©Borgis

*Piotr Trojanowski[1], Krzysztof Pyra[2], Michał Sojka[2], Michał Górnik[2], Agnieszka Trojanowska[3], Janusz Klatka[1], Tomasz Jargiełło[2]

Incidence of the peroneal magnus artery in patients planned for free fibula transfer

Częstość występowania dominującej tętnicy strzałkowej u chorych planowanych do przeszczepu wolnego płata strzałkowego

[1]Department of Otolaryngology and Head and Neck Surgery, Medical University in Lublin
Head of Department: Professor Janusz Klatka, MD, PhD
[2]Department of Interventional Radiology and Neuroradiology, Medical University in Lublin
Head of Department: Professor Małgorzata Szczerbo-Trojanowska, MD, PhD
[3]Department of Radiology and Nuclear Medicine, Medical University in Lublin
Head of Department: Professor Andrzej Drop, MD, PhD

Keywords

angiography, free fibula flap, vascular variants

Słowa kluczowe

angiografia, wolny płat strzałkowy, naczyniowe odmiany anatomiczne

Summary

Introduction. Free fibula flap is recognised as the workhorse flap for mandible reconstruction. There are several anatomical variations of the crural arteries and its branches and knowledge of these has important clinical implications for fibula flap harvest. Surgeons performing free fibula flap transfer in patients with dominating peroneal artery should be aware of high risk of leg ischaemic complication.

Aim. The aim of this study was to report our experience on 65 free fibula flaps, highlighting a type of anatomical variation of the peroneal artery – peroneal magnus artery in patients undergoing osteocutaneous free fibula flap transfer for mandible reconstruction.

Material and methods. Sixty-five patients from the Department of Otolaryngology and Head and Neck Surgery Medical University in Lublin were planed to free osteocutaneous fibula flap harvest for the mandibular reconstruction due to the defects after oncological resections (squamous cell cancers). Patients underwent clinical examination, they all had normal distal pulse. Before operations angiography of lower extremities was performed in all patients. After selective injection of 15 ml of contrast media to the popliteal artery in both legs crural arteries were visualised.

Results. Out of 65 patients, in two, angiography reviled diffuse arteriosclerotic changes in all tree crural arteries. In two next patients one 48y old male in both extremities and in one 64y old female in left lower extremity an anatomical anomaly of peroneal artery was detected. In both patients anterior and posterior tibial arteries were hypoplastic. Anatomical variant, the peroneal magnus artery was diagnosed.

Conclusions. The free fibula flap is the gold standard for microsurgical reconstruction of bone defects involving the mandible and other anatomical regions. Surgeons conducting reconstructive surgery should be aware of possible vascular anomalies of crural arteries. Even in patients with normal distal pulses, before harvesting of fibula flap angiographic investigations should be considered to avoid foot ischaemia at the donor site.

Streszczenie

Wstęp. Wolny płat strzałkowy jest podstawowym płatem wykorzystywanym do rekonstrukcji żuchwy. Występuje wiele odmian anatomicznych tętnic goleni i wiedza na ten temat ma bardzo istotne znaczenia kliniczne. Chirurdzy przeprowadzający zabiegi rekonstrukcyjne przy użyciu wolnego płata strzałkowego u chorych z dominującą tętnicą strzałkową (ang. *peroneal magnus artery*) powinni brać pod uwagę możliwość powikłań niedokrwiennych związanych z pobraniem tej tętnicy do przeszczepu.

Cel pracy. Celem prcy jest przedstawienie własnych doświadczeń z wykonania 65 wolnych przeszepów strzałkowych z podkreśleniem znaczenia odmiany anatomicznej w postaci dominującej tętnicy strzałkowej.

Materiał i metody. Sześćdziesięciu pięciu chorych z Kliniki Otolaryngologii UM w Lublinie zostało zaplanowanych do zabiegu rekonstrukcji żuchwy z powodu ubytku po resekcji raka płaskonabłonkowego (ang. *squamous cell cancer*). W badaniu fizykalnym

Conflict of interest
Konflikt interesów

None
Brak konfliktu interesów

Address/adres:

*Piotr Trojanowski
Department of Otolaryngology
and Head and Neck Surgery
Medical University in Lublin
ul. K. Jaczewskiego 8, 20-954 Lublin
tel. +48 (81) 724-41-54
fax +48 (81) 724-48-00
troja23@gmail.com

u wszystkich chorych oceniono tętno na stopie jako prawidłowe. Przed zabiegiem chirurgicznym u chorych wykonano angiografię tętnic kończyn dolnych. Po wybiórczym podaniu 15 ml środka cieniującego do tętnic podkolanowych w obu kończynach uwidoczniono tętnice goleni.

Wyniki. Spośród 65 chorych u dwóch w badaniu angiograficznym stwierdzono rozległe zmiany miażdżycowe pod postacią licznych przewężeń światła i odcinkowych niedrożności. U kolejnych dwóch chorych – 48-letniego mężczyzny w obu kończynach i 64-letniej kobiety w lewej kończynie dolnej – wykryto anomalię naczyniową tętnicy goleni. U obu chorych stwierdzono hypoplastyczne tętnice piszczelowe przednie i tylne. Rozpoznano u obu chorych wariant anatomiczny w postaci dominującej tętnicy strzałkowej.

Wnioski. Wykorzystanie wolnego płata strzałkowego do rekonstrukcji żuchwy i ubytków w innych obszarach anatomicznych jest bardzo często wykorzystywane. Chirurdzy wykonujący operacje rekonstrukcyjne z użyciem tego płata powinni brać pod uwagę ewentualne wady naczyniowe w obrębie goleni. Nawet u chorych z zachowanym prawidłowym tętnem na stopie przed pobraniem wolnego płata strzałkowego powinna być wykonana angiografia tej kończyny, by uniknąć ewentualnych powikłań niedokrwiennych w obrębie kończyny.

INTRODUCTION

The introduction of microsurgical flaps for osseous reconstruction had a major role in the clinical practice. The free fibula flap was first described by Taylor et al. (1) in 1975 for the reconstruction of post-traumatic bone defects where an osteocutaneous fibula flap for mandibular reconstruction was developed by Hidalgo in 1991 (2). From that time the free fibula flap is recognised as the workhorse flap for mandible reconstruction. The length of the bone and the thin, pliable, cutaneous island allow extensive reconstruction not only of the mandible but also of the surrounding soft tissues. The fibula flap offers usually 25 cm or more of straight cortical bone and a vascular pedicle up to 12-15 cm length, with perforators of the adequate caliber to supply the skin island (3-5).

Crural vascularisation originates from the popliteal artery, which crosses the popliteal fossa and gives origin to the Anterior Tibial Artery (ATA), and the tibio-peroneal trunk that gives rise to the Posterior Tibial Artery (PTA) and the Peroneal Artery (PA) (fig. 1) (6). There are several anatomical variations of the crural arteries and its branches, and knowledge of these has important clinical implications for free fibula flap harvest. As the number of patients with microsurgical fibula transfers increase every year surgeons are more often confronted with anatomical variants that may complicate the operating plans.

AIM

The aim of this study was to report our experience on 65 free fibula flaps, highlighting a type of anatomical variation of the peroneal artery – peroneal magnus artery in patients undergoing osteocutaneous free fibula flap for mandible reconstruction.

MATERIAL AND METHODS

Sixty-five patients from the Department of Otolaryngology and Head and Neck Surgery Medical University in Lublin were planed to free osteocutaneous fibula flap harvest for the mandibular reconstruction of defects after oncological resection (squamous cell cancer). There were 47 male (72%) with a mean age of 53 years and 19 female (28%) with a mean age of 57 years. Patients underwent clinical examination, they all had normal distal pulse. Before surgery patients were referred to angiography of lower extremities. Angiography of the lower legs was performed in the Department of Interventional Radiology and Neuroradiology Medical University in Lublin. When the harvest of the left fibula flap was planed access for angiography was from the right femoral artery. In patients who were prepared for reconstruction with the use of the right fibula flap angiography was performed with the puncture of the left femoral artery.

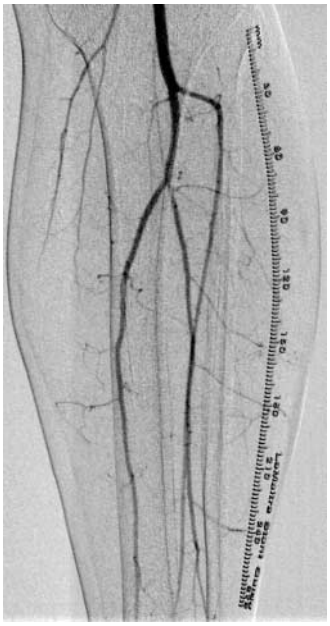

Fig. 1. Angiography of the crural arteries. Type A – normal division of the popliteal artery

Under local anaesthesia using Seldinger technique a puncture of the common femoral artery was performed. After puncture of the femoral artery in the groin the 5F catheter was introduced to the iliac artery and then to the contralateral femoral artery. Then catheter

was selectively guided into the popliteal artery. Angiography was performed with a use of 20 ml of contrast media (Visipaque 350, GE HealthCare). The catheter was then placed in the ipsilateral iliac artery and angiography was carried in the same manner. Crural arteries and the foot arteries were visualised. After angiography the patient remained in bed for 24 h.

RESULTS

In all patients diagnostic angiography was obtained.

In 2 patients arteries of lower extremities showed diffuse arteriosclerotic symptoms demonstrated by multiple stenosis and segmental artery occlusions (fig. 2).

Two other patients had anatomical variations of the tibial arteries. In one 48y old male in both extremities and in one 64y old female in left lower extremity an anatomical anomaly of peroneal artery was detected. In both patients anterior and posterior tibial arteries were hypoplastic (fig. 3). Anatomical variant the peroneal magnus artery was diagnosed.

DISCUSSION

There are several variabilities of the ATA, PTA and PA in their origin, diameter and course. Lippert and Pabst (7) and later Kim et al. (8) introduced an anatomical classification of crural vessels. They distinguished three groups of the anatomical variation of the crural arteries. Knowledge of these variations is crucial for surgeons performing fibula flap harvest.

Group III shows variations in the arterial supply to the foot because of hypoplasia or aplasia of the tibial branches. In type III-A, the PTA is hypoplastic or aplastic and the PA replaces the posterior distal circle. In type III-B, there is ATA hypoplasia or aplasia and a large peroneal artery is replacing the dorsalis pedis artery at the ankle. In type III-C, in which both ATA and PTA are hypoplastic or aplastic, dorsalis pedis and tibial arteries are replaced by the peroneal artery at the ankle (9, 10).

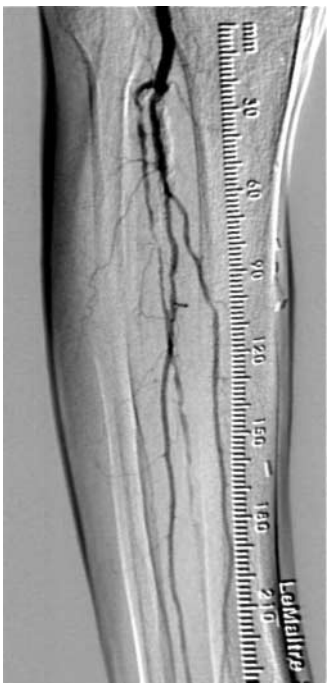

Fig. 2. Angiography of the crural arteries. Diffuse arteriosclerotic symptoms demonstrate multiple stenosis and segmental artery occlusions

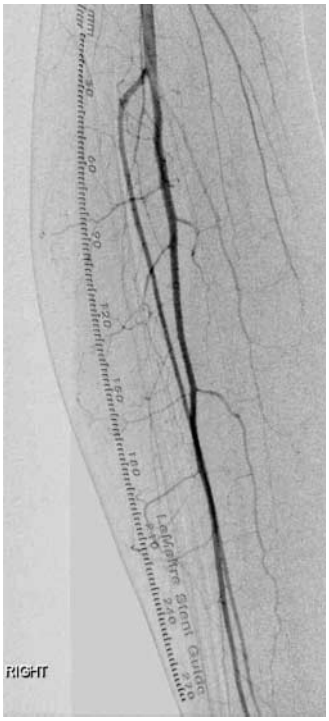

Fig. 3. Angiography of the crural arteries. Dominant peroneal artery. Hypoplastic anterior and posterior tibial arteries

The blood supply to the fibula is based on the peroneal artery (PA). On its course it gives important branches like the fibular nutrient artery and up to six circular arteries which branches supply the lateral skin of the leg. Variations of this anatomical pattern are found in about 8% of the population (8).

The peroneal artery is not usually the main supplier of blood to the leg. Blood flow is supplied through ATA and PTA. However in cases of congenital anomalies or atherosclerosis of the tibial arteries, the peroneal artery is becoming the main nutrient artery.

From the anatomical studies of Lippert and Pabst (7) and Kim et al. (8) we can learn that the peroneal artery was the exclusive blood supply of the foot in 0.2% and was congenitally absent in less than 0.1%. Abou-Foul and Borumandi analysed 5790 limbs and dominant peroneal artery was found in 5.2% of all limbs (11).

Despite awareness of several anatomical variants of the crural arteries evaluation of the vascular system preoperatively before free fibula flap transfer remain controversial.

Disa and Cordeiro evaluated hundred patients as candidates for free fibula harvest and stated that routine preoperative arteriography was unnecessary (12). Oxford and Ducic transferred free fibula in 16 patients and they used preoperative angiography to select appropriate candidates for this procedure (13).

Young et al. before considering fibula flaps in 28 patients evaluated their preoperative angiograms (14). Angiographic abnormalities altered their operative

plans in seven patients by showing anatomical variations. Two of these patients had a peroneal magnus artery despite normal distal pulses. In this group of patients incidence of peronea magna was 7%. They recommended the routine use of preoperative bilateral angiography of the legs in each patient in whom fibula flap is taken into consideration. In our group of patients peroneal magnus artery was detected in 2 patients which makes 3% of the whole group.

Clinical studies presented above showed much higher (4.3-7%) frequency of peroneal magnus artery than (0.2%) that was detected in the anatomical studies of Lippert and Pabst (7) and Kim et al. (8).

Lorenz and Esclamado evaluated 32 patients prepared for transplantation of free fibula flaps (15). They have found that the correlation between patent proximal arteries and palpable distal pulses was unreliable. Our observation support this opinion but is in controversy to the statement of Lutz et al. who postulated that clinical evaluation of the pedal pulses will provide enough information about the donor leg (16). In their opinion the only condition in which lower leg angiography is essential are abnormal pedal pulses and previous serious trauma to the donor leg.

Based on clinical studies relatively high incidence of peroneal magnus artery (usually considered to be rare) and unreliable examination of the normal distal pulses (palpable even in patients with hypoplastic or aplastic tibial arteries) require pre harvest imaging of crural arteries in all candidates for free fibula reconstruction (17, 18). This procedure will allow to diminish risk of complications at the donor site, especially foot ischemia.

CONCLUSIONS

The free fibula flap is the gold standard for microsurgical reconstruction of bone defects involving the mandible and other anatomical regions. Surgeons conducting reconstructive surgery should be aware of possible vascular anomalies of crural arteries. Even in patients with normal distal pulses, before harvesting of fibula flap angiographic investigations should be considered to avoid risk of foot ischaemia at the donor site.

BIBLIOGRAPHY

1. Taylor GI, Miller GD, Ham FJ: The free vascularised bone graft: a clinical extension of microvascular techniques. Plast Reconstr Surg 1975; 55: 533-534.
2. Hidalgo DA: Fibula free flap: a new method of mandible reconstruction. Plast Reconstr Surg 1989; 84: 71-79.
3. Wei FC, Chen HC, Chuang CC, Noordhoff MS: Fibula osteoseptocutaneous flap: anatomic study and clinical application. Plast Reconstr Surg 1986; 78: 191-200.
4. Cross L, Hall J, Howdieshell TR et al.: Clinical anatomy of the popliteal blood vessels. Clin Anat 2000; 13: 347-353.
5. Anand R, Mourouzis R, Wilbourn M et al.: An unreported variation of the course of peroneal artery during fibula flap harvest. Brit J Oral Maxillofac Surg 2007; 45: 588-589.
6. Jones SA, Roberts DC, Clarke NM: Popliteal vasculature injuries in paediatric trauma patients. Injury 2012; 43: 1709-1711.
7. Lippert H, Pabst R: Arterial variations in man: classification and frequency. J. F. Bergmann Verlag, Munchen 1985.
8. Kim D, Orro DE, Skillman JJ: Surgical significance of popliteal arterial variants – a unified angiographic classification. Ann Surg 1989; 210: 776-781.
9. Anand R, Mourouzis R, Wilbourn M et al.: An unreported variation of the course of peroneal artery during fibula flap harvest. Brit J Oral Maxillofac Surg 2007; 45: 588-589.
10. Young DM, Trabulsy PP, Anthony JP: The need for preoperative leg angiography in fibula free flaps. J Reconstr Microsurg 1994; 10: 283-287.
11. Abou-Foul AK, Borumandi F: Anatomical variants of lower limb vasculature and implications for free fibula flap: Systematic review and critical analysis. Microsurgery 2016; 36: 165-172.
12. Disa JJ, Cordeiro PG: The current role of preoperative arteriography in free fibula flaps. Plast Reconstr Surg 1998; 102: 1083-1088.
13. Oxford L, Ducic Y: Use of fibula-free tissue transfer with preoperative 2-vessel runoff to the lower extremity. Arch Facial Plast Surg 2005; 7: 261-265.
14. Young DM, Trabulsy PP, Anthony JP: The need for preoperative leg angiography in fibula free flaps. J Reconstr Microsurg 1994; 10: 283-287.
15. Lorenz RR, Esclamado R: Preoperative magnetic resonance angiography in fibular-free flap reconstruction of head and neck defects. Head Neck 2001; 23: 844-850.
16. Lutz BS, Wei FC, Ng SH et al.: Routine donor leg angiography before vascularised free fibula transplantation is not necessary: a prospective study in 120 clinical cases. Plast Reconstr Surg 1999; 103: 121-127.
17. Lohan DG, Tomasian A, Krishnam M et al.: MR angiography of lower extremities at 3 T: pre-surgical planning of fibular free flap transfer for facial reconstruction. AJR 2008; 190: 770-776.
18. Rosson GD, Singh NK: Devascularising complications of free fibula harvest: peronea arteria magna. J Reconstr Microsurg 2005; 21: 533-538.

received/otrzymano: 02.03.2017
accepted/zaakceptowano: 24.03.2017