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Review

Anatomy of the vasculature of the lower leg and harvest of a fibular flap: a systematic review

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Abstract

The fibular free flap (FFF) is based on the peroneal artery, which has a consistent anatomy and makes a minimal contribution to the pedal circulation. However, certain anatomical variations in the vasculature of the leg might leave the peroneal artery with a major role in the perfusion of the foot, and to raise a FFF could lead to ischaemic complications. Our aim was to review the implications of anatomical variants on planning and harvest of a FFF. We systematically reviewed all relevant publications, and included 28 cases that described a dominant peroneal artery and FFF. Most of the patients had clinically normal pulses, and the dominant peroneal artery was diagnosed by preoperative vascular mapping. Variants of the peronea arteria magna were the most common. Bilateral anatomical variations were reported in 10 cases. The surgical plan to harvest the fibula was altered in 21 patients with vascular aberrations. In 17 of the 21, the leg with the anatomical variant was not used. The opposite fibula was used in 10 cases. In four of the 21, the FFF was harvested from the leg with a dominant peroneal artery, after the technique of harvest had been modified. The FFF was successfully harvested without any modification in only five cases. Two patients who had not had preoperative vascular mapping developed acute ischaemia of the limb after harvest of the FFF because of an existing peronea arteria magna. Preoperative vascular mapping is a valuable way to assess that perfusion of the foot is adequate, and it provides accurate information about the vascular anatomy, cutaneous perforators, and the fibular blood supply, with minimal or no added cost or risks. © 2017 The British Association of Oral and Maxillofacial Surgeons. Published by Elsevier Ltd. All rights reserved.

Keywords: Fibular artery; fibular flap; variations; anomalies; dominant artery; peronea arteria magna

Introduction

The fibular free flap (FFF) is often raised for composite tissue transfer, particularly for defects in the head and neck region.^{1–4} The availability of an adequate stock of bone makes this flap feasible for osseointegration of dental implants and oral rehabilitation after tissue has been lost.^{3–7}

The fibular flap can be harvested at the same time that the tumour is resected, with low donor site morbidity.^{8–10}

The flap is based on the peroneal artery, which offers a long vascular pedicle (up to 12–15 cm) and has a calibre of 3 mm; it has consistent anatomy and makes a minimal contribution to the pedal circulation.^{1,11–16} However, certain anatomical variations in the vasculature of the leg leave the peroneal artery and its branches as the dominant blood vessels to the foot, which can have implications both for the harvest of a FFF and donor site morbidity. These vascular variations are well-known, and were previously classified by Kim et al.¹⁷ Because of its dominant role in perfusion, the peroneal artery is named the “dominant” peroneal artery

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throughout this review. The prevalence of a dominant peroneal artery has been reported to be 5% of any given leg, and up to 10% of all affected patients.¹⁶ Iatrogenic clamping and removal of a dominant peroneal artery during harvest of a FFF can reportedly lead to ischaemia of the leg in subjects with dominance of the peroneal artery.^{3,18}

Preoperative diagnosis of anatomical variants such as a dominant peroneal artery may affect the surgical plan, and more importantly may have an impact on the harvest of the fibular flap if it is identified during the procedure. A thorough medical history and clinical examination are both essential before the flap is harvested, but the need for preoperative vascular mapping is controversial. Apart from some anecdotal case reports and small series, little evidence exists about the actual implications of a dominant peroneal artery for FFF surgery.

We have reviewed the surgical implications of anatomical variants of the vasculature of the leg on harvest of a fibular flap. To the best of our knowledge this has not been done previously.

Material and methods

Databases and search strategy

This systematic review was made according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.¹⁹ The search of publications included MEDLINE, EMBASE, and CINAHL databases and was made independently by two of the coauthors on 2 May 2016. Fig. 1 shows the full electronic search strategy and all the combinations of keywords used for the primary search. We did not use a language filter initially, as long as there was an abstract in English, but we ultimately reviewed the full texts of papers written only in English or French. Because the FFF was first introduced to practice only in 1975, we excluded papers published before that year.²⁰ Results were electronically deduplicated by RefWorks[®] citation management software.²¹

Titles and abstracts of studies retrieved by the primary search were systematically screened against our prearranged exclusion and inclusion criteria. All potentially relevant studies with the main text written in English or French were shortlisted for review of the full text. A wide-angle search strategy was adopted to capture the most eligible cases. The full text of all papers that described donor-site complications after FFF, or anomalous vascular patterns, in their abstracts were also reviewed. Papers that reported more than 25 harvested fibular flaps were reviewed for the possible reporting of patients with dominant peroneal arteries. The search was also supplemented by manual follow-up screening through the references of the full texts of papers, and additional cases were added.

Inclusion criteria

All reported cases of anatomical variants with a dominant peroneal artery related to harvest of a FFF were included, and complications associated with these anomalies during the harvest of the FFF were of particular interest. Equally interesting were the cases reported in which the surgical planning had been altered after detection of the anatomical variation.

Exclusion criteria

Cases with an acquired dominant peroneal artery or in which the dominant peroneal artery was used as a recipient vessel for the free flap were excluded. We also excluded cases that were described in abstracts from meetings, or reports with insufficient data about the surgical planning and outcome.

Extraction of data

Eligible cases were reviewed, and relevant data about the patients' clinical and personal details, type of variant of the dominant peroneal artery, and whether it was bilateral or unilateral, were extracted. We also collected data about the reported results of clinical pedal vascular examination, peri-operative investigations, impact on surgical planning, and donor-site complications related to the legs with a variant dominant peroneal artery.

Results

Results of the search of published papers

Our primary search yielded a total of 835 papers (Fig. 1). After electronic deduplication, 495 titles and abstracts were screened, and 66 papers were finally shortlisted. Review of the full texts of shortlisted reports gave us 15 eligible cases reported in 10 studies. A manual bibliographic search added an additional 11 cases, giving a total of 26 cases reported in 18 studies to be included in the final review (Table 1). Two additional previously unreported cases were included from our department (cases 27 and 28).

Personal and clinical details of patients studied

The mean (range) age of patients was 47 (9–80) years, and the male:female ratio was 0.6:1, reported in 16 patients. Peronea arteria magna (type III-C anomalies) were the most common variants (found in 12), followed by III-A and III-B variants in 9 and 7 cases, respectively (Table 1). Bilateral anomalies were reported in 10/25 patients. The two cases added from our department were men 30 and 80 years old who were being treated for oral cancer. Their computed tomographic angiographic scans showed bilateral type III-A variants of a dominant peroneal artery in both patients (Figs. 2 and 3).

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