Panafrican Journal of Plastic Reconstructive and Aesthetic Surgery Vol. 1 No. 2 December 2024
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ABDOMINAL FLAP: A VIABLE OPTION IN RECURRENT PEDIATRIC POST-BURN ELBOW CONTRACTURE RECONSTRUCTION

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SUMMARY

The management of post-burn contractures and keloid formation in pediatric populations pose significant challenges. This case report presents the comprehensive management of recurrent post-burn contracture involving the left elbow. An 11-year-old female presented with recurrent post-burn left elbow flexion contracture for 8 years. Contracture release surgery followed by reconstruction with an abdominal flap was done. Moreover, the patient underwent intermittent nocturnal splinting and physiotherapy sessions. Following, these interventions, the elbow range of motion improved by approximately 80 degrees. A multidisciplinary approach involving surgical and rehabilitative therapies is important in management of post-burn contractures.

Keywords: **Pediatric burns, post-burn contracture, keloid formation, surgical reconstruction, multidisciplinary care.**

INTRODUCTION

Pediatric burns are devastating due to the delicate nature of children's skin and their increased vulnerability to complications such as infections, hypertrophic scarring, and contractures (1) particularly as sequelae of burns in children in whom the psychologic burden and skin characteristics differ substantially from adults. Prevention of hypertrophic scars and keloids after burns is currently the best strategy in their management to avoid permanent functional and aesthetical alterations. Several actions can be taken to prevent their occurrence, including parental and children education regarding handling sources of fire and flammable materials, among others. Combination of therapies is the mainstay of current burn scar management, including surgical reconstruction, pressure therapy, silicon gels and sheets, and temporary garments. Other adjuvant therapies such as topical imiquimod, tacrolimus, and retinoids, as well as intralesional corticosteroids, 5-fluorouracil, interferons, and bleomycin, have been used with relative success. Cryosurgery and lasers have also been reported as alternatives. Newer treatments aimed at molecular targets such as cytokines, growth factors, and gene therapy, currently in developing stages, are considered the future of the treatment of postburn hypertrophic scars and keloids in children.According to recent research, between 23% and 54% of hospitalized burn patients get scar contractures (2). Burn-related skin contractures are more likely to occur following primary excision and skin grafting of deep burns (3).

A shorter and unusually compact scar tissue following burn injury is frequently the result of improper initial care, atypical scar tissue remodeling, or a lack of physical therapy (2). Scar contractures may restrict movement when they involve joints of the extremities (3). After burn scar contractures develop, rehabilitation and surgery is frequently necessary to preserve the affected joint's range of movement and function (4).

Surgical reconstructive techniques for burn scar contracture release include the use of either skin grafting or skin flap. Of the two techniques, skin grafting is by far the more common in the treatment of post-burn contractures (4). However, evidence regarding the effectiveness of either technique is inadequate thus posing a great challenge in developing a standardized treatment algorithm (5). A previous review reported that perforator flaps had better outcomes compared to full-thickness skin grafts (FTSG). Nevertheless, the review identifies the need for research focusing on preferred type of perforator flap depending on the location of the contractures (4). Based on the foregoing, we report a case of an 11-year-old female who presented with post-burn scarring of the left upper limb and chest with consequent elbow

contracture that was successfully managed with an abdominal flap.

CASE PRESENTATION

An 11-year-old female from Thiba, Mwea, Kenya, presented with a history of scald burns sustained eight years ago. The burns occurred when hot tea spilled from a boiling pot, resulting in scald injuries to the left upper limb, axilla, and chest. Initial management at a local facility involved cleaning and wound dressing, which led to wound healing but with significant scarring and the development of a left elbow contracture (Figure 1).

Figure 1: *Post-burn contracture of the left elbow with hypertrophic scars of the forearm, arm and chest in the 11-year-old female*

Despite undergoing contracture release surgery, which involved excision of scar tissue and release of contracture followed by FTSG, the contracture recurred. Three years following the initial injury, the patient was referred again for management of the contracture.

Upon the second presentation, the patient was in fair general condition with no evidence of pallor, jaundice, dehydration, lymphadenopathy, or edema. Vital signs were within normal limits. Physical examination revealed a left elbow scar with contracture limiting maximum extension to 60 degrees. Hypertrophic scars were noted on the left hand, elbow, left breast, and axillary region. The patient had no apparent developmental delays.

The treatment plan involved left elbow contracture release and reconstruction using an abdominal flap. The procedure was performed successfully in two stages: contracture release plus raising and insetting of the flap was done first, and the flap was left attached to its base to continue receiving blood supply from its source vessels. Flap donor site was grafted using a split-thickness skin graft (STSG). After three weeks, the flap was divided from its base (Figure 2) and the flap insetting was completed (Figure 3). A tissue expander procedure was planned to achieve primary closure of the donor site without the need for skin grafting which was done when the flap was raised.

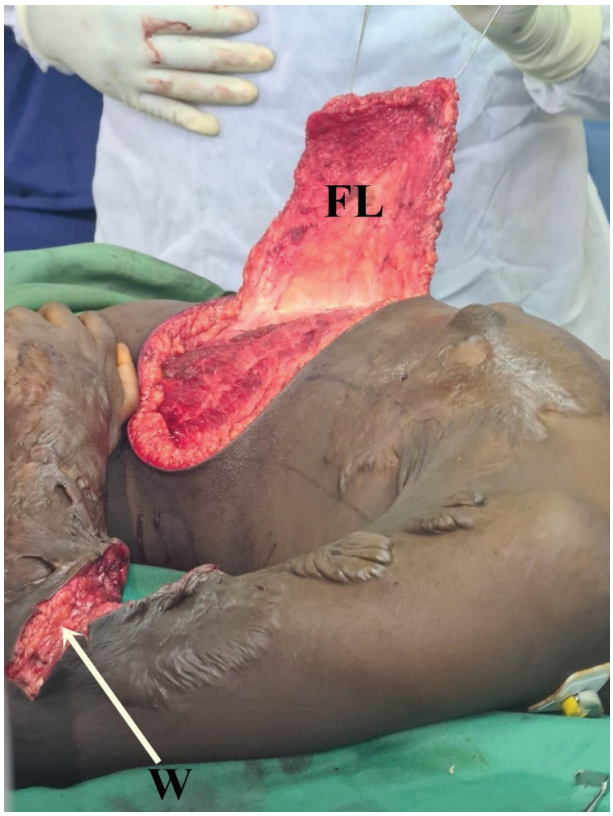

Figure 2: *The abdominal flap (FL) after it has been raised ready to be inset into the wound (W)*

Postoperatively, the patient commenced a 10-month physiotherapy program to optimize functional outcomes and prevent contracture recurrence. The program also involved intermittent nocturnal splinting. Although the scar tissue at the elbow was excised, achieving adequate elbow extension required addressing the shortened soft tissue structures. These structures needed gradual lengthening to avoid immediate postoperative damage. Physiotherapy facilitated this gradual extension and improved muscle function, while splinting maintained the gains achieved. This comprehensive approach ensured a gradual and safe restoration of mobility and function (Figure 4 a).

Figure 3: *Post-surgical image of the contracture release with abdominal flap reconstruction*

The patient experienced mild complications including pain at the scar sites (left elbow and abdomen) and abdominal "muscle pull" on short-term review (Figure 4b). Additionally, however, the patient reported severe and intermittent itching, with subsequent bruising after scratching on long-term review. Physical examination revealed keloids at the scar sites, characterized by hyperkeratosis on the skin flap and gross hypertrophic scarring extending from the distal phalangeal area of the left hand to mid-humeral region. Management of the keloids included the application of creams for wound care, along with triamcinolone injections.

Figure 4 (a, b): *The patient's elbow and forearm a few months post-surgery(left) showing hyperkeratosis on the skin flap and extensive scarring. The same elbow 2 years post-surgery with markedly reduced hyperkeratosis and scarring (right). The flap donor site 2 years post-surgery with extensive scarring.*

Throughout the course of treatment, the patient remained under close observation and received multidisciplinary care involving plastic surgeons, physiotherapists, and wound care specialists. Post-treatment, the patient exhibited significant improvements in functionality. Following the surgical intervention, physiotherapy, and splinting, the patient achieved an elbow extension of approximately 140 degrees. This functional recovery allowed her to perform daily activities with greater ease. Regular follow-up assessments were conducted to monitor progress, address complications, and adjust treatment strategies as needed.

DISCUSSION

The patient sustained the burn injury at a very young age and developed a severe contracture that persisted despite initial surgical intervention. Despite undergoing contracture release and FTSG, the patient experienced contracture reformation. This finding aligns with previous studies highlighting the high recurrence rates of post-burn contractures that have been noted in pediatric populations (3,6)the authors identified 48 articles published since 1965 and written in English which reported the incidence and risk factors for hypertrophic scarring or assessed outcomes related to scarring. Most studies had important methodological limitations limiting the generalizability of the findings. In particular, the absence of standardized valid measures of scarring and other outcome variables was a major barrier to drawing strong conclusions. Among studies on hypertrophic scarring, the prevalence rate varied between 32 and 72%. Identified risk factors included dark skin, female gender, young age, burn site on neck and upper limb, multiple surgical procedures, meshed skin graft, time to healing, and burn severity. With regard to psychosocial outcomes, two studies compared pediatric burn survivors with a nonburn comparison group on a body image measure; neither study found differences between groups. Across studies, burn severity and location had a modest relationship with psychosocial outcome variables. Psychosocial variables such as social comfort and perceived stigmatization were more highly associated with body image than burn characteristics. To advance our knowledge of the epidemiology of scars and the burden of scars, future studies need to implement more rigorous methodologies. In particular, standardized valid measures of scarring and other outcomes should be developed. This process could be facilitated by an international collaboration among burn centers. Recurrence of post-burn contractures, following inadequate management of post-burn contractures (PBC). Factors contributing to recurrence include incomplete release of scar tissue, inadequate postoperative rehabilitation and the presence of underlying scar contracture mechanisms (6)following inadequate management of post-burn contractures (PBC. The recurrence of the contracture highlights the complexity of managing post-burn sequelae in pediatric patients.

The management of post-burn contractures often involves scar excision, release of contracture, and tissue reconstruction (7)leading to significant functional impairment and costs. Effective prevention and treatment strategies are necessary to decrease morbidity and unnecessary costs. This scoping review aimed to summarize prevention and treatment strategies used for management of burn scar contractures published in the literature since 2000. A comprehensive PubMed review was performed in October 2022 to identify methods of burn contracture prevention and treatments. Non-English, duplicate, and unavailable articles were excluded. Data were extracted including publication year, techniques, and outcomes. A total of 327 publications met criteria for inclusion. Most articles were published in 2011 (n = 22. The source of skin flap used in the reconstruction of post-burn contracture varies with contracture location (8)frequently with persistent wounds. Proper planning and tissue selection are essential to minimize donor site morbidity optimizing outcomes. The principle of burn reconstructive surgery requires that the defects after release should be replaced with donor tissues which have matching texture and color as well as enough pliability. Autologous skin grafting or flap surgeries meet these criteria to replace scar tissues and resurface the subsequent to post-released scar defects. Despite the benefits, the use of flaps is often limited in burn patients for many reasons. If a surgeon intends to release completely and reconstruct in one-stage operation, a large defect may result in large donor site morbidity, necessitating flap surgery including free flap surgery. A lot of different methods and procedures are available for resurfacing the defects, and these are reviewed. In this article, algorithms for the release of burn contractures and reconstructive methods are presented. These treatment algorithms should aid in achieving significant improvement in both joint motions and aesthetic deformities. In a previous review , fasciocutaneous island flaps with proximal septal perforators of the radial artery were most commonly used in antecubital contractures (4). Moreover, another review reported latissimus dorsi to be the most utilized flap overall in covering the defect in the elbow region. While the same review also describes studies on abdominal flaps used in reconstruction of elbow defects, their review fails to mention the cause of the elbow defects (9).

In this case, the use of an abdominal flap for reconstruction following contracture release proved to be a viable option, allowing for adequate tissue coverage and functional restoration. The abdominal flap was selected due to several key advantages over a free flap, such as donor site availability, vascularity, and the need for durable tissue coverage to prevent recurrence. The abdominal flap, particularly the pedicled type, offers robust vascularity and a substantial tissue volume, essential for covering large defects and ensuring reliable healing. This flap is anchored to its blood supply, reducing the risk of vascular compromise compared to free flaps, which require microvascular anastomosis. Hence although free flap surgery remains the gold standard in the reconstruction ladder, it was not considered a good option in this specific case due to possibility of distorted anatomy of the blood vessels secondary to the contracture. While flap reconstruction has demonstrated efficacy in addressing post-burn contractures, its success depends on various factors, including patient characteristics, wound location, and surgeon expertise (8)frequently with persistent wounds. Proper planning and tissue selection are essential to minimize donor site morbidity optimizing outcomes. The principle of burn reconstructive surgery requires that the defects after release should be replaced with donor tissues which have matching texture and color as well as enough pliability. Autologous skin grafting or flap surgeries meet these criteria to replace scar tissues and resurface the subsequent to post-released scar defects. Despite the benefits, the use of flaps is often limited in burn patients for many reasons. If a surgeon intends to release completely and reconstruct in one-stage operation, a large defect may result in large donor site morbidity, necessitating flap surgery including free flap surgery. A lot of different methods and procedures are available for resurfacing the defects, and these are reviewed. In this article, algorithms for the release of burn contractures and reconstructive methods are presented. These treatment algorithms should aid in achieving significant improvement in both joint motions and aesthetic deformities.

The development of keloids represents a common complication in scar management in dark-skinned patients. Keloid formation results from aberrant wound healing processes with excessive collagen deposition and uncontrolled fibroblast proliferation (10). In this case, the patient exhibited keloids with hyperkeratosis and itching, necessitating creams and triamcinolone injections. While these interventions may provide symptomatic relief and flatten keloids, their long-term efficacy remains variable (1) particularly as sequelae of burns in children in whom the psychologic burden and skin characteristics differ substantially from adults. Prevention of hypertrophic scars and keloids after burns is currently the best strategy in their management to avoid permanent functional and aesthetical alterations. Several actions can be taken to prevent their occurrence, including parental and children education regarding handling sources of fire and flammable materials, among others. Combination of therapies is the mainstay of current burn scar management, including surgical reconstruction, pressure therapy, silicon gels and sheets, and temporary garments. Other adjuvant therapies such as topical imiquimod, tacrolimus,

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CONCLUSION

A multidisciplinary approach involving surgical and rehabilitative therapies is essential in the management of post-burn contractures. Despite the failure of the initial reconstructive procedure that utilized a FTSG and the subsequent success in using an abdominal flap, it cannot be concluded that flaps are superior to grafts in post-burn contractures due to the limited nature of evidence from a case report. Therefore, larger case series on the use of abdominal flaps in the management of elbow contractures and studies comparing the efficacy of various flaps as well as flaps versus grafts in the management of elbow contractures are needed.

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