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A Study on the Effects of Split Skin Grafting in Wound Healing of Diabetic Foot Ulcer

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ABSTRACT

AIMS AND OBJECTIVES:

It has been estimated that one in five of all diabetic patient admissions to the hospital are for limb lesions. A significant number of such patients will require long-term hospital treatment and amputations.

In diabetes, effective treatment of ulceration is seen as key to the reduction in the number of amputations.

METHODS:

100 casesof all grades of diabetic ulcer admitted in Department of General Surgery of MVJMC & RH in surgical wards.

Cases will be allocated randomly into test group and control group.

RESULTS & CONCLUSIONS:

This comparative study shows a significant reduction in the Duration of Healing and Healing Rates in the patients undergoing Split Thickness Skin Grating. Duration of Healing was 50% lesser in the Test Case Group undergoing Split Thickness Skin Grafting as compared to the Control Group Undergoing Traditional Dressings.

Keywords: Diabetic Foot Ulcers; Split Thickness Skin Grafting; Wagner Grade of Diabetic Foot

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SUMMARY

Split Thickness Skin Grafting is a good procedure to be undertaken for all Grades of Diabetic Foot Ulcers for faster and better healing rates as compared to Traditional dressings only.Split Thickness skin grafting by providing a faster healing rate provided a better socioeconomic outcome for the patient and decreased the morbidities associated from prolonged wound care and hospital care by providing a faster functioning limb.

Introduction

Diabetes mellitus is defined by the American Diabetes Association (ADA) Expert Committee in their 1997 recommendations as "a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action or both. The chronic hyperglycaemia is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidney, nerves, heart and blood vessels." Thus, diabetes covers a wide range of heterogeneous diseases.

Pyrce described a case of perforating ulcer in diabetes and atretic symptoms as early as 1887.

In 1934, Elliot Joslin, one of the pioneers of Diabetology, published an article entitled "The menace of diabetic gangrene", in which Joslin described the common causes of diabetes foot lesions.

However, it was not until 1950s that the Diabetic Neuropathy, ischemia, and infection were finally recognized as precondition of foot complications in diabetics.

Split-thickness skin grafting (STSG) is a plastic surgery technique with documented use dating back to 3000 B.C. in India for traumatic facial wounds.

Ollier began experimenting with skin grafting methods in 1872.

An electrodermatome was used to harvest STSG by Pagett& Hood in 1939.

Modern techniques involving the use of meshed STSG was first described in 1964 by Tanner et al. Despite the original use for facial reconstruction, STSG is now commonly employed on

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burn wounds, when skin coverage is required, and to close chronic ulcerations, frequently seen in the diabetic population.

It is possible to manage diabetic ulcer lesions with split thickness skin grafting with early healing giving us favourable results like limb salvage and maintenance of a functional limb. A limb with less functional capacity is always preferable to no limb at all.

While progress had been made in the treatment of diabetic foot ulcerations peculiarly by the establishment of dedicated diabetic foot clinics which reduced bed usage by up to 38% there still remains much morbidity and mortality.

Literature Review

Diabetic foot ulcers are a wound that occurs on the feet of the people with Type 1 and Type 2 diabetes mellitus. The global burden of diabetes is projected to increase from the current 246 million people to over 380 million people by the year 2025. Among the people with diabetes 15% will experience a foot ulcer in their lifetime.

Foot ulceration with infection is one of the leading cause of hospitalisation for the patients with diabetes mellitus. It is now appreciated that 15-20% of patients with such foot ulcers go on to need an amputation, especially major lower extremity amputation. Similarly 85% of major lower limb amputation are preceded by foot ulcers.

Once one limb has been amputated not only is there an increased risk that the other limb will also require amputation but the patient's 5 year survival rate is only about 30%.

Since they are major causes of lower limb amputation in these people they should be treated aggressively in order to have a better outcome.

Diabetic foot ulcers contributed by –

1. Sensory, motor and autonomic neuropathy
2. Macrovascular and Microvascular Disease
3. Infections
4. Connective tissue abnormalities
5. Haematological disturbances

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PATHOGENESIS OF DIABETIC ULCERS:

NEUROPATHIC ULCERS:

Neuropathic ulcers may be due to :-

1. Sensory disturbances
2. Motor disturbances
3. Autonomic disturbances

CAUSES OF NEUROPATHY:

There are essentially two theories as to the causation of diabetic peripheral neuropathy – One related to metabolic factors and the other associated with microvascular disease. The metabolic theory suggests that the peripheral nerve damage arises from the abnormalities of sugar alcohol metabolism. Hyperglycemia results in increased levels of interneural sorbitol which may be directly toxic to the neural tissue. Hyperglycemia also reduces the sodium-dependant uptake of myoinositol by competitive inhibition

EFFECTS OF NEUROPATHY:

Loss of somatic sensation over the plantar aspect of the foot can lead to extrinsic neuropathy, foot ulceration following trauma. The trauma can be varied – ill-fitting footwear, thermal, foreign body, in shoes and toenail cutting are merely examples.

The initial trauma is often minor and a person with intact sensation would naturally tend to protect the injury until it is healed.

In the absence of somatic sensation, however areas, which would normally be painful are not perceived as such so allowing tissue damage to continue, once started, an established ulcer is the end point of this process.

The somatic motor neuropathy, results in weakness of the intrinsic muscles of the foot which in turn allows abnormal movement of the small bones of the foot and joint subluxation occurs. Weakness of foot ligaments due to abnormalities of collagen metabolism contribute to this effect

Visceral sensory neuropathy reduces or abolishes proprioception. Though the early deformity is small, as patient continues to walk, ligaments and joints capsules are stretched further and the bony structures of the foot are altered permanently.

As time goes on these changes lead to foot deformities such as claw foot with

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prominent metatarsal heads or a Rocker Bottom foot with collapse of the longitudinal arches and prominence of the tarsal bones. The inflammation of the subluxed joints leads to charcot'sarthropahty.

The above bony changes produce localized areas of high pressure on the sole of the foot particularly under the metatarsal heads, on the tips of toes, on the heel and under the midfoot.

These high pressure areas are associated with ulceration around three quarters of neuropathic ulcers occur in the forefoot while the remainder occur under the midfoot and on the heel.

The initial response to the high pressure is the formation of protective callus. In addition to the vertical load force resulting from the patient's weight acting on the callus, the transverse and longitudinal shear force are also established.

The shear forces particularly those in the longitudinal plane traumatise the subcutaneous tissues between the underlying bone and overlying callus producing cavities containing serum or blood.

The cavities under the callus coalesce and eventually the callus breaks down resulting in an ulcer. The breakdown tends to occur centrally and the defect in the callus is much smaller than the cavity underneath.

This pattern of deep tissue destruction proceeding epithelial breakdown is typical of neuropathic ulceration and differs from most other forms of ulcers.

Autonomic neuropathy also contributes to the formation of calluses throught a reduction in sweating. Sweat contains keratinolytic enzyme which help in breakdown of hyperkeratotic areas.

In their absence, the callus shows unimpeded growth. The absence or reduction of sweating also results in skin that sis dry, inelastic and prone to trauma.

ISCHEMIC ULCERS: DIABETIC MICROVASCULAR DISEASE:

There are structural abnormalities of the capillary basement membrane in diabetes. The

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basement membrane is thickened as part of the general abnormalities of extracellular matrix components and its composition is altered by excessive glycosylation of collagen and proteoglycans.

The glycosylation reduces the charge on the membrane. These changes explain the increase in capillary permeability to highly charged molecules such as albumin.

It also affects trans capillary movement of leucocytes and macromolecules. Diabetics have shown to have abnormal function of increased flow through the distal arterio-venous shunts proximal to the dermal capillary beds. There is an increased capillary luminal diameter secondary to basement membrane thickening and there is also an increase in capillary flow.

Although there is, Increased capillary flow there is less ability to vasodilate and increased blood flow in response to various stimuli like trauma or infection. Furthermore the vasoconstrictor response to the vertical posture is reduced with the result that capillary pressure rises. The increase edema formation with the effect of impairing tissue perfusion.

Endothelial functions are also disturbed in diabetes. There is normally fine balance in favour of vasodilatation over vasoconstriction and as anti-thrombotic tendency brought about by reactions involving nitric oxide (Endothelium derived relaxing factor). Diabetes impair this function of the endothelium, which results in impaired microcirculation.

All the above changes seen in the diabetes have a real effect on tissue perfusion and potentially play an important role in ulceration.

Diabetics are four to seven times more prone to atherosclerosis than non-diabetics and the process appears to be accelerated in diabetic patients requiring vascular surgery are therefore likely to be younger than non-diabetics.

INFECTION:

Infection is not generally a primary cause of foot lesions in diabetes with the exception of fungal infection between the toes which can lead to skin breakdown and secondary bacterial infection.

Once a lesion has developed infection plays an important role in determining its outcome wheter the primary etilogy is neuropathic, ischemic or a combination of the two. (i.e, neuro ischemic lesion)

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There are several reasons for an increased propensity to infections in diabetes. These include abnormalities of the immune system with deficiencies in cell mediated immunity, impaired leukocyte chemotaxis, phagocytosis intracellular bactericidal activity and serum opsonisation. There is reduction of granulocyte motility and activity.

The infection is virtually always a polymicrobial with gram positive and gram negative aerobes and anaerobes including staphylococcus aureus, bacterioides, proteus, enterococcus, clostridia, and Escherichia coli being present.

Bacteria that overcome the host defences quickly colonise the wound, increasing in density until their cell signalling increases and gene expression alters.

The bacterial responses produces a three-dimensional polysaccharide matrix, forming a 'BIOFILM' which increases virulence, lessens the host response to infections and thereby increasing the antimicrobial resistance.

The 'BIOBURDEN' may be responsibefordelayed wound healing where bacterial numbers reach 'CRITICAL COLONISATION' with no overt host response when the 'bioburden' reaches beyond the point of critical colonisation (10^5 bacteria/g) and bacteria invade the tissues causing direct cell damage.

Necrotic tissue should be debrided to reduce the bioburden, similarly infected bone required proper surgical debridement to enable healing.

When infection is secondary to primary neurpathic or ischemic lesion it may remain superficial and localized.

A spreading cellulitis is blocked either by hyperkeratinisation or by inpissatedcontenets, then the infection is direly to spread into the deeper tissues and bones. This may result in abscess formation or osteromyelitis.

In this way infection is responsible for most of the tissue destruction seen in complicated diabetic foot lesions. It's actually a vicious cycle which helps in spreading the infection to surrounding areas, by compromising the blood flow due to edema formation.

The small vessels within this area are prone to thrombosis and occlusion as a result of sluggish flow due to platelet and leucocyte adhesion to vessel wall. These two factors may combine to produce localized tissue ischemia and even gangrene particularly in presence of macrovascular disease.

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CONNECTIVE TISSUE ABNORMALITY:

The hyperglycemia of diabetes can significantly affect the structure and functions of proteins. This is most commonly brought about by non-enzymatic glycosylation, a process in which glucoses firs binds reversibly with amino groups on proteins. These the irreversibly bind more glucose to form advanced glycosylation end products.

These can them form covalent cross-links with amino groups on other matrix proteins or on extravasated plasma proteins. These reactions are seen with haemoglobin, where glycosylated product is haemoglobinA1c – a well known marker of the plasma glucose level over the previous 6 weeks.

The structural proteins collagen and keratin are all affected. As a result the inter-molecular cross linking products tissues that are rigid, inflexible, and resistant to digestion by proteases.

The rigidity of the subcutaneous tissue between the callus and underlying bone renders it more likely to be torn by the shear foeces referred above. The resistance of the keratin to keratinase helps explain the production of callus both at sites of high pressure and at edges of open ulcers.

The protein cross linking makes this callus hard and at the edge of an ulcer which delays the wound healing by preventing wound contracture.

The collagen of the ligaments and joint capsules of the foot is affected in the same way. These structures then become weak and inelastic and the process contributes to the deformation of the bony structures of the foot.

HEMATOLOGICAL DISTURBANCES:

Rheological abnormalities in diabetes contribute to ischemic ulcer formation and to the spread of infection. Red cells are less deformable possibly due to glycosylation of their cell membranes.

This along with a tendency towards hypercoagulability and increased plasma viscosity may play a part in reducing capillary circulation so contributing to any ischemia that is present.

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TREATMENT OF DIABETIC FOOT ULCERS:

Here again there are many options like medical management, surgical intervention and also include the patient education

These are –

ANTIBIOTICS:

It is effective when the infection is local or superficial. The choice of the drug should take into account of the polymicrobial nature of these lesions. Currently, no specific antibiotic regimen has superior value for treatment of these diabetic foot infections.

SURGICAL GOALS:

The following are the goals of surgery in treating the Diabetic Foot ulcers:

1. Reduce the risk of ulceration/amputation.
2. Reduce the foot deformity.
3. Provide stable foot for amputation.
4. To reduce the pain.
5. Improve the appearance of the foot.

The following surgical interventions are done in these patients to promote the wound healing:

1. Wound Debridement
2. Reconstruction procedures Flaps/Skin grafts
3. Endovascular Procedures
4. Bypass Procedures
5. Amputation

Topic

SKING GRAFTS IN DIABETIC FOOT ULCERS

Skin grafts are appropriate for partial thickness wounds or for deeper wounds that are well perfused. Sir Astely Cooper was the first to perform successful skin graft in 1817.

TYPES OF GRAFTS:

- PARTIAL THICKNESS SKIN GRAFTS
- FULL THICKNESS GRAFTS
- COMPOSITE GRAFTS

PARTIAL THICKNESS SKIN GRAFTS (SPLIT SKIN GRAFTS)

Also called as THIERSCH GRAFT**.** Split Skin Graft consists of epidermis and a

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variable thickness of dermis. There remains some dermis on the donor site that heals by epithelialisation from the cut ends of hair follicles and sweat glands in a manner similar to the healing of a superficial burn.

PROCEDURE:

The thigh is most frequently used as a donor site, but almost anywhere else can be used. Grafts harvested using a skin graft knife or HUMBY'S KNIFE or a power dermatome and a guard that can be adjusted to determine the thickness of the graft.

This graft be thin or thick. The survival of the graft on the recipient area is known as TAKE.

HARVESTING SKIN GRAFT FROM THIGH

PRE AND POST OPERATIVE PICTURES

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FULL THICKNESS GRAFTS

It is also called as a WOLFE GRAFT. It includes both the epidermis and full dermis. Here donor site is closed by primary suturing. These are also used in diabetic ulcer coverage for a better cosmetic look as scar contraction postoperatively is minimal .

COMPOSITE GRAFT

Composite graft consists of skin and some underlying tissue such as fat or cartilage. As with any wound a foot wound in a patient with diabetes should be debrided of infected and necrotic tissue. This is usually accomplished most efficiently by sharp excision before planning for a skin grafting .

Subtopic

PRESENTATION OF DIABETIC FOOT:

There is a spectrum of presentation of diabetic foot problem ranging from a mere pain to gangrene. They are:

1. Pain in the foot
2. Sores, ulcers, blisters
3. Absence of sensation
4. Absence of pulsation in the foot
5. Loss of join movement
6. Abscess formation
7. Change in color and temperature when gangrene sets in
8. Patient may succumb to ketoacidosis, septicaemia, or myocardial infarction.

CLASSIFICATION OF DIABETIC FOOT ULCERS:

There are various classifications, they are:

1. WAGNER MEGGIT CLASSIFICATION
2. UNIVERSITY OF TEXAS SYSTEM CLASSIFICATION
3. BRODSKY DEPTH ISCHEAEMIA CLASSIFICATION

The most commonly followed classification is WAGNER-MEGGIT CLASSIFICATION

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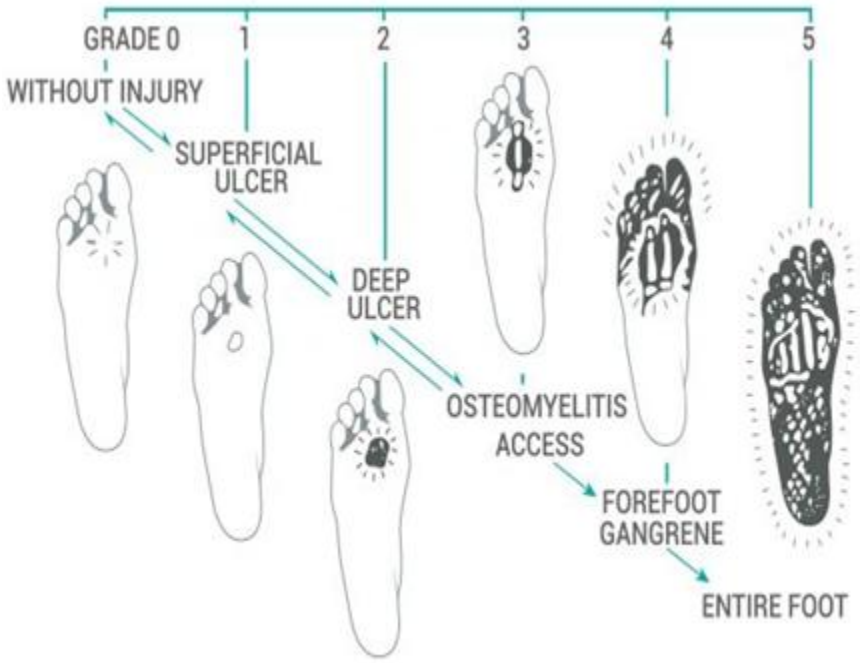
Our study was based on the Wagner meggit classification for classification of wound severity.

WAGNER MEGGIT CLASSIFICATION

GRADES	ULCERS
0	Preulcerative lesion
1	Partial Thickness wound upto but not through the dermis
2	Full thickness wound extending to tendons are deeper subcutaneous tissue but without bony involvement or osteomyelitis
3	Full thickness wound extending to and involving the bone
4	Localized gangrene
5	Gangrene of the Whole foot



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DIABETIC FOOT ULCER PROGRESSION

Methods

This is a prospective study conducted Patients presenting to our hospital from November 2019 – October 2021 (24 months) All cases of all grades of diabetic ulcer admitted in Department of General Surgery of MVJMC & RH. 100 cases of patients admitted with all

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grades of diabetic foot ulcers in surgical wards of M V J Medical College and Research Hospital.

Detailed history of the patients and thorough clinical examination was done in all cases. Documentation was done using a stratified proforma which included demographic data of the patient studied. For all patients Haematological, Biochemical, Microbiological and Radiological investigations were carried out as enumerated in the Performa. Blood sugars both fasting and postprandial were done. Renal parameters were done. X-ray of the affected foot, Chest X-ray, ECG and cardiac evaluation were done. The vascular status of the patient was also assessed.

Wound preparation was done for all the patients by wound debridement, all the patients were put on broad spectrum antibiotics according to their respective wound culture reports. Their glycaemic status was assessed and all of them were put on Inj. Human Insulin both monotard and actrapid according to their blood sugar level. After getting assessed by the anesthetist the test group were taken up for surgery – Split Skin Graft.

Cases will be allocated randomly into TEST GROUP AND CONTROL GROUP, test group treated with split thickness skin grafting and control group treated with traditional dressing. Groups will be done considering the confounding factors, which are matched.

Post operatively the patients were followed up for length of hospital stay as well as Graft complications such as - graft failure, ulcers at other aspects of the same foot, duration of dressings required post operatively and recurrence of ulcers in graft area.

INCLUSION CRITERIA –

All patients with all grades of diabetic ulcer undergoing Split Skin Grafting will be studied.

EXCLUSION CRITERIA –

1. Patients with underlying vascular abnormalities.
2. Malignancy.
3. Patients with comorbidities which are known to hamper healing and affect the general well-being of the patient, such as:

i. Collagen Vascular Disorders
ii. Patients undergoing Radiation/Chemotherapy
iii. Any congenital abnormality affecting wound healing

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iv. Any chronic disorders or syndromes requiring lifelong management

4. Patient not willing for study.

Methodology

The present study was conducted in our hospital and the findings are tabulated as below. During the study period from November 2019 to October 2021 100 Diabetic Patients with ulcers of the lower limb were randomized into Control Group (Traditional Dressing) and Case Test Group (Split Thickness Skin Grafting). These groups were studied for the effect of Traditional Dressings versus Split Thickness Skin Grafting on wound healing of diabetic foot ulcers and assessed as duration of healing or graft take time as appropriate.

Data Analysis

AGE DISTRIBUTION:

Out of the total of 100 patients, 50 patients received traditional dressings(Control Group) and 50 patients received Split thickness skin grafting(Case Test Group). Highest Number of patients was observed to be in the 51-60 years group indicating diabetic foot ulcers are most common in that age group. The Mean Age between the two groups was statistically not significant (p=0.702). The Age distribution amongst the two groups was also studied and was found to be not significant(p=0.951). The mean age as well as the patients falling into their respective age groups in the whole study as well as that as per the randomisation into Control and Case Test Group is as follows:

* p value <0.05 is significant. Student‘t’ test done

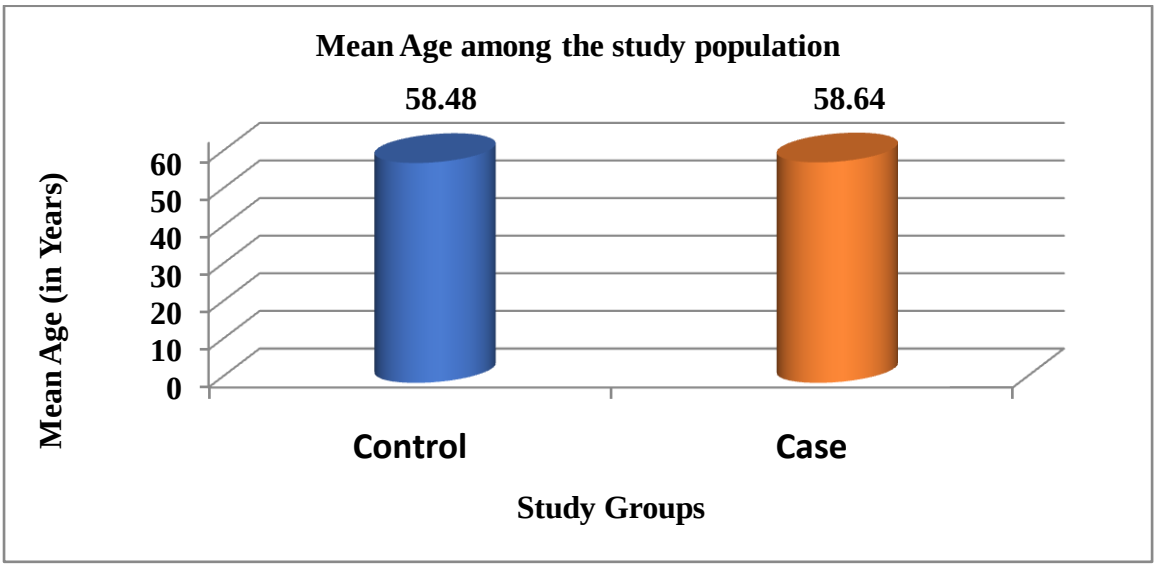

FIG:1 Mean Age of the patients among the study population

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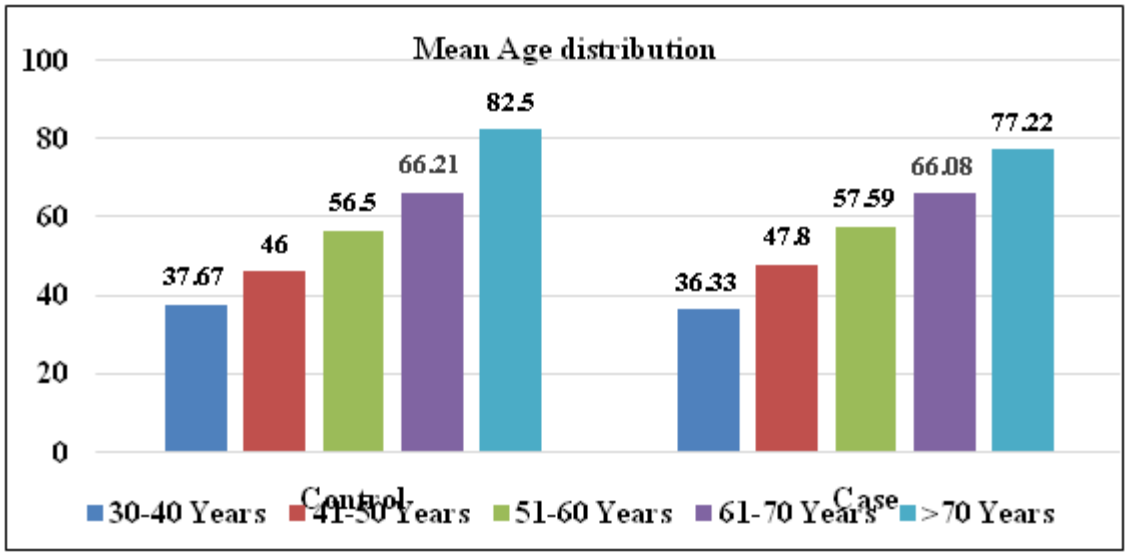

FIG:2Mean Age distribution among the cases and control groups

$\chi 2 = 2.182$, p value = 0.702 **(NS)**

* p value <0.05 is significant. Pearson Chi-square test doneS

* p value <0.05 is significant. Anova test done.

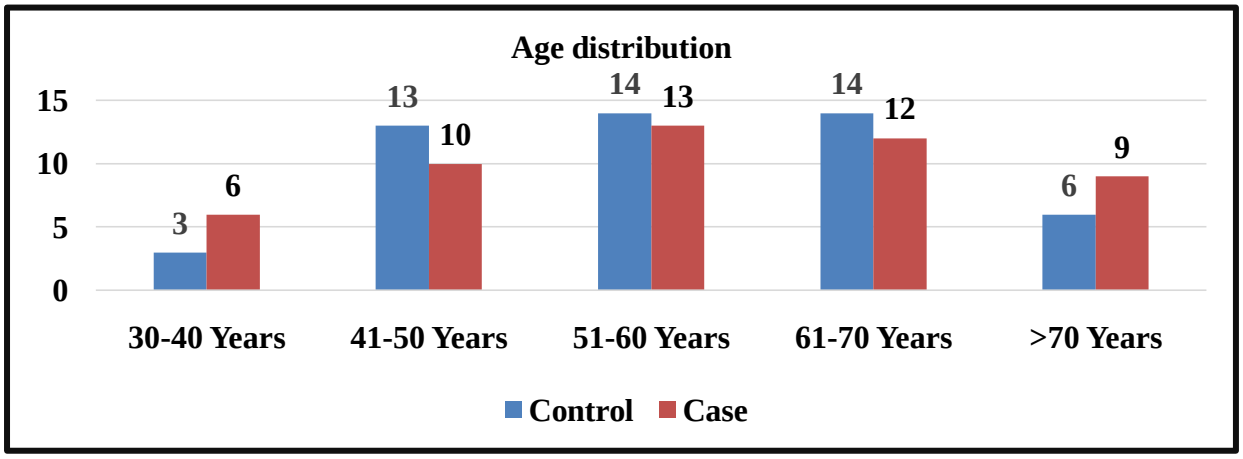

FIG:3Age distribution among the cases and control groups

GENDER DISTRIBUTION:

Out of 50 patients on Traditional Dressings(Control Group), 38 were male and 12 were female and of the 50 patients receiving Split thickness skin grafting(Case Test Group), 35 were male and 15 were female. Male to female ratio in the Traditional dressings group is 3.1:1 and the spit thickness skin grafting group is 2.3:1.

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There is no statistical significance between the gender distribution of the two groups (p=0.499)

$\chi 2 = 0.457$, p value = 0.499 **(NS)**

* p value <0.05 is significant. Pearson Chi-square test done

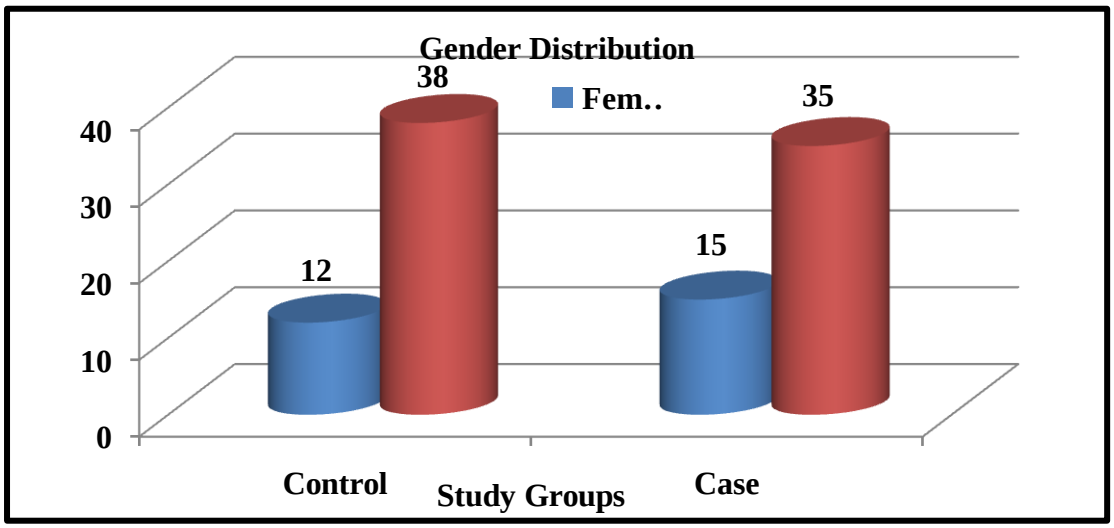

FIG:4Gender distribution among the cases and control groups

LATERALITY OF LOWER LIMB AFFECTED:

Out of 100 patients selected for the study highest number of patients showed to have the right foot affected followed by the left foot and one case having both feet affected. Out of 50 patients in the Traditional Dressings Group(Control Group), 33 had the right foot affected, 16 had the left foot and 1 had Both feet affected. Out of 50 patients in the Split Thickness Skin Grafting(Case Test Group) 36 had the right foot affected and 14 have left foot affected. There is no statistical significance between the two groups in terms of laterality of the lower limb affected(p=0.552)

$\chi 2 = 1.264$, p value = 0.532 **(NS)**

*p value <0.05 is significant. Pearson Chi-square test done

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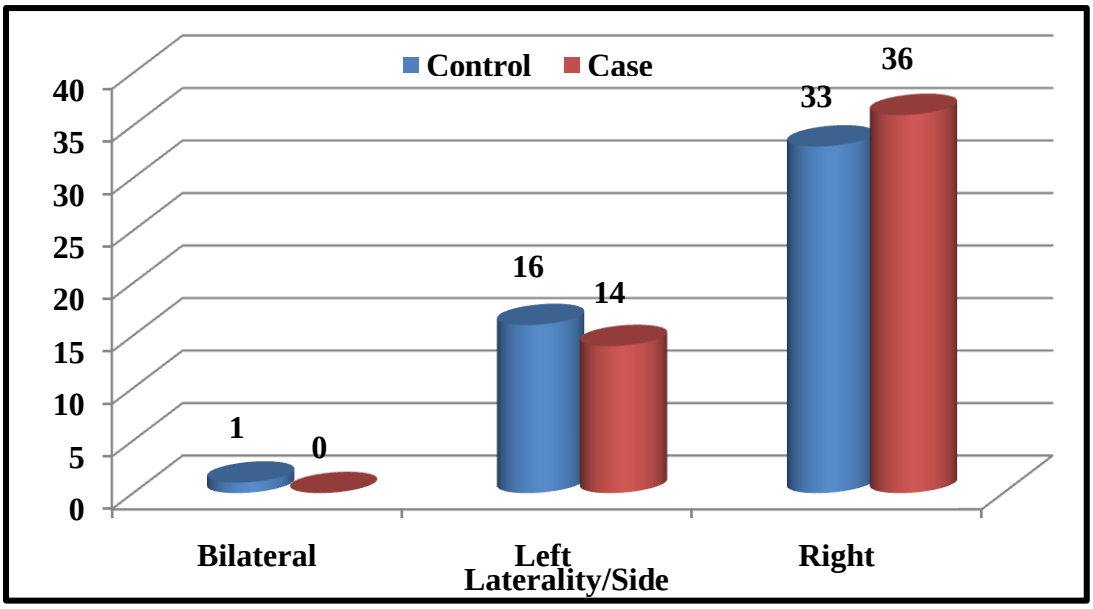

FIG: 6 laterality of lower limb affected among the study groups

FEATURES OF FOOT BASED ON STUDY GROUPS:

At the time of admission, the number of patients in both the groups were compared regarding the features of the diabetic foot ulcer, in which the distribution was statistically similar(p=0.420). 28 patients had Ulcer on the Dorsum of the right foot of which 15 were in the control group and 13 were in the test case group, 16 patients had Gangrene of the great toe of which 10 were in the control group and 6 were in the test case group.

DISTRIBUTION BASED ON WAGNER GRADES:

At the time of study, the number of patients in both the groups were compared regarding the Wagner Grades of Diabetic Foot, in which the distribution was found to be statistically similar (p=0.331). Highest number of cases were of the Wagner Grade 2 represented by 58 cases 28 in control group with traditional dressing and 30 in the Test Case group with Split thickness skin grafting was done. Others Grade distribution are as follows:

$\chi 2 = 4.602$, p value = 0.0.331 **(NS)**

* p value <0.05 is significant. Pearson Chi-square test done

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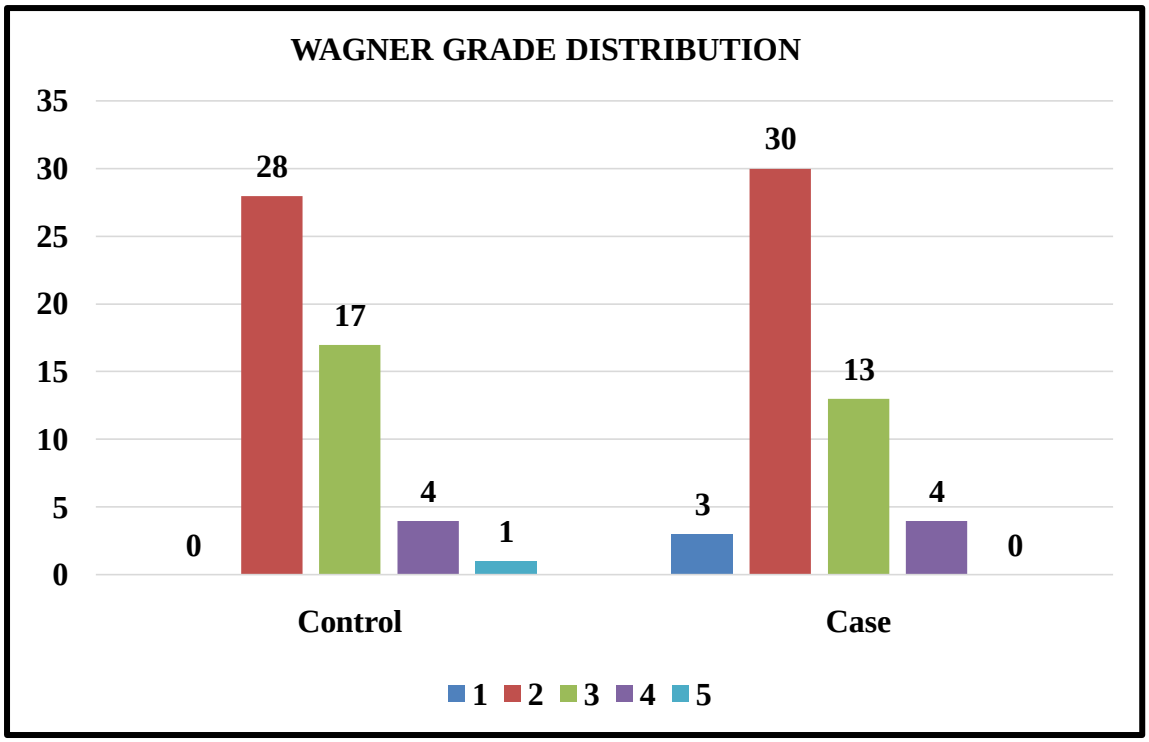

FIG:7 Distribution of patients among the cases and control group based on Wagner grade of the diabetic foot ulcer

INITIAL TREATMENT GIVEN:

The patients in the study after randomization into Control group and Test Case Group were treated as per the foot presentation and then as Traditional Dressing or Split Thickness Skin Grafting. Highest number of patients underwent debridement, 63 patients of which 30 were in Control Group and 33 in Test Case Group. Next were those patients who underwent Great Toe Ray's Amputation, 17 patients of whom 11 were in Control Group and 6 were in Test Case Group. Rest of the initial treatments provided were ranging from dressing to debridement to Ray's Amputation to one patient having a below knee amputation as shown below. The Initial Treatments given in both the groups however was statistically similar (p=0.712).

$\chi 2 = 5.423$, p value = 0.712 **(NS)**

* p value <0.05 is significant. Pearson Chi-square test done

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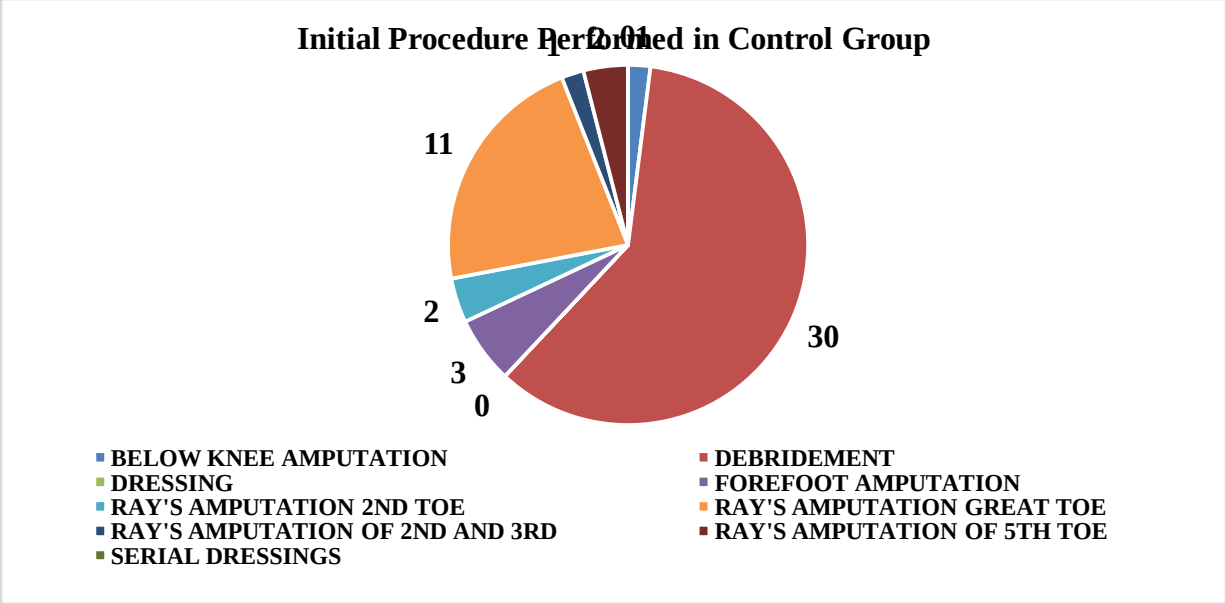

FIG:8Initial Procedure Performed in Control Group represented in a sector diagram

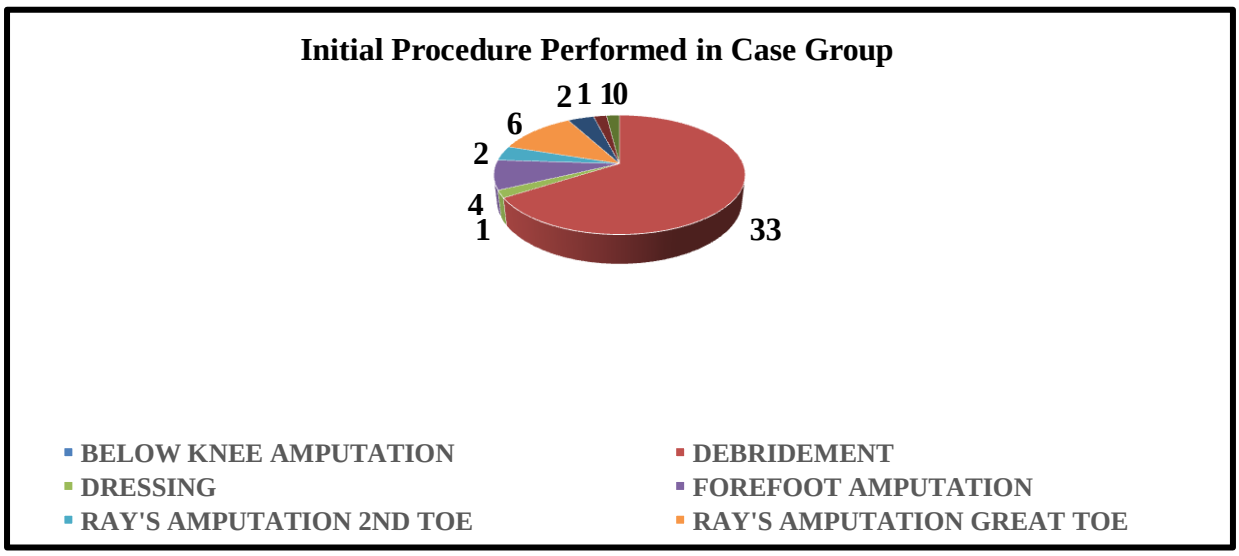

FIG:9Initial Procedure Performed in Case Group represented in a sector diagram

Results

OUTCOME OF INTERVENTION:

Of the 50 patients in Control Group who underwent the Traditional Dressings 43 had Healed, 6 did not heal and there was one death. Of the 50 patients in the Test Case Group who had undergone Split Thickness Skin Grafting 46 had complete Graft Take and healed whereas 4 showed Graft failure in the form of necrosis, infection etc. as shown below. Based on outcome alone Split Thickness Skin Grafting showed to be better than Traditional

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Dressings.

TABLE 8: OUTCOME BASED ON STUDY GROUPS

* p value <0.05 is significant. Pearson Chi-square test done

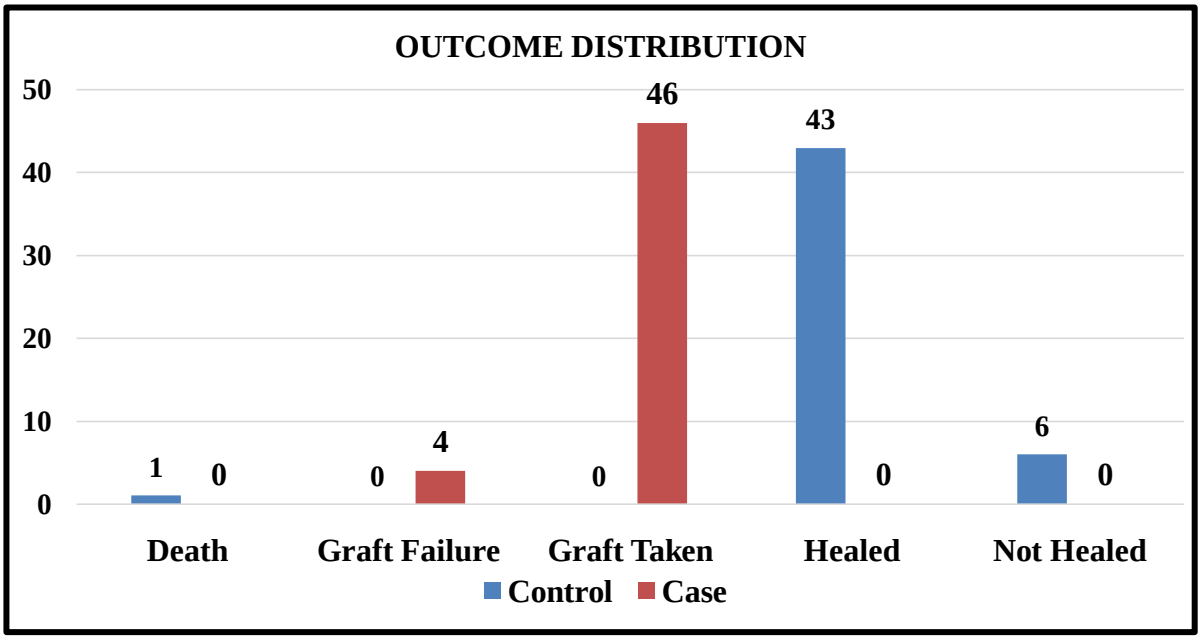

FIG: 10 Outcome in the cases and control groups at the end of study

OUTCOME BASED ON DURATION OF DRESSING:

Out of all the patients in the study, majority of the Test Case Group undergoing Split Thickness skin grafting, that is 31 patients, recovered within 2 weeks and another 10 patients over 3 weeks. This is Earlier than the Control Group who had undergone traditional dressings where 38 of them required dressings for about 12-20 weeks. The duration of dressings for both study groups clearly demonstrates that the Split Thickness Skin Grafting Group healed earlier than those undergoing Traditional Dressings.

$\chi 2 = 85.876$, p value = 0.000 **(SIG)**

* p value <0.05 is significant. Pearson Chi-square test done

Control – Duration of dressing vs outcome

POST PROCEDURE COMPLICATIONS:

Out of 100 patients Majority of the patients, that is 89 patients, did not have any post treatment complications from both the study group. In the Control Group 7 patients required re-intervention due to complications. 1 patient requiring Below Knee Amputation, 1 patient

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having Deep Pockets of Pus, 3 patients having Foot Abscess, 1 patient requiring re-debridement and 1 patient having Sole sloughing with tissue loss. In the Test Case Group 4 patients developed post procedure complication of which 3 patients had Graft Site Infection and 1 patient had graft necrosis. The Test case group having fewer number of Post Procedure complications as shown below:

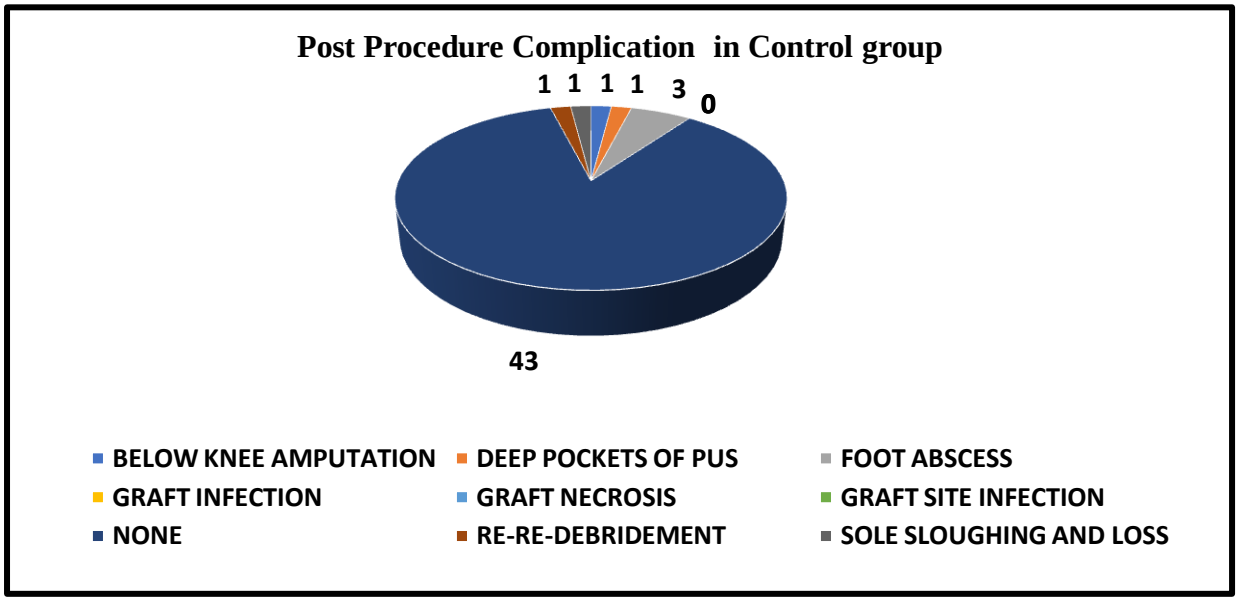

FIG:11Post Procedure Complication in Control group

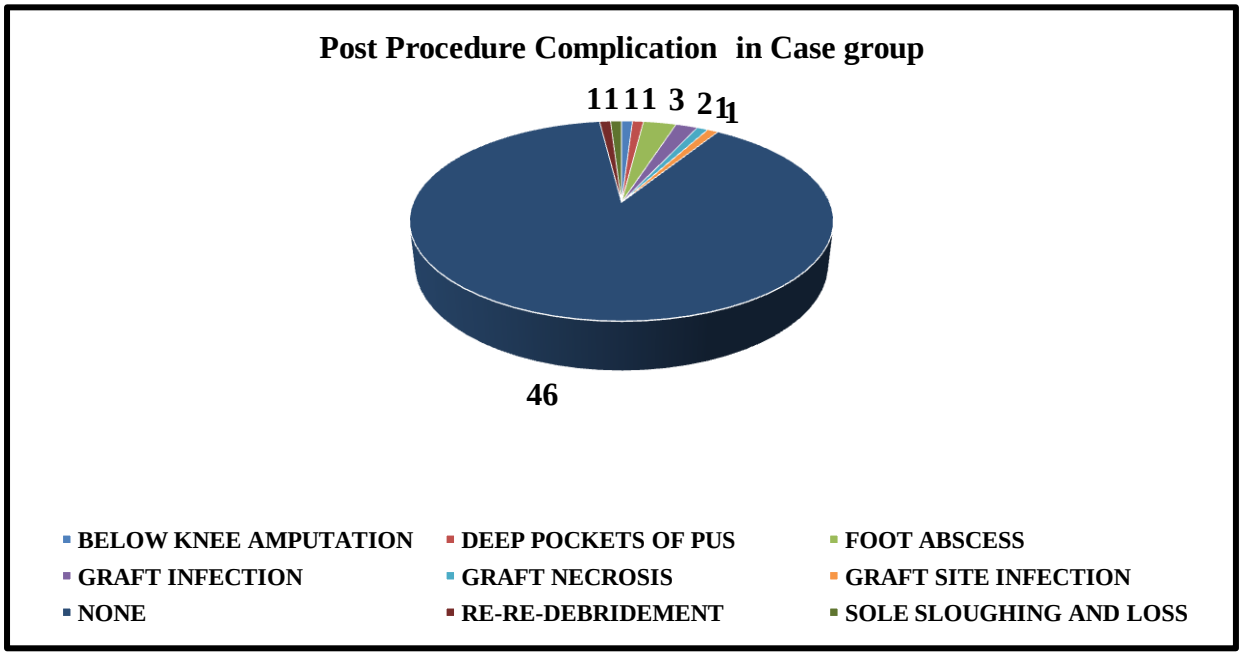

FIG:12Post Procedure Complication in Control group

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OUTCOME IN CONTROL GROUP:

Out of 50 patients in Control Group who had Traditional Dressings done the Number of patients who had healed was 43 patients, 6 having not healed and 1 death. Out of 43 patients who had healed when evaluated outcome in terms of duration keeping 12 weeks as a Cut off we notice that 67.4% that is 29 patients required more than 12 weeks for healing and 32.6% that is 14 patients required less than 12 weeks for healing. This outcome when analysed was not statistically significant (p=0.586).

$\chi 2 = 1.071$ p value = 0.586 **(NS)**

* p value <0.05 is significant. Pearson Chi-square test done

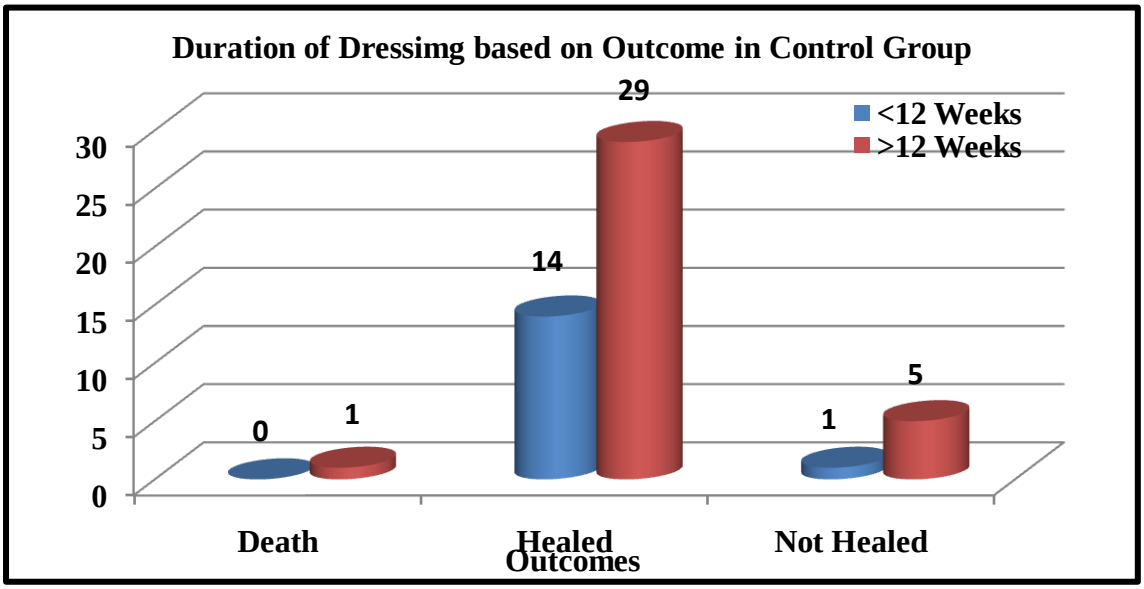

FIG: 13 Duration of Dressimg based on Outcome in Control Group

OUTCOME IN TEST CASE GROUP:

Out of 50 patients who under went Split Thickness Skin Grafting in the Test Case Group 46 had Graft Take and 4 had Graft Failure. When analysing this outcome in terms of duration keeping 4 weeks as the cut off of the 46 patients who had graft take 95.7% that is 44 patients had graft take in 4 weeks whereas 4.3% that is 2 patients had graft take after 4 weeks. This outcome when statistically analysed was found to be Significant. (p=0.000)

$\chi 2 = 31.884$ p value = 0.000 **(SIG)**

* p value <0.05 is significant. Pearson Chi-square test done

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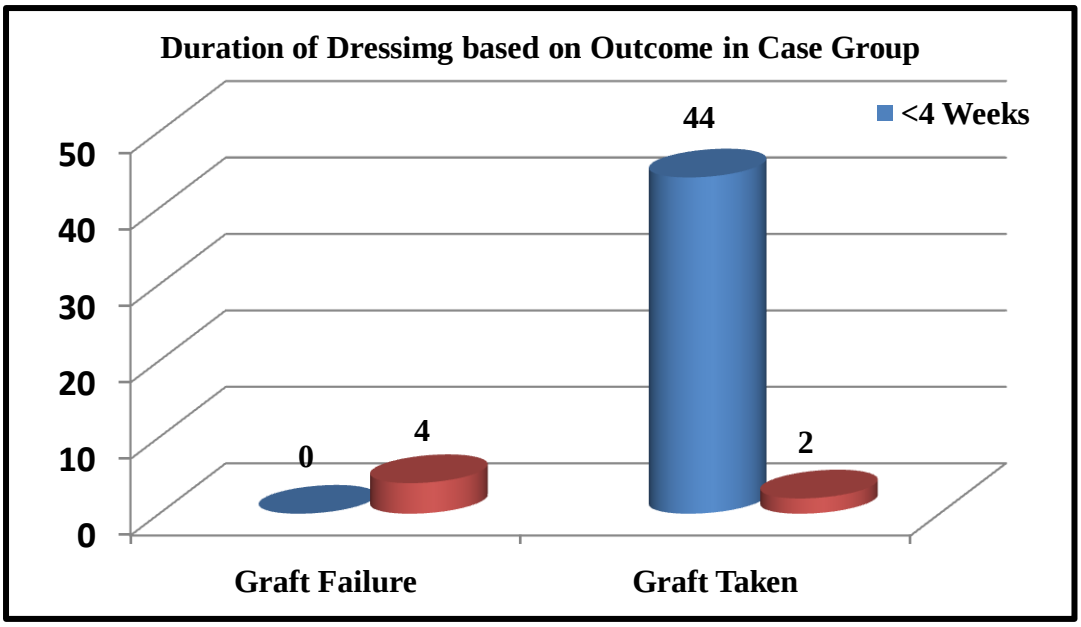

FIG:14 Duration of Dressings based on Outcome in Case Group

Discussions

The Diabetic foot care has evolved over the last few decades with much development made not only on the Primary Prevention of Diabetic Foot complications but also on the Primary care provided on an already formed Diabetic Foot Ulcer. Such as wound dressings, which have evolved from the status of providing physical protection to the raw surface, absorbing exudates and controlling local infection by local metabolites to the level of providing adequate environment promoting wound healing by using agents that promote granulation tissue formation.

However now, Split Thickness Skin Grafting following optimisation of the recipient ulcer site has come out as the most efficient treatment of Diabetic Foot Ulcers providing not only an early healing time but also decrease in the duration of post-operative dressing and care.

In this Study, patients of all Wagner Grades of Diabetic Foot were randomised into Control and Test Case group, the former receiving Traditional Dressings only and the latter Split Thickness Skin Grafting. Base line Characteristics like age, Gender, Laterality of foot ulcer, Wagner Grade of Diabetic Foot Ulcer and other confounding factors were matched.

Majority of the patients fell into the age group 51-60 years. Male gender distribution

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was more in comparison to female gender with male: female ratio of 3.1:1 in the control group undergoing Traditional Dressings and 2.3:1 in the Test Case Group undergoing Split Thickness Skin Grafting.

In this study when laterality of the foot was analysed 69 patients had Right foot affected and 30 patients had the left foot affected and 1 patient had bilateral foot affected by diabetic foot ulcer. Showing the preponderance of Right foot to be most commonly affected by diabetic foot ulcers.

In this study according to the Wagner Grade for diabetic foot classification 58 patients in our study had Wagner grade 2, 30 patients with Wagner Grade 3, 8 were of Wagner Grade 4, 3 of Wagner Grade 1 and 1 patient was of Wagner Grade 5. Thus showing that the patients presenting to a hospital usually do so with a Wagner Grade 2 Diabetic Foot Ulcer.

In this study the patients had initially undergone a procedure for optimisation of the diabetic foot before a definitive study intervention could be done. Of them, majority, around 63 patients, of the patients had undergone Debridement followed by Amputation of the Toes to Below Knee as and when deemed necessary. Showing that at the time of presentation most diabetic foots will require some degree of Pre Intervention optimisation.

When the outcome was analysed in the Control Group 43 patients had healed with traditional dressings and 6 had not healed and 1 patient died. The patients also showed a longer duration of requirement of dressings and follow up with most patients falling in between 12-20 weeks of follow up. However in the Test Case Group undergoing Split Thickness Skin Grafting 46 patients showed Graft take and healing of diabetic foot ulcer, 4 patients had graft failure with 3 having Graft infection and one having Graft necrosis with 31 patients showing healing of diabetic foot within 2 weeks and 41 within 3 weeks. Thus establishing that split thickness skin grafting not only allows for higher healing rates but also lesser duration of dressings and post intervention care required.

Post Intervention complications were noted amongst 6 of the patients undergoing Traditional dressings, 1 patient who had undergone a Great toe Ray's Amputation required a revision Below Knee Amputation and later died, of the 5 patients with Complications 3 patients had foot abscess, 1 patient developed deep pockets of pus, 1 patient required re-debridement and 1 patient had Sole of Foot sloughing. Of the 50 patients undergoing Split Thickness Skin Grafting 4 patients had complications, 3 patients developed Graft Infection and 1 patient showed Graft Necrosis.

From this study we can infer that irrespective of the Wagner Grade of the Diabetic

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foot the Test Case Group showed a superior result in healing as well as in duration of healing which was statistically significant (p=0.00) as compared to Control Group patients who underwent Traditional Dressings only(p=0.586). Thus this Comparative study shows a significant improvement in diabetic foot treatment by Split Thickness skin grafting not only in the healing rates but also the duration of treatment required lessening the socioeconomic burden as well as the morbidities and burnouts associated with prolonged treatment.

We can draw parallels in our study with those done by Mangolis et al reported a healing rate ranging between 24.2% and 47% whereas our study showed a healing rate of 62% with split thickness skin grafting. Yammine et al showing a healing rate as high as 85% within 5.3 weeks in the metanalysis study done.

Conclusion

We draw the following conclusions:

- Split Thickness Skin Grafting showed faster and better healing rates as compared to Traditional dressings in all Grades of Diabetic Foot Ulcers.
- Split Thickness skin grafting by providing a faster healing rate provided a better socioeconomic outcome for the patient.
- Split Thickness skin grafting decreased the morbidities associated from prolonged wound care and hospital care by providing a faster functioning limb.

Limitations and Future Studies

- The Cost burden on patient not analysed.
- Not a blinded Study.

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