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Case Report

Successful five flap reconstruction for extensive crush injuries of bilateral lower limbs using local pedicled flaps in a 73-year-old patient: a rare case report

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ABSTRACT

Extensive soft tissue defects with periosteal stripping over critical areas of tibia pose a tough challenge to the reconstructive plastic surgeon. Treatment of choice for these defects is free tissue transfer. Local pedicled fasciocutaneous or muscle flaps are used only when the free tissue transfer is not possible. The gastrocnemius and soleus flaps either raised as a combined flap or as individual separate flaps can be used in selected cases after a meticulous preoperative planning. Here we report a 73-year-old male patient a case of extensive crush injuries involving both lower limbs following a motor vehicle accident (MVA) in whom we have successfully reconstructed the extensive soft tissue defects with exposed tibia with five local pedicled flaps. The purpose of writing this case report is that when free tissue transfer is not possible in patients with such extensive crush injuries, a durable functionally and cosmetically acceptable reconstruction with pedicled hemi medial gastrocnemius and proximally based medial hemisoleus flaps can be done after a meticulous planning and flap design without any significant functional donor site morbidity.

Keywords: Crush injury, Debridement, Pedicled muscle flaps, Soft tissue reconstruction

INTRODUCTION

Before the advent of free tissue transfer, local pedicled muscle flaps such as the combination of the medial gastrocnemius and medial hemisoleus muscle flaps had been tried for soft tissue reconstruction of an extensive tibial wound of the leg.[1] However, the outcome from most reconstructive surgeons have not been consistent and satisfactory by using these local pedicled muscle flaps.[2,3] Presently microsurgical free-tissue transfer is considered as a 'standard' surgical procedure of choice for soft-tissue reconstruction of an extensive tibial wound of the leg.[2,3,5,6] However free tissue transfer surgery is not without limitations as not all reconstructive surgeons are trained in microvascular free-tissue transfer, all hospitals don't have the availability of the microvascular equipment like high magnification operative microscopes and facility of postoperative monitoring. Besides these reasons, some trauma patients may not be surgical candidates for free-tissue transfer because of their instability after polytrauma, overall poor comorbid status or expected to have poor compliance with proper post-operative treatment protocol after free tissue transfer which may affect the success of these procedures. A solution to these limitations of free tissue transfer is the utilization of a combined pedicled gastrocnemius and hemi-soleus flap, first described in 2004 by Hyodo et al.[7] This combined flap utilizes either the medial or lateral head of the gastrocnemius, which is combined with a hemi-soleus as a contiguous bimuscle flap based on the inter-muscular perforators between them. Pu et al further modified on this technique, using the gastrocnemius and soleus as a single unit for coverage of mid-tibial wounds.[8] The limitation of the above two techniques was that the intra muscular perforators were preserved, hence limiting the reach of the flap. Over the last two decades, the medial hemisoleus muscle flap has

been used to reconstruct tibial wound in the middle or distal third of the leg with good and predictable outcome.[9-12] Here in this case report we present a 73-year-old fragile patient, case of extensive crush injury involving both lower limbs in whom we have successfully reconstructed the lower limb defects by using five local pedicled flaps as an alternative to free tissue transfer.

CASE REPORT

A 73-year-old male with lean and thin body mass was referred to our medical city as a case of extensive crush injuries of bilateral lower limbs following a motor vehicle accident (MVA) two weeks back. According to patient's history, he was washing his car when the brakes the vehicle failed and his lower limbs were caught between the car and the boundary wall of his home and after around 10 minutes he was rescued by the neighbours and taken to the nearby hospital from where he was referred to our hospital for plastic surgery intervention. On reception, patient was stable and all the vitals were in normal range. The life-threatening injuries were already ruled out by the referring hospital according to latest advanced trauma life support (ATLS) guidelines. On local examination of the lower limbs, patient had extensive crush injury of the skin and the underlying soft tissue involving distal two-third of the right leg, left knee with proximal two-third of left leg. Dry black thick eschar, admixed with small islands of raw area, with clear demarcation from the surrounding healthy tissue was present over both lower limbs (Figures 1 and 2). There was complete left foot drop and limb length descripency (LLD) as the right limb was shorter than left because the patient had history of neck of femur fracture same side for which he was operated eight years back (Figure 1). All the base line investigations were done including blood grouping and cross matching. X ray of the lower limbs were showing undisplaced fracture of the lateral condyle of the right tibia with signs of healing (Figure 3). Patient was discussed with orthopaedic team regarding the fracture and they advised for conservative management for this non displaced healing fracture. After taking into account the age and general lean and thin condition of the patient; nature, severity and bilaterality of the injury, we discussed all the possible treatment options with the patient ,with risks and benefits of each treatment option, and decided to proceed with the local pedicled flap reconstruction including a proximally based fasciocutaneous flap raised from medial aspect of the knee and distal thigh for left knee, a combined medial gastrocnemius and hemisoleus bimuscle flap for the exposed tibia of the proximal two third of the left leg, separate medial gastrocnemius and proximally based hemisoleus muscle flaps for middle and distal third of the exposed tibia of right leg respectively. The patient was optimized for the surgery, an informed consent was documented and preoperative anaesthesia check-up (PAC) was performed. A separate consent was taken by the anaesthesia team for the general anaesthesia. Patient was subjected to general anaesthesia and under torniquet control debridement of all the necrotic tissue of both limbs was done, the left common peroneal nerve (CPN) was non-viable resulting in a nerve defect of around 12 cms. The distal and proximal ends were tagged by prolene 3-0. The exposed tibial bones and the patella were freshened by scrapping the outer cortices and final soft tissue defects were created for reconstruction (Figure 4). The exposed tibia with stripped off periosteum were measuring 26×6 cm in the left leg and 31×6 cm in the right leg. Patella with the rectus femoris tendon of the left knee got exposed on surgical debridement (Figure 4). Tissues for bacterial and fungal cultures and sensitivities were taken. Wounds were thoroughly irrigated. A proximally based fasciocutaneous was raised from medial aspect of the knee and the distal thigh to cover the left knee joint (Figure 5). We approached the posterior compartment of the both the legs through the wounds to raise the pedicled muscle flaps. For left leg the medial head of gastrocnemius and proximally based medial hemisoleus were raised as combined bimuscle flap to cover the proximal two third of the exposed tibia (Figure 6). In this combined flap we preserved the perforators between the two muscles flaps. For coverage of the exposed tibia of right leg we raised the medial head of gastrocnemius and proximally pedicled medial hemisoleus as separate muscle flaps to enable the latter to cover the distal tibia (Figure 7). Here we sacrificed the perforators between the two muscle flaps to increase the reach of the hemisoleus to cover the distal third of the tibia. Scoring of the muscle bellies was done to increase the surface area. While harvesting the flaps vascularity was checked clinically during whole process. A 16-size suction drain was placed in the donor site, complete hemostasis achieved and flap inset given using vicryl 2-0. The flaps were reassessed for viability daily and on 5th post operative day, the distal most part of the combined bi-muscle flap was found to non-viable. The non-viable portal was debrided and the resultant defect covered by local proximally based Extensor Digitorum Longus (EDL) muscle flap and split thickness skin grafting (STSG) was done to cover the flaps in the same setting. The patient was operated in three settings, to reduce the risk of long duration anaesthesia. Firstly, the debridement of both lower limbs and flap cover of left limb was done, in second setting flap cover of the right leg and EDL muscle flap for left leg and finally in the third setting meshed (1:1.5) STSG was done for both limbs. Skin grafted was harvested from anterior aspect of both thighs. First graft dressing was done on 3rd post-operative day (POD) (Figure 8).

Figure 1: Pre- operative picture showing extensive crush injury of both lower limbs in critical areas with thick dry eschar in place admixed with islands of raw areas.

Figure 2: Pre–operative picture showing close view of the extensive crush injury involving the critical areas of both lower limbs.

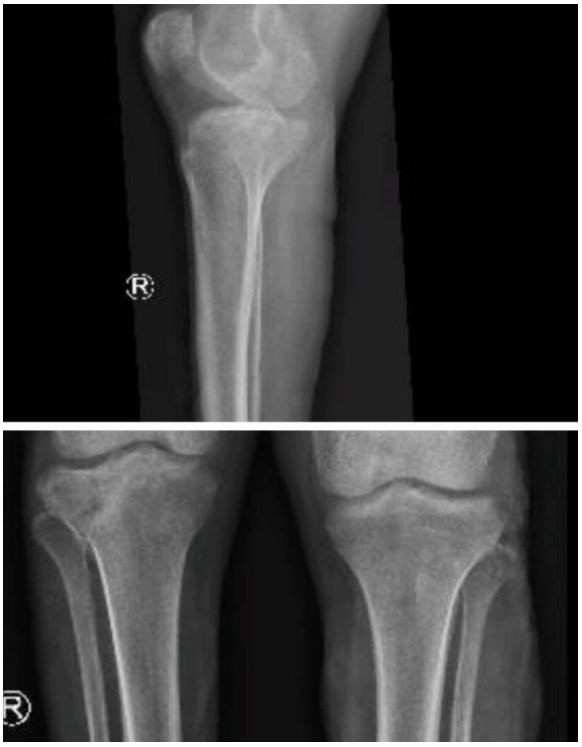

Figure 3: Llateral and AP X ray views of knee joints showing healing undisplaced fracture of the lateral condyle of the right tibia.

Figure 4: Intra- operative picture showing surgical debridement of both limbs with exposed tibia of both legs and left knee joint.

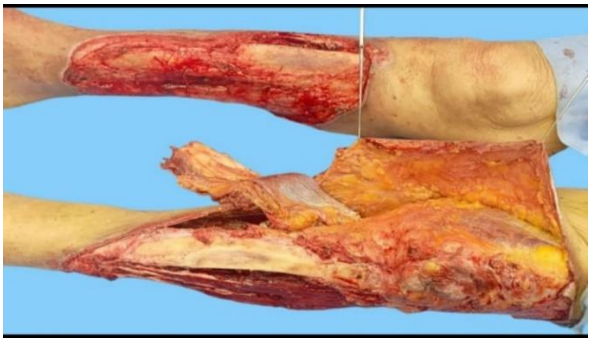

Figure 5: Intraoperative picture showing raising of proximally based fasciocutaneous flap for exposed left knee joint and combined medial head of gastrocnemius and proximally based medial hemisoleus bimuscle flap for proximal two- third of the left leg.

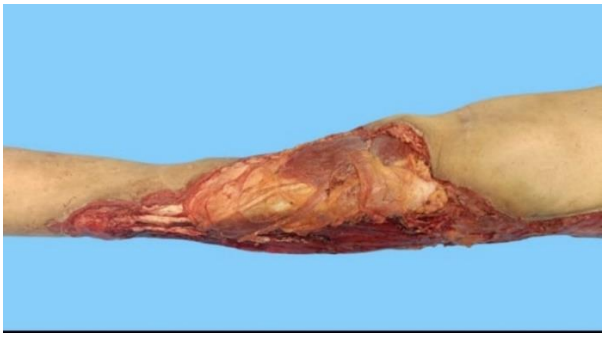

Figure 6: Intraoperative picture showing coverage of the exposed critical areas by the local flaps.

Figure 7: Intraoperative picture showing coverage for the bilateral lower limb wounds by local five flaps, proximally based fasciocutaneous flap for left knee, combined medial head of gastrocnemius and medial hemi soleus bimuscle flap and proximally based EDL muscle flap for proximal two- third of left tibia and separate medial head of gastrocnemius and proximally based medial hemisoleus muscle flaps for middle 3rd and distal 3rd of right tibia respectively.

Around 5th POD patient developed invasive wound infection with tissue cultures showing fungal growth of *Candida albicans* and bacterial growth of *Pseudomonas aeruginosa*. The white blood cell count was 11000/ ml, CRP and ESR were 110 md/dl and 52 mm/ hour

respectively. However, the patient was clinically stable with no features of any systemic inflammatory response syndrome (SIRS). The patient was discussed with infection control specialist and put on parenteral antifungal and antibiotics. Around 4 days after starting the parenteral definitive therapy there was noticeable clinical improvement in the wounds, however by this time there was already around 5 percent flap loss in the left leg, which resulted in two small islands of tibial exposure, and 30 percent skin graft loss in each leg (Figure 9). We used negative pressure wound therapy (NPWT) to cover the exposed tibial bones islands and the prepare the wound for STSG. By two sessions of continuous NPWT, each lasting 5 days, the small islands of exposed bones granulated and were graftable (Figure 10).

Figure 8: Post-operative picture after first dressing change.

Figure 9: Post-operative picture showing well vascularized skin graft over the flaps with two small islands of exposed left tibia, secondary to the flap loss because of wound infection.

Figure 10: Post VAC picture showing patches of raw area with healthy granulations covering the two small previously exposed tibial islands.

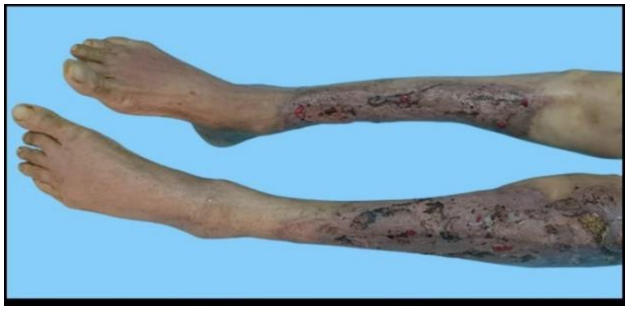

Figure 11: Post operative picture with well vascularized stable wound coverage.

Redo skin grafting was done which finally completed the wound coverage (Figure 11). The patient may need tendon transfer for left foot drop as a secondary procedure in future. The patient was referred to physical medicine and rehabilitation (PMR) for rehabilitation and physiotherapy.

DISCUSSION

Soft tissue reconstruction of legs with extensive crush injuries is commonly done by free tissue transfer and the utilization of combined local muscles for these injuries has not been widely practised. For Gustilo type IIIB fractures with extensive soft tissue injury and periosteal stripping, the gold standard is soft tissue coverage by free flaps and regarding the soft tissue reconstruction the same standard of care stands true for our patient though he didn't have any tibial shaft fracture but only soft tissue defect with stripped off periosteum. Since our patient was not apparently a fit candidate for the free flap surgery because of his old age, fair general health condition, severity and the bilaterality of the extensive crush injuries, we performed the soft reconstruction with local pedicled muscle flaps including medial head of gastrocnemius, proximally based medial hemisoleus and proximally based EDL muscle flap, after searching the relevant literature. When planned properly the usage of these local pedicled flaps are a suitable alternative to free flaps in soft tissue reconstruction of lower limbs in patients who are not suitable candidates for long duration free flap surgery, besides being simpler and don't need the microsurgical expertise while providing equally good and durable soft-tissue coverage for an extensive tibial wound. In addition to these benefits, these are also more cost effective.[13] The concept of combined bimuscle flap consisting of medial head of gastrocnemius and hemisoleus to be raised as a single unit to cover tibial wounds was originally described by Hyodo.[7] In this bimuscle flap the soleus muscle component which is raised as a distal extension of the gastrocnemius flap is vascularised by feeding intermuscular perforators from the gastrocnemius muscle. This is similar to that used by Pu who used it to cover anterior tibial soft tissue defects.[8] However, Van Halen raised the gastrocnemius and soleus muscles as separate pedicled flaps, by sacrificing the intermuscular perforators between the two muscles, for reconstruction of post tibial sarcoma resection soft tissue defects, allowing each to be moved as separate units thereby increasing mobility and reach of each individual muscle flap and allowing for

resurfacing of a larger area than the methods previously described by the other authors.[14] Our patient was an exception as he had involvement of both lower limbs with soft tissue defect involving proximal third of the left leg and extending to the knee while as for the right leg the soft tissue defect was over the distal two-third. So we planned to raise a combined bimuscle flap of medial gastrocnemius and proximally based medial hemisoleus for resurfacing the left leg and for right leg we raised the gastrocnemius and medial soleus as individual separate flaps by sacrificing the intermembranes perforators to increase the reach of hemisoleus flap to cover the distal part of the defect. Previously, Pu has successfully resurfaced the distal tibial defects with medial hemisoleus muscle flap.[9] In our patient we did not notice any significant functional donor site deformity, though there was mild lower limb joint stiffness secondary to the prolonged immobilization and old age. The knee flexion as well as plantar flexion were well maintained in our patient however his mobilization got delayed because of his overall general weak condition of health, elderly age and relatively more time taken by the extensive wounds to heal besides the associated complete left foot drop and short right lower limb with the limb length discrepancy, secondary to past post-traumatic fracture of neck of right femur, also created a hurdle in early ambulation. In previous studies also, authors have reported little functional donor-site morbidity in patients who had either medial gastrocnemius or entire soleus muscle flap reconstruction as the preserved portions of these muscles compensate and perform high and the patients were able to ambulate independently and resume back the routine activities of daily life (ADL).[15,16]

CONCLUSION

In patients with extensive soft tissue injuries of legs with periosteal stripping of tibia reconstruction by local pedicled gastrocnemius and proximally based medial hemisoleus muscle flaps is a suitable and effective alternative, when free tissue transfer is not possible, in such limb salvage surgeries.

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