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Original Article

Influence of preoperative imaging on fibula free flap harvesting

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ABSTRACT

Introduction: The fibula free flap (FFF) is the gold standard for the reconstruction of large maxillofacial defects. Magnetic resonance angiography (MRA) seems to supersede digital subtraction angiography (DSA) as the reference in preoperative evaluation, being non-invasive and having equivalent diagnostic results. The aim of this study was to assess the impact of preoperative MRA versus DSA on the viability of FFF and its success rate.

Material and methods: A total of 216 patients, who underwent mandibular or maxillary FFF reconstruction from January 1995 to January 2011, were retrospectively included in the study. Of them, 101 patients underwent preoperative DSA and 115 underwent MRA. Recorded criteria were as follows: age, sex, tobacco consumption, defect etiology, preoperative vascular assessment, donor-site choice and flap failure. The DSA group was compared to the MRA group.

Results: The harvested side was switched in 15.7% of cases with preoperative MRA versus 4% with DSA. Our success rate was higher (96.1%) with MRA than with DSA (88.1%) ($P < 0.05$). More atherosclerotic patients ($P = 0.004$) were diagnosed through MRA. MRA and DSA showed similar results in anatomical variation detection.

Conclusion: MRA is less invasive and more effective in atherosclerosis detection than DSA. Therefore, donor-site switching was more frequent in the MRA group, which led to a better success rate. MRA should replace DSA as the reference in preoperative assessment.

1. Introduction

The fibula free flap (FFF) is the most widely performed flap for large maxillary or mandibular defects reconstruction. Taylor first described FFF as an osseous flap in 1975 to reconstruct a leg defect [1] and in 1989, Hidalgo was the first to perform this flap as an osteocutaneous flap and to use it to reconstruct a mandibular defect [2]. Since then, the FFF is considered as the gold standard for large maxillary or mandibular reconstruction as it supplies a large amount of bone easily segmented and shaped and allows dental implant placement. Moreover, two surgical teams can work simultaneously (the harvesting team and the head and neck team) [3,4].

The anterior tibial artery (ATA), the posterior tibial artery (PTA) and the fibular artery (FA) are the three main arteries of the leg. The FA and its satellite veins are harvested when an FFF is raised. Feet are mostly vascularized by the ATA and PTA; therefore, the risk of feet ischemia after FA harvest is minimal, except in cases of atherosclerosis, congenital anomalies, or previous trauma. In these cases, the harvested side should be switched or another flap should be performed. Many preoperative evaluations have been proposed to detect vascular anomalies, but none has been clearly defined as the gold standard. For a long time, the benefit of preoperative imaging was discussed [5–10]; it is now approved to avoid vascular complications and for medico-legal considerations [5,11–14].

The following radiographic examinations can be used as preoperative evaluation: magnetic resonance angiography (MRA), digital subtraction angiography (DSA), computer tomographic angiography (CTA), and color Duplex sonography [13,15,16]. For many years, DSA was the most frequently performed because its image resolution is satisfying. However, it is also invasive and requires an iodine contrast medium, which can cause anaphylaxis and renal failure. Recently, CTA and MRA were introduced [16–21] as alternative imaging techniques. MRA is notably interesting because it is less invasive and needs gadolinium as a contrast agent instead of iodine, and it does not require hospitalization for monitoring.

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From 1995 to 2005, in our department, DSA was the reference to assess the leg vascular anatomy before reconstructive surgery. From 2006 onwards, the reference was switched to MRA as it is less invasive and easier to perform than the DSA protocol.

The aim of this study was to assess the impact of preoperative MRA versus DSA on the viability of the FFF and its success rate. We also evaluated the detection of vascular anomalies (atherosclerosis, thrombosis or severe stenosis) and their influence on donor-site switching (the opposite leg or a different flap).

2. Material and methods

2.1. Patients

The study was conducted as a retrospective analysis considering patients who underwent mandibular or maxillary FFF reconstruction from January 1995 to January 2011. Bone defect size was equal or greater than 3 cm. All FFFs were performed in the department of oral and maxillofacial surgery, centre hospitalier régional et universitaire de Lille, France. Every patient had a preoperative lower limb DSA or MRA evaluation. Exclusion criteria were previous FFF, MRA, or DSA contraindication. The same examiner retrospectively reviewed every patient's file, imaging, and operative report. The recorded parameters were age, sex, tobacco consumption, defect etiology, preoperative vascular assessment, donor-site choice, and flap failure. The minimum follow-up was 2 years.

Patients were split in two groups depending on the type of preoperative vascular examination: the DSA group and the MRA group. Preoperative DSA was performed until January 2006 when it was replaced by MRA.

2.2. DSA protocol

DSA was performed in the cardiologic radiology department, centre hospitalier régional et universitaire de Lille, France, through femoral puncture and iodine opacification with early and late imaging. Anterior-posterior and lateral views were taken from both sides. Acquisition resolution was 512×512 pixels with 3.6 line pairs per millimeter and the pixel resolution was 0.14 mm. Hospitalization of 24 hours was required for leg vascularization monitoring and hemostasis with arterial compression.

2.3. MRA protocol

A total of 92.2% of MRA was performed in cardiologic radiology department, centre hospitalier régional et universitaire de Lille, France, and the remaining 7.8% was performed in other radiological centers, near to the patients' homes. Every MRA, was performed using a 1.5-Tesla MRI system (Achieva scanner Philips Healthcare® in Lille) and gadolinium-based contrast agent. The MRA protocol was as follows: flip angle 25°; pulse repetition time: 4.6 ms; echo time: 1.36 ms; and acquisition Voxel resolution was $1.0 \times 1.32 \times 0.8$ mm. No hospitalization was required.

2.4. Decisional algorithm

FFF was the first choice to reconstruct large mandibular or maxillary defects, 3 cm or greater. First, the harvested fibula was selected according to surgical considerations: the side of the defect, the length of the pedicle, and the prospective position of the skin paddle (mostly on the lingual side). It is easier to place the skin paddle in the desired position and the pedicle is longer, facilitating anastomosis realization, when the fibula on the contralateral side of the oral defect is harvested [8,22]. In cases of median defect, no side was preferred based on surgical considerations. Second, this selection was confirmed to agree with the leg's arterial supply: physical examination with pulse palpation and radiographic examination with arterial occlusion or anatomical variation screening. The selected side was then confirmed, switched for the opposite side, or another donor site was chosen. The selection rules are as follows:

- if the FA on the selected side presented with significant atherosclerosis, thrombosis, or stenosis (30% or higher), the side was switched;
- if the FA was adequate on the selected side, but one of the tibial arteries was severely occluded, the side was switched;
- if one of the three arteries of the opposite leg was occluded, the two arterial supplies were compared and the best side was finally selected;
- if both legs showed severe vascular anomalies, another donor site was considered to reconstruct the defect.

Inter-surgeon variability in assessing MRA and DSA findings was difficult to evaluate retrospectively. However, it seemed to be low, because every surgeon followed the radiologist's report and the decisional algorithm. The radiologists were able to accurately quantify the stenosis. Fibula flap removal during the follow-up period was considered to be a failed reconstruction.

2.5. Statistical treatment

The population, tobacco consumption, flap viability, and donor-site switching in both the DSA and MRA groups were compared with a Chi^2 test. A Student's *T*-test was used to compare the mean age in each group.

3. Results

A total of 216 patients were included in this study. They were divided in two groups depending on their preoperative vascular assessment: MRA or DSA. The minimumfollow-up was 2 years.

3.1. DSA group

A total of 101 patients were included in this group. Every preoperative DSA was performed in the Cardiologic Radiology Department, Centre Hospitalier Regional et Universitaire de Lille, France, between January 1996 and December 2005. There were 96 mandibular defects (37 bilateral or median, and 59 lateral) and 5 maxillary defects (2 median and 3 lateral) (Fig. 1).

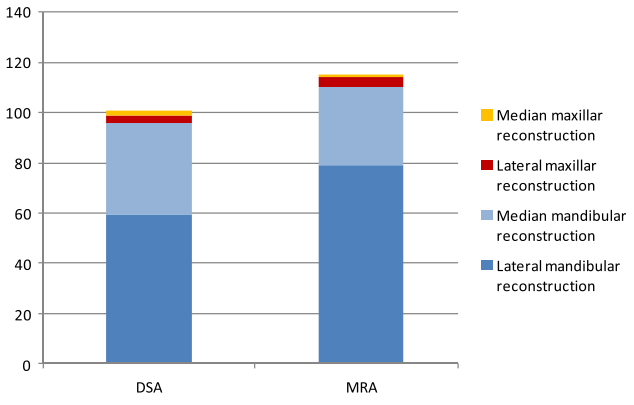

Fig. 1. Defect site in each group.

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