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Original Research Article

Post burn flexion contracture of hand: a prospective study

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ABSTRACT

Background: Burn contracture of the hand can cause severe functional and psychological deprivement in patients. This study mainly concentrates on different types of hand deformity cases presenting to our department and the various options used to correct them. The postoperative functional outcome is also compared so that standardization of procedures can be done. This study assesses the severity of the deformity, the success of various reconstruction options and the functional outcomes of cosmetic procedures.
Methods: This work includes the study of 60 patients who underwent reconstruction for post-burn flexion contracture of the hand including fingers, in the department of plastic surgery, Government Rajaji Hospital, Madurai. The patients were treated between September 2009 to February 2012.
Results: Males were twice commonly affected by burn injuries and thermal burns were more common than electrical burns. The little finger was more frequently involved and contracture release followed by grafting was the commonly done reconstructive procedure. Complications like recurrence, residual contracture, partial graft loss and infection were noted.
Conclusions: Contracture release by multiple Z–plasty with or without skin grafting was sufficient in most cases of contracture due to thermal burns. Flaps were required for reconstructing electrical burns. Complication rates are higher in children than in adults and postoperative physiotherapy and splinting is mandatory to achieve a better functional outcome.

Keywords: Burns, Contracture, Flexion, PIP, Z-plasty, Split skin graft, Full thickness graft

INTRODUCTION

The hand is a highly specialized organ, described as the third eye with many delicate structures. The deficiency of every structure in hand causes a functional deformity, which leads to impairment of routine activities. Burns are the most common causes of hand contractures. In hand, burns produce crippling deformities which can restrict the activities of daily living.[1] In major burns, priority is always given for resuscitation measures and patient survival followed by skin cover. The deformity occurring in hand is dealt with in the secondary phase.

The main causes of post-burn contractures are the failure to seek timely medical attention, inadequate treatment, and healing by secondary intention. Post-burn deformities of the hand serve as a constant visual stigma to the patient and are functionally limiting. They will occur at a certain rate irrespective of the initial treatment method. Sheridan and colleagues have reported their experience with 698 hand burns in children.[2] Those treated with dressing changes during the initial burn eventually developed contractures that required surgical correction in 4.4% of cases. Among the patients who required grafting during their initial burn care, 32% developed

contractures and required subsequent follow-up surgery. The severity of a burn contracture depends on factors like the location and the depth of the burn, the time of surgical or nonsurgical treatment, post-injury splinting, hand therapy and scar care during the maturation process.[3] McCauley designed a severity rating for burn contractures of the hand by grading them I to IV.[4,5] Grade 1 and 2 contractures can be managed with typical therapy while grade III and IV contractures are further subcategorized as flexion, extension and mixed deformities. Severe contractures require more complex reconstruction and good functional outcomes have been achieved in even grade IV contractures.[5]

Apart from releasing the contracted skin and giving suitable coverage to the soft-tissue defect, the surgeon must also address the secondary changes to the musculotendinous unit, ligaments, and joints so as to provide a patient with the best functional outcome.[6,7] Although surgical treatment presents unique challenges, functional improvement and patient satisfaction remain high after these operations. The functional outcome of deformity correction is less encouraging and often depends upon the severity of hand burns. So this study mainly concentrates on different types of hand deformity cases presenting to our department and various options used to correct them. The postoperative functional outcome is also compared so that standardization of procedures can be done.

The main of this study is to:

1. To assess the severity of the deformity.
2. To study the appropriate reconstructive options for post-burn flexion contracture of the hand including fingers.
3. To assess the result as per success of reconstruction, options chosen and performed with donor site morbidity.
4. To study the functional and cosmetic outcomes of different procedures.

METHODS

This work includes the study of 60 patients who underwent reconstruction for post-burn flexion contracture of the hand including fingers, in the department of Plastic surgery, Government Rajaji Hospital, Madurai. The patients were treated between September 2009 to February 2012. The methods include obtaining history from patients, thorough clinical examination and necessary investigations and appropriate surgical reconstruction. Intraoperative, postoperative complications were noted and managed accordingly. Patients were advised regarding rehabilitation and advised for regular follow up. The patients were followed up every week for two months and then monthly for a period of six months. The maximum follows up was for a period of 6 months. All information was entered in a proforma specially designed for this study.

The patient's name, age, sex, history of presenting illness and its duration was obtained. Past history of chronic medical and surgical illness was noted. Personal history like smoking, alcohol consumption and diet pattern was obtained. Detailed physical examination of flexion contracture of the hand including fingers was recorded and reconstruction planned accordingly.

Extension contracture of the hand including fingers were excluded from the study. Basic investigations like blood Hb estimation, urine examination, blood sugar and renal parameters like urea, creatinine were done. X-ray chest, X-ray of the local part and ECG were taken. All the patients were informed about the surgical procedures, the intraoperative, postoperative complications and rehabilitation. A detailed informed written consent regarding the procedure and its complications were obtained. Patients were operated under general or regional anesthesia.

RESULTS

In our study of 60 patients, children aged <12 years were most commonly affected. Males were twice more commonly affected than females and the proportion of difference peaks towards males when electrical burns are concerned (M:F=4:1). Thermal burns were common than Electrical burns with a ratio of 3:1. Isolated single finger involvement is more common than other injuries. The little finger was affected in more than one-third of the cases when individual fingers were considered. Isolated ring finger involvement was not encountered but seen in multiple finger injury. Contracture release followed by skin grafting was the most common procedure done for reconstruction. Flaps were done in only 8 out of 60 cases (13.3%). The split skin graft was done in 41% of the cases, full thickness skin graft in 7% of the cases and cross finger flap in 8% of the cases. Multiple Z-plasty, web release, instep grafts and distant flaps were the other procedures done.

Table 1: Age group (n=60).

Sl. no.	Age group (in years)	No. of cases	%
1	< 6	18	30
2	6-12	7	12
3	12-24	15	25
4	25 - 40	17	28
5	>40	3	5

Table 2: Sex incidence (n=60).

Sl. no.	Sex	No. of cases	%
1	Male	42	70
2	Female	18	30

In PIP (proximal interphalangeal) joint contracture, grade I deformity accounts for more than 60% of cases and

grade III is least. The ratio of linear vs diffuse contracture was 1:3. Flaps were most commonly used in electrical burns. Grafts accounts for <35% of the procedures performed and children accounted for 75% of recurrence. The complications observed in this case series were recurrence (4 cases), residual contracture (3 cases), partial graft loss (5 cases) and infection (2 cases). Flap dehiscence was not seen in any of the patients in this study.

Table 3: Area involved (n=60).

Sl. no.	Area	No. of cases	%
1	Single finger	25	42
2	Multiple fingers	20	33
3	Palm	5	17
4	Web space	10	8

Table 4: Segregation among single fingers (n=25).

Sl. no.	Segregation	No. of cases	%
1	Thumb	2	8
2	Index	7	28
3	Middle	5	20
4	Ring	0	0
5	Little	11	44

Table 5: Procedures done (n=60).

Sl. no.	Procedure	No. of cases	%
1	SSG	25	41
2	Multiple 'Z'-plasty	10	17
3	Web release	10	17
4	FTSG*	4	7
5	Instep graft	3	5
6	CFF**	5	8
7	Distant flaps	3	5

*FTSG: Full-thickness skin graft; **CFF: cross-finger flap.

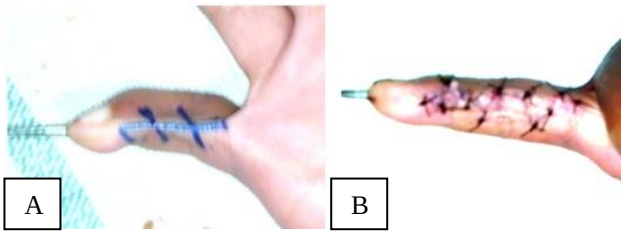

Figure 1 (A and B): Child–multiple Z–plasty.

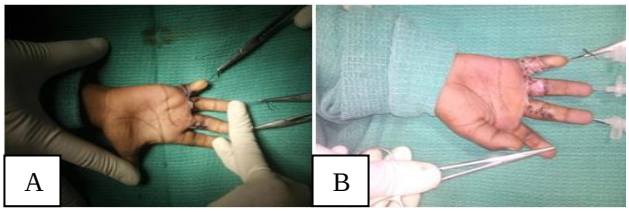

Figure 2 (A and B): Instep graft.

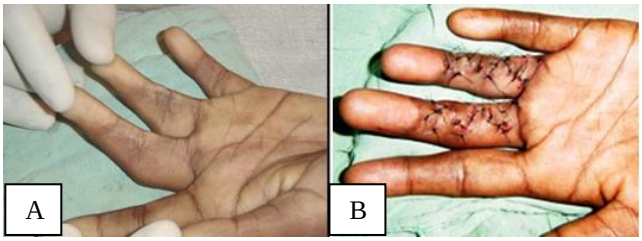

Figure 3 (A and B): Multiple Z–plasty–multiple fingers.

Figure 4 (A and B): Cross finger flap–adjacent fingers.

Figure 5 (A-D): Five flap Z-plasty, 1st web release.

DISCUSSION

Hand contracture after deep hand burns is a common event in everyday practice, in spite of the better treatment available, the early initiation of physiotherapy procedures and the early surgical management of deep burns.[8] Surgery was conducted in 60 patients in our study under regional or general anaesthesia and the incision was irregularly depending upon the contracture. The effort was made to save as much of the unburned tissue because it is irreplaceable by any kind of graft.[9,10]

In our study of 60 patients children aged <12 years were more commonly affected involving about 42%, indicating their vulnerability to burns and post burns deformity. Males were twice commonly affected than females and the proportion of difference peaks towards males when electrical burns were concerned (m:f=4:1). Thermal burns were more common than electrical burns in the ratio of 3:1. In Electrical burns males were affected more than females indicating their nature of work. Isolated web space involvement was not seen but its involvement was encountered along with other fingers injury**.**

The little finger was affected in more than one-third of cases, probably due to the more flexed position of the little finger than other fingers. It is the most exposed finger in the protective posture of the hand and most often suffers circumferential burns than the other fingers. Palmar involvement was present along with multiple fingers involvement, but the incidence of the deformity was less because of the good healing capacity of palm. The palmar fascia and fibrous septae provide additional layers that protect the flexor tendons and digital neurovascular bundles. Deep palmar burns take more than 3 weeks to epithelize but have comparatively mild scarring and contracture[11,12]. Diffuse contractures were more common than linear variety. It shows the amount of lateral tissue shortage needing additional skin supplements which may be provided in the form of SSG or Flaps.

Linear contractures were often served by Z-plastic release and SSG was the most common procedure done followed by Multiple Z plasty. It reflects the nature and type of deformity encountered. Post electric burns sequel release often needs flap cover due to deeper tissue involvement resulting in tendon or skeletal exposure. Flaps are commonly used in contracture release due to electrical burns. In thermal burns deep tissue involvement is uncommon. Grade-I contracture is most commonly encountered for which multiple Z plasty or release and SSG would be adequate in most cases.

K–wire stabilization was used in grade–II and grade–III PIP joint contractures. Buchan reported his experience with thermoplastic splints in a study as early as 1975.[13] Although no objective outcome data were reported with splinting, they were advocated as an early treatment to patients by most physicians for the prevention of contracture.[14-16] It is imperative that patients are kept to a strict regimen of splinting and therapy. Delayed or missed splinting periods will increase the likelihood of developing a contracture.

The recurrence rate is high in children than adults who had undergone release and skin grafting. In children the normal posture of hand is more flexed when compared to adults. The post-op splinting and physiotherapy was very difficult and their compliance was poor. Brown and colleagues found in a study of 953 pediatric burns that contact burns of the palm and volar fingers were most frequent injuries to the hand. Burned or grafted skin does not expand and grow in the same plasticity as that of normal skin.[17] It is common that a child who is initially asymptomatic may later develop a function-limiting contracture. Furthermore, children with an early age burn injury might require multiple procedures over their lifetime. Prolonged skin contracture can also cause deformities to develop bones and joints, that further leads to a more complicated surgical correction.[18]

Instep graft provides better cosmetic appearance than split skin grafts from other areas. But the rate of secondary contracture of instep graft could not be assessed since the sample size is less.

Infection occurred in 2 cases were managed with antibiotics and daily dressings. Partial graft loss which occurred in 5 cases was managed conservatively. Residual contracture occurred more commonly at DIP joint level and the contracture angle is 10–15 degrees which were functionally acceptable. These patients refused further correction. Stern and his colleagues in their study reported that 88% of surgically treated flexion contractures had less than 20° of residual contracture. They also found that older patients and those with more severe contractures had poorer outcomes.[19,20]

Patients with Thermal burns who underwent reconstruction with release and grafting followed by splinting and physiotherapy had a better functional and cosmetic outcome. Soft tissue splints with 18 G venflon was found to be very useful for joint immobilization in children. It was removed once graft settled well by the second week. Postoperatively patients were advised regarding splinting and physiotherapy.

One of the major determinants of quality of life in burns survivors is the function of the hand. Post-burn contracture of the hand can produce a significant impact on the quality of life by reducing the patient's ability to perform activities of daily living. Reconstructive procedures can greatly improve the function of hands.

CONCLUSION

In our study it was found that the claw deformity of hand was more common and in that Grade–I PIP joint flexion contractures were common. Contracture release by multiple Z–plasty with or without skin grafting was sufficient in most cases of contracture due to thermal burns. Flaps were generally required for reconstructing contracture due to electrical burns. Patients who had undergone contracture release & SSG and multiple Z-plasty followed with regular physiotherapy and splinting had very good functional recovery. Complication rates were higher in children who had undergone release and SSG. Hence flaps were ideal for children than SSG. Instep graft provides the best cosmetic appearance and it should be used whenever the required area is minimal.

Proper post-surgical physiotherapy and splinting were essential in achieving a good functional outcome.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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