arch Otorhinolaryngol. 2023 Feb;280[2]:689-693. doi: 10.1007/s00405-022-07550-0.

10. Hsu YC, Kuo CL, Huang TC. A retrospective comparative study of endoscopic and microscopic Tympanoplasty. J Otolaryngol Head Neck Surg. 2018;47[1]:44. doi: 10.1186/s40463-018-0289-4.

11. Lade H, Choudhary SR, Vashishth A. Endoscopic vs microscopic myringoplasty: a different perspective. Eur Arch Otorhinolaryngol. 2014 Jul;271[7]:1897-902. doi: 10.1007/s00405-013-2673-z.

12. Gulsen S, Karatas E. Comparison of surgical and audiological outcomes of endoscopic and microscopic approach in stapes surgery. Pak J Med Sci. 2019; 35[5]:1387-1391. doi: 10.12669/pjms.35.5.439.

13. Gopalan P, Kumar M, Gupta D, Phillipps JJ. A study of chorda tympani nerve injury and related symptoms following middle-ear surgery. J Laryngol Otol. 2005 Mar;119[3]:189-92. doi: 10.1258/0022215053561657.

14. Mueller CA, Khatib S, Naka A, Temmel AF, Hummel T. Clinical assessment of gustatory function before and after middle ear surgery: a prospective study with a two-year follow-up period. Ann Otol Rhinol Laryngol. 2008 Oct;117[10]:769-73. doi: 10.1177/000348940811701012.

15. Saito T, Manabe Y, Shibamori Y, Yamagishi T, Igawa H, Tokuriki M, *et al.* Long-term follow-up results of electrogustometry and subjective taste disorder after middle ear surgery. Laryngoscope. 2001 Nov;111[11 Pt 1]:2064-70. doi: 10.1097/00005537-200111000-00037.

International Journal of Medical Arts

https://ijma.journals.ekb.eg/
Print ISSN: 2636-4174
Online ISSN: 2682-3780