CASE SERIES

Free flap reconstruction after lower limb trauma — outcome analysis using National Surgical Quality Improvement Programme (NSQIP) parameters

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Abstract

Objective: To assess the outcomes of free flap reconstructions performed for the management of lower limb trauma.

Methods: This retrospective study was conducted at Aga Khan University Hospital (AKUH), Karachi and included data from June 2017 to May 2019 of patients who underwent free flap reconstruction as part of management of lower limb trauma.

Results: The mean age of the 8 adult patients was 34±11 years. Also included were two paediatric patients aged 7 and 8 years. Nine of the total 10 patients were male. Road traffic accidents were the most common mechanism of injury, occurring in 5(50%), followed by blast injuries in 3(33%). The anterolateral thigh flap was the most common type of flap used for reconstruction, done in 8(80%) patients. Flap survival rate was 90% and full flap loss was seen in only 1(10%) patient. Re-exploration surgery was done in 5(50%) patients during the same hospital stay. The length of hospital stay varied greatly from 4 to 105 days depending on associated diagnoses and whether the free flap surgery was performed during an elective admission. One patient did not survive to discharge, and the cause of death was attributed to septic complications. Functional outcomes on follow-up could not be determined.

Conclusion: Free flap reconstruction surgery is an effective solution for management of lower limb trauma and has a high flap survival rate. Further studies are needed to ascertain the functional outcomes of limb salvage after free flap surgery.

Keywords: Free Flaps, Free Tissue Transfer Flaps, Trauma, Extremity, Lower, Complication, Postoperative.

Introduction

Severe lower limb trauma has historically presented a big challenge for surgeons. In past decades, the mainstay of severe lower limb trauma treatment used to be amputation or salvage without restoration of muscle function.[1] However, the repercussions of amputations stay with patients throughout their lives. Limb function limitations not only have physical but also serious emotional implications. Ensuring better quality of life for the patient, including both mental and physical well-being, is of paramount importance for all parties involved. In developing countries especially, an amputation is often not considered a desirable option by the patient and his/her family as compared to limb salvage, who consider a limb with continuing problems superior to an amputation.[2] Indications for amputation include unreconstructible osseous or soft-tissue injuries, irreparable vascular injuries, severe loss of the plantar skin and soft tissue, and hemodynamic instability.[2] However, for many cases, an amputation is far from the ideal management option.

With recent developments, new reconstructive techniques have surfaced in trauma management that include microvascular tissue transfer, bone grafting, etc. These allow attempts at limb salvage in complex lesions that could previously only be treated by amputation. Studies have shown that limb salvage and reconstruction often have better outcomes than amputations. The mean lower extremity impairment ratings have been shown to be significantly worse for amputees (73.5%) as compared to those who underwent successful limb salvage (17.6%), highlighting the importance of alternatives involving salvage.[3] A meta-analysis done in 2011 which included 1138 cases of lower limb trauma also showed that limb reconstruction in mangled lower limb injuries yielded better outcomes psychologically as compared to an amputation. However, there was no significant difference noted in physical morbidity.[4] The key criteria considered when choosing the right course of treatment after severe lower limb trauma are soft tissue health, time of ischaemia, blood loss, bone status and nerve injury.[5] Choosing the right management option is vital because failed attempts at reconstruction and salvage have been associated with an increased morbidity (e.g. secondary amputations) and mortality.[6]

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Continuous improvements in microsurgical techniques and latest equipment have enabled the reconstruction of extensive soft tissue defects in the lower extremity using microsurgical free flaps as a standard procedure. This has significantly reduced amputation rates and according to some reports, improved functional outcomes as well.[7]

Various factors such as osteomyelitis, smoking and diabetes mellitus have been demonstrated to significantly impact free flap outcomes.[8,9] Higher American Society of Anesthesiologists (ASA) scores and increased operative times have also been linked with an increased risk of post-operative medical and surgical complications.[9] The prognosis of flap survival is also significantly worse in flaps that need to be revised secondary to occlusion of micro-anastomoses.[8,10]

Multiple limitations can be identified with the current studies available on this topic. Only a few studies have provided relevant clinical data on perioperative risk factors and operational details that may go on to affect surgical outcomes such as wound sizes, the choice of recipient vessels, comorbidities, the type of vascular anastomoses, etc.[7] To the best of our knowledge, there are no published studies from Pakistan evaluating the outcomes of free flap reconstructions for lower limb trauma management.

Therefore, the main objective of this study is to investigate the outcomes of free flap reconstruction after lower extremity trauma so that targeted quality improvement initiatives may be designed and implemented.

Material/Subjects/Patients and Methods

This study was conducted at Aga Khan University Hospital (AKUH) through retrospective chart review. All data included had been routinely collected during patient care. There was no direct or indirect contact with patients for the purposes of this study.

All patients who underwent free flap reconstruction surgery at AKUH as part of the treatment for lower extremity trauma from June 2017 - May 2019, inclusive, were included. We planned to exclude patients who discontinued care against medical advice or whose discharge time was less than 30 days from the start of data collection. However, no included patients met these exclusion criteria. We identified 10 patients who satisfied the inclusion criteria during our study period.

Our primary outcome variables were the flap-related or systemic complications faced by patients during their hospital stay for free flap reconstruction surgery. The flap related complications were further classified into major and minor complications based on previous studies.[11] The major complications included flap failure (full or partial) and flap thrombosis (venous or arterial). The minor complications included flap dehiscence and flap infections. Other parameters considered donor site complications such as infection and wound dehiscence. Hospital stay related outcomes included length of hospital stay, re-exploratory surgeries during the same hospital stay and readmission rates. The Centers for Disease Control definitions were used to evaluate the presence of an infection.[9,12]

The Institutional Review Board (IRB) of AKUH approved this study and granted an exemption from ethical review. The data collection parameters were derived mainly from the measures recorded in the American College of Surgeons' (ACS) National Surgical Quality Improvement Program (NSQIP) database. This database has been validated through multiple studies and has been used to evaluate microsurgery outcomes. The parameters included in this study were significantly associated with outcomes.[13]

Patient charts were reviewed manually, and laboratory data was extracted from electronic health records (EHR). All data was de-identified and stored in a secure encrypted folder behind the AKUH firewall, accessible only to the researchers.

The data was analyzed by SPSS version 22. Descriptive analyses of patient demographics and complications associated with free flap reconstructions have been reported as means ± standard deviation, or medians where appropriate.

Results

There were 10 patients overall in the study, with 8 adult patients and 2 paediatric patients (age less than 18 years at time of surgery). The mean age of the adult patients was 34±11 years. The paediatric patients were aged 7 and 8 years. Of the ten patients, 9(90%) were male. The mean body mass index (BMI) of the adult patients was 24.8±4.4 kg/m^2. There was a positive current smoking status in 1(10%) patient. Alcohol history was negative in all patients.

Road traffic accidents were the most common mechanism of injury occurring in 5(50%) patients. There were also 3(33%) cases of blast injuries, 1(10%) case with a gunshot wound, and 1(10%) case with a crush injury. All free flap reconstructions were performed by one of two plastic surgeons at AKUH operating as the primary surgeon. The decision to perform a reconstruction instead

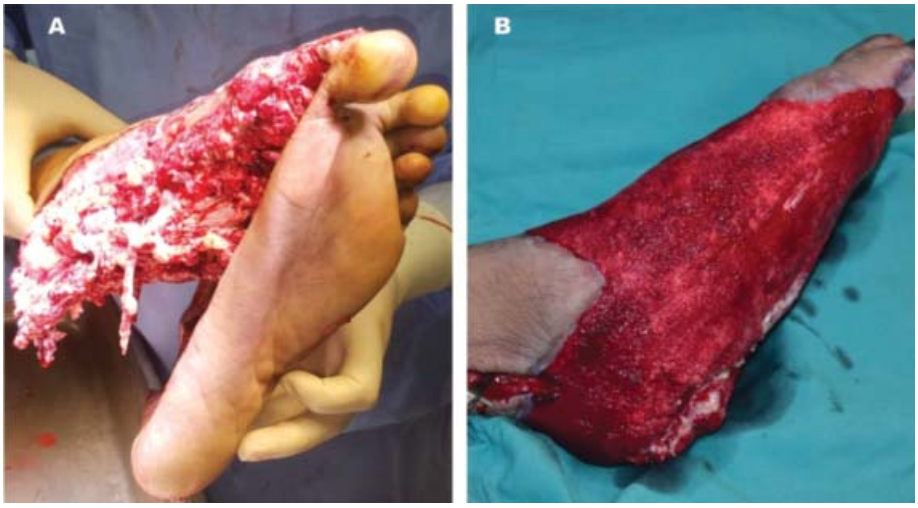

Figure-1: Case 1: A -Left foot degloving injury after an RTA; B - Appearance of foot 1 month after trauma on the day of planned free-flap reconstruction (initial debridement has been done due to skin necrosis,and granulation tissue can be seen).

Figure-2: Case 1: Appearance of foot during an outpatient follow-upapproximately 2 months after free-flap reconstruction with an anterolateral thigh flap. The patient was able to ambulate at this follow-up visit.

of other alternative management options was taken on a case by case basis, taking into account the clinical judgment of the severity of injury, patient preference, patient comorbidities and nature of other injuries. All (100%) patients had undergone one or more surgeries as treatment of their current traumatic injury prior to their free flap reconstruction surgery.

Distal limb perfusion was compromised in 1(10%) patient. Associated nerve injury was identified in 1(10%) patient. There were various associated lower limb fractures present in 7(70%) patients. Foot, distal leg and thigh injuries were most commonly present, in 5(50%) patients. Proximal leg injuries were present in 4(40%) of the patients. 7(70%) of the patients had associated lower limb fractures involving the tibia, fibula, femur and metatarsals.

The median length of hospital stay was 14 days (interquartile range = 34 days) and ranged from a minimum of 4 days to a maximum of 105 days. Of the 10 patients, 9(90%) survived till discharge. The deceased patient had developed septic complications. The median length of follow-up of the surviving patients with the plastic surgery department was 18 days (interquartile range = 210.5 days) from discharge date and ranged from 0 to 291 days. One (10%) patient had an Intensive Care Unit (ICU) stay recorded during the hospital course whereas 3(33%) out of 9 patients who survived till discharge had to be readmitted within 30 days of discharge.

The anterolateral thigh flap (ALTF) was the most common type of free flap used and was done in 8(80%) patients. A free fibular flap and thoracodorsal perforator free flap were used in one patient each. Seven (70%) patients were classified as ASA (American Society of Anaesthesiologists) Class II, 2(20%) were ASA Class 1, and one patient was ASA Class III. The mean operative time was 439±163 minutes. The mean intraoperative crystalloid volume administered was 3300±1140 ml. The posterior tibial artery was most commonly used in 7(70%) patients for arterial anastomoses and the technique utilized in all cases was an end-to-side anastomosis.

Partial flap loss was seen in 1(10%) patients and it later progressed to full flap loss. The most common flap-related complication was thrombosis, seen in 5(50%) patients. Of these five, 2 patients had venous thrombosis, 0ne had arterial, and the differentiation between arterial and venous thrombosis was unclear in 2 patients. Two (20%) patients suffered a primary flap infection which was managed with antibiotics; however, the flap could not be saved in 1(10%) patient and this case progressed to full

flap failure. No dehiscence or leakage was noted in any of the flaps. Only one patient suffered a major systemic complication - this patient developed sepsis and had to be intubated; however, he could not survive to discharge. Re-exploratory flap surgery was performed during the same hospital stay on 5(50%) patients.

Discussion

Free flap reconstruction for lower limb trauma proved to be a successful strategy for limb salvage. We observed a high rate of flap survival, and low complication rates. Our flap survival rates were comparable to other international outcome analyses.[14,15]

This procedure is performed relatively rarely in our practice as part of trauma management, with only 10 cases being performed over the study duration of 2 years. The available options for management of these defects range from free tissue transfer to local rotational flaps. Free tissue transfer is one of the most complex options available and requires a high amount of technical expertise.

A large review consisting of 197 consecutive cases was conducted in Switzerland and analyzed patient data from 1992 to 2002.[15] It was similar in design to our study and analyzed outcomes of procedures done under the supervision of two surgeons. This study reported an overall flap success rate of 96% and re-exploratory surgery rate of 20% compared to our rate of 50%. Various factors could potentially be contributory to the higher re-exploratory rate observed in our study such as a smaller sample size, surgeon experience with this procedure, etc. Our thrombosis rate was also significantly higher (50%) as compared to the aforementioned study (6.5%). There was also a difference in the type of flap used with the ALTF being most commonly used in our setting while the scapular/parascapular flap was the most common fascio-cutaneous flap used in the Swiss study. Further studies are needed to determine the factors leading to a higher complication and re-exploration rate observed in our setting.

Hill et al. reported an overall flap failure rate of 13.3% in 60 patients analyzed.[16] They also assessed whether the duration between the traumatic injury and free flap reconstruction had any impact on failure rate; however, no significant association was identified. There was a trend noted though towards a lower failure rate in free flaps performed 90 or more days after the traumatic injury as compared to within 30 days (p=0.053).

A similar study was conducted in Karachi, Pakistan in 2014 and analyzed the outcomes of distal based flap reconstructions for soft tissue defects in the upper two-thirds of the tibia.[17] It reported a flap survival rate of 100% and partial flap failure was noted in 9.5% of the patients. However, our study adds to this by analyzing free flap outcomes along the same lines.

Conclusion

Free flap reconstruction is an effective management option for limb salvage with a high flap survival rate and minimal complications. However, it is a highly specialized procedure and requires a high degree of surgical expertise. Further research is needed to determine long-term functional outcomes of free flap reconstructions.

Limitations

This study has been conducted using standard ACS' NSQIP data parameters which enable us to compare it with other published works. The study findings, however, are limited due to its retrospective nature. We were also unable to assess the long-term outcomes of this type of procedure in terms of the rate of secondary amputations or limb functionality due to the retrospective nature of this analysis and lack of appropriate data. These are potential areas which we plan to analyze through further studies.

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