Our Experience of Proximally Based Sural Artery Flap with Ilizarov Fixator Around The Knee

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ABSTRACT

Objective: To determine the survival of sural artery flap reconstruction of complex soft tissue defects around the knee and use of ilizarov for fixation of proximal tibial fracture.

Methods: This descriptive study was conducted in Orthopedic Department of Sheikh Zayed Medical College/Hospital, Rahim Yar Khan in the period extending from 23rd February 2014 to 23rd June 2019. All the patients fulfilling the inclusion criteria were operated for proximally based sural artery flap to cover the defect and fracture stabilized with Ilizarov fixator. Follow up was for a period of minimum of 06 months for flap survival and up to 1 year for fracture union and knee range of motion.

Results: There were total 17 cases including 14(82.3%) male and 3(17.6%) female with mean age 35±9 years. Road traffic accidents were responsible for majority(64.7%,n=11) of cases while 6(35.2%) had gunshot injuries. The flap sizes ranged from 6x6cm up to 12x cm with pedicel length ranges from 4x10cm.Majority(88.2%,n=15) of flap survived. Proximal tibial fractures united in all patients. Full knee range of motion was documented in all the patients at final follow up.

Conclusion: Proximally based sural artery fasciocutaneous flap with Ilizarov fixator is a reliable method for reconstruction of complex soft tissue defects around the knee. It has good outcome and only few complications.

Key words: Complex soft tissue defects, Sural artery, Ilizarov external fixator.

This article may be cited as: Chaudhry NA, Azeem M, Ahmad AA, Waheed F. Our Experience of Proximally Based Sural Artery Flap with Ilizarov Fixator Around The Knee. J Pak Orthop Assoc 2019;31(2):

INTRODUCTION

In human body the knee is the most prominent sub-cutaneous joint and hence prone to trauma.[1] The most common causes of defect around knee joint include trauma, oncological excision, chronic infection, release of post burn flexion contracture and break down of surgical wounds after total knee replacement.[2,3] Knee trauma often require multidisplinery approach involving vascular surgeon, plastic surgeon and Orthopedic surgeon because reconstruction of soft tissue defect around knee is always a challenge. There is continuous battle between blood supply and the beauty. The good results of reconstructive surgery mainly rely on the stability of the vascular component[4], which is fundamental that ensures survival and function of the transferred tissue. Reconstruction of soft tissue is easy but choice is difficult. So multi displinary team is required to plan reconstruction according to individual needs. Several factors must be considered before reconstruction like patient's general condition, wound geometry and infection. But most important factors are exposed bone, joint, tendon and implants or prosthesis.[5] Peripheral vascular disease, chronic liver disease, chronic renal disease, obesity, cigarette smoking and diabetes are important comorbidities that must be considered before planning for knee coverage.[6] There are different options but the best policy is "replace with the same". The option started from conservative wound management or debridement with reconstruction carried out in the presence of necrotic tissue.[7] Various other option have been utilized for soft tissue reconstruction for these defects i.e. local muscle flaps, perforators flaps, fasciocutaneous flaps, cross legs flap and free flaps.[8] If the wound is deeper with exposed tendons or implant then the choice of flap coverage is local muscle flap. Combined gastrocnemius and soleus[9] is also used for this purpose. For complex and extensive defects if local

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flaps are not available this requirement is fulfilled with distant muscle flap or micro vascular tissue transfer for coverage. But these flaps are associated with more morbidity and gives further trauma to the already traumatized limb. Free tissue transfer is a good option as it is single stage and with less donor and recipient site morbidity but it requires infrastructure, expertise and the selection of the recipient vessel is challenging[10]. Cross leg flap is very easy and usually not much technically demanding but it has some disadvantages like several operative stages, long immobilization and inability to apply Ilizarov to the fracture.

Recently trend is shifted towards perforators flaps due to advancement and improvement in medical technology. Local perforators flaps are very good option with significant advantages due to their aesthetic look and very low donor and recipient morbidity but requires hand held Doppler to find out the perforators before surgery.[11] However, recharging and supercharging are required in some cases due to short arc of rotation and very thin vein walls. Keeping in view the complexity and low donor site morbidity, this study was conducted to assess the outcome of sural artery flap with illizarove technique for reconstruction of complex soft tissue defects around knee.

METHODS

The design of our study was descriptive and it was conducted in Orthopedic Department of Sheikh Zayed Medical College/Hospital, Rahim Yar Khan in the period extending from 23rd February 2014 to 23rd June 2019. All the patients that presented in Orthopedic unit with complex soft tissue defects around knee and associated proximal tibial fractures(Gustilo Anderson type IIIB) were included in our study. Post surgical defects and older soft tissue defects(more than a week) were excluded from the study. Ethical approval and patient's consent was documented. All the patients were treated according to Advance Trauma Life Support(ATLS) protocol. We did wound debridement and planned for reconstruction within one week after trauma. We measured the wound dimension of anterior aspect of knee in full knee flexion and used hand held Doppler for the identification of superficial vessel. The Data was analyzed with SPSS(version 20).Important study variables were represented as frequency, percentages and mean. All thed patients were followed up for flap survivals up to 3 months and long follow up for fracture union up to one year.

SURGICAL TECHNIQUE

All the surgeries were done under tourniquet control on radiolucent table in lateral decubitus position initially for flap and then changed to supine position for the application of Ilizarov fixation. All the patients were given pre op antibiotics(injection Cefuroxime 1.6gm). We debrided recipient site and flexed the knee to measure the actual size of the wound which needed coverage. Then this size was mark with 2cm increment at donor site to prevent tension at sutures. After marking the donor site, arc of rotation and site of pivot is marked 2cm below the knee crease. We dissected first proximally to identify the neurovascular bundle and then dissected the flap from distal to proximal(Fig I). The flap consisted of islet of skin, subcutaneous tissue, deep fascia, sural nerve, median superficial sural artery and lesser saphenous vein. The deep fascia was excised wider to take more perforator to be included in the pedicle to increase the chances of flap survival. We finally dissected the flap up to pivot point of rotation(Fig II). We did not use tunnel for the passage of flap because flap size was larger and chances of vascular compromise was more. So we we made a path way by incising the skin deep to fascia and undermine margin of skin for later closure and to decrease pressure on neurovascular bundle. When the dissection was complete before shifting the flap to recipient site we deflated the tourniquet to check the vascularity of the flap by seeing the fresh bleeding spots, and observing texture and color of the flap. After confirming the vascularity we shifted it to the recipient site and then secured the flap with suture. Skin graft from lateral and posterior aspect of thigh is taken and primarily applied at the donor site of the flap. We changed the position of the patient from lateral to supine for the application of Illizarov fixator for fracture tibia(Fig III). Image intensifier was used to confirm proper wire placement and fracture reduction. We did not involve plastic surgeon for flap coverage and both the procedures were done independently by our team because in busy government hospital it was difficult to collaborate due to the patient over load and different schedules of the different surgical Departments.

For flap viability or survival we checked the post-operative vascularity of the flap by noting the color of the flap, its margins, signs of poor perfusion / congestion, blistering and epidermal shrinkage.

Patients were instructed for pin tract care of Ilizarov. Non-weight bearing ambulation with walkers was permitted on 3rd or 4th post operative day. Follow up visits were scheduled at 2 weeks initially and then monthly. The femoral ring was removed after six weeks and the knee flexion extension and quadriceps exercises were started. Ilizarov ring fixator was removed after radiologically union usually at 3 to 6 months.

RESULTS

The total number of patients in our study were 17. Male patients were 14(82.3%) and female were 3(17.6%). The mean age was 35±9 years(range 20 to 55 years). Road traffic accidents were responsible for majority(64.7%,n=11) of cases while 6(35.2%) had gunshot injuries. Right side was involved in 11(64.7%) and left in 6(35.2%) patients. Schatzker type VI fractures were present in 7(41.1%) patients, type V in 5(29.4%) and type IV fracture in 5(29.4%) patients. The flap sizes ranged from 6x6cm up to 12x cm with pedicel length ranges from 4x10cm.Majority(88.2%,n=15) of flap survived. Proximal tibial fractures united in all patients. Full knee range of motion was documented in all the patients at final follow up. Only 2(11.7%)patients developed marginal necrosis. While in 1(5.8%) patient with tibial bone loss of 15-20cm the flap survived but later on the flap bridge between proximal and distal bone fragment. One(5.8%) patient had loss of split thickness skin graft margins at donor site which later on healed without intervention by migration from surrounding tissues.

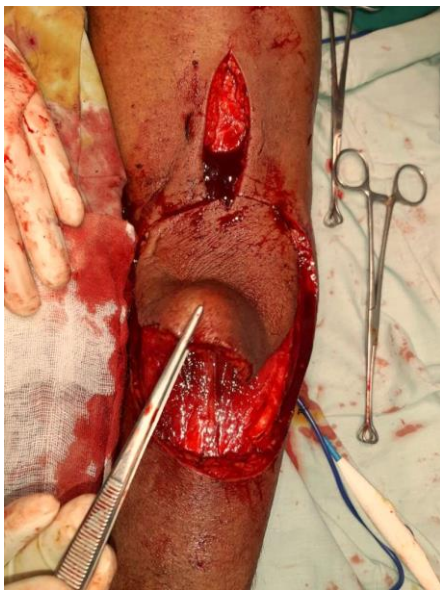

Fig I: Flap dissection

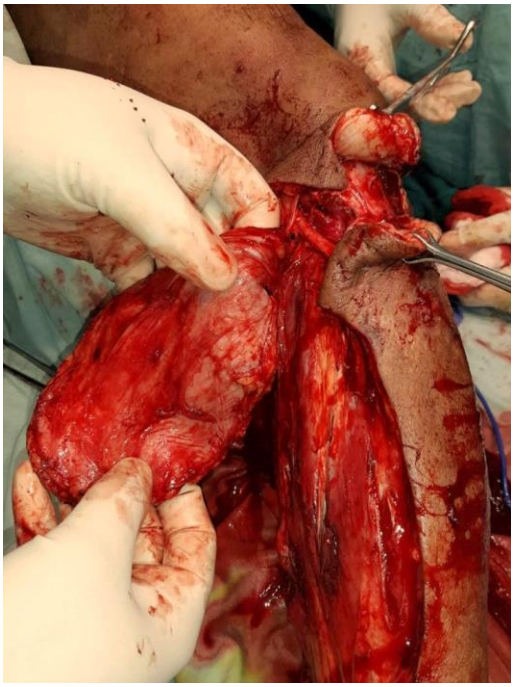

Fig II: Flap dissection

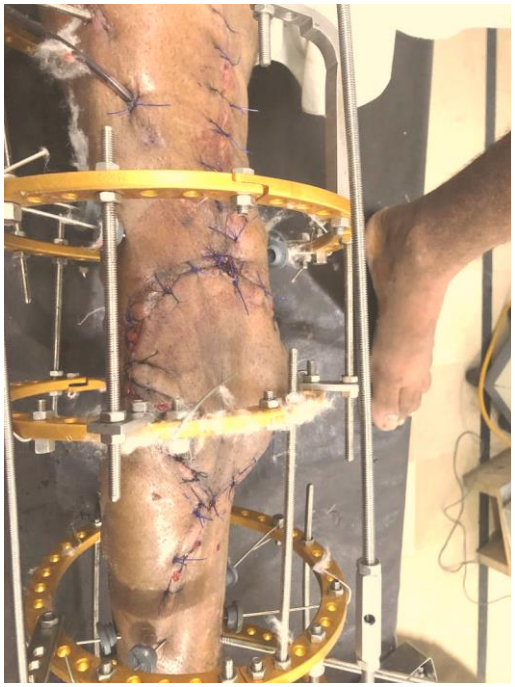

Fig III: Flap sutured and Ilizarov applied

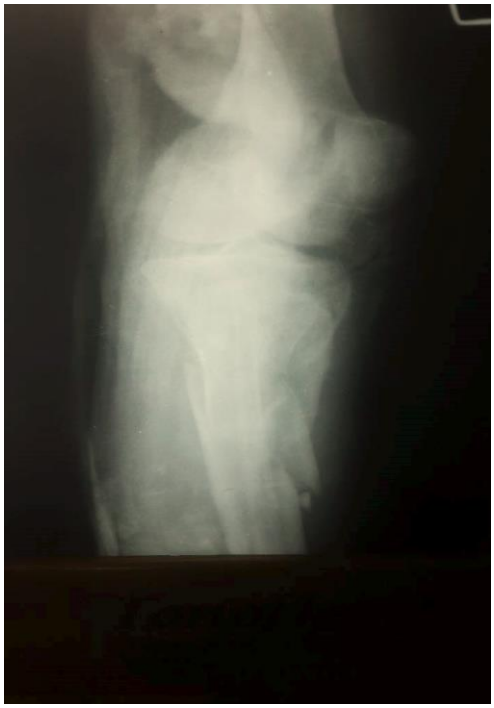

Fig IV: Pre op Xray

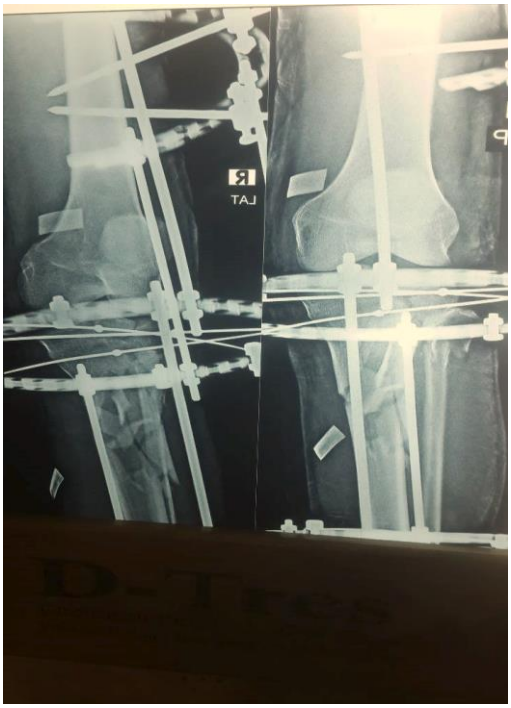

Fig V: Post op Xray

DISCUSSION

In the past gastrocnemius muscle flaps were considered as the work horse for covering knee joint because of simplicity and more reliable axial blood supply and were specially indicated for more complex soft defects with prosthesis or joint exposures. This large muscle flap obliterates the dead space in three dimension and provides rich blood supply to the wound for wound healing and facilitate antibiotic delivery. Medial gastrocnemius is most commonly used for this purpose because of its longer vascular pedicle and greater arc of rotation. The combine gastrocnemius with soleus flap is preferred for large infra patella defects.[12] Other muscles like Gracilis, Sartorius and Vastus Medialis can be used for this coverage. But this coverage is against the rule of "Replace with the same". This coverage has more bulk and it hinders gliding of patella during flexion and extension and the morbidity is more in ambulated patient or high performance athletes because gastrocnemius and soleus are important stabilizer of knee and ankle and play an important role in propelling foot forward during gait cycle.[13]

Free flaps play a good role in patients with extensive defects when the local muscle, musculocutaneous, fasciocutaneous or perforators flaps are un-available. This flap provides stability to the wound and promotes healing but the most challenging task is the selection of recipient vessel.[14]

A study carried out by Igari K et al[15] on free transfer of Latissimus Dorsi for knee coverage reported 85% flap survival rate and 100% limb salvage. They concluded that free flap reconstruction offers good wound coverage but there is no improvement in the distal circulation. This study revealed that free flap needs high demanding technique which can be carried out only in specialized centers in contrast to proximal based sural artery flap which is simple and not highly demanding and can be carried out even in small centers by Orthopedic surgeon with simultaneous fracture fixation.

Taylor[16] introduced perforator flaps in 1989.He described the first application of such flaps due to the improvement in anatomical knowledge of cutaneous, sub cutaneous and intramuscular vessels arising from major vascular axis of the limb that has allowed development of several type of perforator flap which are most commonly used in clinical practice. Due to low donor morbidity and better esthetic outcome anterolateral thigh island perforator flap, the anteromedial thigh flap and peroneal artery perforator flaps are frequently used now a days. But these flaps demands high surgical skills and preoperative Doppler study is mandatory.Moreover and the reconstructive

surgeon should always be ready for vascular compromise which may require flap recharging and supercharging.[17] Sural artery flap is simple, easy with minimal complications and recharging and supercharging of flaps are not required.[18]

Many studies on the distally based sural artery flaps can be found in the literature but data on proximally based sural artery flap data is lacking. Proximally based sural artery flap is superior to distally base flap because there is no sensory loss of flap. It has low morbidity of the donor site and no damage to the muscles of posterior compartment of the leg. This flap provides excellent results with thin stretchable and sensate skin because it obeys the rule "replace with the same". This flap allows patella under surface gliding, does not restrict the excursion of extensor apparatus during flexion and extension of knee. It does not need expertise and microsurgical technique and has good survival rate due to constant blood supply. Some minor disadvantages are the loss of sensation at dorsolateral aspect of the foot, neuroma and scaring at the donor site but these are negligible.

Our results are comparable with studies carried out by Opara[19] and Cheon.[20] But both studies were done by plastic surgeons.

Due to limited literature on this topic, we are unable to compare our results in terms of flap coverage for soft tissue and Ilizarov for fracture fixation.Moreover our sample size is small.We recommend further large sample size studies to confirm our results.

CONCLUSION

Proximally based sural artery fasciocutaneous flap with Ilizarov fixator is a reliable method for reconstruction of complex soft tissue defects around the knee. It has good outcome and only few complications. Any Orthopedic surgeon can easily perform this procedure even in small centers after a short period of learning recommendations.

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Authorship and contribution Declaration

Naseer Ahmad Chaudhry, Conception and design of the study, acquisition of data
Muhammad Azeem, interpreted the data
Ahmad Awad Ahmad, Revised the manuscript critically for important intellectual content,
Final approval of the version for publication
Faisal Waheed, Drafted the manuscript