

Spray on Skin Therapy used for Bilateral Traumatic above Knee Amputations: A Case Report Demonstrating Efficacy in Traumatic Wounds

Paul Fine¹; Mimi R Borrelli^{2*}; Menlo Leuders¹

¹Lincoln Hospital, The Bronx, New York, NY, USA.

²AVITA Medical, Inc., Valencia, California, USA.

Abstract

Traumatic amputations following subway accidents are a frequent occurrence in New York and impose a significant burden on both patients and society. Proximal and bilateral amputations often limit the availability of tissue for Split-Thickness Skin Grafts (STSG). The Autologous Skin Cell Suspension (ASCS) technology is autografting with significantly reduced donor tissue which may also expedite healing; however, it has been underreported for its application in traumatic injuries. This study presents a case involving a 48-year-old male who sustained traumatic partial bilateral Above-Knee Amputations (AKA) due to a subway accident. After completion amputation, appropriate wound preparation, ASCS was applied in conjunction with a widely meshed STSG (9:1 - right, 4:1 - left). By day 23, graft take on the left stump was 100%. The right stump required a secondary grafting for a small open area, which re-epithelialized by day 42. No additional complications were observed, and the patient achieved functional mobility by day 65, with excellent repigmentation of the grafted areas.

Keywords: Spray on skin cells; Autologous skin cell suspension; ASCS; Split-thickness skin graft; STSG.

Introduction

Traumatic amputations following subway accidents are a devastating yet common occurrence in New York City. Limb salvage is rarely possible, and success is limited when attempted [1,2]. More common is management via completion amputation and staged soft tissue reconstruction [3]. Above-knee (AKA) and Below-Knee Amputations (BKA) are associated with significant morbidity and mortality, and the physical and emotional burden is significantly worse with AKA [4]. Traumatic extremity amputations amount to enormous costs and the individual and societal level, reported to

exceed \$300 million per year [5]. Furthermore, subway incidents predominantly affect the underserved members of society whose healing potential may be complicated by the higher incidence of psychiatric disorders, alcoholism, and unemployment [1,2]. Poly-trauma and AKA can complicate pressure off-loading and ability to perform adequate wound care, which may further slow healing in the acute stages. Proximal amputations, especially when bilateral, also limit tissue available for Split-Thickness Skin Grafts (STSG) [6]. Minimizing patient morbidity by expediting healing and decreasing hospital Length of Stay (LOS) is a priority.

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Correspondance: Mimi R Borrelli, AVITA Medical, Inc., Valencia, California, USA. Email: mimi.r.borrelli@gmail.com

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The Autologous Skin Cell Suspension (ASCS) technology has become widely adopted for reconstruction of thermal injuries due to its ability to significantly reduce donor tissue [7,8]. On June 07, 2023, The Food and Drug Administration (FDA) recently approved ASCS for use in the reconstruction of full-thickness skin defects along with STSG [9]. To date only very few articles have been published on the use of ASCS for traumatic injuries [10], and most of the work has been completed outside the United States. In 2020, Rivard et al. published a case report on a 22-year-old-male who received ASCS with STSG to reconstructive the wound at the stump of his traumatic AKA [11]. The patient took 11 months to heal and had evidence of chronic wound requiring hyperbaric oxygen therapy as well as blistering. To establish clinical significance of findings and the applicability of these findings across diverse patient populations additional case reports play a valuable role. This patient was also fair-skinned, and pigmentation results are different. The presence of autologous melanocytes (~3-5%) in the cellular suspension [12] also helps return of baseline pigmentation. This manuscript describes the use of ASCS with widely meshed STSG for reconstruction of traumatic partial bilateral Above Knee Amputations (AKA).

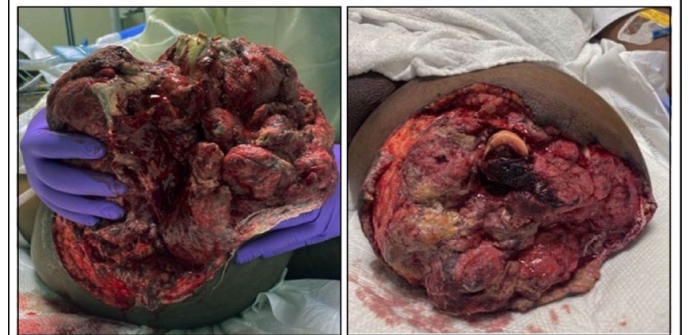
Case report

A 48-year-old male patient with a history of hypertension and substance use, presented via ambulance to the level I trauma center with traumatic partial bilateral AKA after jumping onto the metro tracks in February 2023 (Figure 1). After stabilization, patient underwent completion guillotine amputation bilateral leaving a 40 cm² open wound on the left stump and a 35 cm² wound on the right (Figure 2). Four subsequent operative debridements were performed (Figure 3) with local muscle rearrangement for closure of wound edges and Negative Pressure Wound Therapy (NPWT) was used between surgeries until there was significant granulation tissue flushed and an even surface for grafting (Figure 4). Application of STSG (meshed 9:1 on the left and 4:1 on the right) was performed in separate surgeries, starting with the right site. The ASCS was prepared following the manufacturer instructions. Perioperative antibiotics were used throughout the operative management. Dressings were non-absorbent porous transparent dressing primarily with petroleum gauze and NPWT using white foam for seven days (125 mmHg). There was a small area of non-healing wound at the right stump which required further STSG application on day 34. The graft on the right stump had 100% re-epithelialized by 84 (Figure 5). No other complications, including infections, were reported. Mobility was completely restricted initially but patient eventually was fitted with a prosthetic and was supported by physical therapy for increased use of his extremity. At the clinic follow-up appointment on postoperative day 65, both stumps had excellent return of pigmentation with minimal scarring. The reconstruction remained durable, and skin was supple on palpation. Patient reported satisfaction with the results and continued to use his extremities with fitted prostheses without issues.



At presentation

Figure 1: Clinical photograph showing patient at presentation to the Level I trauma center after subway trauma with partial bilateral traumatic above knee amputations. Below the amputation level injuries appear macerated and unsalvageable. The black box on left is covering patient genitalia which were uninjured.



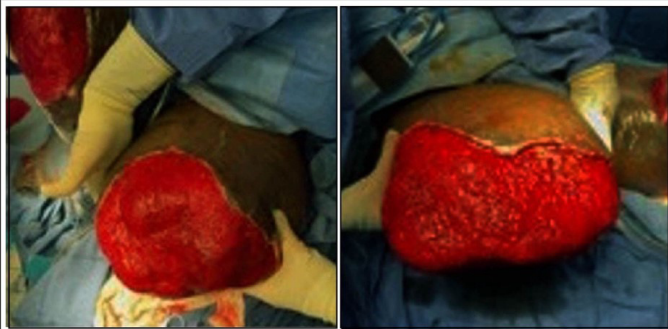
Day 4 Post Injury & Completion Amputation

Figure 2: Clinical photo showing patient's bilateral lower extremity stumps (left stump – right image, right stump – left image) 4-days post injury after bilateral completion amputation of traumatic above knee amputations. The wound beds exhibit multiple cavities and different tissues in need of further debridement and preparation before autografting can be considered.



Day 12 Post Injury

Figure 3: Day 12 post injury and after treatment with negative pressure wound therapy (NPWT) showing m granulation tissue at the right stump wound base but not complete coverage over bone or flushed surface.



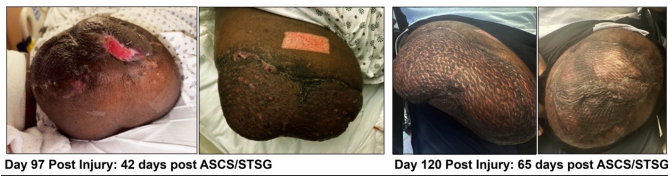
Day 25 Post Injury

Figure 4: Day 25 post injury and after placement of dermal matrices and treatment with Negative Pressure Wound Therapy (NPWT) showing more granulation tissue at the wound base but not complete coverage over bone or flushed surface; left stump – right image, right stump – left image.



Day 78 Post Injury: 23 days post ACS/STSG

Day 84 Post Injury: 29 days post ACS/STSG



Day 97 Post Injury: 42 days post ACS/STSG

Day 120 Post Injury: 65 days post ACS/STSG

Figure 5: Progression of the right and left stump sides at day 78 (upper left), day 84 (upper right), day 96 (bottom left), and day 120 (bottom right) after autografting with Split-Thickness Skin Grafting (STSG) and Autologous Skin Cell Suspension (ASCS) technology.

Discussion

This case highlights the potential of ASCS for use in traumatic amputations where donor skin is limited, and healing potential may be compromised. Meshing ratios typically used by trauma surgeons are around 1:3 and the wide meshing here highlight the potential for significant reduction of donor skin enabled by the ASCS technology. The breakdown of a graft area in the right stump site, where 1:9 was used, may suggest a lower ratio (e.g., 1:6) may be preferable. Healing could have been compromised for multiple additional factors, and often postoperative graft protection to minimize shearing forces is a common reason for need for repeat grafting procedures. An additional benefit of the ASCS exemplified in the follow-up of this patient was the return of skin pigmented, which resulted in excellent cosmetic appearance of the stump sites especially by day 120.

The results with this patient are favorable in comparison to the prior case report of a traumatic amputation [11], where ASCS was used with STSG to reconstruct a wound at the stump of a traumatic AKA. The previous report describes wound breakdown and blistering, and a total healing time of 11 months. This difference highlights the role for case reports with emerging therapies, especially

with respect to surgical cases where technique and management can be highly varied. Although limited by in patients followed and the lack of statistical sampling or comparative nature. This article demonstrates how ASCS technology may reduce healing time and improve cosmetic outcomes. Future work should focus on comparing greater number of patients and understanding whether these outcomes translate to reduced hospital stay and costs.

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