Egypt, J. Plast. Reconstr. Surg., Vol. 34, No. 1, January: 23-29, 2010

Micro Vascular Reconstruction of Thigh Defects

KHALED SIEF EL-DIN ZAKARIA, M.D.

The Department of Plastic Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt.

ABSTRACT

The indications for a free flap for reconstruction of extensive thigh defects are relatively uncommon. Reasonable recipient vessel site will always be of paramount importance Conflicting data have been reported on the outcome of the transferred flaps, depending on the vessel used or the location of anastomosis. The major femoral vessels, usually accessed via the medial thigh, would be a conventional selection. If these are at risk within the zone of injury, or if the defect is more lateral, the descending branch of the lateral circumflex femoral vessels might be a more suitable alternative Sometimes the defect is more posterior and in this situation neither lateral or medially suited vessels would be helpful and another recipient vessels posteriorly should be selected. The purpose of this article is to review the role of microsurgery in reconstruction of thigh defects and to establish an algorithm for proper selection of recipient vessels for free tissue transfer to the thigh.

INTRODUCTION

Soft tissue defects of the thigh can result from run-over accidents, war injuries, chemical burns, radical resection of soft tissue sarcomas and post irradiation necrosis. Usually the resulting defects can be reconstructed in a straight forward manner using skin graft or available local flap **[1]**. Free tissue transfer is uncommon in the thigh region due to the generous muscle bulk surrounding the femur bone. Yet sometimes, free-flaps may be indicated in reconstruction of extensive muscle and skin thigh defects resulting either from trauma or tumor excision. They are also indicated in cases of infected exposed femoral bone or vital structures in the thigh (vessels, nerves, tendons, prosthesis). Finally they are indicated in cases of severe contour deformity and functional muscle deficit of the thigh.

The Selection of an appropriate recipient vessel in the thigh is an important issue as the proper donor site selection. It should be outside any zone of injury that preferably can be reached without the need for vein grafts **[2]**. Unfortunately, the published details about potential recipient sites and their exposure in the thigh are limited **[3,4]**. Vessels around the knee may suffice as the recipient site to allow coverage the most distal thigh defects. The popliteal vessels had a 'classic' role at least for knee reconstruction **[5,6]**. The distal superficial femoral vessels **[7,10]** and its descending genicular branch **[5,10]** and the descending branch of the lateral circumflex femoral (LCF) **[5]** have also been used for knee salvage. For the remainder of the thigh, there is a paucity of information, although Strauch and Yu have described exposure of the common femoral, superficial femoral and profunda femoris vessels as large-vessel options **[11]**. Muscle splitting approach was used on the superior and inferior gluteal vessels for the preparation of a recipient vessel in free-tissue transfer to the sacral, gluteal and ischial regions **[12]**. Usually there is a prolonged thinking interval while choosing a recipient vessel during performing free flap reconstruction to the thigh region, aiming to have successful vascular anastomosis without endangering limb vascularity.

PATIENTS AND METHODS

From November 2002 to April of 2006 thirteen consecutive, microvascular, free tissue transfers were performed for reconstruction of twelve thigh defects in twelve patients (Table 1). The causes requiring soft-tissue coverage included trauma (4), unstable scars (2), severe contour deformity (3) femoral bone defect (1) and exposed femoral prosthesis (2). In one patient there was flap loss due to delayed venous thrombosis and another free flap was used to cover the defect in a later session. The age of the patients ranged from 6 to 45 years. The study was conducted in the Department of Plastic Surgery of Ain Shams University Hospitals from November 2002 till April 2006 the mean follow-up was 23 months (range, 6 to 33 months). Defect size ranged from 8 x15 cm to 28 x 14 cm.

All patients were operated upon under general anesthesia. All the free flaps to the thigh defects were done as a delayed reconstruction, except patients with exposed femoral and knee prostheses where simultaneous reconstruction with orthopedic team was performed. In all cases of unstable scarring and contour defects excision of the scar tissue was done till reaching healthy bed and edges. Cases of trauma were operated upon by a first and second look debridement followed by the definitive micro-vascular reconstruction. In one case with combined bony and soft tissue loss, reconstruction of soft tissue defect was first done utilizing the ipsilateral distally based rectus abdominis myocutaneous flap then a vascularized fibular graft was applied to the femur bone defect using the transposed inferior epigastric vessels included in the myocutanous flap as the recipient vessel. In ten patients the donor flap was the latissimus dorsi muscle or myocutaneous flaps. In the remaining two the rectus abdominis muscle flap and vascularized fibular grafts were used. Arterial micro-vascular anastomosis was done first in all the cases followed by the venous one. In cases where SFA was the recipient artery, end to side anastomosis was used but cases with recipient artery other than SFA; the end to end anastomosis was performed. In each flap venous anastomosis was done with the two veins, either with the two venae comitants accompanying the recipient artery, or with one of them and a transposed branch of the great saphenous vein. All patients were given a single prophylactic dose of heparin according to their body weight at the time of release of the micro-vascular clamps. All flaps were monitored every 15 minutes in the first hour then every half hour for the next six hours then hourly for 2 days and then twice daily for the next eight days. Flaps donors were closed primarily leaving suction drains. The first dressing of the flaps was done on the third day post operatively then every other day for one week then STSG was applied to the transferred muscle flap.

RESULTS

Twelve soft tissue defects of the thigh were reconstructed using thirteen free flaps. Eleven free flaps survived completely and one flap became completely necrotic due to delayed venous thrombosis by the ninth day. This flap needed debridement and reconstruction by another Latissimus dorsi muscle flap. All surviving flaps provided satisfactory coverage for the defects and the underlying exposed bone or prostheses without occurrence of infection and gave a reasonable thigh contouring (Figs. 1,2,3).

Table (1): Free flaps used, defect site, etiology, recipient vessels.

Flap	Thigh defect	Etiology	Artery	Vein
LD	Posterior	Trauma	Inf. gluteal a.	Inf. gluteal v.
LD	Anterolateral	Contour defect	SFA	GSV
LD	Anterolateral	Contour defect	SFA	GSV
RA	Distal Lateral	Femoral prosthesis	LCF-desc.br.	LCF-desc.br.
LD	Distal Lateral + knee joint	Trauma	LCF-desc.br	LCF-desc.br
LD myocut.	posterolateral	Unstable scar	SFA	GSV
Fibula	Mid shaft femur	Chemical burn	DIEA	GSV
LD	Distal Lateral + knee joint	Trauma	LCF-desc.br	LCF-desc.br
LD	Anterolateral	Contour defect	SFA	GSV
LD myocut.	Distal lateral + knee joint	Exposed prosthesis	SFA	GSV
LD	Lateral + knee joint	Trauma	LCF-desc.br	LCF-desc.br
LD myocut	Anterolateral	Unstable scar	SFA	GSV

LD : Latissimus dorsi.
LD myocut: Latissimus dorsi myocutaneous flap.
RA : Rectus abdominis flap.
GSV: Greater saphenous vein.
LCF-desc.br.: Descending branch of the lateral circumflex femoral.
SFA : Superficial femoral artery.
Inf. gluteal a: Inferior gluteal artery.
DIEA: Deep inferior epigastric artery.

Fig. (1-A): Unstable scarring of distal lateral thigh and knee region with unhealthy skin between the 2 incision lines.

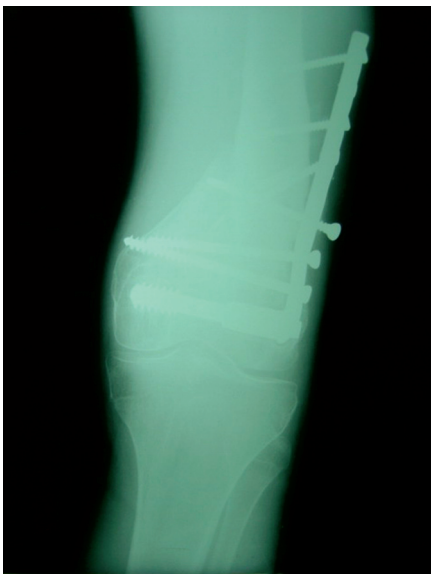

Fig. (1-B): P-A X-ray showing malpositioned protheses.

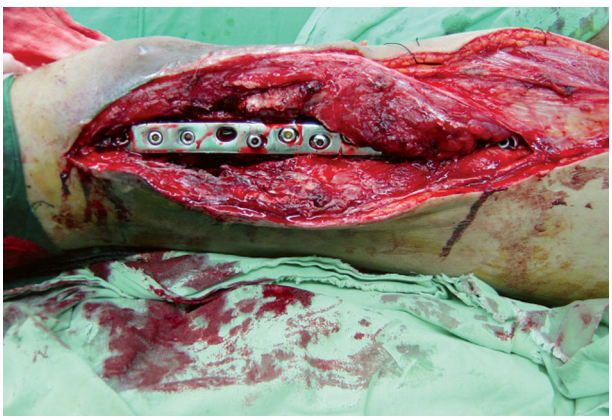

Fig. (1-C): Newly applied plate fixation with soft tissue defect that needs cover.

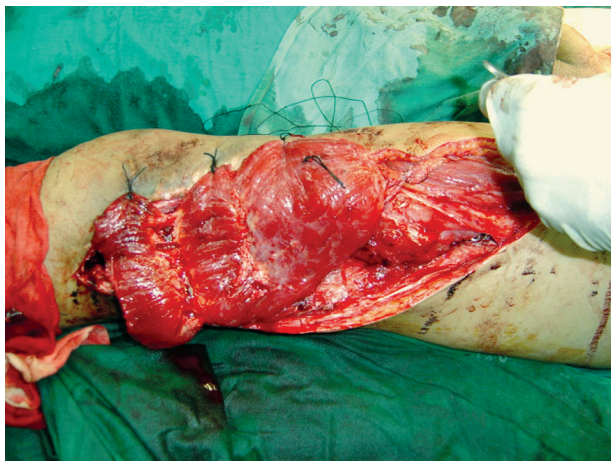

Fig. (1-D): Free Rectus Abdominis muscle flap covering the defect after anastomosis of with descending branch of Lateral Circumflex Femoral LCF vessels.

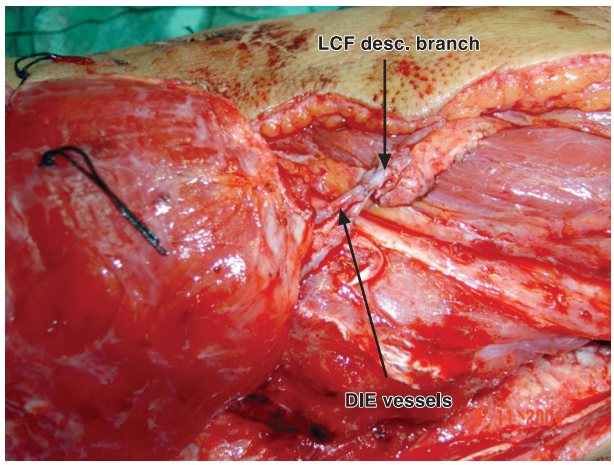

Fig. (1-E): Lateral Circumflex Femoral (LCF) descending. branch brought superficial for easy exposure and manipulation while performing the microvascular anastomosis with Deep Inferior Epigastric (DIE) vessels.

Fig. (1-F): Late postoperative with applied skin graft to rectus abdominis muscle.

Fig. (2-A): Lateral view showing posterior thigh defect with extensive muscle loss & contour defect.

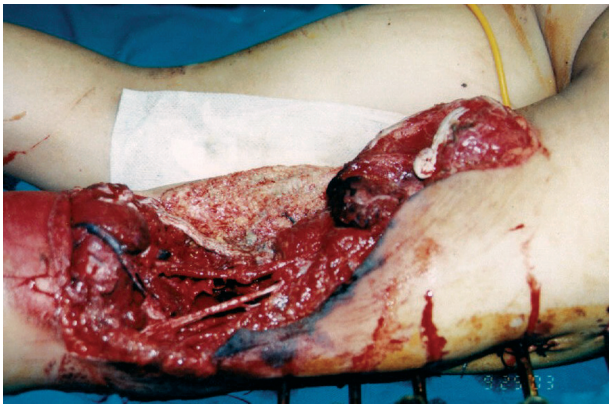

Fig. (2-B): Extensive posterior thigh defect with exposure of sciatic nerve. Down to the left appears the thrombosed popliteal artery.

Fig. (2-C): Applied Latissimus dorsi muscle flap to posterior thigh defect.

Fig. (2-D): Late postoperative with Latissimus dorsi muscle flap and applied skin graft.

Fig. (3-A): Soft tissue defect of distal lateral thigh region, with femoral bone exposure.

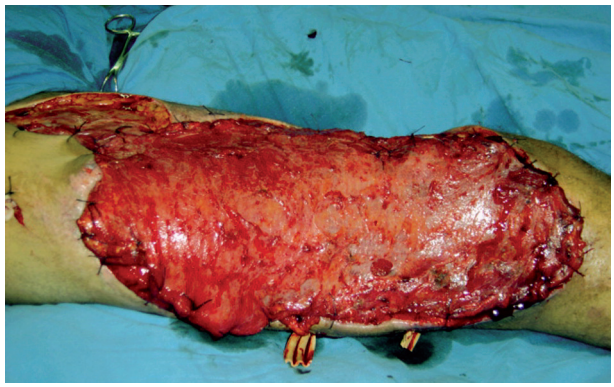

Fig. (3-B): Coverage of femoral bone defect with Latissimus dorsi muscle flap.

Fig. (3-C): Healed STSG on applied latissimus dorsi flap to distal lateral thigh defect, with accepted thigh contour.

DISCUSSION

Extensive soft tissue thigh defects may result from war injuries, run-over accidents, chemical burns, radical resection of soft tissue sarcomas and post irradiation necrosis. The indications of free flap reconstruction in thigh defects are relatively uncommon. This is mainly due to the generous muscle bulk surrounding the femur bone but sometimes, extensive soft tissue thigh defects necessitate microvascular reconstruction. A challenging situation usually arises if the defect is extensive, distal lateral, posterior, or around the knee joint. In these regions local flaps are few and their use is so limited.

Although little has been specifically reported regarding potential recipient vessels exposure in the thigh **[3,4]**, any of the major vessels including the common femoral, superficial femoral, profunda femoris, or popliteal would be straight forward options suitable in most circumstances **[5-7,10,11]**. These options may be already compromised or put at risk if used. So it is better not to be the first choice as recipient vessels in the thigh. Other measures like prefabricated arterio-venous loop between femoral artery and vein, **[12]** or using the wrist as the free flap carrier **[13]** had all been proposed to establish a viable recipient. However, survival rate of free flaps with interposition vein grafts ranged from 70-100% in different hands **[14]** making the vein graft an unsafe method. The "wrist carrier" tactics increased the risk of vascular pedicle injury **[15]**. Here the presence of a reliable recipient vessel which is near to the defect and does not endanger major vessels or limb vascularity will be of great help. Conflicting data have been reported on the outcome of the transferred flaps, depending on the vessel used or the location of anastomosis.

The inferior gluteal vessels were presented as recipient vessels for free tissue transfer to the posterior thigh mainly to gluteal and ischeal regions **[16]**. On the other hand the vascular pedicle of the anterolateral thigh flap (Lateral circumflex femoral vessels LCF descending branch) was another alternative recipient vessels for free tissue transfer for both distal lateral and anteromedial regions of the thigh **[10,17,18]**. It had the advantage of being long and can be easily brought out and maneuvered superficially while performing the microsurgery (Fig. 1-D). Other advantages include the constant anatomical coarse **[19]** and the good length and caliber which simplify end-to-end anastomosis. Finally, no major limb vessel is put at risk with this choice. It has been also used as reverse-flow recipient vessel for free flaps to lateral knee region **[18]**. Also superior medial genicular vessels, descending genicular vessels, sural vessels, the medial inferior genicular artery and the anterior tibial artery have been reported as recipient vessels in the knee joint region and also have been used for knee salvage **[1,5,7,10]**. Hung et al. and Chen et al. **[23,24]** had employed perforating arteries of the deep femoral vessels as recipient to support a free flap. But they have the disadvantage of being located deep down and very difficult to access **[15]**.

To our knowledge there is no algorithm suggested before for the selection of the recipient vessels in microvascular reconstruction of the thigh. In every case, all the currently feasible options for recipient vessels were included and the opinions of the other surgeons were reviewed. Variables, including the site and size of the injury, the flap used in reconstruction, the donor and recipient vessels, were identified and recorded in the thigh free flap sheet After reviewing thirteen consecutive free tissue transfers to the thigh, an algorithm for the proper selection of a recipient vessel was suggested. The most important factor in selection of recipient vessel was the site of injury, site of planned micro-vascular anastomosis and the flaps used for microvascular reconstruction.

1- The site of injury and the vascular status of the lower extremity are the most important factors in recipient vessel selection in thigh defects reconstruction.

2- Direct end to end vascular anastomosis is the first choice followed by indirect anastomosis using vein grafts or vascular loop for distal defects.

3- For anterior thigh defects, if direct arterial anastomosis is planned, the first choice recipient artery is the descending branch of lateral circumflex femoral artery. Second choice is one of the small branches of the femoral artery (Superficial external iliac artery or external pudendal artery). Third choice is the deep inferior epigastric artery after its dissection and transposition. The last choice is the superficial femoral artery itself using end to side anastomsis or indirect anastomosis.

4- For lateral thigh defects, sequence of choice will be first the descending branch of LCF artery. Second the reverse flow descending branch of the LCFA and this should be restricted to specific conditions **[18]**. The last choice is the superficial

femoral artery itself using end to side anastomsis or indirect anastomosis.

5- For posterior thigh defects, the sequence of choice will be firstly the inferior gluteal vessels using muscle splitting approach **[16]** followed by stump of the superficial femoral artery by direct end to end anastomosis. Lastly by indirect anastomosis.

6- Regarding free flap selection, the latissimus dorsi muscle flap was used in the majority of the cases for reconstruction of extensive soft tissue defects in the current study and in the published articles **[15,16,17]** because it is a reliable flap of large size with long pedicle and very little anatomical variations. It is easy to harvest and can be done in very small children **[25]**. It can be transferred as functional muscle and being a muscle it is highly resistant to osteomyelitis. Its donor site morbidity is in the form of linear suture line of the back. In smaller defects the rectus abdominis flap was employed using descending branch of the lateral circumflex iliac artery as the recipient artery. The anterolateral thigh and parascapulr flaps were not used although they present another option for coverage of large defects, because their role in infection resistance is limited and their donor site morbidity is noticeable.

Conclusion:

Free tissue transfer is uncommonly used in the thigh region due to the generous muscle bulk surrounding the femur bone but sometimes it may be indicated. Too little has been reported regarding potential recipient vessels exposure in the thigh. The most important factor in selection of recipient vessel was the site of injury, site of planned microvascular anastomosis and the flaps used for microvascular reconstruction. An algorithm for the proper selection of a recipient vessel was suggested.

REFERENCES

1- Hallock G.G.: Utility of both muscle and fascia flaps in severe lower extremity trauma. J. Trauma, 48: 913-917, 2000.

2- Vlastou C., Earle A.S. and Jordan R.: Vein grafts in reconstructive microsurgery of the lower extremity. Microsurgery, 13: 234-235, 1992.

3- Strauch B. and Yu, H.I.: Atlasof Microvascular Surgery. New York: Thieme Medical Publishers, 1-2, 1993.

4- Chen H.C., Chuang C.C., Chen S., Hsu W.M. and Wei F.C.: Selection of recipient vessels for free flaps to the distal leg and foot following trauma. Microsurgery, 15: 358-363, 1994.

5- Park S. and Eom J.S.: Selection of the recipient vessel in the free flap around the knee: The superior medial genicular vessels and the descending genicular vessels. Plast. Reconstr. Surg., 107: 1177-1182, 2001.

6- Godina M., Arnez Z.M. and Lister G.D.: Preferential use of the posterior approach to blood vessels of the lower leg in microvascular surgery. Plast. Reconstr. Surg., 88: 287-291, 1991.

7- Hallock G.G.: The medial approach to the sural vessels to facilitate microanastomosis about the knee. Ann. Plast. Surg., 32: 388-393, 1994.

8- Ghosh M.M.: The gastrocnemius vessels as recipient vessels for lower limb free-tissue transfer. Plast. Reconstr. Surg., 112: 936-937, 2003.

9- Johnson P.E., Harris G.D., Nagle D.J. and Lewis V.L.: The sural artery and vein as recipient vessels in free flap reconstruction about the knee J. Reconstr. Microsurg., 3: 233-242, 1987.

10- Yuen J.C. and Zhou A.T.: Free flap coverage for knee salvage. Ann. Plast. Surg., 37: 158-166, 1996.

11- Strauch B. and Yu H.I.: Thigh region. Atlas of Microvascular Surgery. New York: Thieme Medical Publishers, 201-216, 1993.

12- Rechnic M., Edelson R.J. and Fosburg R.G.: Single-anastomosis femoral arteriovenous shunt as recipient vessels for free-flap reconstruction of a massive lumbosacral wound. Plast. Reconstr. Surg., 99: 242-244, 1997.

13- O'Brien B.M., Barton R.M. and Pribaz J.J.: The wrist as an immediate free flap carrier for reconstruction of the pelvis: A case report. Br. J. Plast. Surg., 40: 427-431, 1987.

14- Karanas Y.L., Yim K.K., Johannet P., Hui K. and Lineaweaver W.C.: Use of 20 cm or longer interposition vein grafts in free flap reconstruction of the trunk. Plast. Reconstr. Surg., 101: 1262-1267, 1998.

15- Chang L.R. and Lee J.W.: Free flap coverage of gluteal defects using posteriorly translocated deep femoral vessels as recipient. J. Microsurgery, 28: 157-159, 2008.

16- Park S.: Muscle-splitting approach to superior and inferior gluteal vessels: Versatile source of recipient vessels for free-tissue transfer to sacral gluteal and ischial regions Plast. Reconstr. Surg., 106: 81-86, 2000.

17- Hallock G.G.: The vascular pedicle of the anterolateral thigh flap as an alternative recipient site for thigh free flaps. J. Reconstr. Microsurg., 24 (2): 131-136, 2008.

18- Chien W.H., Chen C., Tan T.S. and Tang Y.W.: Salvage of knee joint tumor prosthesis using turnover reverse-flow descending branch of lateral circumflex femoral artery as recipient vessel for the free ALT flap: Case report. J. Reconstr. Microsurg., 23 (8): 505-509. 2007.

19- Wei F.C., Jain V., Celik N., Chen H.C., Chuang D.C.C. and Lin C.H.: Have we found an ideal soft-tissue flap? An experience with 672 anterolateral thigh flaps. Plast. Reconstr. Surg., 109: 2219-2226, 2002.

20- Tsai C.C., Lin S.D., Lai C.S., et al.: Reconstruction of the upper leg and knee with a reversed flow saphenous

island flap based on the medial inferior genicular artery. Ann. Plast. Surg., 35: 480-484, 1995.

21- Lee M.G. and Minn K.W.: Distally based free flap using retrograde arterial flow. Plast. Reconstr. Surg., 104: 2063-2067, 1999.

22- Minami A., Kato H., Suenaga N. and Iwasaki N.: Distally-basedfree vascularized tissue grafts in the lower leg. J. Reconstr. Microsurg., 15: 495-499, 1999.

23- Hung S.J., Chen H.C. and Wei F.C.: Free flaps for reconstruction of the lower back and sacral area. Microsurgery, 20: 72-76, 2000.

24- Chen H.C., Weng C.J. and Noordhoff M.S.: Coverage of multiple extensive pressure sores with a single filleted lower leg myocutaneous free flap. Plast. Reconstr. Surg., 78: 396-398, 1986.

25- Banic A. and Wulff K.: Latissimus dorsi free flaps for total repair of extensive lower limbs injuries in children. Plast. Reconstr. Surg., 79: 769-75, 1987.