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Intraoperative Localization Of The Marginal Mandibular Nerve In The Pakistani Population: A Cross-Sectional Study

Mishal Rehman[1], Muhammad Wasim Ibrahim[2], Maidah Hanif[3]

Abstract

Objective: This study aims to evaluate the proximity of the marginal mandibular nerve to the lower border of the mandible in the Pakistani population, in comparison with previous studies to reduce the risk of inadvertent nerve damage during surgical interventions.

Methods: A total of 60 patients in the age range between the second & sixth decade requiring incision in the submandibular region were selected. Intraoperative identification of the nerve followed by measurement of its lowest point from the inferior border of the mandible was done. A total of 45 distinct nerves were recognized. Measurements on both the left and right sides were taken and compared with each other. The association of nerve position with the age of the patients was distinguished.

Results: A total of 45 nerves were identified. The average position of the Marginal Mandibular Nerve was determined to be 11.75 mm below the inferior border of the mandible. There was no significant difference between the left and right sides and about age.

Conclusion: The inferior border of the mandible is where the Marginal Mandibular Nerve is situated, consistent with prior research. There is no significant variation between the left and right sides. The position of the nerve is not affected by age as there is no association detected between the position of the nerve and age. The placement of an incision by previous recommendations of one finger breadth below the inferior border of the mandible can be used in the Pakistani population to avoid iatrogenic damage to the marginal mandibular nerve, leading to lesser complications and distress to the patient.

Keywords: Marginal mandibular branch, facial nerve, mandible, Injury.

[1] Post-Graduate Trainee, Foundation University, Islamabad; [2] Professor and Dean, Foundation University, Islamabad; [3] Assistant Professor, Foundation University, Islamabad.

Correspondence: Dr. Maidah Hanif, Assistant Professor, Foundation University, Islamabad. **Email:** md7534@hotmail.com.

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1. Introduction

The facial nerve (seventh cranial nerve), emerges from the pons and subsequently takes on an additional cranial path. It is a mixed nerve that controls the muscles that control facial expression, lacrimal secretions, as well as a portion of the gustatory system.[1]

After leaving the skull through the stylomastoid foramen, the facial nerve reaches the parotid gland and releases five terminal branches that supply the facial muscles. Of these terminal branches, the marginal mandibular nerve is exclusively prone to iatrogenic injury from a variety of local surgical procedures.[2] The facial nerve's marginal mandibular branch supplies the muscles responsible for pulling the lower lip downward and tightening the angle of the mouth, including the depressor labii inferioris and depressor anguli oris, orbicularis oris, and mentalis muscle. When the marginal mandibular nerve is damaged, noticeable and significant aesthetic deficiencies can occur, such as asymmetry and discrepancy in the lower lip and saliva pooling.[3]

The marginal mandibular nerve travels deep to the platysma and depressor anguli oris along the inferior border of the jaw.[4] This position makes the nerve vulnerable to damage during various surgical procedures including head and neck surgery, parotidectomies, rhytidoplasties, surgical procedures of mandibular fractures and other procedures involving the submandibular region.[5] The resultant cosmetic and functional damage as well as psychological and emotional distress to the patient, along with medicolegal implications make it imperative to have a detailed knowledge of the anatomy and location of said nerve about specific landmarks to avoid such complications.[6]

The variations in anatomy as well as in position about the inferior border of the mandible, along with the greater number of procedures being performed in proximity to the marginal mandibular nerve make it susceptible to iatrogenic trauma.[7] Recent literature indicates that the position of this branch of the facial nerve is approximately 1 cm anterior to and beneath the angle of the mandible. Subsequently, it is noted that the nerve descends below and in front of the

mandible, traversing across the facial vessels at a distance of roughly one finger's breadth beneath the mandible.[5] According to a study by Anthony DJ, the recorded maximum distance was 17.65 mm, according to his study, the mean maximum distance documented was 7.12 ± 2.97 mm.[1] In many patients, the course and position of the nerve do not adhere to the aforementioned description. Moreover, a dearth of studies concerning the anatomical variations of the nerve in the South Asian population also makes it important to investigate the anatomical position of the nerve in vivo, to be able to identify any variations in the nerve position compared to Caucasian populations, upon which previous studies are largely based.[8] Differences in the nerve position from other populations from which previous data has been collected would mean a different course of action and site of incision to safeguard the integrity of the MMN. This study seeks to assess the distance of the marginal mandibular nerve from anatomical landmarks located on the lower border of the mandible during live surgical procedures. The objective is to obtain representative data regarding the anatomy and average positioning of the nerve, thereby aiding in the prevention of potential complications.

2. Materials & Methods

A Cross-sectional study was carried out in the Oral & Maxillofacial Surgery Department. The duration of the study was 18 months after approval from the Ethical Review Committee. A non-probability purposive sampling technique was used by using the WHO calculator for sample size calculation with level of Confidence of 95%, Population Mean value of 7.12.

The sample size includes 60 Patients presenting to the Oral & Maxillofacial Surgery department at FUCD & H after fulfilling the specific standards. The inclusion criteria included the age of the patient between 15-50 years, Patients requiring surgical procedures involving submandibular incision and no previous nerve injury. Whereas, the exclusion criteria included the patient refusing consent for the study, tumors of the submandibular region and previous radiation of the neck.

Approval for the research project was obtained from the Ethical Review Committee for the study. A comprehensive history and clinical assessment of patients presenting to the Oral and Maxillofacial Surgery (OMFS) department for surgical procedures necessitating a submandibular incision or engagement of the submandibular area (such as head and neck surgeries, parotidectomies, and open reduction of mandibular fractures) was conducted. A documented informed consent from the patient was secured using a consent form. Patients who met the inclusion criteria within our sample will be chosen. The surgical procedures were conducted by the same surgical team. Patients were positioned with shoulders rolled to keep the neck extended. Surgical incisions were created on the neck along the natural skin creases, approximately 20mm below the lower edge of the mandible. This was succeeded by dissection in the sub-platysmal plane, employing surgical magnification loupes for enhanced visibility. Identification of the MMN using standard landmarks and an electric nerve stimulator was carried out, the nerve usually runs superficial to the anterior facial vein to be visualized by the use of loupes. The angle of the mandible was located, and two fixed reference lines were designated: the first reference line was positioned along the lower border of the mandible, while the second reference line was established 10mm (1cm) beneath the mandible. The following measurements were taken using Vernier caliper, vertical distance of the mean and lowest point of the nerve from the angle of the mandible and the distance of the mean and lowest point of the nerve from the inferior border of the mandible.

All the above measurements recording the mean position of the nerve from the inferior border of the mandible were recorded in proforma to obtain mean values. MMN nerve functioning can be appreciated by contraction of mentalis & lower lip twitching. Monitoring the functioning of MMN was conducted in the ward postoperatively.

Data was analyzed by entering into the Statistical Package for Social Sciences software (SPSS) for Windows (version 23, IBM Corporation Chicago, IL, USA). An Independent sample t-test was performed to get mean values of quantitative variables like the nerve distance from reference points and differences between the right and left sides. Quantitative variables like age and mean distance of nerve from reference point were measured as mean and SD. Qualitative variables like the right and left side of the mandible were measured as frequencies and percentages, with bilateral measurements taken only in cases where bilateral incisions were made. Effect modifiers like age, gender,

and difference between the right and left sides were controlled by stratification. The chi-square test was used for post-stratification. A P-value of 0.05 or less was considered statistically significant.

3. Results

Data was entered and analyzed in SPSS 23.0. Total number of patients considered for analysis were 60 with 9 (15.0%) males and 51 (85.0%) females. The majority of patients 80.0% belonged to the fifth decade of life, 11.7% belonged to the fourth decade, 5.0% belonged to the third decade and 1.7% each belonged to the second and sixth decade of life. Among various diagnoses, there were 23.3% and 18.2% SCC mandibular alveolus cases on the left and right side respectively, 16.7% and 6.7% SCC buccal mucosa cases on the left and right side, 15.0% cases of SCC tongue, 5.0% cases of mucoepidermoid carcinoma, 11.7% cases of OSCC maxilla and 1.7% case each for OSCC lip and submandibular gland removal. In terms of neck dissection type, there were 41.7% of procedures in which the right nerve was dissected, 46.7% of procedures in which the left nerve was dissected, additionally, 10.0% of procedures had bilateral neck dissection as given in Table 1.

The overall mean distance from the left nerve was found to be 10.34±0.47 cm with a minimum of 10.0 mm and a maximum of 12.33 mm. Similarly, the overall mean distance from the right nerve was reported to be 10.42±0.50 mm with a minimum of 10.10 mm and a maximum of 12.33 mm. The average position of the nerve on both the right and left side was almost similar with no significant difference, the difference in position was 0.12 mm between the two nerves. On the other hand, the mean to lower boundary distance was calculated to be 2.68±0.70 mm with a minimum of 1.3 mm and a maximum of 5.2 mm. There was no significant difference found between the mean distance from the left nerve, right nerve or mean to lower boundary distance and gender as given in Table 2.

The mean distance from the right nerve among males was 10.3±0.26 while 10.4±0.53 among females. Similarly, the mean distance from the left nerve among males was 10.1±0.08 while 10.39±0.52 among females. The mean to lower border distance for males was 2.37±0.36 and 2.7±0.73. There was no significant difference found between the mean distance from left nerve, right nerve or mean to lower boundary distance and age. The details are given in Table 3.

Table 1: Characteristics like gender distribution, age groups, diagnosis and types of neck dissection about frequency and percentage

Characteristics		Frequency (n)	Percentage (%)
Gender	Male	9	15.0%
	Female	51	85.0%
Age categories	Second decade	1	1.7%
	Third decade	3	5.0%
	Forth decade	7	11.7%
	Fifth decade	48	80.0%
	Sixth decade	1	1.7%
Diagnoses	SCC mandibular alveolus left	14	23.3%
	SCC mandibular alveolus right	11	18.3%
	SCC buccal mucosa left	10	16.7%
	SCC buccal mucosa right	4	6.7%
	SCC tongue	9	15.0%
	Meca left	3	5.0%
	OSCC Maxilla	7	11.7%
	OSCC lip	1	1.7%
	Submandibular gland removal	1	1.7%
Neck dissection type	Right	25	41.7%
	Left	28	46.7%
	Bilateral	6	10.0%
	None	1	1.7%

Table 2: Mean distance (mm) from left & right nerve and lower border of the mandible

Mean distance	Mean	Standard Deviation	Min	Max
from left nerve (mm)	10.34	0.47	10.0	12.33
from right nerve (mm)	10.42	0.50	10.10	12.33
lower boundary (mm)	2.68	0.70	1.3	5.2

The marginal mandibular nerve (MMN) originates from the anterior caudal borders of the parotid gland, situated beneath the parotid-masseteric and deep cervical neck fascia, just inferior to the angle of the mandible. The course of the MMN exhibits variability based on the position of the neck, and notably, the anatomical landmarks are clinically palpable in all cases. The damage to the marginal mandibular nerve leads to considerable cosmetic deformity, as it results in the loss of nerve supply to the depressor anguli oris and labii inferioris muscles, causing asymmetrical movements of the lower lip on the affected side.

Table 3: Comparison of distance from the right & left nerves and lower border of the mandible (mm) among various age groups

		Distance right nerve (mm)			Distance left nerve (mm)			Lower boundary distance (mm)		
		Mean	Standard deviation	p	Mean	Standard deviation	p	Mean	Standard deviation	p
Age groups	2nd decade	10.19	0.13	0.850	10.12	0.00	0.733	2.37	0.36	0.802
	3rd decade	10.29	0.27		-	-		2.7	0.73	
	4th decade	10.42	0.52		10.22	0.13		2.40	0.00	
	5th decade	10.34	0.00		10.37	0.52		2.96	0.60	
	6th decade	10.38	0.47		-	-		2.54	0.53	

4. Discussion

In this study, 60 subjects were chosen, and marginal mandibular nerves were located intra-operatively. 9 (15.0%) males while 51 (85.0%) were females. A comparable work was carried out in the United Kingdom by Batstone, who looked at data from 66 patients who had undergone 85 neck dissections over five years. The majority of the patients in this study were men (61%) and 25 of them were in the 65+ age range.[8]

The current study yielded a single branch of the MMN. Studies have shown the MMN to have a variable number of branches. Riaz et al demonstrated up to three rami of the nerve in varying patterns.[9]

This study evaluated the surgical positioning of the MMN about the inferior mandibular boundary in live patients. 60 nerves were found; 6 patients had bilateral nerve identification, compared to 25 patients who had only right-side nerve identified, and 28 had nerve identified only on the left side. In a study by Anthony et al., measurements were taken bilaterally for each individual while using 22 cadavers to examine the link between the inferior border and MMN.[7] In the department of anatomy at the University of Pretoria in South Africa, Potgieter et al. explored the anatomical relationship of MMN utilizing 36 cadaveric face halves (18 left sides and 18 right sides), of which 22 belonged to males and 14 to girls.[8,9]

The lower edge of the mandible was used as the reference point for the study. The distance between this reference point and the caudalmost point of MMN was measured. 48 cadavers were used by Dale et al. to locate the MMN and measure its separation from five anatomical markers along the inferior border of the mandible.[10] The findings of our investigation showed that the lower border's distance from the MMN ranges from a minimum of 10 mm to a maximum of 12.33 mm. The platysma and the investing layer of the deep cervical fascia are where all of the examined nerves run beneath the inferior border. All of the patients were positioned with their necks stretched in a dorsal decubitus position. There were no discernible differences between the right and left sides. To prevent harm to the MMN, we advised making a submandibular incision at least 2 cm away from the lower edge of the jaw.

In our study, Anthony et al. measured nerves at a minimum distance of 10.8 mm and a maximum distance of 17.70 mm, with no appreciable changes between the right and left sides. All of the nerves were situated inferior to the lower border of the mandible. Baur et al. identified three separate variants in the nerve's path, with 60% of instances of MMN beginning inferior to gonion and coursing superiorly, but our investigation consistently found the MMN to be inferior to the lower border of the mandible.[11] The distance between the MMN and the angle of the jaw, according to Potegeiter's study, ranges from 6.2 mm to +5.1 mm, with the majority of the nerve specimens being inferior to the inferior border of the mandible, comparable to our study. Al Hayani et al. discovered, in contrast to our findings, that the nerve's proximity to the inferior border of the jaw was variable. They discovered that 44% of MMN specimens were inferior to the lower border, 28% were above the inferior boundary, and 28% were both above and below it. Unlike other studies, which are typically conducted on cadavers, our investigation was conducted on living individuals. Variations in measures must be taken into consideration because living tissues differ from constricted cadaveric tissue.

The uniformity of the patients in our study was one of its strengths. The measures made while the patients were still alive increased the precision of our conclusions. Due to the minimal patient intake at our centre, one limitation is the small number of patients chosen, but a general idea of the mean position of the nerve owing to the generous age ranges included can still be ascertained. The MMN has several rami that are positioned in eccentric locations however, our study only examined the rami that are caudal to the MMN. While this will help the surgeon

decide the lower limit of the incision, cephalic lying branches and incisions near them need to be studied further. Lip symmetry is also influenced by cervical branches of the facial nerve, and injury to them can result in lip symmetry as well. This could make it difficult to determine the level of handicap brought on by damage to the MMN alone.

5. Conclusion

The study concluded that the inferior position of the MMN is below the lower border of the mandible, by other studies. The correct placement of the submandibular incision, at least two finger breadths below the lower border of the mandible would help in preventing inadvertent damage to the MMN. Knowledge of the course and anatomy of the MMN and carefully planned surgery keeping the position in mind will aid in averting iatrogenic damage to the nerve, saving both the patient and the surgeon from unneeded distress. Further studies with larger sample sizes and perhaps with patients selected from specific geographical areas within Pakistan would enrich the current findings.

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