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Superior long term functional and scar outcome of Meek micrografting compared to conventional split thickness skin grafting in the management of burns

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ABSTRACT

Introduction: Autologous skin grafting is the mainstay of treatment in burn patients. Extensive full thickness burns remains a challenge to the burns surgeon due to the lack of autologous skin donor sites. The conventional split thickness skin grafting (SSG) and the Meek micrografting (Meek) technique are part of the armamentarium of the burns surgeon to curtail the challenge of paucity of donor sites. With advances in burn care, mortality rates of burn patients have reduced. As a result, with more patients surviving acute burn, there is a paradigm shift of research towards assessment of functional outcomes and quality of life of the burn survivors. As there is lack of research regarding the functional outcome of the Meek technique, this study was designed to examine the long term functional outcome of the Meek technique and SSG in burns.

Method: A cross-sectional study was conducted in Hospital Universiti Sains Malaysia to assess patients with burns between 10 to 40% total body surface area (TBSA) and with at least one year after injury. The Burn Specific Health Score-brief (BSHS-B) was utilized to compare the functional outcome whilst the Vancouver Scar Scale (VSS) was used for comparison on the scar outcome of the two skin grafting techniques.

Results: Forty three patients (Meek,15; SSG,28) were included. The mean current age (years old) of Meek and SSG was 24.7 (range, 7–75) and 25.9 (range, 7–65) respectively. The mean TBSA (%) of the Meek group was 26.7 (range, 13–40) while that of the SSG group was 16.1 (range, 10–32). A simplified domain structure was used for the BSHS-B questionnaire. The work and sexuality subscale were analyzed separately due to missing data. There mean scores of affect and relations was higher in Meek compared to SSG (Meek, 3.86; SSG, 3.75; $p > 0.05$). Function domain was also better in Meek compared to SSG (Meek, 3.88; SSG, 3.73; $p > 0.05$). The Meek group displayed superior scar outcome compared to SSG as evidenced by the statistically significant difference in score for the pigmentation, pliability, height and total VSS score.

Conclusion: The Meek group showed more favorable BSHS-B scores compared to the SSG group. The scar outcome of the Meek technique is significantly superior to SSG. Therefore, the Meek technique is superior in the management of burns because the long term scar and functional outcome of this technique is better compared to conventional SSG.

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1. Introduction

Severe burn poses a great challenge to the burn surgeon. With advancement in acute burns care, due to more refined surgical technique and improved burns intensive care, survival of patients with severe burns is enhanced. Now, early tangential excision of burns with autologous skin graft is well advocated as the mainstay of burns management [1–3]. In extensive full thickness burn, the lack of autograft donor sites is a known limiting factor to the burn surgeon in the quest to achieve complete wound closure [1,2]. To deal with this problem, skin autograft harvested can be meshed or expanded via the Meek technique [2,4]. With advances in burn care over the last 30 years, mortality rates have reduced. Nowadays, even patients sustaining massive burns have high survival rates [4–6]. Therefore, with more patients surviving acute burn, focus of outcome assessment has shifted away from crude mortality and morbidity towards assessment of functional outcomes and quality of life. Many functional dimensions such as physical, mental and social problems are observable among survivors of major burns. [6]. With growing attention for functional outcome after burns, Van Baar et al. [6] reviewed 50 publications and found that authors reported a wide spectrum of functional dimensions. Falder et al. [7] in their clinical review identified seven core domains for burn outcome assessment in adults. Van Baar et al. [6] also pointed that the frequently applied burn-specific measure is the Burns-Specific Health Scale (BSHS). Yoder et al. [8] stated in their systematic review that the BSHS is commonly used for quality of life assessment in burn survivors. The BSHS was described in 1982 to assess important dimensions of health among burn survivors [9]. Blades et al described the original BSHS which comprised of 114 items that measures the health status among survivors of burn injuries [10]. It was subsequently refined by various authors whereby the items were reduced or modified [11,12]. To further improving the scale for clinical use, Kildal et al. [9] used a factor analytic approach on the BSHS-Abbreviated and BSHS-Revised to derive an instrument with 40 items called the Burn Specific Health Scale-Brief (BSHS-B). Cicero Parker Meek pioneered the description of a device-based procedure in producing postage stamp-like small skin grafts. However it was superseded by Tanner's meshed graft in 1964 as mesh skin grafts were much more easier to be produced [13,14]. In the early 90s, the Meek technique was used again and technically improved [13]. Ultimately, Kreis et al. [15] introduced the modified Meek technique and found that it was a reliable method which was comparable to mesh grafts for obtaining widely expanded skin islands when donor sites were inadequate. There were many authors who described their experience on advantages of the Meek micrografting technique in the English literature [1–3,15–20]. One of the advantages is the good aesthetic outcome of the Meek technique [1,19–21]. This is an important factor as a good aesthetic outcome can be reflected to better self-confidence and less self-shame. There is paucity of research on functional outcome of Meek micrografting, therefore we conducted a comparative study to examine the functional advantage of Meek micrografting in burns.

2. Methodology

2.1. Study design

This is a cross sectional cohort study to compare the functional outcome of Meek micrografting and conventional split thickness skin grafting in burns at Hospital Universiti Sains Malaysia.

2.2. Study population

All patients admitted to Hospital Universiti Sains Malaysia (HUSM) between January 2010 and December 2016 were retrospectively screened via case notes in the record office. The burns unit of Hospital Universiti Sains Malaysia is one of the two burns units in the state of Kelantan which has a population of 1.85 million people [22]. The patients who were included were burn patients with total body surface area between 10 to 40% undergoing autologous skin grafting using the conventional split thickness skin graft or the modified Meek micrografting method. Patients with no less than one-year after injury and has normal cognition were included in this study. The burn total surface area of 10 to 40% was chosen as within this range, patients grafted with Meek micograft or conventional split thickness skin graft can be captured. In this range, despite being average in size, the Meek micrografting technique was advocated when there was paucity of donor site. Patients with burn total surface area less than 10% were excluded as in this subset of patients, Meek micrografting will not be justified. On the other hand, patients with burn total surface area of more than 40% were excluded as in these patients with severe burns, Meek micrografting will the preferred option. In other words, in range of 10–40%, the data will be comparable between Meek micrografting and conventional split thickness skin graft. The number of patient grafted with the Meek micrografting technique and the conventional split thickness skin grafting is not proportionate. In our population of burn patients, the patients grafted with the conventional split thickness skin grafting method were more compared to those who were grafted with the modified Meek micrografting technique. Therefore, the disproportionate stratified random sampling was employed to facilitate adequate sample recruitment from both Meek micrografting and conventional split thickness skin grafting subgroups [23]. Sample size was determined and calculated using power and sample size (PS) software version 3.2.1(U.S.A) [24]. The calculated sample size for this study was 14 patients for Meek micrografting and 28 patients for conventional split thickness skin grafting.

2.3. Ethical considerations

Ethical approval to conduct the study was granted by Human Research Ethics Committee (HREC) of Universiti Sains Malaysia (USM/JEPeM/16110527). This study was registered with the Medical Research & Ethics Committee (MREC) Ministry of Health Malaysia (NMRR-17-384-34912). Both the research project and patient record retrieval were approved by the institutional review board. Patients' consent for using their

data in the research project was also obtained. The study was conducted according to the Declaration of Helsinki and a written informed consent was obtained from every patient who agreed to participate in the study.

2.4. Population sampling and study procedure

Patients were identified according to the inclusion and exclusion criteria of this study. A list containing the cohort of patients who fulfilled the study criteria was made. All patients were assigned to identification numbers without names. The type of grafting was not stated in the list. The list containing the contact details of the patients was used for contact tracing. There were patients who no longer attended follow up and we did not have data for functional outcome for all patients as objective functional assessment was not a routine practice in our center. Therefore, patient recruitment began by contacting the patients via phone to obtain a cross-sectioned cohort for evaluation of these patients at a longer follow up. The process of contacting patient was performed by the first author (L.S.Z) and upon this; the caller was blinded on the type of grafting the contacted patient had. Assessment of functional outcome was performed by the first author (L.S.Z) using the Malay version of the Burn Specific Health Score-brief (BSHS-B) and the Vancouver Scar Scale. The simplified 3-domain structure of the BSHS-B questionnaire was used [25]. Photographs were taken during the follow-up for interview on grafted areas and the autograft donor sites. Photography of scar was performed using Digital Single Lens Reflex camera E-510 (Olympus, Japan) and a wide zoom Zuiko Digital (Olympus, Japan) lens (focal length, 12–60 mm; aperture, f/2.8–4.0). The conduct of this study was summarized in Fig. 1.

2.5. Patient recruitment and related challenges

Patients were contacted via phone. Patients who agreed to participate in the study were scheduled for visit to the burns

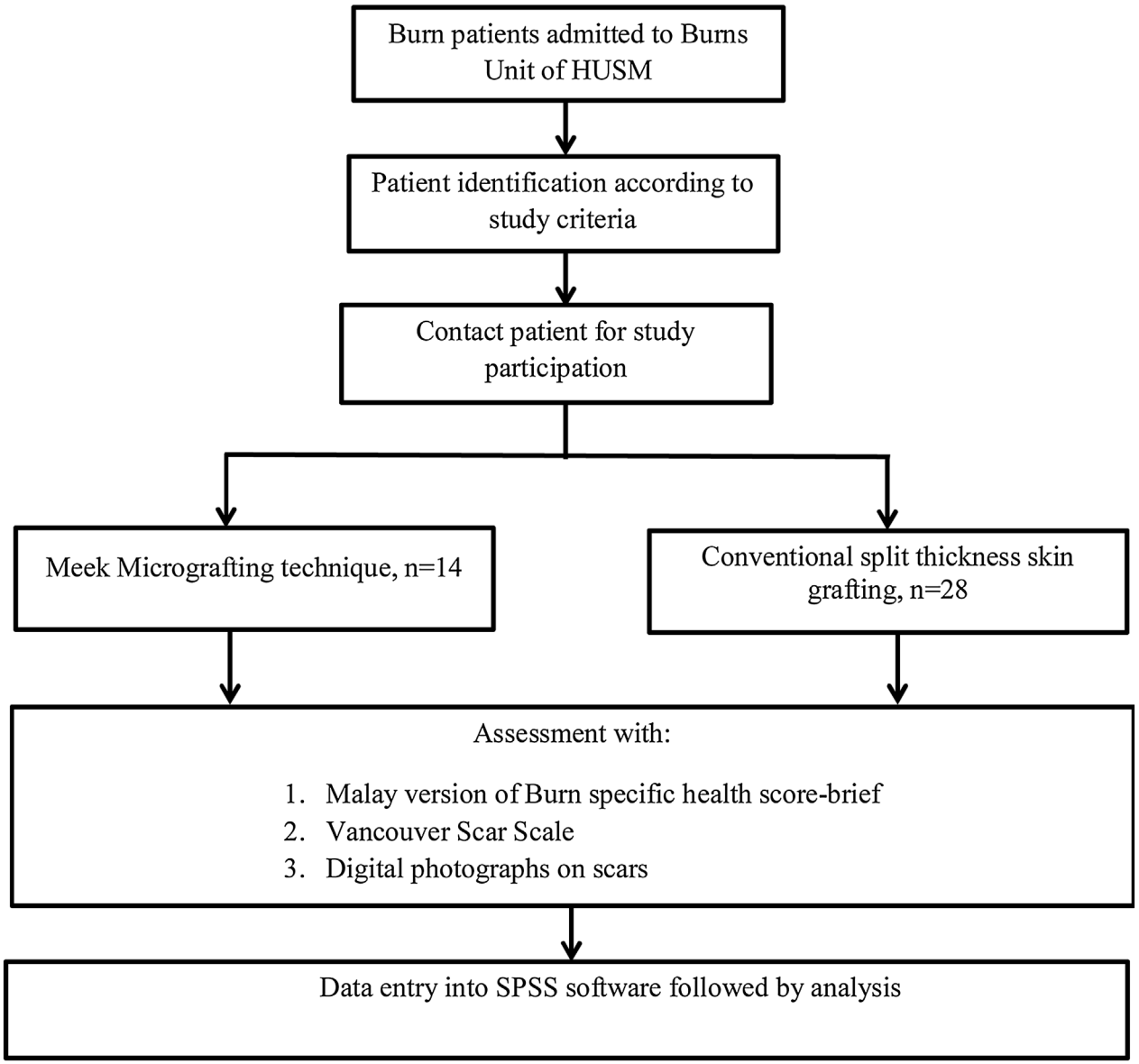

Fig. 1 – Study flow chart.

unit or the outpatient clinic for assessment. Upon the process of patient recruitment for the study, the challenges encountered during the initial attempt to contact patients are: inability to be present to HUSM due to logistic reasons, contact number no longer in service and shift of permanent residential area to another state. As this is a study of long term follow up, it is vital to meet the patients in order to perform an objective assessment. Therefore home visit was necessary to reach out to the patients. The contact details of patients which consisted of name, contact number, residential address and name of accompanying person (if any) were retrieved from patients records via record office of HUSM. At least three attempts on separate days were made to contact the patient via the phone number retrieved from record office. Subsequently, a population of patients who were uncontactable via phone were compiled and were grouped according to locality to facilitate further contact tracing. Using the residential addresses, attempts were made to locate the patients by visiting those addresses within 30 km radius from HUSM. Upon arrival those areas, help was obtained from local residents as guide. Upon arrival to those areas which were mainly suburban residential areas and houses were haphazardly scattered throughout a wide area, help was obtained from the local residents to assist us in locating the exact house of the patient. For those with addresses beyond 30 km radius from HUSM and were not contactable via phone; and those patients (<30 km) who were not contactable despite attempt to reach out to them, help from local health clinics and the police was sought (Fig. 2). After the completion of contact tracing, home visit and visit to district hospital were organized to reach out to patients who were unable to come to HUSM for interview [26].

2.6. Study variables

Baseline demographics variables at burn collected included age, ethnic group, gender, marital status, education and occupation. Details of burns retrieved included % total body surface area burn (%TBSA), inhalation injury, mechanism of burns, duration of exposure to burns, location of incidence, first aid of burns, length of stay (LOS) and topography of burns. Course of treatment variables collected included need for escharotomy, microorganism cultures over burn wounds, first grafting and outcome parameters (percentage of graft take, mortality, contracture and contracture surgeries).

2.7. Statistical analysis

Data analysis was done using Statistical Package for Social Science (SPSS) software version 22. All data underwent normality test. The mean and standard deviation were used to describe the central tendency for variables. Categorical data were summarized using proportion (%). Comparisons of categorical variables were performed using the Pearson Chi-square or the Fisher exact tests. An independent samples t test was used to compare means. A two-way between group analysis of variance (ANOVA) was performed to assess the interaction effect of categorical variables on the main effect (graft types) of this study. A one-way between group analysis of covariance (ANCOVA) was used to control the continuous variables on the main effect of this study. Pearson correlation was used to measure the relationship between continuous variables. Partial eta squared value was used to measure the effect size of variables [27]. Statistical significance was designated at 0.05.

3. Results

3.1. Baseline demographics

One hundred and forty burn patients were admitted to HUSM and undergoing autologous skin grafting between January 2010 and December 2016. Of these, 24 patients underwent Meek micrografting (Meek) whilst 116 patients were grafted with conventional SSG (SSG). 88 patients (Meek, 6; SSG, 82) were excluded as they were not within the TBSA criteria of this study. This results in a cohort of 70 patients (Meek, 18; SSG, 52) for recruitment. All Meek patients were successfully contacted; however 3 patients were no longer on follow up and were not willing to participate in this study. 34 SSG patients were contacted during the process of sampling. However, six patients were excluded because of patient's refusal to participate in this study or missing medical record. A total of 43 patients were entered into the data analysis (Meek, 15; SSG, 28). Home visits (8 patients) and visits to district hospitals (7 patients) were needed to facilitate the conduct of the study. Baseline demographics variables are illustrated in Table 1. Male to female ratio of Meek and SSG were 2 and 2.1 respectively. The mean age of this study cohort for Meek and SSG were 24.7 years (SD, 19.6 years) and 25.9 years (SD, 18.3 years) respectively. Majority of the patients were ethnic Malays (90.7%). The level of education at burn varied with mean years of education for Meek and SSG at 5.4 years (SD, 5.8 years) and 6.1 years (SD, 4.9 years) respectively. Only 37.3% of patients were employed upon the injury while the rest were either studying (27.9%) or unemployed (34.9%). All parameters were comparable between Meek and SSG as there were no significant difference between them (Table 1).

3.2. Details of burns

Details of burns of patients are summarized in Table 2. Majority of the mechanism of burns were flame burns (60.5%) and first aid was not performed in most of the patients (90.7%). Most of burns occurred at home (74.5%) and 3 patients (Meek, 2; SSG, 1) sustained inhalation injury receiving mechanical ventilation support. The mean TBSA for Meek was 26.7% (SD, 8.5%) whist SSG was 16.1% (SD, 6.4%). Mean LOS for Meek and SSG were 52.7 days (SD, 28.2 days) and 30.1 days (SD, 18 days) respectively. Generally, topography of burns for Meek and SSG was comparable without statistical differences except for genitalia. Both Meek and SSG has comparable cases with hand involvement. All patients in SSG group were grafted only with conventional split thickness skin grafting. In the Meek group, four patients underwent regrafting using split thickness skin grafts for residual wounds of 1–5%. The lower extremities were our preferred donor site of skin autograft harvest. In Meek, 11 cases (79%) had burns injuries involving lower extremities. The thigh was the donor site of choice for all Meek patients.

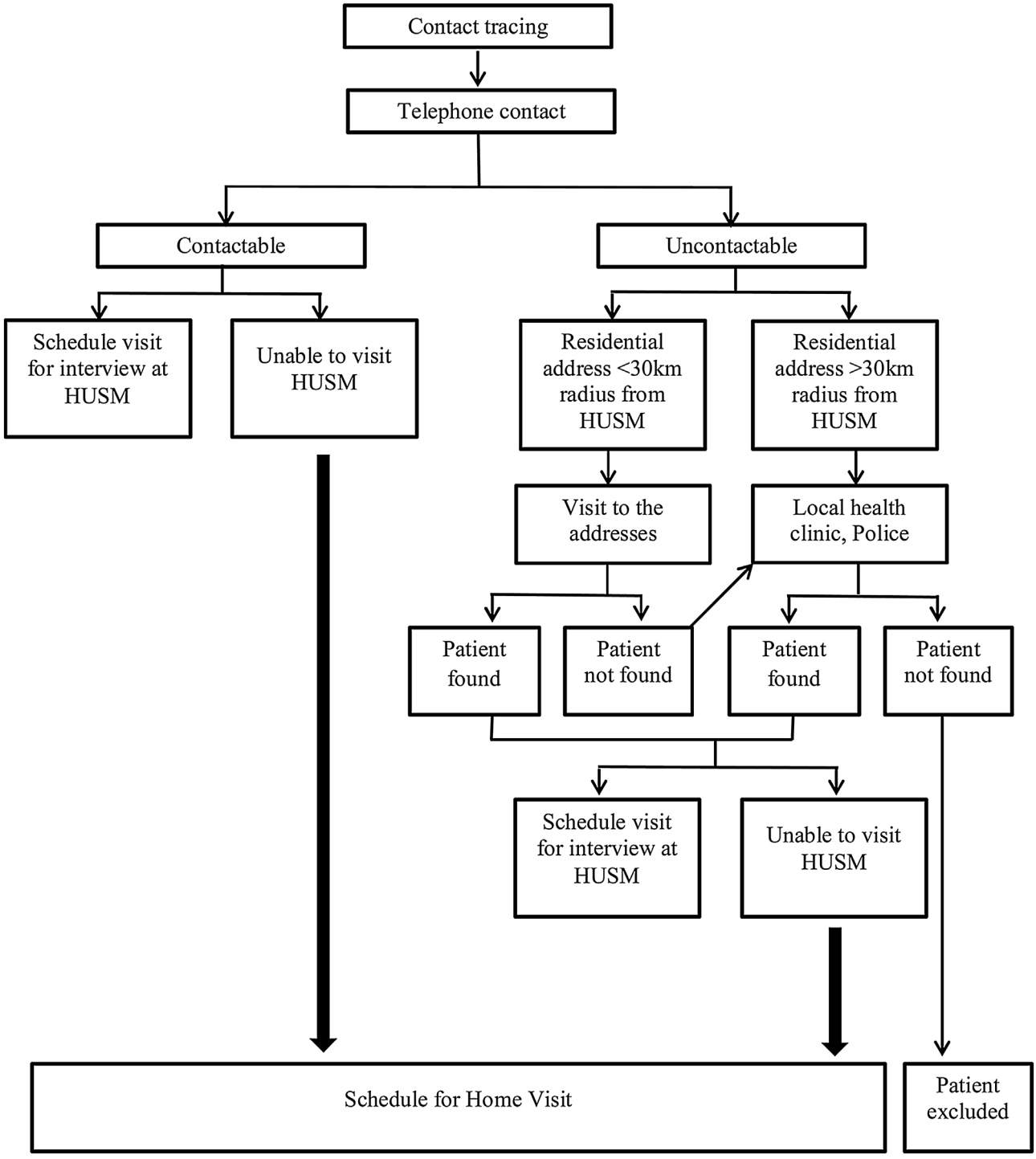

Fig. 2 – Contact tracing flow chart.

3.3. *Course of treatment*

Table 3 displays the variables on course of treatment. 14 patients (32.6%) underwent escharotomy of the extremities. Patients with Meek were tangentially excised and grafted earlier within a mean of 4.5 days (SD, 2.7 days) compared to those with SSG (Mean, 10 days; SD, 9.3 days). Mean graft take of Meek compared to SSG were 83.5% (SD, 14%) and 93% (SD, 6.5%) respectively. 18.6% of patients received contracture surgery. Most parameters were comparable between Meek and SSG except for first grafting, graft take and need of regrafting. These patients were operated by a group of surgeons in our center. This group of surgeons performed Meek micrografting and SSG on a similar, day-to-day proportions.

Table 1 – Baseline demographics (n = 43).

Characteristics	Meek micrografting (n = 15)	Conventional SSG (n = 28)	P-value
Age (years; at burn)[a]	20 (18.6, 4–68)	21.4 (18, 3–59)	0.80
Age (years; current)	24.7 (19.6,7–75)	25.9 (18.3, 7–65)	0.85
Gender			
Male	10 (23.3%)	19 (44.2%)	>0.99
Female	5 (11.6%)	9 (20.9%)	
Ethnic			
Malay	13 (30.2%)	26 (60.5%)	0.60
Chinese	2 (4.7%)	2 (4.7%)	
Marital status (at burn)			
Married	3 (7%)	9 (20.9%)	0.49
Single	12 (27.9%)	19 (44.2%)	
Education at burn			
Preschool	5 (11.6%)	6 (14%)	0.49
UPSR	0 (0%)	3 (7%)	
PMR	0 (0%)	3 (7%)	
SPM	3 (7%)	5 (11.6%)	
STPM	0 (0%)	2 (4.7%)	
Others	6 (14%)	8 (18.6%)	
University	1 (2.3%)	1 (2.3%)	
Education at burn (years)[a]	5.4 (5.8, 0-15)	6 .1(4.9, 0-14)	0.66
Occupation (at burn)			
Studying	4 (9.3%)	8 (18.6%)	0.96
Unemployed	5 (11.6%)	10 (23.3%)	
Employed	6 (14%)	10 (23.3)	

SSG, split skin graft; UPSR, Ujian Pencapaian Sekolah Rendah; PMR, Penilaian Menengah Rendah; SPM, Sijil Pelajaran Malaysia; STPM, Sijil Tinggi Persekolahan Malaysia.
[a] Mean (standard deviation, range).

3.4. *Burn Specific Health Score-brief (BSHS-B)*

Table 4 illustrated the outcome of the BSHS-B questionnaires All 43 patients understood the Malay version of the BSHS-B questionnaire and were able to provide responses to the items of the questionnaire either independently or with assistance by the interviewer. Twenty (46.5%) patients did not provide responses to the sexuality subscale. In the work subscale, 23 (53.5%) patients omitted the provided items. When the 9 subscales were compared individually, all subscales showed higher mean scores in Meek compared to SSG except the work and the heat sensitivity subscale.

To facilitate a better and broader description of the functional outcome [25], the simplified 3-domain structure was analyzed (Table 5). Due to the drop out of responses in the work and the sexuality subscales, these two subscales were analyzed as individual item and were excluded from the domain structure. Affect and relation; and function domain showed Meek produced higher mean score than SSG. In the skin involvement domain, Meek had slightly higher mean score than SSG. The sexuality subscale had higher mean score in Meek compared to SSG while the work subscale showed higher mean score in SSG. However, all scores differences were not statistically significant.

2-way ANOVA test showed that the interaction effects of mechanism of burn, escharotomy and regrafting on the main effect of graft types (Meek and SSG) on BSHS-B score were statistically significant (Table 7). Follow-up test using a one-way between-groups ANOVA showed that for both graft types, there was no statistical significant difference in work subscale score for mechanism of burn. For escharotomy and regrafting variables, follow-up test using the independent-samples t test showed that for both graft types, there was no statistical significant difference in the interacted domains or subscales score. Other categorical variables did not cause significant interaction effect on the main effect.

A one-way between-group ANCOVA test was conducted to compare the functional outcome of two grafting methods based on the BHSH-B questionnaires (Table 7). Upon controlling the covariates of this cohort, the outcome of BSHS-B between graft types did not reach statistical significance. Furthermore, partial eta squared values of all covariates showed that the effect size on BSHS-B scores was generally small to moderate. First grafting (partial eta squared, 0-0.03) and graft take (partial eta squared, 0-0.02) showed small effect size. TBSA (partial eta squared, 0-0.11) and length of stay (partial eta squared, 0-0.09) showed small to moderate effect size.

3.5. *Vancouver Scar Scale (VSS)*

Table 6 displays the comparison of VSS on Meek and SSG. Meek showed significantly lower mean score compared to SSG in the pigmentation, the pliability and the height components. The total mean score for Meek was significantly lower than that of SSG.

A two-way between-group ANOVA test showed that the interaction effects of all categorical variables on the main effect of graft types (Meek and SSG) on outcome of VSS score did not reach statistical significance (Table 8). Regrafting (partial eta squared, 0-0.53) had small effect on VSS scores outcome.

A one-way between-group ANCOVA test was conducted to compare the VSS score outcome of the two grafting methods

Table 2 – Details of burns (n = 43).

Characteristics	Meek micrografting (n = 15)	Conventional SSG (n = 28)	P value
Mechanism of burns			
Hot water	1 (2.3%)	10 (23.3%)	0.18
Flame	12 (27.9%)	14 (32.6%)	
Thermal	0 (0%)	1 (2.3%)	
Chemical	1 (2.3%)	0 (0%)	
Electrical	1 (2.3%)	2 (4.7%)	
Others	0 (0%)	1 (2.3%)	
First aid			
Yes	0 (0%)	4 (9.3%)	0.28
No	15 (34.9%)	24 (55.8%)	
Duration of exposure (sec)[a]	34.1 (47.1, 2–180)	67.7 (102.5, 1–300)	0.24
Location of incidence			
Home/domestic	10 (23.3%)	22 (51.2%)	0.52
At work/industrial	3 (7%)	4 (9.3%)	
Assault	1 (2.3%)	0 (0%)	
Others	1 (2.3%)	2 (4.7%)	
Inhalational injury			
Yes	2 (4.7%)	1 (2.3%)	0.28
No	13 (30.2%)	27 (62.8%)	
Length of stay (day)[a]	52.7 (28.2, 14–128)	30.1 (18, 14–92)	0.00*
TBSA (%)[a]	26.7 (8.5, 13–40)	16.1 (6.4, 10–32)	0.00*
Topography of burns			
Head and neck	6 (14%)	8 (18.6%)	0.51
Trunk	12 (27.9%)	21 (48.8%)	>0.99
Arm and forearm	11 (25.6%)	19 (44.2%)	>0.99
Lower limbs	12 (27.9%)	19 (44.2%)	0.49
Genitalia	3 (7%)	0 (0%)	0.04*
Hand involvement	10 (23.3%)	15 (34.9%)	0.41

SSG, split skin graft; TBSA, total body surface area.
* $P < 0.05$.
[a] Mean (standard deviation, range).

(Table 8). Upon controlling all covariates, the mean total score of Meek was still significantly lower than that of SSG. After adjusting for TBSA, length of stay, graft take and first grafting, majority of the mean component scores of Meek were still significantly lowered than that of VSS. TBSA (partial eta squared, 0–0.05), length of stay (partial eta squared, 0.01–0.03), first grafting (partial eta squared, 0–0.01) and graft take (partial eta squared, 0–0.05) showed small effect size.

3.6. *Relationship between VSS and BSHS*

The relationship between total score of VSS and BSHS was investigated using Pearson product-moment correlation coefficient (Table 9). There was a moderately negative correlation with skin involvement domain and work subscale. The negative correlation with affect and relation domain; and the function domain was small. Sexuality subscale showed no correlation with total score of VSS.

3.7. *Burn topography and study outcome*

A two-way between-group ANOVA test was conducted to examine the interaction of burn topography on the main effect of graft types on outcome of both BSHS-B and VSS scores. Table 10 illustrated the effects of burn topography on BSHS-B scores and total score of VSS. The influence of burn topography on BSHS-B and total score of VSS did not reach statistical significance. Hand involvement and burn over arm and forearm caused moderate to strong effect on BSHS-B score. The effect size of topography on total score of VSS was small.

4. Discussion

Burn care is challenging and benefits from a holistic approach medically and surgically. In extensive full thickness burns, early tangential excision of burn eschar [1,17,28,29] and coverage with autologous skin graft is the mainstay of treatment in acute burns surgery [1,4,29]. Burn injuries affect all age group and can be due to a variety of mechanisms. There is lack of research regarding burn care in Malaysian literature. Most of the published researches were epidemiological studies [30–32]. Our research is thus the pioneer for functional outcome assessment in the Malaysian population. Chan et al. [30] and Ghani et al. [31] conducted single-center retrospective review respectively in mixed-age group. Ibrahim et al. [32] described childhood burns in 94 children. Being our neighboring colleagues, Song and Chua studied on epidemiology of burn injuries in Singapore [33]. Despite focusing on functional outcome, the baseline demographic data and burns details of this cohort of the Malaysian East Coast can contribute to the scanty epidemiological studies for the Malaysian population.

The demographic data and burns detail of this cohort were not comparable to published epidemiological studies

Table 3 – Course of treatment (n = 43).

Characteristics	Meek micrografting (n = 15)	Conventional SSG (n = 28)	P value
Escharotomy			
Yes	7 (16.3%)	7 (16.3%)	0.18
No	8 (18.6%)	21 (48.8%)	
Microbiology			
No growth	11 (25.6%)	9 (20.9%)	0.19
Mixed growth	3 (7%)	1 (2.3%)	>0.99
Staphylocccus aureus	2 (4.6%)	0 (0%)	0.54
MRSA	0 (0%)	1 (2.3%)	0.35
Pseudomonas	14 (32.6%)	8 (18.6%)	0.84
Acinetobacter spp.	2 (4.6%)	1 (2.3%)	>0.99
Acinetobacter MRO	2 (4.6%)	1 (2.3%)	>0.99
Enterococcus spp.	1 (2.3%)	0 (0%)	>0.99
Proteus mirabilis	1 (2.3%)	0 (0%)	>0.99
First grafting (days after burn)[a]	4.5 (2.7, 1–12)	10 (9.3, 2–46)	0.03*
Graft take (%)[a]	83.5 (14, 50-97)	93 (6.5, 75-100)	0.00*
Regrafting			
Yes	10 (23.3%)	8 (18.6%)	0.02*
No	5 (11.6%)	20 (46.5%)	
Contracture			
Yes	5 (11.6%)	7 (16.3%)	0.72
No	10 (23.3%)	21 (48.8%)	
Contracture surgery			
Yes	5 (11.6%)	3 (7%)	0.10
No	10 (23.3%)	25 (58.1%)	

MRSA, methicillin resistance *Staphylococcus aureus*; MRO, multiple resistance organism.
* $P < 0.05$.
[a] Mean (standard deviation, range).

Table 4 – BSHS-B scores.

Functional subscale	Mean (SD, range)		t Statistic[a]	P value
	Meek micrografting	Conventional SSG		
Affection (n = 43)	3.76 (0.35, 2.86–4)	3.65 (0.39, 2.71–4)	−0.95	0.35
Sexuality (n = 23)	3.93 (0.15, 3.67–4)	3.72 (0.57, 2–4)	−1.087	0.29
Interpersonal relationship (n = 43)	3.97 (0.13, 3.5–4)	3.85 (0.3, 3–4)	−1.805	0.08
Hand function (n = 43)	3.88 (0.29, 3–4)	3.68 (0.75, 1.2–4)	−1.257	0.22
Work (n = 20)	3.13 (1.2, 0.5-4)	3.27 (1.25, 0-4)	0.261	0.80
Simple abilities (n = 43)	3.89 (0.27, 3–4)	3.77 (0.47, 2.33–4)	−0.869	0.39
Heat sensitivity (n = 43)	3.21 (1.2, 0.4–4)	3.49 (0.59, 1.4–4)	0.826	0.42
Treatment regimes (n = 43)	3.39 (0.77. 1.4–4)	3.28 (0.74, 1–4)	−0.451	0.64
Body image (n = 43)	3.52 (0.79, 1–4)	3.29 (0.81, 1.25–4)	−0.902	0.37

SSG, split skin graft; SD, standard deviation.
[a] Independent t test.

[30,31,33], however it displayed similarities in certain aspects. The male to female ratio (Meek,2; SSG, 2.1) of our cohort was similar to those reported in the literature [30,33]. The incidence of burn injuries on male was higher due to few reasons. In the Malaysian population, the majority (61%) of labor force consisted of male workers [34]. With two thirds of employed persons being semi-skilled and low-skilled workers, many are therefore exposed to higher occupational risk. For those who were unemployed, being the dominant gender in most families, the males were more involved in domestic responsibilities which are prone to cause burns. On the other hand, male children tend to be more adventurous and mischievous [33]. Similar to study by Chan et al. [30], the majority of patients were ethnic Malay as the Malays are the ethnic majority in the Malaysian population.

The most common mechanism of burns in this study was flame injury. This is in contrary to other published study whereby scalding injury was the commonest mechanism of burns [30,31,33]. This does not reflect the epidemiology of our population as the population sampling for our research objective involved patients with deep burns who underwent skin grafting. Similar to study by Ghani et al. [31], the majority of burns injury in our study occurred at home. This is because our study involved mixed-age group and only one third of our

Table 5 – BSHS-B functional domains.

Functional domains	Mean (SD, range)		t Statistic[a]	P value
	Meek micrografting	Conventional SSG		
Affect and relation (n = 43) Affect Interpersonal relationship	3.86 (0.23, 3.18–4)	3.75 (0.31, 2.98–4)	−1.271	0.21
Function (n = 43) Hand function Simple abilities	3.88 (0.2, 3.4–4)	3.73 (0.6, 1.77–4)	−0.984	0.33
Skin involvement (n = 43) Heat sensitivity Treatment regimes Body image	3.37 (0.75, 1.33–4)	3.35 (0.58, 1.55–4)	−0.108	0.91

SSG, split skin graft; SD, standard deviation.
[a] Independent t test.

Table 6 – Vancouver Scar Scale (n = 43).

Component	Mean (SD, range)		t-Statistic[a]	P value
	Meek micrografting	Conventional SSG		
Pigmentation	1 (0.85, 0–2)	1.71 (0.46, 1–2)	3.606	0.00*
Vascularity	0.47(0.52, 0–1)	0.82 (0.82, 0–2)	1.519	0.14
Pliability	1.40 (1.12, 0–3)	2.29 (1.21, 1–5)	2.341	0.02*
Height	0.67 (0.62, 0–2)	1.07 (0.54, 0–2)	2.230	0.03*
Total score	3.53 (2.33, 0–8)	5.96 (2.43, 2–10)	3.175	0.00*

SSG, split skin graft; SD, standard deviation.
* $p < 0.05$.
[a] Independent t-test.

patients were employed when they sustained the burns injuries. The mean TBSA for Meek was significantly higher than that of SSG as Meek is preferably used in our patients who had major burns with paucity of skin autograft donor sites while minimizing donor site morbidity. Thus, this was translated to a significant longer length of stay for Meek compared to SSG. However, the average length of stay per percentage for Meek in this study (1.9 days per percentage of burn) is comparable to the study by Lee et al. [20] in major pediatric burns (1.6 days per percentage of burn). TBSA was examined using multivariate analysis; however, it did not impact on outcome of BSHS-B and VSS for the two grafting techniques (Tables 7 and 8).

We concur with Ghani et al. [31] that the limbs were the commonly involved burn area. The trunk was also a comparable frequent site. In our study population, almost half of the patients had burns over hands. The limbs allow us to interact with the environment and thus enabling us to perform various complex daily functions exquisitely. As reflected in our study, the trunk is one of the commonest burn areas as it is directly exposed surrounding while daily activities are performed. In addition, the frequency of hands involvement in our study is parallel to published literature as the hands are the mechanisms which facilitate precise human interaction with the environment [35–37]. Analysis of effect size in this cohort showed that despite being small in surface area, the hand had moderate to strong influence on the outcome of BSHS-B scores compared to other parts of the body which had larger surface area (Table 10).

We practiced early tangential excision and grafting in majority of our patients [28]. However, in this cohort, there was a significant difference in day of first grafting between Meek and SSG. Patients who were grafted using the Meek technique were grafted early (Table 3). This is because the burn TBSA for Meek was greater than that of SSG, thus in this group of patients, early tangential excision was prioritized to avoid the morbidity associated with systemic inflammation and local infection. Furthermore, in patients with higher TBSA, paucity of skin autograft donor sites became the challenge to obtain burn wound coverage. Thus Meek was preferably used. In the group of patients grafted with SSG, the burn TBSA was lower; therefore, tangential excision was delayed for better wound demarcation so as to prevent over-debridement and ultimately reducing donor site morbidity to the minimum. This (first grafting) did not affect the outcome of BSHS-B and VSS for the two grafting techniques when this factor was adjusted as covariate in multivariate analysis (Tables 7 and 8).

Table 7 – Relationship of study variables on the BSHS-B outcome of two graft types.

	Affect and relation (n = 43)			Function (n = 43)			Skin involvement (n = 43)			Work (n = 20)			Sexuality (n = 23)		
	df	F	P value	df	F	P value	df	F	P value	df	F	P value	df	F	P value
Interaction[a]															
Gender	1,16	0.07	0.79	1,16	2.12	0.17	1,16	0.76	0.40	1,16	2.74	0.12	1,16	0.43	0.52
Ethnic	1,16	0.20	0.65	1,16	0.62	0.44	1,16	2.35	0.15	1,16	2.62	0.13	1,16	3.81	0.07
Marital status	1,16	0.44	0.52	1,16	1.31	0.27	1,16	4.38	0.05	1,16	3.23	0.09	1,16	0.04	0.84
Educational status	2,11	0.26	0.78	2,11	0.57	0.58	2,11	3.76	0.06	2,11	3.57	0.06	2,11	20.50	0.18
Occupation (at burn)	1,15	2.47	0.14	1,15	1.57	0.23	1,15	0.12	0.74	1,15	0.38	0.55	1,15	0.11	0.75
Mechanism of burn	2,34	2.62	0.09	2,34	3.26	0.05	2,34	1.16	0.33	1,13	10.10	0.01*	1,16	3.46	0.08
First aid	0	–	–	0	–	–	0	–	–	0	–	–	0	–	–
Location of incidence	2,13	0.20	0.83	2,13	1.64	0.23	2,13	0.10	0.91	2,13	0.07	0.94	2,13	0.52	0.61
Inhalational injury	1,16	0.25	0.62	1,16	0.04	0.84	1,16	0.001	0.98	1,16	0.03	0.86	1,16	0.07	0.80
Escharotomy	1,39	4.03	0.05	1,39	2.44	0.13	1,39	5.23	0.03*	1,16	18.59	0.00*	1,19	1.56	0.23
Regrafting	1,16	8.37	0.01*	1,16	1.21	0.28	1,16	8.24	0.01*	1,16	5.47	0.03*	1,16	0.45	0.05
Contracture	1,39	3.98	0.05	1,39	1.41	0.24	1,39	0.02	0.90	1,16	1.40	0.26	1,16	4.39	0.05
Contracture surgery	1,39	0.68	0.42	1,39	0.61	0.44	1,39	1.00	0.32	1,16	0.03	0.86	1,16	0.13	0.72
Covariates[b]															
Age (at burn)	1,17	0.14	0.72	1,17	0.21	0.65	1,17	0.46	0.51	1,17	0.05	0.83	1,17	0.52	0.48
Age (current)	1,17	0.12	0.74	1,17	0.22	0.64	1,17	0.52	0.48	1,17	0.05	0.83	1,17	0.55	0.47
Education at burn	1,17	0.06	0.82	1,17	0.15	0.70	1,17	0.83	0.37	1,17	0.21	0.65	1,17	0.57	0.46
Duration of exposure	1,17	0.01	0.91	1,17	0.04	0.85	1,17	0.20	0.66	1,17	0.33	0.58	1,17	0.18	0.68
Length of stay	1,17	0.10	0.75	1,17	1.16	0.30	1,17	1.90	0.19	1,17	0.09	0.77	1,17	1.10	0.31
TBSA	1,17	0.98	0.34	1,17	1.83	0.19	1,17	0.33	0.58	1,17	0.45	0.51	1,17	0.49	0.49
Graft take	1,17	0.07	0.80	1,17	0.17	0.69	1,17	0.29	0.60	1,17	0.04	0.80	1,17	0.58	0.46
First grafting	1,17	0.01	0.93	1,17	0.73	0.40	1,17	0.32	0.58	1,17	0.32	0.58	1,17	0.11	0.74

TBSA, total body surface area; df, degree of freedom.
* $p < 0.05$.
[a] 2-way ANOVA test.
[b] ANCOVA test.

The graft take of SSG was significantly better than Meek in this cohort. Despite not comparable with SSG, the mean graft take of 84% for Meek in this cohort was comparable with published literature of 85%–95% [1,2,17,19]. Meek patients were more likely to undergo regrafting compared to SSG patients. This is due to the higher burn TBSA in Meek patients. Graft take and regrafting were examined using multivariate analysis; however, they did not impact on outcome of BSHS-B and VSS for the two grafting techniques (Tables 7 and 8).

Donor site morbidity was minimized as much as possible in our center. Therefore, the thigh was the preferred donor site as it would be well concealed and not easily noticeable when patients returned back to their daily living. By using the Meek technique, the amount of skin harvested can be kept to the minimum. Moreover, even small amount of unburnt skin on the thigh can be harvested and expanded to various ratios for adequate coverage of burn wounds.

Due to advancement in burn care, survival rate of major burns has increased, leading to the greater emphasis on functional outcome assessment. The BSHS-B questionnaire is a widely used tool for functional outcome assessment and was validated in various translated languages [38–42]. The BSHS-B [9] questionnaire was used to assess a range of functional and psychosocial outcomes following burn injury. The BSHS-B contains 40 items that are rated on a 5-point Likert scale from 0, extremely; 1, quite a bit; 2, moderately; 3, a little bit; to 4, not at all. The items assess perceived difficulties, and thus, low scores indicate extreme difficulties, whereas high scores indicate no perceived difficulties. The items are divided into nine subscales: simple abilities, hand function, heat sensitivity, treatment regimens, body image, affect, interpersonal relationships, sexuality, and work. Each of the domains are internally consistent and can be used as separate clinically meaningful subscales to evaluate burned patients [9]. Thus each subscales will have a mean score [43]. The Malay language is one of the commonest spoken languages in Malaysia and no authorized formal validated Malay version of the BSHS-B is available so far. The questionnaire for the patient was translated into the Malay language by professionals and linguists from School of Languages, Literacies and Translation, Universiti Sains Malaysia. Once translated, face validation [44] was conducted on 10 random burn respondents. Any ambiguity of words and misinterpretation of questions were rectified and the questionnaire was re-validated. The finalized Malay version of BSHS-B was used for the study. The nine subscales were grouped into three domains [25] which comprised of affect and relations (affect, interpersonal relationships, sexuality), function (simple abilities, hand function, work) and skin involvement (heat sensitivity, treatment regimens, body image). Grouping of subscales were described by Willebrand et al. [25] based on the prior study on development of BHSH-B by Kildal et al. [9] Grouping of 9 subscales into 3 simplified domains increased the understanding of outcome after burn injury and was useful in the routine clinical use of the BSHS-B.

Table 8 – Relationship of study variables on the VSS outcome of two graft types.

	Pigmentation (n = 43)			Vascularity (n = 43)			Pliability (n = 43)			Height (n = 43)			Total score (n = 43)		
	df	F	P value	df	F	P value	df	F	P value	df	F	P value	df	F	P value
Interaction[a]															
Gender	1,39	2.61	0.11	1,39	3.35	0.08	1,39	1.06	0.31	1,39	0.10	0.76	1,39	0.29	0.59
Ethnic	1,39	0.28	0.60	1,39	1.54	0.22	1,39	1.46	0.23	1,39	0.58	0.45	1,39	1.09	0.30
Marital status	1,39	0.15	0.70	1,39	0.50	0.48	1,39	0.04	0.85	1,39	0.12	0.73	1,39	0.04	0.85
Educational status	3,32	0.21	0.89	3,32	0.31	0.82	3,32	0.19	0.90	3,32	0.18	0.91	3,32	0.13	0.94
Occupation (at burn)	2,37	1.20	0.31	2,37	1.89	0.17	2,37	0.24	0.79	2,37	0.17	0.32	2,37	1.38	0.27
Mechanism of burn	2,34	0.32	0.73	2,34	0.09	0.92	2,34	0.01	0.99	2,34	0.42	0.66	2,34	0.07	0.93
First aid	0	–	–	0	–	–	0	–	–	0	–	–	0	–	–
Location of incidence	2,36	2.88	0.07	2,36	0.53	0.59	2,36	0.75	0.48	2,36	0.90	0.42	2,36	1.04	0.37
Inhalational injury	1,39	0.14	0.72	1,39	0.91	0.35	1,39	1.39	0.25	1,39	0.39	0.53	1,39	0.04	0.84
Escharotomy	1,39	0.03	0.86	1,39	0.15	0.70	1,39	4.89	0.05	1,39	0.05	0.83	1,39	1.23	0.28
Regrafting	1,39	1.50	0.23	1,39	0.00	0.96	1,39	2.75	0.11	1,39	2.20	0.15	1,39	2.63	0.11
Contracture	1,39	0.93	0.34	1,39	1.57	0.22	1,39	1.43	0.24	1,39	1.06	0.31	1,39	1.78	0.19
Contracture surgery	1,39	1.70	0.20	1,39	0.25	0.62	1,39	1.35	0.25	1,39	0.20	0.65	1,39	0.72	0.40
Covariates[b]															
Age (at burn)	1,40	12.80	0.00*	1,40	2.51	0.12	1,40	6.61	0.01*	1,40	5.12	0.03*	1,40	11.4	0.00*
Age (current)	1,40	12.82	0.00*	1,40	2.53	0.12	1,40	6.68	0.01*	1,40	5.16	0.03*	1,40	11.57	0.00*
Education at burn	1,40	13.65	0.00*	1,40	2.30	0.14	1,40	5.18	0.03*	1,40	4.69	0.04*	1,40	9.621	0.00*
Duration of exposure	1,40	11.40	0.00*	1,40	2.42	0.13	1,40	4.51	0.04*	1,40	4.54	0.04*	1,40	9.00	0.01*
Length of stay	1,40	14.25	0.00*	1,40	1.62	0.21	1,40	6.85	0.01*	1,40	2.34	0.13	1,40	9.46	0.00*
TBSA	1,40	15.09	0.00*	1,40	0.65	0.42	1,40	2.21	0.15	1,40	4.46	0.04*	1,40	7.26	0.01*
Graft take	1,40	11.9	0.00*	1,40	5.02	0.03*	1,40	5.90	0.02*	1,40	3.51	0.07	1,40	10.83	0.00*
First grafting	1,40	11.69	0.00*	1,40	2.57	0.12	1,40	4.24	0.04*	1,40	4.86	0.03*	1,40	9.04	0.01*

TBSA, total body surface area; df, degree of freedom.
* $p < 0.05$.
[a] 2-way ANOVA test.
[b] ANCOVA test.

Therefore, each domain in the simplified grouping will be used as research objectives for our study so that burn functional outcome can be better described. This questionnaire was not applied in the daily practices of our center. As a sprouting attempt to introduce this tool to our center, this tool was applied by one person during the course of this study to minimize misunderstandings on the questionnaire. This study is thus the pioneer in the introduction of the translated Malay version of the BSHS-B.

During the conduct of the study, there were missing data in the work (n = 20) and sexuality (n = 23) subscales. Only 46.5% of patients provided responses to the work subscale as only one third of patients in this cohort were employed during burn injury. Therefore, the work subscale was excluded from the function domain and was used as an independent outcome subscale in this study. This echoed the similar findings by Willebrand et al. [25] whereby the work subscale was excluded from the simplified 3-domain BSHS-B questionnaire due to consistent double loading in statistical factor analysis. For the sexuality subscale, only 53.5% of patients completed the items.

Table 9 – Pearson correlation of total score of Vancouver Scar Scale.

Total score of Vancouver Scar Scale	n	r	P value
Affect and relation domain Affect Interpersonal relationship	43	−0.141	0.37
Function domain Hand function Simple abilities	43	−0.176	0.26
Skin involvement domain Heat sensitivity Treatment regimes Body image	43	−0.444	0.00*
Work subscale	20	−0.374	0.10
Sexuality subscale	23	−0.007	0.97

r, Pearson correlation coefficient.
* $P < 0.05$.

Table 10 – Burn topography and study outcome.

	Head and neck		Trunk		Arm and forearm		Lower limb		Genitalia		Hand involvement	
	η^2	p	η^2	p	η^2	p	η^2	p	η^2	p	η^2	p
BSHS-B components												
Affect and relation domain	0.00	0.95	0.03	0.51	0.14	0.13	0.00	0.80	0.01	0.63	0.15	0.11
Function domain	0.04	0.46	0.02	0.58	0.07	0.30	0.05	0.39	0.01	0.69	0.09	0.24
Skin involvement domain	0.00	0.80	0.04	0.44	0.19	0.07	0.00	0.89	0.05	0.32	0.17	0.09
Work subscale	0.00	0.86	0.01	0.71	0.15	0.11	0.07	0.28	0.03	0.46	0.15	0.11
Sexuality subscale	0.05	0.40	0.06	0.33	0.00	0.99	0.05	0.38	0.02	0.58	0.00	0.87
VSS												
Total score	0.03	0.31	0.01	0.53	0.03	0.32	0.01	0.46	0.00	0.67	0.03	0.32

η^2, partial eta squared; p, P-value.

One of the reasons for this was because of the mixed-age group of our cohort in which some items in the sexuality subscale was not answered. In addition, due to the more conservative mindset of our cohort which consisted of mainly the ethnic Malays of the Malaysian East Coast states, the items in the sexuality subscales were not answered. Therefore, in order to facilitate analysis of this study, the sexuality subscale was analyzed as an independent subscale too. The exclusion of the sexuality subscale can possibly be a modification of the 3-domain BSHS for the Malay predominant population or even for the population Southeast Asian region which might possess a more conservative approach on sexuality awareness.

A Burn injury can result in long-term psychological and social disturbances to survivors [45,46]. These catastrophic sequelae will jeopardize the function of survivors as the related adverse effects can take precedent in everyday life of the survivor. The psychosocial problems and dysfunction related to a burn injury is not transient and can last for a long period of time after a burn injury; and therefore overriding the positive effects of survivorship [46]. In the affection and relation domain, the mean score of Meek was higher than SSG. Despite there was no statistical significance, this clinical difference in score reflected that the patients of Meek were emotionally better and were able to bond with family members more dynamically compared to patients of SSG. In this functional domain, the upper limbs (arm and forearm; and hand involvement) had greater effect size compared to other body parts as the upper limbs were commonly involved the daily interpersonal interactions. This domain showed that Meek patients had better psychosocial recovery and better adaptation into normal life compared to SSG survivors.

Hand is exposed to external environment and is commonly involved in burns injuries [35–37]. Despite accounting for approximately 6% of burn TBSA [36], the hands' contribution to activities of daily living are great that any form of morbidities occurred from burns injury will incur substantial functional impairment. Hand involvement has moderate effect size on function domain (Table 10). However, the interaction of hand involvement on the outcome of function domain was not significant. We found that Meek has higher mean score in function domain compared to SSG. Albeit not statistically significant, the function domain for Meek was clinically better than SSG and the outcome of function domain in this cohort was due to the main effect of graft type. In surgical management of hand burns, autologous SSG is recommended and sheet SSG is a preferred choice compared to mesh SSG [35–37]. Brian et al. [36] stated that the healing of meshed grafts via epithelization of interstices causes scar contractures, thus meshed grafts are not recommended in hand burns. In contrary to published literature, Meek can be used in cases of hand burns especially in extensive burns with limited skin autograft donor sites while achieving superior functional outcome than conventional SSG (Figs. 3 and 4)).

In skin involvement domain, Meek patients achieved slightly higher mean score compared to that of SSG (Table 5). This outcome was main due to the main effect of the two grafting technique after examining all the variables of this cohort with multivariate analysis (Tables 7 and 8). In this domain, we found that the upper limb incurred the most effect compared to other body parts mainly because the upper limbs were commonly involved in daily interactions with the environment (Table 10). This domain is important as the skin reflects the image of an individual. The subscales of this domain were examined and there were higher mean scores in the body image and treatment regime subscales. The self-perception on body image and the adaptation on treatment protocols of Meek patients were better compared to SSG. These contributed to better self-confidence and less shame; ultimately translates into positivity in survivorship and functional outcome.

Hypertrophic scarring after burn injury results in significant challenges for both burn survivors and burn-care providers. Scarring can have repercussions on functional and psychological outcome of burn survivors. Falder et al. [7] identified scarring as an outcome of one of the seven core domains for burn outcome assessment. An unsightly hypertrophic scar will lead to shame, lack of confidence and social avoidance; thus negatively affecting functional outcome. Furthermore, burn scar contracture is sequelae that is invariably challenging for the burn surgeon to achieve good functional outcome. Burn scar assessment was performed using the four-component Vancouver Scar Scale, first described by Sullivan et al. [47] in 1990. Pigmentation, vascularity, pliability and scar height were assessed independently. The scores of all components were summed as total score [48,49]. Normal skin had a score of 0. Increasing score was assigned to

Fig. 3 – 40% TBSA flame burn in a 21 year-old gentleman involving both upper extremities and hands which were grafted using the Meek technique. (A–C) 7 years after Meek micrografting with good hand range of movement. There was flexion contracture over the left little finger (minor joint). (D) Good pliability over the Meek grafted area.

greater pathological condition of the scar. This scale facilitated the objective assessment of the scar outcome of our cohort. Lee et al. [20] examined the outcome of Meek technique in pediatric-only population and described about the good aesthetic appearance and the low contracture formation using the Meek technique. In this study, we concur that the scar appearance of Meek was significantly superior compared to SSG as evidenced by lower mean score of most of components of VSS and also the total score of VSS (Table 6).

Interestingly, we found that the total score of VSS has a negative correlation with BSHS-B in our cohort (Table 9). This further strengthen the fact that burn scarring is a factor that should never be neglected in burn care. In the domain of skin involvement, the negative correlation was moderate and was statistically significant. Scarring causes shame and eventually poor functional recovery. As the upper limb contribute to greater effect size in this domain despite being lower in surface area compared to other body parts, scarring will produce a substantial amount of functional deficit on burn survivors. Another advantage of this correlation is that the VSS total score will enable us to reciprocally have a rough idea on the impact of the functional outcome of the patient.

In this study, our primary outcome of long term functional outcome consisted of the BSHS-B questionnaires and the VSS. The clinical data of Meek and SSG showed that both groups were comparable except few variables (Tables 1–3). However, multivariate analysis showed that the variables of this study does not interfere with the main effect of graft types on the primary outcome (Tables 7 and 8). In the simplified 3-domain structure (Table 5), despite there was no statistical significance, all functional domains produced higher mean scores in Meek compared to SSG. The better score of BSHS-B domains is considered as a relevant clinical significance in our cohort. On

Fig. 4 – 15% TBSA scalding burn in a 4 year-old boy involving right forearm and hand. Forearm was grafted using SSG with 1:1.5 meshed expansion whereas the hand was grafted with SSG sheaths. It was complicated with flexion and extension contractures over the hand.

the other hand, in the aspect of burn scarring, Meek showed superior scar outcome which was statistically significant. The correlation of BSHS-B and total score of VSS is clinically relevant too. Therefore, with the yield of these two objective assessments, we can conclude that Meek had better long term functional outcome compared to SSG.

To our best knowledge, this is the first comparison study on functional outcome of the Meek technique versus conventional SSG. We recognize that there are few notable limitations in our study. The study design is not prospective in nature, thus selection bias will be a limitation in this study despite much effort made during the conduct of this study to keep bias to the minimum. The sample size of our cohort is not large because in this retrospective study, recruitment of patients for follow up was challenging and home visits were necessary to obtain adequate patients. Meek micrografting is not as common compared to conventional SSG in management of burn in our center. As such, collaboration with other centers in future would be beneficial to extend this study to achieving greater impact. In addition, this study cohort involved mixed-age group whereby the functional assessment questionnaire used required guidance from the interviewer especially in the younger and the elderly spectrum of patients. The Malay version of the BSHS-B questionnaire was not formally validated. However, this study enabled us to identify points required to tailor the questionnaire to our population; thus becoming a stepping stone towards a formal validation in future. A prospective study with similar goals using the validated Malay version of the BSHS-B shall be the next aim in our center in the near future.

5. Conclusion

Parallel to the paradigm shift towards functional outcome assessment in burns care, our study revealed that the patients grafted using the Meek technique have better long term functional outcome compared to that of conventional SSG. Despite not statistically significant, the BSHS-B scores of Meek clinically overshadowed SSG. Moreover, the scar outcome of Meek was statistically superior to SSG. Therefore, we recommend the use of the Meek technique in management of major burns in all age groups.

Conflict of interest

None.

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