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Assessment of Microsurgical Reconstruction of Traumatic Major Defects of the Lower Limb in Paediatrics

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ABSTRACT

Microsurgical reconstruction of extensive soft-tissue defects of the foot and lower leg regions has now become the preferred choice of reconstruction at many centers in the adult population, as it allows for adequate, stable, one-staged reconstruction for complex defects.

Although it is well established that free tissue transfer in children can be accomplished safely and successfully, few series to date has specifically addressed the microsurgical management of pediatric lower extremity trauma.

In this study 42 child with ages ranging from 2-17.5 and a mean of 9.08 years were managed by either free latissimusdorsi or rectus abdominusmyocutaneous flap for such defects with a success rate of 90.4%. The aim for this paper is to assess the feasibility and difficulties encountered when embarking on such endeavor.

INTRODUCTION

Repair of traumatic soft-tissue defects of the foot and lower leg region in children and adults is a challenging job as often trauma precludes the use of local flaps. Adequate soft-tissue coverage can be achieved using a variety of methods including different distally based fasciocutaneous flaps and cross-leg flaps, which have been used successfully and proven to be reliable in many occasions **[1,2]**. These techniques, however, when used in children inflict a significant amount of discomfort because of prolonged periods of immobilization and hospitalization, and the need to subject patients to multiple surgical procedures. Conversely, free tissue transfer provides adequate soft and skeletal tissue that allows for a single stage reconstruction and early mobilization of the injured extremity.

The basic principles delineated in many published series **[3,4]** are universally accepted and applied today: Wide débridement, external fixation, early coverage with well vascularized tissue, and delayed bone grafting. At many centers, this choice of reconstruction has now become the preferred treatment option for extensive soft-tissue defects of the foot and ankle region in the adult population **[5-7]**.

Although it is well established that free tissue transfer in children, though more difficult, can be accomplished safely and successfully, **[8-10]** few series to date has specifically addressed the microsurgical management of pediatric lower extremity trauma. Fewer still are the studies that have assessed the effect of the free tissue transfer on the growth pattern in these patients **[11]**, control of local infection and the ability to use the limb later on.

Aim of the work:

This work was conducted to assess the feasibility, difficulties and long term effect of microsurgical reconstruction of major post traumatic leg and foot defects in paediatric patients.

PATIENTS AND METHODS

During the last 3 years; 42 free flaps for lower limb defects; all of them were trauma patients whose age ranged between 2 and 17.5 years; had been carried out in the Main Alexandria University Hospital and the National Health Insurance Hospital. Thirty-three patients were managed in the early phase by free tissue transfer (FTT) for the traumatic defect. The other 9 patients were either patients referred by our colleagues in the Orthopedic Surgery Department to provide adequate soft tissue coverage for their planned intervention to correct the bony skeleton of the foot or leg or patients who needed stable coverage for an unstable scar.

Preoperative duplex was performed to all the cases to ensure the patency and adequacy of the vascular tree of the reconstructed lower limb, MRI angiography was rarely resorted to.

Patients were managed either with latissimusdorsi muscle flaps or free rectus abdominis muscle flaps, skin padels were kept to minimal to minimize the bulkiness of the flaps.

All procedure were performed as a single team in which the first step was preparing the recipient area, followed by preparation of the recipient vessels; this was followed by raising the flap, fixing it to the recipient site and finally performing the microsurgical anastomosis.

Heparin at 50 units per Kg bodyweight was given a few minutes before clipping the flap's pedicle then maintained at a dose of 20U/Kg/h for the next three days [12], in older children 12 years and above enoxaparin sodium (Clexane) at a dose of 1mg/kg every 12 hours.

RESULTS

The age of our patients ranged between 2 and 17.5 years with a mean of 9.08 years. Eight of them were below 6 yrs of age while 19 of them were between 6 and 10 years.

During the period of this study; 32 free LD (latissimusdorsi) myocutaneous flaps and 10 free RA (rectus abdominis) muscle flaps have been performed. The commonest site for coverage was the ankle joint (22 cases) either together with the foot or with the lower third of the leg. The least common site was the heel (11 cases). Foot coverage was achieved in 19 cases while lower leg was the site of coverage in 17 cases with a total of 69 areas that was covered in our 42 patients.

Operation time ranged from 4.5 hours to 6.5 hours with a mean of 5.58±0.59 for the free rectus and 5 to 8.5 hours with a mean of 6.09±0.68 for the free LD myocutaneous flap. This is longer than what is usually reported in most series due to the fact that all cases were performed on a single team basis.

The overall success rate in this series was 90.4% that is 38 successful cases out of 42. Four cases were lost; three of them due to venous complications while the fourth case was secondary to arterial occlusion.

Post operative venous congestion was seen in 7 cases all of them were taken to the operative theatre: In 3 cases the condition could not be resolved and it progressed to flap loss, in 2 cases the condition was reversed with partial flap loss in one of them, and in the remaining two cases it proved to be a false alarm.

Ischaemia of the distal part of the flap was an unexpected complication that was met in two of our younger patients managed with Free LD flaps.

There was no post operative congestion in those two cases that can explain such occurrence.

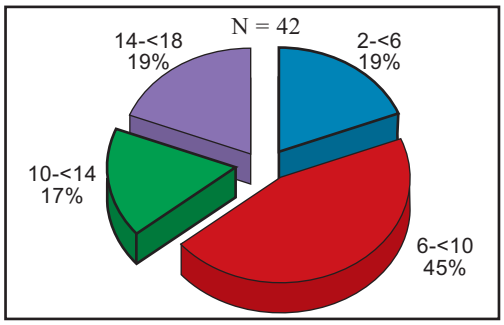

Fig. (1): The distribution of patients according to age.

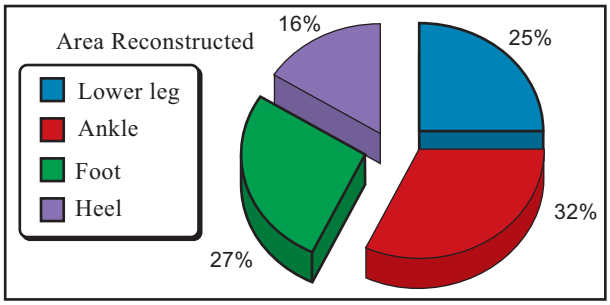

Fig. (2): The distribution of areas of the lower limb covered.

Fig. (3A): A case of free LD muscle flap for coverage of lower leg, ankle and foot in a 2-year old child (preoperative view.

Fig. (3B): Early postoperative view for free LD flap, before skin grafting.

Fig. (3C): Late postoperative view.

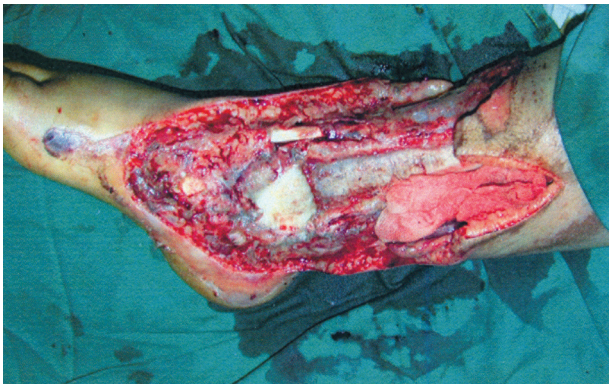

Fig. (4A): A case of exposed tibia in the lower leg and open ankle joint in a 4-year old child (intra-operative view).

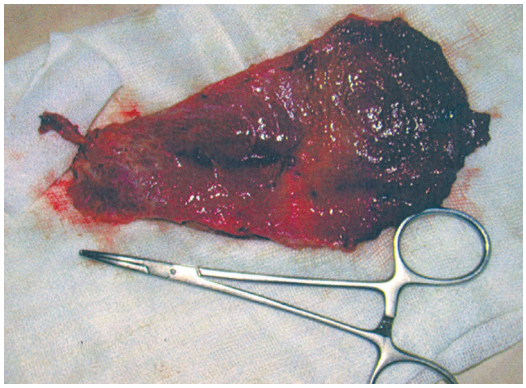

Fig. (4B): Latisismusdorsi flap raised.

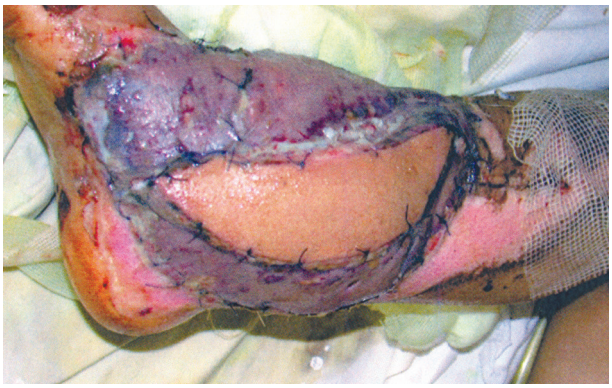

Fig. (4C): Free LD flap with immediate SSG, early post-operative view.

Fig. (4D): Late postoperative view.

Fig. (5A): Exposed medial malleolus.

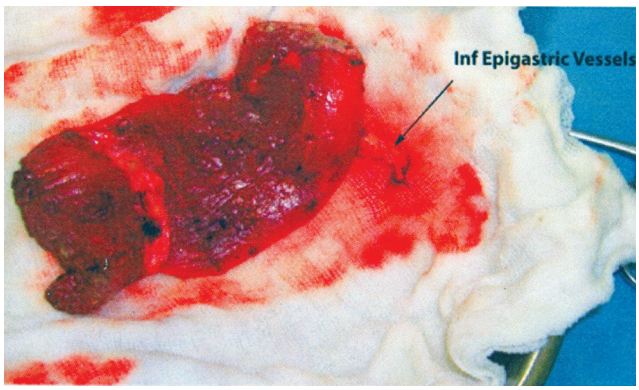

Fig. (5B): Rectus abdominis free flap raised.

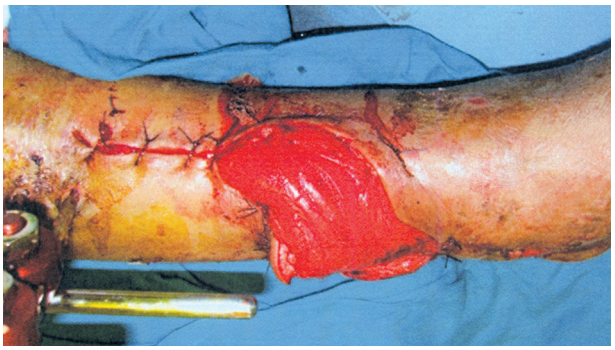

Fig. (5C): Immediate postoperative view.

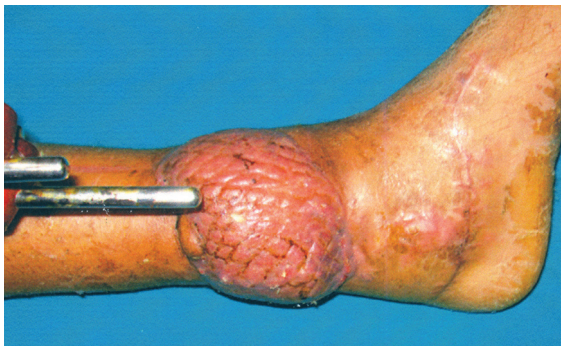

Fig. (5D): Late postoperative view.

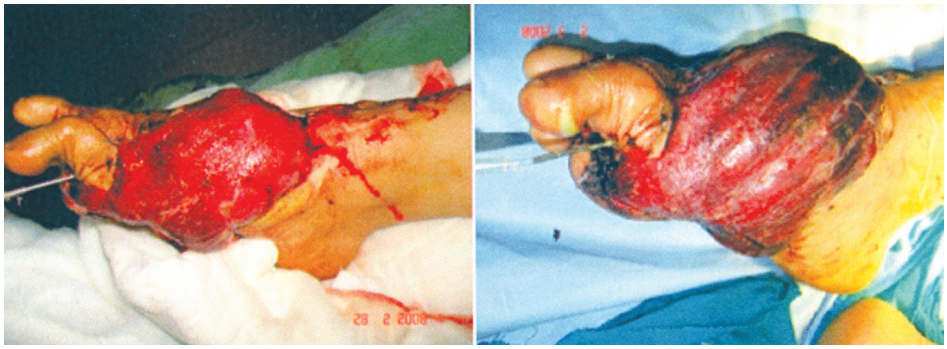

Fig. (6): A case of free rectus abdominis flap with early postoperative venous congestion.

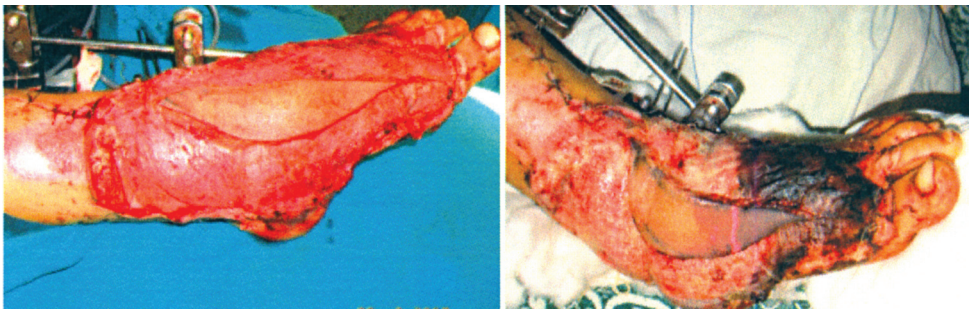

Fig. (7): A case of free LD flap with distal ischemia of the flap as seen few days post operatively.

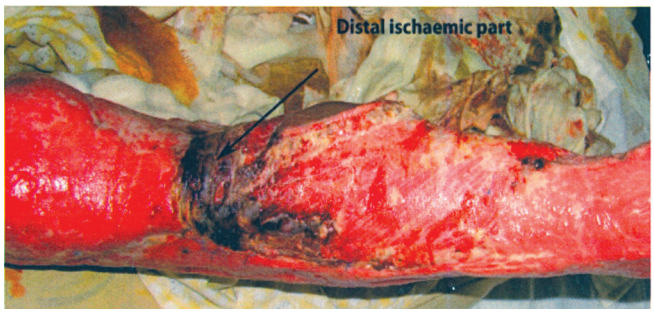

Fig. (8): A case of free LD flap for coverage of lower leg with distal ischemia of the flap as seen few days post operatively.

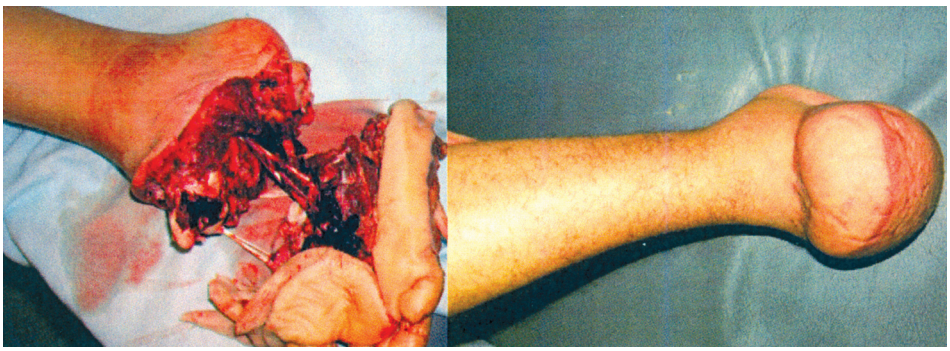

Fig. (9): 11 years old child presenting with traumatic amputation of the foot, and his folow-up photo 3 years later after being managed with a free LD myocutaneous flap.

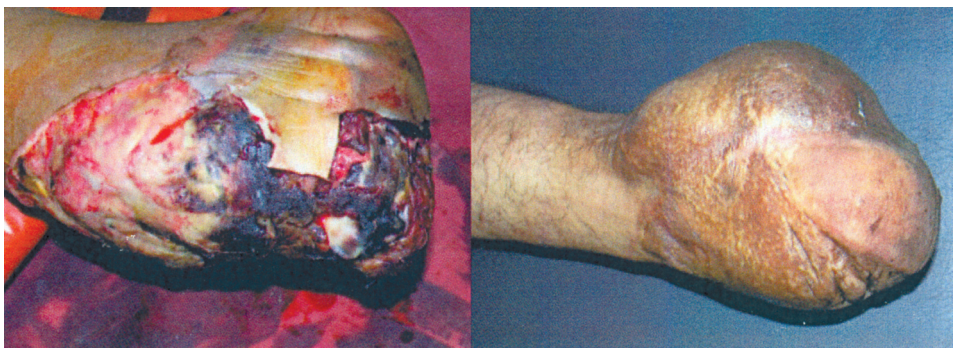

Fig. (10): 13 years old child presenting with traumatic amputation of the foot, and his follow-up photo 3.5 years later after being managed with a free LD myocutaneous flap.

DISCUSSION

We had been faced with three problems significantly different from adults. The first of which was the very small size of deep veins associated with anterior and posterior tibial arteries; especially in our younger patients, we overcame this problem by resorting to using the long saphenous vein as recipient (Fig. 11), however this resulted in increased venous pressure in the flap, and as we depended on clinical assessment to monitor flap viability, increased venous pressure manifested itself as bluish discoloration, and decreased temperature in the flap. In two incidents we had to take the patient back to the operating theatre to examine the anastomosis and it proved to be a false alarm. Proper flap monitor facilities such as invasive Doppler monitoring, if available, would have been greatly appreciable.

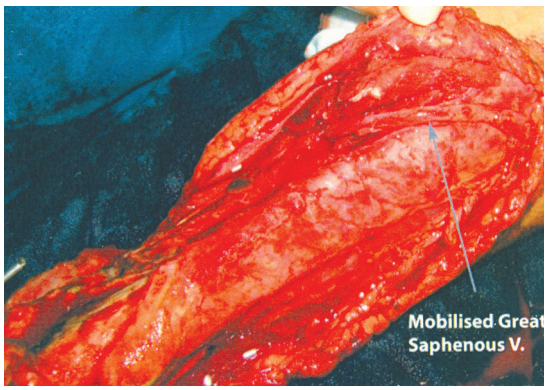

Fig. (11): 3 years old child with exposed bone over the lower half of the tibia in whom the great saphenous vein was mobilized and brought to share as a recipient for anastomosis performed with the anterior tibial artery.

The second problem met with in our cases that also differed from adults was the occurrence of distal ischaemia in our younger patients managed with Free Latissimus dorsi flaps, which happened in two cases (Figs. 7,8) and it could not be explained by any other explanation than that the vascular territory of the thoraco-dorsal artery in children is smaller than that of the adults, which is quite contrary to the belief that circulation in young children is better than adults, and we think that this assumption needs further verification.

The third problem was a practical point involving the usage and dosage of anti coagulants in the immediate and early post-operative period as the use of low molecular weight heparin substitutes (such as Enoxaparine) is contraindicated in children, and we have to resort to using heparin, however data about accurate dosage of heparin in young children is lacking and we had to use the doses adopted for management of other thrombo-embolic condition with a loading dose of 50U/Kg and a maintenance dose of 15-20U/Kg/h. This dose is hard to adjust outside ICU and needs to be monitored closely by APTT.

Regarding the long term result of our patients' normal development of the injured limb was noted in almost all successful cases (Figs. 10,11), normal gait after rehabilitation was usually achieved.

Taking in consideration the overall success rate and the long term results of using microsurgical free flaps for reconstruction of major lower limb defects in children is still promising even in institutes with limited facilities such as ours.

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