International Journal of Anatomy and Research,
Int J Anat Res 2024, Vol 12(3):8964-71. ISSN 2321-4287
DOI: https://dx.doi.org/10.16965/ijar.2024.130

Original Research Article

Usual and Unusual Variations of Marginal Mandibular Branch of Facial Nerve – Nerve That Helps Symmetrical Smile

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ABSTRACT

Background: Marginal mandibular branch of facial nerve , one of the motor terminal branches of facial nerve if injured inadvertently during different operative procedures in head & neck region, it produces neurodeficit as a – weakness of the lower lip muscles on the injured side. This study will increase our understanding about the anatomical details of this nerve in question, so that damage to this nerve during surgical intervention can be avoided. IN spite of considerable surgical importance, there are not many studies on Marginal Mandibular Nerve particularly from this zone of India which drives the present researcher to pursue this cadaver based study on Marginal Mandibular Nerve, one of the terminal branches of Facial Nerve with respect to its course relations and communication.

Aim: The aim of the present study is to provide information regarding the number of branches of Marginal Mandibular Branch of Facial Nerve (MMBFN), relation of these branches to the facial vessels, communication between branches of MMBFN with other branches of Facial nerve and its relation to lower border of the body of the mandible. This knowledge will definitely help the surgeons performing Parotidectomy, Carotid end-arterectomy, Submandibular gland excision, Deep dissection of neck, Mandibular advancement surgery etc.

Materials and Methods: A Cross-sectional observational study was conducted in Nil Ratan Sircar Medical College Kolkata, West Bengal within 2021 to 2023 after Institutional Ethical clearance. In this study 50 halves of faces of embalmed cadavers of both sexes were dissected & analysed. Number of branches, course & relation with facial vessels, relation with lower border of mandible & to deep fascia and communications of MMBFN if any was noted after meticulous dissection. All the variables collected for statistical analysis were then evaluated by SPSS 20.0.1

Results: In the present study, MMBFN was represented by Single branch in 42 (84%) cases, exhibit two rami in 14% cases and as three rami in 2% cases. 55(93.2%) out of 59 rami of MMBFN , crossed facial vessels externally and in 4(6.8%) branches, the MMBFN divided into two branches and reuniting again to form a single nerve trunk. The loop so formed enclosed facial artery. 20.3% of MMBFN passed above the inferior border of mandible,45.8% along the inferior border of mandible and 33.9% passed below the inferior border of mandible. Communication between the main or subsidiary branches of MMBFN was present in 10% cases and communication between MMBFN with Buccal branch of FN in 30% cases.

Conclusion: Anatomical knowledge about the branching pattern and relationship of the MMBFN will help the Maxillofacial, Plastic/Cosmetic, General Surgeons to safely identify and preserve the Marginal Mandibular Nerve, during different operative procedures.

KEYWORDS: Asymmetrical smile, Plastic Surgery, Pleomorphic adenoma, Rhytidectomy.

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Access this Article online	Journal Information
Quick Response code	**International Journal of Anatomy and Research** ISSN (E) 2321-4287 | ISSN (P) 2321-8967 **https://www.ijmhr.org/ijar.htm** **DOI-Prefix:** https://dx.doi.org/10.16965/ijar
DOI: 10.16965/ijar.2024.130	**Article Information**
	Received: 30 Apr 2024 Accepted: 22 Jun 2024 Peer Review: 02 May 2024 Published (O): 05 Sep 2024 Revised: 16 May 2024 Published (P): 05 Sep 2024

INTRODUCTION

Facial nerve is one of the important cranial nerves in face & neck region. After passing through the stylomastoid foramen the facial nerve passes through the parotid gland to ramify on face. Within the substance of the parotid gland it gives two main branches just behind the retromandibular vein(within 5mm): Superior - temporofacial trunk and Inferior - cervicofacial trunk [1].

Trunks branch further to form 5 main terminal branches, temporal, zygomatic, upper & lower buccal, marginal mandibular and cervical. These branches pass forward within the parotid gland and then leaves the gland by its anteromedial surface just medial to its anterior margin and supply the muscle of facial expression [1].

There are usually two marginal mandibular branches(MMB), which run forward toward the angle of mandible under platysma, superficial in the upper part of digastric triangle and then run upward & forward across the body of mandible superficial to facial vessels then deep to depressor anguli oris. In relation to lower border of mandible, the nerve/nerves lie either along the lower border of mandible or may pass below the lower border with a reported incidence of 20% to 50% within 1.2 cm of lower border of mandible. The MMB supply the risorius, and the muscles of lower lip and chin that are-depressor labi inferioris, depressor anguli oris and mentalis [1].

During the development of a peripheral nerve, neurite - target relationship is an important entity. In case of somato-motor neurons the targeted end organ is a developing muscle fibre. This target-specific migration of developing nerve fibres is occurring totally under the influence of specific signals. Tracing and transplantation studies have shown that motor neurons are target specific [2].

Complexity of the nerve's course, branching patterns, and its anatomic relationships are established during intrauterine life. During the first 3 months of intrauterine life facial nerve with its branches grow and develop and simultaneously muscles of facial expression also differentiate, becoming functional i.e. acquiring their ability to actively contract.

Due to its location MMB of FN is prone to injury during different operative procedures, like - SMAS, Parotidectomy, Resection of Submandibular salivary gland, Deep dissection of neck, Carotid endarterectomy, Mandibular advancement surgeries, Open reduction of Mandibular angle fracture, Liposuction [3-7].

Inadvertent operative procedures involving the face & neck region can damage different branches of facial nerve. In Rhytidectomy or Facelift elevation of skin flap is coupled with judicious skin excision and modification of superficial musculoaponeurotic system(SMAS). Current trend towards more aggressive undermining in rhytidectomy (Sub-SMAS dissection) has increased the incidence of facial nerve injury, & most commonly this specific concerned terminal motor branch of Facial nerve [3].

Since the Facial nerve and its terminal branches are directly passing through the parotid gland, there are very high chances that these terminal branches get injured during surgeries involving the parotid gland [4].

The most common complication of parotid surgery is facial nerve palsy, particularly of marginal mandibular nerve. In recurrent parotid tumor and deep lobe tumors excisions, incidence of facial dysfunction is high, compared to incidence of facial nerve injury & post-operative complications encountered in superficial lobe pleomorphic adenoma [4].

Features of temporary nerve damage can be encountered following parotidectomy, which is not an uncommon event, however patients recover from these untoward injuries within 6 post operative months in most cases [5].

Unlike parotid gland, the entire submandibular gland is usually removed in tumor of the gland, or chronic infections secondary to salivary stone. In some cases, where the nerve goes directly through the malignant tumor, MMB of FN might have to forgo for near complete cancer removal. In such cases Facial reconstruction procedures to be followed in future to improve facial appearance [6].

Neck dissection to clear cervical lymph nodes is common practice in management of

malignancies of head and neck region.

In spite of considerable surgical importance, there are not many studies on Marginal Mandibular Nerve particularly from this zone of India which drives the present researcher to pursue this cadaver based study on Marginal Mandibular Nerve, one of the terminal branches of Facial Nerve with respect to its course relations and communication.

MATERIALS AND METHODS

A Cross-sectional observational study was conducted in Nil Ratan Sircar Medical College Kolkata, West Bengal within December 2021 to December 2023 after taking clearance from Institutional Ethical Committee. 25 well embalmed & properly maintained cadavers of both sexes, above 18yrs age, available for UG & PG dissection classes from December, 2021 to December, 2023 were selected for study & their head & neck region were dissected bilaterally. So, 50 halves of face & neck were available for this study. Cadavers with facial deformity, having operative scar marks over face and neck region or with any kind of external injury excluded from the study.

As the data collection has to be completed within stipulated time frame, so subjective sampling was done based on background knowledge, available time frame & cadavers in the Department.

In the midline, a shallow (2mm) skin incision was made that begins on the Middle of forehead hairline (A) and continues up to mental protuberance (B) encircling the mouth at the margin of lips using scalpel and blade and toothed forceps. Starting at the nasion(D), another incision was made that encircles the orbital margin, then extending from the lateral angle of eye up to the ear near anterior root of helix (C). An incision was made from mental protuberance (B) along a line 2cm below and parallel to the lower border of mandible up to the ear lobe and then up anterior the ear up to point (C). Another oblique incision was made from the angle of mouth up to the root of ear (point C). Skin removed from lower part of face beginning at the midline and proceeding laterally.

After making skin incision according to the diagram shown in Fig 1, at first parotid duct was identified & dissected out & do and traced anteriorly up to masseter & posteriorly up to anterior margin of parotid gland. After dissecting the parotid sheath using a sharp probe, branching pattern of facial nerve & facial vessels dissected clearly [8].

Then MMBFN analysed under following parameters:

Number of branches of Marginal Mandibular Branch of Facial nerve.

Relation of these branches of MMBFN to the facial vessels.

Relation of these branches of MMBFN to the lower border of mandible.

Relation of these branches to deep fascia.

Communication between branches of MMBFN with other branches of Facial nerve as well as sensory nerves in the vicinity.

All the variables were collected in For statistical analysis at first all the data were entered into Microsoft excel spreadsheet and then evaluated by SPSS 20.0.1 and GraphPad Prism version 5. Data had been summarized as percentages for categorical variables. Z-test (Standard Normal Deviate) was used to test the significant difference of proportions. p-value $\leq$ 0.05 was considered for statistically significant.

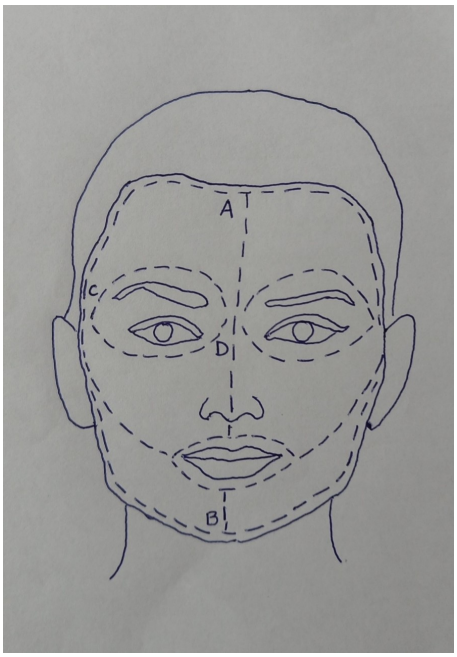

Fig. 1: Line of skin incision. A: Forehead hairline, B: Mental Protuberance, C: Anterior root of Helix, D:Nasion.

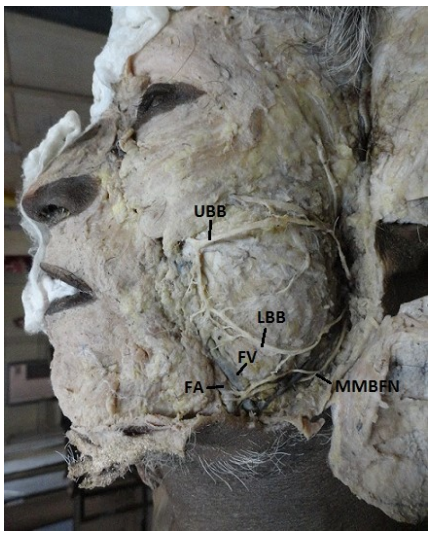

Fig- 2i: A Photograph of left half of face showing MMBFN, at first as a single trunk, then dividing into two branches as leaving the parotid, both of which are passing below the lower border of mandible, and the two forming a closed loop through which passes the anterior division of retromandibular vein. Both the branches then entered face crossing the lower border of mandible and then forming loops again, through which facial artery passes. Upper branch is having a communication with lower buccal branch.

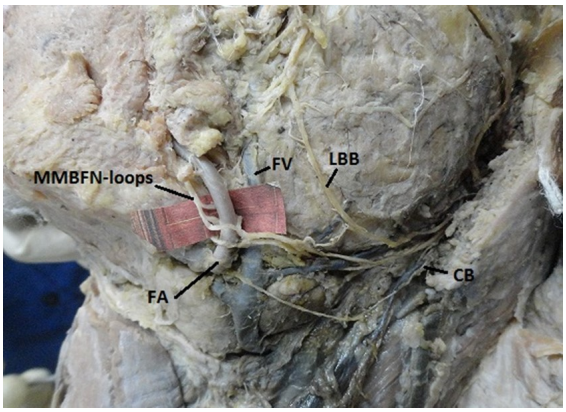

Fig-2ii: Photograph taken with a piece of paper strategically placed to make the loops clearly visible of above specimen.

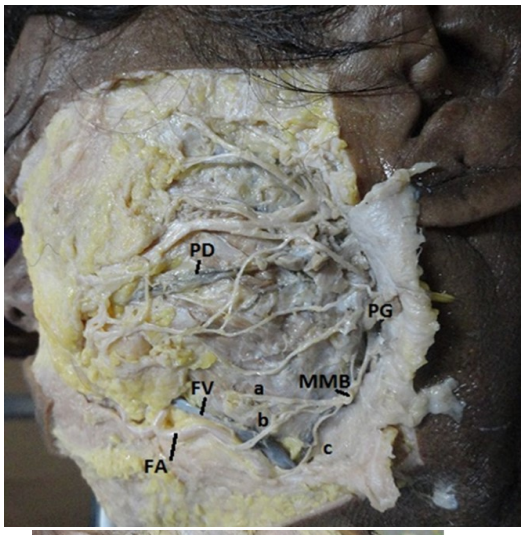

Fig 3: A Photograph of the left half of face specimen showing the Marginal Mandibular Branch(MMB) of Facial Nerve emerging as a single branch from the lower pole of parotid gland (PG) and dividing into 3 branches (a,b,c).Upper(a) & Middle(b) branch passing above and parallel to lower border of mandible whereas lower(c) branch passing below the lower border of mandible. Middle branch (b) passing superficial to facial artery to supply lower lip muscles. Branch c passing deep to deep cervical fasica in submandibular region ,then re-entering into face by curving upward crossing the lower border of mandible.

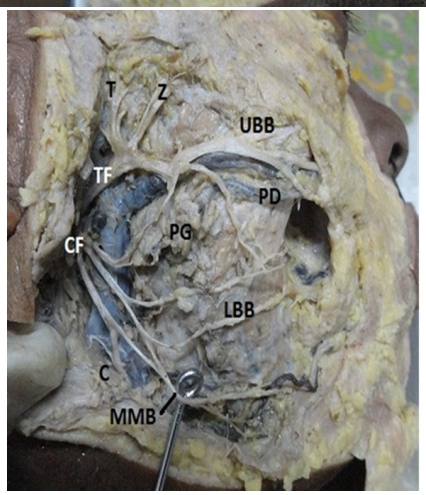

Fig. 4i: A Photograph showing right half of face showing 3 nerves arising from the Cervicofacial (CF) trunk. Upper (a) joining the Uper Buccal branch(UBB).Middle(b) and Lower(c) branch joining to form a plexus,and from that plexus Lower buccal branch(LBB),Marginal Mandibular branch (MBB),Cervical(C) arising as single branch.

Fig 4ii: As the marginal mandibular nerve is running forward it is dividing into two branches a & b. Upper branch(a) is running along the lower border of mandible and dividing into two branches and reuniting again to form a single nerve trunk. Facial vessels are passing within the nerve loop. Lower branch(b) entering into the submandibular region & passing superficial to facial artery below lower border of mandible and ending by supplying the platysmal continuation to risorius.

RESULTS

In 42(84.0%) cases MMBFN was presented by one branch (Fig 13i), 7(14.0%) cases were presented by two branches (Fig.10), and 1(2.0%) case presented by three branches. The Standard score is 7.0014. The p-value is <0.0001. The result is significant since p <0.05. Proportion of MMBFN presented by one branch was significantly higher than others.

In 42out of 50 specimens, the MMBFN was represented by a single ramus emerging from the sharp anterior margin of parotid gland. In 7 out of 50 specimens, the MMBFN exhibited two rami. In only 1 specimen out of total 50 halves of the face, the MMBFN was represented by 3 rami. Hence in 50 halves of face total no. of MMBFN = 42+14+3=59

According to Relation to facial vessels, 55(93.2%) branches of MMBFN passed external to facial vessels and in 4(6.8%) branches, facial vessels passed within nerve loop (Fig 9ii,13ii), The Standard-Score is 9.3899. Here the p-value is <0.0001. The result is significant since p <0.05. Proportion of MMBFN passing superficial to facial vessels was significantly higher than the loop presentation.

According to Relation to inferior border of mandible, MMBFN were along in 27(45.8%) specimens, below in 20(33.9%) specimens and above in 12(20.3%) specimens. The Standard-Score is 0.9341. The p-value is 0.35238. The result is *not* significant at p >0.05. According to Relation to deep fascia, in 39(66.1%) specimens MMBFN were deep to PF and in 20(33.9%) specimens were deep to DCF. The Standard-Score is 3.4982. The p-value is 0.00046. The result is significant at p <0.05. Proportion of MMBFN passing deep to PF was significantly higher than the proportion of MMBFN passing deep to DCF.

According to Presence of communication, 37(62.7%) branches there was absence of any communication, in 15(25.4%) branches were with LBB and in 7(11.9%) branches were with other MMB. The Z-Score is 4.0793. The p-value is <0.0001. The result is significant at p <0.05. Proportion of With LBB and MMB was significantly lower than no communication.

Table 1: Distribution of cases according to the Number of rami of Marginal Mandibular Nerve (n=50).

Number of rami/branches	Frequency	Percentage
One	42	84.00%
Two	7	14.00%
Three	1	2.00%
Total	50	100.00%

Table 2: Distribution of branches of MMBFN according to relation (n=59).

Relations of MMBFN	To Facial vessels			To Inferior border of Mandible			To deep fascia	
	Superficial	Loop	Deep	Above	Along	Below	Deep to DCF	Deep to PF
	55(93.2%)	4(6.8%)	0(0%)	12(20.3%)	27(45.8%)	20(33.9%)	20(33.9%)	39(66.1%)

*MMBFN: Marginal mandibular branch of Facial nerve, DCF: Deep cervical fascia, PF: Parotid fascia

Table 3: Distribution of Branches according to the Presence of communication with other nerve (n=59)

Presence of communication	Branches	Percent of branches
No	37	62.70%
With LBB	15	25.40%
With MMB	7	11.90%
Total	59	100.00%

LLB: Lower buccal branch, MMB: Marginal mandibular branch

According to Presence of communication, 37(62.7%) branches there was absence of any communication, in 15(25.4%) branches were with LBB and in 7(11.9%) branches were with other MMB. The Z-Score is 4.0793. The p-value is <0.0001. The result is significant at p <0.05. Proportion of With LBB and MMB was significantly lower than no communication.

DISCUSSION

Table 4: Showing comparison between present study and previous studies on the basis of branching pattern of MMBFN.

Author	Sample size	Country	1 Branch	2 Branches	3 Branches	4 Branches
Woltmann M et al [6].	45	Brazil(2006)	31%	60%	9%	-
Al-Hayani A et al. [9]	50	Saudi Arabia (2007)	32%	40%	28%	_
Kim DI et al. [10]	85	Korea (2009)	28%	52%	18%	2%
Batra AP et al. [11]	50	India (2010)	88%	12%	_	_
Atif S et al. [12]	100	Pakistan (2013)	74%	20%	6%	_
Khanfour A et al. [13]	30	Egypt (2014)	36.70%	43.30%	20%	_
Present Study	50	India (2023)	84%	14%	2%	_

Table 5: Showing comparison between present study and previous studies on the basis of relation of MMBFN with Facial artery.

Author	Sample no.	Country	Superficial	Deep	Loop
Batra et al. [11]	50	India (2010)	100%	----	----
Khanfour et al. [13]	30	Egypt (2014)	98%	7%	----
This study	50	India (2023)	94%	----	6%

Table 6: Showing comparison between present study and previous studies on the basis of relation of MMBFN with IBM(Inferior border of Mandible).

Author	Country	Sample size	Above the IBM	Below the IBM	Along the IBM
Al-Hayani [3]	Saudi Arabia(2007)	50	28%	44%	28%
Batra et al. [5]	India(2010)	50	74%	26%	----
Khanfour et al. [7]	Egypt(2014)	30	80%	10%	10%
Dingman et al. [8]	USA(1962)	100	81%	19%	----
Ziarah et al. [9]	England(1981)	110	47%	53%	----
Wang et al. [10]	China(1991)	120	67%	37%	----
Woltman et al. [11]	Brazil(2006)	45	58%	43%	----
Saylam et al. [12]	Turkey(2007)	50	16%	32%	52%
Weerapant et al. [14]	Thailand(2010)	49	57%	43%	----
This study	India(2023)	50	24%	38%	54%

Table 7: Showing comparison between present study and previous studies on the basis of any communication of MMBFN.

Author	Country	Sample size	With Cervical branch of FN	With Buccal branch of FN	With other rami of MMB	No communication with other branches of FN	With Mental nerve	With transverse cervical nerve.
Batra et al. [11]	India(2010)	50	----	12%	----	88%	28%	----
Atif S et al. [12]	Pakistan(2013)	100	1%	36%	----	62%	----	----
Khanfour A et al. [13]	Egypt(2014)	30	----	40%	53.50%	----	----	3.30%
Karapinar et al. [16]	Turkey(2012)	44	97.70%	4.60%	----	----	----	----
This Study	India (2023)	50	----	30%	10%	74%	----	----

When MMBFN present itself as a single ramus as recorded by Batra AP [11] in 88% and Atif S [12] in 74% cases, may result into post-operative lip deformity resulting from intra-operative nerve damage because of absence of substitute innervation of muscles supplied by MMBFN, which helps in lip depression. Presence of multiple rami as reported by Woltman et al [6], in 60%, Al-Hayani [9] in 40% Kim et al. [10] in 52% cases reduces the magnitude of paralysis if a single branch of MMBFN is injured.In present study we found MMBFN presented as single rami in most of the cases, i.e 84% which is similar to the findings of Batra et al. [11].

According to Savary et al. [14] MMBFN was present as 3 rami in majority of cases (72.7%) followed by two rami in 27.3% cases. Presence of 4 rami was only reported by Kim et al. [10] in 2% cases. In present study 3 branches of MMB was recorded in 2% cases but 4 rami was not recorded.

Study conducted by Khanfour et al. [13] showed that in 93% specimens either the main or one of the secondary branches of MMBFN crossed superficial to the facial vessels and in 7% of the cases one of the secondary branches of MMBFN passed deep to facial vessels, similar to the findings of Dingman et al. [15], who reported that MMBFN may be presented as 2 branches, which cross ;one superficial and one deep to facial vessels. While Batra et al. [11] found, MMBFN is superficial to the facial vessels in 100% cases .In this study MMBFN is superficial to the facial vessels in 94% cases ,and in 6% cases the MMBFN formed a loop around facial vessels.

Although different articles are available which can provide a clear distance of MMB to lower border of mandible, but the reference landmark used, types of samples, geographical origins of the samples greatly vary from article to article. These all parameters can give rise to undesired & disagreeable variations in results. Moreover position of cadaveric head & neck, during measurement and also the state of cadaveric tissue generate different results, since in fresh cadavers or in living intraoperative patients, connective tissue is lax, the MMBFN can even extend up to 4 cm from the inferior border of mandible versus fixed cadavers where the connective tissue contracts and stiffen. Difference in the measurement may also occur due to dehydration in fixed cadavers, and oedema in surgical patients. Hence **in present observer's view in relation to this criterion of MMBFN, was mostly a non-comital one.**

When the number of rami of MMBFN is increasing [6,9,10,13], the communications with other terminal motor branches of Facial nerve also increases [11-16]. Increasing number of communications, though it is not too common (in present study) limits the extent of paralysis and post-operative lip deformity, following injury to the nerve.

CONCLUSION

From the present study it can be said that, Presence of multiple rami reduces the magnitude of paralysis if a single branch is injured though it is not very common as seen in the present study, to find the MMBFN presented as two or multiple branches.

Facial artery can guide surgeons for easy & proper intraoperative identification of MMBFN, because identification of facial artery by palpation near the anteroinferior angle of the masseter is a common practice by clinicians ,and additional care must be taken as nerve may form a loop around the facial vessels , manipulation of the facial artery in these cases may severely endanger the nerve.

Increasing number of communications though it is not too common (in present study) limits the extent of paralysis and post-operative lip deformity, following injury to the nerve.

ABBREVIATIONS

MMBFN: Marginal mandibular branch of Facial nerve,
DCF: Deep cervical fascia,
PF: Parotid fascia
LBB: Lower buccal branch
IBM: Inferior border of Mandible
UBB: Upper buccal branch
FA: Facial artery
FV: Facial vein
PD: Parotid duct
CB: Cervical branch

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Author Contributions

Sarbani Das: Concept of Study.Collection of Data,Reviw of literature,manuscript preparation.
Swapan Bhattacharjee: Concept of the study , revision of the manuscript.

Conflicts of Interests: None

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How to cite this article: Sarbani Das, Swapan Bhattacharjee. Usual and Unusual Variations of Marginal Mandibular Branch of Facial Nerve – Nerve That Helps Symmetrical Smile. Int J Anat Res 2024;12(3):8964-8971. **DOI:** 10.16965/ijar.2024.130