

The Use of Autologous Platelet-Rich Plasma in Treating Web Space Scar Contractures in Pediatric Burn Patients

Anirudh Dwajan¹, Ravi Kumar Chittoria^{2,*}, Amrutha J.S.³

Abstract

Burn injuries are prevalent among children, with scald injuries emerging as the predominant type among those under the age of five, constituting more than 65% of cases. Despite receiving appropriate initial treatment and compressive therapy, deep burns often result in contractures, with web space and hand contractures being the most frequent and functionally limiting. To address these challenges in burn management, Autologous platelet-rich plasma (APRP) has emerged as a significant player in the medical field. Its remarkable wound healing and scar-modifying properties have positioned it as a valuable therapeutic intervention. The incorporation of APRP in the management of burn cases has proven to be instrumental in achieving favorable outcomes. The utilization of APRP in this specific case signifies a strategic approach toward enhancing the healing process and mitigating the development of contractures. By harnessing the regenerative potential of platelet-rich plasma derived from the patient's blood, clinicians aim to optimize the recovery trajectory and minimize the long-term functional impairments associated with deep burns. In conclusion, the integration of Autologous platelet-rich plasma in burn management represents a proactive step towards ensuring a more comprehensive and efficacious therapeutic approach. This innovative strategy holds promise in not only addressing the immediate concerns of wound healing but also in preventing and managing the debilitating consequences such as contractures, particularly in sensitive areas like the web space and hands.

Keywords: Burns, web space, contracture, autologous platelet rich plasma, pediatric burns

INTRODUCTION

Burn injuries constitute a significant contributor to mortality in developing nations like India. Despite receiving timely and appropriate initial treatment along with compressive therapy, the prevalence of contractures remains high, especially in cases of deep burns. Among the various types of contractures, those affecting the web space and hands are particularly common and pose functional limitations. In recent years, advancements in skin regenerative techniques have garnered attention, offering promising

outcomes in the realm of wound management. Autologous Platelet Rich Plasma (APRP) stands out as a notable example, demonstrating enhanced efficacy in reducing inflammation and facilitating the overall healing process. The application of APRP in wound management reflects a paradigm shift in therapeutic approaches, particularly in addressing the challenges posed by deep burns. The regenerative potential of APRP lies in its ability to harness the body's healing mechanisms. This entails the extraction and concentration of platelets from the patient's blood, creating a platelet-rich plasma infused with growth factors and cytokines.

Platelet-rich plasma's unique composition, rich in growth factors and cytokines, plays a pivotal role in

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mitigating inflammation and promoting the intricate process of tissue regeneration. These bioactive components within APRP are believed to modulate the inflammatory response, thereby creating a more favorable environment for the healing cascade. Additionally, the growth factors present in APRP contribute to cell proliferation and differentiation, fostering an accelerated and organized tissue repair process. In the context of burn injuries, where inflammation can impede the healing trajectory, the anti-inflammatory properties of APRP become particularly valuable. By minimizing inflammation, APRP creates a conducive milieu for cellular activities critical to wound closure and tissue regeneration. Furthermore, the scar-modifying properties of APRP offer an additional layer of benefit, addressing concerns related to scar formation and potential contractures.

The significance of APRP in wound management extends beyond its immediate impact on healing. The regenerative potential of platelet-rich plasma also plays a role in scar remodeling. Scar tissue, often associated with decreased flexibility and function, can be influenced by the application of APRP. The growth factors and cytokines within APRP contribute to a more organized and less restrictive scar formation, mitigating the functional limitations that commonly accompany deep burns. The integration of APRP into burn management protocols underscores a commitment to holistic and patient-centric care. This innovative approach not only addresses the immediate challenges of wound healing but also considers the long-term functional outcomes, particularly in areas prone to contractures such as the web space and hands. The utilization of APRP aligns with the evolving landscape of regenerative medicine, where harnessing the body's innate healing potential takes precedence in optimizing patient recovery and minimizing the sequelae of traumatic injuries like deep burns.

In conclusion, the incorporation of Autologous Platelet Rich Plasma in the context of burn injuries in countries like India represents a progressive stride towards more efficacious and comprehensive wound management. Beyond its immediate impact on inflammation and healing, APRP offers a promising avenue for scar remodeling, addressing the intricate challenges associated with deep burns. As research continues to unfold in the field of regenerative medicine, the role of APRP in burn management stands as a testament to the ongoing commitment to improving patient outcomes in the face of complex and debilitating injuries.

MATERIALS AND METHODS

This study was conducted in the Tertiary Care Centre in the Department of Plastic Surgery after getting the department's ethical committee approval. Informed consent was obtained. The subject was a 9yr/M with scar contracture of left ring finger and 3rd webspace contracture. The patient came with complaints of inability to extend his left middle finger for 6 years after suffering scald burns at the age of 2 years following which he developed a scar over his left upper limb. He had a history of In-hospital admission for scald burns at 2 years, the release of scar contracture at left middle finger with SSG, and the release of contracture of 2nd, and 3rd webspace.

For the 3rd Webspace contracture, preoperative webspace splinting was done for 2 weeks. The maximum angle of abduction was measured with a goniometer (Figure 1) and documented. He underwent JESS distractor application (Figure 2) and APRP injection (Figure 3) into the webspace contracture site. Post-operatively slow distraction was started. When the preoperative angle of maximum abduction was achieved, no further distraction was done. JESS distractor was retained for 3 weeks. After removal, the angle of abduction in 3rd webspace was assessed- the maximum angle was achieved (Figure 4, 5). The patient was advised to continue passive and active physiotherapy and splinting.

RESULTS

The patient experienced uneventful intraoperative and postoperative periods. A noticeable reduction in deformity resulting from post-burn contractures was observed, accompanied by significant functional improvements in hand mobility. The procedure included releases to address webspace contractures,

contributing to the overall enhancement of hand function. Remarkably, the entire process transpired without encountering complications or side effects. This positive outcome underscores the success of the intervention in mitigating post-burn deformities and fostering improved functionality in the patient's hand. The absence of complications reflects the precision and efficacy of the medical procedure, affirming its overall safety and positive impact on the patient's well-being.

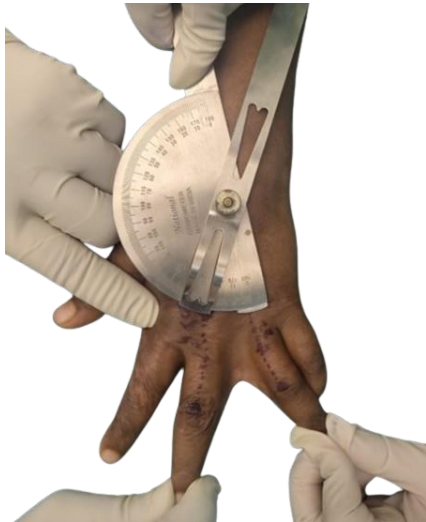


Figure 1. Preoperative assessment of reduced webspace angle of 32°.



Figure 2. Application of JESS distractor.



Figure 3. APRP injection over web space contracture.

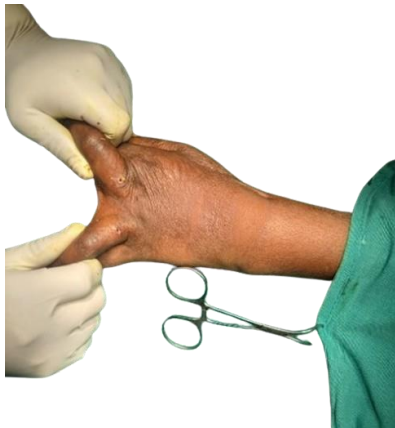


Figure 4. Intraoperative webspace stretching after JESS removal.

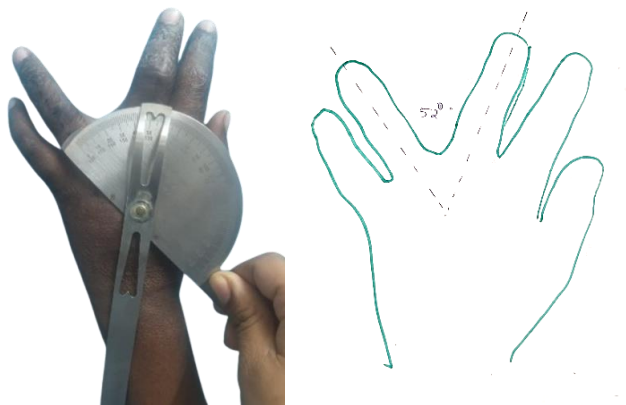


Figure 5. Post-JESS removal webspace angle attained is measured using a goniometer.

DISCUSSION

The hands make up less than 5% of the total body surface area, yet a significant number of burns requiring hospitalization involve them [1, 2]. Hand burns are classified as severe injuries by the American Burn Association and should be referred to specialized care centers to reduce the long-term effects such as nail deformities, hypertrophic scars, digit loss, and contractures. The skin on the palm and back of the hand have different characteristics, with the back being thinner and more flexible, making it more prone to contracture formation due to its proximity to the extensor mechanism [3, 4]. In contrast, the thicker skin and additional protective layers on the palm make it less susceptible to contractures. Post-burn contractures affecting the spaces between fingers can cause functional and aesthetic issues.

Autologous platelet-rich plasma (PRP) is used in chronic wounds due to its rich source of growth factors, which promote cell proliferation, blood vessel formation, and tissue healing. PRP has been shown to stimulate the proliferation of human dermal fibroblasts, increasing the production of type I collagen, which is crucial for scar management. Additionally, activated PRP provides a concentrated dose of growth factors locally, accelerating wound healing and scar remodeling by five to ten times the normal concentration [5–8]. These contractures may involve either the back or palm of the hand or both, leading to changes in hand shape and function. In severe cases, these contractures may involve underlying bone abnormalities, which can be identified through radiographic evaluation to guide treatment decisions [9, 10].

CONCLUSION

Addressing post-thermal burn scars on the hand presents a formidable challenge, given the complexities of scar contracture and the resultant loss of functional use in the fingers and hand. In

tackling such intricate cases, we have showcased a method that proves not only effective but also successful in managing these challenges. Our approach involves a combination of Autologous Platelet Rich Plasma (APRP) injection and the implementation of JESS distraction.

The utilization of APRP injects innovation into the therapeutic landscape, harnessing the regenerative properties of platelets. By administering the patient's concentrated platelet-rich plasma, we introduce a powerful biological component that aids in tissue repair, reducing inflammation and promoting the healing process. This, in turn, contributes to addressing scar contractures and facilitates an environment conducive to functional recovery.

Complementing APRP, the incorporation of JESS distraction serves as a strategic component in our method. The JESS (Joint Extensor Sidearm System) distraction system offers a mechanical solution to counteract the effects of scar contractures. By applying controlled distraction forces, it allows for gradual and precise correction of deformities, enabling the restoration of optimal hand function. Our comprehensive approach, integrating APRP injection and JESS distraction, signifies a multifaceted strategy in managing the intricate challenges posed by post-thermal burn scars on the hand. This method not only addresses the visible manifestations of scarring but also focuses on restoring functional utility to the fingers and hand. The synergistic effects of APRP and JESS distraction underscore a commitment to holistic patient care, aiming for both aesthetic improvement and enhanced quality of life in individuals grappling with the aftermath of thermal burns. Through this innovative and successful intervention, we contribute to advancing the field of burn scar management, offering a ray of hope for those facing the functional limitations imposed by post-burn hand scars.

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