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Review Article

Enhancing Burn Wound Healing: The Synergistic Benefits of APRP and Lipoaspirate Therapy

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Abstract

Wound healing is a multifaceted biological process that relies on intricate immunological and cellular interactions. Lipoaspirate, a rich source of stem cells, has demonstrated significant potential in tissue regeneration and repair. Additionally, the incorporation of autologous platelet-rich plasma (APRP) enhances its regenerative properties by promoting angiogenesis and reducing inflammation. This study examines the combined application of APRP and autologous lipoaspirate in a pediatric patient with facial burn injuries, highlighting their synergistic effects in accelerating wound healing and improving overall tissue recovery.

Key words: autologous; lipoaspirate; wound healing

Introduction

Wound healing is a natural physiological response of the body to physical, chemical, mechanical, or thermal injuries. This complex process occurs in multiple stages, including hemostasis, inflammation, proliferation/granulation, and remodeling/maturation. However, when the healing process is disrupted, wounds may become stalled in the inflammatory phase, preventing proper recovery. Burn injuries, in particular, often exhibit impaired healing. In modern medical practice, the use of natural or synthetic scaffolds has gained popularity and recognition as a means to support wound repair.

Wound healing involves a series of immunological and biological mechanisms that follow a well-regulated cascade of events, where different cell types appear at specific stages to facilitate tissue repair. If wounds fail to progress normally, they may enter a chronic inflammatory state, leading to delayed or impaired healing.

Mesenchymal stem cells (MSCs) possess immunomodulatory properties that help regulate inflammation by secreting cytokines, which promote tissue regeneration and support healing. By reducing the inflammatory response, MSCs aid in wound progression beyond the inflammatory phase, preventing the formation of chronic wounds. Lipoaspirate serves as a rich source of MSCs, particularly adult stem cells, which can be extracted from adipose tissue using minimally invasive techniques, making it an effective and practical option for wound healing.

The regenerative potential of lipoaspirate can be further enhanced by combining it with autologous platelet-rich plasma (APRP). APRP contains a high concentration of growth factors that stimulate cell proliferation, angiogenesis, and collagen synthesis, which are crucial for tissue repair. When used alongside lipoaspirate, APRP can accelerate healing by improving stem cell viability, promoting fibroblast activity, and enhancing overall wound regeneration. This synergistic approach has shown promising results in optimizing wound healing, particularly in burn injuries.

Materials and Methods

This study was conducted in the Department of Plastic Surgery at a tertiary care center after obtaining approval from the department's ethical committee. Written informed consent was obtained from the child's guardian before the procedure.

The subject was a 10-year-old female child who sustained an 8% mixed-depth scald injury involving the left axillary, infra-axillary, and medial arm due to an accidental burn. She was initially taken to a nearby hospital within 30 minutes, where initial resuscitation was inadequate. By the following day, the child developed blistering and swelling in the affected areas and was brought to our center after a 5-hour delay. Upon admission to the tertiary burn care unit, she was managed with intravenous fluids, analgesics, and prophylactic antibiotics. Autologous lipoaspirate therapy enhanced with autologous platelet-rich plasma (APRP) was initiated on day 1 to improve

wound healing. The lipoaspirate preparation followed the method described by Rigotti G et al.

Preparation of Autologous Lipoaspirate

1. Obtaining Fat Graft:(fig 1)
    - The donor site (lower abdomen) was cleaned and draped.
    - A tumescent solution was prepared using 100 mL of saline, 75 mg levobupivacaine, 40 mg mepivacaine,
    - and 0.5 mL of 1:1000 adrenaline and was infiltrated into the donor site.
    - A 2-3 mm blunt cannula was connected to a syringe, and a small incision was made at the donor site.
    - The cannula was inserted into the subcutaneous tissue, and negative pressure was applied by pulling the plunger of the syringe. Fat was harvested using the Coleman microcannula technique.

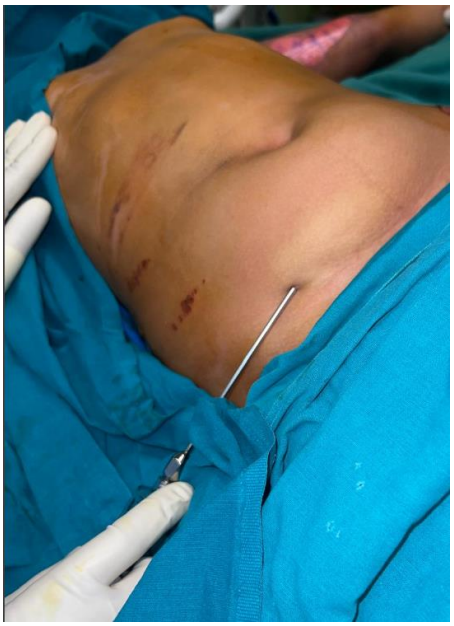

Figure 1: harvesting fat

    - Approximately 05 mL of adipose tissue was collected.
2. Processing the Lipoaspirate:(fig 2)
    - The harvested fat was transferred into centrifuge tubes and centrifuged at 3000 rpm for 3 minutes.
    - After centrifugation, three layers were formed:
        - Top layer: Oil from ruptured fat cells (discarded).
        - Middle layer: Compact adipose tissue containing stem cells (retained for therapy).
        - Bottom layer: Blood and residual infiltrating agents (discarded).
            - The middle layer was extracted and used for lipoaspirate therapy.

Figure 2: Processed Lipoaspirate

Preparation of Autologous Platelet-Rich Plasma (APRP)(fig 3)

1. Blood Collection & Centrifugation:
    - 10 mL of venous blood was drawn from the patient and placed into a heparinised tube.
    - The sample was centrifuged at 1500 rpm for 10 minutes, separating it into three layers:
        - Bottom layer: Red blood cells (discarded).
        - Middle layer: Platelet-poor plasma (removed).
        - Top layer: Platelet-rich plasma (PRP, retained for use).

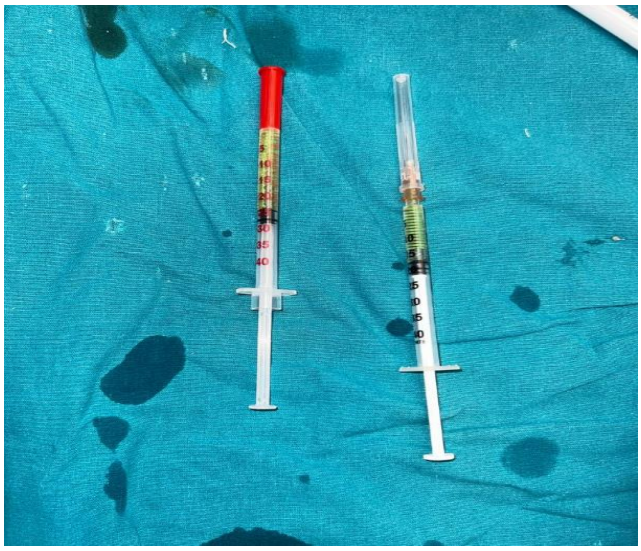

Figure 3: Top layer APRP harvested

2. Mixing APRP with Lipoaspirate:(figure 4)
    - The obtained PRP was carefully mixed with the lipoaspirate to enhance its regenerative properties.
    - This combination was then applied to the wound surface and injected subcutaneously along the wound edges. (figure 5)

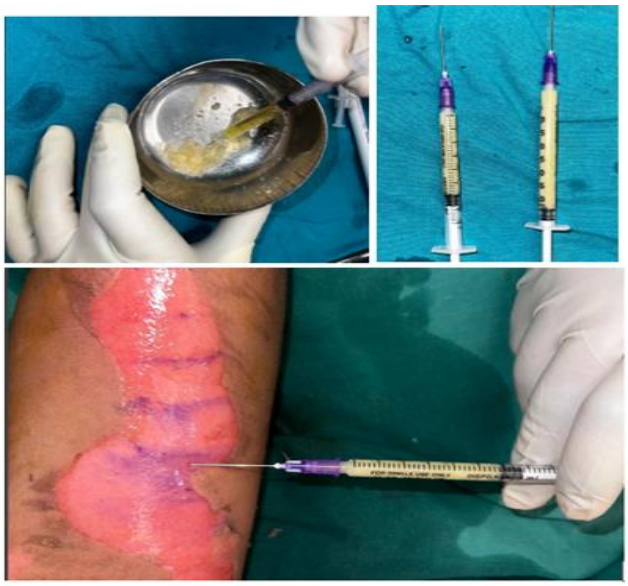

Figure 4: Clockwise- mixing of APRP and liposprite, combination for injection

Discussion

The combination of autologous platelet-rich plasma (APRP) with lipoaspirate has shown promising results in improving fat graft retention, cellular viability, and tissue regeneration, particularly in burn wound healing. One of the major challenges in fat grafting is volume loss due to resorption, poor vascularization, and inadequate cellular integration. The addition of APRP addresses these limitations by providing bioactive growth factors, such as vascular endothelial growth factor (VEGF) and platelet-derived growth factor (PDGF), which enhance angiogenesis, improve oxygen supply, and accelerate tissue remodeling [1,2]. This is particularly beneficial in burn wounds where compromised vascularization can delay healing and increase scar formation.

Burn wounds often exhibit prolonged inflammation, leading to fibrosis and poor skin regeneration. APRP has strong anti-inflammatory properties, as it modulates cytokine release and reduces excessive inflammatory responses [3,4]. This helps prevent excessive scar tissue formation and promotes normal dermal reconstruction. Additionally, APRP stimulates mesenchymal stem cells (MSCs) present in lipoaspirate, enhancing their proliferation, differentiation, and integration into damaged tissue [5]. These stem cells play a crucial role in regenerating dermal structures, restoring skin elasticity, and reducing post-burn contractures.

Furthermore, APRP promotes extracellular matrix (ECM) remodeling and collagen synthesis, both of which are critical for the structural integrity of healed burn wounds [6]. Collagen plays a vital role in wound healing, providing tensile strength and improving skin texture. The growth factors in APRP accelerate epithelialization, leading to faster wound closure and reduced infection risks, which is particularly important in severe burns with large surface areas [7]. Additionally, the synergistic effect of APRP and lipoaspirate provides improved skin hydration, elasticity, and pigmentation, leading to superior aesthetic and functional outcomes in burn scar management [8].

Several clinical studies have demonstrated that combining APRP with fat grafting results in improved graft survival and better long-term wound healing outcomes [9,10]. This is attributed to the enhanced vascularization, reduced inflammatory damage, and optimized cellular environment provided by APRP. The enriched fat graft integrates more effectively into the recipient site, minimizing fat necrosis and maximizing the healing response.

Conclusion

In conclusion, APRP significantly enhances the therapeutic potential of lipoaspirate in burn wound healing by promoting angiogenesis, reducing inflammation, accelerating epithelialization, and improving overall skin quality. Its role in improving fat graft survival and optimizing tissue repair makes it a valuable addition to burn management strategies. Future research should focus on standardizing APRP preparation protocols and identifying the optimal concentration of growth factors to maximize clinical benefits.

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