Original Article

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Plastic Surgical Procedures for Lower Limb Reconstruction at a Tertiary Hospital in Nepal

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ABSTRACT

Background: This study assessed the lower limb reconstruction outcome so that it will provide a baseline evidence to enable data-driven decision making to improve outcome in the future.

Methods: In this study, hospital records from 1st January to 31st December 2019 were collected retrospectively. Complete data of all patients' records treated for lower limb defects at Kirtipur Hospital were included and incomplete data were excluded**.** Univariate and Bivariate analyses were performed

Results: In total 110 patients were included in this study with a male predominance of 66.4% (n=73). The mean age of the patients was 38.7 years (+/- 20). The majority of the patients were from outside Kathmandu valley 79.1% (n=87) and referred 55.5% (n=61). The commonest cause of lower limb defects was trauma 69.1% (n=76), the procedure performed was skin graft 48.5% (n=72), and complication was wound infections, 43% (n=13) of total complications. The hospital stay of more than two weeks was more common among the referred patients 63.9% (n=39) as compared to non-referred patients 30.6% (n=15) and trauma etiology 34.2% (n=26) had more complications than other etiology. The mean age of patients with complications (32.4 years) was lower than those without complications (41.1 years). More number of referred patients (n=43) required multiple surgeries than non-referred patients (n=21).

Conclusions: Referred cases were more likely to have multiple surgeries and a longer hospital stay than non-referred cases. Infection was the commonest complication and the majority of complications were seen in trauma and younger age group.

Keywords: Lower limb defect; plastic surgery; reconstruction

INTRODUCTION

The most important causes of lower limb soft tissue defects include trauma, burns, infection, diabetes mellitus, peripheral vascular disease and defect after surgical excision of tumor.[1] High-energy trauma such as road traffic injury is one of the leading causes of lower limb soft tissue defects worldwide and also in Nepal.[1,2] The management of lower limb soft tissue defects is usually multidisciplinary and plastic surgeons are commonly involved in the coverage of defects and reconstruction of both salvaged and amputated limbs.[1,3,4]

For resource-constrained countries such as Nepal, there are limited studies on plastic and reconstructive surgical management of lower limb defects. This study aims to review the pattern of lower limb reconstruction and assess the surgical outcome based on the number of surgeries, duration of hospital-stay, and complications so that it will provide a baseline evidence to enable data-driven decision making to improve outcome in the future.

METHODS

The data was collected retrospectively from the Medical Records Section of Kirtipur Hospital. Department of Burns, Plastic and Reconstructive Surgery at Kirtipur Hospital consists of six plastic surgeons and is a referral centre for lower limb reconstruction surgeries. Ethical approval was obtained from the Institutional Review Committee of the Public Health Concern Trust Nepal (phect -Nepal). Phect-Nepal is a national level non-government organisation committed to health development in Nepal. It runs Kirtipur Hospital and monitors all its activities including research. The data between 1st January and 31st December, 2019 was collected. Patients that were treated for lower limb defects in Department of Burns,

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Plastic and Reconstructive Surgery were included. Patients with incomplete data were excluded. Moreover, burn injuries of the lower limb that underwent tangential excision and skin graft were excluded as this management is considered as primary burn surgery instead of reconstructive surgery.

The minimum required sample size was calculated to be 109, using the formula for a finite population[5] based on the annual lower limb reconstructive surgeries at the study hospital. The total of 132 records from 1st January to 31st December 2019 were retrieved of which 110 records had complete data and 22 records had incomplete data. The demographic characteristics, causes of lower limb defects, number of surgeries done, plastic surgical procedures done, complications, and duration of hospital stay data were collected.

All data were analyzed using SPSS version 23. Chi-Square test was used to compare the difference in categorical variables and independent sample t-test was performed for the continuous variables. A p-value < 0.05 was used as a significant level for all data analysis.

RESULTS

A total of 110 patients were included in this study of which the majority were male accounting for 66.4% (n=73). The mean age of the patients was 38.7 years (+/- 20) with the age range of 1-90 years. The majority of the patients were from outside the Kathmandu valley accounting for 79.1% (n=87) of the total patients. Most of the patients were referred from other health care centres accounting for 55.5% (n=61) and 44.5% (n=49) patients presented to hospital primarily (Table 1).

Table 1. General characteristics of the patients

Demographic characteristics	N-110 n (%) / mean (SD)
Age (Years)	38.7(20)
Sex	
Female	37 (33.6%)
Male	73 (66.4%)
Address	
Inside Kathmandu Valley	23 (20.9%)
Outside Kathmandu Valley	87 (79.1%)
Referral	
Referred	61 (55.5%)
Not Referred	49 (44.5%)
Etiology	
Trauma	76 (69.1%)
Infection	25 (22.7%)
Diabetes Mellitus	5 (4.5%)
Tumour Removal	2 (1.8%)
Site	
Single region	94 (85.5%)
Multiple	16 (14.5%)
Side	
Unilateral	105 (95.5%)
Bilateral	5 (4.5%)
Surgery	2.7 (2.4)
Single	46 (41.8%)
Multiple	64 (58.2%)
Complication	
No	80 (72.7%)
Yes	30 (27.3%)
Duration of Stay (Days)	17.9(16.2)
Less than 2 weeks	55 (50%)
2 weeks or more	55 (50%)

The common causes of lower limb defects requiring plastic surgical intervention were trauma [69.1% (n=76)], infection [22.7% (n=25)], diabetes mellitus [4.5% (n=5)], and tumor excision [1.8% (n=2)]. The majority of defects involved a single region (85.5%) like thigh or knee or leg or ankle or foot and were unilateral (95.5%) (Table 1).

The mean number of surgeries done per patient was 2.7 (+2.4) with a minimal number of surgeries done per patient being one and the maximum being 13. Patients requiring multiple surgeries, that is more than one, were 58.2% (n= 64) of the total patients. The mean duration of hospital stay was 17.9 days (+/-16.2) with a range of 1-94 days (Table 1).

The total number of plastic surgical procedures done was 148. This is less than the number of total surgeries performed because many patients underwent multiple debridement especially those with high voltage electrical burn injuries, infected traumatic wounds, etc. The most common plastic surgical procedure performed was skin graft, that was 72 (48.5%). Flaps were 30 (20%) of total plastic surgical procedures of which five were fascio-cutaneous flaps, eight were pedicle flaps and perforator flaps each and nine were free flaps. Amputations were 17 (11.5%) and, Vacuum-Assisted Closure (VAC) was nine (6%). The free flaps included Anterolateral thigh flap and Gracilis flap. The perforator flaps included Peroneal artery perforator flap and Medial sural artery perforator flap. Pedicle flaps included Reverse sural artery flap, Medial plantar artery flap, Gastrocnemius flap, and Lateral calcaneal artery flap (Table 2).

The overall complication rate was 27.3% (n= 30) and wound infections were the most common complications accounting for 13 (43%) of them, followed by graft loss (partial or total) in seven (24%), flap loss in three (10%), wound dehiscence in three (10%), stitch granulomas

in two (6.5%) and death in two (6.5%) of them. Among the three flaps lost, one was a total flap loss and two were partial flap loss (Table 2). Two patients died during treatment in this study. They were cases of polytrauma, referred from other hospitals after primary management and died due to sepsis and multiorgan failure during the course of treatment.

Table 2 Plastic surgical procedures and postoperative complication

	N-148
Plastic Surgical Procedures	n (%)
Skin graft	72 (48.5%)
Split Thickness Skin Graft	67 (93%)
Full Thickness Skin Graft	4 (5%)
Allograft	1 (2%)
Flaps	30 (20%)
Local random	5 (16.5%)
Regional Flaps	16 (53.5%)
Pedicle flaps	8 (50%)
Perforator flaps	8 (50%)
Free flaps	9 (30%)
Amputation	17 (11.5%)
VAC	9 (6%)
Tendon/Nerve/Blood Vessel repair	7 (4.5%)
Primary Closure	5 (3.5%)
Leukocyte Platelet Rich Fibrin	4 (2.5%)
Excisional Biopsy	3 (2%)
Post-burn contracture release	1 (0.5%)
Post-operative Complications	30 (27.3%)
Infection	13 (43%)
Partial Graft Loss	7 (24%)
Flap Loss	3 (10%)
Partial	2 (66.5%)
Total	1 (33.5%)
Wound dehiscence	3 (10%)
Stitch Granuloma	2 (6.5%)
Death	2 (6.5%)

Among all demographic and clinical characteristics, referral characteristic (referred or primary contact with hospital) was the only character showing significant difference in duration of hospital stay. A total of 63.9% (n=39) of referred patients had two weeks or longer duration of stay at the hospital whereas 30.6% (n=15) of non-referred patients had two weeks or longer duration of hospital stay (p=0.001) (Table 3).

The mean age of patients with complications was 32.4 years (+/-19.6), which was significantly lower than the mean age of patients without complications, ie. 41.1 years (+/- 19.7) (P=0.042). Trauma etiology 34.2% (n=26) had significantly more complications than other etiology (P=0.015) (Table 4).

Table 3. Difference in duration of hospital stay based on characteristics of patients.

	Less than 2 weeks	2 weeks or more
	n (%)/ mean (SD)	n (%)/ mean (SD)
Age (Years)	37.1 (21.2)	40.3 (18.8)
Sex		
Female	21 (56.8%)	16 (43.2%)
Male	35 (47.9%)	38 (52.1%)
Address		
Inside Kathmandu valley	17 (73.9%)	6 (26.1%)
Outside Kathmandu valley	39 (44.8%)	48 (55.2%)
Referral		
Referred	22 (36.1%)	39 (63.9%)*
Not Referred	34 (69.4%)	15 (30.6%)
Etiology		
Trauma	38 (50%)	38 (50%)
Infection	12 (48%)	13 (52%)

**p-value less than 0.05*

Table 4. Difference in complication outcomes based on characteristics of the patients.

	Without Complication	With Complication
	n (%)/ mean (SD)	n (%)/ mean (SD)
Age (years)	41.1 (19.7)	32.4 (19.6)*
Sex		
Female	26 (70.3%)	11 (29.7%)
Male	54 (74%)	19 (26%)
Address		
Inside Kathmandu valley	20 (87%)	3 (13%)
Outside Kathmandu valley	60 (69%)	27 (31%)
Referral		
Referred	41 (67.2%)	20 (32.8%)
Not Referred	39 (79.6%)	10 (20.4%)
Etiology		
Trauma	50 (65.8%)	26 (34.2%)*
Infection	21 (84%)	4 (16%)

**p-value less than 0.05*

In total 70.5% of the referred patient (n=43) required multiple surgeries as compared to 42.9% (n=21) of non-referred patients requiring multiple surgeries (p=0.003) (Table 5).

Table 5. Difference in multiple surgeries performed based on general characteristic of patients.

	Multiple Surgery NO	Multiple Surgery YES
	n (%)/ mean (SD)	n (%)/ mean (SD)
Age (years)	38.3 (16.7)	38.9(22.2)
Sex		
Female	32 (43.8%)	41 (56.2%)
Male	14 (37.8%)	23 (62.2%)
Address		
Inside Kathmandu valley	13 (56.5%)	10 (43.5%)
Outside Kathmandu valley	33 (37.9%)	54 (62.1%)
Referral		
Referred	18 (29.5%)	43 (70.5%)*
Not Referred	28 (57.1%)	21 (42.9%)
Etiology		
Trauma	32 (42.1%)	44 (57.9%)
Infection	10 (40%)	15 (60%)

**p-value less than 0.05*

DISCUSSION

This study showed that the majority of the patients who underwent lower limb reconstruction surgeries were male. Moreover, the referred patients were more likely to have longer hospital stays and undergo multiple surgeries. Furthermore, the younger patients and those with traumatic aetiology were more likely to have complications. The findings reflect the need of having gender-specific, age-specific, and referral specific preventive and surgical measures for better treatment outcomes.

Similar to this study, a study from Brazil also showed a male predominance in lower limb reconstruction.[6] The reasons for male gender being more vulnerable to trauma and road traffic accidents could be higher mobility, higher activity level, participation in injury-prone high-risk activities such as driving and riding, over-speeding or drunken driving.[2,7,8] Moreover, the younger age having lower limb reconstruction in this study reflects the working-age group with higher mobility and getting exposed to hazards on the streets and workplace.[7,8] The common causes of workplace injuries included cut injuries and high voltage electric burns. Educating and monitoring of traffic safety and traffic rule and maintaining workplace personal safety protocol and equipment may reduce the accidents and lower limb injuries.[9,10]

From the surgical point of view, the majority of the patients required multiple surgeries in this study. This might be because of the need for multiple debridement to acquire clean wound without active infection and necrotic tissue. In case of electric burn injuries especially in high voltage burn, serial and multiple debridement are required and one previous study showed that 2.3 debridement per patient were required before definitive procedure.[11,12] In case of traumatic or infected wounds, some patients need multiple debridement to get a clean wound.[1,13] Wound should be healthy before a definitive reconstructive procedure is carried. There is higher success rate with less complication of reconstructive procedures if wounds are healthy.[1,11-13]

The commonest type of reconstructive procedures performed included skin grafts, mostly a split-thickness skin graft. Similarly, studies from Brazil and Kuwait showed skin graft as the commonest reconstructive procedure for traumatic lower limb reconstruction.[6,14] Skin grafts are performed where there is healthy granulation tissue with no bone or tendon or neurovascular bundle exposure or for patients who are not fit for longer procedures or who refused flap following VAC.

In this study, the majority of the patients were referred, and these patients have a higher chance of requiring multiple surgeries and longer hospital stays as compared to non-referred patients. This might be because these cases tend to have a more complex wound, have complications like spreading infection, local tissue necrosis leading to bigger defects and deteriorating conditions. As a referral center the cases are usually referred by other treatment centers when it is beyond their surgical expertise or the injuries are more complex in nature, which may further explain the longer stay and multiple surgeries required among referred patients. Moreover, our department also runs a burn center where most of the electric burn injuries are referred. Electric burn injuries required longer hospital stay and multiple surgical interventions as they might have many medical and surgical problems.[11,12,15] There are not many studies looking into the difference in outcomes between referred and non-referred patients. Further studies are warranted to look into the factors affecting the outcomes in these two types of patients.

But, studies have shown that in complex lower limb injury, multidisciplinary team and surgical experience have better patient outcomes.[16-18] This leads to the development of an orthoplastic approach for complex lower limb injury reconstruction for optimal outcomes.[17,18] Orthoplastic approach is the application of principles and practice of orthopaedics and plastic surgery.[17,18] Timely referral and coordination with specialities centres might result in optimal outcomes and might reduce the need for multiple surgical interventions and longer hospital stay.[19] So, it is recommended that patients with complex lower limb injuries be managed at centres having a

multidisciplinary team with high surgical experience and we need to strengthen our coordination with referring health centres.

The complication rate in this study was 27.3%. This is similar to the range of complication rates in different studies for lower limb reconstruction which range from 9.6% to 38%.[20-23] The commonest complication observed in this study was infection. A study from India has also identified infection as the commonest complication in severe lower limb injuries.[24] This finding highlights the need for infection prevention measures not only at the primary treatment centres but also at referral centres during pre-operative, intraoperative as well as postoperative period. A Cochrane Review shows antibiotic prophylaxis reduces infection in open limb fractures.[25] Studies have shown no relation in the incidence of infection and time of debridement but proper debridement has been widely advocated to reduce infection.[24, 26, 27] The rate of postoperative wound infection is reduced by following standard aseptic and antiseptic techniques during the preoperative, intraoperative and postoperative period.[28] So, antibiotic prophylaxis and proper wound debridement should be done as soon as possible, and standard aseptic and antiseptic techniques should be practiced to minimise the incidence of wound infection.

Moreover, traumatic aetiology and younger age groups were associated with increased complications in this study. Studies suggest that comorbidities or environment associated with age could be risk factors for post-surgery complications however; age alone is not considered a risk factor.[29] However severe lower extremity injuries are associated with significant number of complication.[30] In this study, traumatic lower limb injuries were due to high velocity injury and high voltage electric burn injury. The younger age group showing higher complication rates in this study may be related to their higher mobility and exposure to streets and workplaces that could have increased the risk for severe and complex injuries.[7, 8]

Two patients died during treatment in this study due to septic shock. A study has shown a high mortality rate among trauma patients who develop sepsis compared to those who did not.[30] A low mortality rate in this study might be because majority of the patients are referred for specialized care after being stabilised and immediate life-threatening conditions managed in other centers. Though the mortality rate remains low in this study, it still highlights the need of infection prevention measures at primary health centres before referral.

This study has certain limitations. Firstly, it has inherited the limitations of a data collected retrospectively done in a single department. The sample size is small and patients presented in our department were only included so the findings may not be generalised to a wider population. However, as a major referral centre, it still reflects the patients coming from different parts of Nepal. As this study was done based on hospital data, more detailed socio-demographic characteristics were not available. Such findings could have enriched our understanding of the factors associated with the treatment outcomes. However, factors leading to multiple surgeries and longer hospital stay such as type of wound, contamination and infected status, duration form injury to first debridment and, timely use of antibiotics in the golden period were not explored in this study. This study nevertheless provides important baseline information on the patterns of lower limb defects and the outcomes of reconstructive surgery. The findings of this study highlight the need for larger longitudinal studies with primary data collection from the patients.

CONCLUSIONS

This study showed that the majority of male patients underwent lower limb reconstruction surgeries. Trauma was the commonest cause of lower limb problem. Referred cases in this study were more likely to have multiple surgeries and a longer hospital stay as compared to non-referred cases. Infection was the commonest complication, and the majority of complications were seen in trauma and younger age group.

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