Journal of Plastic, Reconstructive & Aesthetic Surgery (2014) 67, 93—98

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Free-flap cover of complex defects around the knee using the descending genicular artery as the recipient pedicle

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Received 10 December 2012; accepted 3 September 2013

KEYWORDS
Knee;
Knee reconstruction;
Free flaps;
Descending genicular artery;
Recipient vessel for free flap transfer

Summary *Background:* Selection of ideal recipient vessels is one of the most important factors determining success in free-flap reconstruction of the lower limb. At the knee, the choice of vessels has traditionally been either the common femoral or the popliteal vessels and their branches but these are often difficult to use or cannot be used.
Methods: A series of 32 free flaps for cover of complex injuries of the knee involving the distal femur, the knee joint and the upper tibia were reconstructed using the descending genicular branch of the femoral artery in the adductor canal and its muscular branches to the vastus medialis as the recipient vessels.
Result: All but one flap survived with no major complications.
Conclusion: The use of the descending genicular artery as the recipient vessel for reconstruction with free flaps around the knee has various advantages including: (i) it is mostly remote from the zone of trauma, (ii) it is constant in location, (iii) the recipient vessels are an excellent size match for end-to-end anastomosis, (iv) there is no need for changes of position of the patient when using most free flaps commonly used for knee reconstruction, (v) it is easy to harvest these simultaneously, (vi) secondary exposure of the underlying skeleton from all quadrants is unlikely to divide the flap pedicle as it is superior and (vii), perhaps most important of all, it obviates the need for exploration of the popliteal fossa.

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1748-6815/$ - see front matter
http://dx.doi.org/10.1016/j.bjps.2013.09.011

Cover of large and complex knee defects is a challenge. There is a paucity of large local flaps in this region and the injury may make these unusable. Gastrocnemius and large fasciocutaneous flaps have been the local workhorses for these defects. However, in the presence of associated fractures and in extensive injuries, free flaps are our first choice for reconstruction, mainly because of the availability of large free flaps, such as the latissimus dorsi and anterolateral thigh flaps.

Selection of ideal recipient vessels is one of the most important factors determining success in free-flap reconstruction of the lower limb.[1,2] At the knee, the choice of vessels has traditionally been either the common femoral or the popliteal vessels and their branches. The popliteal vessels and their associated gastrocnemius and sural branches, use of which was popularised by Godina,[3] are deep in the fat of the popliteal fossa and, so, difficult to dissect, and their use necessitates a change of position of the patient. They are also far from ideal when cover of the anterior aspect of the knee is needed as the pedicle has to be taken around the lateral border of the knee and/or the proximal part of the flap is wasted in this circumlocation of the joint. The vessels are good recipient vessels for proximal tibial defects but have to turn backwards for use for distal thigh defects. The superficial femoral vessels, in the adductor canal, have been used as recipient vessels in femur reconstruction, mostly with arterial end-to-side anastomosis to the femoral artery.

Use of the descending genicular branch of the femoral artery as a recipient vessel for knee reconstruction was first described in three cases by Park and Eom,[4] but only one subsequent report has examined its use in this context, in two patients.[5] More recently, this artery has been used more extensively as a source of vascularised corticoperiosteal grafts from the medial condyle of the femur and the anatomical consistency and favourable characteristics for safe microsurgical use of this pedicle have been emphasised.[6–16]

This study describes the technical considerations of our experience of use of the descending genicular artery and its branches in the distal thigh, or in the adductor canal where it originates from the femoral artery, as the recipient vessel for 32 free flaps for complex knee defects.

Patients and methods

Between June 2007 and October 2012, we performed free-tissue transfer for cover of complex knee defects in 32 patients who had suffered injury in road traffic accidents. All of the patients had extensive soft-tissue defects over the anterior aspect of the knee joint with a mean area of skin loss requiring flap cover of 304 cm^2 (range 35–800). As many as 26 patients sustained injury to the right lower limb and six patients to the left. The series included two women and 30 men with a mean age of 34 years (range 6–71).

A total of 19 free latissimus dorsi muscle flaps and 13 anterolateral thigh flaps were used to cover the defects. The descending genicular vessels were used as the recipient vessels in all 32 cases. The details of the patients, the size of the defects, the underlying skeletal status, the recipient vessel used, secondary procedure and outcome are presented in Table 1.

Anatomy

The descending genicular artery, accompanied by venae comitantes of 1.5–2 mm size, is a branch of the superficial femoral artery (Figure 1). It originates just proximal to the adductor hiatus, approximately 13–15 cm from the knee joint.[6,13] It passes distally between the adductor magnus and the vastus medialis and gives three branches. A free length of 2–3 cm is available before it gives off its branches. The saphenous branch accompanies the saphenous nerve, passing distally between the sartorius and the gracilis muscles. It supplies the skin of the upper and medial aspect of the leg, and terminates by anastomosing with the inferior medial genicular artery. The muscular branches descend between the adductor magnus and the vastus medialis muscles and supply them. The articular branches are the terminal branches of the artery and supply the periosteum of the medial femoral condyle. Sometimes, these branches have a separate origin from the femoral artery.

Surgical technique

An exploratory incision extending proximally from the margin of the defect along the anteromedial aspect of the distal thigh was made in the all cases (Figure 2). The sartorius is retracted medially and the vastus medialis muscle retracted laterally to expose the descending genicular vessels. The muscular branches entering the vastus medialis and the adductor magnus (which include an artery and a vein) can be observed immediately and are of adequate size for use as the recipient vessels. If they are too small, the main arterial trunk is traced proximally into the adductor canal and used for anastomosis at whatever level its calibre is the best match in size to that of the flap being transferred. The long saphenous vein, lying in close proximity, is useful as a 'life boat' for additional venous drainage.

Results

The details of the 32 cases are shown in Table 1.

All but one flap survived with no major complications. The 23rd patient in the series suffered an arterial pedicle thrombosis on day 5. We were unable to salvage the flap.

Discussion

Free flaps are our first choice for the reconstruction of large and complex knee defects. The particular free flap to be used is selected on the basis of the location and nature of defect. In isolated soft-tissue losses with no fractures, our preference is to use the latissimus dorsi muscle flap and a skin island, the island being planned in such a way as to lie longitudinally over the knee, to aid unhindered knee movement (Figure 3). In cases in which the defect is very large or there are associated skeletal problems and it is anticipated that a secondary skeletal procedure may be needed, we use the anterolateral thigh flap, the advantages of which are that of size and ease of access for