Original Research Article

New Indian Journal of Surgery
Volume 9 Number 5, September - October 2018
DOI: https://dx.doi.org/10.21088/nijs.0976.4747.9518.27

Split Thickness Skin Grafts for the Treatment of Non Healing Foot and Leg Ulcers in Patients with Diabetes: A Prospective Study

R.S. Teja Reddy[1], Muneendra Kumar M.S.[2]

[1,2]Assistant Professor, Department of General Surgery, Narayana Medical College, Nellore, Andhra Pradesh 524003, India.

How to cite this article:

R.S. Teja Reddy & Muneendra Kumar M.S. Split Thickness Skin Grafts for the Treatment of Non Healing Foot and Leg Ulcers in Patients with Diabetes: A Prospective Study. New Indian J Surg. 2018;9(5):676-81.

Abstract

Context: The diabetic foot syndrome is a very severe and common complication in patients with diabetes mellitus with a cumulative lifetime incidence of up to 25 %. Management is based on the simple principles of eliminating infection, the use of dressings, offloading techniques, debridement to accelerate endogenous healing and facilitate the effectiveness of topically applied substances. Timely healing and closure is critical to reducing the cost and morbidity associated with chronic diabetic lower extremity wounds. Split thickness skin grafts (STSG) are a well-known and widely accepted method for soft tissue coverage of open wounds though there are a vast number of wound care products and synthetic grafts available to the clinician today. *Aims*: Aim is to study the clinical use of STSG in a diabetic population and also identify any risk factors that may affect healing time or lead to complications. *Settings and Design:* A Prospective with 50 diabetic wound patients during November 2012 and September 2014. *Methods and Material:* up on admission random sugars and HbA1c were sent and sugars were managed with insulin and drugs. Regular dressing and debridement was done and once granulation appeared posted for skin grafting. Wound size and mean healing times were noted. *Results:* In our study 32% were seen in 51-60 years age group. According to Wagner's Grade 70% were in Grade 2, 14 % in Grade 3, 8% in Grade 4. On culture 72% of cases were infected with single organism, 16 % had polymicrobial infections. 26 (52%) patients had wound size < 50cm^2, 18 (36%) patients had 50-100cm^2 and 6 (12%) patients had > 100cm^2. The mean healing time was 5.3, 5, 6.2 weeks. There was no significant difference in the healing times of wounds based on the wound size. The mean healing time at STSG site was 6.5 weeks in poorly controlled patients when compared to 5.6 weeks in patients with good glycemic control. Donor site mean healing time was almost similar in all the groups 42 patients had associated morbidities and 8 patients had only diabetes without any other risk factors. 7 cases had complications like infection and failure. *Conclusions:* Diabetis is emerging cause of non healing foot ulcers and major cause of hospitalisation and surgery. Wound debridement and glycemic control is must for proper wound healing. Once a good granulation appears split skin graft provides adequate cover for the wound.

Keywords: Diabetic Foor; Debridement; Split Skin Grafting.

Corresponding Author: Muneendra Kumar, Assistant Professor, Depatment of General Surgery, Narayana Medical College, Nellore, Andhra Pradesh 524003, India.

E-mail: munikumar83@gmail.com

Received on 06.05.2018, **Accepted on** 22.05.2018

Introduction

The diabetic foot syndrome is a very severe and common complication in patients with diabetes mellitus with a cumulative lifetime incidence of up to 25% [1]. Diabetic foot and leg ulcers are the leading cause of hospitalization in patients with diabetes and 70-80% of all diabetic related amputations [2,3]. The factors that delay wound healing in diabetes are multiple and relate both to the impaired glucose metabolism and to the effect of neurovascular complications. Diabetic foot ulcers readily become chronic; all too often these wounds do not heal primarily.

Management is based on the simple principles of eliminating infection, the use of dressings, offloading techniques, debridement to accelerate endogenous healing and facilitate the effectiveness of topically

applied substances. Timely healing and closure is critical to reducing the cost and morbidity associated with chronic diabetic lower extremity wounds [4,5,6]. Split thickness skin grafts (STSG) are a well-known and widely accepted method for soft tissue coverage of open wounds [7]. Though there are a vast number of wound care products and synthetic grafts available to the clinician today, STSG remain the gold standard and may be considered a first-line treatment for lower extremity wounds associated with diabetes.

Aim is to study the clinical use of STSG in a diabetic population and also identify any risk factors that may affect healing time or lead to complications.

Materials and Methods

It is a Prospective Study, done in Narayana Medical College Hospital, Nellore during November 2012 and September 2014. Diabetic patients with ulcers in foot or leg are studied. Patients were treated with insulin or an oral hypoglycemic agent, random sugars were measured periodically.

Prior to application of the graft, All patients underwent local wound care till a uniform granular wound bed with minimal wound exudates was evident. All grafts were performed in an operating room. Surgical wound preparation was done by sharp or mechanical. Graft was taken from the thigh with a Humby's knife and meshing was done manually and graft is fixed using 3-0 chromic cat gut suture and dressing is done using Cuticell guaze. Plaster of paris cast is applied in cases where restriction of movement is required. Graft uptake is assessed on 5th post-operative day and regular dressings are done depending on the status of the graft. Once healed patients are sent home and further followed up in subsequent visits for every four weeks up to six months from the date of STSG application. Comparison of graft uptake in infected and non-infected ulcers is made and healing times and for various comorbidities are compared and analyzed.

Results

In a swab sent from the surface of ulcer only 6 patients the wound was not infected. Single organism was found in 36 patients and multiple organisms were seen in the cultures of 8 patients. The pattern of infection as observed in the present study reveals that while 72% of cases were infected with single infection of gram positive organism, 16% of cases had polymicrobial infections.

E.coli was the most common organism found in the culture followed by Proteus and Pseudomonas species

Antibiotic sensitivity to the isolated organisms revealed that majority of the organisms were sensitive to Cefotaxime and gentamycin followed by ciprofloxacin, ampicillin and doxycycline.

In our study Failure of the graft take was seen in one case of end stage renal disease due to seroma formation and displacement of the graft and failure to revascularise. 5 cases of graft failure were due to infection of which the causative organism was streptococcus in three cases, pseudomonas in one and

Table 1: Age and sex distribution

Age	Male	%	Female	%	Total	%
0-20	0	0	0	0	0	0
21-30	1	2	0	0	1	2
31-40	3	6	2	4	5	10
41-50	7	14	4	8	11	22
51-60	9	18	7	14	16	32
61-70	10	20	4	8	14	28
71-80	2	4	1	2	3	6
Total	32	64	18	36	50	100

Table 2: Classification according to Wagner's system

Grade	No. of Patients	%
0	0	0
1	4	8
2	35	70
3	7	14
4	4	8
5	0	0

Table 3: Time to complete wound healing in various risk factors

Risk Factor	No. of patients	%	Mean weeks to healing	
			Recipient area	Donar area
Smoking	14	28	6.5	2.2
Alcohol use	16	32	5.8	1.3
Chewing tobacco	3	6	5.5	1.4
Hypertension	20	40	5.4	2.1
Cardiac disease	4	8	5.0	1.3
Peripheral Vascular disease	7	14	6.5	2
End stage renal disease	2	4	7.5	3.4
Anemia	6	12	4.8	2
No comorbidities	8	16	5.2	1.4

Table 4: Mean healing time for based on Percentage of Graft take

Percentage of graft take	No. of Patients	Mean weeks to complete healing
100 %	32	5.2
95-99 %	8	6.0
< 95%	10	7.5

Table 5: Mean healing times based on size and site of the ulcer

	No of Patients	Mean weeks to healing
Wound size < 50 cm^2	26	5.3
Wound size 50-100 cm^2	18	5.0
Wound size >100 cm^2	6	6.2
Right foot	16	4.5
Right leg	12	5.4
Left foot	14	5.2
Left leg	8	5.4

Table 6: Mean healing times in recipient and donor sites based on Hba1c Levels

HBA1C Levels	No of patients	Mean healing time	
		STSG (weeks)	Donar (weeks)
<6.5%	18	5.6	2.1
6.5-7.5%	24	6.4	1.5
>7.5%	8	6.5	2.4

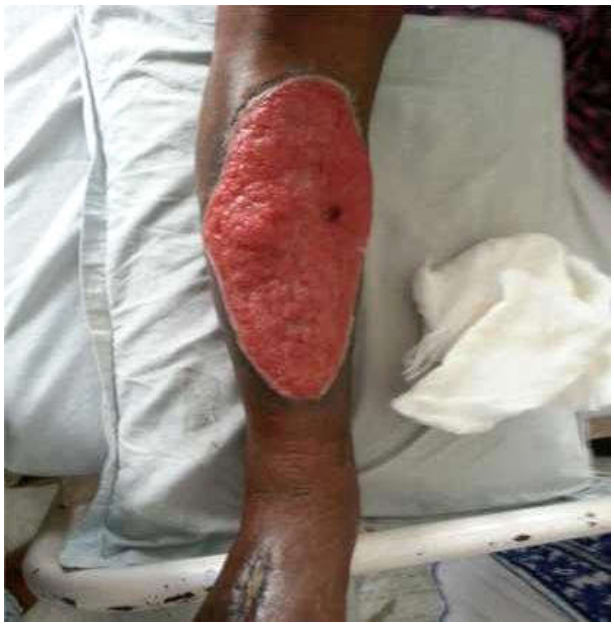

Fig. 1: Prepared healthy wound bed pre graft

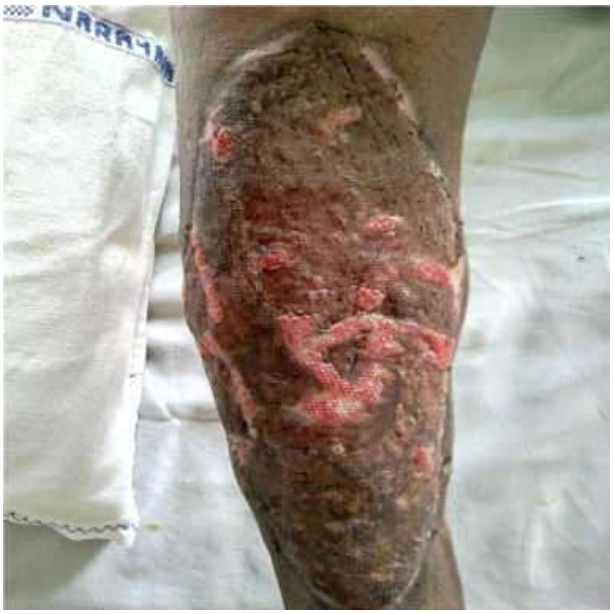

Fig. 3: STSG on 5th Post operative day

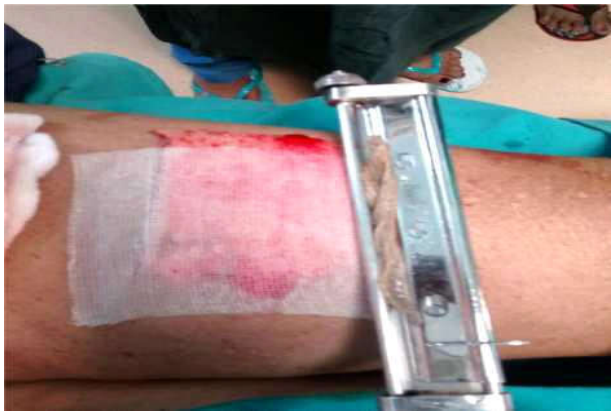

Fig. 2: STSG harvest using humby's blade

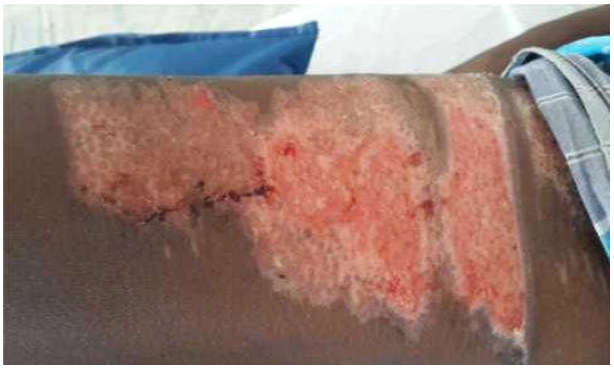

Fig. 4: Donor site on 7th Post operative day

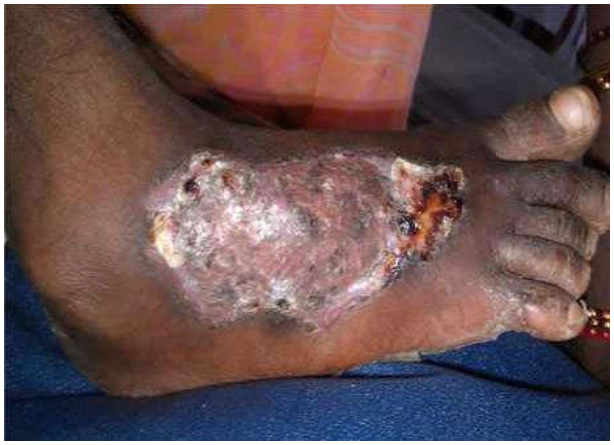

Fig. 5: Graft take of more than 95%

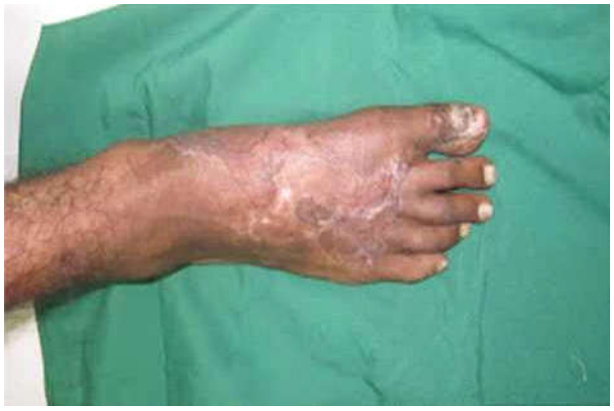

Fig. 6: Completely healed STSG

staphylococcus in one case. Graft pulling off was noticed in one patient due to improper immobilization of the limb. All these patients needed revision surgeries resulting in prolonged hospital stay.

Discussion

In our study of 50 cases of Diabetic foot and leg ulcers, 32% were seen in 51-60 years age group, while it was 43% in the 41-70 years age-group. This is similar to the study from Karl Franzens University, Austria (Mean age 66 years) and by Hasbum et al from Mexico Hospital [8] (Mean age 60±4 years).

In Wagner's Grade 2 ulcers, the overall chance of local or major amputation is estimated to be around 60%. In the present study, 70% were in Grade 2, 14% in Grade 3, 8% in Grade 4. In Treece et al study from City Hospital [9], UK of 389 diabetic ulcer patients, 78.4% were of Grade 2, 10.8% had Grade 3 and rest Grade 4. Similarly Hasbum et al. from Mexico Hospital [8] have also reported 23% of their diabetic cases with Grade 2 ulcers and 21% with Grade 3.

Appropriate tissue and bone cultures are useful to guide the use of antibiotic therapy. Gram positive organisms account for the majority of infections, and Methicillin resistant Staphylococcus aureus has become prevalent in recent years. Unachukukwu et al. have stated that although gram positive organisms are overwhelming in chronic diabetic ulcers, the polymicrobial nature of bacterial growth should not be ignored in the management planning, especially in developing countries [10].

In the present study on culture 72% of cases were infected with single gram positive organism, 16% had polymicrobial infections. Among them E. coli and Proteus were the predominant. Antibiotic sensitivity revealed sensitive to Cefotaxime and gentamycin followed by ciprofloxacin, ampicillin and doxycycline.

In our study, all diabetic ulcer patients had early surgical debridement. George et al stated that debridement is an important aspect of the treatment of diabetic wounds. Benjamin et al. said that sharp debridement with scalpel, scissors, or tissue nippers is generally preferable to hydrotherapy or topical debriding agents, which are less definitive and controllable and may require prolonged and repeated applications [11].

In present study the wound sizes were measured during the admission and the mean healing times have been compared, 26 (52%) patients had wound size less than 50cm^2, 18 (36%) patients had wound size between 50-100cm^2 and 6 (12%) patients had wound size of more than 100cm^2. The mean healing time of wounds less than 50cm^2 was 5.3 weeks, in wounds 50-100cm^2 was 5.0 weeks and in wounds more than 100cm^2 was 6.2 weeks.

In study by Anderson et al 49.5% patients had wound size of less than 50cm^2 and the mean healing time was 5.2 weeks. 34.6% of patients had wound of size between 50-100cm^2 and the mean healing time was 4.2 weeks. 15.9 % patients had wound of size more than 100cm^2 with mean healing time of 5.7 weeks. There was no significant difference in the healing times of wounds based on the wound size.

The level of HbA1c was noted during the beginning and the mean healing times were calculated. Out of 50 patients 18 patients had good glycemic control and 8 had poor control. The mean healing time at STSG site was 6.5 weeks in poorly controlled patients when compared to 5.6 weeks in patients with good glycemic control. Donor site mean healing time was almost similar in all the groups. Ramanujam et al. did not find a statistically significant difference in preoperative hemoglobin A1C levels and healing time, despite high average preoperative hemoglobin A1C values in their patients [12]. Conversely, a study by Marston found a direct correlation between hyperglycemia and wound healing [13].

The patients in this study who had < 95% graft takeup had an average healing time of around 2.3 weeks slower than those with a graft take of 100% and almost 1.5 week slower than those with graft take

between 95-99%. In study by Anderson et al. patients who had graft take of 100% had average healing time of 4.8 weeks while those with 95-99% and < 95% had 5.0 and 7.9 weeks respectively.

Skin graft healing and incorporation is a complex biological process involving various stages of adherence, nourishment, revascularization, and final incorporation [14]. Once harvested, the skin graft is deprived of its native nutrients and blood supply and can only survive by adherence to the wound bed and diffusion of nutrients from the underlying vascular supply until revascularization occurs. It stands to reason that any mechanical or biological disruption of this process puts the graft at risk for failure or prolonged healing.

In present study, the vast majority of our patients (80%) had greater than 95% graft takeup and, of those, 64 % had 100% graft takeup. Only 10 patients (20%) had less than 95% graft takeup, but this group took longer to heal. Clearly, the amount of graft take is an indication of the underlying healing process. STSG with poor graft take can naturally be expected to take significantly longer to heal.

In this study 7 cases of graft failure were recorded. 5 cases had infection at the recipient site with streptococcus in three cases and pseudomonas isolated one case and staphylococcus in one case. One patient with end stage renal disease had graft failure due to seroma at the recipient site as the graft failed to revasularise. And in one patient the graft was pulled off due to poor immobilization by week 2. All the patients were given aggressive wound care and regrafting was done within 2 weeks. It stands to reason that postoperative complications such as infection, noncompliance, seroma, swelling and STSG pressure delay healing time by disruption of the graft and interfering with the healing process.

The complication rate in this study was 14%. Ramanujam et al. reported a post-graft complication rate of 35% with 16 patients experiencing an infection [12]. Similarly, Mahmoud et al. reported that 38% of their diabetic patients who received a STSG failed to heal by post-operative week eight [15].

Out of 50 patients STSG was applied to Right foot in 16 (32%), to the right leg in 12 (24%), to the left foot in 14 (28%) and to the left leg in 8 (16%). In a study by Anderson et al 107 patients were applied STSG of which 27.1% were applied to the right foot , 23.4% to the right leg, 26.2% to the left foot and 23.4% to the left leg .

In this study, 42 patients had associated morbidities and 8 patients had only diabetes without any other risk factors. Out of the 42 patients smoking was a risk factor in 28% of the patients and the mean healing time after application of STSG is 6.5 weeks.

In a study by Anderson et al. Out of 107 patients smoking was a risk factor in 5.6% of the patients and the mean healing time is 6 weeks which is similar to our study. Reus William et al. stated that anastomotic patency and flap survival were not different (95% and 94%), delayed wound healing at the recipient site was different (35% and 24%), and that smokers require an additional procedure to achieve final wound closure more frequently (27% and 12%) among smokers and non-smokers. These suggest that cigarette smoking increases risk for complications, not at the site of the anastomosis in free-tissue transfer, but at the flap's interface with the wound or overlying skin graft [16].

Alcohol use was noted in 16 patients (32%), 3 (6%) patients had habit of chewing tobacco, the mean healing times in these patients were 5.8 and 5.5 weeks respectively. In study by Anderson, Alcohol use was seen in 4.7% of the patients and 1.9% had habit of chewing tobacco. The mean healing times were 5.6 weeks and 4.5 weeks. 2.8% patients had cardiovascular disease, 8.4% of patients had end stage renal disease, 6.5% patients had peripheral vascular disease and 24.3% had hypertension.

In our study the mean healing time in patients with cardiac disease is 5.0 weeks, mean healing time in peripheral vascular disease is 6.5 weeks, mean healing time in patients with hypertension is 5.4 weeks and mean healing time in end stage renal disease is 7.5 weeks which is comparable to the study by Anderson et al where the mean healing time in cardiac disease, peripheral vascular disease, hypertension and end stage renal disease are 4.0, 5.7, 5.2 and 6.1 weeks respectively.

In a review of 107 patients undergoing STSG placement after debridement and control of diabetic foot infections, Anderson et al found that the mean time to healing was 5.1 weeks, with a complication rate of only 2.8%. Puttirutvong [17] reported that meshed STSG placement yielded consistent healing in people with diabetes. McCartan and Dinh [18] performed a meta-analysis of the few available publications on STSG placement for diabetic wounds. They computed a graft take rate of ≥ 90% in 78% of patients by 8 weeks, and therefore recommended it as a viable option in wound care. In a retrospective review of 200 patients undergoing STSG placement for foot wounds, Ramanujam et al. found that comorbidities associated with diabetes, such as peripheral vascular disease, retinopathy, nephropathy, and cardiovascular disease, conferred more risk of graft failure than the diabetes itself.

This study correlates with success rate of 86% which is similar to Mahmoud et al. Hence STSG can be considered a safe and reliable method for the treatment of non healing diabetic ulcers.

Conclusion

Diabetis is emerging cause of non healing foot ulcers and major cause of hospitalisation and surgery. Wound debridement and glycemic control is must for proper wound healing. Once a good granulation appears split skin graft provides adequate cover for the wound.

Acknowledgement

My special thanks to Dr. Sreeram Satish M.S. , Dr. I. Sireesh M.S., Dr. K.L. Sampathkumar M.S., Dr. Vireeshalingam M.S., Dr. V.V. Subramanam M.S.. and Dr. Rupkumar M.S for their valuable guidance and support.

Source(s) of support: Nill

Conflict of Interest: Nill

References

1. N. Singh, D. G. Armstrong, and B. A. Lipsky. Preventing foot ulcers in patients with diabetes. Journal of the American Medical Association, 2005;293(2):217–28.
2. Frykberg RG, Zgonis T, Armstrong DG, Driver VR,Giurini JM, Kravitz SR, et al. Diabetic foot disorders. A clinical practice guideline (2006 revision). J Foot Ankle Surg 2006;45:S1-66.
3. Vuorisalo S, Venermo M, Lepa¨ntalo M. Treatment of diabetic foot ulcers. J Cardiovasc Surg (Torino) 2009;50: 275-91.
4. Ramsey SD, Newton K, Blough D, McCulloch DK, Sandhu N, Reiber GE, et al. Incidence, outcomes, and cost of foot ulcers in patients with diabetes. Diabetes Care 1999;22:382-7.
5. Reiber GE, Lipsky BA, Gibbons GW. The burden of diabetic foot ulcers. Am J Surg 1998;176:S5-10.
6. Mayfield JA, Reiber GE, Sanders LJ, Janisse D, Pogach LM. Preventive foot care in people with diabetes. Diabetes Care 2003;26:S78-9.
7. Chick LR. Brief history and biology of skin grafting. Ann Plast Surg 1988;21:358-65.
8. B. Hashum, Descriptive study of Diabetic Foot Clinic, Internal Medicine, Mexico Hospital.
9. Yakubu A. Muhammad I, Major limb amputation in adults, Zaria, Nigeria, Jr. Coll. Surg.Edinb. 1996;41:102-4.
10. Lipsky BA, Deery HG et al., Diagnosis and treatment a diabetic foot infections. Clinic Infectious Diseases, 2004; 39:885–910.
11. Benjamin A. Lipsky, a Anthony R. Berendt,a H. Gunner Deery, John M. Embil, Warren S. Joseph, Adolf W. Karchmer, Jack L. LeFrock, Daniel P. Lew, Jon T. Mader, b Carl Norden and James S. Tan. Diagnosis and Treatment of Diabetic Foot Infections. Clinical Infectious Diseases 2004;39:885–910.
12. Ramanujam CL, Stapleton JJ, Kilpadi KL, Rodriguez RH, Jeffries LC, Zgonis T. Split-thickness skin grafts for closure of diabetic foot and ankle wounds: a retrospective review of 83 patients. Foot Ankle Spec 2010;3:231-40.
13. Marston WA. Risk factors associated with healing chronic diabetic foot ulcers: the importance of hyperglycemia. Ostomy Wound Manage 2006;52:26-8.
14. Chick LR. Brief history and biology of skin grafting. Ann Plast Surg 1988;21:358-65.
15. Mahmoud SM, Mohamed AA, Mahdi SE, Ahmed ME. Split-skin graft in the management of diabetic foot ulcers. J Wound Care 2008;17:303-6.
16. Reus William et al : Tobacco smoking and complication in elective microsurgery. J Plast Reconst Surg 1992; March.
17. Puttirutvong P. Meshed skin graft versus split thickness skin graft in diabetic ulcer coverage. J Med Assoc Thai 2004;87:66-72.
18. McCartan B, Dinh T. The use of split-thickness skin grafts on diabetic foot ulcerations: a literature review. Plast Surg Int 2012;2012:7152-73.