Original Research Article

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Study of soft tissue reconstruction in postburn flexion contracture of the hand

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ABSTRACT

Background: Burn contracture of the hand can leave patients with severe functional and psychological limitations. This study evaluates the severity of the deformity and various reconstructive options in post-burn hand injuries.

Methods: This work includes the study of 50 patients who underwent reconstruction for post-burn flexion contracture of the hand, including fingers, in the department of plastic surgery. The patients were treated between April 2007 to April 2009.

Results: Males were more commonly affected by burn injuries and thermal burns were more common than electrical burns. The little finger showed higher involvement and contracture release followed by grafting was the commonly done reconstructive procedure.

Conclusions: Split thickness skin graft (SSG) were more effective in reconstruction in thermal injuries, while cross finger flaps (CFF) showed more promise in electrical injuries of the hand.

Keywords: Hand, Burn, Contractures, SSG, CFFs

INTRODUCTION

The hand, sometimes known as the third eye, is a highly specialized organ with several sensitive components. Every structural deficit in the hand results in a functional deformity, which impairs daily activities. Burns can be triggered by different sources. The most common sources that cause burns are thermal (fire/flame, scalds, hot objects), electrical, and chemical agents, respectively. Burns are the most prevalent cause of hand contractures. Burns involving the hand cause debilitating abnormalities that can limit daily activities. 1

The most distressing late consequences of burn damage are post-burn scarring and contracture that impedes function.³ Scar tissue that is tight and shorter characterizes these burn injuries. They can form over joints, limiting movement or causing deformity due to

their interaction with a movable anatomic component. Because these muscles usually are stronger and the flexed posture is often the most comfortable, they are more common on the flexor surfaces of the hand.⁴

The aim of timely treatment of hand burns is not only to restore function but also to provide improvement in aesthetic outcomes. Priority is always given to resuscitation measures and patient survival in serious burns, followed by skin cover. In the secondary phase, the deformity in hand is addressed. The inability to seek prompt medical attention, insufficient therapy, and healing by secondary intention is the main causes of postburn contractures. Post-burn abnormalities of the hand are both visually and functionally debilitating to the sufferer. Regardless of the initial treatment procedure, they will occur at a specific rate and treatment must be immediate and planned.⁵

With a hand burn, delicately balanced musculotendinous systems, the thin and highly mobile dorsal skin and the sensory-rich palmar skin, are all at danger.⁶

When contractures or scarring affect the dominant hand, as they usually do, the patient's vocation and, as a result, their financial situation suffers. Appropriate procedure selection and surgical timing, followed by supervised rehabilitation, can be a lifesaver for a burn's survivor.⁷

Serial clinical evaluation by a plastic surgeon remains the gold standard for identifying the severity of a hand burn injury. Burns of the first and second degree heal nicely in about two weeks, with satisfactory functional and aesthetic outcomes. Deep second-degree (partial-thickness), third-degree (full-thickness), and fourth-degree (tendon, bone, nerve, or joint involvement) burns heal slowly, leave scars, and may require operational debridement and wound covering surgeries.⁹

For the treatment of post-burn hand abnormalities, a range of therapeutic procedures have been documented, including skin grafting, Z-plasties, local flaps, regional flaps, island flaps, and free flaps. Each method has its own set of benefits and cons. It is critical to evaluate the effectiveness of various procedures in terms of functional recovery and cosmetic improvement.⁸

Soft tissue coverage is a major challenge for burn contracture. Assessment of the diffuse area, depth, underlying structures affected, joint status and functional morbidity is a major complex diagnostic goal to get a better outcome with precise planning. Sometimes the extent of release to get a good outcome is very important. Sometimes it is necessary not to release the whole contracture to anatomical position because it can cause unnecessary exposure of vital structures and damage of structures is a possibility. To avoid this, the plastic surgeon should release the contracture to the suboptimal situation without exposure of the structures, adequate soft tissue cover should be given coupled with good physiotherapy, complete release and good function outcome is a possibility.

Aim of the study

The present study is focused on evaluating different kinds of post-burn hand injuries and the success of the soft tissue reconstruction achieved through the different surgical procedures employed for treatment of post-burn contractures of the hand.

METHODS

This prospective study included patients with post-burn hand contracture admitted to the Department of Plastic Surgery of our Hospital from April 2007 to April 2009. A total of 50 patients of both genders with post-burn hand contractures of all ages that required surgical correction were included in the study. Simple random sampling

method was used. Those patients not willing for surgery, physiotherapy and follow up were excluded from the study. Patients with evidence of involvement of the bone and or joint were also excluded from the study.

A complete burn history of the patients comprising the source of burn (thermal and electrical), area of the hand involved, fingers involved, the surgical procedure employed, and the flap used for the soft tissue reconstruction was recorded for each patient.

All patients are clinically evaluated for contracture site and kind, as well as a range of motion restriction, and are categorized into 4 severity classifications by McCauley;

Grade 1: Symptomatic tightness but no limitation in range of motion, normal architecture.

Grade II: Mild decrease in range of motion without significant impact on activities of daily living, no distortion of normal architecture.

Grade III: Functional deficit noted, with early changes in normal architecture of hand.

Grade IV: Loss of hand function with significant distortion of the normal architecture of the hand

Each written informed consent was obtained from the participants about the procedure.

All data were recorded and analysed.

RESULTS

In our study of 50 patients, the highest incidence of burns was seen in the age group of 12-24 years, with a higher prevalence in males, as shown in Figure 1.

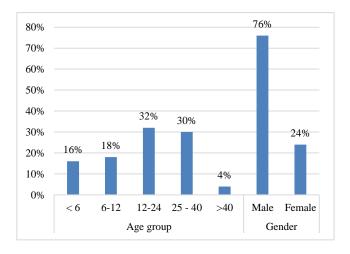


Figure 1: Distribution of age group and gender

Thermal burns more common than electrical burns. The involvement of a single finger was observed to be more prevalent than involvement of other structures (Figure 2).

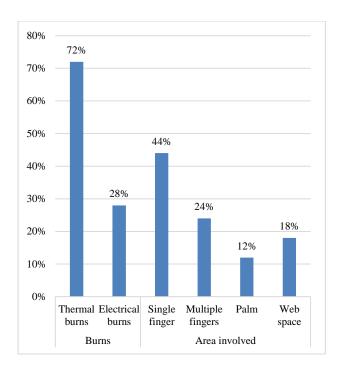


Figure 2: Source of burns and area of hand involved in burn.

When individual fingers were considered, the little finger was damaged in more than $1/3^{\rm rd}$ of the instances (Figure 3).

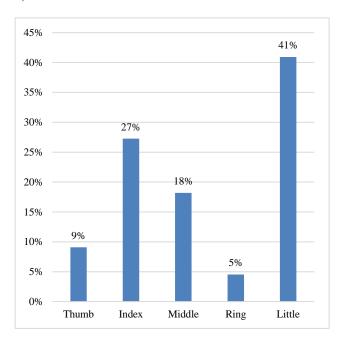


Figure 3: Segregation among single fingers.

Contracture release followed by skin grafting was the most common procedure done for reconstruction.

The SSG was done in 35% of the cases, full-thickness skin graft in 5%, and CFF in 7% of the cases. Multiple Z-plasty, web release, instep grafts and distant flaps were other procedures done as seen in Figure 4.

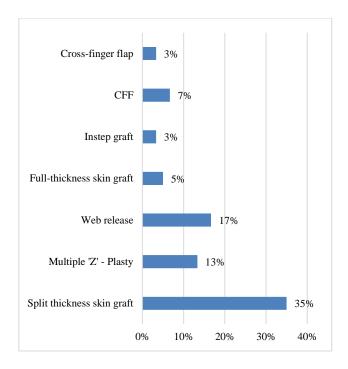


Figure 4: Procedures done.

Electrical burns (n=14) were treated with different kinds of flaps. The most common is CFF, recorded in the Figure 5.

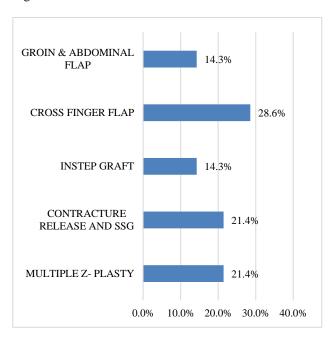


Figure 5: Procedures performed in electric burn injury.

The linear contracture to diffuse contracture ratio was 1:3, as seen in Figure 6.

Based on Macauley's severity grade,70% cases came under grade I followed by grade II and the least number of cases were reported under the grade III category, as we see below in Figure 7.

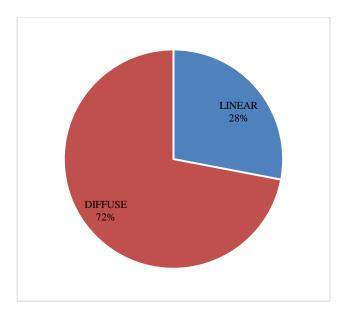


Figure 6: Linear and diffuse contracture.

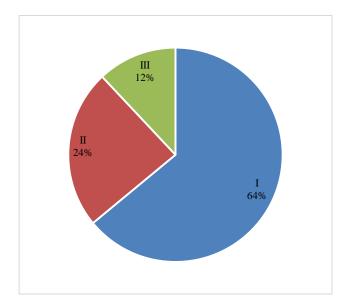


Figure 7: Macauley's severity grade.

DISCUSSION

The hands make up less than 5% of total body surface area, but their loss results in a 57% loss of function for the entire person. In the present study comprising 50 patients, participants between 12-24 years were most commonly affected, with a higher prevalence in males. This study reflects susceptibility to burns and deformities following burns in young adult males.

Thermal burns incidence was approximately 3 times more than electrical burns. The severity of a deformity in the hands caused by a thermal injury is determined by the depth of the burn. If the burn is superficial, it is reported that 97% of patients regain normal hand function, however only 81% of patients with extensive burns regain normal function.⁵

The involvement of a single finger, particularly the little finger, was the highest of all fingers involved with burn injuries. This is due to the little finger's flexed position compared to the other fingers. In the defensive position of the hand, the little finger is the most exposed digit and is more prone to circumferential burns than the other fingers. Because of its high healing capacity, palmar involvement was the least. Additional layers of protection for the flexor tendons and digital neurovascular bundles are provided by the palmar fascia and fibrous septae. Deep palmar burns take longer to epithelize than superficial burns, but have less scarring and contractures. ^{13,14}

Linear contractures were less common than diffuse contractures. It depicts the degree of lateral tissue deficiency that necessitates the insertion of extra skin that could come in the form of SSG or flaps.¹²

Z plastic release was frequently used to treat linear contractures, with SSG being the most prevalent surgery followed by multiple Z plasty. It depicts the nature and severity of the abnormality. Due to deeper tissue involvement resulting in tendon or bone exposure, post-electric burns sequel release frequently needs flap cover. Flaps are frequently utilised to alleviate contractures caused by electrical burns. Deep tissue involvement is unusual in thermal burns. Grade I contracture is the most prevalent type, and in most cases, multiple Z plasty or release, as well as SSG, would suffice. 12

Grade I contractures were the most common in our research. The grading system is useful since it combines anatomical and functional deficit. This provides a highly effective means of assessing hand contracture and can aid in the prediction of post-surgery prognosis. Relapse is a serious and common complication following contracture relief.¹⁵

In the majority of the instances in this study, SSGs were used. Early debridement and SSG covering of hand burns has been demonstrated to have significantly better outcomes than delayed coverage in recent trials. Early coverage has been shown to offer several major benefits, including preventing the progression of burn injuries by preventing tissue conversion from the stasis zone to the coagulation zone. It reduces wound infection by necrotic tissue, reduces soft eliminating desiccation, and allows for early mobilisation. SSG is a tried-and-true method of covering hand burns. Excellent functional recovery has been frequently achieved when combined with tangential excision of the burn site. SSGs have the benefit of being easily available in the majority of burn patients and providing definitive skin covering as an autologous tissue. 16

Abdominal and Groin flaps found limited use in this study. Abdominal flap and groin flaps serve as reliable donor area sources for flap coverage of hand defects but carry a limitation of prolonged immobilization. ¹⁸

In our research, we mostly used a CFF for electrical injury restoration. The CFF was initially described by Gurdin and Pangman. The CFF harvested from the dorsal aspect of the neighbouring finger is traditionally used to cover deformities on the volar aspect of the finger, in the position of the middle phalanx or the distal phalanx. Although adjacent fingers can be utilised as donor fingers for the CFF, if the middle finger has a defect, the flap can be harvested from the ring or index finger. It is customary to avoid harvesting a flap from the index finger since scarring on the index finger is undesirable. ¹⁷

CONCLUSION

Considering burns are a life-threatening and disfiguring injury, the priority is to save the patient's life, and then the patient's aesthetic concerns are addressed. In this situation, the hands are frequently overlooked. No other post-burn deformity worsens over time like the hand. Therefore, time is crucial for functional rehabilitation. As a result, the hand must come first when scheduling corrective procedures, even if the patient requests repair of facial and other aesthetic defects first. Rehabilitation of the burned hand is challenging but vital in minimizing functional deficits.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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