



Lower Limb Defects and Effectiveness of Step Ladder Pattern in its Management in Present Time (2019)

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ABSTRACT

Lower limb reconstruction following trauma, chronic infection and cancer ablation remains challenging. However various options are now possible for lower limb reconstruction due to the more details available today about perforators. In recent years, the management of lower extremity has evolved with numerous new techniques and innovations and thus extremities are salvaged that would have been amputated in the past. Today we are able to cover various complex defects with the help of free flaps due to more of research and knowledge in this field which was previously unknown. In developed countries, all these procedures can be used because of the availability of good resources, good manpower, and the latest technologies. But in developing countries like India in spite of being aware of many of this methods, there is a limitation on using all these methods due to the limitation of resources, economic burden, limited manpower, and surgery time. The concept of the reconstructive ladder was proposed to achieve wounds with adequate closure using a stepladder approach from simple to complex procedures. The reconstructive elevator requires creative thoughts and consideration of multiple variables to achieve the best form and function rather than a sequential climb up the ladder. However, this paradigm of thought does not eliminate the concept of the reconstructive ladder but replaces it with a ladder of wound closure that makes its mark in the field where a variety of advanced reconstructive procedures and techniques is not readily available. Therefore the model of step ladder pattern of soft tissue defect management remains the good option for developing countries like ours. Also, various lower limb defects from simple to complex can be covered with simple methods rather than going for the most complex ones first. It helps in fast management and low economic burden to society with a lesser hospital stay.

Keywords: Lower limb defect, Step ladder pattern, Wound management 2019, High output centers

INTRODUCTION

The lower extremity reconstruction continues to challenge the plastic surgeons seeking safe repair with minimal morbidity and minimum downtime. Lower limb reconstruction following trauma, chronic infection and cancer ablation remains challenging [1,2].

Traumatic lesions involving lower extremity have become a common occurrence and the ever-increasing vehicular accidents in our crowded cities are their main cause. Treatment of high energy lower extremity trauma with soft tissue and bone injury remains a formidable problem [3]. The goal in the treatment of open fractures and lower extremity salvage is to preserve a limb that will be more functional than an amputation.

In recent years, the management of lower extremity has evolved with numerous new techniques and innovations and thus extremities are salvaged that would have been amputated in the past. Today we are able to cover various complex defects with the help of flaps due to more of research and knowledge in this field which was previously unknown [4,5].

Initial evaluation of the lower extremity wound should give an idea of what the ultimate function of the limb will be. The initial plan should aim to achieve this goal. Though techniques of lower limb reconstruction have improved over the years, salvage of non-functional, insensate or chronically painful extremities should be avoided. Various methods have been described, including primary suturing, skin grafting, NPWT therapy, local, distant, and free flaps with their indication, limitations, advantages, and disadvantages [6,7].

The concept of the reconstructive ladder was proposed to achieve wounds with adequate closure using a stepladder approach from simple to complex procedures. The reconstructive elevator requires creative thoughts and consideration of multiple variables to achieve the best form and function rather than a sequential climb up the ladder. However, this does not eliminate the concept of the reconstructive ladder but replaces it with a ladder of wound closure that makes its mark in the field where a variety of advanced reconstructive procedures and techniques is not readily available [8,9].

Today in most developed countries plastic surgery team reconstruct the lower limb defect with free flaps. However, still, the indications, the selection of a particular technique for the different cases are not well established and are rather a matter of personal judgment. Limb reconstruction is a long complicated process. India has many industrialized cities which are located on the major motor highways and has long railway track. This brings a significant number of lower limb injuries to various hospitals and present with a challenge to provide reconstruction for massive lower limb defects with limited men power, lots of patients [10].

MATERIALS AND METHODS

From January 2017 till March 2019, 104 patients with lower limb defects underwent surgery at our institution. Of these patients, 92 patients were male and 12 patients were female. The most common cause of lower limb defect was trauma and was most common in the age group of 20-29 years. From these, 43 patients underwent STSG after regular dressing and after NPWT therapy in total, 35 patients were operated with fasciocutaneous flap, 16 patients had muscle flap, 10 patients had other surgery done like soleus muscle flap, medial plantar artery based flap, cross leg flap and so on. All patients were either referred from orthopedic department or surgery department to plastic surgery in a later period for management of defects.

The operative procedure is planned to keep in mind the following factors:

- The site of lesion
- The size of the lesion
- Type and quantity of tissue loss
- The age of the patient
- The condition of joints
- The availability of donor sites
- The nature of circulation at the donor and recipient sites

Step ladder pattern of wound closure is used for planning of lower extremity wound coverage and reconstruction.

Management

Different type of surgery were performed for lower limb reconstruction:

- Skin grafting
- Closure
- Fasciocutaneous flaps
 - Superiorly based
 - Inferiorly based
 - Perforator based
- Muscle flaps
 - Gastrocnemius muscle flap+STSG
 - Gastrocnemius musculocutaneous flap+STSG
 - Soleus muscle flap
 - Tibialis anterior muscle flap

- Cross leg flap
- Medial plantar artery based flap
- Reverse sural artery based flap
- Medial calcenium artery based flap

RESULTS

Table 1 describes the various methods of operation for soft tissue reconstruction of the lower limb.

Table 1 Various methods of operation for soft tissue reconstruction of lower limb

Type of Surgery	Number of Cases
Split-thickness skin grafting (STSG)	25
Split-thickness skin grafting after NPWT	18
Fasciocutaneous Flap and STSG	35
• Superiorly based	12
• Inferiorly based	10
• Perforator based	13
Muscle Flap and STSG (Gastrocnemius)	12
Musculocutaneous Flap	4
Other	10
Total	104

Table 2 describes the regions of leg involved during the treatment.

Table 2 Different regions of leg involved

Region	Number of cases
Thigh	3
Upper third	21
Middle third	41
Lower third	17
Foot/Sole	15
Tendo Achilles	7

Table 3 describes the types of flaps performed during the treatment.

Table 3 Type of flaps performed

Flaps	Number
Superiorly Based Fasciocutaneous	12
Inferiorly Based Fasciocutaneous	10
Reverse Sural	13
Gastrocnemius Muscle	25
Gastrocnemius Myocutaneous	8
Soleus Muscle	5
Tibialis. Anterior	1
Peroneus Muscle	1
Medial Calcaneal Artery Based	1
Medial Plantar Artery Based	1
Rotation/Closure	12
Cross Leg	2
Perforator Based	13

DISCUSSION

A total of 104 patients were studied. Out of 104 patients, 75 patients were referred to us from the Department of Orthopaedics Surgery, while remaining 29 patients came to us from the Surgery department and few came directly [11].

From January 2017 till March 2019, 104 patients with lower limb defects underwent surgery at our institution. Of these patients, 92 patients were male and 12 patients were female. The most common cause of lower limb defect was trauma and was most common in the age group of 20-29 years. From these 43 patients underwent STSG after regular dressing and after NPWT therapy in total, 35 patients were operated with fasciocutaneous flap, 16 patients had muscle flap, 10 patients had other surgery done like soleus muscle flap, medial plantar artery based flap, cross leg flap and so on. All patients were either referred from Orthopedic Department or Surgery Department to plastic surgery in a later period for management of defects [12,13].

We treated 2 cases with cross leg flap and had 100% uptake. Similarly a few cases of the soleus muscle, tibialis anterior, peroneus, medial calcaneal artery based, medial plantar artery based, perforator based were also present. In 2 cases we had partial removal of the dead anterior cortex of tibia of a middle and lower third defect involving less than 1/3rd of the circumference. NPWT, acriflavine dressing was used and granulation tissue covered the defect, which was covered with STSG in the final stage. There was no complication in all these cases except for plantar artery based flap with partial loss of flap [14,15].

Surgery of lower limb defects currently has a number of options capable of solving most cases. But most of the patient with lower limb defects came from low socio-economic status with a major financial concern. As a result, our aim was also to provide effective care to a maximum number of cases in allotted surgery time. However, we used the simplest techniques wherever possible to cover the defects in shorter duration and with best possible outcome possible. As a result, the patient returned to their work faster [16].

Though we could have selected micro-surgical techniques in many cases, due to a shortage of manpower and to give operative care to a maximum number of patients we selected the procedures in each case with a simple method, minimum operative time and maximum success rate. Thus step ladder pattern and its use in reconstruction of the lower limb is very effective in high output centers with good and fast results. Also, it is effective from an economic point of view and the number of patients can be treated in a limited time frame [17].

CONCLUSION

Although in today's world microsurgery is considered as a gold standard for defect coverage especially complex one. But we have achieved good results using the simplest surgery options using a step ladder pattern for reconstruction. From our series, we can conclude that

- In high output center having a variety of cases pertaining to plastic surgery, we have successfully managed all cases of lower limb defect using the simplest procedure from a reconstructive ladder
- The hospital stay was short and with good success rate and best possible outcome for patients
- Variety of cases with different locations were managed in our institution with proper planning and almost all defects were covered using step ladder pattern
- NPWT played a key role in the management of defects and in few cases the management was changed from flap coverage to STSG because of its use
- Gastrocnemius muscle flap with or without skin coverage is the best option for an upper third defect involving the knee
- Where the surrounding area is not appropriate for flap cross-leg flap is another good option
- A hospital stay can be reduced by proper planning and early beginning of management at the time of hospitalization, which was delayed in our hospital due to the transfer of the patient to us in later stage
- Not a single patient was transferred or converted to amputation in our series
- Thus even complex defects can be managed with the proper planning using simple step ladder pattern approach and simplest of surgery

DECLARATIONS**Conflict of Interest**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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