

Original Article

Demographic characteristics and outcome of burn patients requiring skin grafts: a tertiary hospital experience

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Abstract: Split thickness skin graft (STSG) and full thickness skin graft (FTSG) are the integral part of burn wound management. However the impact of these graft types on the outcome still remain a matter of controversy. The purpose of this study was to determine the demographic characteristics and outcome of graft surgery of the patients undergone STSG and FTSG at Plastic Surgery Department of Prince Sultan Military Medical City (PSMMC), Riyadh, Kingdom of Saudi Arabia. This retrospective study included 85 burn patients who received STSG (56 cases) and FTSG (29 cases) at PSMMC during 2010-2015. Demographic characteristics (age, gender, etiology of burn, and area of burn) and outcome (graft loss, graft contraction, skin pigmentation, altered sensation, infection rate and duration of hospital stay) were recorded among the patients who received STSG or FTSG. Out of 85 patients 50 patients were male and 35 female with a ratio of 1.42:1. The patients under the age of 10 years comprised the largest burn group with 28 cases (32.9%) out of total 85 patients. The number of patients above the age of 30 years was relatively smaller. Flame (49.3%) and scald (27%) burns constituted the majority of burn cases. The incidence of contraction among STSG (12.5%) and in FTSG (17.2%) cases was similar. Altered sensation was observed in 7.05% of STSG patients and 13.7% of FTSG cases. Loss of graft was observed in 16% of STSG and 20.6% of FTSG patients. The pigmentation was quite similar in STSG (21.4%) and FTSG (24.1%). The hospitalization time in FTSG (28 days) patients was also comparable with STSG (26.9 days) group. This study showed that majority of the skin graft cases at PSMMC were male under the age of 30 years mostly affected by flame or scald burns. The outcome following STSG and FTSG surgery was comparable with no significant advantage of one over the other. It may be deduced that both STSG and FTSG have relative merits and demerits and either of these grafting procedure may be considered depending on depth and extent of injury, location and surface area of burn.

Keywords: Burns, pattern and etiology, skin graft, outcome of graft surgery

Introduction

Burns represent a massive global health problem with high rates of mortality and morbidity [1]. They are amongst the most devastating injuries that leave not only physical deformity but also cause immense psychosocial and emotional damage [1-4]. Every 5 seconds someone is severely burned involving nearly 11 million people annually. A majority (95 percent) of burn cases occur in developing countries. Worldwide, an estimated 6 million patients seek medical help for burns annually resulting in more than 300,000 deaths from fire-related burn injuries [1, 5-7]. Millions more suffer from burn-related disabilities and disfigurements

which have highly significant economic impact on both the survivors and their families. Burn is the 6th leading cause of lost productive years (disability adjusted life years-DALYs). It is of utmost importance to determine the pattern of burn injuries, their etiology, morbidity and mortality to take proper therapeutic, preventive and safety measures. During the last decade International Society for Burn Injuries and World Health Organization have launched massive campaign to confront global burden of burn injuries. Improved burn care include better capabilities for resuscitation of burn victims, better care of burn wounds through techniques such as skin grafting, better infection control and improved rehabilitation. This care strategy

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Table 1. Age and gender distribution of patients with burn injuries

Age group (years)	Male	Female	Total (%)
0-10	16 (18.82%)	12 (14.11%)	28 (32.94%)
11-20	8 (9.41%)	6 (7.05%)	14 (16.47%)
21-30	13 (15.29%)	5 (5.9%)	18 (21.2%)
31-40	6 (7.05%)	2 (2.35%)	8 (9.41%)
41-50	3 (3.52%)	4 (4.7%)	7 (8.23%)
51-60	1 (1.18%)	2 (2.35%)	3 (3.52%)
>60	3 (3.52%)	4 (4.7%)	7 (8.23%)
Total (%)	50 (58.8%)	35 (41.17%)	85 (100%)

may lower mortality, diminish disfigurement and disability and greatly assist survivors to lead full and meaningful lives [8].

Kingdom of Saudi Arabia (KSA) is one of the leading countries in Middle East region to vigorously implement burn care program. Facilities of burn management in Saudi Arabia are distributed all over the Kingdom, with 17 burn units [9]. The Burn Unit and Plastic Surgery Department of Prince Sultan Military Medical City (PSMMC) is actively involved in strengthening burn care services including skin grafting program and long-term rehabilitation. Although skin grafting is generally done as part of elective plastic surgery procedures, it is most extensively used in the treatment of burns [10]. In case of second or third-degree burns, the skin may be destroyed to its full depth often involving underlying tissues as well. In such cases of burns skin grafting is preferred mode of treatment [11, 12]. This study was carried out with the objective to determine the patterns of burn cases treated at PSMMC and to assess the comparative outcome of STSG and FTSG.

Materials and methods

The Burn Unit of Prince Sultan Military Medical City (PSMMC) is a major referral center under the auspices of Medical Services Department of Ministry of Defense, Kingdom of Saudi Arabia. This center caters to the patients referred from different regions of Saudi Arabia. That is why a study from this center is considered a good representative of KSA in general. In this retrospective study, analysis of data was carried out from the medical record of 85 Saudi burn patients who had undergone skin grafting at Plastic Surgery Department of PSMMC during 2010 to 2015. The study was approved by the Research and Ethics Committee of the PSMMC. A full thickness or split-thickness skin

graft technique is performed on burn patients according to the routine procedure. The skin graft is harvested and laid onto the burned wound area, the selection of harvesting site depends on the appearance, colour, texture, thickness and vascularity of the donor site to match the recipient site. Predesigned forms were used to collect the relevant data from the case notes of patients including age, sex, cause of burn and its location on the body, surface area of burn, type of grafting (split thickness skin grafting or full thickness skin grafting). The outcome parameters

included loss of graft, skin pigmentation, contraction, altered sensation, episode of infection and duration of hospitalization.

Statistical analysis

The data was analyzed using the SPSS Version 17 involving descriptive analysis and Chi Square test. *P* values less than 0.05 were considered as significant.

Results

Study of case notes of 85 patients who received STSG or FTSG skin graft at Plastic Surgery Department of PSMMC showed a clear male (50) predominance over female (35) gender with a male to female ratio of 1.42:1.

Age

The age of burn injury patients who received STSG or FTSG skin graft is presented in **Table 1**. The patient under the age of 10 years comprised the largest group with 28 cases (32.9%) out of total 85 patients. There were 16 males and 12 females with a ratio of 1.25:1 under 10 year age group. The patients in the age groups of 11-20 years (16.47%) and 21-30 years (21.2%) also dominated with higher frequency of males as compared to females. Only 29.4% of skin graft recipient were over the age group 30 years (**Table 1**).

Etiology

Flame accounted for almost half 42 (49.3%) of the total 85 of burn cases who received skin graft. The male (28) to female (14) ratio in flame burn cases was 2:1. The scald burn was second most frequent (27%) cause of burn among the patients who received skin graft. The most noticeable point is that a significantly higher

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Table 2. Etiology of burn in relation to age and gender

Age group (years)	Flame		Scald		Chemical		Friction		Total (%)
	Male	Female	Male	Female	Male	Female	Male	Female	
0-10	7 (8.23%)	2 (2.35%)	6 (7.05%)	8 (9.41%)	1 (1.18%)	0	2 (2.35%)	2 (2.35%)	28 (32.94%)
11-20	6 (7.05%)	1 (1.18%)	1 (1.18%)	5 (5.9%)		-	1 (1.18%)	0	14 (16.47%)
21-30	6 (7.05%)	3 (3.52%)	-	-	6 (7.05%)	2 (2.35%)	1 (1.18%)	0	18 (21.1%)
31-40	4 (4.7%)	2 (2.35%)	-	-	2 (2.35%)	0	-	-	8 (9.41%)
41-50	2 (2.35%)	3 (3.52%)	0	1 (1.18%)	1 (1.18%)	0	-	-	7 (8.23%)
51-60	1 (1.18%)	1 (1.18%)	0	1 (1.18%)	-	-	-	-	3 (3.52%)
>60	2 (2.35%)	2 (2.35%)	0	1 (1.18%)	1 (1.18%)	1 (1.18%)	-	-	7 (8.23%)
Total (%)	28 (32.9%)	14 (16.47%)	7 (8.23%)	16 (18.82%)	11 (12.94%)	3 (3.53%)	4 (4.7%)	2 (2.35%)	85 (100%)

Table 3. Percentage Total Body Surface Area (TBSA) affected by Burn

Burn body (BSA) involved (%)	Male	Female	Total
1-10	30 (35.29%)	19 (22.35%)	49 (57.64%)
11-20	8 (9.41%)	8 (9.41%)	16 (18.82%)
21-30	3 (3.52%)	2 (2.35%)	5 (5.9%)
31-50	6 (7.05%)	5 (5.9%)	11 (12.94%)
>50 (massive)	3 (3.52%)	1 (1.18%)	4 (4.70%)
Total (%)	50 (58.8%)	35 (41.17%)	85 (100%)

number of females (18.8%) suffered from scald as compared to males (8.2%). Burns due to chemicals were the third most frequent (16.47%) cause of burns among the patients who received skin graft. The male cases were significantly higher (12.94%) as compared with females (3.5%) in chemical related burn group. Only 7% of cases who received graft had an etiology of friction skin injury (**Table 2**).

Burn extent-body surface area (TBSA) covered by burn

Forty nine out of 85 cases (57.64%) who received skin graft had TBSA less than 10% with a male to female ratio of 35.29% vs. 22.35%. Only 16 patients (18.82%) had burn surface area between 11-20% with similar numbers of (8 each) males and females in this group, whereas 5.9% of cases had total burned surface area between 21-30%. Only 17.64% of total patients suffered burn area more than 30% of the total body surface (**Table 3**).

Comparative outcome of full-thickness vs. split-skin grafting

A total of 85 patients received skin grafts for their burns. Fifty six of 85 patients (65.8%) had

split-thickness grafting and 29 of 85 patients (34.1%) received full thickness skin graft. The outcome of the STSG and FTSG is presented below.

Loss of graft

The number and percentage of the cases who suffered graft loss following STSG and FTSG is shown in **Table 4**. Nine out of 56 patients (16%) who received split thickness skin graft suffered loss of skin graft, whereas 6 of 29 cases (20.6%) lost skin graft in FTSG group. The frequency of graft loss in STSG and FTSG groups was not found to be statistically significant ($P > 0.05$).

Contracture of graft

The incidence of contracture in STSG group was 7 of 56 cases (12.5%), as compared to 5 out of 26 cases (17.2%) contracture in FTSG patients. These figures did not reach statistical significance (**Table 4**).

Altered sensation

Four out of 56 patients (7.1%) had altered sensation in the split thickness group as compared to four out of 29 patients (13.7%) full thickness skin graft group. The difference in altered sensation in two groups was found to be statistically significant ($P < 0.05$) (**Table 4**).

Skin pigmentation

Similar discoloration/pigmentation of recipient site was observed in both STSG and FTSG groups. In split thickness group 12 patients out of 56 (21.4%) showed altered pigmentation as compared to the normal skin color. On the other hand, 7 patients out of 29 (24.1%) developed

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Table 4. Comparison of outcome among patients receiving split thickness and full thickness skin grafts

Outcome Parameter	Split thickness skin grafting (STSG)	Full thickness skin grafting (FTSG)	P value
Number of cases	56 (65.8%)	29 (34.1%)	-
Graft loss	9 (16.0%)	6 (20.6%)	0.538
Graft contraction	7 (12.5%)	5 (17.2%)	0.363
Altered sensation	4 (7.1%)	4 (13.7%)	0.021
Skin pigmentation	12 (21.4%)	7 (24.1%)	0.618
Episode of infection	12 (21.42%)	11 (37.93%)	0.127
Mean time of hospitalization duration (day)	26.92±3.95 (SE)	28.0±6.19 (SE)	>0.05

P < 0.05 was considered as significant.

altered pigmentation in full thickness group. There was no significant difference of abnormal pigmentation in two groups (**Table 4**).

Infection rate

Infection and graft loss are well known complications encountered following skin graft. In the split thickness group, 12 out of 56 patients (21.42%) suffered from infection, whereas 11 out of 29 patients (37.93%) suffered from infection in full thickness group. The difference of infection rate between STSG and FTSG was found to be statistically insignificant (**Table 4**).

Discussion

The review of case notes showed that the majority of patients who received skin graft at PSMCC were young males with flame and scalding burns as the most common etiology. The largest age group among burn patients in this cohort was 0-10 years (57.6%) with overall majority under the age of 30 years. These observations are consistent with burn pattern reported from other cities of KSA as well as the neighboring countries [13-19]. Such a high incidence of burns among young age group is attributed to large families in the community, and the fact that a lot of time, children are involved in unsupervised activities at home and surrounding areas. The sex distribution analysis showed higher involvement of male (58.8%) in burn accidents with a male to female ratio of 1.42:1. This finding correlates with most reported studies around the world showing male dominance [17-24] although opposite findings have been reported from some countries [20, 24, 25]. Generally young males are more adventurous, less dependent and prefer to spend

time with their peers rather than elders in this region, on the other hand young girls spend most of the time inside their houses under the supervision of mothers.

The most common etiology was flame burns (49.3%), followed by scald. This finding is similar to several earlier studies, which identified flame as the main cause of burn [26-31]. Gas cylinder accidents significantly contributed to flame burns, reflecting the careless handling of this commonly used cooking facility [32, 33]. It is worth mentioning that wood and charcoal stoves, used for heating in some areas of KSA, may also contribute to flame burns. This is because most of these heaters are designed to be installed at floor level, within easy reach of children. In this study scald burns (27.05%) was second most common etiology of burn injury. Earlier reports showed that women and children under 15 years are at a higher risk of scald burn. The most scald burns occur in kitchen due to hot liquids including water, tea, coffee, milk or oil. Some cases of hot bath are also reported [34]. Chemical burns constituted 16.7% of the cases which is similar to the results of earlier studies [32, 33, 35, 36]. These burns are caused as a result of contact with acid and bases generally known as caustic burns. The most common cause of chemical burn include acid used for car battery, cleaning products, bleach, ammonia and swimming pool chlorinating products.

The extent of injury is best described using the percentage of total body surface area affected by the burn. The majority of cases 49 (57.64%) in this study suffered TBSA less than 10% affected by burn which is in line with earlier reports from this region [33, 35, 36]. Our data

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showed the higher involvement of critical areas including face, hands, feet, and legs. The TBSA and distribution of burn in different parts of body is critical for the management including selection of grafting method such as FTSG or STSG.

In this study out of 85 burn cases who received skin graft 56 patients received STSG whereas 29 patients received FTSG. The decision to use FTSG or STSG was based on the size, location and extent of the burn, available donor site, vascularity of the recipient site, and esthetic considerations [37]. Graft failure, graft contraction, hyperpigmentation, altered sensation, infection, and duration of hospital stay following skin graft were recorded. In this study we observed 20.6% graft loss among the patients who received FTSG compared to 16.0% graft loss in STSG case. These findings suggest a slightly better outcome following STSG as compared to FTSG. Besides being easier to harvest compared to FTSG, STSG have higher survival rate [37, 38]. On the contrary, the use of STSG has functional and esthetic complications including undesirable appearance, pain and discomfort in the early postoperative period as well as delayed wound healing and scar and pigmentation formation.

The skin graft contraction was observed in 12.5% of STSG cases and 17.2% of patients who received FTSG (**Table 4**). The factors influencing shrinkage of graft include elasticity of the donor site and graft thickness [38, 39]. Graft contraction is believed to be more prominent as the thickness of the graft decreases [40, 41]. Earlier studies have shown that a granulating recipient bed, burn size, age of patient, anatomical location and grafting over mobile tissue may determine graft contraction [42-45]. Graft contracture results due to unopposed action of elastic fibers, leading to variable degrees of shrinkage. It has been suggested that the network of elastic fibers of the dermis has the ability to stretch and shrink under the movement of the underlying tissues [45]. On the other hand infection adversely affects graft contraction including poor outcome and prolongation of recovery. In this study there was 37.93% infection in FTSG group compared to 21.42% in STSG patients. Stephenson et al 2000 [46] found that the presence of infection resulted in significant graft contraction to

almost half the initial size, whereas in patients with no infection, the graft contracted by one-third.

There was no significant difference in skin pigmentation among the patient who received STSG (21.4% of cases) or FTSG (24.1% of cases). The hyperpigmentation of the skin graft is variable and depends on the amount of pigmentation present in the donor site. Although FTSGs maintain the best pigment match, STSGs often develop significantly dark pigmentation [48]. Exposure to sunshine during the first six months may aggravate pigmentation hence use of sun-blocking agents or clothing to prevent long-lasting hyperpigmentation in a new skin graft is recommended. Color mismatch and pigmentation differences are generally temporary and improve gradually [38].

Altered sensation was observed in 7.1% of patients following STSG grafting as compared to 13.7% of FTSG grafting. Contrary to our finding earlier report suggest that full-thickness skin grafts achieve better sensation than split-thickness grafts, although the rate of return of innervation is faster in STSGs [48]. The patients with skin grafts often do not regain completely normal sensation after receiving the skin graft [39, 49]. The recovery of sensation is a slow process that begins as early as one to two months after surgery, and may continue to improve during and beyond the first year.

Our findings suggest that the outcome of FTSG and STSG is comparable. Both FTSG and STSG have their relative advantages. STSG is preferred because the graft can easily be harvested in rectangular form using a dermatome. The donor site of STSG has a long healing period and the disadvantages of postoperative pain, scar formation, and esthetic problems [50]. Likewise, STSG requires much more effort in terms of postoperative care of the donor site [51]. FTSG offers the advantages of superb esthetics [52], less postoperative shrinkage, and minimal postoperative pain and scar formation through primary closure compared to STSG [50, 53].

Conclusion

In brief, it may be concluded that majority of the burn patients at PSMHC were male under the age of 30 years. Flame related burn was the

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most prevalent etiology followed by scald burns. In this study total body surface area covered by burn was less than 10% in majority of patients mostly involving face, hands, feet and legs. Nearly two third of patients received STSG and remaining received FTSG skin graft. Comparison of outcome parameters following skin graft including graft failure, graft contraction, hyperpigmentation, altered sensation, infection rate and hospital stay showed that both STSG and FTSG were comparable with no significant advantage of one over other. This study clearly suggests a need for further multi-center randomized controlled trial using larger sample to compare the relative merits and demerits of FTSG and STSG.

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Disclosure of conflict of interest

None.

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