DONOR SITE MORBIDITY: COMPARING THE USE OF COBBETT KNIFE WITH ZIMMER ELECTRIC POWER DERMATOME IN HARVESTING PARTIAL THICKNESS SKIN GRAFT

ABSTRACT

Introduction: Skin grafting in many low resource centres is mostly harvested with Humby Knife and its various modifications. However, there is a gradual paradigm shift to the use of the electric dermatome.This study aimed to compare the rate of re-epithelialization of donor site wound, pain index, and scar formation using Cobbett Knife with Zimmer electric power dermatome in harvesting partial thickness skin grafts.

Materials and methods: The study comprised 76 patients recruited over a one year period. The patients were randomized into two groups (A and B) using systematic sampling. Those in group A had their donor site harvested with Cobbett Knife, while those in group B had their donor site harvested with Zimmer electric power dermatome. The predictive variables were the percentage rate of re-epitheliliazation, assessment of pain index, and scar formation. The outcome variable was to use a photographic picture on the 10th, 14th, and 21st day respectively to assess the rate of re-epithialization. A Numerical rating scale was employed to assess the pain index.

Result: There was no significant difference in the donor site morbidities between Cobbett knife and Zimmer electric dermatome in the percentage rate of re-epithelialization and evaluation of scar formation with a P-value of 0.304 and 0.416 respectively. However, data analysis of donor site pain between Cobbett knife and Zimmer electric dermatome was statistically significant with

a P- value of 0.042 and 0.031 respectively, in patients with mild pain at the 6th hr （hour） and 3rd day. There was no statistically significant difference on the 10th day with a p- value of 0.857.

Conclusion

From this study, the use of the Cobbett knife for the harvest of partial thickness skin graft is comparably the same as Zimmer electric power dermatome in terms of re-epitheliazation and scar formation. However, Cobbett knife is associated with more intense early post-operative pain compared to Zimmer electric power dermatome

Keywords: Donor site, Cobbett knife, morbidity, Zimmer electric power dermatome, partial thickness skin graft

INTRODUCTION

Donor site morbidities such as delay in re-epithelialization ~~of donor site wound,~~ infection, persistent donor site pain, or scar formation can occur after a partial thickness skin grafts.[1] Donor site morbidity of partial thickness skin grafts can be challenging resulting in longer hospital admission and higher cost of management.[2]

The effect of donor site morbidity has remained a public health problem globally, with its consequent postoperative complication ranging from dyschromia, itching, hypopigmentation, infection, and exaggerated pain.[3] Post-operative scar formation on the donor site was observed to be proportional to skin graft thickness and donor site infection; the deeper the layer of the donor site skin harvested, the longer it takes the donor site to heal and the greater the risk of infection.[2]

Several co-morbidities are known to increase the risk of donor site morbidity.[3,4] Hence preoperative evaluation of patient will help to mitigate these risk factors capable of increasing donor site morbidity. These risk factors include uncontrolled diabetes mellitus, abuse of steroid

injection, patients on chemotherapeutic drugs, HIV/AIDS patient not on medication, severely malnourished patients, jaundiced patients, previously radiated skin, liver and kidney disease.[4]

In addition, adequate preoperative assessment of donor skin is necessary to ameliorate donor site morbidity.[1]

The surfaces of the body selected as donor site for partial thickness skin graft should be easily concealed during recreational activities and by clothing, such places should also minimize discomfort during re-epithelization.[5] The most common sites include the upper anterior and lateral thigh, buttock, upper arm, forearm, and abdominal wall.[6]

Olawoye and colleague observed that 93.5% of plastic surgeons in West Africa sub-region use Humby knife or other modifications in harvesting skin graft whereas only about 40.4% used Power dermatome.[7] Few literatures have cited objective assessment of the rate of re-epthelialization of the donor site , its post-operative pain index, and scar formation when using different modifications of Humby knife for harvesting of skin.[3,7,8,9] Its advantages are based on the accessibility and availability of the various modification of Humby knife (Figure 1) in our low resource centres is indispensable.[7,8] Where electric power dermatome is available most plastic surgeons will opt for it use, because it provides a uniform skin harvest.[7]

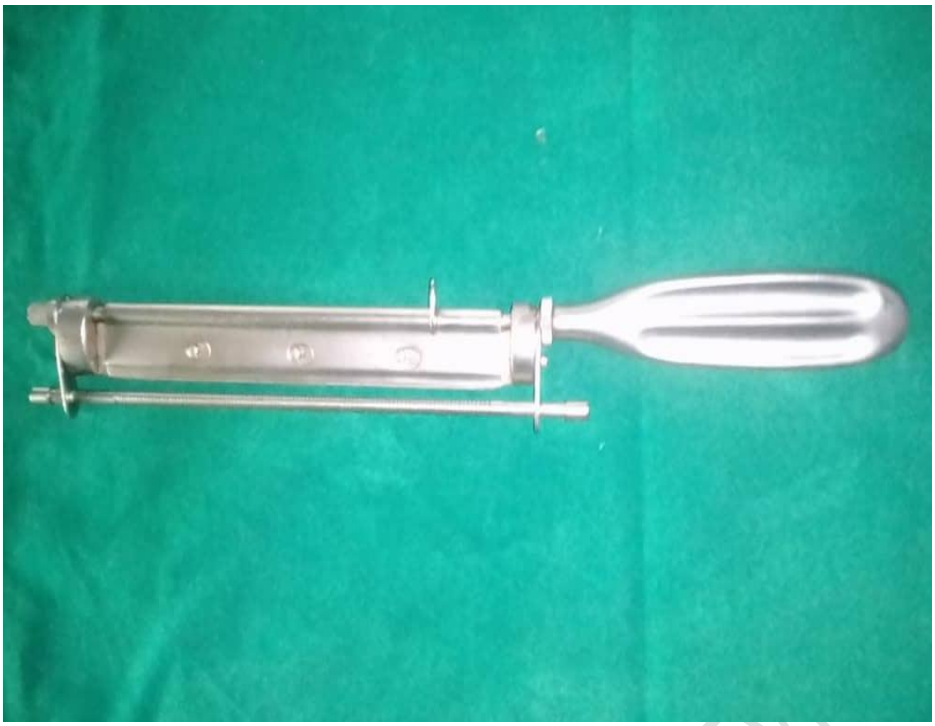

Figure 1: COBBETT KNIFE

In West Africa, donor site complications are poorly reported and few studies of donor site complications exist in the literature in our sub-region, where excessive tissue scarring is a major issue.[1] To the best of our knowledge, there are still no documented studies currently in our sub-region to validate the effectiveness of power dermatome over the traditional Humby knife and its modifications in the assessment of donor site rate of re-epithelialization, post- operative pain index, and scar formation. The purpose of this study is to compare the rate of re-epithelialization of donor site wound, pain index, and scar formation using Cobbett Knife with Zimmer electric power dermatome (Figure 2) in harvesting partial thickness skin grafts.

Fig 2: Zimmer Electric Power Dermatome

Materials and methods

This was a prospective study carried out over a period of one year （ pls mention the years）.

The study population was drawn from patients aged 18 to 70 years old. All patients with wounds requiring partial thickness skin grafts who consented were recruited into the study. Patients with HIV/AIDS, patients on steroid, patients with uncontrolled diabetes mellitus,or patients with peripheral vascular disease were excluded from this study.

The Cochrane's formula[10] for calculating the minimum size for comparative study was employed. The calculated sample size after adding the 10% attrition rate was 76. In each arm were 38 patients respectively in groups A and B.

A randomized systematic sampling method was used. Each patient recruited in the study was made to pick an envelope in a box containing 76 envelopes with 38 in group A and 38 in group B respectively. History and physical examination of the patients were carried out and recipient sites were prepared till they were free from B-haemolytic Streptococcus infections. Donor sites for both group A and B were prepared by cleaning twice with Cetrimide lotion (Savlon), dried with dry gauze and cleaned finally with methylated spirit before draping to expose site for surgery.

Cobbett knife was used to harvest skin graft in Group A, while group B used Zimmer electric power dermatome to harvest skin graft.

A sterile multilayered dressing material was applied to the donor site comprising of the inner sofra-tule as the non-adherent layer, gauze dressing soaked in povidone iodine as the capillary layer, gamgee as the absorbent layer, and lastly crept bandage as the adhesive layer in each group of patients on the donor site.

Donor site was inspected daily for strike through of blood or serous discharge as well as evidence of infections by observing the dressings over the wounds. Where unusual tenderness or pus discharge was observed, dressing was taken down, wound swabbed for culture and sensitivity and appropriate wound care commenced with wound dressings and antibiotics.

Pre- and post-treatment clinical photographs was taken using a Sony-Shot DSC-T110 16.1MP Digital Still Camera Carl Zeiss Vario-Tessar 4x Optical Zoom Lens and 3.0-inch Touch screen Camera with fixed illumination and accommodation distance of 25cm.The photographs were taken at post-operative day 10, 14, and 21 respectively . The photographic pictures were analyzed using adobe photo shop software for adequate collation and data analysis. At the 5th day postoperative period, the initial change of dressing of the donor site was done by debulking and subsequent inspection and removal of the capillary layers until all layers were completely removed leaving behind only the sofra-tulle dressing. Also, part of the sofra-tulle dressing layer was gradually removed by the 10th day.

A modification of the scale and scoring system used by Sharquie et al [11] which employs evaluation in five criteria (Colour, Elevation, Consistency, Itching and Pain) with scoring from 0-3 was used in evaluating the patients' response to treatment. The assessment of patient for scar formation was done after 4 weeks postoperative period. A caliper was used to measure the elevation of scar formation. Data obtained were subjected to descriptive analysis using the International Business Machine for Statistical Package for Social Sciences (IBM SPSS) version

22 software. Continuous variables were presented as means and standard deviations. Association between categorical variables was analyzed with the Chi-square tests or other non-parametric tests where applicable. The difference in the means between continuous variables was tested with the student's t-test. A p-value of < 0.05 was considered significant.

RESULTS

A total of 76 patients were recruited for this study. There were 36 (47.4%) males and 40 (52.6%) females. The ages of the patients ranged from 20 to 70 years with a mean age of 42.5±11.5 years. The demographic variables of the study participants are as shown in table 1.

Table 1: Demographic data of study participants

Variables	Zimmer power dermatome Mean(SD)	Cobbett knife Mean(SD)	Total	t-test	p-value
Age (years)	43.8(13.8)	41.9(8.7)	42.5(11.5)	1.034	0.305
Age range (years)	20-69	23-62	20-69		
Demographic – for categorical data				$\chi 2$ test	p-value
Age category (years)	N(%) N=38	N(%) N=38			
20-29	8(21.1)	4(10.5)	12(15.8)	8.344	0.080
30-39	6(15.8)	8(21.1)	14(18.4)		
40-49	11(28.9)	21(55.3)	32(42.1)		
50-59	7(18.4)	3(7.9)	10(13.2)		
60-69	6(15.8)	2(5.2)	8(10.5)		

Sex					
Male	18(47.4)	18(47.4)	36(47.4)	0.0001	0.591
Female	20(52.6)	20(52.6)	40(52.6)		
Occupation					
civil servant	5(13.2)	3(7.9)	8(10.5)		
Trader	14(36.8)	18(47.4)	32(42.1)		
Students	5(13.2)	6(15.8)	11(14.5)	3.073	0.689
Artisan	12(31.6)	7(18.4)	19(25.0)		
Professional	1(2.6)	2(5.3)	3(3.9)		
Retired /Pastor	1(2.6)	2(5.3)	3(3.9)		

This study used more regional anesthesia in each group than general anesthesia. (25.0% GA vs 75.0% regional). There was no significant difference in the type of anesthesia used in this study (p=0.427). The donor site for most of the study participants was thigh in 97.4% of participants with no statistically significant difference in the area of donor site selected (p=0.152). (pls mention other donor sites)

The distribution of percentage re-epithelialization was significantly different (p=0.034) among the two groups in favour of the Zimmer power dermatome group. Most of the study participants had re-epithelialization in the post-operative day (POD) 14. However, it was higher in Zimmer power dermatome (table 2). The distribution of dressing slippage between the two instruments was the same (p=1.000).

Table 2: Measure of re-epithelialization and wound healing among Zimmer power dermatome group and Cobbett humby knife group

Variables	Zimmer power dermatome N(%) N=38	Cobbett humby knife N(%) N=38	Total	$\chi 2$ test	p-value
Percentage re-epithelialization					
POD 10	1(2.6)	1(2.6)	2(2.6)	6.773	0.034
POD 14	34(89.5)	25(65.8)	59(77.6)		
POD 21	3(7.9)	12(31.6)	15(19.7)		
dressing slippage					
Yes	3(7.9)	3(7.9(	6(7.9)	0.00001	1.000
No	35(92.1)	35(92.1)	70(92.1)		
Day of complete re-epithelialization (days)					
14	32(84.2)	31(81.6)	59(77.6)	4.063	0.398
17	1(2.6)	0	1(1.3)		
21	5(13.2)	4(10.5)	12(15.8)		
22	0	1(2.6)	1(1.3)		
25	0	2(5.3)	2(2.5)		
delay healing of donor site wound after 21 days					
Yes	1(2.6)	3(7.9)	4(5.3)	1.056	0.304
No	37(97.4)	35(92.1)	72(94.7)		
Presence of infection					
Yes	4(10.5)	6(15.8)	10(13.2)	0.461	0.497
No	34(89.5)	32(84.2)	66(86.8)		

There was no statistically significant difference in distribution of the days of complete re-epithelialization (p=0.304). Most of the study participants (77.6%) had complete re-epithelialization within the 14th day.

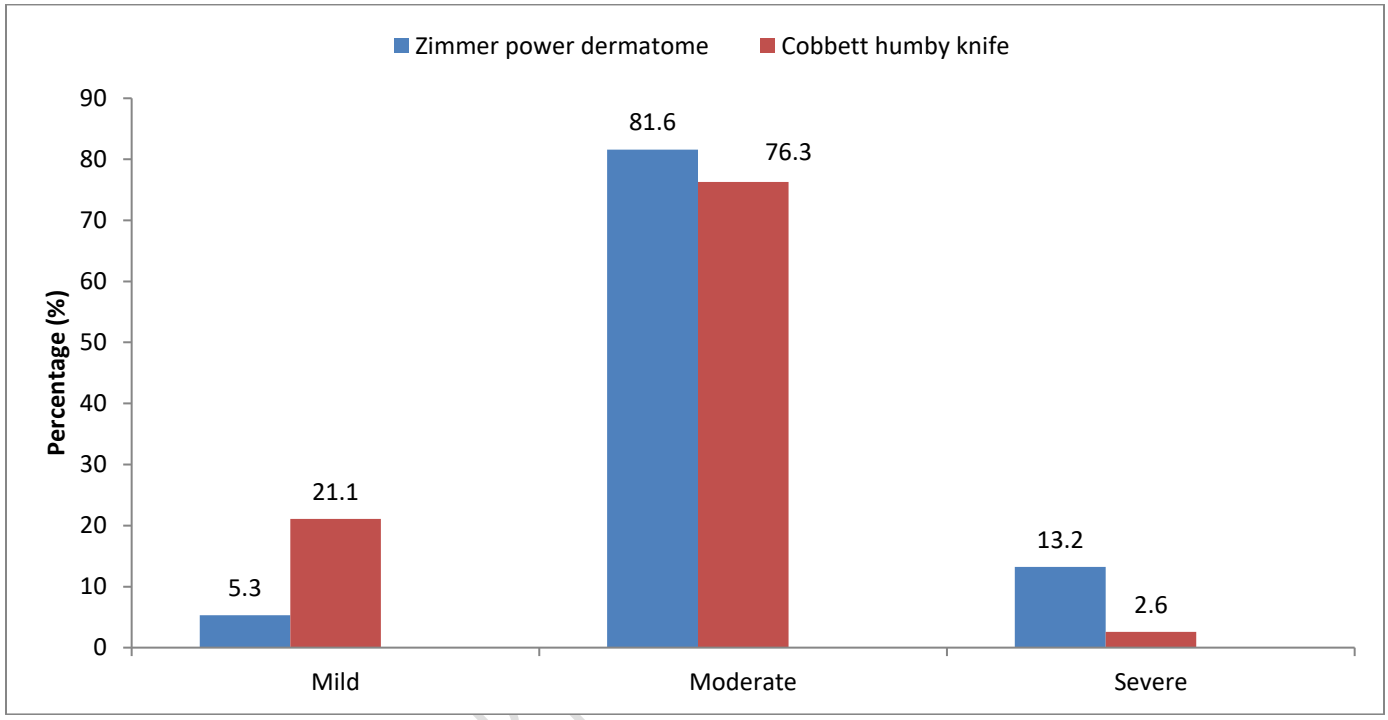

Figure 3: Measure of pain at donor site at 6hours (p = 0.042)

The measure of pain at the donor site at 6 hours (figure 3) indicate a statistically significant difference with the methods used (p=0.042). There was more moderate and severe pain in the Zimmer power dermatome compared with the Cobbett knife.

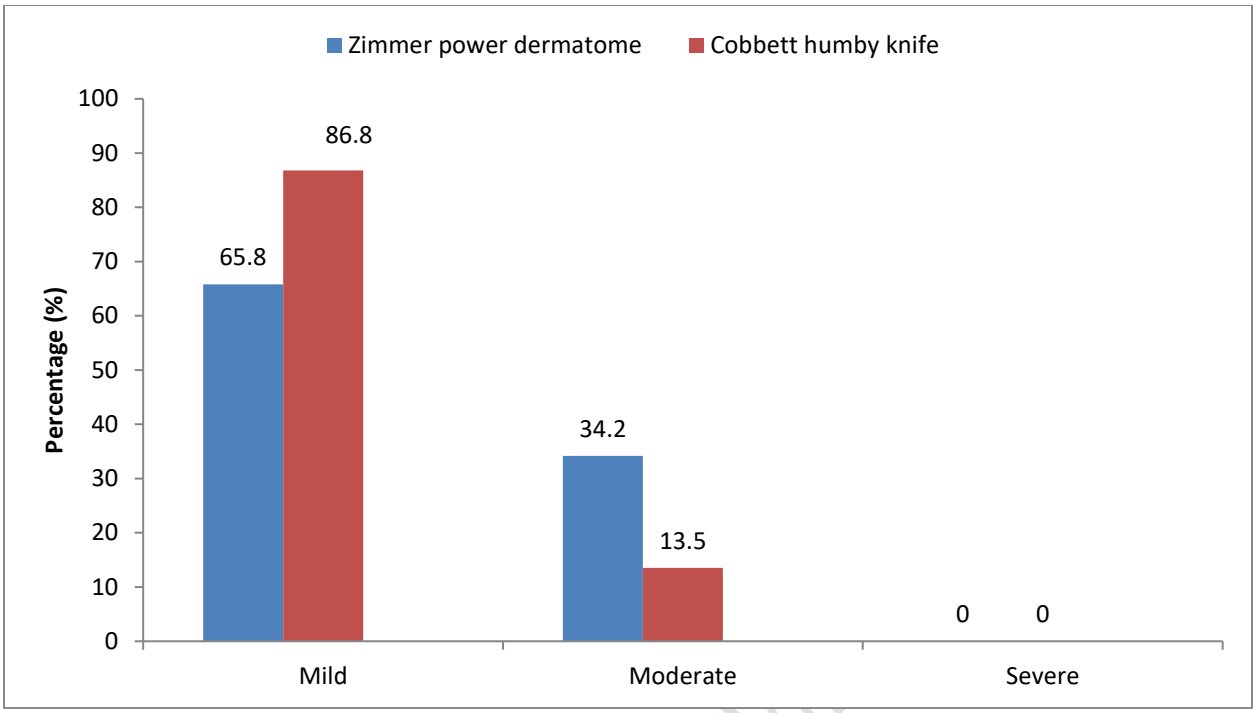

Figure 4: Measure of pain at donor site at 3 days (p=0.031)

Also, the measure of pain at donor site at 3rd day (figure 4) shows there was a statistically significant difference with the methods used (p=0.031).

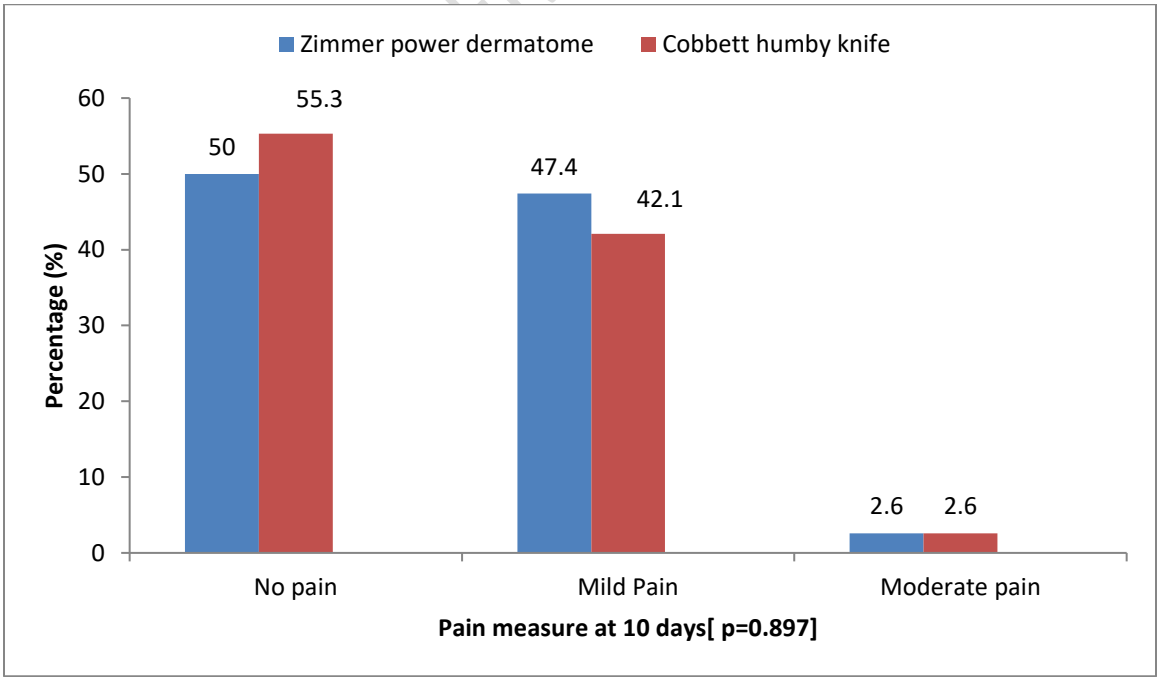

Figure 5:Measure of pain at donor site at 10 days (p=0.897)

However, the measure of pain at donor site at 10th days shows no statistically significant difference with the methods used (p=0.897).

Table 3: Measure of Scoring Criteria of scar

Scoring Criteria	Zimmer power dermatome N(%) N=38	Cobbett knife N(%) N=38	Total	$\chi 2$ test	p-value
Colour				.849	0.654
pink appearance	1(2.6)	2(5.3)	3(3.9)		
hyper pigmentation with areas of hypo pigmentation	32(84.2)	33(86.8)	65(85.5)		
hyper pigmentation	5(13.2)	3(7.9)	8(10.5)		
Elevation				2.492	0.288
1-4? in height above the surrounding skin	29(79.3)	23(60.5)	52(68.4)		
4-8 mm in height above the surrounding skin	8(21.1)	12(31.6)	20(26.3)		
more than 8 mm in height above the surrounding	1(2.6)	3(7.9)	4(5.3)		
Consistency				2.081	0.353
Partially Soft	1(2.6)	0	1(1.3)		
Firm	18(47.4)	14(36.8)	32(42.1)		
Hard	19(50.0)	24(63.2)	43(56.6)		
ITCHING				3.981	0.137
No Itchy Sensation	4(10.5)	10(26.3)	14(18.4)		

Mild Itchy Sensation	33(86.8)	28(73.7)	61(80.3)		
Moderate Itchy Sensation, Moderate And Tolerable	1(2.6)	0	1(1.3)		
Pain					
No Pain	9(23.7)	20(54.1)	29(38.7)	8.433	0.015
Mild Pain	27(71.1)	17(45.9)	44(58.7)		
Moderate Pain	2(5.3)	0	2(2.7)		

Sharquie et al [10] scar formations scoring and scale criteria was only statistically significant between the two groups in terms of pain (table 3).

Table 4: Comparing scar formation between Zimmer power dermatome and Cobbett knife

Scar formation score of 5 items	Zimmer power dermatome Mean ±SD	Cobbett humby knife Mean ±SD)	Total	t-test	p-value
Scar formation	7.6±1.2	7.3±1.6	7.4±1.4	0.669	0.416
Range	6-10	4.-10	4-10		

The scar formations scale and scoring system used by Sharquie et al[11] after summation of the 5 items indicate there was no significant difference in score criteria in the methods used (p=0.416), using independent t-test (table 4).

Discussion

Partial thickness skin graft is a very common surgical procedure and donor site morbidity can occasionally be challenging for both the patients and the surgeons. Partial thickness skin graft

donor site is usually expected to heal like any abrasion. Patients, however, sometimes complain of some discomfort, pain, or scar formation that may follow partial thickness skin graft. Not much has been done to document the morbidity associated with split thickness skin grafts in our sub-region with black population.

The age distribution showed that a significant percentage of the participants were less than 50 years of age (Table 1). Both study groups had more females than males 52.6% for each group respectively. This is at variance with study done by Otene et al[3] which showed male preponderance of 59.2%.

Epithelialization occurs at the wound's margins, where basal keratinocytes transform into proliferating migratory cells and cover the injured area. Epithelial cells line each hair follicle and sweat gland, allowing them to contribute to epithelial regeneration over the injured surface. The distribution of percentage re-epithelialization in this study was not statistically different between the use of Cobbett knife and Zimmer Power dermatome though the Zimmer Power dermatome had a higher percentage (92.1%) within the post-operative day 14 period than was in the Cobbett knife group (68.4%). This was validated by the study of Roogbergen et al[12] who noticed there was 100% rate of re-epithelialization in donor site wound within 14 days. However, the donor site in his study was predominantly the scalp which had a better blood supply and a thicker dermis. In this study, the thigh was 94.7% in Zimmer's power dermatome and 100% in the Cobbett.

Surgical site infection within the donor site was characterized by sippage at the donor site and hence prolonged the percentage rate of re-epithelialization to 21th day. However, there was no significant difference in surgical site infection in this study. In a study done by Otene et al[3] in

south-east Nigeria, the infection rate at one month was 17.5% which is higher compared to the 13.2% combined infection rate in this study.

Pain is an important consideration in the assessment of donor site wound and this however influences the suitable instrument in harvesting the skin graft as the degree of pain affect the patient's experience of the surgical procedure. Donor site pain is also one of the most distressing symptoms reported by patients in the early postoperative period.[13,] Overall, comparing the assessment of pain between the Cobbett knife and Zimmer Power dermatome provides a rationale for the instrument needed for a harvest of skin graft and would positively affect patient choices during surgical practice. It is generally expected that pain is intense within the first 24 hours post-operative period due to exposure of the nerves ending as against the recipient site (Moriati sign- positive)[14] and decreases considerably as each day progresses except if the wound site is infected. In a similar study[3], it was noticed that irrespective of the group, pain at the donor site was intense at the first 24 hours due to exposure of the nerves endings and subsequently declined at post-operative days three and nine. This study showed a statistically significant lower pain level in the Cobbett knife group. Another study had also shown a similar trend with a decrease in pain threshold and other advantages of using a Humby knife.[9]

Scar formation has also been reported in donor sites after grafts were taken at .012" to .020", particularly in patients with dark skin pigmentation, such as Blacks, Hispanics, and Orientals[3].

Figure 6: ZIMMER POWER DERMATOME (DONOR SITE AT 6 WEEKS)

Figure 7: COBBETT KNIFE (DONOR SITE AT 6 WEEKS)

Scarring may have a psychological impact and negatively affect the patient's quality of life. The parameter for assessment of scar formation(figures 6 and 7) was five items employed by sharquie et al[11] which involves the colour, elevation of scar access with the use of a caliper graduated in millimeters, consistency of the scar, itching and pain index using the numerical scale. The rate of dyschromic scars from this study between Zimmer and Cobbett electric power dermatome were comparable (table 4). The scarring noted may be as a result of infection which is probably due to the deepening of the wounds.[3,15] It was noticed that mild itching sensation was marked in both the use of Zimmer power electric dermatome and Cobbett knife(table 3). Itching in healing wounds is a frequent symptom and has been attributed to the growth of free nerve endings. Following split thickness wounds, the nerve endings are exposed and the growth of new nerve endings also worsen the itching experienced by the patients. Where the donor site is extensive as with many of the participants in this study, the itching is marked and may be intolerable. This fact was validated by many scholars who noted that itching was a prominent donor site morbidity.[3,6,1215,16] Mild pain was noticed to be higher in Zimmer electric power dermatome and? Cobbett knife and worse within the first 24 hours of surgery. Otene et al[3] also substantiate the fact that the pain index worsens within the first 24 hours and regresses subsequently.

As healing is faster and hypertrophic scar / keloid formation is more in younger age (<30yrs). It will be preferable to give analysis of data regarding age related donor site healing and scar score.

Conclusion

The use of Cobbett knife in low resource centres should not be abandoned or trivialized since the outcome of this study indicated that it is as effective as the technologically evolving Zimmer dermatome in harvesting skin graft.

Strength and limitation of this study

The limitation of the study was the short-term assessment period of scar quality which was done at 6 weeks. The duration of the study (one year) limited our ability to assess long term scar quality as scars have been known to mature over time. Meanwhile, the strength of this study is that it enables us to carefully observe and follow up with patients to arrive at a logical conclusion regarding the outcome variables.

Ethical approval

Ethical approval was obtained from the Irrua Specialist Teaching Hospital (Ref: ISTH/HREC/20201805/069)

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