

# Presentation and Management Outcome of Post-burn Contractures of the hands and Wrists in Children

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## Introduction

Burn injuries among children carry considerable morbidity and mortality in the low and middle-income countries.<sup>1-3</sup> Burn injuries continue to plague the children of poor nations in particular. Such injuries have both acute as well as long term ramifications. In the acute phase, robust management by specialized burn care providers help to not only reduce the associated mortality but also prevent the formidable long-term sequelae. In addition to the advances in burn care in the form of improved intensive care and infection prevention, early excision and skin grafting has been a remarkable breakthrough in the successful management of deep burns. It helps not only to save precious lives in the acute phase but also helps to prevent the development of disabling contractures.<sup>1, 4-6</sup>

The post-burn contractures (PBCs) continue to be a common clinical presentation in plastic surgery clinics in our country. They are often associated with severe physical disability and psychological distress. The developed nations have made considerable advances in the acute management of burns; however, the developing nations have not been able to achieve high standards in the acute burn care. Resultantly, PBCs are not only more frequent but often more severe among children in the developing countries.<sup>5, 7, 8</sup>

The PBCs of the hands need corrective surgery for addressing both the functional deficits as well as the associated aesthetic disfigurements. Surgery aims to ensure adequate release of the PBC and reconstruct the resultant defects with thin and pliable skin, thus restoring the lost function and cosmesis of the hand.

## ABSTRACT

**Objectives:** To document the epidemiologic profile of children with post burn contractures (PBCs) of the hands and determine the relative contribution and success rate of various reconstructive tools employed in their management.

**Methodology:** This descriptive case series study was carried out at the National Institute of Rehabilitation Medicine, Islamabad over a period of five years. All children who presented with PBCs of the hands or wrists of at least one-year duration were included. Children who had associated contractures elsewhere in the body were excluded. The primary outcome measure was the adequacy of contracture release and survival of the flaps and grafts whereas the secondary outcome measure was the recurrence of contracture at one-year follow-up.

**Results:** Out of 177 children, 81.35% (n=114) were males and 18.64% (n=63) were females. The age ranged between 1-14 years with a mean age of 4.51±3.79 years. Fingers and thumbs 80(45.19%) were the commonest site of PBCs. This was followed by contractures of the first web space 23(12.99%); wrist contractures 21(11.86%); claw hand deformities (n=17: 9.60%); fist hand deformities (n=15: 8.47%); dorsal hand contractures 11(6.21%); and post burn syndactyly 10(5.64%). The various reconstructive procedures performed included full thickness skin grafts (FTSGs) (n=91); Z-plasties (n=73); groin flaps (n=40); split thickness skin grafts (STSGs) (n=7); and abdominal and posterior interosseous flaps (n=3) each. 44 (95.65%) flaps healed without any complications. Majority (n=87; 88.7%) of the FTSGs/ STSGs had good take. Majority (71.75%) of the children had satisfactory functional outcome. Recurrence of PBCs at one year follow up was observed among 23 (12.99%) children.

**Conclusion:** Postburn contractures of the hands were more frequent among male children aged 1-5 years. Scalds were the commonest underlying cause of these contractures. Z-plasties and full thickness skin grafts were the most commonly employed reconstructive tools. Majority of the children had successful contracture release and survival of the flaps and grafts employed for the reconstruction. Recurrence at one year was observed among 12.99% children.

**Key words:** Burn injuries; Post burn contractures; Contracture; Hand contractures.

Commonly the reconstruction is undertaken by following the principles of the reconstructive ladder. The various reconstructive options include Z-plasties or local transposition flaps, split thickness skin grafts (STSGs), full thickness skin grafts (FTSGs), local and loco-regional flaps, distant flaps and free flaps.<sup>5</sup>

The current study was conducted to document the epidemiologic profile of children with post burn contractures (PBCs) of the hands and determine the relative contribution and success rate of various reconstructive tools employed in their management.

## Methodology

This descriptive case series study was carried out at the Department of Plastic surgery, National Institute of Rehabilitation Medicine (NIRM), Islamabad over a period of five years. Written informed consent was taken from the patients. The study conformed to the principles of the Helsinki's declaration of 1975, as revised in 2008. Anonymity of the included children was guaranteed. Non-probability consecutive sampling was done. All children who presented with PBCs of the hands of at least one-year duration were included. The exclusion criteria were children who had associated contractures of other body areas such as the neck, axilla and elbow.

The children were initially evaluated with history and thorough physical examination. Baseline investigations were performed to assess the general health of the children. The demographic profile of the children, anatomic areas of the hands affected by contractures, type of initial burn injury, type of reconstructive procedure instituted, survival or otherwise of the flaps and grafts employed for reconstruction, and recurrence of contracture at one year follow up were all recorded.

The children underwent the surgeries under general anesthesia after hospitalization. Each surgery was focused to achieve adequate release of the contracture; reconstruct the resultant defects with Z-platy, skin grafts or flaps; and to restore the normal mobility of the affected joints. Once the reconstructed wounds healed, rehabilitation was started. The rehabilitation measures included the use of massages and physiotherapy to restore range of motion. The primary outcome measure was the adequacy of contracture release and survival or take of the flaps and skin grafts whereas the secondary

outcome measure was the recurrence of contracture at one-year follow-up.

The skin graft take/ flap survival was considered Good when  $\geq 95\%$  of the skin graft or flap survived. It was regarded as Fair when 80%-95% of the skin graft or flap survived. It was declared Poor when  $< 80\%$  of the skin graft or flap survived. The functional outcome of contracture management was graded by using a quality grading system which documented the postoperative functional condition compared with the preoperative contracture status. The functional outcome was graded as Poor (when there was no improvement in function), Satisfactory (when there was modest improvement) and Excellent (when complete normal function or range of motion was restored).

Figures 1 through 8 show some illustrative cases of the PBCs included in the study.



Figure 1. These clinical photographs show the most common forms of postburn contractures of the hand and wrist observed among the children.



Figure 2. This clinical photograph shows a post-burn contracture of the right ring finger in a child aged four years. After complete release, reconstruction has been performed with full thickness skin graft (FTSGs).



Figure 3. This clinical photograph shows a post-burn contracture of the right middle and ring fingers in a child aged six years. After complete release, reconstruction has been performed with Z-plasties.



Figure 7. These clinical photographs show a characteristic fist hand deformity. Complete release of the contracture and coverage with full thickness skin graft (FTSGs) gave optimal functional and aesthetic results.



Figure 4. This clinical photograph shows severe post-burn contractures predominantly involving the dorsal aspects of the right little, ring and middle fingers in a child aged seven years. After complete release, a groin flap has been employed for reconstruction of the resultant defect.



Figure 8. These clinical photographs show a severe post-burn contracture involving of the palm and thenar area of the right hand in a girl aged 10 years. After complete release, reconstruction has been performed with full thickness skin grafts (FTSGs).



Figure 5. These clinical photographs show an 11 old child who presented with severe post-burn contracture of the right wrist. After complete release, reconstruction has been performed with grin flap.



Figure 6. These clinical photographs show the typical claw hand deformities. Such deformities were addressed with staged and serial reconstructive procedures. The first stage included excision of the scar and coverage groin flap. The second stage included release of the metacarpophalangeal joints (MCPJs) followed by aggressive physiotherapy starting in the immediate postoperative phase. For ensuring adequate release of the MCPJs, the collateral ligaments were released, joint capsulotomies were performed and the volar plate was released.

The data were analysed through Statistical package for social sciences version 22. Various descriptive statistics were used to calculate frequencies, percentages, means and standard deviation. The numerical data such as age of the patient was expressed as Mean  $\pm$  Standard deviation whereas the categorical data such as the anatomic locales affected were expressed as frequency and percentages.

## Results

Out of 177 children, 81.35% (n=114) were males and 18.64% (n=63) were females. The age ranged between 1-14 years. The mean age was  $4.51 \pm 3.79$  years.

The types of initial burn injuries included scalds in 101 (57.06%) children, flame burns in 59 (33.33%) children, electrical burns in 16 (9.03%) children, and chemical burns in 1 (0.56%) child.

Among the various anatomic areas of the hand affected by contractures, the commonest were the fingers and thumbs (n=80: 45.19%); followed by contractures of the first web space (n=23: 12.99%); wrist contractures (n=21: 11.86%); claw hand deformities (n=17: 9.60%); fist hand deformities (n=15: 8.47%); dorsal hand contractures (n=11: 6.21%); and post burn syndactyly (n=10: 5.64%). 37 (20.90%) children had contractures of more than one fingers.

All the children underwent the operative procedures under general anesthesia. The operative procedures entailed complete release of the contractures followed by reconstruction with skin grafts or flaps. The various reconstructive procedures performed alone or in various combinations included FTSG (n=91); Z-plasties (n=73); groin flaps (n=40); STSG (n=7); and abdominal and posterior interosseous flaps (n=3) each.

Marginal necrosis was observed in 2(4.34%) flaps whereas the remainder flaps (n=44: 95.65%) healed without any complications. Among the children with FTSGs/ STSGs, majority had good take (n=87; 88.7%) of the skin grafts. 10(10.20%) children had fair take whereas 1(1.02%) had poor take of the skin grafts. Functional outcome was satisfactory among (n=127; 71.75%) children, excellent among (n=47; 26.55%) children and poor among (n=3; 1.69%) children.

Recurrence of PBCs at one year follow up was recorded among 23 (12.99%) children. Majority (82.60%) of the children with recurrence were less than three years of age. No mortality was observed in our series.

## Discussion

Burn injuries continue to be endemic in the low-income countries like ours (Pakistan). Children are particularly vulnerable to sustain burns owing to their lack of conscious awareness and self-protection from dangerous situations that may result in burns. The low-income countries have a host of issues that lead to suboptimal management of such injuries. Resultantly these unfortunate children end up with disabling scarring and contracture formation.

In our study, hand contractures were more frequent among males than female children. Most of the published studies have reported similar predominant involvement of male children with hand contractures. Terziqi H et al<sup>11</sup> however; in their

pediatric series of post burn contractures from Kosovo reported almost equal share of both genders. i.e., 71 males (49.3%) and 73 females (50.7%).<sup>9-11</sup>

In our study, the mean age of the children was 4 and half years. Terziqi H et al<sup>11</sup> reported their patients to be aged between 9-216 months, with a mean age of 12 years.

Our study included only children with hand contractures. In the published literature, the hand has been reported to constitute the commonest site of contractures. Terziqi H et al<sup>11</sup> in their study included children with post burn contractures involving the upper limbs. They reported hands to be the most frequent anatomic site of affliction (68%), followed by elbows (18%), axilla (8%) and the wrist (6%).

In our study, we included children who had the post burn contractures of the hands for at least one year duration. As a general rule, the post-burn contractures which are still in their active phase of inflammation are better not operated. The reason for this conventional wisdom is that the immature scars and contractures are lush vascular and hence bleed more during their release and resurfacing. Additionally, there is an associated higher risk of recurrence if these immature contractures are operated. Generally, the scars and contractures become mature by the age of one year. Achauer et al<sup>12</sup> recommended that careful consideration should be exercised when deciding to operate upon the immature and active scars, keeping in mind the associated higher risk of recurrence. The published literature has highlighted certain exceptions to this rule of thumb of not operating on such immature contractures. Among these include severe post burn contractures involving the neck, incapacitating microstomia and severe contractures involving major joints.<sup>12-14</sup>

In our study, we observed favorable outcomes of managing most of the PBCs with Z-plasties and full thickness skin grafts (FTSGs). The published studies have reported similar favorable results with use of skin grafts and Z-plasties. For hand reconstruction, the FTSGs are preferred as these are associated with superior color and texture match. Also, there is lesser secondary contraction of these thick skin grafts. There are some issues with use of FTSGs too. For instance, large surface areas need larger grafts which may be challenging to harvest as the secondary defects of harvest sites may need coverage with split

thickness skin grafts (STSGs). Also sometimes there may be problems with the take of the thick skin grafts.<sup>5, 15-17</sup>

## Conclusion

Postburn contractures of the hands were more frequent among male children aged 1-5 years. Scalds were the commonest underlying cause of

these contractures. Z-plasties and full thickness skin grafts were the most commonly employed reconstructive tools. Majority of the children had successful contracture release and survival of the flaps and grafts employed for the reconstruction. Recurrence at one year was observed among 12.99% children.

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