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Original Research Article

Management of hand burns using tangential excision and grafting versus delayed excision and grafting

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ABSTRACT

Background: A burn injury to the hand, whether in isolation or associated with a major systemic burn injury, continues to be a challenge to the treating surgeon, as correct clinical judgment and decision regarding management thereof can affect the final outcome both aesthetically and functionally.
Methods: A total of 84 patients (140 hands) were covered under the study, bilateral hand involvement in 56 patients (80% of hands) and unilateral involvement in 28 patients (20% of hands). Each group had 42 patients each. All patients were admitted to the hospital within 48-96 hours of the injury and operated within 3-7 post injury day.
Results: The skin graft take was much superior in the early excision group as compared to delayed excision group and hence resulted in decreased overall hospital stay. The functional and aesthetic outcomes were better achieved with less need of secondary surgical procedures. There were no major complications. Patients were followed up for a period ranging from six to twenty four months.
Conclusions: The skin graft take was much superior in early excision group as compared to delayed group and hence resulted in decreased overall hospital stay. The functional and aesthetic outcomes were better achieved and the needs for secondary surgical revision were far lesser with early excision and grafting. Both early excision and grafting, and delayed excision and grafting modalities lead to post-burn deformities of hand, albeit different from each other, but more common with delayed grafting.

Keywords: Delayed excision, Hand, Tangential excision, Thermal burns

INTRODUCTION

With the ever improving burn care the world over, the frontier has shifted from improving rate of survival to improving quality of life following injury. The questions we now face are how best to prevent the horrific scarring that has classically been associated with burns and to preserve function. Both these questions are more evident in the care of the burned hand than in burns over other parts of the body.[1-3] Our hands are so instrumental in maintaining one's independence that even simple tasks take on a new level of complexity with hand disabilities.[4,5] A burn injury to the hand, whether in isolation or associated with a major systemic burn injury, continues to be a challenge to the treating surgeon, as correct clinical judgment and decision regarding management thereof can affect the final outcome both aesthetically and functionally.[6,7] Hands are frequently affected by serious and deep burns, more often located on the dorsum. Even though the total surface area of the hands is small, due to the functional and social role of the hands, a rapid and satisfactory functional recovery along with a good aesthetic outcome is crucial.[8,9] Objectives of the study to compare and study the management of hand burns using tangential excision and grafting, and delayed grafting in terms of;

- Functional outcome,
- Aesthetic outcome,
- Requirement of a secondary procedure for either functional improvement or aesthetic improvement.

METHODS

Study area

The patients referred/transferred from peripheral hospitals or directly admitted to the Burn Centre of Command Hospital, Western Command, of Indian Army. The Burn Centre of the hospital is a 20-bedded unit with an independent Operation Theatre.

Study population

All patients with indeterminate, deep-partial or full thickness burns of hand below 70% total body surface area (TBSA) burns, admitted to the Burns Centre between Jan 2015 to Dec 2016 were included in the study. Patients with 'indeterminate' hand burns who healed completely by the end of three weeks were excluded from the study. Patients with poor general condition or with poor initial resuscitation when referred from peripheral hospitals and burns of more than 70% TBSA were excluded from the study. Patients who were lost to follow up or where follow up period was less than six months were also excluded from the study.

Sample size and sample technique

A total of 332 patients were admitted to the Burns Centre during the study period. Out of these 104 patients had partial- and full-thickness burns of the hands, mostly over the dorsal aspect. Patients were randomized into two groups based on age profile, mode of injury, extent of burns and the time lag in reporting to this centre. The two groups were an early tangential excision and grafting group (Group I) (Figure 1, 2 and 3) and delayed excision and grafting group (Group II).

Figure 1: Tangential excision of burn wound of the finger.

20 patients (30 hands) were lost to follow up from a total of 104 with deep hand burns and were excluded from the study. A total of 84 patients (140 hands) were covered under the study, bilateral hand involvement in 56 patients (80% of hands) and unilateral involvement in 28 patients (20% of hands). Each group had 42 patients each.

Figure 2: Tangential excision of burn wound of the hand and forearm.

Figure 3: Excised wound covered with meshed autograft.

Data collection technique and tools

The data collected was quantitative numerical on continuous scale in which scores were given between 1 to 10 by patients and treating surgeon (the first author,) for aesthetics, satisfaction, pain, activity of daily living and requirement of a secondary reconstructive procedure for improving functional or aesthetics of hands for both the group at the end of a follow up period of twelve months. Higher score for requirement of secondary procedure denotes the felt need for procedure. The data was then divided into a good score (≥6) or a poor score (≤5) for all except for pain and requirement of a secondary reconstructive procedure where reverse criterion was used. The functional assessment was done by measuring pinch and palmar grip strength at the end of one month and comparing the same with normal pinch and palmar grip strength for the population (Figure 4 and 5). The functions were assessed using portable hydraulic hand dynamometer for pinch and tip grips and mechanical pinch gauge in terms of key and palmar pinch strength.

The normal values were calculated using 100 healthy subjects attending or visiting in-patients. A value of 7 kg was used for pinch strength and 42 kg for palmar grip strength as normal. A score of 10 was given for patients achieving more than 90% of normal value, a score of 8 for 80-89%, a score of 7 for 70-79% and so on. In pediatrics age group, pinchometer/palmar grip measurements were not used. The splinting and pressure garments were provided to both the groups as standard practice in the study institution.

Figure 4: Pinch grip measurement.

Figure 5: Power grip measurement.

Data analysis

The mean of scores awarded by the patient and treating surgeon were calculated for function, aesthetics, satisfaction, pain, activity of daily living and requirement of a secondary reconstructive procedure for improving functional or aesthetics of hands. The mean scores for each head were calculated and 95% confidence interval (CI) limits were worked out for both groups.

The data was further analyzed making 2×2 tables to compute odds ratio and Chi square test. p value of <0.05 was taken as significant for Chi square test. The statistical analysis was carried out using SPSS 16.0 and EPI INFO 2002.

RESULTS

The incidence of burns as reflected in the study includes both work related accidents and domestic accidents. A total of 84 patients (140 hands) were covered under the study, bilateral hand involvement in 56 patients (80% of hands) and unilateral involvement in 28 patients (20% of hands). Each group had 42 patients each. A total of 104 patients had deep- partial thickness or full thickness burns over the hands making a 31.2% of all admissions to the burn centre with hand injuries. The male to female ratio was 1.63:1 again indicating the incidence of hand burns being higher in males.

The age range varied from 10 months to 75 years, with an average age of 30.7 years in Group I while 34.3 years in Group II. There were 39 patients in age group 21-40 years (46.4% of total patients under study). There were 17 children below the age of 15 years, making approximately 20% of the patients under study. Out of these 17 children, 10 suffered from deep partial-thickness burns due to scalds, making it the most common mode of injury in this age group. 7 children sustained flame burns. There were 5 patients above the age of 61 years (5.9%). The commonest mode of injury in this study was flame burns which was responsible for burns in 63 patients (75%). This was followed by scalds in 11 patients (13.1%), electric burns in 4 (4.8%), flash burns in 4 patients (4.8%) and chemical burns in 2 (2.4%). 33 patients (39.3%) of flame burns were managed with early tangential excision while 30 patients (35.7%) were managed with delayed excision and grafting. Out of 11 patients who suffered scalds, 6 patients (7.1%) were managed with delayed excision and grafting while 5 patients (6 %) were managed with early excision and grafting. Patients with electric burns and flash burns were equally divided in both treatment groups with 2 each. There were 2 patients with chemical burns who were managed with topical therapy and grafting.

TBSA involved ranged from 7% to 60%. A total of 31 patients (36.9%) had 21-40% burnt TBSA out of which 19 patients (22.6%) were in Group I while 12 patients (14.3%) were managed with delayed excision and grafting in Group II. Average percentage of TBSA burnt in Group I was 33.09% as compared to Group II in which it was 38.33%. Average TBSA excised in Group I was 11.07% as compared to 13.57% in group II. The graft dressings were done in both groups in similar fashion and percentage of graft take in Group I was 88.28% as compared to 82.11% in Group II. This lower percentage of graft take in Group II could be because of chronic nature of wound bed with poor granulation and bacterial colonization.

Requirement of blood during operative and immediate post–operative period was higher in Group I as compared to Group II for every percentage of excision done. Patients in Group I had a blood requirement of an average

of 2.80 units (each one being 350 ml pack) whereas in Group II it was 1.49 units.

The length of hospital stay was significantly much longer in Group II patients. For Group I patient it was 23.2 days as compared to 53.2 days in Group II. Descriptive statistics are depicted in Table 1.

Functional assessment had a mean score of 8.78±1.55 in Group I and 7.95±1.77 in Group II. 60 hands were placed under a good score while 4 in poor score in Group I as compared to 65 hands with good score and 11 with poor score in Group II. The p value for chi square test worked out to be just more than 0.05 (0.058) which was statistically not significant.

Aesthetic assessment had a mean score of 8.83±1.50 in Group I and 7.86±1.63 in Group II. 62 hands were placed under good score while 2 in poor score in Group I as compared to 65 hands with good score and 11 with poor score in Group II. The p value for chi square test (OpenEpi, Version 2) worked out to be 0.0105 which was statistically significant.

Figure 6: Well settled aesthetically pleasing skin graft in Group II patient.

Figure 7: Good fist formation in the same patient as Figure 6.

Satisfaction as for overall treatment and result, which included social acceptance at work place and home, had a mean score of 8.80±1.53 in Group I and 7.80±1.58 in Group II. 61 hands were placed under good score while 3 in poor score in Group I as compared to 68 hands with good score and 8 with poor score in Group II. The p value for chi square test worked out to be 0.1006 which was statistically not significant, thus implying similar result for both groups at the end of mean follow up period of one year.

Table 1: Descriptive statistics according to groups.

Assessment Parameters		Group I	Group II
Function	Mean	8.78	7.95
	Median	9.00	9.00
	SD	1.55	1.79
Aesthetics	Mean	8.86	7.87
	Median	9.00	8.00
	SD	1.47	1.80
Satisfaction	Mean	8.80	7.80
	Median	9.00	8.00
	SD	1.52	1.63
Pain	Mean	1.33	1.84
	Median	1.00	2.00
	SD	1.60	1.73
ADL	Mean	9.13	8.43
	Median	10.00	9.00
	SD	1.11	1.70
Secondary procedure	Mean	1.31	3.38
	Median	0.00	0.00
	SD	3.08	4.30

Pain assessment, at the end of treatment and mean period of one year, had a mean score of 1.22±1.42 in Group I and 1.84±1.72 in Group II. 62 hands were placed under good score while 2 in poor score in Group I as compared to 73 hands with good score and 3 with poor score in Group II. The overall low score in both the groups indicate a low residual pain at the end of follow up period. The p value for chi square test worked out to be 0.3970 which was statistically not significant.

Activity of daily living (ADL) was assessed by the capability of the patient to do things like unfastening of shirt buttons, unlocking the locks, tying shoelaces, ability to write legibly and to sign documents, combing of hair and feeding themselves. The mean score for ADL was 9.12±1.11 in Group I and 8.43±1.22 in Group II. 62 hands were placed under good score while 2 in poor score in Group I as compared to 68 hands with good score and 8 with poor score in Group II. The p value for chi square test worked out 0.04515 which was statistically significant, thus implying better result for Group I at the end of mean follow up period of one year.

The felt need requirement for a secondary procedure to correct post burn deformities had a mean score of 1.31±3.09 in Group I and 3.38±3.20 in Group II. 54

hands were placed under good score while 10 in poor score in Group I as compared to 48 hands with good score and 28 with poor score in Group II. The p value for chi square test worked out to be 0.002460 which was strongly statistically significant, thus implying good result for Group I at the end of mean follow up period of one year. However, there was definite difference in types of deformities observed in two groups. Group I had more of web contractures, linear scar bands and sponge deformities as compared to hypertrophic scarring, dorsal skin contractures, fifth finger abduction deformity, extensor tendon adhesions and Boutonnière deformities seen in Group II (Figure 6 and 7).

Odds ratio, 95% CI values and p values of all assessment parameters are listed in Table 2.

Table 2: Assessment parameters in the groups.

Assessment parameters	Group	Good scores (number)	Poor Scores (number)	Odds ratio	95% CI (p values)
Function	I	60	4	2.54	0.69–10.06 (p=0.19)
	II	65	11		
Aesthetic	I	62	2	5.25	1.03–35.80 (p=0.04)*
	II	65	11		
Satisfaction	I	61	3	2.39	0.54–11.98 (p=0.33)
	II	68	8		
Pain	I	62	2	1.27	0.17–11.31 (p=0.84)
	II	73	3		
ADL	I	64	0	Undefined	
	II	68	8		
Secondary procedures	I	54	10	3.15	1.30–7.79 (p=0.008)*
	II	48	28		

*=statistically significant value.

Table 3: Non-parametric Mann Whitney U test.

Parameter	Group	Number	Mean rank	Sum of ranks	P value
Function	I	64	81.73	5230.50	0.002
	II	76	61.05	4639.50	
	Total	140			
Aesthetic	I	64	83.43	5339.50	0.000
	II	76	59.61	4530.50	
	Total	140			
Satisfaction	I	64	84.56	5412.00	0.000
	II	76	58.66	4458.00	
	Total	140			
Pain	I	64	63.57	4068.50	0.054
	II	76	76.34	5801.50	
	Total	140			
ADL	I	64	78.95	5052.50	0.017
	II	76	63.39	4817.50	
	Total	140			
Secondary procedure	I	64	61.00	3904.00	0.002
	II	76	78.50	5966.00	
	Total	140			

Odds ratio in respect of function was 2.54. The odds of getting the outcome as good aesthetic outcome was more than five times in intervention group (Group I) rather than control group (Group II) with a statistically significant p value (0.04). As regards satisfaction, the odds of getting a good satisfaction outcome in Group I was 2.39 times that of Group II. However, this was not statistically significant (p=0.33). As regards pain assessment, the odds of getting a good outcome in Group I was 1.27 times that of Group II. This was again not statistically significant (p=0.84). The odds ratio for ADL assessment was undefined as there were no readings for

poor score in group I. For secondary procedures, the odds of receiving a good score in Group I compared to that in Group II was 3.15 times. This value was statistically significant (p=0.008). Test group was superior to the control group in all assessment parameters except pain.

Non-parametric Mann Whitney U test was used to assess if there was any statistical difference in the median scores in the two groups with respect to various assessment parameters. The results are tabulated in Table 3.

It was seen that all assessment parameters except pain showed statistically significant difference in the two groups with Group I, the test group, being superior.

DISCUSSION

Most of the hand burns happens as domestic accident and are self-treated at home.[1-3] Approximately 1% of population suffers a hand burn each year and only 25% of those require medical attention, and a minority of these requires inpatient care.[1,2] Pruitt has reported that over 85% of patients admitted to hospitals following thermal injuries have burns of the hand of varying depth.[3] Burn admissions at various burn centers around the world have shown an incidence of 54% to 90% involving burns of one or both hands.[1-4] Good functional results can be reliably obtained for the burned hand when it is treated by an experienced team of surgeons, nurses and rehabilitation therapists using a standardized protocol.[5]

There are two surgical approaches for patients with deep partial-thickness and full thickness burns to the hand - an early tangential excision and skin grafting within the first few days of injury or an initial topical treatment followed by late eschar excision and grafting. Both techniques have advantages and limitations, as brought out in various studies.[1,2,6-9] However, each of these studies have limitations as regard to patient selection and comparison taking into account age, mode of injury, percentage of total body surface area (TBSA) burnt, timing and criteria for surgical intervention and follow up period.[6,7] The present study is an endeavour to study the both modalities of treatment in patients with deep-partial thickness and full-thickness burns of hands by assessing functional and aesthetic outcomes in relation to timing of surgery and evaluating felt need of secondary surgical revision.

Early tangential excision and grafting

Whenever partial-thickness and full thickness burns of hands are addressed by early tangential excision and grafting consideration needs to be given to the staging and timing of surgery for the hands burns, as this will be influenced by the presence of associated burns and medical status of the patient.[5] When the patient has more extensive and potentially life-threatening burns, excision and closure of the large surface areas, such as trunk and legs, always take priority over surgery for the hands. However, if only hands are burned, surgery should be done at the earliest opportunity. If both hands are burned, a bilateral procedure becomes a lengthy operation unless two surgical teams work simultaneously.[5,10] The late complications in this subset of patients are low and when occurring are easier to treat. It includes web contractures, linear scar bands and sponge deformity at graft edges.[11]

Delayed Eschar excision and grafting

This form of treatment is advocated to preserve all viable tissue till eschar separates out on its own by the end of three weeks. If eschar is still adherent by the end of three weeks it is surgically excised and raw areas are skin grafted. Proponents of this approach suggest that, with an experienced rehabilitation team that can provide vigorous physiotherapy, functional results with the conservative approach are as good as those with early surgical approach; moreover, frequency of late complications and need for secondary reconstructive surgery is no different.[12-16]

Early tangential excision and grafting versus delayed excision and grafting

It is proposed that surgery within two weeks is associated with superior function and fewer reconstructions later, and there are several reports that support this assertion.[1, 2,6-9] Cartotto supports early excision and grafting and believes that the benefits are also associated with a shorter, less costly hospital admission.[5] Engrav et al reported and supported early excision and grafting in a randomized prospective study.[17] Some surgeons consider preservation of all residual, viable dermal elements to be of critical importance and opt for late surgery following eschar separation, when necessary.[8] Provided intensive dedicated hand therapy is administered, functional results at one year have been shown to be similar to series where early excision is done.[12,13,16] However, reconstructive procedure rates are significantly greater with later approach.[5] Cartotto evaluated 29 patients with deep partial- or full-thickness hand burns managed with early excision and grafting. A year or more after injury, these patients had normal mean pinch strength but decreased grip strength and a mean TAM of 225 degrees, which is considered functional but is clearly well below the normal of 260 degrees.[5]

Ong et al carried out a meta-analysis to seek to establish if early excision and grafting is better or equivalent to the conservative treatment of burns in both children and adults with minor or major burns. The outcomes of interest were mortality, wound healing time, duration of sepsis, operating hours, complications of surgery, length of hospital stay, blood transfusion requirements and long term morbidity like joint contractures and hypertrophic scarring. They concluded that early excision of burns is beneficial in reducing mortality (in patients without inhalational injury), and length of hospital stay. The drawback is the greater volume of blood loss.[18]

Kowalske et al review the management strategies and analysis of hand outcomes and set goals for future research goals in this field. The hand panel agreed that analysis of hand outcomes is an ongoing challenge, primarily because of the lack of validated assessment tools that correlate the extensive data which can be collected for range of motion at each joint, hand strength and sensation with overall functional outcome.[19]

Limitations of the study

This study comprised a small sample size and thus cannot be said to be conclusive for general population. Randomization of subjects into two groups was done keeping in mind the age profile, mode of injury, extent of burns and the time of reporting to this centre. This randomization, however, got influenced at times as the early surgical approach was not always possible, since depth and extensions of lesions and general condition of the patient before and after injury could play a limiting role. The follow up period ranged from six to twenty four months (with a mean of one year) which may have influenced certain scores awarded by the patients.

CONCLUSION

The skin graft take was much superior in early excision group as compared to delayed group and hence resulted in decreased overall hospital stay. The functional and aesthetic outcomes were better achieved and the needs for secondary surgical revision were far lesser with early excision and grafting. Both early excision and grafting, and delayed excision and grafting modalities lead to post-burn deformities of hand, albeit different from each other, but more common with delayed grafting. The study also highlighted the requirement of blood and blood product to be significantly higher in early tangential and grafting as compared to delayed excision and grafting

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