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Feasibility of a bone and soft tissue chimeric anterolateral thigh free flap? Anatomic study and report of two cases for oral cavity reconstruction

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Summary The anterolateral thigh flap (ALT) is a workhorse for a spectrum of reconstructive problems including head and neck defects. Its versatility as a chimeric flap employing a variety of *soft tissues* with a robust pedicle is useful for three-dimensional defects. The authors investigated the anatomical relationship between the vascular supply to the ALT and anterior femur. We studied 16 fresh cadaver limbs to identify the typical branching patterns to the femur off the descending branch of the lateral circumflex femoral artery. These patterns can facilitate dissection of this type of chimeric ALT. The authors have integrated a bone component of vascularised femur in this flap off the lateral circumflex femoral artery system to address oral cancer defects in two patients. A retrospective review of these cases correlating with the anatomic study was undertaken. Both patients had recurrent disease with limited donor site options. Both had extensive floor of mouth and tongue defects as well as small mandible defects of 2 cm. Both went on to heal at the donor and recipient sites at 32 months' follow-up.

Introduction

The anterolateral thigh (ALT) flap and the variations based off the lateral circumflex femoral artery (LCFA) have allowed great flexibility in addressing reconstructive problems throughout the body. The variety of tissues available, including skin, fascia, muscle, nerve and tendon, allows creativity in flap design while simplifying the reconstruction by using a single robust vascular pedicle as the source. In addition,

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these tissues can be harvested in great abundance with acceptable donor site morbidity, allowing defects with imposing dimensions to be addressed.

There is no question that the spectrum of flaps based off this arterial axis rivals the versatility of the flaps based off the upper extremity analog, the subscapular artery. The descriptions of incorporating bone with the ALT flap are limited to case reports or limited series (Acarturk, Dorafshar et al.).[1,2] Composite defects of the head and neck as well as the extremities may require bone in order to achieve the goals of reconstruction.

We present an anatomic investigation using 16 fresh cadaver lower extremities to elucidate the vascular anatomy of the femur in relation to the descending branch of the lateral circumflex femoral artery. We reviewed clinical correlations in two cases of head and neck tumors requiring a composite tissue reconstruction including bone as a chimeric ALT flap.

Methods

We undertook an anatomic analysis using fresh cadaver lower extremities to study the relationship between the descending branch of the LCFA, the vastus lateralis/intermedius musculature and the middle to distal anterior femur. Sixteen lower extremities were injected in eight cadavers with no clinical history of peripheral vascular disease or history of lower extremity surgery or trauma. Eight fresh adult cadavers (median age 61 years) were injected at the common femoral artery with normal saline followed by latex perfusion technique. The latex was allowed two weeks to set.

Dissection was performed antegrade from the common femoral artery (FA) to the profunda femoris artery (PA) and the LCFA. The descending branch of the LCFA was dissected along with the trace perforating vessels to the femur. Parallel branches to the femur were dissected as they originated from the profunda femoris artery. Length of branches from originating vessel, extraluminal branch diameter and distribution of branches were recorded.

We did a retrospective chart review following IRB guidelines at our institution. We reviewed clinic paper charts and the electronic medical record to compile data of a case series of patients who underwent head and neck reconstruction with a bone and soft tissue chimeric ALT flap. STROBE guidelines were used for reporting. Limitations include the limited number of patients treated, the retrospective nature of the review, the variation in clinical circumstances and co-morbidities, as well as inability to identify a reasonable case-control group given the circumstances of the interventions.

Results

We observed four patterns of vascular branching to the anterolateral middle to distal third of the femoral shaft (Table 1). Three (I, II, and III) of the four patterns observed include branching off the descending branch to the femur through the vastus intermedius muscle (Figure 1). A type I pattern was most common (8 of 16 specimens) and consisted of a single large branch (BOB) off the descending branch artery (Figure 2). This branch coursed through the vastus intermedius muscle along the length of the femur. A type II pattern consisted of multiple short branches (PBS) off the descending branch that travel through the vastus intermedius muscle to the femur. These branches had a mean extraluminal diameter of 0.3 mm. With the type I and II patterns, all branches originated from the lateral circumflex femoral system.

Type III (4 of 16) vascular supply to the femur demonstrated contributions from parallel systems with a large branch from the profunda femoris and a large branch from the descending branch. Both branches travel through the vastus intermedius muscle and have mean extraluminal diameters of 1.2 mm measured at the origin of the branch. Type IV (2 of 16) vascular supply to the femur does not demonstrate any contribution from the LCFA or the DB. Branching from the superficial or deep femoral artery was observed in two specimens.

Case #1

A 56-year-old gentleman with a biopsy-proven SCC of the right oral tongue extending to the floor of mouth and across the midline presented to our institution after prior treatment with a local resection. Subtotal vs total glossectomy with resection of the floor of mouth was planned with possible marginal mandibulectomy. An ALT flap to reconstruct the tongue and floor of mouth was planned.

Intraoperatively, a subtotal glossectomy with resection of 2/3 of the oral tongue, floor of mouth and right hypophar-

Table 1 Four patterns of blood supply to the anterior femur.

Four patterns of blood supply to anterior femur				
Type	I – Single big branch to bone from DB	II – Multiple PBS to bone from DB	III – Double big branch to bone from DB & PF	IV – Single big branch from PF or FA
Numbers	8	2	4	2 (1 from PF, 1 from FA)
Number from descending branch	14			
Mean distance to origin	11 cm (6–15 cm)	8 cm	14 cm (7–15 cm)	4 cm (4–6 cm)
Mean distributive range	7.5 cm (6–9 cm)	7 cm	7.5 cm (7–8 cm)	8 cm
Mean diameter from origin	(1.2 mm) 1.5–2.0 mm	0. 3 mm (0.2–0.6)	1.2 mm (1.2–2.0 mm)	1.2 mm
Mean terminal diameter	Mean 1.0 mm (0.4–1.5 mm)	0.2 mm	0.5 mm (0.4–1.5 mm)	0.6 mm (0.4–1.0 mm)

DB – descending branch of the LCFA, PBS – perforating branches, PF – profunda femoris artery, FA – common femoral artery.