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ORIGINAL RESEARCH

A Study of Long-Term Outcome of Split Thickness Skin Grafts at Receipt Site: An Observational Study

Mukul Dhabhai[1], Kavita Choudhary[2], Arun Goel[3], Anant Vyas[4]

[1]Senior Resident, Department of Burns and Plastic Surgery, SMS Medical College & Hospital, Jaipur, Rajasthan, India.
[2]Associate Professor, Department of Community Medicine, Shri Kalyan Government Medical College, Sikar, Rajasthan, India.
[3]Ex-Consultant Plastic Surgeon, Department of Burns and Plastic Surgery, Lok Nayak Hospital, New Delhi, India.
[4]Consultant Plastic Surgeon, Shri Ram Hospital - Mahamandir Branch, Jodhpur, Rajasthan, India.

Corresponding author:
Dr. Anant Vyas
Consultant Plastic Surgeon, Shri Ram Hospital - Mahamandir Branch, Jodhpur, Rajasthan, India.
Email: dranatvyas@gmail.com

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Abstract:
Background:In any busy plastic surgery practice, one is almost always dealing with patients with skin loss. Skin grafting covers a wound, accelerates healing and minimises scarring. Skin grafts are used in a variety of clinical situations, such as raw areas following full thickness burn injury, post-burn contractures and other post-burn reconstructive problems. Once the graft has 'taken' well i.e., survived and stabilized over a period of a couple of weeks or more, several changes occur during the next several months to a year or so till it matures. However, what happens to the skin graft in the subsequent years in future with respect to various parameters for example hypertrophy, abnormal pigmentation, durability and aesthetic appearances, return of sensation, etc., have not been studied adequately in the long run.
Objectives:To study the long-term outcome of graft maturation with respect to various changes that take place during this period after which a split skin graft is said to be fully matured and no longer expected to change
Material and Methods: Cross-sectional observational study conducted in the Department of Burns and Plastic Surgery, Lok Nayak Hospital and associated Maulana Azad Medical College, New Delhi for 12 months among 53 patients. After taking informed consent, a questionnaire of detailed history and present subjective symptoms and objective findings on clinical examination was recorded in the proforma. The prevalence of various clinical parameters, symptoms as well as signs, e.g., itching, ulceration, hypertrophy, return of sensation, hair pattern, need for lubrication, colour changes (hyperemia/congestion), pigmentation (hyper/normal/ hypo) and appearance, etc. at the recipient site of split skin graft after five years of transplantation was recorded and analysed using SPSS v25.
Results: Skin was healthy, and colour was normal in all the patients. Hair growth was absent in 73.6% patients. Sensation was normal in 58.5% and decreased in 41.5% of study participants. Wrinkles were absent from all the patients. Pinch ability was good in 81.1% and moderate in 7.6% of patients. Mobility over the bed was present in 94.4% of patients. Hyperpigmentation was present in 16.9% of patients. Junctional hypertrophy was absent in all cases.
Conclusion: Maturation phase after a split skin grafting surgery is a long-drawn process taking several years (3-5 years or so) during which, several changes toward improvement / betterment take place in the graft.
Keywords: Long-Term Outcome,Split Thickness Skin Grafts, Receipt Site, Graft Maturation.

INTRODUCTION

Skin is the largest and one of the most important organs in the body with a very wide range of vital functions which are essential for sustaining life. It represents approximately 8% of the total body weight with a surface area of approximately 1.72 sq. m in an adult.[1,2] The main functions of skin are to protect the body from the external environment (including pathogens) and prevent excessive water loss. Insulation, temperature regulation, sensation, immune function and the synthesis of vitamin D are all critical functions of the skin. In any busy plastic surgery practice, one is almost always dealing with patients with skin loss. Hence, providing adequate skin cover in the form of a skin graft constitutes one of the most commonly performed reconstructive procedures

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whose origin can be traced back to ancient India as far back as 2500 BC.[3,4]Although it is one of the earliest described surgical procedures, it got widespread acceptance in the 19th century only.[5]The procedure has evolved over a period of time and has become more and more sophisticated with ongoing research.

Restoration of an intact skin barrier is of utmost importance following wounding to prevent infection, to minimize wound contraction, to maintain function, decrease cosmetic disfigurement and to avoid fluid volume depletion. Skin grafting covers a wound, accelerates healing and minimises scarring. It should be considered when wounds are extensive and cannot be closed by sutures. Currently, skin grafting is one of the most rapid and effective methods of reconstructing large skin defects.Skin grafts are used in a variety of clinical situations, such as raw areas following full thickness burn injury, post-burn contractures and other post-burn reconstructive problems (e.g., vitiligo patches, unstable scar ulcers etc.), defects after excision of giant hairy nevus, secondary defects following various pedicled and free flaps, oncologic resection like following wide excision of squamous cell and basal cell carcinomas of the skin, traumatic skin avulsion injuries, etc.Once the graft has been harvested from any suitable and appropriate donor site, it is placed over the recipient site devoid of skin and immobilized by any one or more surgical techniques.[6,7]Once the graft has 'taken' well i.e., survived and stabilized over a period of a couple of weeks or more, several changes occur during the next several months to a year or so till it matures.[1] This period is the stage of graft maturation when several changes occur in the graft, most significantly the graft contraction.Although the stage of maturation is a natural phenomenon, various therapeutic measures have been taken by the reconstructive surgeons over a period of time so as to have a favorable outcome.[8] The duration of this phase of maturation is said to be 9-12 months or more by various workers.[1] The changes and appearances which occur during this maturation are seen routinely by the surgeon during the early post operative follow up visits upto 9 months or so. However, what happens to the skin graft in the subsequent years in future with respect to various parameters for example hypertrophy, abnormal pigmentation, durability and aesthetic appearances, return of sensation, etc., have not been studied adequately in the long run. Thus, the time when the graft stops showing any further changes i.e., late outcome is not known.Present study was conducted todetermine the long-term outcome of graft maturation with respect to various changes that take place during this period after which a split skin graft is said to be fully matured and no longer expected to change.

MATERIALS AND METHODS

Place of study: This study was done in the Department of Burns and Plastic Surgery, Lok Nayak Hospital and associated Maulana Azad Medical College, New Delhi.

Study Population: Patients who had undergone split-thickness skin grafts for various indications more than five years ago.

Study design: This was a cross-sectionalobservational study conducted in the Department of Burns and Plastic Surgery, Lok Nayak Hospital and associated Maulana Azad Medical College, New Delhi.

Duration of the study: The total duration of the study was 12 months.

Sample size: Due to the limited time duration allotted to the study and the number of individuals fulfilling the inclusion criteria visiting the hospital, the sample size in this study was taken as 50.

Inclusion Criteria: Patients who had split-thickness skin grafting done on surgically created raw areas at least 5 years back presenting in OPD of the Department of Burns and Plastic Surgery, Lok Nayak Hospital, New Delhi and patients of both genders between 18 and 45 years of age.

Exclusion Criteria: Patients who had skin grafts applied to granulating wounds or with surrounding scarring.

Methodology: Patients who had undergone plastic surgery procedures involving split thickness skin grafting for surgically created raw areas at least 5 years back presenting to the OPD of the Department of Burns and Plastic Surgery were studied. After taking informed consent. A proforma of particulars of the patients was filled. A questionnaire of detailed history and present subjective symptoms and objective findings on clinical examination was recorded in the proforma.

Outcome: The prevalence of various clinical parameters, symptoms as well as signs, e.g., itching, ulceration, hypertrophy, return of sensation, hair pattern, need for lubrication, colour changes (hyperemia/congestion), pigmentation (hyper/normal/ hypo) and appearance, etc. at the recipient site of split skin graft after five years of transplantation was the primary outcome.

Statistical analysis: The collected data was entered into a MS-Excel sheet and was statistically evaluated using SPSS v25.

Ethical Committee Approval: The study protocol was presented before the Scientific Research Committee (SRC) of Lok Nayak Hospital, New Delhi and its approval was obtained vide letter No. F. PS./MD/LNH/2020/544 dated 01-12-2020.

RESULTS

Maximum patients (40 out of 53 =75.5%) were below 25 years of age at the time of skin grafting. The mean age at the time of skin grafting was 19.8 years ±9.67**.**

The mean duration from the time of skin grafting to the examination of the patient was 84.42 ± 17.84 months (7.03 years). The minimum duration after skin grafting was 60 months (5 years) and the maximum

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duration was 120 months (10 years) in the present study.

Maximum patients had skin grafting following the release of post-burn contracture (37.7%)

Release of contracture with SSG was the most common operation performed (56.60%), leg was the recipient site in the maximum number of cases (20.7%) and a skin graft was harvested from thighs in (88.67%) of patients in the present study.

Skin grafts at the recipient site were healed completely by 2 weeks in maximum no. of patients (92.5%). The most common complaint reported by patients was sensory loss (20.7%). 88.6% of the patients applied oil/cream, 22.5% used pressure garments, 3.8% used silicon sheet as the supportive treatment after complete healing of the graft recipient site.

Skin was healthy and colour was normal in all the patients. Hair growth was absent in 73.6% patients. Sensation was normal in 58.5% and decreased in 41.5% of study participants. Wrinkles were absent in all the patients. Pinch ability was good in 81.1% and moderate in 7.6% of patients. Mobility over the bed was present in 94.4% of patients. Hyperpigmentation was present in 16.9% of patients. Junctional hypertrophy was absent in all the cases.

Table 1: Distribution of study participants according to various variables at the time of skin grafting.

Variables	Frequency	Percentage
Age groups in years		
<18	25	47.2
18-25	15	28.3
26-35	8	15.1
36-45	5	9.4
Duration after skin grafting (months)		
60 - 72 Months	16	30.2
73 – 84 Months	13	24.5
85 - 96 Months	12	22.6
97 - 108 Months	3	5.6
109 -120 Months	9	16.9
Primary diagnosis		
Post thermal Burn contracture	20	37.7
Post- electric Burn contracture	6	11.3
Benign /Malignant skin lesions	5	9.4
Post burn scar and vitiligo patches on head and neck	5	9.4
Post Traumatic contracture/defects	12	22.7
Donor site of flap for oral cancer	3	5.7
Provision of skin cover on neo-phallus	2	3.8
Operation performed		
Release of contracture with SSG	30	56.60
Excision of benign /malignant cutaneous lesions	5	9.43
Donor site of radial artery forearm flap	4	7.54
Donor site of sural artery flap	8	15.09
Donor site of laterally based forehead flap (for ca cheek)	2	3.77
Donor site of miscellaneous local flaps	4	7.54
Recipient site		
Scalp	3	5.7
Forehead	3	5.7
Neck	6	11.3
Axilla	3	5.7
Arm	3	5.7
Forearm	4	7.5
Hand	7	13.2
Cubital fossa	2	3.8
Anterior trunk including breast	5	9.4
Popliteal fossa	2	3.8
Leg	11	20.7
Foot dorsum	2	3.8
Penis	2	3.8
Donor site		
Thigh	47	88.67
Leg	5	9.43
Abdomen	1	1.88

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Table 2: Distribution of various variables related tohealing of grafted recipient site as per history given by the patient.

Variables	Frequency	Percentage
Days taken in healing		
Up to 14 days	49	92.5
14-21 days	4	7.5
Complaints		
Itching	4	7.5
Pain	0	0
Raised scar	3	5.7
Sensory loss (diminished sensation)	11	20.7
recurrent ulceration / allergy / cellulitis	0	0
Non-healing ulcer	0	0
Supportive treatment received		
Massage with oils/cream	47	88.6
Use of pressure garments	12	22.5
Silicone sheet	2	3.8

Table 3: Distribution of clinical parameters of study participants on clinical examination of skin grafts.

Parameters	Frequency (N =53)	Percentage (%)
Skin		
Healthy	53	100
Ulcerated	0	0
Colour		
Normal	53	100
Congestion	0	0
Hyperemia	0	0
Hair growth		
Absent	39	73.6
Sparse	14	26.4
Sensation		
Absent	0	0
Decreased	22	41.5
Normal	31	58.5
Hypersensitive	0	0
Wrinkles		
Present	0	0
Absent	53	100
Pinch ability		
Good	43	81.1
Moderate	4	7.6
Nil	6	11.3
Mobility over the bed		
Yes	50	94.4
No	3	5.6
Hyperkeratosis		
Yes	0	0
No	53	100.0
Fissuring		
Yes	0	0
No	53	100
Soft and supple	53	100
Firm and Thick	0	0
Pigmentation		
Hyperpigmented	9	16.9
Normal skin colour	44	83.1
Hyperpigmented		
Mild	5	55.5
Moderate	4	44.5

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Severe	0	0
Junctional hypertrophy:		
between graft and healthy surrounding skin	0	0
between graft and another graft	0	0
between graft and scarred surrounding skin	0	0

DISCUSSION

Skin grafting is one of the earliest described procedures whose origin can be traced back to ancient India as early as 2500 BC.[3,4] This procedure is extensively used to cover from very small (which cannot be closed primarily) to very extensive defects (e.g. post burn reconstruction, avulsion injuries and post infective skin loss e.g. necrotising fasciitis).[8,9] Skin grafting is also very commonly performed to cover the donor sites of various skin flaps (e.g., radial artery forearm flap and superficial sural artery flap) and following excision of various benign and malignant skin lesions (e.g., basal cell carcinoma, dermatofibrosarcoma protuberans etc).[1,7]

The knowledge of long-term outcome of the skin grafted sites following surgery is highly important, as it can help in proper prognostication by the treating surgeon to the patients and/or attendants, with respect to: a) expected results following split skin graft application. b) the final appearance of the skin graft per se and vis-à-vis the surrounding areas after its complete maturation and stabilisation and c) what can be advised to the patient/attendants to decrease the morbidity and improve the final outcome including scarring?

Additionally, the knowledge of natural history of skin graft over a long period of time can allow the surgeons to develop graft maturation products/methods which decrease the maturation period and improve the final result and guide the surgeon as to how best results can be obtained from skin grafting operations and reduce unfavourable results in their future patients. It also helps in decreasing the litigation against the surgeon.

In the only study similar to ours by Horn (1980) 'On the long-term behaviour of grafts of the meshed skin', 47 patients were included.[10] However, the long term behaviour of only 10 patients (6 female and 4 male) aged between 17 and 85 years were available for analysis of results. Additionally, all the patients in his study had meshed grafts as compared to all the patients having sheet grafts in our study.

Theoretically, split skin grafts can be and have been harvested from almost any part of the body from scalp to sole. There are a number of factors which determine the skin graft donor sites.[11] Some of them are whether a full thickness or partial thickness graft is required, amount of graft required etc. Very large amounts and very big sheets of graft can be harvested from thighs, legs, arms and forearms. Many British surgeons, in a survey, found anatomical sites other than thigh unsuitable for the harvest of split skin graft in adults.[12] In our department, thighs and legs are the preferred sites. Otene et al (2011) harvested all the grafts from the thigh.[13] Beldon (2004) also included upper thigh as the donor site.[14] Horn[10] also harvested all the split skin grafts from the thighs only. In the present study also, 88.67% (N=53) patients had split skin graft harvested from the thigh, 9.43% from leg and only 1.9% from the abdomen.

In the present study, the graft related complaints were noted as per history given by the patients. Most common complaint reported by patients was sensory loss (20.7%, N=53). Four patients (7.5%) complained of itching while 3 patients (5.7%) had raised scars. Only one patient out of total of 53 patients reported need for continuous lubrication**.** Horn also reported subjective complaints such as itchiness to be uncommon or inconsequential occurrence.[10] Out of the 10 patients who were available for the analysis in his study, different patients reported diminished sensations with respect to touch, pressure, cold, warmth and pain but no clinical evaluation by the surgeon was done in the study.

All the patients in our study (N=53) had soft and supple skin grafts. In the present study, the pliability was also tested by the pinchability of grafts clinically. Our 43 patients (81.1% N=53) had good pinchability while 4 patients (7.6%) had moderate pinchability and in 6 patients (11.3%) pinchability was absent. We did not come across any study which reported as to what all the factors were assessed to declare the final graft maturation.

When a split skin graft is applied to a raw area, it sticks to the bed to obtain its blood supply. Mobility of the graft over the bed is another sign of split skin graft maturation. This mobility is checked clinically by pulling or pushing the graft in all directions over the bed. The graft placed over the bony surfaces (e.g., calvarium, shin, etc) are less mobile and pinchable as compared to other areas. In our study, majority of the patients (94.4% N=53) had graft with mobility over the underlying bed while, in only 3 patients (5.6%) mobility was absent. Absence of wrinkles after their initial presence due to secondary skin graft contraction is also a sign of maturation of the split skin graft. In the present study, none (N=53) of the patients had any wrinkles over the grafted areas. Again, we could not find any study to compare with.

Kim et al used a chromameter and the colours of the skin graft, the area adjacent to the recipient site and the donor site were measured. They found that over time, the grafted skin became lighter, redness decreased, yellowness increased and the colour difference decreased. As the donor site was lighter, the grafted skin was lighter and less red. Their study evaluated the change in colour of skin grafts up to 3 years after the procedure.[15]In the present study, 44

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patients had normal skin colour (83.1%, N=53) while only 9 patients (16.9%) had hyperpigmentation. In five out of nine patients, the hyperpigmentation was mild while it was moderate in four patients.

CONCLUSION

Maturation phase after a split skin grafting surgery is a long-drawn process taking several years (3-5 years or so) during which, several changes toward improvement / betterment take place in the graft. The patients' symptoms of itching, loss of sensation, junctional hypertrophy, ulcerations, colour changes, etc. resolve completely during this period.

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