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Comparison of FTSG & STSG in Post Burn Flexion Contracture of Digits in Pediatric Age Group

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Abstract: Post burn scarring of the hand in children mostly leads to flexion contracture involving the digits. The mainstay of management is release of fibrotic band with either STSG or FTG cover. Children of age (1-10yrs) with Mc Cauleys grade 3A & 4A were planned to undergo release of contracture with K wire fixation and graft cover. Children with single finger involvement were given FTG while rest of cases had combination of FTG and STSG. Significant rates of graft failure were found in the FTG group while the STSG group had higher rates of secondary contracture. In cases of flexion contractures in more than 3 fingers it is better to perform a STSG and follow a strict splinting protocol. If secondary contracture occurs it can be managed by FTG. For single fingers it is better to perform a FTG in the first setting itself.
Keywords: Burn, Contracture, Digits, Pediatric

INTRODUCTION

The hands account for less than 5% of total body surface area [1], but loss of the hand constitutes a 57% loss of function for the whole person [2,3].

This is why post burn scarring and contracture affecting function of the hands adds a great amount to the handicap of the patient. Adding to this the rapid developmental growth in children and we have a problem that needs early surgical intervention so that the chid can develop normal function. Failure to seek medical help, inadequate medical care and inadequate post-healing care are common causes of burn contractures [4].

Most of the cases of pediatric post burn contractures of the hand presenting to our institute were flexion contractures involving the digits. A plausible reason could be the inquisitve and curious nature of children which leads them to grasp objects which result in thermal or electrical burn injuries

The mainstays of management of these contractures include complete surgical release of fibrotic bands and resurfacing of the resultant soft tissue defect with full-thickness or split thickness skin grafts [5].

The objective of this study is to compare rates of Graft failure of STSG & FTG in Post Operative period following release of contracture and to compare rates of secondary contracture between cases of FTG & STSG in the follow up period

METHOD

All pediatric patients (age group 1 to 10 years) admitted with Post Burn Flexion contractures of the IP joints of the hand were assessed from Jan 2013 to Jan 2016.

On Admission the children were graded according to Mc Cauleys Classification of Burn Severity [6].

Grade I 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 normal architecture of the hand.

Subset classification for Grade III and Grade IV contracture:

- Flexion contractures

- Extension contractures
- Combination of flexion and extension contractures.

Children with Grade 3A & 4A with broad scars were planned to undergo Release of contracture with grafting over the defect along with K wire fixation of the fingers [7].

FTG's were harvested preferentially from the wrist crease and from lateral part of inguinal region. STSG's in all cases were harvested from the thighs of the patient

Graft fixation was done with the vicryl 4-0 sutures and fibrin tissue glue (Tisseel). A thin layer of the slow clotting variant was applied by dripping it over the defect site followed by graft placement. This was followed by additional fixation of the graft at the peripheries by using vicryl 4-0 sutures.

The patients were given a bolus dressing intraoperatively which was removed after 7 days. Patients received 2 subsequent dressings at interval of 2 days in the department before discharge.

Patient was discharged only if >50% of the graft survived otherwise grafting was done again. K wires were removed after 3 weeks and extension splint was given to all patients thereafter.

After removal of K wire day and night splintage for 4 weeks followed by night splinting for 6 weeks was applied. Decision for repeat surgery is taken after 3 months after completion of post op protocol.

In the follow up if the patient presents with a secondary contracture of grade 3A then another release of contracture was advised.

Post Surgical Analysis was done by analyzing the number of cases having graft failures & number of patients requiring release of contractures more than once.

RESULTS

74 males and 41 females were assessed and type of burn injury causing contracture was recorded.

Table-1: Mode of Injury

Electrical Burn	Contact	Flame
67	36	12

Table-2: Number of digits and treatment received

Fingers Involved	Cases	STSG	FTG
1	21	0	21
2	32	23	09
3 or more	62	52	10

Of the 115 patients admitted 84 patients of grade 3a and 31 patients of grade 4a were operated. A large number of grade 4a contractures group comprised of electrical burn injury followed by flame burn and then contact injury. The higher severity of burns caused by electrical current also increases the severity of contracture as deeper tissues are affected.

75 patients were given STSG and 40 cases required FTG cover. Of the STSG group 15 patients needed grafting again while 20 cases in FTG required regrafting before discharge. All cases of single finger contractures that we received were grade 3 contractures so all were given a FTG.

The graft failure rate was significantly higher in the FTG group as compared to the STSG (fischer Exact T test shows a value of less than 0.01).

Table-3: Failure and Uptake of FTG & STSG

	Graft Failure	Successful Uptake	Total
STSG	15	60	75
FTG	20	20	40
	35	80	115

Fig-1: Grade 3 contractures

Fig-2: Grade 4 Contracture

On further analysis of the FTG group we found that a significantly higher number of graft failures occurred in the grade 4a contractures. We found that of the 16 digits that were of the grade 4a group only 2 had a succesful graft uptake while the graft uptake of the FTG in the grade 3a digits was more succesful.

Table 3 Results of FTG uptake with respect to severity of contracture.

On analysing the number of recontractures we found that of the 75 patients who were given STSG cover 28 presented with secondary contracture and 7 of the FTG group presented with secondary contracture which required another sugery.

Table-4: Secondary contracture in FTG & STSG

	Secondary contracture	No Recurrence	Total
STSG	28	47	75
FTG	7	33	40
	35	80	115

There was a significant reduction in the number of cases presenting with recurrence of contracture in the FTG group ($p<0.01$ Chi Square Test) as compared to those patients receiving STSG. We also analyzed if the grade of severity of contractures was having an effect on the occurrence of recontractures but found no stastically significant difference between the rates of secondary contractures occuring in those grade 3 patients who received STSG and grade 4 patients who received STSG. We think these points towards the significant role that the splinting regime plays during the follow up period of the patient. The ability to make the guardians of the children understand the importance of these splints will eventually pay off in better results for the patients

DISCUSSION

The presence of burn contractures is inversely proportional to the standards of initial treatment, with patients receiving best of care having minimum number and severity of these problems. But sometimes it is also negligence of these injuries in the face of the much bigger problems that these patients face such as an accompanying large burn area elsewhere on the body or the presence of inhalational injuries which leave the patient immobilized for long periods of time

An understanding of the burn wound healing is fundamental not only to the management of the acute burn wound, but also for the prevention, minimisation and treatment of post-burn scars and scar contractures.

The healing of a burn wound is accomplished either by *restitution* (complete regeneration) or *substitution*. Restitution is possible only if the skin is burnt as deep as the stratum papillare and all the specialised cells of the organ are preserved, which is only possible in superficial burns. The epithelial cells, in these cases, are derived from the epithelial appendages such as sweat glands in the central portion and wound edges at the periphery. The sequences of cellular events that comprise epithelialisation include cellular detachment, migration, proliferation and differentiation.

If the skin is affected deeper in the zone of stratum reticulare, as in the cases of second degree burns then the defect is covered by substitutive unspecialised connective tissue. The final result is demonstrated by a lesser or more extensive formation of the cicatrix. With full thickness loss of skin, wound contraction and epithelialisation from the margins occurs leading to contractures.

Contraction is an active biological process by which an area of skin loss in an open wound is decreased due to concentric reduction in the size of the wound. The reduction in size of wound causes lesser degree of connective tissue deposition and the amount of epithelialisation needed is decreased. Wound contraction involves an interaction of fibroblasts, myofibroblasts and collagen deposition and is a satisfactory mechanism when the tissue loss is small, in a non-critical area and surrounded by loose skin.

Scar contracture, on the other hand, is the end result of the process of contraction where because of a large tissue defect a larger quantity of collagen deposition occurs. When this process occurs across the joint lines it will lead to joint contractures

Planning relaease of joint contractures involves assesment of scar maturity.Mature scars asre soft supple and avascular and their release is much easier and chances of graft survival better. But severe hand contractures such as grade 3 / 4 need immidiate intervention. Some of our patients with multiple finger involvements presented with immature scars which were released immidiately and grafted. Most of the patients with multiple finger involvement had large burns on other parts of the body as well. This is why the donor areas have to be managed appropriately as other vital areas are planned for contracture release in the same sitting as well. Such areas are usually ectropion of the lower eyelids, severe neck contractures, and popliteal contractures. The main problem with operating on an active, highly vascular scar is that the wound bed is already in a phase of contraction and local tissue response due to trauma of surgery will only enhance the phase of contraction leading to further contractures

In our study we found a significant increase in graft failure in the FTG group as compared to the STSG even though a majority of the STSG group patients had more than 3 fingers involved while majority of the FTG group had only single finger involvement. Most of our patients presented with mature scars with contractures after a period of 6 to 8 weeks following injury. A possible reason for graft failure could be the decreased blood supply as the vessels are under strain when the finger is extended and fixed with K wire [8]. The nutritional requirement of the FTG is more than STSG so this is the reason why we had a higher incidence of FTG failure. The higher nutrituion and more exacting demands of the FTG are highlighted in the case of acute burns of pediatric fingers. Here again the FTG shows poor uptake in the wound bed as there is large edema and severe inflamatoru infiltrate in the wound bed [12-14].

Another factor could be that following the removal of bolus dressings in these patients the grafts are exposed to a greater shear force as the children do not make very compliant patients.

Our follow up of the patients over a period of 6 months revealed that the incidence of secondary contracture was higher in the STSG group of patients. The fact that some of the STSG group patients had received fgraft placement on an immature scar bed could play an important role in the presence of high rate of recontractures. A study by Chandrasegaram MD & Harvey J revealed a 27% incidence of contractures with SSG and 2% with FTG($P < 0.001$) on review of 174 cases which were followed up for 10 years.

Contracture formation is common after STSG in pediatric hand burns because of the properties of the graft, the growth of the child, and proximity to joints [13, 14]. The follow up period in our study was not long enough to evaluate the rates of secondary contracture due to phalangeal growth as the fusion of the epiphyses of phalanx occurs by 14- 16 years of age [15].

An important factor in children is the lack of compliance in adhering to the splinting regime after the removal of K wires. If strict splinting regime is followed a better functional outcome is possible even with the STSG grafts. Prasentyono *et al*. [16] also made a similar observation after their review which says that currently, there is no strong, high-quality evidence to prove that FTSG is superior to STSG to cover pediatric palmar burns. Either FTSG or STSG can be utilized with consideration of several influential factors especially splinting and physiotherapy

CONCLUSION

In case of release of grade 3 contractures the FTG seem to perform well and would be a good choice. But for Grade4 contractures especially of multiple

fingers with burns in other parts of the body it would definitely be better to proceed with STSG cover of the defect to protect the limited sites of the FTG. Even if we get a case of isolated hand burn with grade 4 contracture (where plenty of donor site is available for FTG) it is advisable to go with STSG in the first setting as the graft take rates are better, therefore patient can be started with hand rehabilitation exercises earlier. After all it is restoration of function to the hand that must always be of importance.

For pediatric hand burns with immature scars it would be better to use FTG cover considering the increased risk in these cases of recontracture. Still the most important role in preventing recontracture would still be a strict adherence to post op splinting and a proper counselling of the parents / guardians of the patient.

Finally it should be mentioned that if a good aesthetic result is needed then the FTG harvested from the wrist crease and lateral inguinal area are the best options as compared to the the STSG harvested from the thigh.

Fig-3: Better colour match with FTG as compared to hyperpigmented STSG

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