

Marginal mandibular branch of the facial nerve in human fetuses

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ABSTRACT

الأهداف: تقييم التشريح التحليلي لفرع عصب الوجه الحافي في الفك السفلي، ودراسة علاقته بالحافة السفلية للأوعية الدموية في الوجه والفك السفلي.

الطريقة: أُجريت هذه الدراسة في قسم التشريح بأكاديمية غلهاان الطبية العسكرية في أطليق، أنقرة، تركيا وذلك خلال الفترة من فبراير 2009م إلى أبريل 2010م. شملت الدراسة 44 عينة مأخوذة من الوجه لحوالي 22 جنين، وقد تم تشريح العينات باستخدام مجهر ستيريو، وفيما بعد تم تقييم علاقة فرع عصب الوجه الحافي في الفك السفلي بالتراكيب المجاورة (مثل الأوعية الدموية وعضلات الوجه) والحافة السفلية للفك السفلي.

النتائج: لقد وجدنا بأن هناك واحد إلى أربعة فروع من عصب الوجه الحافي في الفك السفلي، وقد امتد فرع هذا العصب إلى وريد الوجه بشكل مائل في 42 عينة (95.5%) من أصل 44، وامتدت كافة فروع هذا العصب إلى شريان الوجه بشكل مائل في 30 عينة (68.2%) من أصل 44. لقد امتد فرع هذا العصب إلى شريان الوجه بشكل متوسط في عينتين، فيما امتد شريان الوجه بين فرعين من فروع هذا العصب في 10 عينات. وقد امتد فرعين من العصب بين شريان ووريد الوجه وذلك في عينتين. أشارت نتائج الدراسة إلى أنه لم يكن هناك اختلافاً واضحاً بين الجزء الأيمن والأيسر من الوجه أو اختلافاً بين الجنسين.

خاتمة: أثبتت الدراسة بأن الحافة السفلية للفك السفلي قد تكون علامة مميزة لتجنب إلحاق الضرر بفرع عصب الوجه الحافي في الفك السفلي أثناء إجراء العملية الجراحية. ولهذا يتوجب على الجراح الذي سوف يتدخل في مثل هذه المنطقة الحساسة من الجسم أن يمتلك معرفة واسعة بتشريح مثل هذه المنطقة وأن تكون قراراته موزونة.

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

Methods: This study was conducted in the Department of Anatomy, Gulhane Military Medical

Academy, Etlik, Ankara, Turkey from February 2009 to April 2010. The 44 hemi-face specimens of 22 fetuses were selected for this study, and dissected under a stereomicroscope. The MMB relationship was evaluated between adjacent structures (like vessels and muscles) and the lower border of the mandible.

Results: We found a number of one to 4 branches of the MMB. The MMB ran laterally to the facial vein in 42 (95.5%) of the 44 specimens. All the branches of the MMB ran laterally to the facial artery in 30 (68.2%) of the 44 specimens. In 2 specimens, it ran medially to the facial artery. In 10 specimens, the facial artery ran between 2 branches of the MMB. In 2 specimens, the 2 branches of the MMB ran between facial artery and vein. There were no statistical differences between the left and right sides, and in both genders.

Conclusion: The inferior border of the mandible may be an important landmark to avoid injury to the MMB of the facial nerve. It is for this reason, that surgeons who are willing to operate on this area should have a true knowledge and accurate judgement regarding the anatomy of this branch.

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The marginal mandibular branch (MMB) of the facial nerve runs forward below the angle of the mandible, and passes along the inferior border of the mandible under the platysma and the depressor anguli oris muscle. It supplies the muscles of the facial expression, like the platysma and the depressor anguli oris, and joins the mental nerve.¹ The MMB has an

important surgical relationship with the lower border of the mandible.¹ The MMB may descend up to 2 cm below the inferior border of the mandible,¹ and its position is crucial for the surgical approach to the submandibular region.² The MMB shows many variations during its course.¹ Toure'et al² reported a case where the MMB lay 17.5 mm from the inferior border of the mandible. To avoid injury to the MMB during surgery of the submandibular region, the surgeon must have a clear understanding of the anatomy of the MMB, the most frequently damaged branch of the facial nerve. The aims of this study were to determine the distance of the MMB to the inferior border of the mandible, in order to determine the best and safest location to approach to the posterior mandibular region, and its course and relations, especially with other branches of the facial nerve and the facial vessels.

Methods. This study was performed in the Department of Anatomy, Gulhane Military Medical Academy, Etlik, Ankara, Turkey from February 2009 to April 2010. The MMB was examined in 44 facial halves of 22 fetuses. Eighteen of them were male and 4 of them were female. The mean age of the fetuses were 23 month old (range; 16-32 weeks). The MMB was dissected carefully under a stereomicroscope (Stemi 2000; Carl Zeiss, Jena, Germany). The measurements were taken using digital calipers. Permission to conduct this study was obtained from the local ethics committee of Gulhane Military Medical Academy. First, we evaluated the number of the MMB at the level of its exit from the parotid gland. Then, the MMB relationship was evaluated between adjacent structures (like the facial vessels and the platysma, and the depressor anguli oris muscle), and the lower border of the mandible. We measured the mean distance of the MMB and its branches from the inferior border of the mandible. We also investigated the anastomoses with the other branches of the facial nerve (especially the buccal and cervical ramus). Finally, we noted its branches connecting with the mental nerve.

Mann-Whitney U test was performed for comparisons between the right and left sides of the cases. A $p > 0.05$ was considered statistically significant.

Results. A number of one to 4 branches of MMB was observed while leaves the parotid gland. The most common pattern was 2 branches in 24 specimens of the fetuses. There was a single branch in 10 specimens, 3 branches in 8 specimens, and 4 branches in 2 specimens of fetuses (Figure 1). The maximum distance between the lowest point of the MMB and the inferior border of the mandible was 3.65 mm (Figure 2). The maximum distance between the uppermost point of

the MMB and the inferior border of the mandible was 3.82 mm (Figure 3). The MMB was distributed in a quadrilateral area, from below average 2.13 mm and above average 2.46 mm inferior border of the mandible. The single branch lay below inferior border of the mandible in 6 of the 10 specimens, and above the inferior border of the mandible in 4 of the 10 specimens. One of the 2 branches of MMB ran below, and the other above the inferior border of the mandible in 3 of the 12 specimens. In 4 specimens, both of them ran below, and in 5 specimens, both of them ran above the inferior border of the mandible. In 2 of the 4 specimens, in which 3 branches of MMB were seen, the branches lay below the inferior border of the mandible. In one specimen, all the 3 branches lay above. In one specimen, one of the 3 branches ran below the inferior border of the mandible, and other branches ran above it. In one specimen 4 branches arose radially from the common root, and ran below the inferior margin of the mandible. In the submandibular region, the MMB ran laterally to the facial vein in 42 of the 44 specimens. In one specimen, the nerve was medially to the facial vein. All the branches of the MMB ran laterally to the facial artery in 30 of the 44 specimens. In one specimen, it ran medially to the facial artery. In 5 specimens, the branches of the MMB lay superficially and deeply to the facial artery. Thus, the facial artery ran between the 2 branches of the MMB (Figure 4). In 2 specimens, the 2 branches of the MMB ran between facial artery and vein (Figure 5). The evaluation of the fetuses showed anastomoses with the buccal and cervical branches of the facial nerve. There were anastomoses only with cervical branch in one specimen, and with buccal branch only in 2 specimens of the fetuses. In 2 specimens, there were anastomoses with both cervical and buccal branches (Figure 6). There were no anastomoses in the remaining 17 specimens. All the branches of the MMB lay lower of the platysma and above the depressor anguli oris muscle in all specimens. No statistically significant difference was found ($p > 0.05$). There were no statistical differences between the left and right sides, and both genders. In addition, we have not observed the joining of the MMB with the mental nerve in any of the fetuses.

Discussion. The results of the present study correlated with the results of other authors from the anatomical and surgical points of view. Fetus' studies have not been enough so far. However, it is rapidly increasing in literature, as fetal face is an important structure that can provide valuable information in the search for congenital malformations.³ It is for this reason that we used fetus specimens in this study. Al-Hayani⁴ in his study found an MMB presented by one branch (32%), 2 branches (40%) and 3 branches (28%). Liu

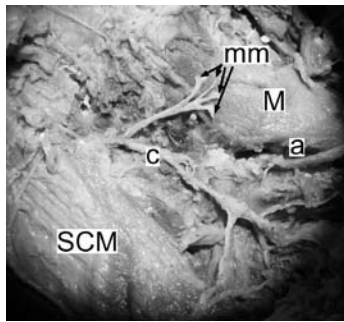


Figure 1 - Lateral view of the right side of the head and neck. Mandible (M) and sternocleidomastoid muscle (SCM), the facial artery (a), cervical (c) and marginal mandibular (mm, black arrows) branches of the facial nerve.

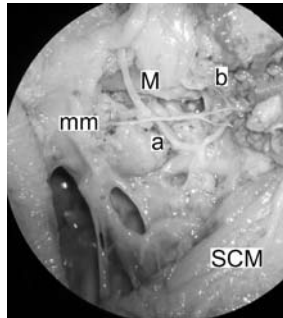


Figure 2 - Lateral view of the left side of the head and neck. Mandible (M) and sternocleidomastoid muscle (SCM), the facial artery (a), marginal mandibular (mm) and buccal (b) branches of the facial nerve.

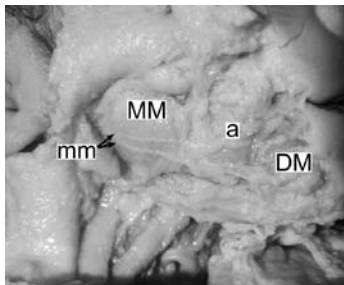


Figure 3 - Lateral view of the right side of the head and neck. The facial artery (a), marginal mandibular (mm, black arrows) branch of the facial nerve, depressor anguli oris muscle (DM) and masseter muscle (MM).

et al⁵ reported that the MMB was double or single in 95.9% of the specimens. Many researches measured the distance between MMB and the inferior border of the mandible in an adult cadaver. Many authors reported the distance between MMB and inferior border of the mandible as 3-3.5 cm.⁶ Anatomical studies have generally agreed regarding the measurements proposed by Risdon's technique, with an incision made 3-5 cm long, and at 2 cm below the inferior border of the mandible.⁶ In Al-Hayani's⁴ study it was either totally above the lower border of the mandible (28%), below

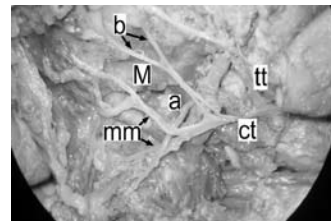


Figure 4 - Lateral view of the left side of the head and neck. Mandible (M), the facial artery (a), temporofacial (tt) and cervicofacial (ct) divisions of the facial nerve, marginal mandibular (mm and black arrows) and buccal (b) branches of the facial nerve.

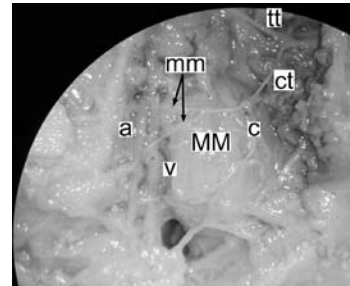


Figure 5 - Lateral view of the left side of the head and neck. The facial artery (a), facial vein (v), temporofacial (tt) and cervicofacial (ct) divisions of the facial nerve, cervical (c) and marginal mandibular (mm and black arrows) branches of the facial nerve and masseter muscle (MM).

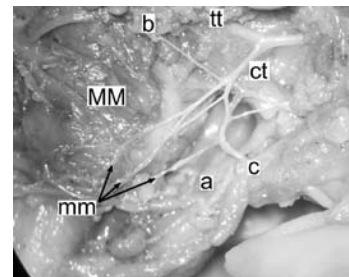


Figure 6 - Lateral view of the left side of the head and neck. The facial artery (a), temporofacial (tt) and cervicofacial (ct) divisions of the facial nerve, buccal (b), cervical (c) and marginal mandibular (mm, black arrows) branches of the facial nerve and masseter muscle (MM).

the mandible (44%), or in 28% of cases lying above and below it. Other author⁶ has recommended that the incision be made further from the mandible. We found that the lowest branch of the MMB was located below an average of 2.13 mm from the inferior border of the mandible, and the MMB was distributed in a narrower zone than those of other studies as our study was carried out in fetuses.

It was concluded that the lower border of the mandible can serve as an important landmark to avoid injury to the nerve, above it a subplatysmal flap is satisfactory, but below it a sub fascial flap is much safer.⁴ Potgieter et al⁷

stated that the standard technique used to protect the nerve is to place an incision, 2 fingerbreadths inferior to the mandible. For this reason, we consider that an incision distance does not need to be as far as 3-4 cm below the inferior border of the mandible. Incisions in the submandibular region should be performed at least 2 cm below the inferior border of the mandible. According to Kim et al,⁸ the cervicofacial division of the facial nerve arose in relation to the lateral aspect of the facial vein in 83% of specimens, and in relation to the medial aspect in 17%. The results of our study is similar to the finding of this author⁸ (in the present study, the MMB ran laterally to the facial vein in 42 (95.45%) of the 44 specimens). The facial artery passes between the branches of the MMB. Additionally, Kim et al⁸ found that the MMB coursed both superficial (in front of), and deep (behind) to the facial artery at the same time for a facial half. Batra et al⁹ explained the MMB of the facial nerve was found superficial to the facial artery and facial vein (anterior) in all cases (100%). Thus, the facial artery can be used as an important landmark in locating the marginal mandibular nerve during surgical procedures.⁹ Kim et al,⁸ likewise found that the MMB did not cross the facial artery even if the artery followed a course above the inferior border of the mandible. This is an excellent place to locate the MMB, and helps the surgeon to avoid any damage to the nerve during the surgery in the surrounding the mandibular angle.⁴

In 17.3% of cases in a study carried out by Kwak et al,¹⁰ the MMB sent nerve twigs to the buccal branch, which originated from the upper and lower divisions. Also, in 17.3% of cases, the nerve twigs from the zygomatic and MMBs merged to the buccal branch arising from the 2 main divisions.¹⁰ Batra et al⁹ explained that of the 50 cadavers studied for MMB of the facial nerve, it has anastomosis with the buccal branch of the facial nerve of the same side and the mental nerve. Previous authors found this in approximately 60% of cases,⁶ but we found it in 22% of the specimens. Hwang et al¹¹ in their study found between MMB of the facial nerve and mental nerve in all specimens' interconnections.¹¹ However, we have not observed the joining of the MMB with the mental nerve in any of the fetuses.

In conclusion, as in this study we observed the course of the MMB, and the relationship of MMB to the inferior border of the mandible and facial vessel, we found that the MMB had 2 branches or one single branch in 77.3% of the specimens. Likewise, the MMB coursed within the distance between 3.82 mm above, and 3.65 mm below the lower border of the mandible. Based on the findings of the present anatomosurgical study, it is recommended that an incision of 3.65 mm below the inferior border of the mandible is associated to a careful dissection in planes and flap retraction. The results of this study are different from previous studies

examining different populations as our study was carried out in fetuses. The MMB of the facial nerve is one of the most vulnerable branches to surgical injury due to its location.¹² For this reason, surgeons who are willing to operate on this area should have true knowledge and accurate judgement regarding the anatomy of this branch. It is important to emphasize the consequences of these associations between anatomical and surgical findings. This variability and differences between individuals means that the surgeon should consider the incision landmarks carefully according to the inferior border of the mandible during surgery. To be more useful for surgeons, more studies are needed on this issue.

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