

Role of Hybrid Reconstruction Ladder in Management of Lower limb Defect

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Abstract

Lower limb Defects were encountered by the plastic surgeons most commonly in the practise. The management and reconstruction of complex lower limb defects needs a multidisciplinary team approach. A multidisciplinary team has successfully adopted advanced reconstructive methods combined with modalities from regenerative medicine to enhance the results of difficult reconstruction. These procedures, known as "Hybrid reconstruction ladder," combine conventional reconstruction techniques with regenerative medicine applications. This review article provides a summary of the benefits of using a hybrid reconstruction ladder to create a healthy wound bed and reconstruction in a case of Lower limb defect reconstruction.

Keywords: Hybrid reconstruction ladder; Regenerative medicine; Lower limb defect; management.

INTRODUCTION

There are a number of insults that can compromise the soft tissue envelope of the lower limb making lower limb injuries a common

presentation in emergency. Exposed tendons, bones, nerves and vessels, are seen with little skin and soft tissue reserves for coverage in the distal lower limb.¹ Tissue reconstruction of lower limb aims at restoring the functionality of the lower limb. Traditionally, reconstruction process is often started with secondary intention closure, followed by direct closure, local flaps and finally remote flaps. The hybrid reconstruction ladder gives a promising alternative for faster wound healing.² The hybrid reconstruction model (Fig. 1) aids in maximizing the regeneration while minimizing the disability and morbidity associated with traditional reconstruction. This review article provides a summary of the benefits of using a hybrid reconstruction ladder to create a healthy wound bed and reconstruction in a case of lower limb defect.

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Fig. 1: Hybrid reconstruction ladder

MATERIALS AND METHODS

This study was conducted in the department of plastic surgery in a tertiary care center after obtaining the departmental ethical committee approval. Informed written consent was taken from the patient. The study is a prospective observational study done on a 59-year-old male with known comorbidity diabetes mellitus for 12 years on oral hypoglycaemic drugs. He was apparently well one month back when he had alleged history of road traffic accident with injury to the right lower limb, for which he got operated in outside hospital intramedullary nailing was done. After which he got wound infected with exposed bone and raw area in the junction of middle 1/3rd and distal 1/3rd of the right lower limb.

The patient was presented with raw area (Fig. 2a - 2b) over right lower limb and got admitted in the department of plastic surgery in our centre for further wound care.



Fig. 2a: Exposed Tibia devoid of periosteum and osteomyelitis on anteromedial aspect



Fig. 2b: Raw area on the posterolateral aspect of right lower limb

The Patient was started on intravenous antibiotics and underwent wound debridement (Fig. 3).



Fig. 3: Post wound debridement of the right lower limb and limb reconstruction system application

There are various modalities of regenerative therapies for wound care. Written informed consent was obtained from both the relatives and the patient. The wound bed was prepared with regenerative therapies to improve the healthy granulation tissue. Hydro jet debridement done to remove the unhealthy slime layer over the granulation tissue. Low level laser therapy (Fig. 4),

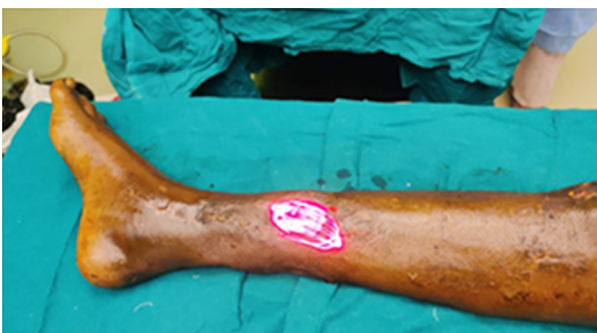


Fig. 4: Low level laser therapy for the wound

Autologous platelet rich plasma (Fig. 5), Prolotherapy, biological scaffold.



Fig. 5: Autologous Platelet Rich Plasma for the wound

(Autologous tensor fascia Lata - Fig. 6), cyclical negative pressure wound therapy, Low level laser therapy. Dermabrasion assisted debridement was done. Packed Red Blood Cell transfusion was done after every wound debridement and regenerative session. Intramedullary nail was removed and External fixator with Limb reconstruction system was applied. Tensor Fascia Lata graft done over the exposed raw area. Split this skin graft was applied over the raw area once bone was covered with very good granulation. Split thickness graft uptake was good. Patient underwent corticectomy and bone transport for the bone defect.



Fig. 6: Tensor fascia Lata free graft for the raw area

RESULTS

In our case with the application of hybrid reconstruction ladder, the wound bed was prepared effectively and reconstruction was done (Fig. 7). The Skin graft was applied over the raw area and the uptake was good uptake was good.



Fig. 7: Lower limb with limb reconstruction system in place

Bone Transport was done successfully (Fig. 8). No complications were noted.

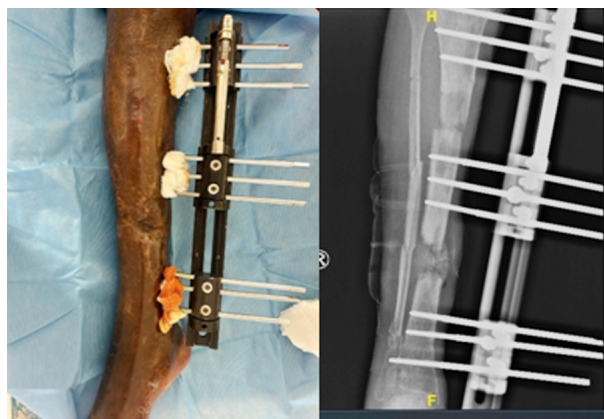


Fig. 8: After 4 weeks of Bone transport

DISCUSSION

The reconstructive ladder was a term coined by plastic and reconstructive surgeons to describe levels of increasingly complex management of soft tissue wounds. Theoretically, the surgeon would utilize the lowest part of the ladder that is, the simplest reconstruction technique to address a clinical reconstructive problem. The reconstructive surgeon would move up the ladder as a more complex or suitable method was required for a given reconstruction problem.^{3,4,5} A hybrid reconstructive ladder that augments the traditional reconstructive ladder with regenerative medicine modalities helps in improving unhealthy wound for better flap survival. There were improved outcomes at each step on the reconstruction ladder and these modalities may allow for the expansion of indications for each step on the reconstruction ladder. The reconstructive grid⁵ is a dynamic construct that takes into account the multiple reconstructive options available to the plastic surgeon. It also takes into consideration factors that

help the reconstructive surgeon determine the best possible option to achieve the three reconstruction goals, namely, form, function, and aesthetics.⁶ The factors that aid the judgment of a reconstruction specialist, including wound complexity, surgeon skill, resources (and technology) available, and patient requests, form the boundaries of the reconstructive grid. The study effectively employed dermal regenerates, soft tissue regeneration techniques, biologic scaffolds in reconstruction. Low Level Laser Therapy (LLLT) is one of the proposed modalities to improve wound healing and scar quality. LLLT is claimed to increase collagen synthesis, decrease inflammation and has a positive impact on scar remodeling.⁷ Dry collagen was used as a scaffold for tissue regeneration of the wound bed for further intervention.⁸ Prolotherapy believe that the injection of hypertonic dextrose causes cell dehydration and osmotic rupture at the injection site that leads to local tissue injury that subsequently induces granulocyte and macrophage migration to the site, with release of the growth factors and collagen deposition.⁹ In vitro studies have shown that even concentrations as low as 5% dextrose have resulted in the production of several growth factors critical for tissue repair. Some of these growth factors include PDGF, TGF- β , EGF, b-FGF, IGF-1, and CTGF. Negative Pressure Wound therapy (NPWT) involve removal of exudates and infectious materials and contraction of wound margin. NPWT has been shown to be safe and effective in post debridement wounds.¹⁰ Hence NPWT was started, and size of the wound was measured at the time of change of dressing. Platelets act as regulators of inflammation, angiogenesis, cell migration, and proliferation with the release of various growth factors and anti-inflammatory cytokines which is thought to help in faster and better healing of the wounds.¹¹ Autologous platelet rich plasma (APRP) has growth factors which when injected in the wound site or sprayed, act at the intracellular level to bring about cell proliferation and healing of a wound.¹²

CONCLUSION

Wounds which are difficult to reconstruct and healing are approached effectively with hybrid reconstructive ladder. It helps in fastening the healing rate and the patient has good compliance with the regenerative therapy. The regenerative medicine plays a major role in the hybrid reconstructive ladder and it helps in rescue the patients when the reconstructive options for the patients are limited. Regenerative therapies

provide the healthy environment for improving the survival of the flap.

Conflicts of Interest: None

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