FREE VASCULARIZED FIBULAR BONE GRAFTS

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Bone grafts have been used since the nineteenth century for a variety of orthopaedic complications including nonunion of long bones, bone loss following trauma or tumor resection, pyogenic and nonpyogenic infections, and replacement of joint surfaces.[1] For defects that are situated in a highly traumatized or irradiated area, with significant scarring and relative avascularity, bone grafts transferred with intact vascular pedicles offer significant advantages over conventional modes of grafting.[2] By maintaining the vascular supply through microvascular anastomosis, osteocytes and osteoblasts in the graft can survive, thereby eliminating the usual replacement of the graft by creeping substitution.

The fibula has become the most commonly used bone for reconstruction of large long bone defects in the tibia, femur, humerus and radius. Plastic surgeons who reconstruct mandibles are currently using the fibula as the primary free vascularized bone of choice. In children, one of the most valuable applications of this transfer is the repair of congenital pseudarthrosis of the tibia.[2]

Preoperative arteriograms of both donor and recipient sites are mandatory to identify any possible vascular abnormalities. This is a major concern when the recipient site has suffered trauma, and the apparent zone of injury extends either proximally or distally from the apparent bone defect.

When performing a procedure which involves the free vascularized fibular graft, the peroneal artery along with its venae comitantes, and their relationship to the fibula is the primary anatomy that must be identified.[2,3] The nutrient artery of the fibula originates as a branch of the peroneal artery. While the peroneal artery arises from the posterior tibial trunk. The endosteal circulation is supplied through a nutrient artery which usually enters in the middle third of the fibula.[4] The nutrient artery enters the bone through a foramen located on the posterior or medial surface, near the crest of the fibular. The artery then divides into the short ascending and long descending intramedullary branches.[5] The nutrient artery originates from the peroneal artery which has a short pedicle, usually at least 6 cm long, with a diameter of 1.8 to 3mm.

The peroneal artery is the largest branch of the posterior tibial, arising 2-4 cm below the origin of that vessel. The peroneal artery passes obliquely from the posterior tibial artery, laterally and inferiorly across the posterior aspect of the tibialis posterior muscle. It then continues to the ankle in the fascia between the tibialis posterior and the flexor hallucis longus, just medial to the fibula. Multiple branches from the peroneal artery supply the fibula, including the nutrient artery. In order to preserve these branches, a portion of the flexor hallucis longus and the posterior tibial muscles are taken with the transfer.[4] The anterior and posterior tibial arteries may be very small or absent, the peroneal artery is always present.[6] Since the peroneal artery is always present, the fibula can be used reliably as a transfer. However, if the posterior or anterior tibial arteries are absent, vascular supply to the leg can be jeopardized. Preoperative angiography will confirm the presence or absence of these arteries.[7]

SURGICAL TECHNIQUE

Many authors have described the surgical technique for obtaining the vascularized fibular bone graft.[1,2,3,4,5] This paper will present a brief introduc-

tion to the most commonly used surgical sequence.

The patient is placed in a supine position on the operating table, under general anesthesia. The knee is flexed between 120 and 140 degrees, and the hip is flexed approximately 60 degrees. A tourniquet is used during the dissection. Using loupe magnification, a linear incision is made from the head of the fibula to the lateral malleolus.[6]

The peroneus longus and soleus muscles are identified, and the deep fascia is incised along the entire length of the incision. Blunt dissection is performed between the peroneus longus and soleus muscles. Dissection of the peroneus longus and soleus muscles are reflected from the fibular diaphysis proximally leaving 1mm of muscle on the periosteum. One must be concerned with the superficial peroneal nerve on the deep surface of the proximal part of the peroneus longus. The dissection is then carried around the front of the fibula between the lateral and anterior muscle compartments, detaching the extensor digitorum longus and extensor hallucis longus and exposing the interosseous membrane. The anterior tibial artery and deep peroneal nerve may be identified on the deep surface of the tibialis anterior.[7] The interosseous membrane is incised along the full length of the fibula.

Posterior dissection is achieved by leaving 1mm of muscle on the periosteum. Dissection is advanced to expose the flexor hallucis longus. The peroneal artery is usually found on the medial side of the flexor hallucis longus. The periosteum just beyond the intended bone cuts may be incised in order that extra periosteal cuff may be left on the fibula transfer.[8] Eight centimeters of the most proximal and distal portions of the fibular are maintained and not removed from the leg.

A small bone clamp is placed on the proximal fibula after both portions of the fibula have been cut. The fibula is rotated anteriorly to identify the vascular pedicle. The peroneal artery is followed to the upper margin of the flexor hallucis longus. The flexor hallucis longus is then divided longitudinally from superior to inferior, harvesting intact any muscle which lies between the artery and bone. The fibula is then rotated posteriorly, dividing the tibialis posterior, leaving a half centimeter strip of muscle on the bone.[5] The peroneal artery should be visualized though out the entire fibular and pedicle dissection. The peroneal artery is followed distally beyond the distal osteotomy and then ligated. The proximal portion of the pedicle is identified at the level of the posterior tibial artery. A vessel loop is then placed around the peroneal artery and venae comitantes. The fibula is returned to its bed until the recipient site is prepared, and the tourniquet is deflated to allow circulation to return to the graft. Dissection should take approximately 1 and 1/2 hours.[9]

Once the donor site is prepared, the graft site is re-entered and the arterial and venous supply to the fibular are detached. The now free vascularized fibular graft is ready for anastomosis into its recipient bed.

The microsurgical techniques which are employed in this procedure, while complex, are certainly within the realm of the properly trained podiatric surgeon. The qualified podiatric surgeon may expect to become a valuable member of a limb reconstruction team.

With these skills, another chapter in podiatric reconstructive surgery can be opened. Major reconstructive procedures such as replacement of an entire first metatarsal or other large bone defects become much more feasible. The future is unlimited to the surgeon with the proper training and foresight.

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