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The Infraorbital Artery in Fetuses: Clinical Relevance in Perforator Flap Surgery

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ABSTRACT

Introduction: The reconstruction of soft tissue detects in mid facial region are highly demanding. Most challenging region are nasal alla. For full thickness nasal alla defects most authors use nasolabial flap based on facial/angular arcade,but for recidivans tumors the infraorbital perforator flap is a good solution. **Aim:** The aim of our research was to analyze the number and the course of the infraorbital artery terminal branches. **Material and methods:** Material was 60 fetal hemifacial specimens of different gestational ages. Fetuses were fixed in 10% formalin and arterial blood vessels were injected with Micropaque solution (barium sulfate). Samples were further processed by Spalteholz technique, their images captured with digital camera and analyzed. Infraorbital artery was constant artery and had 2 to 4 terminal branches supplying infraorbital region. The majority of its terminal branches were characterized with descending course. Reach anatomical network of infraorbital artery made anastomoses with facial artery. **Conclusion:** Perforator flap based on infraorbital artery had well defined vascular supply with numerous soft tissue branches, which qualify this flap as safe solution for nasal reconstruction.
Key words: Anatomy; Infraorbital artery; Perforator flap; Nasal reconstruction; Surgery

1. INTRODUCTION

Numerous arteries which supply the soft tissues of the face such as facial, superficial temporal, posterior auricular, occipital, infraorbital and ophthalmic arteries were described in the classical anatomical literature. However, three blood vessels are dominant in the arterial supply of the skin of the face. These are facial, superficial temporal and infraorbital artery (1). Perforator branches of latter cited arteries might be used as vascular stalks of numerous flaps which could be used for the facial soft tissue defects reconstruction (2).

Facial artery is the anterior branch of the external carotid artery. Its main trunk firstly travels behind the posterior belly of the digastric and stylohyoid muscle and submandibular gland. Afterwards, it crosses the base of mandible and enters into the facial region. Its side branches such as submental artery, superior and inferior labial arteries, lateral nasal branch angular artery supply mental region, lips, lower part of the parotidomasseteric region, checks then orbital, infraorbital and nasal regions (3, 4). Many authors cited in their papers their positive experience in successful application of the flaps, for which some branches of the facial artery were used as vascular stalk, in the reconstruction of the perioral and nasal region soft tissue defects (5-9).

Superficial temporal artery represents one of the external carotid artery terminal branches. It has ascending course between the external auditory meatus and temporomandibular joint, where it accompanies auriculotemporal nerve. Its branches like transverse facial artery, zygomatic-orbital artery, middle temporal artery and anterior auricular branches take part in the vascular supply of the parotidomasseteric region upper part, then auricular and zygomatic regions and, partially in the supply of the buccal, orbital and infraorbital regions (3, 4). There are numerous literature data about the application of superficial temporal artery and its branches in the reconstruction of the soft tissue defects of the face (10, 11).

Infraorbital artery (IOA) is the branch of the maxillary artery. It appears in pterygopalatone fossa as a branch of third part of maxillary artery.It enters the orbit through inferior orbital fissure traveling anteriorly through infraorbital groove and infraorbital canal. Intraorbital part of artery gives the branches for orbit, upper teeth and max-

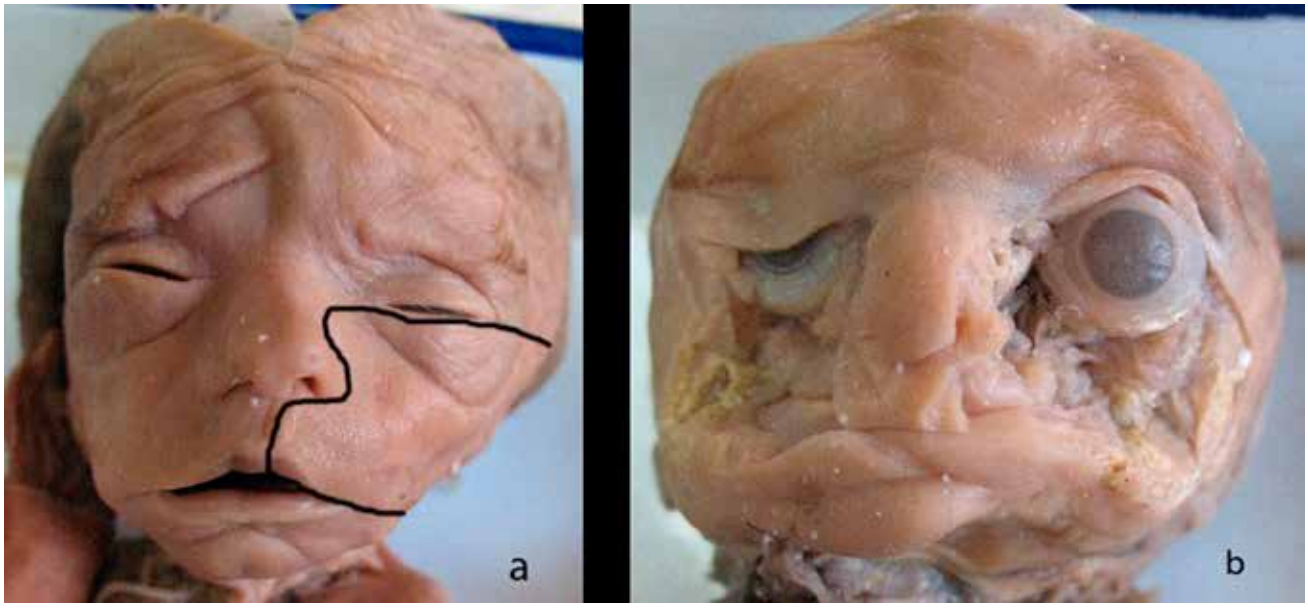

Figure 1. Image of the left side of one fetal case face on which are the boundaries of the dissected region for further processing and analysis of IOA marked with black line (a) and, the face of the fetal case with this region dissected on both sides (b).

illary sinus. Its terminal part passes through infraorbital foramen to enters the face and on the anterior surface of maxilla terminate with several terminal branches (3, 4). These branches form anastomoses with angular artery in lower eyelid, then with facial artery in upper lip and, with dorsal nasal, buccal and transverse facial artery, respectively. Although less frequently than the latter cited arteries, some authors in their papers describe the possibilities of the IOA and its terminal branches application in the reconstruction of the facial soft tissue defects as infraorbital perforator flap (IOPF) (12, 13). We successfully applied the IOPF in the nose defects reconstruction, with good color matching and minimal donor-site morbidity during the last 5 years (14). So, the aim of our research was to detect and analyze the number and the course of the IOA terminal branches.

2. MATERIAL AND METHODS

The material used in this study was both sides (right and left) of the 30 human fetuses face. The fetuses have been previously fixed in 10% formalin and their arteries injected with Micropaque solution (barium sulfate) (Merck, Darmstadt, Germany). They are part of the Department of Anatomy of the Faculty of Medicine in Niš collection. All fetuses were medico legally provided from the Clinic of Gynecology and Obstetrics of the Faculty of Medicine in Nis, where it was established that they were without anatomical deformities and systemic disease. (All clinics and departments, as parts of the Faculty of Medicine University Nis, have integrated professional cooperation and internal ethical control).

Fetal age ranged from the forth to the ninth lunar month which was established by measuring crown-rump length. Microdissection was performed under 5× magnifying lenses. Skin incision which extended from lower eyelid, across the cheek up to the upper lip was made. Afterwards, the skin and the soft tissues beneath it were removed, as well as a part of the orbital floor which comprised the roof of the infraorbital canal. Figure 1a presents the direction across which the skin incision was made and subsequent soft tissue removal was performed. Figure 1b presents the case with soft tissues removed on both sides of the face. Fetal faces were further processed by Spalteholz technique, their images captured with digital camera and analyzed.

3. RESULTS

The presence of the IOA was detected in all cases on both sides. After the passing through the infraorbital foramen it descended toward the nasolabial sulcus where it divided into terminal branches. The most frequently IOA gave off 3 terminal branches (Figures 2c, 2d) (40% of the evaluated cases). Less frequently (33.3% of the cases) IOA bifurcated inferiorly into 2 terminal branches (Figures 2a, 2b). In 23.3% of the cases IOA divided into 4 terminal branches at its end and, only in 2 cases (3.4%) it gave off a "bouquet" of terminal branches (Figures 2g, 2h).

In all samples the first branch (the most medial ones) supplied upper lip and nasal alla, while the rest of them traveled inferiorly toward buccal region and in such way could present reliable anatomical source for infraorbital perforator flap. The differences between left and right side were not significant. Anastomosis with facial artery was observed in 46 samples (76.6%).

4. DISCUSSION

The nasal reconstruction has been a challenging procedure for the plastic surgeons since the 18th century. One of the first published reconstructions described the use of delayed random pattern skin flap by Tagliacosi (15). Nowadays the reconstruction must fulfill functional and aesthetic goals (16). Residual deformity in donor region has to be acceptable and functional outcome has to provide proper nasal breathing (17). Nasolabial flap based on facial artery is well analyzed and the most frequently used for nasal reconstructions (18, 19). The anastomoses of facial, transverse facial and infraorbital artery are described and discussed in clinical application of ped-

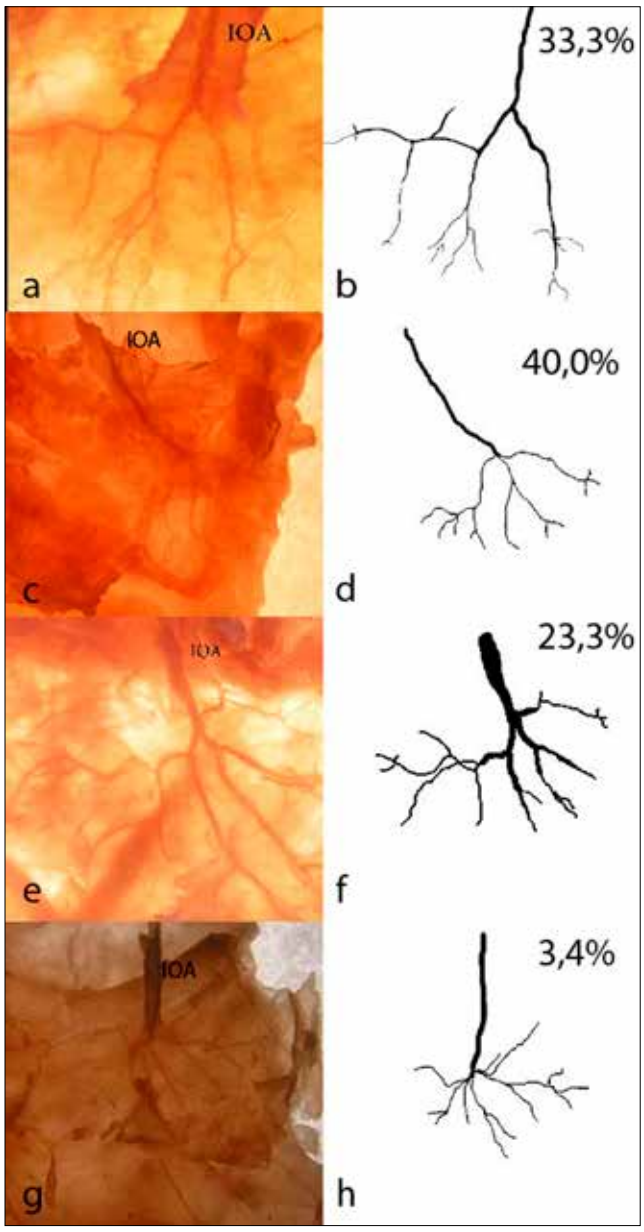

Figure 2. Observed types of the IOA terminal branching their frequency (in percentages) in the evaluated sample; 2 terminal branches (a, b), 3 terminal branches (c, d), 4 terminal branches (e, f) and "bouquet" of terminal branches (g, h).

icled flaps for nasal reconstructions (20-22). The IOPF can be used for nasal defects after burn scar excision, after Werener granuloma excision or after tumor excision (23, 24). The use of IOPF obtains good skin quality and meets aesthetic requirements. The nasal cheek grove is well defined and residual donor site deformity is hidden in nasolabial groove. The IOPF harvest starts with skin and subcutaneous tissue incision and then continues with flap elevation which starts at its inferior border forwarding upward. Sometimes part of zygomaticus major muscle can be included. The infraorbital artery and vein must be preserved as pedicle. Besides some earlier studies such as the ones of Noguchi and Hataya, there are not any more recent literature data which emphasize the importance of infraorbital blood vessels in the nasal ala reconstruction (23, 24). Some authors described infraorbital artery as additional supply for nasolabial flap based on angular artery (8, 9, 25).

According to the normal functional anatomical study of Lasjaunias et al, blood supply of the facial skin was provided by the facial system and transverse-maxillary system (26). These authors thought that it is easy to understand the functional arterial supply of this region if two points in the course of the facial trunk – the jugal point and the labial point – are identified. If the jugal point is dominant, the facial system would be of primary importance in the supply of this area. Conversely if the labial point is dominant, the transverse-maxillary system becomes more significant. Xiong et al suggested that the vascular distribution has certain directivity on different areas (1). For instance, in the middle of face the vessels run horizontally from ear to nose; in the frontal region, blood vessels are distributed vertically in inferior to superior direction; and in the mental region, the vessels run obliquely from the mandibular margin to internal superior (nose). The branches that diverge from these arteries anastomose and form a subdermal vascular network. The results of our study showed that at least of the IOA terminal branches travels directly inferiorly through the soft tissue of the cheek. This fact could represent the advantage of this blood vessel in relation to the others which are usually applied as vascular stalk for these kinds of the flaps.

Infraorbital artery is permanent anatomical structure which supply lateral part of nose, cheek and part of upper lip. It forms reach anatomical network with facial and transverse facial arteries (27, 28). Its clinical application as pedicle for the flap exclusively based on infraorbital artery support the application of infraorbital artery perforator flap.

CONFLICTS OF INTEREST: NONE DECLARED.

REFERENCES

1. Xiong SH, Cheng XD, Xu DC, Li N, Yan L, Zhao TL, Yu L, Liao H, Suwa F, Takemura A, Toda I, Ike H, FangYR. Facial subdermal vascular network flap: anatomic study and clinical application. Surg Radiol Anat. 2002; 24(5): 258-264.
2. Yang D, Tang M, Geddes CR, Morris SF. Vascular Anatomy of the Integument of the Head and Neck in Blondeel Ph et all. (ed) Perforator Flaps: Anatomy, Technique & Clinical Applications. Quality medical publishing, St Louis, 2006: 133.
3. Williams PL, Warwick R, Dyson M, Bannister LH.. Gray's Anatomy. Churchill Livingstone. New York, 1995.
4. Dauber, W. Pocket atlas of human anatomy. Thieme, New York, 2007: 234-238.
5. Karsidag S, Ozcan A, Sumer O, Ugurlu K. Single-stage alanasi reconstruction: lateral nasal artery perforator flap. J Craniofac Surg. 2010; 21(6): 1887-1889.
6. *Nakajima, H, Imanishi N, Aiso S.* Facial Artery in the Upper Lip and Nose: Anatomy and a Clinical Application. PlastReconstr Surg. 2002; 109: 855-861.
7. Sohn WI, Choi JY, Seo BF, Jung SN. Reconstruction of nasal ala with nasolabial perforator flap after cancer removal. Head Neck Oncol. 2012; 4(4): 83.
8. Gardeto A, Erdinger K, Papp C. The Zygomatic flap: a further possibiliity in reconstructing soft tissue defects of the nose and upper lip. Plast reconstr Surg. 2004; 113(2): 485-490.
9. Gardeto A, Moriggi B, Maurer H, Erdinger K, Papp C. Anatom-

ical basis for a new island axial pattern flap in the periorbital region. Surg Radiol Anat. 2002; 24(3-4): 147-154.
10. Li S, Cao W, Cheng K, Yin C, Qian Y, Cao Y, Chang TS. Microvascular reconstruction of nasal ala using a reversed superficial temporal artery auricular flap. J Plast Reconstr Aesthet Surg. 2006; 59(12): 1300-1304.
11. Yamauchi M, Yotsuyanagi T, Yamashita K, Ikeda K, Urushidate S, Mikami M. The reverse superficial temporal artery flap from the preauricular region, for the small facial defects. J Plast Reconstr Aesthet Surg. 2012; 65(2): 149-155.
12. Cöloğlu H, Koçer U, Kankaya Y, Sungur N, Oruç M. Lower eyelid orbicularis oculi musculocutaneous flap for reconstruction of nasal tip and supratip defects.Plast Reconstr Surg. 2006; 117(1): 239-246.
13. Liang CY, Zhao HW, Wang LJ, Li LJ. Reconstruction of penetrated nasal defects with nasolabial skin flap pedicled on the infraorbital vessels. J Craniofac Surg. 2010; 21(1): 68-70.
14. Kovacevic P, Hrgovic I, Kovacevic T, Hrgovic Z. Singe stage turn in perforator infraorbital flap for nasal ala reconstruction, Med Arch. 2013; 67(6): 450-453.
15. Losch GM. The history. in Berger A, Hierner R (ed). Plastic surgery basics, principles techniques, Springer WerlagHaidelberg, 2003: 6-24.
16. Kalus R, Zamora S. Aesthetic consideration in facial reconstructive surgery: the V-Y flap revisited. Aesthetic Plast Surg. 1996; 20: 83-86.
17. Lavasseur JG, Mellete JR. Techniques for reconstruction of perialar and perialar-nasal ala combined defects. DermatolSurg. 2000; 26: 1019-1023.
18. Cameron RR, Latham WD, Dowling JA. Reconstructions of the nose and upper lip with nasolabial flaps. Plast ReconstrSurg. 1973; 52: 145-150.
19. Herbert DC. A subcutaneous pedicled cheek flap for reconstruction of alar defects. Br J Plast Surg. 1978; 31: 79-92.
20. Chen E, Johnson T, Ratner D. Introduction to flap movement: reconstruction of five similar nasal defects using different flaps. Dermatol Surg. 2005; 31: 982-985.
21. Redondo P. Advancement flap in the reconstruction of lateralnasal sidewall defect. Dermatologic Surg. 2006; 32: 855-857.
22. Steenfos H, Tarnow P, Blomqvist G. Experience with the modified defatted nasolabial transposition flap in nasal reconstruction. Scand J Plast Reconstr Hand Surg. 1995; 29: 51-52.
23. Hataya Y, Kosaka K, Yamazaki M, Asai S, Suzuki K. Reconstruction of burned nasal alae with vascular island skin flap pedicled on the infraorbital vessels. Burns. 1995; 21(4): 313-315.
24. Noguchi M, Matsuo K, Hirose T. Reconsruction of short nose deformity using nasolabial flaps pedicled on the infraorbital vessels. Br J Plast Surg. 1991; 44(8): 567-569.
25. Giebfried JW, Urken ML, Lawson W, Biller HF. Reconstruction of nasal defect with a nasolabial island flap. Arch Otolaryngol Head Neck Surg. 1987; 113(3): 295-298.
26. Lasjaunias P, Berenstein A, Doyon D. Normal functional anatomy of the facial artery. Radiology. 1979; 133: 631-638.
27. Whetzel TP, Mathes SJ. Arterial anatomy of the face: an analysis of vascular territories and perforating cutaneous vessels. Plast Reconstr Surg. 1992; 89(4): 591-603.
28. Rorich RJ, Conrad MH. The superiorly based nasolabial flap for simultaneous alar and cheek reconstruction. Plast Reconstr Surg. 2001; 108: 1727-1730.