The reversed-flow medio-distal fasciocutaneous island thigh flap: anatomic basis and clinical applications

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Summary: A new fasciocutaneous reversed-flow island flap of the thigh is presented which is independent of the presence of perfused blood vessels below the level of the knee joint-line. The pedicle, which is supplied by the proximal genicular anastomotic network, consists of the osteoarticular branch (OAB) and concomitant veins of the descending genicular artery. Based on cadaver dissections the OAB arose in 23/30 specimens (77%) together with the saphenous artery (SA). In 2/30 specimens (7%) the OAB originated directly from the superficial femoral artery and in 1/30 specimens (3%) the OAB was absent. The OAB gave off one to three cutaneous branches to the overlying skin in 26/30 specimens (87%). We were able to elevate a flap on the osteoarticular branch alone in 57%. Additional length could be added to the pedicle in 33% by including the most proximal part of the saphenous artery together with its first cutaneous branch. Thus, in 90% of the dissections a reversed-flow island flap could be raised which reached the proximal half of the leg, the knee and the most distal part of the thigh. We report our early clinical experience.

Key words: Fascio-cutaneous flap — Lower limb — Descending genicular artery — Osteoarticular branch

Soft tissue coverage of defects around the knee remains a reconstructive challenge. Muscular or fasciocutaneous flaps from the calf are not always available, particularly if there has been previous trauma, utilization, or in through-knee and especially below-knee amputations. Various procedures for these difficult situations, including the distally based vastus lateralis muscle flap [13], the vastus medialis muscle as a rotation flap [2] or as advancement flap [15], the popliteo-posterior thigh fasciocutaneous island flap [12], the lower posterolateral thigh flap [9], cross-leg flaps [3] and free flaps [7] have been described to accomplish this end. Other options are the reversed-flow saphenous...
island flap [16], the saphenous postero-
medial cutaneous island thigh flap and the saphenous superomedial cutaneous island leg flap [5], the medial septocuta-
neous island thigh flap [4], the sartorius myocutaneous island flap [14], the reversed flow saphenous island flap based on the medial inferior genicular a. [17], and the adipofascial flap based on the saphene-
ous a. [10]. Inspired by a previous report by Hertel and Masquelet [6], describ-
ing a reversed-flow medial knee osteoperiosteal flap, we present an anato-
mic study and clinical experience of a new skin flap for closure of soft tissue defects around the knee and proximal half of the leg. This flap is a fasciocuta-
neous island flap and is harvested from the medial aspect of the lower half of the thigh. It is supplied by reversed-flow in the osteoarticular branch of the descend-
ing genicular a., thus being independent of the presence of perfused blood vessels below the level of the knee joint-line.

Material and methods

The anatomic study was carried out on 15 fresh cadavers (30 dissections) of both sexes, and the ages ranged from the fifth to the ninth decade. Both legs were injected with colored neoprene latex via the femoral a., and dissections were carried out after 2 days. Technical details of the dissection are described in the section “Flap design and operative procedure”. The vascular anatomy of the descending genicular a. (DGA) was studied with emphasis on the different combinations of its branches (the osteoarticular branch (OAB), the saphenous a. (SA) and the muscular branch (MB)). Special attention was given to the presence of cutaneous branches arising from the OAB and to anastomoses of the latter with the arterial anastomotic circle of the knee. The geni-
cular anastomoses are formed by the medial and lateral superior genicular, medial and lateral inferior genicular, middle genicular, anterior and posterior tibial recurrent, descending branch of the lateral circumflex femoral and circumflex fibular aa. [8, 18].

The following data were recorded:

a) the distances between the medial joint-line of the knee and the origins of the DGA, OAB, SA and MB,

b) the diameter at their origin of the DGA, OAB, SA and MB,

c) the length of the DGA before its division,

d) the number and diameter at their origins of the cutaneous branches of the OAB,

e) the distance between the medial joint-line of the knee and the origin of the cutaneous branches of the OAB,

f) the pedicle lengths of two different vascular patterns (ie OAB alone and OAB + SA).

Clinical experience includes two patients with soft tissue defects around the knee.

Results

Anatomic study

Descending genicular a. (DGA)

The distal superficial femoral a. (SFA) or the proximal popliteal a. gave off three vascular axes: the OAB, the SA and the MB, each accompanied by two venae comitantes. When two or three of the above mentioned arteries arose from a common trunk, the latter was called the DGA [6]. In 27/30 specimens (90%) a DGA was found. The DGA arose from the SFA at an average of 14 cm (range 18.5 – 11.5 cm) above the medial joint line. Its average diameter at its origin measured 2.0 mm (range 1.5 – 2.6 mm). Within 1.6 cm of its origin (range 0.2 – 3.5 cm) it divided into its branches. The combinations of vessels forming the DGA and their frequency are listed in Table 1.

Osteoarticular branch (OAB)

The OAB arose in 23/30 specimens (77%) together with the SA (OAB + SA + MB and OAB + SA). In 2/30 speci-

mens (7%) the OAB originated directly from the SFA. In 1/30 (3%) the OAB was absent. The OAB arose at an average of 12 cm (range 10 – 18 cm) above the medial joint-line. Its mean diameter at its point of origin was 1.3 mm (range 0.6 – 2.0 mm). The OAB ran in a distal direction on the posterior surface of the medial intermuscular septum alongside the adductor magnus tendon. In 16/30 specimens (53%) the OAB divided into a medial and a lateral branch after having reached the medial femoral condyle, and in the remaining cases it divided more proximally. The terminal vessels of the lateral branch, spreading over the medial femoral condyle, constantly anastomosed with the genicular anastomoses, ie the medial superior genicular and, in many cases, through a well-developed anterior anastomosis with the lateral superior genicular a. The medial branch of the OAB ran distally in front of the medial collateral ligament, crossing the joint line and anastomosing with the inferior geni-
cular anastomoses, primarily with the medial inferior genicular a. The OAB gave off one to three cutaneous branches to the overlying skin in 26/30 specimens (87%). For numbers of cutaneous branches per dissected specimen see Table 2. The mean diameter of the cuta-

nous branches at their origin was 0.6 mm (range 0.2 – 0.9 mm). They arose between 3 and 14 cm above the medial joint-line. The cutaneous branches bifur-
cated into ascending and descending branches, which formed a vascular arca-

de with the next ascending branch.

Saphenous a. (SA)

The origin of the SA was at an average of 12.5 cm (range 9.5 – 19 cm) above the medial joint-line. Its mean diameter at its source was 1.2 mm (range 0.7 – 1.8 mm).

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Table 1. Combinations of vessels forming the descending genicular a. (DGA) and their frequen-

cy (OAB = osteoarticular branch, SA = saphenous a., MB = muscular branch)

<table>
<thead>
<tr>
<th>Combinations</th>
<th>No. of specimens</th>
</tr>
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<tbody>
<tr>
<td>OAB + SA + MB</td>
<td>11/30 (37%)</td>
</tr>
<tr>
<td>OAB + SA</td>
<td>12/30 (40%)</td>
</tr>
<tr>
<td>OAB + MB</td>
<td>4/30 (13%)</td>
</tr>
<tr>
<td>No DGA</td>
<td>3/30 (10%)</td>
</tr>
</tbody>
</table>

Table 2. Numbers of cutaneous branches arising from the OAB per dissected specimen (* including one specimen lacking an OAB)

<table>
<thead>
<tr>
<th>No. of cutaneous branches</th>
<th>No. of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2/30 (7%)</td>
</tr>
<tr>
<td>2</td>
<td>9/30 (30%)</td>
</tr>
<tr>
<td>1</td>
<td>15/30 (50%)</td>
</tr>
<tr>
<td>0</td>
<td>4/30 (15%)</td>
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