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Salvage of Severely Mutilated Lower Limb Using Cross-Leg Free Latissimus Dorsi Flap

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ABSTRACT

The purpose of this article is to introduce the early experience of the authors with technique of the cross leg free flap in cases of severely mutilated limbs. In these situations local cutaneous or muscle flaps cannot be used due to extensive soft tissue loss. The combination of extensive soft tissue and bone loss make the use conventional cross leg fascio-cutaneous flap very difficult. Moreover these recipient legs cannot benefit from conventional free tissue transfer as there is lack of suitable recipient vessels for anastomosis due to either direct vascular injury or post-traumatic vessel disease. In this study seven patients with extensive post-traumatic leg defects with bony fractures and applied external-fixators were managed using the technique of cross leg free flap. Transferred tissues were the free latissimus dorsi myocutaneous flap except in one case, where the serratus anterior muscle was included on the same pedicle. The average dimension of the defects was (23.5 X 14.5cm). The recipient vessels were of the contralateral sound leg. Good results were achieved in the form salvage of the seven limbs. This technique is to be left as the last trial for limb salvage in cases of serious soft tissue leg defects where both local and regional flaps cannot be used and the limb vessels are unsuitable for anastomosis.

INTRODUCTION

Microsurgical free flap transfer is now a well-established reconstructive procedure for severely damaged lower extremities with huge soft tissue defects. In these situations local cutaneous or muscle flaps cannot be used either due to extensive soft tissue loss including the donor muscle flap itself or direct damage of the flap pedicle itself. Also in this type of injuries there is a combination of extensive soft tissue loss, bone exposure and fractures, in the presence of an external-fixator in the recipient leg which make the use classic cross leg fascio-cutaneous flap very difficult. Sometimes these recipient legs cannot benefit from free tissue transfer as there is lack of suitable recipient vessels for anastomosis in the neighboring regions of the defect. This is either due to direct vascular injury or post-traumatic vessel disease or in case of failure of previous free flap. Also sometimes the use of long venous grafts or A-V loops may not be feasible or preferred to vascularize free flap away from the zone of injury. Because it requires another donor site and increases the number of vascular anastomosis which in turn increases the risk of thrombosis and failure of the free flap. An arterial jump graft from the ipsilateral popliteal artery is another option for reconstruction of the defect at the same leg but there is a possibility of kinking of the grafts and stenosis of distal anastomosis **[1]**. In such cases, the vascular pedicle of the free flap can be anastomosed to the recipient vessels in the contralateral healthy leg temporarily and then divided after adequate neo-vascularization of the flap occurs from the wound bed, hence the name "cross leg free flap", first described by Taylor et al. **[2]** in 1979 using osteocutaneous iliac flap. Only a few case reports and small patient series using different types of flaps have been reported in the literature including osteocutaneous, muscle and myocutaneous flaps **[3-12]**. Also modifications in anastomosis were described to offer the advantage of preservation of the recipient artery was accomplished in two stages by safe end-to-end anastomosis **[13]**.

PATIENTS AND METHODS

In this article early experience of authors in the technique of cross leg free flap is reported for the salvage of 7 limbs in 7 patients with severely mutilated lower limbs with both soft tissue loss and bony fractures in absence of recipient vessels in the injured leg (Table 1). Six patients had six defects on the lower two thirds of the leg and ankle joint. One patient was suffering from post traumatic near-circumferential soft tissue loss of the foot. The age of the patients ranged from 8 yrs to 27 years old. The study was conducted in the

department of plastic surgery of Ain Shams University hospitals from October 2002 till November 2006 with follow-up of an average 16 months. Defect size ranged from 16x11cm to 34x16cm.

All cases were operated upon under general anesthesia. All patients were operated upon at first by aggressive primary debridement and external fixation. A second debridement was done after 48 hours to ensure viable edges of the defect together with measuring the exact defect size to plan the procedure. Free latissimus dorsi myocutaneous flap was raised in six cases. In the seventh case serratus anterior and latissimus dorsi myocutaneous flap were raised on the same pedicle together because of the huge defect size, compared to the small sized latissimus dorsi muscle in this 8 years old child. The donor was closed directly in all patients leaving suction drain. End to end anastomosis was used in all cases, based on the contralateral posterior tibial artery in three cases and on the contra-lateral anterior tibial artery in four cases. In one patient restoration of the continuity of anterior tibial artery was done by suturing of the serratus anterior artery included during flap dissection to the cut distal end of anterior tibial artey of the donor leg. In all the cases venous drainage was done on single vena comitant of the recipient artery and the great saphenous vein of the contra lateral leg. Suturing of the proximal portion of the free flap to the skin of the other leg was done to prevent direct traction on the pedicle. Tubing of the proximal portion of the free flap around the vascular bridge was done also to safeguard the pedicle from desiccation (Fig. 2C). Inset of the flaps was done to cover the defects leaving 2 rubber drains under the flap to prevent hematoma occurrence. Fixation of both lower limbs was done to prevent kink or stretch of the feeding pedicle using a combination of casting, Elastoplasts and crepe bandage leaving both legs in resting parallel position (Fig. 4). Patients were put on prophylactic low dose of heparin to guard against DVT due to long time of bed stay. The first dressing of the flaps was done on the fifth day post operatively, then every third day until flap division. All flaps were divided after 28 to 32 days post operatively with direct closure of the contra lateral leg donor. One week later STSG was applied to the transferred muscle on both sides of the cutaneous island of the flap.

Table (1): Patient's age, site and size of the defect and associated vascular injury.

Case	Age	Defect	Size	Vascular injury
1	12yrs.	Lower 2/3 Rt. Leg + ankle	18X13 cm	Anterior tibial a. + peroneal a
2	8yrs.	Lower 2/3 Rt. Leg, ankle + proximal 1/2 dorsum foot.	16X11 cm	Anterior tibial a. + Posterior tibial a.
3	14yrs.	Lower 2/3 Rt. Leg	22X15 cm	Anterior tibial a. + peroneal a
4	27yrs.	Lower 2/3 Lt. leg + ankle	34X16 cm	Anterior tibial a. + peroneal a
5	19yrs.	Medial & lateral aspect Rt. Foot & ankle + sole. & heal	29X 17 cm	Anterior tibial a. + Posterior tibial a.
6	18yrs.	Lower 2/3 Rt.leg + ankle	22X14 cm	Anterior tibial a. + Posterior tibial a.
7	21yrs	Lower 2/3 Lt. leg + ankle	24X16 cm	Anterior tibial a. + peroneal a

RESULTS

Seven patients with post traumatic extensive soft tissue loss of leg, ankle and foot with bony fractures, applied external fixation and associated with vascular injuries, were reconstructed using cross leg free latissimus myocutaneous or muscle flaps. All flaps survived completely at time of flap division except one flap suffered from congestion and loss most probably due to immobilization problem and subsequent vascular pedicle kink. This case needed debridement and was then reconstructed immediately using cross-thigh fasciocutaneous flap and STSG. All legs had satisfactory coverage and secondary orthopedic reconstruction was done with subsequent limb survival. Flap donor site healed primarily in all patients without complications (Figs. 1,2,3).

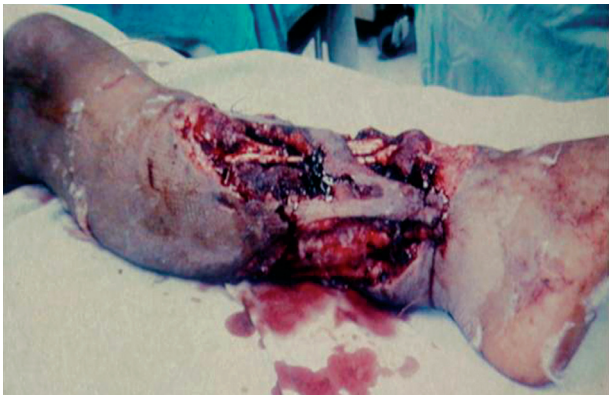

Fig. (1-A): Severely crushed right leg with fracture both bones and extensive soft tissue loss.

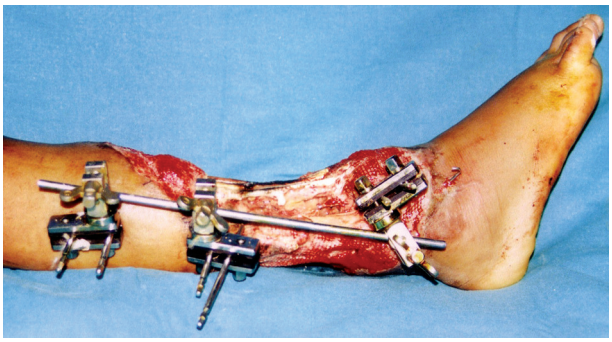

Fig. (1-B): Debridement of the necrotic tissue leaving huge defect after external fixation with injured both anterior and posterior tibial arteries.

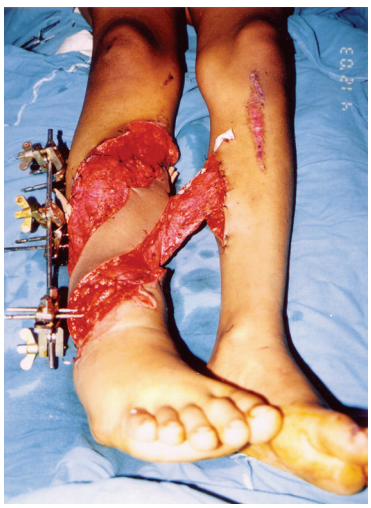

Fig. (1-C): Coverage of soft tissue defect using cross leg free Latissimus dorsi myocutaneous flap. Notice the comfortable position of both legs during immobilization in bed.

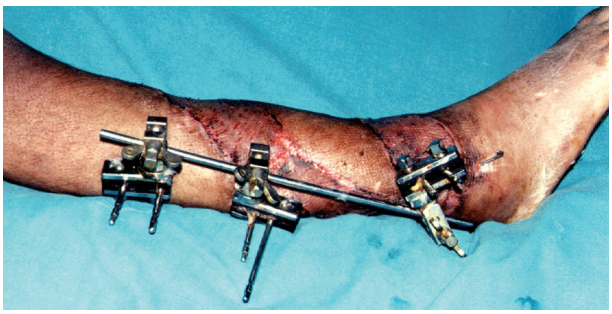

Fig. (1-D): Postoperative view after division of the flap with applied STSG to the muscle above and below the cutaneous island.

Fig. (2-A): Near total avulsion of Rt. Foot skin sparing dorsum of foot.

Fig. (2-B): Defect after right foot debridement showing loss of whole sole, lateral and medial ankle and foot skin.

Fig. (2-C): Flap bridging from sound leg to cover medial and planter aspect of the injured foot.

Fig. (2-D): Lateral view after inset of the flap.

Fig. (2-E): Lateral view after correction of drop foot deformity 14 months postoperatively.

Fig. (2-F): Follow-up 16 months postoperatively with patient standing after healing of Rt. Leg fractures.

Fig. (3): Latissimus dorsi donor site morbidity in the form of linear suture line.

DISCUSSION

Severe injuries of lower extremities usually result in extensive soft tissue loss, bony loss, fractures and even major-vascular injuries rendering reconstruction a very difficult procedure. Sometimes local and regional flaps are of inadequate size due to extensive soft tissue loss. The fact that in this type of injuries there is a combination of extensive soft tissue loss, bony fractures and external-fixation at the recipient leg make the use conventional cross leg flap very difficult to apply. Moreover, these recipient legs cannot benefit from conventional free tissue transfer due to lack of suitable recipient vessels for anastomosis as a result of either direct vascular injury or post-traumatic vessel diseases. The use of long vein grafts or A-V loops to vascularize free flap away from the zone of injury is not preferred because it requires another donor site and increases the number of vascular anastomosis which in turn increases the risk of thrombosis and failure of the free flap. An arterial jump graft from the ipsilateral popliteal artery is another option for reconstruction of the defect at the same leg but it is not preferred due to possibility of kinking of the grafts and stenosis of distal anastomosis **[1]**.

The cross leg free flap is indicated in cases of failure to achieve the reconstructive purpose as failure of a conventional pedicled cross-leg flap or even conventional free flap transfer. Because the procedure can be the last choice for salvaging

a severely traumatized lower limb **[7]**, every effort should be made to ensure proper flap selection and safe arterial anastomosis. In this situation selection of the contra-lateral leg as a recipient vessel must be done to avoid jeopardizing the distal blood flow due to possible occlusion of the only intact vessel in the same extremity even if end to side anastomosis was used.

Only a few case reports and small patient series using different types of flaps have been reported in the literature including osteocutaneous, muscle and myocutaneous flaps **[3-12]**. In this article the authors preferred to use latissimus dorsi myocutaneous flap because it is a reliable flap of large size and is long enough to compensate for the distance lost during flap bridging between the two legs, without reduction of the needed size of the flap. It has along pedicle and very little anatomical variations. It is also easy to harvest and can be done in very small children **[14]**. More-over the presence of muscle plays an important role in neovasularization and prevention of possible osteomyelitis formation at exposed bony tissue by providing the best conditions for angiogenesis. Performing the vascular anastomosis in the contralateral healthy leg allowed the surgeons to handle healthy vessels inside virgin tissues avoiding the post traumatic disease and its high incidence of micro-vascular complications. Donor site morbidity was in the form of two suture lines in the back and the other leg thus leaving the normal leg fully functioning. Patient immobilization in bed was much more satisfactory to patient as his legs are put extended in parallel position through the whole procedure, compared to the crossing and flexion of both legs during the conventional cross leg flap.

Disadvantages of this technique is being a lengthy intra-operative procedure and delayed timing of the flap division (28 days) **[15]** but both are not comparable to the benefit of limb salvage. End-to-end anastomosis is another obvious drawback due to sacrifice of a major artery in the other leg which in turn decreases distal blood supply, although an end-to-side anastomosis is favored to keep the continuity of the recipient artery **[15,16,17]**. Yet this was overcome by selection of dorsalis pedes artery for anastomosis **[18]** and modifications that preserves the continuity of the recipient artery **[13]**.

The cross leg free latissimus dorsi myocutaneous flap was able to salvage 6 severely mutilated lower limbs with soft tissue loss, bony fractures and loses in absence of recipient vessels in the injured leg. The flaps survived and were covered by skin grafts, underlying bony fractures healed and bony defects were reconstructed. Flaps were not bulky and allowed the secondary procedures needed to finalize the limbs reconstruction.

In conclusion, the cross-leg free flap technique is to be left as the last trial for limb salvage in cases of extensive soft tissue leg defects where both local and regional flaps cannot be used and the limb vessels are unsuitable for microvascular anastomosis. The latissimus dorsi myocutaneous flap can be the first choice for this procedure being a reliable flap with long pedicle and very little anatomical variations, easy to harvest. Highly vascular to assist in angiogenesis and prevent osteomyelitis and can be also done in very small children with limited morbidity in both injured and healthy legs. Lastly using the contra-lateral sound leg decreases much the incidence of microvascular complications.

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