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Role of Stromal Vascular Fraction in the Management of Post-Burn Scars

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Abstract

Wound healing is a complex process essential for tissue repair, and disruptions can lead to abnormal scars and chronic wounds. While traditional therapies such as cell therapy, gene therapy, growth factor delivery, and wound dressings are commonly used, they often do not yield consistent results across all wound types. Adipose tissue, rich in stromal/stem cells, has emerged as a promising source for regenerative therapies. This case report explores the use of stromal vascular fraction (SVF), prepared through a mechanical method, to manage a post-burn scar and highlights the potential of mechanically prepared SVF as a cost-effective and efficient therapeutic option for improving scar healing.

Keywords: Adipose tissue; Stromal vascular fraction

Introduction

The process of wound healing involves multiple phases and relies on a complex mechanism to repair damaged or injured tissues. Disruptions in this process can lead to abnormal scar development or chronic wounds, which are more prone to infections [1]. Various traditional methods, including cell therapy, gene therapy, growth factor delivery, wound dressings, and skin grafting, have been employed to enhance healing across different types of wounds. However, these approaches often fail to deliver consistent results for all wound types, highlighting the need for more effective therapies. Adipose tissue has emerged as a plentiful and reliable source of adult stromal/stem cells, offering potential for use in tissue engineering and regenerative medicine [2]. This report presents a case where stromal vascular fraction, obtained through a mechanical method, was utilized for managing a post-burn scar.

Methodology

The study was carried out in the Department of Plastic Surgery at a tertiary care centre in South India. The subject was a 15-year-old male with a history of post-burn contractures and scarring, who underwent contracture release and scar management. Stromal vascular fraction (SVF) was prepared (Figure 1-8) and administered using a 1 ml insulin syringe. A volume of 0.1 ml of SVF was injected into the scar bed at 1 cm intervals within the epidermodermal junction. The scars were evaluated weekly using the Vancouver Scar Scale to monitor progress.

Results

Following the application of stromal vascular fraction (SVF) to the scar bed, the Vancouver Scar Scale (VSS) score improved from 5 to 2. The patient expressed satisfaction with the improved appearance of the scar.

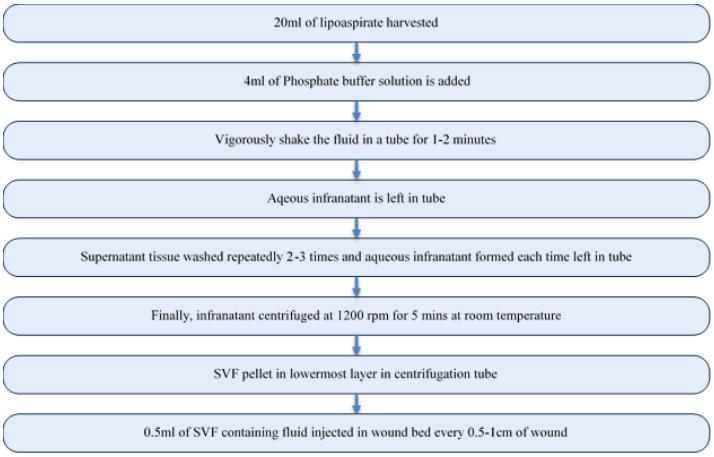

***Figure 1**: SVF preparation by mechanical method.*

***Figure 2**: Lipoaspirate.*

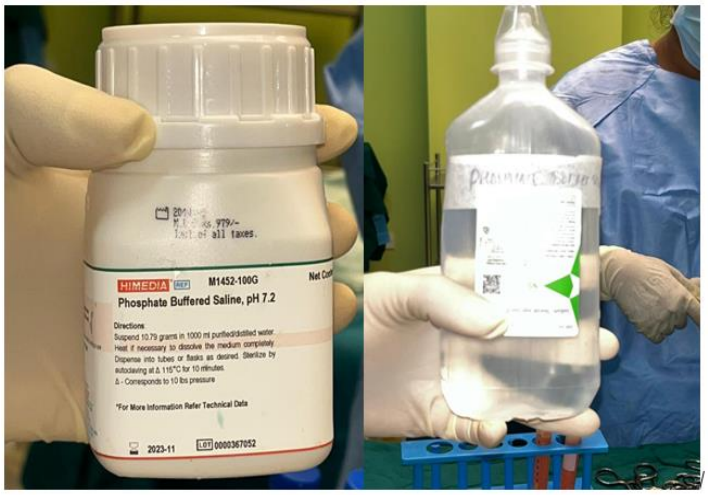

***Figure 3:** Phosphate buffered solution.*

***Figure 4:** Mechanical shaking of lipoaspirate with PBS.*

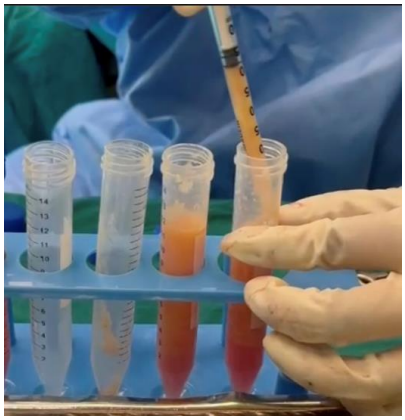

***Figure 5:** Supernatant lipoaspirate separated from infranatant aqueous solution.*

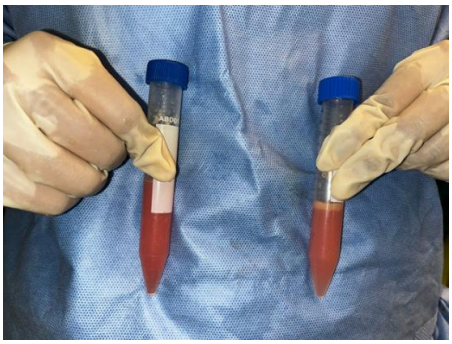

***Figure 6:** Final aqueous solution collected.*

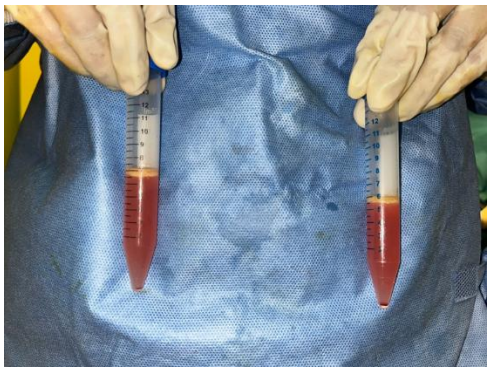

***Figure 7:** Post centrifugation at 1500rpm for 5 mins.*

Figure 8: *SVF injection into scar bed.*

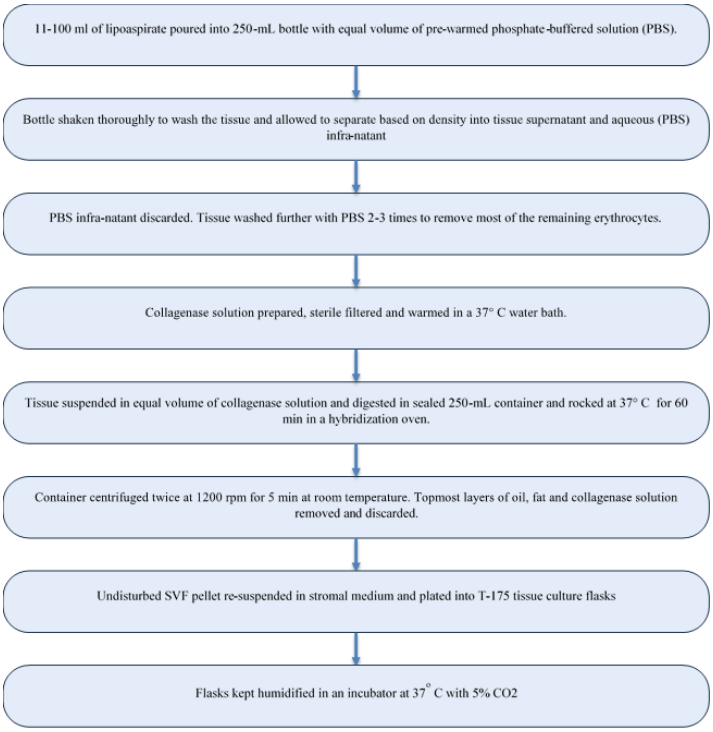

Figure 9: *SVF preparation by enzymatic method.*

Discussion

The range of modalities available for wound management is extensive and can be categorized into four main groups:

1. Conventional therapies include traditional dressings, with or without topical antimicrobial agents or growth factors, and biological dressings such as silver or alginate. Other approaches, like hyperbaric oxygen therapy, are also used [3].
2. Novel therapies utilize advancements like platelet-rich plasma, negative pressure wound therapy (NPWT), and skin substitutes, which are minimally invasive and show improved healing efficacy compared to conventional methods [4].
3. Reconstructive therapies, such as skin and flap grafting, are invasive procedures that may also damage surrounding healthy tissue.
4. Cell-based therapy is a rapidly growing field in wound management, often used in combination with other modalities. Stem cells for these therapies can be sourced from bone marrow or adipose tissue [5].

The clinical application of autologous adipose-derived stem cells (ASCs) is expanding across diverse areas, including wound healing and regenerative medicine. ASCs exhibit pluripotency, survive transplantation while demonstrating anti-apoptotic, anti-inflammatory, and angiogenic effects.

Stromal vascular fraction (SVF) is a heterogeneous mix of cells derived from enzymatic or mechanical processing of adipose tissue. It has shown promising regenerative, immunomodulatory, and anti-inflammatory properties. SVF plays a role in all three phases of wound healing:

1. Inflammatory phase: SVF reduces active scar formation by decreasing mast cells and myofibroblasts through its immunosuppressive and anti-inflammatory effects.
2. Proliferative phase: Adipose-derived stem cells and growth factors in SVF promote tissue regeneration and healing.
3. Maturation phase: SVF suppresses excessive collagen synthesis and remodels collagen via chemokines like TGF-beta3 and matrix metalloproteinases, enhancing scar pliability and quality.

SVF also contains growth factors such as Platelet-Derived Growth Factor (PDGF), Insulin-Like Growth Factor (IGF), Keratinocyte Growth Factor (KGF), Basic Fibroblast Growth Factor (bFGF), and Vascular Endothelial Growth Factor (VEGF), which accelerate healing and contribute to improved scar outcomes. The modulation of collagen synthesis and fibroblast migration further enhances scar pliability [6]. Purification of SVF is crucial for therapeutic use to remove non-functional or harmful components and enrich the cell population for safer and more effective application. SVF preparation can be performed using enzymatic (Figure 9) or mechanical methods. Enzymatic digestion, while efficient, may lead to higher CD45 contamination compared to mechanical methods, which provide cleaner but lower yields and require longer culture times [7]. In our study, we employed readily available materials to prepare SVF mechanically and used it for scar management. The resulting scar showed improved quality, with the patient expressing satisfaction with the outcome.

Conclusion

This study demonstrates the promising potential of stromal vascular fraction (SVF) derived from adipose tissue in enhancing wound healing and improving scar quality. The mechanical preparation of SVF, using accessible materials, proved effective in managing post-burn scars, yielding significant improvements in scar appearance and patient satisfaction. Further research focusing on optimizing SVF purification and its integration with

other treatment modalities may enhance its efficacy in clinical practice, positioning SVF as a valuable tool in wound care and regenerative medicine.

Conflict of Interest

The authors declare that they have no conflict of interest.

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