

The course of the marginal mandibular branch of the facial nerve in adult cadavers

An anatomic study

Ugur Karapinar, MD, Cenk Kilic, MD, Bilal Cetin, MD, Omer Saglam, MD, Engin Dursun, MD, Muzaffer Durmus, MD.

ABSTRACT

الأهداف: مراقبة سير عصب الفك السفلي الهامشي المتفرع عن العصب الوجهي بالنسبة للحدود السفلية للفك السفلي والأوعية الدموية الوجه.

الطريقة: أجريت هذه الدراسة في قسم التشريح، أكاديمية جولهان الطبية العسكرية، أنقرة، تركيا خلال الفترة من أبريل إلى سبتمبر 2012م. تم تشريح 44 شق للوجه مأخوذ من 22 جثة لأشخاص بالغين وتم التشريح تحت المجهر.

النتائج: تم العثور على العصب الذي يتمثل بفرع واحد (36.4%)، و بفرعين (63.6%). كانت المسافة بين العصب والحدود السفلية للفك السفلي متفاوتت بين 13.6 حتى 40.08 مم، و كان متوسط المسافة 21.91 مم. كانت هناك اتصالات مع الفرع الشدقي فقط في عينتين (4.6%). جميع فروع عصب الفك السفلي الهامشي سارت باتجاه وحشي إلى موقع شريان الوجه في 43 (97.7%) من مجموع العينات البالغة 44. سارت فروع العصب في عينة واحدة بين الشريان والوريد الوجهي.

خاتمة: يمكن لعصب الفك السفلي الهامشي المتفرع عن العصب الوجهي في بعض الأحيان أن يتضرر أثناء العمليات الجراحية التي تقتصر على المنطقة الواقعة تحت الفك السفلي نظراً لموقعه ووضعته التشريحية اللانمذجية. عصب الفك السفلي الهامشي ذو الفرعين كان النمط الأكثر انتشاراً والحد الأقصى للمسافة بينه وبين الفك السفلي كانت 40.08 ملم. هذه المعرفة التشريحية قد تكون مفيدة للجراحي الرأس والرقبة في التخطيط لموضع الشقوق في العمليات الجراحية في المنطقة الواقعة تحت الفك السفلي.

Objectives: To observe the course of the marginal mandibular branch of the facial nerve (MMBFN) and its relation to the inferior border of the mandible and facial vessels.

Methods: This cadaveric study was conducted at the Department of Anatomy, Gulhane Military Medical Academy, Ankara, Turkey from April to September 2012. The 44 facial halves of 22 adult cadavers were dissected under a stereomicroscope.

Results: The nerve was found to be presented by one branch (36.4%), and 2 branches (63.6%). The distance of the nerve from the inferior border of the mandible varied from 13.06-40.08 mm, with an average distance of 21.91 mm. There were communications with buccal branch only in 2 specimens (4.6%). All the branches of the marginal mandibular branch ran laterally to the facial artery in 43 (97.7%) of the 44 specimens. In one specimen, the 2 marginal mandibular branches ran between the facial artery and vein.

Conclusion: The MMBFN can occasionally be damaged during surgeries confined to the submandibular region due to its location and anatomical variant. The most common pattern of MMBFN was nerve with 2 branches. The maximum distance between the MMBFN and the mandible was 40.08 mm. This anatomical knowledge may be useful to surgeons of the head and neck in planning incisions and procedures in the submandibular region.

Saudi Med J 2013; Vol. 34 (4): 364-368

From the Departments of Otolaryngology (Karapinar), Plastic and Reconstructive Surgery (Durmus), Bursa Military Hospital, Bursa, and the Department of Anatomy (Kilic), Gulhane Military Medical Academy, Ankara, and the Department of Otolaryngology (Cetin), Gumussuyu Military Hospital, and the Department of Otolaryngology (Saglam, Dursun), Kasimpasa Military Hospital, Istanbul, Turkey.

Received 20th November 2012. Accepted 5th February 2013.

Address correspondence and reprint request to: Dr. Muzaffer Durmus, Department of Plastic and Reconstructive Surgery, Bursa Military Hospital, Hamam Cd. Çekirge, Osmangazi, Bursa 16010, Turkey. Tel. +90 (224) 2393841. Fax. +90 (224) 2393842. E-mail: drmzfdurmus@yahoo.com

The marginal mandibular branch of the facial nerve (MMBFN) innervates the cutaneous muscles of the lower lip, chin, and the angle of the mouth. This branch can be damaged occasionally during head-neck surgery, parotidectomy, surgical treatment of mandibular angle fractures, rhytidectomy, and other forms of surgery in the submandibular region. During surgery of the submandibular region, the MMBFN is the most frequently damaged branch of the facial nerve, leading to ipsilateral depression of the angle of the mouth.^{1,2} The aims of this study were to determine the pattern of MMBFN, the distance of the MMBFN to the inferior border of the mandible and its relations with other branches of the facial nerve and facial vessels. Results were discussed and compared with the results of previous studies of other authors from the anatomical and surgical points of view.

Methods. This cadaveric study was conducted in the Department of Anatomy, Gulhane Military Medical Academy, Ankara, Turkey from April to September 2012. Permission to conduct this study was obtained from the local ethics committee of Gulhane Military Medical Academy. The MMBFN was examined in 44 facial halves of 22 adult cadavers fixed in 10% formaldehyde solution (Tekkim Inc, Turkey) at the laboratory of the Anatomy Department. Cadavers with a history of trauma, surgical procedures, or disorders that might have affected the shape of the mandible were excluded from the study. A submandibular incision was given approximately 4 cm below and parallel to the lower border of the mandible on both sides of the neck. A skin flap was made and the platysma were dissected from the underlying structures by blunt dissection. Facial vessels, course, and number of branches of the MMBFN were all identified with the aid of a stereomicroscope (Stemi 2000, Carl Zeiss, Jena, Germany). The measurements were taken using digital calipers. The following features evaluated were: the number of the MMBFN, distance between the MMBFN and the inferior border of the mandible, the relationships with the facial vein and artery, and its communications with other branches of the facial nerve.

Statistical analysis. Data were stored on a database and analyzed using the Statistical Package for Social

Sciences version 11.0 (SPSS Inc, Chicago, IL, USA). Descriptive statistics were calculated for individual demographics, t-test was used to analyze the parametric data. Statistical significance was considered at $p < 0.05$.

Results. There were 18 men and 4 women, with age range from 33-79 years (51.18 ± 12.68). The number of MMBFN was determined, and a number of one to 2 marginal mandibular branches were observed while leaving the parotid gland. The most common pattern was 2 branches in 28 specimens (63.6%) (Figure 1). There was a single branch in 16 specimens (36.4%) (Figure 2). The distance between the MMBFN and the inferior border of the mandible was evaluated, and the maximum distance between the MMBFN and the inferior border of the mandible was 40.1 mm (mean: 21.91 ± 8.226 mm) (Table 1). The MMBFN ran above the inferior border of the mandible in all (100%) of the specimens. The relationship with the facial vein and facial artery was examined, and in the submandibular region all branches of the MMBFN ran laterally to the facial artery in 43 (97.7%) of the 44 specimens. In one specimen, the 2 marginal mandibular branches ran between the facial artery and vein (Figure 3). Its communication with other branches of the facial nerve, especially the buccal and cervical rami was evaluated, and no communication with the cervical branch was determined in all specimens. There were communications with buccal branch only in 2 specimens (4.6%) (Figure 4). There was no communications in the remaining 42 specimens (95.4%).

Statistical results. When viewed from the distance between the MMBFN and the inferior border of the mandible, there were no statistically significant differences between the left and right sides of the cadavers and both gender. Group statistics are shown in Table 2.

Discussion. Understanding facial nerve anatomy is critical for surgeons operating in the head and neck to be aware of anatomical variant. Likewise, the increasing popularity of lower facial aesthetic procedures makes anatomy of the lower branches of the facial nerve particularly relevant to aesthetic facial surgeons.³

The number of marginal mandibular branches. Many studies have reported that the MMBFN had a number of one to 4 branches and the most common is 2. Toure et al⁴ found a unique marginal branch in 43% of the cases, 2 branches in 44%, and 3 branches in 13%. Similar results were reported by Al-Hayani⁵ who found a single branch in 32%, 2 branches in 40%, and

Disclosure. The authors have no conflict of interests, and the work was not supported or funded by any drug company.

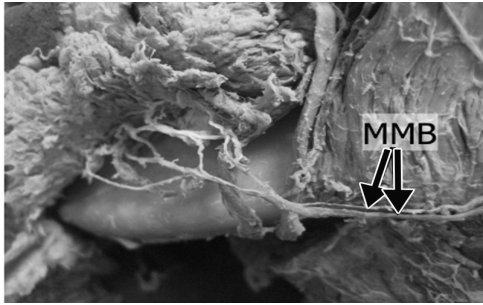


Figure 1 - Lateral view of the left half of the head showing the marginal mandibular branches (MMB) of the facial nerve.

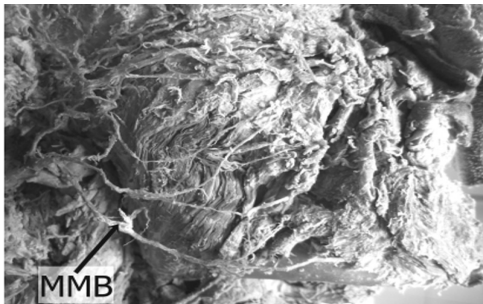


Figure 2 - Lateral view of the right half of the head showing the marginal mandibular branches (MMB) of the facial nerve.

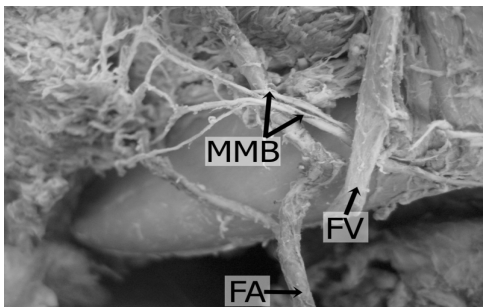


Figure 3 - Lateral view of the left half of the head showing the marginal mandibular branches (MMB) of the facial nerve, facial artery (FA), and facial vein (FV).

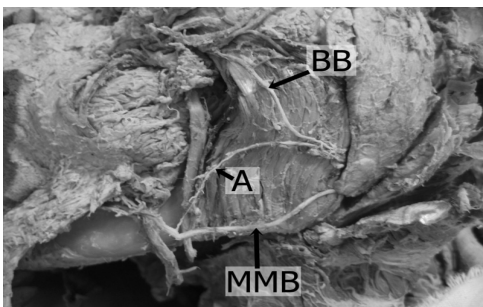


Figure 4 - Lateral view of the left half of the head showing the marginal mandibular (MMB) and the buccal (BB) branches of the facial nerve, the communications between the marginal mandibular and the buccal branches of the facial nerve (A).

Table 1 - The descriptive statistics of the marginal mandibular branches.

Variables	N	Minimum	Maximum	Mean
Age, years	22	33	79	51.2
Distance, mm	44	13	40	21.9

Table 2 - The distance between the marginal mandibular branches and the inferior border of the mandible, and the differences between the left and right sides of the cadavers and both gender.

Variables	N	Distance		P-value
		Mean	Standard deviation	
<i>Direction</i>				
Left	22	22.4	8.6	0.711
Right	22	21.4	8.0	
<i>Gender</i>				
Male	36	22.6	8.3	0.232
Female	8	18.7	7.6	

3 branches in 28% in 50 human specimens. Kirici et al⁶ also dissected 44 facial halves of fetuses to study the relationship of MMBFN in fetuses, and they reported that the most common pattern was 2 branches in 24 specimens (54.5%) of fetuses. According to the study,⁶ a single branch was found in 10 specimens (22.7%), 3 branches in 8 specimens (18.2%), and 4 branches in 2 specimens (4.5%). Liu et al⁷ studied the course and distribution of MMBFN in 24 cadaver specimens and MMBFN was double or single in 95.9% of the specimens. In the present study, we found a single branch in 16 specimens (36.4%), and 2 branches in 28 specimens (63.6%).

The relationship with the lower border of the mandible. Clinically, the palpable inferior border of the mandible is an important surgical landmark. There is a close relationship between MMBFN and lower border of mandible.⁸ This is an excellent place to locate the MMBFN and helps the surgeon to avoid any damage to the nerve during the surgery around the mandibular angle. Several authors^{7,8} reported the distance between the MMBFN and inferior border of the mandible as 3-3.5 cm. Batra et al⁹ concluded that the submandibular incision should be carried out at least 1.6 cm below the lower border and angle of the mandible in order to prevent MMBFN damage. Toure et al⁴ performed 54 dissections to study the anatomical characteristics of MMBFN. Their study demonstrated the wide variability of the MMBFN.⁴ According to the study, the lowest MMBFN was situated 17.5 mm from the inferior border of the mandible.⁴ Nason et al¹⁰ evaluated the anatomy and function of the MMBFN in neck

dissections and the nerve was located in an anterior and downward position with the lowest point 1.25±0.7 cm below the inferior border of the mandible (>0.5 cm below in 54%, and >2cm below in 10%). They concluded that an incision of 2 cm below the lower border of the mandible significantly increases the risk of nerve damage.¹⁰ In the present study, the MMBFN ran above the inferior border of the mandible in all (100%) of the specimens.

The relationship with the facial vein and the facial artery. The MMBFN generally courses laterally to the facial vein and the facial artery, but it is difficult to classify because of their great variability. The MMBFN with a close relationship runs parallel to the course of the facial artery.⁹ In our study, all the marginal mandibular branches was running laterally to the facial artery in 43 (97.7%) of the 44 specimens. In one specimen, the 2 marginal mandibular branches ran between the facial artery and vein. Hazani et al¹¹ measured the distance from the facial artery to the palpable masseteric tuberosity at the angle of the mandible and the distance from the masseteric tuberosity to the mental midline in order to determine a ratio of the facial nerve from the masseteric tuberosity to the mental midline. Distance between the facial artery and the masseteric tuberosity was measured as an average of 3.05 ± 0.13 cm, and the ratio of the marginal mandibular nerve is approximately one-fourth of the distance from the masseteric tuberosity to the mental midline.¹¹

Communications with other branches of the facial nerve. Several studies showed peripheral communications between the MMBFN and the other branch of the facial nerve. Batra et al⁹ examined peripheral communications between the MMBFN and the other branches of the facial nerve, and they found MMBFN and buccal branch of facial nerve communications in 12% of the cases.⁹ They also determined that it frequently communicated with the mental nerve (28%). In a prospective study, Brennan et al¹² found communications between the great auricular nerve and the marginal mandibular division of the facial nerve in 2 of 25 patients. According to the study this communication may lead to some clinical implications.¹² In the present study, only in 2 specimen (4.6%) communications with buccal branch were found, however in the remaining 42 specimens (95.4%) no communications were detected.

Surgical approach to MMBFN. Neck dissection or submandibular incision is a common procedure in head-neck surgery. The MMBFN has a risk to be injured

during surgical procedures. The rate of facial palsy following neck dissection is relatively high, however, severe injuries to the marginal mandibular nerve are uncommon.¹³ Möller et al¹⁴ found a moderate risk of injury to the MMBFN after neck dissection. Gaillard et al¹⁵ analyzed the incidence of facial nerve dysfunction after parotidectomy. They found that the incidence of postoperative facial nerve dysfunction was 30.7% at one month after the parotidectomy, and 0% at 6 months after the parotidectomy. Single nerve branch, in particular, the marginal mandibular branch paresis was common. According to another study,¹⁴ permanent dysfunction was uncommon (3.9%). Kukuckova et al¹⁶ carried out a retrospective analysis of 86 patients with submandibular gland disorder, and transient palsy of marginal mandibular nerve was observed to be the most common complication after the surgery (14%).

The limitation of the study was the difficulty of finding the cadavers with appropriate features.

In conclusion, the MMBFN can occasionally be damaged during surgeries confined to the submandibular region due to its location and anatomical variant. Further anatomical studies have to be conducted. Having the knowledge regarding the relationship between the facial nerve and the adjacent anatomic structures would be a useful guide in young head and neck surgeons' daily practice. Additionally, potential complications due to the increase in facial plastic surgery procedures in the last years could be minimized by anatomical studies as presented here.

Acknowledgment. The authors gratefully acknowledge Dr. Cenk Kilic for the figure layout.

References

1. Kim DI, Nam SH, Nam YS, Lee KS, Chung RH, Han SH. The marginal mandibular branch of the facial nerve in Koreans. *Clin Anat* 2009; 22: 207-214.
2. Daane SP, Owsley JQ. Incidence of cervical branch injury with "marginal mandibular nerve pseudo-paralysis" in patients undergoing face lift. *Plast Reconstr Surg* 2003; 111: 2414-2418.
3. Salinas NL, Jackson O, Dunham B, Bartlett SP. Anatomical dissection and modified Sihler stain of the lower branches of the facial nerve. *Plast Reconstr Surg* 2009; 124: 1905-1915.
4. Touré S, Vacher C, Bertrand JC. [Anatomy of the marginal mandibular branch of the facial nerve] *Rev Stomatol Chir Maxillofac* 2004; 105: 149-152.
5. Al-Hayani A. Anatomical localisation of the marginal mandibular branch of the facial nerve. *Folia Morphol (Warsz)* 2007; 66: 307-313.
6. Kirici Y, Kilic C, Develi S. Marginal mandibular branch of the facial nerve in human fetuses. *Saudi Med J* 2011; 32: 459-462.

7. Liu AT, Jiang H, Zhao YZ, Yu DZ, Dang RS, Zhang YF, et al. [Anatomy of buccal and marginal mandibular branches of facial nerve and its clinical significance] *Zhonghua Zheng Xing Wai Ke Za Zhi* 2007; 23: 434-437. Chinese
8. Potgieter W, Meiring JH, Boon JM, Pretorius E, Pretorius JP, Becker PJ. Mandibular landmarks as an aid in minimizing injury to the marginal mandibular branch: A metric and geometric anatomical study. *Clin Anat* 2005; 18: 171-178.
9. Batra AP, Mahajan A, Gupta K. Marginal mandibular branch of the facial nerve: An anatomical study. *Indian J Plast Surg* 2010; 43: 60-64.
10. Nason RW, Binahmed A, Torchia MG, Thliversis J. Clinical observations of the anatomy and function of the marginal mandibular nerve. *Int J Oral Maxillofac Surg* 2007; 36: 712-715.
11. Hazani R, Chowdhry S, Mowlavi A, Wilhelmi BJ. Bony anatomic landmarks to avoid injury to the marginal mandibular nerve. *Aesthet Surg J* 2011; 31: 286-289.
12. Brennan PA, Webb R, Kemidi F, Spratt J, Standing S. Great auricular communication with the marginal mandibular nerve - a previously unreported anatomical variant. *Br J Oral Maxillofac Surg* 2008; 46: 492-493.
13. Batstone MD, Scott B, Lowe D, Rogers SN. Marginal mandibular nerve injury during neck dissection and its impact on patient perception of appearance. *Head Neck* 2009; 31: 673-678.
14. Møller MN, Sørensen CH. Risk of marginal mandibular nerve injury in neck dissection. *Eur Arch Otorhinolaryngol* 2012; 269: 601-605.
15. Gaillard C, Périé S, Susini B, St Guily JL. Facial nerve dysfunction after parotidectomy: the role of local factors. *Laryngoscope* 2005; 115: 287-291.
16. Kukuckova B, Svec M. Surgical management of submandibular gland diseases: ten years of experience. *Bratisl Lek Listy* 2011; 112: 264-268.

Related Articles

Kamarudin TA, Das S. Anatomical facts on the marginal mandibular branch of the facial nerve. *Saudi Med J* 2012; 33: 96.

Kirici Y, Kilic C, Develi S. Marginal mandibular branch of the facial nerve in human fetuses. *Saudi Med J* 2011; 32: 459-462.

Liu AT, Jiang H, Zhao YZ, Yu DZ, Dang RS, Zhang YF. [Anatomy of buccal and marginal mandibular branches of facial nerve and its clinical significance] *Saudi Med J* 2007; 23: 434-437.