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The Premasseteric Branch of Facial Artery: Its Importance for Craniofacial Surgery

Arteria Facialis Ramus Premassetericus'un Kraniyofasiyal Cerrahideki Önemi

Orhan MAĞDEN[1]
Nüket GÖÇMEN-MAS[2]
Sevda SENAN[3]
Mete EDİZER[4]
Ümit KARAÇAYLI[5]
Hamit Selim KARABEKİR[6]

1 Dokuz Eylul University, Anatomy Department, Izmir, Turkey
2 Afyon Kocatepe University, Anatomy Department, Afyonkarahisar, Turkey
3 Turkish Geriatric Foundation, Ankara, Turkey
4 Ondokuz Mayıs University, Anatomy Department, Samsun, Turkey
5 GATA Medical School, Oral and Maxillofacial Surgery Department, Ankara, Turkey
6 Afyon Kocatepe University, Neurosurgery Department, Afyonkarahisar, Turkey

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Correspondence address:
Hamit Selim KARABEKİR
E-mail: hskarabekir@hotmail.com

ABSTRACT

AIM: The masseter muscle is often exploited by craniofacial surgeons in transposition operations to correct facial palsy, benign masseteric hypertrophy; or neurectomy-induced atrophy of the muscle. A clear understanding of the course of the premasseteric branch of the facial artery and its relations with adjacent structures is essential in maneuvering the masseter muscle safely. In the present study the premasseteric branch was analyzed in details.

MATERIAL and METHODS: Neurovascular and anatomical features and relations of the premasseteric branch and its branches were evaluated according to location, origin, diameter, length and course by bilateral meticulous anatomic micro dissection under 4x loop magnification in formalin fixed 14 adult preserved cadavers.

RESULTS: The premasseteric branch originated separately from the facial artery in all cases. The course of the branch was observed to the upper anterior border of the masseter muscle. The diameter of the premasseteric branch was 1.12 mm (mean) at the level of origin. The diameter of the premasseteric branch was larger than the facial artery in 3% of cases. The location of the branch was defined according to body of the mandible. Branches and anastomoses of the premasseteric branch were also represented.

CONCLUSION: Anatomical data of the premasseteric branch will help craniofacial surgeons elevate flaps safely.

KEYWORDS: Premasseteric branch, Facial artery, Masseter muscle, Flap, Craniofacial surgery

ÖZ

AMAÇ: M. masseter, kraniofasiyal cerrahlara fasiyal palsi, benign masseter hipertrofisi, kraniofasiyal travma, nörektomi sonrası kas atrofisinin düzeltilmesi operasyonlarında büyük avantaj sağlar. Transpozisyon operasyonlarında kasın, kendisini besleyen a. facialis'in dalı olan ramus premassetericus'la birlikte güvenle taşınabilmesi için bu dalın seyrinin anlaşılması büyük önem taşır. Bu amaçla çalışmamızda, ramus premassetericus'un detaylı olarak incelenmesine çalışılmıştır.

YÖNTEM ve GEREÇ: 14 erişkin formalin ile fiske edilmiş kadavrada (12 erkek, 2 kadın; 55-82 yaşları arasında; 27 olgu: 14 sol-13 sağ taraf) anatomik mikrodiseksiyon yöntemiyle 4x büyüteç kullanılarak ramus premassetericus ve dalları ortaya konuldu. R. premassetericus yerleşim, orijin, çap, uzunluk ve seyir özellikleri, musculus masseter ve ductus parotideus ile ilişkisi yönleriyle değerlendirildi.

BULGULAR: Dalın m. masseter'in üst kenarı boyunca seyrettiği gözlendi. Dalın başlangıç noktası seviyesinde çapı ortalama 1,12 mm olarak saptandı. %3 olguda dalın çapı, a. facialis'in çapından daha büyüktü. Dalın yerleşimi corpus mandibula'ya göre belirlendi.R. premassetericus'un dalları ve anastomozları da ortaya konuldu.

SONUÇ: Ramus premassetericus'a ait verilerin kraniyofasiyal cerrahlara flaplerin güvenli kaldırılmasında yardımcı olacağı düşüncesindeyiz.

ANAHTAR SÖZCÜKLER: Arteria facialis, Ramus premassetericus, Musculus masseter, Flep, Kraniyofasiyal cerrahi

INTRODUCTION

Clinically, the masseter muscle which is supplied by the premasseteric branch of the facial artery is widely used in rehabilitation of facial palsy, benign or malign tumor excision of parotid gland, traumatic or non-traumatic upper and lower lip defect repairs. It is therefore important to know anatomical features of the premasseteric branch of the facial artery in detail in order to assist craniofacial surgery [8]. On the other hand, variations of the branch should be determined to enable early and efficient surgery for congenital paralysis related with Mobius syndrome and the tumors of surrounding tissue [8,10]. There are limited and scarce data about importance of the masseter muscle and its blood supplying regarding to flap operations [2], therefore meticulous dissection and attention to anatomic detail is mandatory in procedures that involve raising the flap. Prevention of damage to the premasseteric branch and its superficial and deep branches, and understanding of anatomic characteristics of the adjacent region are of great importance both during elevation or movement of the flaps and also for ensuring postoperative survival.

Classically, the masseter muscle is supplied by the masseteric branches of the maxillary, facial and transverse facial arteries [3,14]. The masseteric branch, also known as the premasseteric branch of facial artery, has an important role in the vasculature of the masseter muscle for reconstruction of the upper and lower lips defect [2].

Tthere are different and inconsistent findings regarding to existence, origin, and course and naming of the branch in the literature, and with the exception of Cunningham, it is ignored by contemporary texts. In 1921, Toldt first illustrated the branch but it was not named. It was described by Adachi in 1928, and it was then named as the premasseteric branch. Medical researchers must pay attention to the insufficiency and ambiguity of the classification about the branch, and these problems should be eliminated in order to allow better craniofacial surgery [2].

We therefore aimed to investigate the origin, location, length, size, adjacent structures of the premasseteric branch that is important for flap surgery and have a major role in masseter muscle bloodstream.

MATERIAL and METHODS

In the present study, the features of the premasseteric branch were evaluated according to the location, origin, diameter, length, course and relation of the branch with adjacent structures by bilateral anatomic micro dissections of 14 (12 males, 2 females; age range 55 to 82 years: 27 cases; 14 left side, 13 right side) formalin fixed preserved cadavers were performed under four times magnification with a loupe. The measurements were taken by using a fine micro caliper and expressed in millimeters. Micro dissections of the masseteric region of each cadaver were carried out and then masseter muscle flap was elevated bilaterally. The facial artery was displayed. The premasseteric branch was seen to originate from the facial artery. Its branches were also displayed in each cadaver by performing tangential dissection of skin, subcutaneous fat tissue, fascia and muscular layers.

The following parameters regarding the premasseteric branch were evaluated: (1) Location; (2) origin; (3) diameter of the branch at its origin; (4) length of the branch at origin; (5) course; (6) distance between origin points of the premasseteric branch and the marginal mandibular branch of the facial nerve; (7) distance between origin points of the premasseteric branch and the buccal nerve (8) distance between origin point of the branch and the superior edge and basis of the body mandible; (9) anastomoses of the premasseteric branch with the buccal branch of the maxillary and the transverse facial arteries of the superficial temporal artery; (10) relation of the branch with parotid duct and the masseter muscle (11) location of its branches, median size and length of (12) the superficial branch and (13) the deep branch; (14) distance between these branches and midpoint of anterior margin of the masseter muscle; (15) course of these branches according to the masseter muscle.

RESULTS

During the dissection of each region, the premasseteric branch of the facial artery was examined in respect of origin, position, branches, course and anatomical relations. The branch was examined by the micro dissection method in 27 cases, and the findings were carefully noted as follows: It was found to be originating separately from the facial artery in all cases. The course of the branch observed to run by anterior border of the masseter muscle (Figure 1). Diameter of the premasseteric branch was 1.12 mm (0.60 mm-2.10 mm) at the level of its origin. In 3% of the cases diameter of the premasseteric branch was found to be larger than the facial artery. Origin of the branch of the masseter muscle was 11.25 mm higher than the basis of the body mandible and 9.44 mm lower than the superior edge of the body mandible. It was located on the same projecting level of the body of mandible in 18.51% of the cases. The premasseteric branch had both a superficial (92.59%) and a deep (62.96%) branches (Figure 2). The mean length of the superficial branch of the premasseteric branch was found to be 27.42 mm (14 mm-58 mm) in 25 cases and the mean diameter of the branch at its origin was 0.90 mm (0.30 mm- 1.40 mm). The distance between superficial branch and midpoint of anterior margin of the masseter muscle was 5 mm (mean) anteriorly and 3 mm (mean) posteriorly. The mean diameter of the superficial branch at the midpoint of anterior border of masseter muscle was 0.88 mm (mean). The mean length of the deep branch of the premasseteric branch was mean 16.06 mm (7 mm-30 mm) and the mean diameter of the branch at its origin was mean 0.91 mm (0.40 mm- 1.60 mm). The relationships between the branches of the premasseteric artery and adjacent structures were determined (Figure 3). The distance between the deep branch and midpoint of anterior margin of the

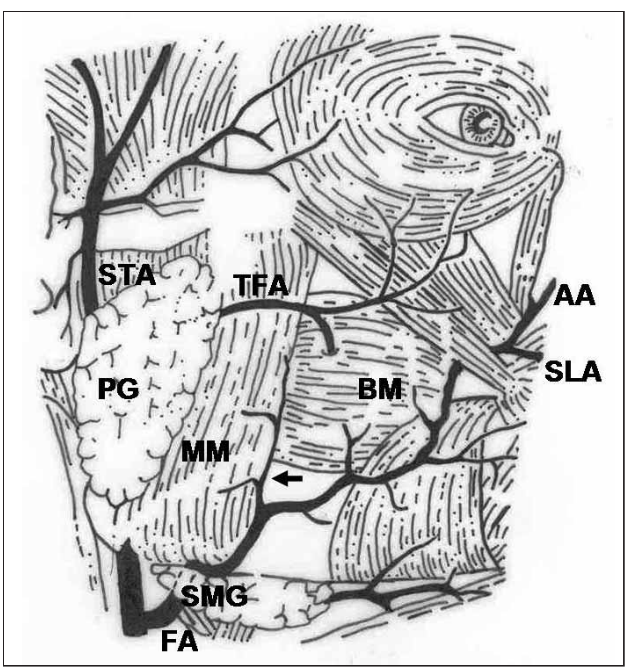

Figure 1. Course of the premasseteric branch and its relations has been demonstrated by the diagram. MM: Masseteric muscle, BM: Buccinator muscle, Arrow: Premasseteric branch, STA: Superficial temporal artery, TFA: Transverse facial artery, FA: Facial artery, SMG: Submandibular gland, PG: Parotid gland, AA: Angular artery, SLA: Superior labial artery.

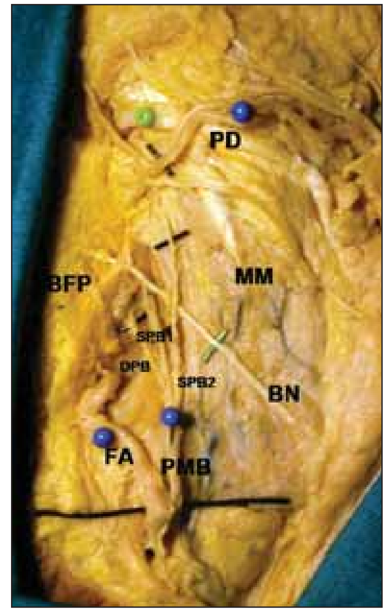

***Figure 2.** The premasseteric branch of the facial artery and its branches have been shown. PD: Parotid duct, BFP: Buccal fat pad, MM: Masseteric muscle, BN: Buccal nerve, PMB: Premasseteric branch, SPB1: Superficial premasseteric branch 1, SPB2: Superficial premasseteric branch 2, DPB: Deep premasseteric branch, FA: Facial artery.*

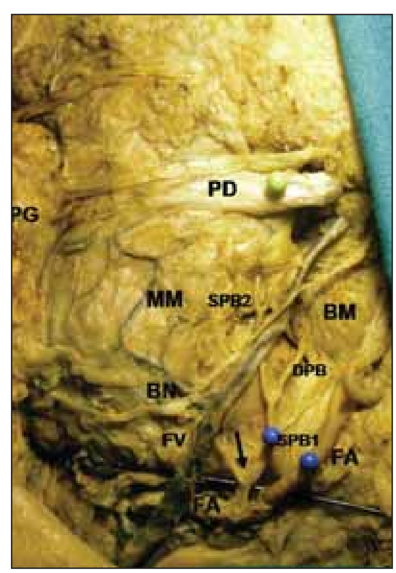

***Figure 3.** Relations with the branches of the premasseteric artery and adjacent structures. PD: Parotid duct, PG: Parotid gland, MM: Masseteric muscle, BM: Buccinator muscle, BN: Buccal nerve, SPB1: Superficial premasseteric branch 1, SPB2: Superficial premasseteric branch 2, DPB: Deep premasseteric branch, FA: Facial artery, FV: Facial vein, Arrow: Premasseteric branch.*

masseter muscle was 5.37 mm (mean). The deep branch was located approximately 5 mm deep within the masseter muscle. Perforating branches which pierced the masseter muscle were found at a rate of 22.22%. The mean distance between the origin points of the premasseteric branch and the marginal mandibular branch of the facial nerve was 9.23 mm (3 mm-49 mm) and with the buccal nerve was 22.57 mm (7 mm-33 mm) on average in all cases. It was determined that the branch was located on the upper side of the buccal branch at a rate of 11% and on the lower side of the buccal branch at a rate of 11% at its level of origin. The mean distance between origin of the deep branch and the parotid duct was 15.07 mm (9 mm-30 mm) and with the buccal branch was 33 mm (13 mm-49 mm) on average in all cases. The premasseteric branch anastomosed with the buccal branch of the maxillary artery (22.22%) and the transverse facial artery of the superficial temporal artery (37.03%) (Figure 4).

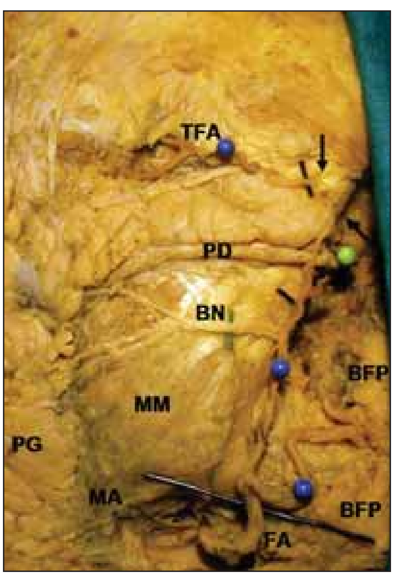

Figure 4. The premasseteric branch and its anastomose. PD: Parotid duct, PG: Parotid gland, BFP: Buccal fat pad, MM: Masseteric muscle, BN: Buccal nerve, TFA: Transverse facial artery, FA: Facial artery, MA: Mandibular angle, Arrows: Anastomose with the transverse facial artery and the premasseteric branch.

DISCUSSION

The masseteric branch of the facial artery may be a convenient and feasible nutrition supply for a masseter muscle flap. It is therefore preferred in upper and lower lip reconstruction, and in transposition operations to correct facial palsy; especially in regional muscle transplantation for the rehabilitation of facial paralysis, or after benign or extensive malignant tumor ablation of parotid gland [2,8,10] and traumatic tissue defects as well. It is also significant to know anatomical features and the course of the facial artery as it is the branch which supplies the masseter muscle. This makes it important with regard to surgical interventions such as applying Botilinum toxin-A for the repair of the benign masseteric hypertrophy, prevention fatal hemorrhaging during resection of masseter muscle and/or mandibular angle osteotomy [4-6,8]. Marinho et al asserted that the masseter muscle received its blood supply from the masseteric branch of the transverse facial, the facial, the maxillary, or the external carotid arteries [7]. In 1973 De Castro Correia and Zani, who noted that the masseter muscle receives blood supply from the masseteric artery (which originates from the internal maxillary artery), studied the vascular supply. They showed that the origin and the course of the masseteric artery are significant for a safe surgical procedure. They determined the location and depth of the incision is also essential to avoid complications [8]. An additional branch of the right external carotid artery in the form of an unusual connection of the masseteric artery to the masseter muscle was reported by Saadeh et al [10].Some variations in the origin patterns of the masseteric arteries have been described in the literature. Suwa et al reported that the masseteric artery arose directly from the posterior deep temporal artery as a variation [12].

Ariji et al aimed to clarify the normal findings regarding the masseter artery and around the masseter muscle, and also to present pathologic changes with Doppler sonography in their study. They examined the vascular appearances for masseteric artery of the facial artery. The facial artery fed the masseteric muscle from the inferior as well as the masseteric branch according to anatomic variation in 22.4% of cases [1]. During the course of our research,it was found that the premasseteric branch lies upward and nearly through the anterior border of the masseter muscle, and its perforator branches which enter the masseteric muscle are given off by the premasseteric branch in 22.22% of the cases.

Although many authors searched the masseteric branches of the transverse facial artery and the maxillary artery, there was no data about using the premasseteric branch of the facial artery in the

Table I:

Parameters	Description	Mean mm	Minimum mm	Maximum mm
1	**Diameter (PMB-at origin)**	1.12	0.60	2.10
2	**Diameter (SB)**	0.90	0.30	1.40
3	**Diameter (DB)**	0.91	0.40	1.60
4	**Length (SB)**	27.42	14	58
5	**Length (DB)**	16.06	7	30
6	**Distance between DB and PD**	15.07	9	30
7	**Distance between DB and BN (at origin)**	33	13	49
8	**Origin level (According to MMB)**	9.23	3	49

*SB; superficial branch
**DB; deep branch
***PMB; premasseteric branch
+BN; buccal nerve
++MMB; marginal mandibular branch
+++PD; parotid duct

craniofacial reconstructive surgery after craniofacial trauma like blow-out fractures [11]. Furthermore, there were have also been some studies about how the premasseteric branch of the facial artery along the anterior margin of the masseter muscle varies among species [13-15]. It is mandatory to know the anatomical features of the masseteric branch, which is also known as the premasseteric branch of facial artery [2], as the process of a successful flap transfer has some difficulties due to its variability.

The branch was first described by Adachi in 1928 and named as the premasseteric branch. He found it to be as big as or even bigger than the facial artery in 3% of cases, and to exist as a small vessel in an unspecified larger number than this. It ascends along the anterior edge of the masseter muscle accompanied by the facial vein [2]. According to classical textbooks, the branch was found to originate from the facial artery in all cases. In the present study, the premasseteric branch was also found to accompany the premasseteric branch of the facial vein in all cases, and the course of the branch was determined to pass upward nearly through the anterior border of the masseter muscle.

Classically, the masseter is a quadrilateral muscle consisting of superficial, middle, and deep layers, which blend anteriorly. We used some anatomic landmarks to evaluate the branch according to the muscle during dissection. We thought that the depth of incision should be limited to the superficial layers in order to avoid vascular damage during reconstructive surgery. We noted that the incision of the muscle should be performed at the junction of the anterior two-thirds with the posterior one-third, or along an imaginary line at the midpoint of the muscle. For a successful craniofacial reconstructive surgery and a suitable flap design, adequate anatomical knowledge is needed, and a meticulous non-traumatic technique is necessary to avoid damaging the adjacent vascular and neural structures. We have not encountered intra and postoperative complications during the use of this incision in our cases. The skin flap was well tolerated and resulted in an acceptable cosmetic appearance.

Our study differs from the literature in that the distance between the origin point of the branch and the facial nerve, the buccal branch and marginal mandibular branch were measured to protect adjacent neurovascular structures and contributing craniofacial reconstructive procedures. In addition, the measurements and significant parameters of adjacent relationships such as the masseter muscle, parotid gland were determined in our study.

We also investigated anatomoses of the premasseteric branch. Pinar et al noted anastomoses with the branch of the transverse facial artery and a branch of the facial artery on the masseteric fascia in all cases [9] whereas in our findings, the premasseteric branch of the facial artery anastomosed with the transverse facial artery of the superficial temporal artery in 37.03% of cases. It was also established that the premasseteric branch of facial artery anastomosed with the buccal branch of the maxillary artery in 22.22% of the cases. According to these data and findings, it may be considered that flaps can be removed safely via their supplementary artery, and that there will be an increase in postoperative survival in addition. The results of this research will be helpful for better understanding of the vascular communication between the premasseteric branch, the buccal branch and the transverse facial artery in the vascular territory of anatomy and surgery.

In addition, the preservation of the premasseteric branch or understanding anatomic characteristics of the adjacent region are a valuable contribution for surgical procedures in cases of craniofacial trauma defect by providing normal anatomical reorganization.

In conclusion our findings will also provide anatomic information and guidance and will support the literature and provide a clinical contribution for designing reliable surgery.

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