"LONGITUDINAL STUDY TO DETERMINE THE APPLICATION OF SITE, ISCHEAMIA, NEUROPATHY, BACTERIAL INFECTION, AREA AND DEPTH [SINBAD] SCORING IN THE OUTCOME AND MANAGEMENT OF DIABETIC FOOT ULCERS"

BY

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KLE Academy of Higher Education and Research

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"LONGITUDINAL STUDY TO DETERMINE THE APPLICATION OF SITE, ISCHEMIA, NEUROPATHY, BACTERIAL INFECTION, AREA AND DEPTH|SINBAD|SCORING IN THE OUTCOME AND MANAGEMENT OF DIABETIC FOOT ULCER – AT KLES DR. PRABHAKAR KORE HOSPITAL"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

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LIST OF ABBREVIATIONS USED

Cm	–	Centimeter
C	-	Celsius.
DFU	-	Diabetic foot ulcer.
DP	-	Dorsalis Pedis
FT	-	Foot Temperature
10g	-	10 grams
HBsAg	–	Hepatitis B Surface Antigen
HIV	–	Human Immunodeficiency Virus
H/O	–	History of
128HZ	-	128 Hertz
IWGDF	-	International working group on diabetic foot.
LEA	-	Lower extremity amputation.
LOPS	-	Loss of protective sensations.
mm	-	Milli metre
mm Hg	-	Millimetre of mercury
MDP	-	Methylene diphosphonate.
P	-	Pulse.
PAD	-	Peripheral Arterial Disease.
PTA	-	Posterior Tibial Artery.
SAD	-	Site, arteriopathy, denervation.
Si	-	Silicone.
SINBAD	-	Site, ischemia, neuropathy, bacterial infection, area and

depth.

SIRS.	-	Systemic inflammatory response syndrome.
TCC	-	Total contact casts.
USA	–	United States of America
JNMC	-	Jawaharlal Nehru Medical College
KAHER	–	KLE Academy of Higher Education and Research
KLES	–	Karnataka Lingayat Education Society

ABSTRACT

Title:

Longitudinal study to determine the application of site, ischemia, neuropathy, bacterial infection, area and depth (SINBAD) scoring in the outcome and management of diabetic foot ulcers.

Aims and objectives:

1.To classify the ulcers and assess the management based on SINBAD scoring system.
2.To predict the outcomes in healing of diabetic ulcers and decrease in rate of amputation according to SINBAD Score.

Methods:

Patients willing to give written and informed consent, either sex of age group 35-70years, with type2 diabetes mellitus, wound or callus on one foot and hemoglobin > 9gm% are included in the study. Total 120 patients are included in the study. wounds are assessed and Scored as per SINBAD Scoring system and management was determined as per Score.

Results:

patients with Score 3(n=23) underwent Debridement except for one patient underwent amputation after one month due to its non healing and gangrenous changes set in. All of the patients with Score of 5(n=25) and 6(n=12) underwent amputation. Score 4(n=60) being a dilemma and majority of our patients come under this Scoring have been chosen for Debridement (n=11) and amputation(n=49) as per wound severity which in our study, graph favours towards amputation.

Conclusion:

SINBAD scoring system is very feasible and helps in predicting outcomes in management of diabetic foot ulcers with acceptable results. However need for proper assessment in early stage and management of ulcers helps in limb salvage**.**

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INTRODUCTION

Diabetes mellitus is one of the most common non-communicable diseases in the Worldwide with a wide variety of clinical manifestations. It is one of the main problems in global health systems that has risen sharply over the previous 20 years.[1] Diabetics are susceptible to a wide range of complications. The complications that need the most attention are diabetic neuropathy and peripheral vascular disease, both of which can result in diabetic foot ulcers[2].

The prevalence of diabetes is 6.4% worldwide and more likely to rise to 7.7% by 2030[2]. From 285 million in 2010 to 438 million in 2030, the prevalence in the 20 to 70-year-old age range is projected to rise.[3] These ulcers have a nexus of pathogenesis comprising inflammatory, vascular, mechanical, oxidative, nutritive and endothelial factors[4].

A diabetic foot ulcer is described as a full thickness wound through the dermis distal to the ankle on a weight-bearing area or exposed surface. The incidence of ulceration on foot is approximately 1-4% with Prevalence ranging from 4-10%. The lifetime risk of developing foot ulceration in diabetics ranges from 15% to 25%.[5]

DFU is regarded as a significant contributor to morbidity and a major reason for hospitalization in diabetic patients[6]. Diabetic foot ulceration leads to physical and emotional distress along with productivity and financial loss, thus impacting on overall quality of life[7]. Impaired wound healing and chronic infection complicate ulcers, placing the patients at higher risk for osteomyelitis, gangrene and eventually lower limb amputations[8]. According to estimates, a leg is amputated due to diabetic foot ulcers globally every 30 seconds[9].

Diabetes is a multi-organ systemic disease, which requires an integrated approach for a management of diabetic foot ulcer in order to receive optimal outcomes. Besides a strict glycaemic control, management of these ulcers encompass a proper initial assessment of wound healing strategies and a scientifically sound knowledge of the causative factors responsible for improper wound healing.

Effective wound healing mandates a proper staging of ulcer, adequate debridement, antibiotic therapy and optimum non-weight bearing and regular dressings. Despite extensive studies and technological developments, there is presently no solitary treatment modality with quantifiable clinical outcome present[10]. Effective assessment must be undertaken to make certain of the etiology which predisposes for the ulcer development and to enable a suitable treatment and management plan for implementation in order to optimize regression and healing[11].

There have been many different classification systems used, including Wagner, pedis, and university of Texas, with Due to the depth of penetration and volume of necrotic tissue, Wagner's is the most used. However, this system lacks understanding of the pathological process underlying the development of ulcers and does not offer a management strategy[12].

Due to recent data that suggested ulcer site is also a significant outcome factor, the SINBAD also includes ulcer site and area. Other studies have reported other than site all other parameters of SINBAD Scoring system is statistically significant in relation to healing.

Patients with diabetic foot ulcers are categorized using the SINBAD Scoring system, which assigns a score of one to mid foot and hind foot ulcers, ischemia, neuropathy, bacterial infection, area larger than 1 cm square, and depth beyond

subcutaneous tissue. Ulcers are therefore scored at the time of presentation, and results are assessed in accordance with the appropriate score[12].

Data on the prevalence of complications from diabetes in developing nations are inaccurately maintained. Therefore, the utilization of several clinical techniques makes it impossible to compare them. This makes a reliable classification system necessary. When different classification groups have been used to look for correlations between baseline factors and clinical outcome, inconsistent results have been obtained[12] .

Clinical audits were intended for the SAD system, which comprises only 3 features: Size, ischemia (arteriopathy) and neuropathy (denervation). However, it is very elaborate to use on a daily basis, especially in high output centres where it is restricted[13] .

The present study was intended to assess the role of the SINBAD Scoring system in diabetic ulcer evaluation and treatment its role in determining the outcomes of healing, decrease the rate of amputation and its usage in daily practice.

OBJECTIVES

Primary:

- To classify the ulcers and assess the management based on the SINBAD Scoring system.

Secondary

- To predict the outcomes in healing of diabetic ulcers and decrease in rate of amputation according to the SINBAD Score.

REVIEW OF LITERATURE

DIABETES MELLITUS

Diabetes is a chronic, illness with complex nature which requires constant medical care with conglomerate risk reduction strategies beyond glycemic control .[14]

Diabetes mellitus is described by the American Diabetes Association as "a group of metabolic diseases characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both[15]."

EPIDEMIOLOGY

Diabetes is one of the burgeoning global health crises of the twenty-first century. According to predictions, there will be 537 million diabetics worldwide in 2021, rising to 643 million by 2030 and 783 million by 2045.

541 million people are predicted to have impaired glucose tolerance in 2021, and 6.7 million people between the ages of 20 and 79 are predicted to die from diabetes-related causes[16].

In the US and Europe, lower extremity amputations (LEAs) caused other than trauma continue to be most frequently caused by diabetes. People with diabetes account for more than 60% of LEAs in the US, or 82,000 on average each year.

Toe amputations make up the most of procedures for lower limb amputations caused by diabetes. Toe LEA had the highest age-adjusted LEA rate (2.6 per 1,000 people) among people with diabetes in 2002, followed by below-knee LEA (1.6 per 1,000 persons).

Age-adjusted incidence rates for above knee LEA and Toe LEA were 0.8 per 1,000 people. These amputation level trends have essentially not changed since 1993.

When compared to non-diabetic populations, the LEA rate is typically 15 to 40 times higher in diabetic populations, and it is at least 50% higher in men than in women. Men had a rate of 7.0 age-adjusted LEA per 1,000 people with diabetes in 2002, compared to women's rate of 3.3[17].

RISK FACTORS [17]

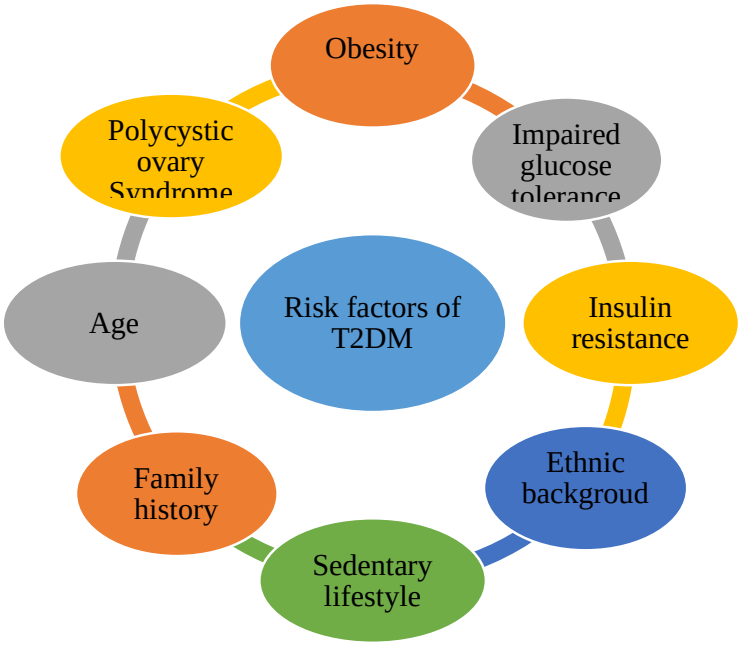
Risk factors for Type 1 diabetes include:

- Having a family history (parent or sibling) of Type 1 diabetes.
- Injury to the pancreas (such as by infection, tumour, surgery or accident).
- Presence of autoantibodies (antibodies that mistakenly attack your own body's tissues or organs).
- Physical stress (such as surgery or illness).
- Exposure to illnesses caused by viruses.

Risk factors for prediabetes and Type 2 diabetes include:

- Family history (parent or sibling) of prediabetes or Type 2 diabetes.
- Overweight/obesity.
- High blood pressure.
- Low HDL cholesterol (the "good" cholesterol) and high triglyceride level.

Figure:1[17]: Risk factors of Diabetes Mellitus



PATHOPHYSIOLOGY

Genetic and environmental risk factors affect autoimmunity, inflammation and metabolic stress states at the cellular level which lead to destruction of the beta cell of pancreas affecting insulin production and/or its activity.

Insulin insufficiency along with reduced response by tissues to it affects the pathways of action of complex hormones at multiple levels.

Diabetes-related abnormalities in protein, fat, and carbohydrate metabolism are caused by inadequate insulin action on target tissues.

The hyperglycemia due to its chronicity consequently leads to long-term impairment of several organs, particularly the nerves, kidneys, eyes, blood vessels, and heart[18].

CLASSIFICATION [19]

Diabetes can be classified into:

1. Type 1 diabetes (because of autoimmune mechanisms)
2. Type 2 diabetes (Hampered beta-cell insulin secretion and insulin resistance)
3. Gestational diabetes mellitus
4. Specific types of diabetes:

For example,

- Monogenic diabetes syndromes.

- Diseases of the exocrine pancreas (Cystic fibrosis and Pancreatitis)

-Drug or chemical-induced diabetes (with Glucocorticoid use, after organ transplantation).

Table :1 Classification of Diabetes Mellitus:

DIABETES MELLITUS		
Type 1 Diabetes Mellitus	**Type 2 Diabetes Mellitus**	**Gestational Diabetes Mellitus**
● Absolute insulin deficiency ● Destruction of beta cells	● Relative Insulin deficiency ● Insulin resistance	● Second or third trimester of pregnancy which was not overt diabetes before gestation

DIAGNOSIS [19]

Table 2: Diagnosis of Diabetes Mellitus

HbA1C	≥ 6.5
Fasting Blood sugar	≥ 126mg/dl
2 hour plasma glucose	≥ 200 mg/dl
Random plasma glucose	≥ 200 mg/dl **with symptoms of hyperglycemia**

COMPLICATIONS [20]

Acute consequences of uncontrolled diabetes include hyperglycaemia, NHS and ketoacidosis.

Diabetes can cause both microvascular and macrovascular issues over the long term. The microvascular consequences include neuropathy, nephropathy, which is a major cause of renal failure, diabetic retinopathy, which results in progressive visual loss. After ruling out other potential causes, diabetic neuropathy is defined as the presence of clinical signs of peripheral nerve damage in diabetics.

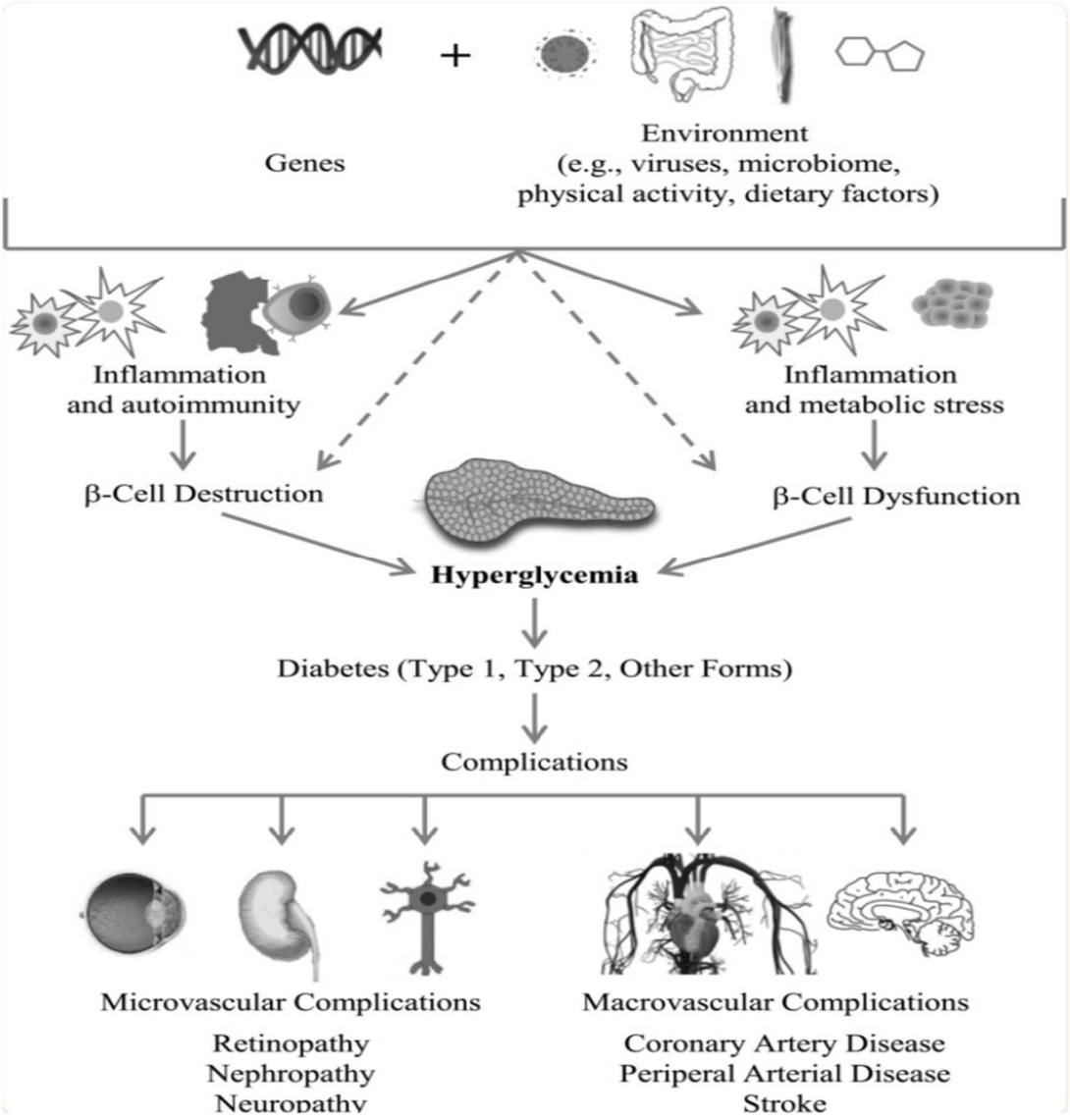
Diabetics who have peripheral neuropathy may experience sensory, multifocal, or autonomic symptoms. The most prevalent form of diabetic neuropathy, distal sensorimotor symmetric polyneuropathy causes charcot joints, foot sores, and amputations.

Clinical signs of autonomic neuropathy include gastrointestinal, genitourinary, and cardiovascular symptoms. The root cause of macrovascular problems in diabetes individuals is the increased risk of atherosclerosis, platelet adhesion, and

hypercoagulability. Cardiovascular, cerebrovascular, and peripheral artery disease are more likely to affect diabetics.

Long-term signs of diabetes mellitus include hypertension and changes in lipoprotein metabolism. Growth is hampered and a person becomes more vulnerable to certain illnesses as a result of chronic hyperglycemia.

Figure :2[20] : Complications of Diabetes Mellitus:



Lower limb complications in Diabetes Mellitus [20]

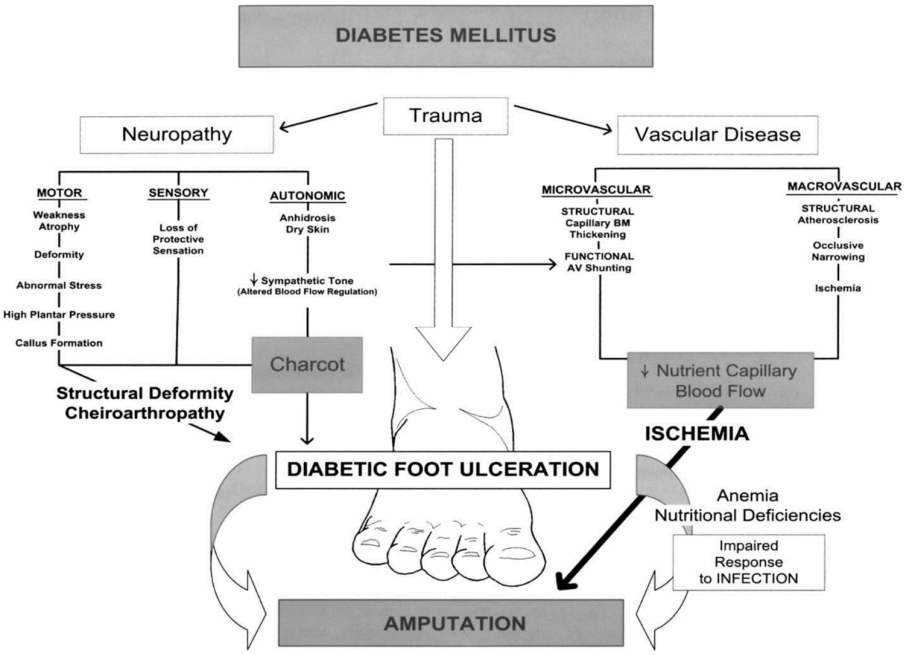
Diabetes's microvascular and macrovascular consequences cause a wide range of problems in the lower extremities. A diabetic patient's foot is vulnerable due to a combination of vasculopathy, infection, and distal sensorimotor peripheral and autonomic neuropathy.

As a result, they experience diminished pain, temperature, and proprioception feelings as well as minor muscle atrophy and callus growth on their dry, skin. All of them increase the possibility of ulcers developing on the patient's foot.

Repetitive foot damage brought on by diminished senses increases the risk of developing an ulcer on the foot. Distal sensorimotor peripheral and autonomic neuropathy, infection and vasculopathy in combination makes the foot of a diabetic patient susceptible.

It is associated with small muscle wasting leading to foot deformities and dry skin leading to callus formation and Long term charcot's Arthropathy.

Figure:3[20] : Lower limb complications of Diabetes Mellitus



DIABETIC FOOT ULCER [21]

The following definition of a diabetic foot ulcer is given: "Infection, ulceration, or destruction of tissues of the foot in a person who has diabetes mellitus, either currently or previously; typically accompanied by PAD and/or neuropathy in the lower extremity."

EPIDEMIOLOGY

Estimates suggest 15% of diabetics carry a risk of forming diabetic foot ulcers in their lifespan, from where15-20% cases eventually result in need for amputation.[22]

Amputations of lower limbs result in the loss of about 40,000 of them in India each year. Of these, more than 75% cases are due to neuropathy with superadded infection, which are potentially avoidable.[22] Every half minute one lower limb or part of lower limb gets lost worldwide because of diabetes.[23]

SURGICAL ANATOMY OF FOOT[24,25,26]

The foot is an integrated complex of tendons, ligaments, muscles and bones arranged in arches with an intricate neurovascular framework.

It provides a pedestal to carry the entire weight of the body and forms the crux of locomotion.

Anatomically Foot is Divided into -

a) Fore Foot- The Distal part consisted of the phalanges, metatarsal bones.
b) Mid Foot- The mid part consisted of the, navicular, and cuneiform bones, cuboid.
c) Hind Foot- The posterior part of the foot that is composed of the talus and calcaneus.

Figure:4a[26]: Dorsal view of right foot

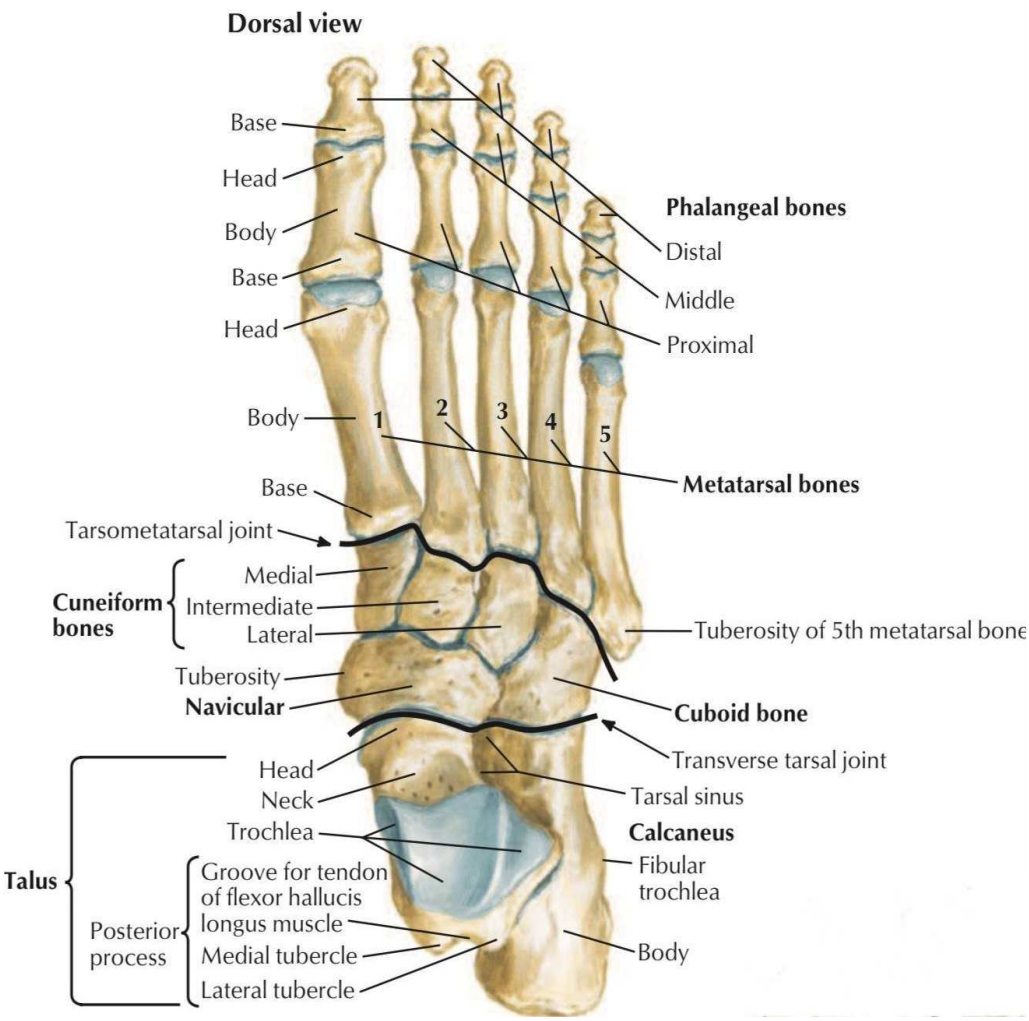
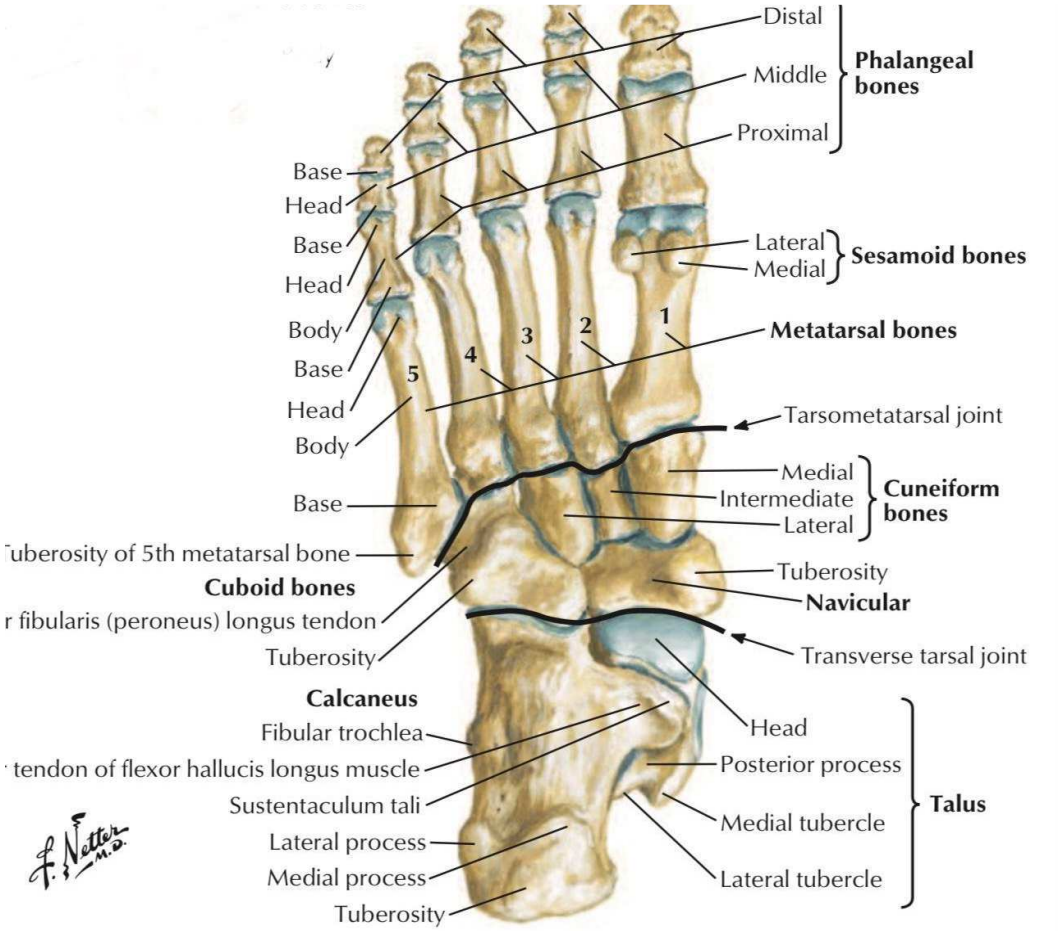


Figure:4b[26]: Dorsal view of left foot



SKIN AND SUBCUTANEOUS TISSUE[24,25]

The skin covering the sole of the foot is thicker and more sensitive than that of the dorsal aspect with lack of sebaceous glands and hair follicles and marked presence of numerous sweat glands.

The subcutaneous tissue deep to the sole is more fibrous and compact than the loose tissue deep to the dorsal skin. Fibrous septa which attach the skin to the plantar

aponeurosis prevents excessive movement of skin during walking. This improves the plantar grip during locomotion.

These 'modified skin ligaments' also concentrate the subcutaneous fat over the weight bearing areas of heel, sole's lateral margin as well as across plantar aspect of heads of metatarsals. This helps those areas to act as shock absorbing pads.

DEEP FASCIA[24,25]

Distal extension of the inferior extensor retinaculum over dorsum of foot called 'plantar fascia' over sole of foot, has a more complex being thicker in the central area and weaker in the medial and lateral areas.

It helps in maintenance of the longitudinal arches of the foot. It also protects the plantar aspect of the foot from injury and keeps the parts of the foot intact. The stronger central portion is termed as the 'plantar aponeurosis. It extends from the calcaneus distally and ends as fibrous digital sheaths enclosing the 5 flexor tendons and 'superficial transverse metatarsal ligament' over metatarsal heads.[72,73]

MUSCLES OF FOOT[24,25]

All the muscles of the sole together stabilize the foot during the support phase of stance by maintaining the integrity of the arches of the foot.

Each foot comprises 20 muscles. There are 2 on the dorsal aspect, 4 in the intermediate and 14 muscles on the sole of foot.

Figure:5a[26] :First layer of muscles of sole

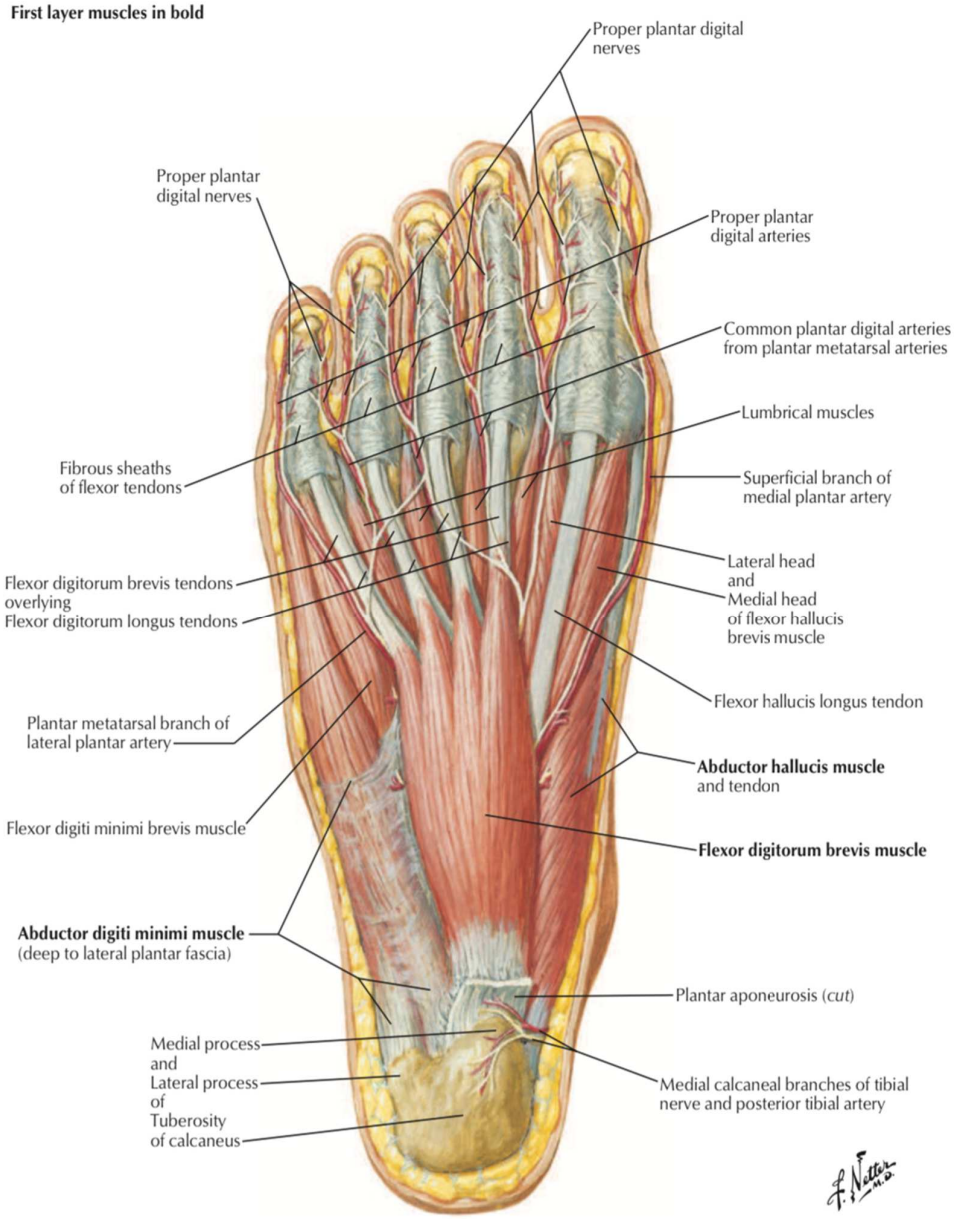


Figure:5b[26] : Second layer of muscles of sole

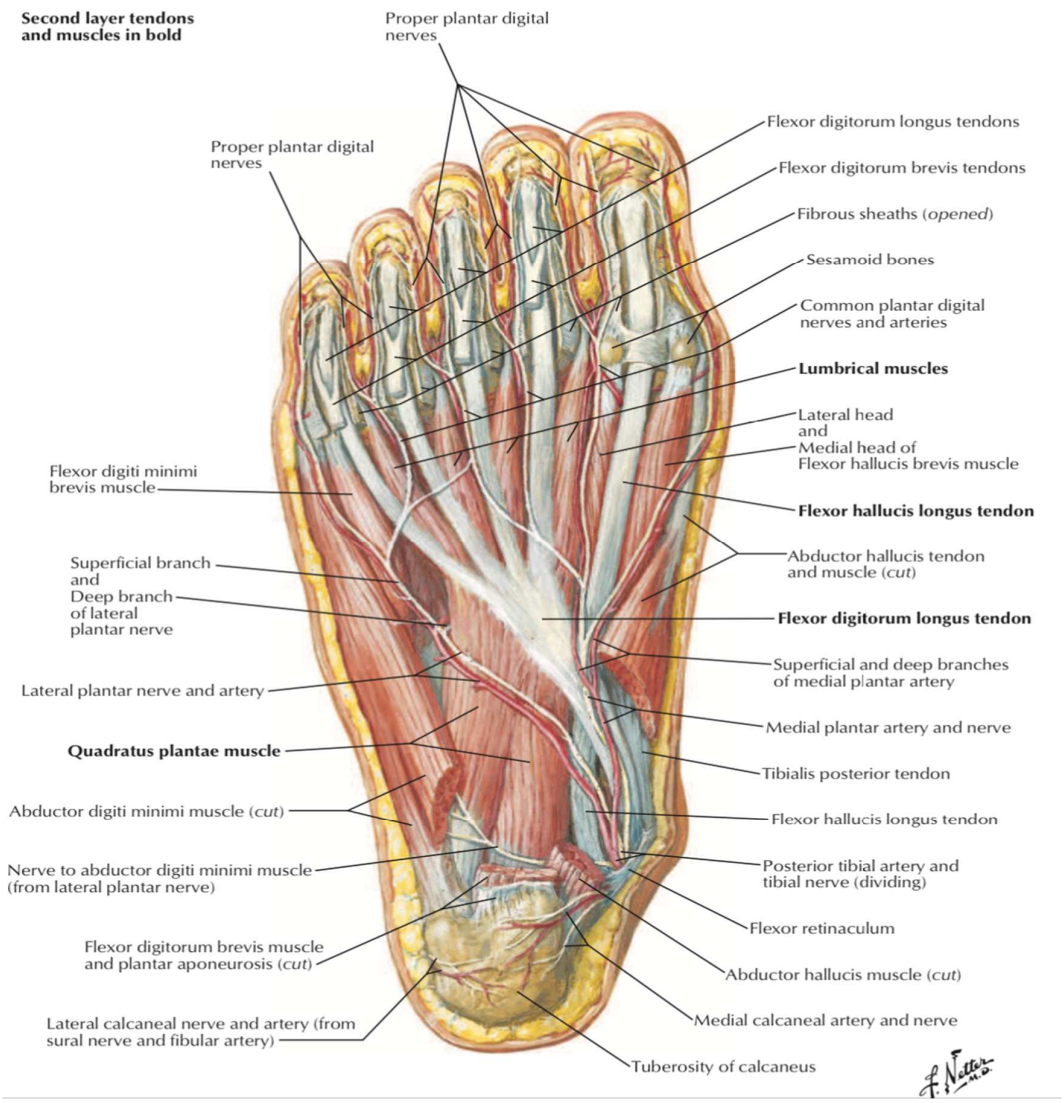


Figure:5C[26] : Third layer of muscles of sole

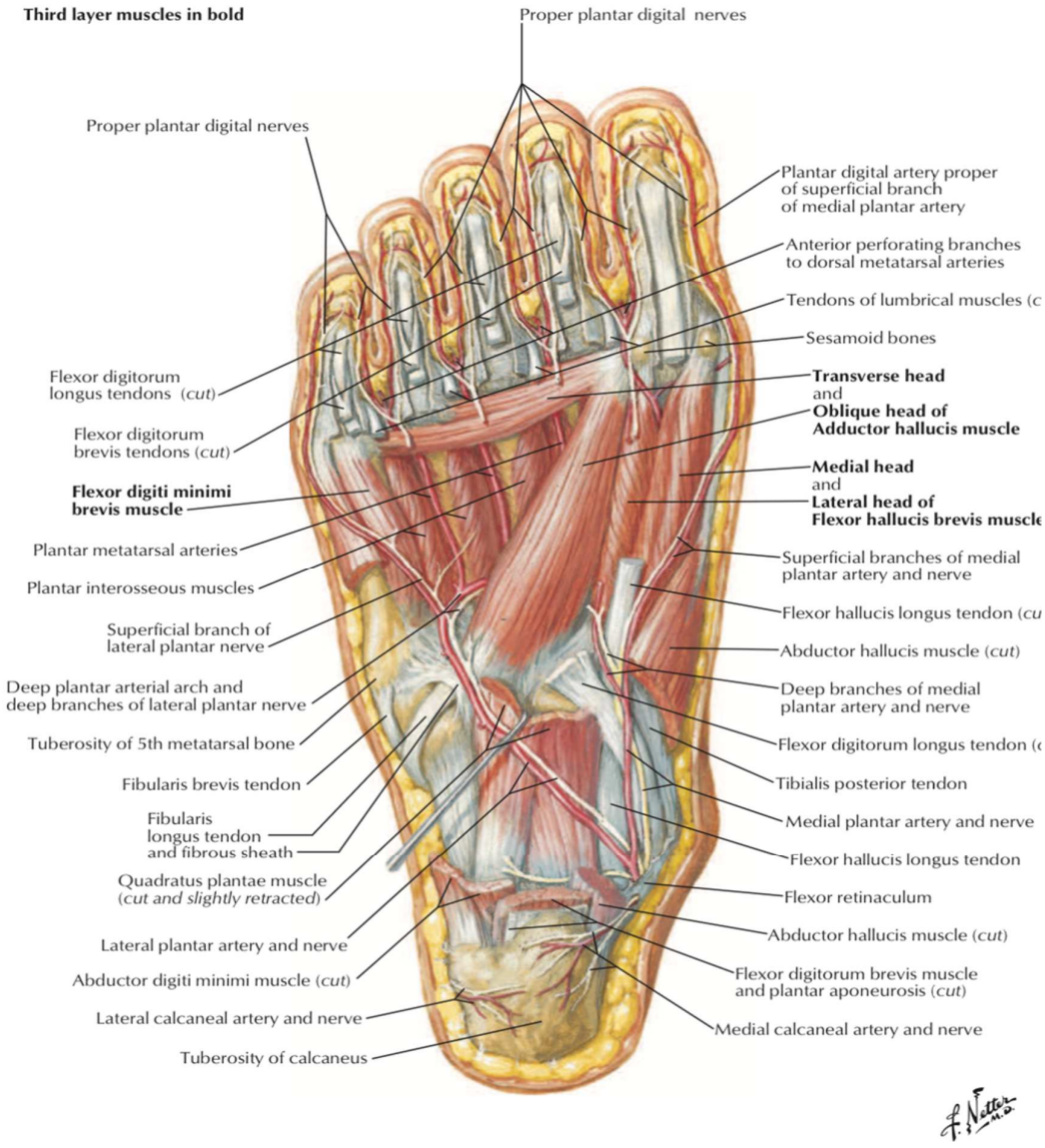


Figure:5d[26] : Dorsal and Plantar view of muscles of foot

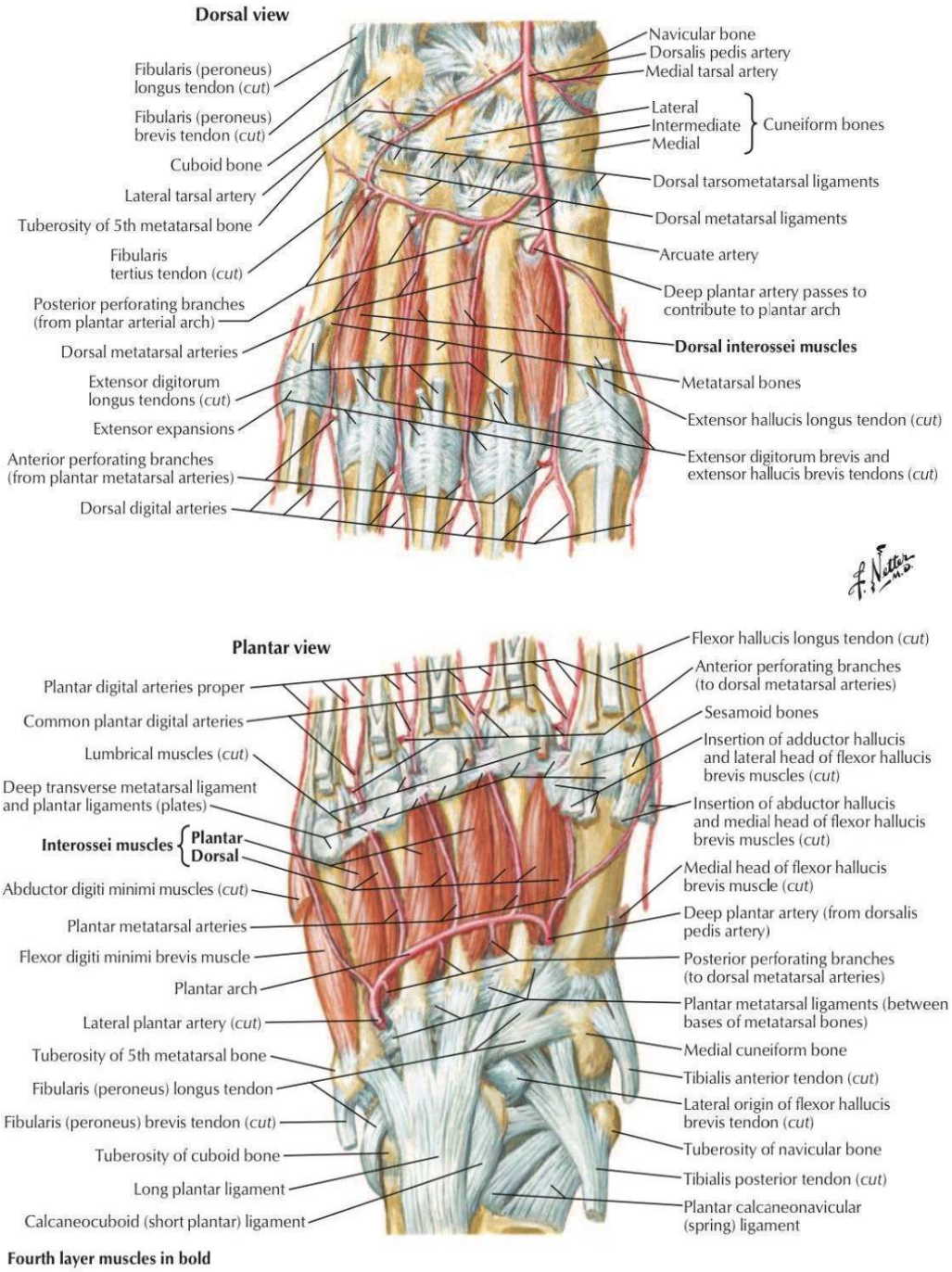
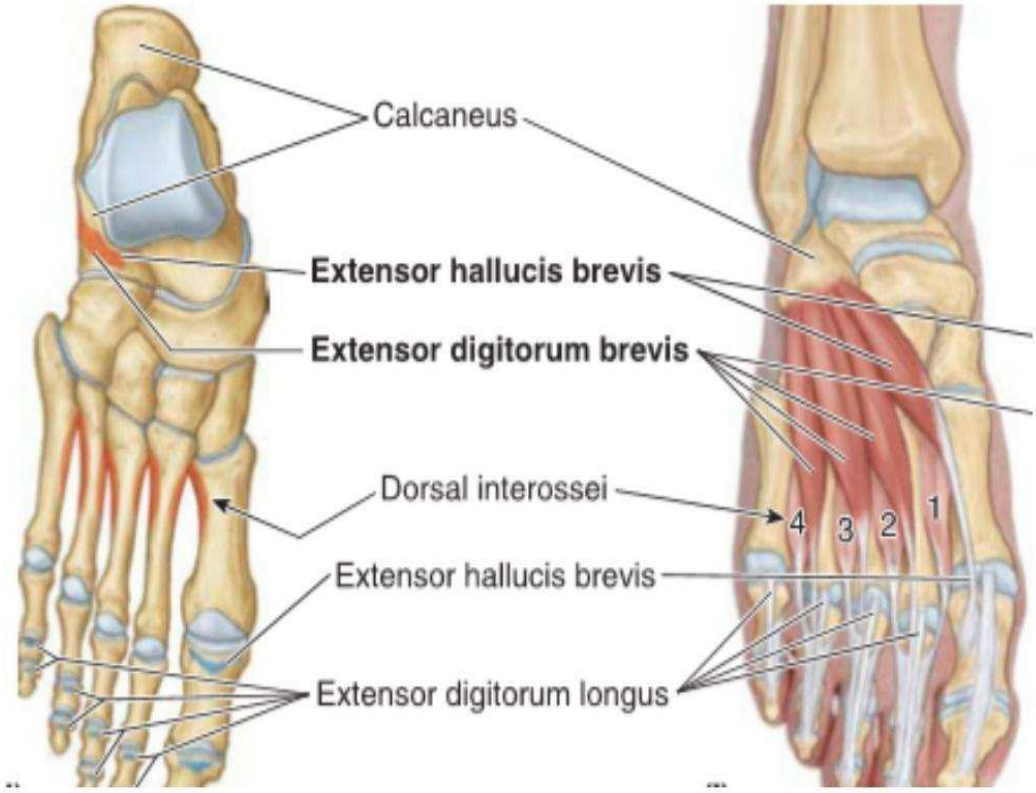


Figure:6[26]:Muscles of Dorsum of foot



ARCHES OF FOOT [24,25]

Arches are formed by bones of foot held together by ligaments, tendons and muscles forming an intricate elastic structure. These arches allow the foot to support the entire weight of the body.

Arches of foot are mainly divided into:

1. Longitudinal arch-

a) Medial longitudinal arch

b) Lateral longitudinal arch

The plantar aponeurosis, Tibialis anterior and Peroneus longus tendons, small muscles on the plantar aspect and articular ligaments are the additional supports of the arch.

2.Transverse arch-

The transverse arches are strengthened by the dorsal, interosseous and plantar ligaments. The piers of the arches are spanned by the tendon of the peroneus longus. Theses arches are also supported by the muscles attached to the 1^{st} and 5^{th} toes example the Adductor hallucis' transverse head.

Function of Arches of foot:

1. Locomotive propellant of the body while walking and running.

2. Provides support and flexibility to the foot.

3. Uniform distribution of weight of the body.

4. Provides space in the sole to contain and protect vessels, nerves and muscles of the sole.

5. To enable the foot to adapt to change in surface contour.

Supports :

Supports of foot are divided into passive and dynamic

Passive support-

1)Spring ligament or Plantar Calcaneo navicular ligament, Short and Long Plantar ligaments.

2) The plantar aponeurosis.

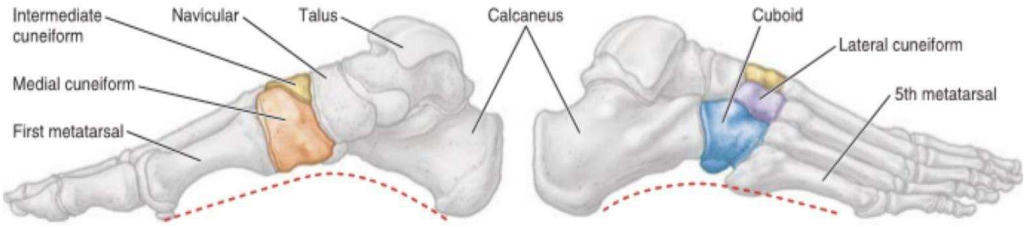
3) The structure of the bones.

Dynamic support-

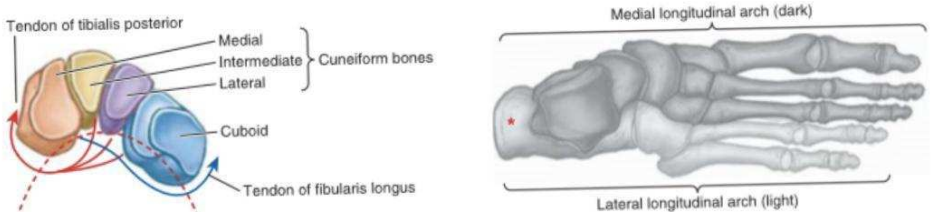
1) The action of intrinsic and extrinsic muscles.

2) The action of the long tendons extending into the foot.

Figure :7[26]Arches of foot



Medial longitudinal arch: medial view. Lateral longitudinal arch: lateral view



Transverse arch (anterior view) Superior view of longitudinal arches

BLOOD SUPPLY[24,25]

Dorsum of Foot-

Arterial Supply by Dorsalis pedis artery - continuation of anterior tibial artery.

PLANTAR ARCH

Sole of Foot

Supply by end branches of Posterior tibial artery:

-Medial plantar artery

-Lateral plantar artery

Dorsalis Pedis artery branches: -Lateral tarsal artery

-Arcuate artery

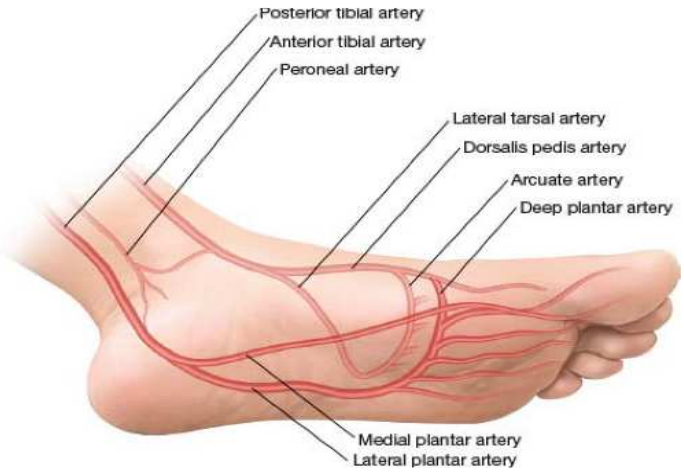
-First dorsal metatarsal artery

-Deep plantar artery (terminal branch)

Plantar arch-

Formed by anastomoses between deep plantar artery and lateral plantar artery, it gives plantar metatarsal arteries to toes.

Figure 8: plantar arch[25]

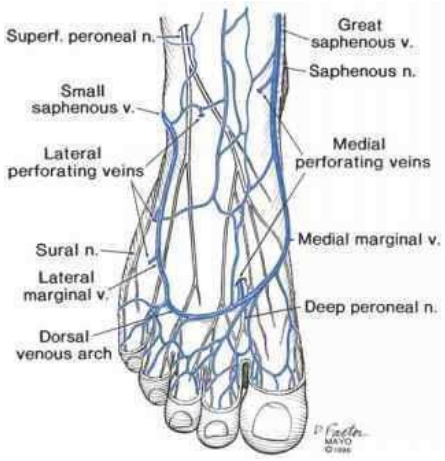


VENOUS DRAINAGE[24,25]:

The Dorsal venous arch drains majority of blood in foot through digital veins and communicating veins from sole into great saphenous vein medially and short saphenous vein laterally.

On the sole of foot, medial and lateral plantar veins traverse along with their corresponding arteries and ultimately unite to form posterior tibial venae comitantes.

Figure :9[25]: Venous Drainage of foot



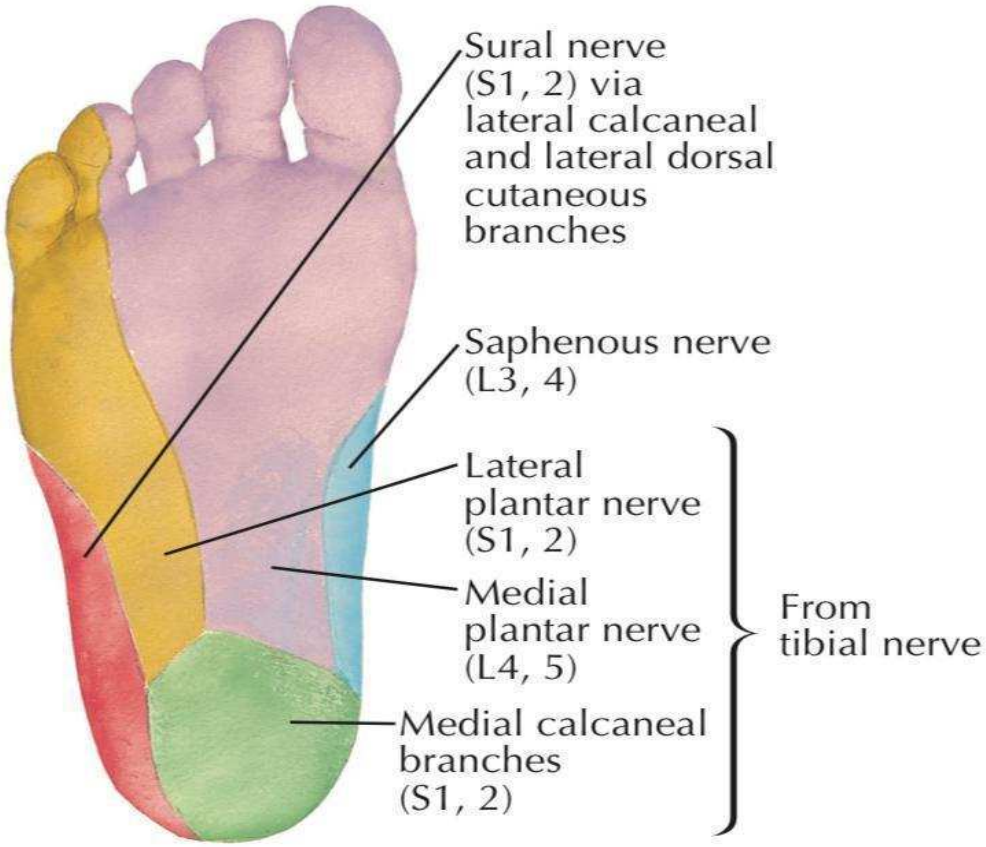
NERVE SUPPLY[24,25 ,26]

-The muscles of sole of foot are innervated by medial and lateral plantar nerves that are tibial nerve's end branches.

The Extensor digitorum brevis muscle on the dorsum of the foot is innervated by the lateral branch of deep fibular nerve.

-Cutaneous nerve supply of foot is by the following nerves:

Figure :10[26]: Cutaneous innervation of sole



Cutaneous innervation of sole

BIOMECHANICS OF FOOT

Exposure to an interplay of forces and their effects exerted on the foot structures forms the basis of foot biomechanics[27]. The basis of deranged biomechanics in a diabetic foot is formed by presence of peripheral neuropathy and elevated plantar pressure especially over sites of bony prominences.[28]

Elevated plantar pressure is due to non-enzymatic glycosylation leading to stiffening of collagen at the joint capsules leads to restricted joint movement at the meta tarso-phalangeal, particularly that of the first toe, along with subtalar joints. extrinsic factors rising the plantar pressure are ill-fitting footwear and barefoot walking.[30,31]

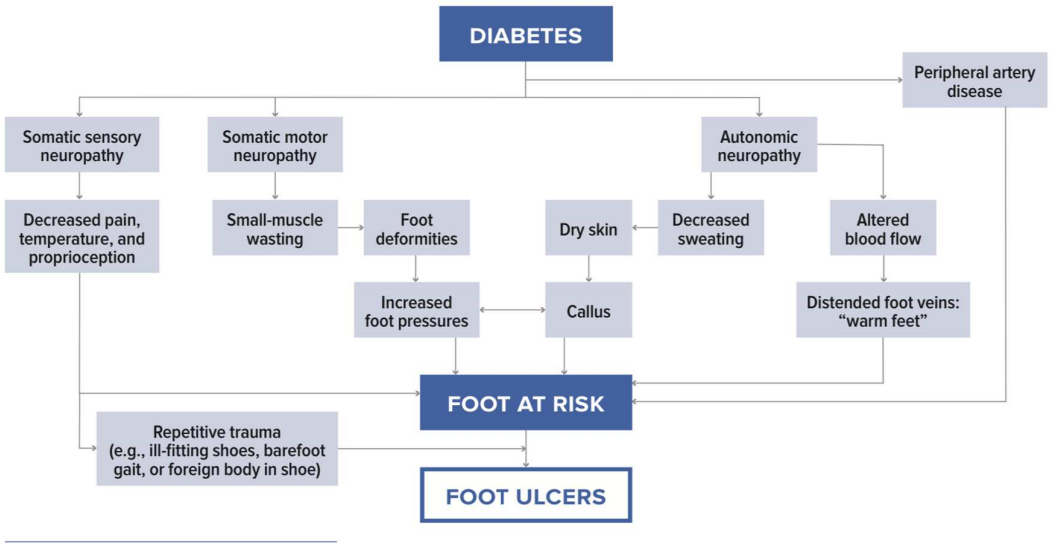
Abnormal biomechanics is often the etiological factor behind abundant callus, foot deformities and foot ulcers[29].

Due to loss of sensations over areas with lack of subcutaneous tissue and fat, the underlying tissue is exposed to damage and leads to callus formation. Once hemorrhage sets in the callus, the site acts as a precursor to an ulcer. Additionally, trauma with peripheral vascular disease act as significant factors causing tissue breakdown.[30,31]

The common sites of ulcer in a diabetic foot are the plantar aspect of forefoot, mid foot and toes followed by the dorsum of heel and toe.

Deformities such as clawing of toes, hammer toes and Charcot's arthropathy expose the heads of metatarsals, tips of toes and the midfoot, respectively to ulcer formation. Tissue breakdown is further accentuated by the absence of subcutaneous fat in these regions when the foot is deformed.[31]

Figure :11[31]: Complications of Diabetes leading to foot ulcers



There are three mechanisms which can give rise to elevated pressure in a diabetic foot predisposing it to ulcer formation.

1. Increased duration of pressures- A low pressure applied for a lengthy time duration leading to ischemia and consequent tissue breakdown. Usually noticed due to incorrect footwear or placement of the heel over a flat surface for a long duration.
2. Increased magnitude of pressures- Over a comparatively small area of skin, a significant amount of force is applied, such as trauma due to a sharp nail or glass piece in a diabetic patient with peripheral neuropathy. A 'foot slap' can cause the same nature of trauma. In this case, weak dorsi flexor muscles cause a decreased slowing down of the forefoot after the foot touches the ground.
3. Increased number of pressures- Failure of the tissue to maintain integrity because of recurrent loading as seen in a neuropathic diabetic foot. The foot is subjected to repeated injury due to loss of sensations. This is also referred to as 'mechanical fatigue'[29,30].

Kosiak, in his study on ischemic ulcers, noted an reverse relationship between force and time. With a rise in force, there is a fall in the time period or frequency of force(s) essential to cause tissue damage.[30]

So it's important that every patient with diabetic foot should undergo a foot biomechanical assessment which consists of testing for range of motion of joint, manual muscle strength testing and static and dynamic gait analysis.

The treatment may include a limb salvage procedure followed by usage of off-loading devices such as prosthetics, custom accommodative and/ or functional orthotics, bracing and custom molded shoes. Occasionally the limb salvage surgery has to be followed with elective balancing procedures. The latter includes tendon transfer and lengthening, bony reconstruction and fusion procedures.[30]

PATHOPHYSIOLOGY OF DIABETIC FOOT ULCER[31,32]

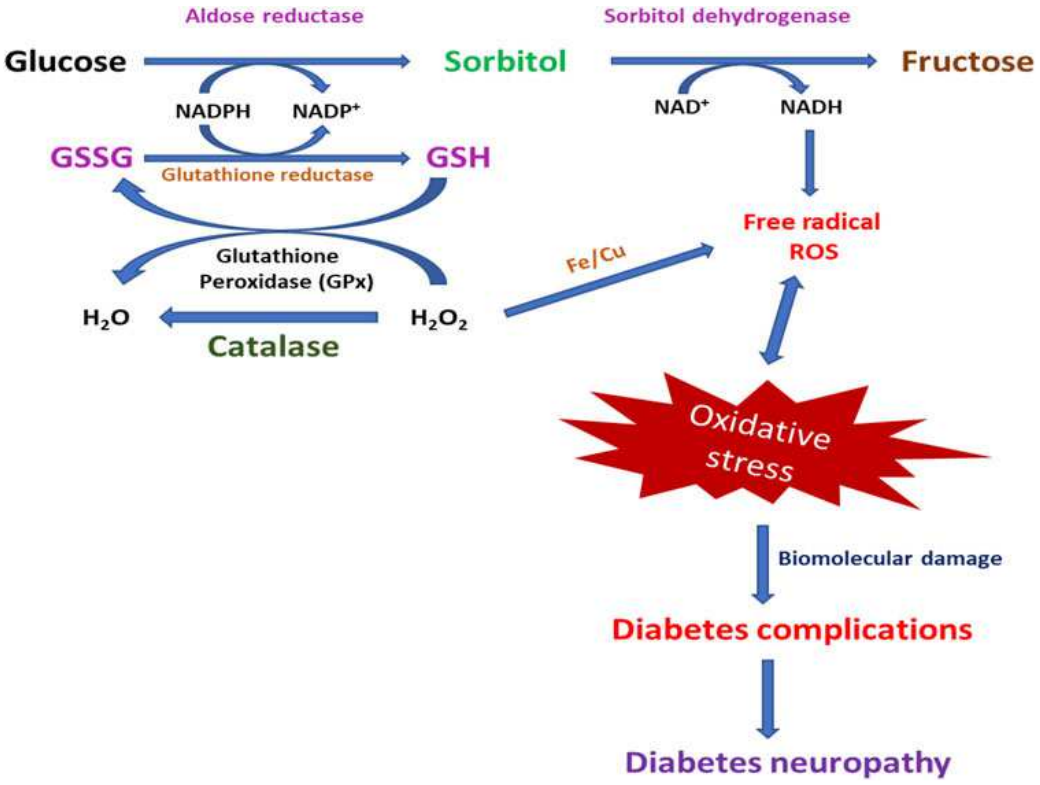
The simultaneous action of numerous contributing causes results in diabetic foot ulcers. Peripheral neuropathy and ischemia and infection are the main underlying causes of these conditions.

1.Neuropathy

Polyol pathway serves as the mechanism of action. The sensory, motor, and autonomic nervous systems of the body all exhibit this neuropathy condition.

The sensorimotor neuropathy is typically symmetrical and is initiated from the distal extremities with an insidious progression centrally.

Figure :12[32]: Oxidative Pathway of Glucose leading to Neuropathy :



Sensory Neuropathy:

loss of the protective pain sensation in the diabetic foot makes it more susceptible to trauma and consequently ulcer formation.

Loss of protective sensation-

An implication of diabetic neuropathy would be the inability to feel light pressure, such as that produced by a 10 g Semmes-Weinstein monofilament being applied.

Motor Neuropathy-

The nerve supply to intrinsic foot muscles is hampered due to destruction of the motor fibers. Due to the intrinsic muscles' atrophy, this causes an imbalance in the foot's ability to flex and extend. Hyperextension of the meta tarso-phalangeal joint with flexion of the proximal or distal interphalangeal joints leads to claw toe and hammer toe deformities.

The resultant foot deformities expose bony prominences which act as pressure points. This makes the foot a vulnerable target for skin erosion and ulcer formation.

Limited joint mobility

Reduced joint mobility in the foot, including the ankle, as a result of changes to the soft tissues surrounding the joints.

Callus

The excessive mechanical loading causes hyperkeratosis.

Charcot-foot

Non-infectious deterioration of the bone and/or joints caused by neuropathy, which exhibits inflammatory symptoms in the acute phase.

Autonomic Neuropathy - There is loss of sympathetic tone which causes increased arteriovenous shunting and inefficient nutrient flow. The functional impairment of sweat and sebaceous glands makes the foot dry and at a risk for skin breach. This predisposes the foot to ulcer formation and also increases the risk for superadded infection.

Charcot Arthropathy

A coalescence of motor, sensory and autonomic neuropathies in chronic diabetics results in arthropathy. Decreased sensation along with muscle atrophy and joint laxity causes structural and functional deterioration of the foot. The condition is accelerated by pathological fractures, joint dislocation and disablement of the foot framework.

Autonomic neuropathy leads to structural impaired vascular smooth muscle action and resultant increased blood flow to the bone. Consequently, inflammation and bone resorption occurs in the bones of the foot further aggravating the arthropathy changes in the diabetic foot. The end result is damage to the foot's arches, which gives the foot a "rocker bottom" appearance.[31,32]

2. Vasculopathy

Peripheral arteries begin to show abnormalities in smooth cells and endothelial cell function as a result of the ongoing hyperglycemic condition. Constriction results from a decrease in endothelium-derived vasodilators.

The vasoconstrictor and platelet aggregation agonist thromboxane A2 is also linked to hyperglycemia in diabetes, which increases the likelihood of plasma hypercoagulability. The tibial and peroneal arteries in the calf are frequently compromised.

Alterations in the vascular extracellular matrix may also cause an arterial stenosis. Additional elements that are common in diabetic patients which aid in the development of PAD include smoking, hypertension, and hyperlipidemia. Eventually, this causes occlusive arterial disease, which increases the risk of ulceration in diabetic patients and causes ischemia in the lower extremity.

The diabetic vasculopathy has a specific bipartite manifestation. A non-occlusive microcirculatory impairment in the blood vessels of retina, peripheral nerves and kidney and a microcirculatory impairment signified by atherosclerosis of blood vessels of the cardiac and peripheral vascular system.

Microvascular-

Leukocyte migration is hampered by the thickened basement membrane of capillaries resulting in functional microcirculatory ischaemia. This causes impairment in the inflammatory response to injury and accentuates by the loss of neurogenic vasodilatory response, making the foot more vulnerable to infection.

Macrovascular-

Peripheral arterial disease is the tell-tale sign of this complication. The lower extremity arterial disease presents primarily due to an accelerated atherosclerosis of tibial arteries. This finally results in critical limb ischemia and potential limb loss.[33,34]

3.Infection

A pathological condition brought on by microbial invasion and growth in the host tissues, which is accompanied by host inflammation and/or tissue damage.

The microorganisms enter through the sites of ulceration leading to the proliferation of microbes which causes an inflammatory reaction and advent of infection in the diabetic foot.

The onset of infection in the foot can have devastating consequences due to the presence of inter-communicating compartments. In addition, the loss of protective sensation, which causes the patient to continue ambulation, allows rapid spread of the infection into deep seated soft tissues and even bone leading to osteomyelitis.

Structures like plantar aponeurosis, fascia and muscle tendons do not possess the ability to resist infection. As a consequence of hyperglycemia, neuropathy and vasculopathy further reduces the body's immunity and facilitates progressive spread of infection. One of the significant immune system changes observed in diabetics is increased T lymphocyte apoptosis which further delays healing.[33,34,26]

BIOFILMS[35]

Aggregates of microorganisms embedded in a matrix of extracellular polymeric materials" is what biofilms are. Once pathogenic biofilms have developed, they are to blame for recurring infections that can delay the healing of ulcers.

These are some of the features that may indicate biofilms in diabetic foot ulcers.

Figure:13[35] :Biofilm formation:

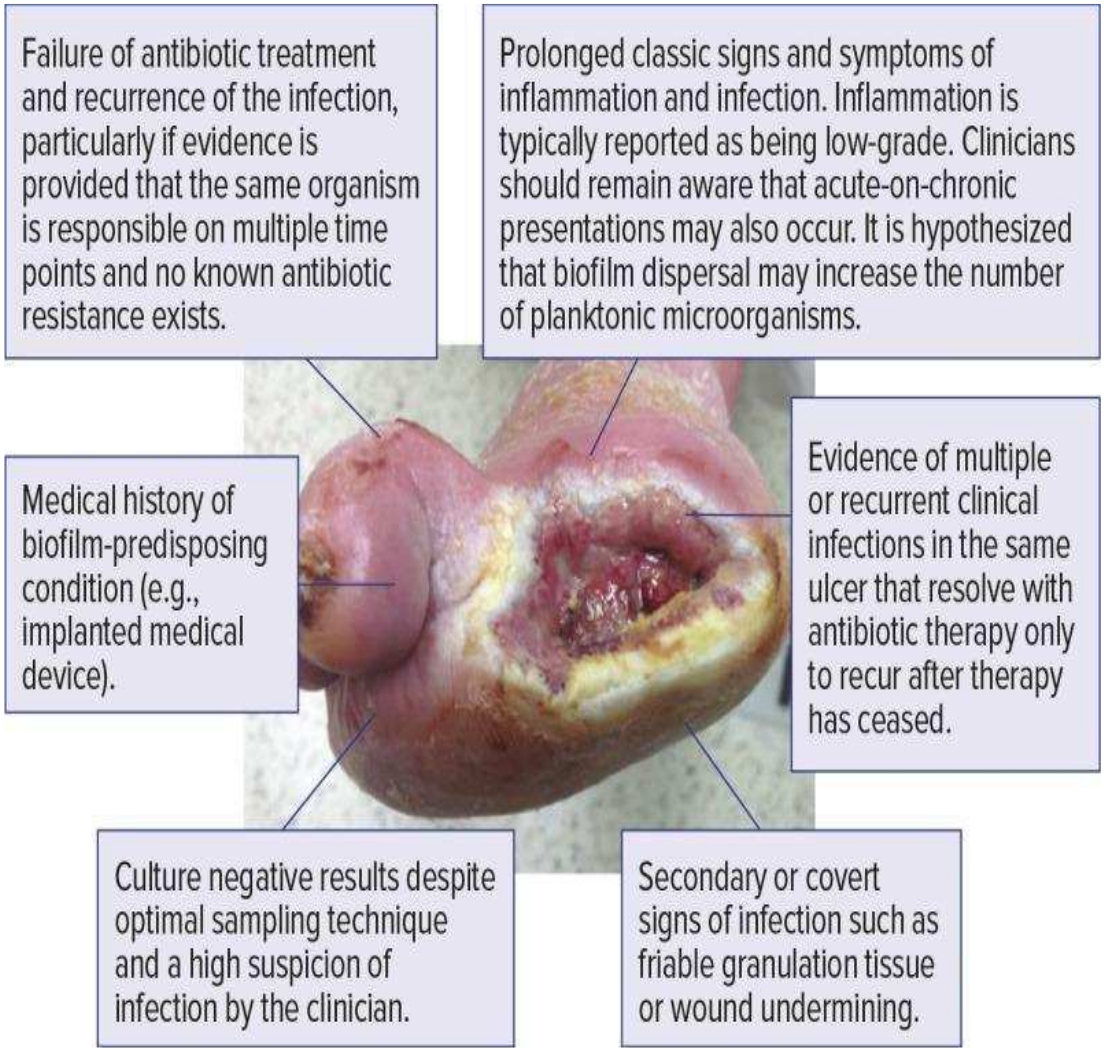


Table: 3 Risk Classification and Screening for diabetic foot ulcer[34,36]:

Risk Stratification	Signs and symptoms	Recommendations
Active ulceration	• Ulcer over the foot with purulent discharge.	Immediate referral/ consultation As determined by specialist
HIGH RISK	• Old ulcer with cutaneous changes • Undetectable pulsations and sensations	Follow up monthly or every alternate month
MODERATE RISK	• Reduced pulsations and neuropathy	Every three months
LOW RISK	• Clinically normal foot	Annual check up

ASSESSMENT OF DIABETIC FOOT[34,36]

Physical Assessment

Thorough history taking which includes any past history of ulcers, amputation, trauma, history of intermittent claudication and rest pain, loss of protective sensations to lower extremity.

Table: 4 : Assessment of History of Patient with Diabetic foot:

Global history	Foot specific History
• Duration of Diabetes • Glycemic control • Cardiovascular, ophthalmic and renal checkups • Nutrition • Social habits: alcohol, smoking etc. • Current medications • Previous hospitalization.	• occupation history • Foot wear • Exposure to chemicals • Foot deformities • Callus formation • Rest pain • Ulcer duration and location • Presence of edema

The general physical examination of the patient should look for any signs of anemia, sepsis with or without fever and vitals to check for hypotension and tachycardia.

Local examination includes checking for any ulcers, skin cracks and fissures, presence of fungal infection, macerated skin especially in web spaces and calluses should be looked for.

Presence of deformities such as the claw toes, hammer toes, hallux limitus, hallux rigidus and pes cavus determine the chronicity of the diabetic infection in the foot. There is a possibility of a high arched foot with visible muscle wasting on the plantar and dorsal aspect of the foot.

On palpation, the temperature denotes the underlying pathology with a cold foot signifying peripheral ischaemia and a warm foot pointing towards active infection of the limb.

Table: 5: Screening of Patient with Diabetic foot:

Assessment	**Tests**	**Significant findings**
Dermatologic examination		• Dry skin • Hair loss • Ingrown nail • Maceration • Ulceration
Screening for Neuropathy	• Semmes-Weinstein monofilament (10g) • Vibration perception threshold testing • Tuning fork (128 Hz)	• Loss of fine touch perception at one or more sites • Vibration perception threshold >25 volts • Abnormal perception of vibration
• Screening for Vasculopathy	• Palpation of DP, PTA pulses • ABI	• Absent pulses examination • ABI <0.90, consistent with peripheral arterial disease

Biomechanical assessment	• Plantar flexion/dorsiflexion of ankles and great toes • Watching patient • Inspection of patient's footwear • Inspection for deformity	• Reduced joint movement • Diminished vision, gait imbalance • Ill-fitting footwear • Corns, hammertoes, calluses, bunions, claw toes, prominence of heads of metatarsal ,

There are validated clinical criteria for identifying and categorizing diabetic foot infection based on severity, according to "The International Working Group on the Diabetic Foot" and the "Infectious Disease Society of America."

Table :6: Classification of diabetic foot infection:

Clinical Criteria	Grade/Severity
No Clinical sign of infection	Grade 1/ uninfected
Superficial tissue lesion with at least two of the following signs: • Acute inflammation (redness < 2cm around ulcer) • Discharge of pus	Grade 2/ mild
Redness >2cm and one other finding: • Infection involving deeper structures with impending gangrene. • No other systems involved	Grade 3/moderate
Presence of systemic signs with at least two of the following: • Hyper or hypothermia • Tachycardia • Tachypnoea • Leukocytosis or leukocytopenia • 10% Immature leukocytes	Grade 4/severe

SCREENING OF NEUROPATHY[35]

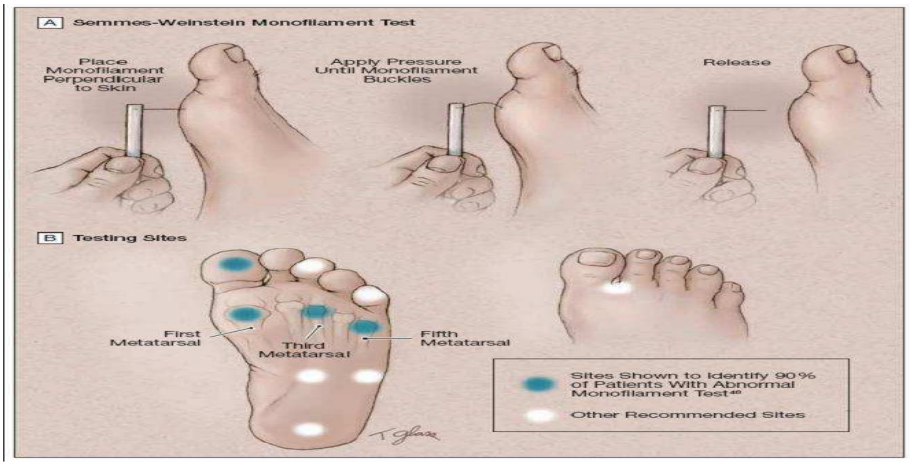
Effective method to check for loss of protective sensation is by using a 10g (Semmes-Weinstein) monofilament. A 10 g monofilament, when placed over the sole and bent, exerts a buckling force of 10g.The inability to sense this pressure is termed as sensory absence.

The other method is by using a 128 HZ tuning fork to test for vibration. In order to increase the accuracy in diagnosis, this test can be combined with other modalities like neurothesiometer and biothesiometer, that are intricate handheld instruments to evaluate test for vibration.

In order to increase the accuracy in diagnosis, this test can be combined with other modalities like neurothesiometer and biothesiometer, that are intricate handheld instruments to evaluate vibration[37,26]

Figure: 14 a[26: Evaluation] of vibration using 128 HZ tuning fork

Figure:14b[26]: Testing of Sensation using 10g monofilament



SCREENING FOR VASCULOPATHY [37,38]

Peripheral arterial disease is present in approximately 40% of patients with diabetic foot ulcers. Along with palpation of the lower limb peripheral artery pulses or By using Hand held Doppler, the ABI can be a reliable measure to quantify the extent of peripheral arterial disease.

It is the ratio of the maximum ankle systolic blood pressure to the arm systolic blood pressure quantified using a Doppler. Normally the ABI ranges between 0.9-1.3.

The limitations of this technique are user dependency, availability of equipment, lack of training. There is a possibility of a false high value owing to diabetics having calcified arteries with poor compressibility.

Table 7: Estimation of Severity of Vasculopathy:

ABI	Interpretation
<0.4	Severe obstruction
0.4-0.69	Moderate obstruction
0.7-0.9	Mild obstruction
0.91-1.3	Normal
>1.3	Poorly compressible vessel

Those with ABPI more than 1.3 due to non compressible vessels can be subjected to alternative tests such measurement of systolic pressures in toes, pulse volume assessment, duplex ultrasound or transcutaneous oxygen quantification. Derangements in these tests prove the presence of peripheral arterial disease.[34,37,38]

EVALUATION OF ULCER

There are various classification for describing diabetic foot ulcers[39,40]

A) The major classification is as follows:

1. The Neuropathic foot – Neuropathy is predominant in this condition.

2. The Neuro ischemic foot – Vasculopathy is predominant although neuropathy plays a major contributory role.

3. The Ischemic foot- Vasculopathy is predominant.

Table 8: Pathological classification of diabetic foot ulcer:

Feature/ Type of ulcer	Sensation	Callus	Wound bed	Food temperature (FT) and pulses (P)
Neuropathic	Loss of Sensation	Thick	Healthy granulation tissue	FT-Warm, P- Bounding
Ischaemic	Pain	Thin, prone to necrosis	Pale, with slough	FT- cool P- absent
Neuro-Ischaemic	Graded loss of sensation	Minimal	Poor	FT- cool P- absent

B) Wagner classification[41] –

Wagner described the most popular classification system, despite the fact that no single system has been universally adopted (292). Wagner allocated foot lesions a grade based on the depth of the wound and level of tissue necrosis.

Table 9: Wagner's grading of Diabetic foot ulcer

Grade	Description of Ulcer
0	At risk patients with cutaneous cover intact
1	Exposure of subcutaneous fat due to Superficial ulceration of skin
2	Exposure of deeper structures like tendons
3	Abscess involving deeper tissue or infection of the bone
4	Gangrene of toes till forefoot
5	Gangrene involving entire foot

C) The most widespread used and accepted classification is the University of Texas Wound Classification System[41]

Table 10: University of Texas Staging and Grading of ulcer:

Stages	**Description**
Stage A	Infection (-)/ ischemia (-)
Stage B	Infection (+)
Stage C	Ischemia (+)
Stage D	Infection & ischemia (+)
Grading	
Grade 0	Normal
Grade 1	Superficial wound
Grade 2	Entends to capsule or tendon
Grade 3	Extension to bone or joint

D) PEDIS CLASSIFICATION [41]

Table:11: Grading of ulcer using Pedis classification:

GRADE	1	2	3	4
PERFUSION	Normal	Non Critical	Critical limb ischemia	-
Extent	Ulcer size (in cm^2)			
Depth (Tissue loss)	Full thickness	Muscular involvement	One and/ or joint	-
Infection	None	Mild	Moderate/ Severe	SIRS
Sensation	Intact	Loss of fine touch	-	-

SAD Classification system:

The SAD classification was proposed in 1996 by Lavery et al and validated by Armstrong in 1998. This makes use of the ulcer depth and area (size), sepsis, arteriopathy and denervation status. This classification system was designed to facilitate audit and research.[38]

SINBAD Scoring system:

The SINBAD ulcer scoring system was developed by Ince et al as a simplification of the SAD system. It is based on six component of examination of ulcers over the feet. These are ulcer site, area, depth, and presence of ischemia, neuropathy, or infection. Each criterion, if present, is added to create a scale of 0–6 reflecting increasing severity. This has been endorsed by the IWGDF.

SINBAD was validated in an international study of 1,340 patients in four centres: two from Europe, Tanzania, and Pakistan.

The national diabetes foot care audit (NHS Digital, 2019) utilises the SINBAD Score to review patient care. The audit results from 2017 indicate that a delay in referral for expert assessment results in more severe ulcers and delayed healing.[38]

Prevention of diabetic foot ulcer

Prior to managing diabetic foot ulcers, patients should take necessary steps in his daily life to prevent the occurrence of the ulcers.

These include:

1. Examination of one's foot every day to look for areas of skin breach
2. Care of skin and nails of the foot
3. Maintenance of clean and dry foot
4. Usage of correct footwear
5. Cessation of smoking

Such measures will help to maximize the care of the foot thus preventing any form of skin epithelium breach.[39,40] Education of the patient and his caregiver along with good family support is crucial for these measures to be successful.

MANAGEMENT OF DIABETIC FOOT ULCER

Management includes investigations and treatment.

INVESTIGATIONS

1. Complete hemogram to evaluate for hemoglobin and total leucocyte count to rule out anemia and infection respectively.
2. Fasting blood sugar level and HbA1C to know the extent of glycemic control, the latter being a reliable predictor of wound healing.
3. Urine ketone bodies to rule out diabetic ketoacidosis.
4. Renal function tests to rule out diabetes induced nephropathy and sepsis.

5. Xray of foot (Antero-posterior and lateral view) to rule out osteomyelitis, foot deformities, Charcot's arthropathy changes; also to grade the diabetic foot ulcer.
6. Wound swab culture and sensitivity to look for bacterial presence and specific antibiotic treatment for infection.
7. Doppler study of lower limb to look for diabetic vasculopathy changes.

Bone scans with (Tc-99 MDP) are frequently used to detect osteomyelitis in diabetic foot infections. Even though this modality is very sensitive, it lacks specificity when treating neuropathic feet.

Tc-99 MDP scanning is less specific for acute infections than indium-111, which labels polymorphonuclear leukocytes specifically. Osteomyelitis can be diagnosed more precisely when Tc-99 MDP and indium-111 are combined.

This combined method is effective because the indium-111 labels the infected bone and the Tc-99 MDP scan localizes the anatomic site of inflammation[37,26].

TREATMENT

The main objectives of managing diabetic foot ulcers are to stop its progression, and speed up the healing process and wound closure.

Now, diabetic foot center has emerged as a speciality that can be taken care of at a multidisciplinary care center which includes surgeon, diabetologist, physiotherapist and nurse.

The key components of diabetic foot ulcer wound management are:

1. Treating the underlying disease process.

2. Local ulcer care with control of localized infection.

3. Pressure offloading.

Treating underlying disease process

Holistic approach of wound management should be done and taken care of by treating underlying disease processes along with local ulcer care.

Achieving optimal diabetic control:

Patient education regarding routine screening and foot care should be advised by a physician. Proper foot care and examination should be explained and proper diabetic diet should be given and nutritional deficiencies should be addressed.

Strict hyper glycaemic control should be achieved by tackling associated risk factors such as hyperlipidemia, hypertension and smoking.

Identification of physical cause of trauma:

Patients should be advised to use proper footwear all the time and avoid barefoot walk. The footwear reflects whether it is a proper fit and type and helps to rule out presence of pebbles, sharp objects etc which might traumatize the foot.[37,26]

Treatment of peripheral ischemia:

With the advent of revascularization procedures, there has been a lot of improvement of wound healing processes and delays a possible future amputation for the patient.

2. Local ulcer care with control of localized infection

The optimal local ulcer treatment includes**:**

-Moisture care

-Control of inflammation and infection

- Debridement of tissue

-Advancement of epithelial edge

Moisture care:

To re-epithelialize or resurface the wound, epithelial cells need moisture to migrate from the wound edges. The cells are said to be "leapfrogging" during this process. These cells must delve deep beneath the wound bed in a dry wound to find a moist area where they can "march" or advance.

The appropriate dressing choice for the patient depends on the ulcer and patient. Factors usually considered are ulcer site and ulcer size, type of discharge from the ulcer, condition of surrounding skin and risk of infection to the ulcer.

The optimal dressing is chosen after thorough local examination of the ulcer. Factors considered include location and extent of ulcer, quantity and nature of ulcer discharge, condition of adjacent skin, ulcer bioburden and quality of life.[38,42]

Characteristics of an Ideal Dressing:[35]

The ideal dressing should :

The dressing should be well absorbent and should provide adequate moisture to the wound and acts as microbial barrier and should facilitates autolytic debridement of the wound

Types of Dressings[38]

Alginate is used for its property of absorption of fluid and autolytic debridement. It controls moisture and suited for wounds with moderate to high content of exudate. It is ineffective in treatment of dry and necrotic wounds. Foams are also suited for similar kinds of wounds.

Traditional medicine makes use of honey for dressing of by virtue of its property of rehydration and autolytic debridement. It has also been found to have antimicrobial action and is suitable for dressing of wounds with moderate exudate and critically colonised wounds. However it may be associated with a dragging type of pain due to osmosis and may cause sensitivity.

Hydrocolloids have a similar action and when combined with silver has becomes antimicrobial in nature. It also causes cooling and is suited for dry to minimally exudating wounds. However, it is not recommended in anaerobic infection and causes maceration of skin.

Povidone-iodine and elemental Silver have antimicrobial action and are used in critically colonised wounds. Both are associated with hypersensitivity reactions and the latter is known to cause discolouration of surrounding skin.

Polysiloxane dressing provides an additional protective layer to epithelial surface and surrounding skin, making it suitable for healing wounds. However, its prolonged application results in its desiccation and Si is known to cause hypersensitivity.

Polyurethrane film controls moisture and allows visualisation of the underlying ulcer due to its transparency. However, it is not suitable for wounds with high to moderate exudates.

Control of Inflammation and Infection:

With the rise in antimicrobial resistance like Methicillin resistant Staphylococcus aureus and because of infection with *Clostridium difficile*, the use of topical antimicrobial formulations provides high local concentration over the increased wound bioburden without penetrating the intact skin or deeper tissues along with systemic antibiotics. Topical antibiotic therapy also benefits patients with vasculopathy leading to poor peripheral vascular supply.

Patients are started with broad spectrum antibiotics and later changed to as per culture sensitivity report of the wound. There is no apt time in giving antibiotics and it mainly depends on the infection and healing rate of the ulcer.

Debridement of tissue:[35]

Debridement is defined as the removal of dead tissue, exudate, bacteria, and metabolic waste from a wound in order to improve or facilitate the healing process by removing potential culture medium for bacterial growth and a proinflammoatory stimulus.

1. Surgical-

Despite the fact that no single procedure has been demonstrated to be the best for debriding an ulcer, surgical debridement is still widely used.

Slough, hyperkeratotic and necrotic tissue, and callus can be removed regularly and sharply using scissors, a knife, and/or forceps until viable bleeding tissue is seen. It eases pressure over the ulcer, aids in the drainage of pus or any other discharge,

and enables a clear examination of the ulcer's underlying floor and base. Effect of topical medications on the ulcer is improved by surgical debridement, which encourages quicker healing.

However, sharp debridement is not recommended in patients with poor peripheral vascularity as the trauma thus caused may outrun the meagre blood supply resulting in increased tissue damaged.

2. Enzymatic

The enzymatic agents used in this technique include collagen obtained from krill or papain, collagenase from crab, dextrans, and a combination of streptokinase and streptodornase. Healthy tissue is kept behind while nonviable tissue is removed. The ideal candidates for this debridement method are ischemic ulcers.

3. Biological

Sterile maggots can consume bacteria and dead tissue without harming living tissue. These have also shown to be effective in treating ulcers caused by Staphylococcus aureus that is resistant to methicillin.

Greenbottle fly larvae, which remove the sticky covering and keep bacteria out of the wound, are the other option. These have been shown to be particularly effective in treating diabetic foot ulcers.

The control of proteases, deterioration of the extracellular matrix, stimulation of fibroblast migration, and probable improvement in skin perfusion are some of the additional advantages of these biological agents. Another finding is that the larvae of the *Lucilia sericata* are a source of growth factors.

5. Hydrosurgical debridement

In this technique, saline or sterile water jets are directed at the ulcer. This type of mechanical debridement enables precise identification and removal of ulcer necrotic tissue.

6. Autolytic debridement

The dead and necrotic are made soft by moisture-laden dressing and are separated from the ulcer's floor by naturally occurring enzymes. This results from the host immune system's neutrophils and macrophages being stimulated. Hydrocolloids and hydrogels are some of the dressings that are helpful in this area.

However, wetness should be avoided as much as possible because it increases the risk of maceration. Patients with peripheral ischaemia, with or without dry gangrene, should not be subjected to this form of debridement.

Advancement of Epithelial edge:[37]

Debridement of ulcer edges eliminates the physical restrictions to epithelial growth on the ulcer floor.

The line demarcating viable from necrotic tissue might become a source of infection and therefore, the devitalized tissue needs to be debrided and eliminated.[34,38,40]

Adjuvant therapies:[37,43]

1. Negative pressure wound therapy- Local application of sub atmospheric pressure causes a fall in ulcer discharge, edema and increases the local angiogenesis.

2. Hyperbaric oxygen therapy- Exposure to high concentration oxygen at a high pressure can cause proliferation of fibroblasts and keratinocytes and improve the capacity of leukocytes to destroy bacteria

3. Ultrasonic stimulation- Vibration of inflammatory wound tissue has been noticed to improve healing

4. Laser therapy- This has the potential to form new blood vessels locally, inhibit inflammation and promote extracellular matrix synthesis.

5. Electrical Stimulation- It can encourage fibroblast activity and form new blood vessels locally along with expressing antibacterial effects.

Pressure Offloading:[37,38,44]

Offloading devices are the recommended method of treatment for simple neuropathic wounds as per IWGDF. Non-removable walkers along with 'Total contact casts' are preferred in neuropathic ulcers.

Devices that can be removed such as Scotchcast boots, 'removable cast walkers', healing sandals, crutches, walkers are preferred for infected and ischemic ulcers. Although removable modalities are more user- friendly and do not hamper the quality of life, they can be removed by patients at their own discretion and thus lead to lower efficacy. 'Total contact casts' are contraindicated in cases of superadded neuropathy and vasculopathy due to risk of further inducing new ulcers owing to skin irritation and lack of sensation. They are also not suitable for infection.

Table:12 : Types of Pressure Off loading Devices:

TYPE	KEY POINTS
REMOVABLE CAST WALKERS	Similar pressure decrease to TCCs More acceptable, easy to remove Can be used on infected and ischemic wounds Reduced healing rate compared with TCCs
SCOTCHCAST BOOTS	Lighter, padded cast covering foot to ankle Can be made non-removable
HEALING SANDALS	-Designed to limit dorsiflexion of metatarsophalangeal joints -Reusable, Light weight, stable. Increases falls in patients with impaired balance
CRUTCHES, WALKERS, WHEELCHAIRS	-off loads foot in entirety -Patients need good upper body strength

Figure:15[30]: Types of Pressure Off loading Devices:

scotch cast boot removable cast Walker Healing sandals.

Wound Healing:

Wound healing is a dynamic and complex process of replacing devitalized tissues. A complete understanding of physiology of wound healing play's important role in dealing with local and systemic factors that hamper the normal healing process.

Physiological wound healing is divided into 4 phases.

Figure:16[34]: Phases of Wound Healing

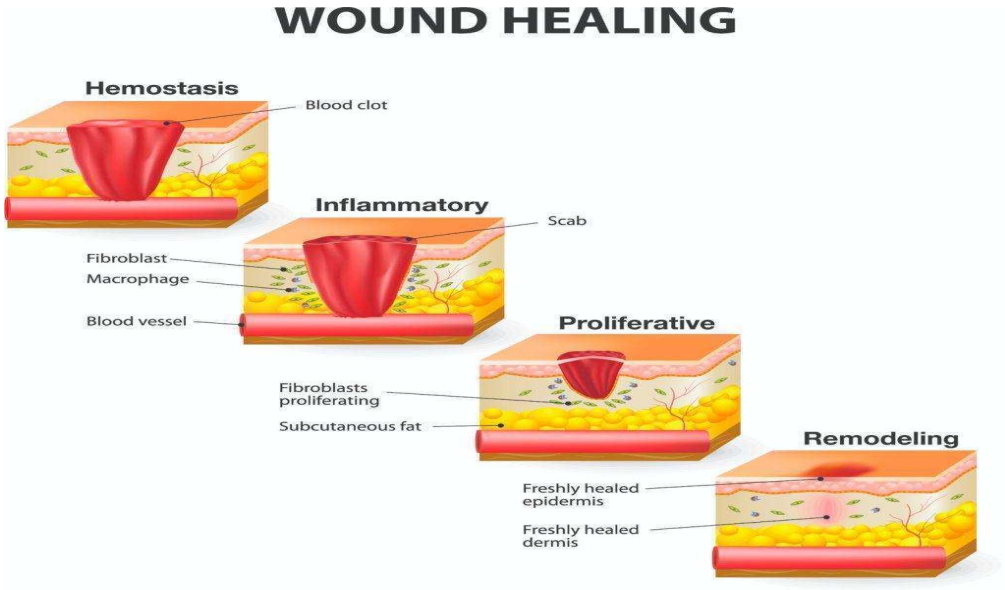


Table:13: Stages and Cellular Events of Wound Healing

PHASE	Cellular and Bio-physiologic events
Haemostasis	• Vasoconstriction • Platelet plug and thrombus formation
Inflammation	• Infiltration of Neutrophil→monocyte (to Macrophage)→ lymphocyte
Proliferation	• Proliferation of epitheliocyte • Neoangiogenesis • Laying down of ECM and Collagen fibres (Type III)
Remodelling	• Type III→Type I collagen • Fibroblast maturation and scar regression

Various Scores are given to measure the healing of ulcers such as push tool, south Hampton scoring system and Bates Janeson wound assessment tool.

The measurement of the ulcer is undertaken by methods such as:

1. Grid tracing- Using a transparent sheet and graph paper

2. Digital plani metry- Using software such as Imito Measure, Tissue Analytics' and 'Wound Matrix' apps.[40,41]

METHODOLOGY

Materials and Methods:

Source of the study:

Source of data were diabetic foot ulcer patients admitted under department of general surgery at KLES Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi, in the year 2021 between January to December.

a) STUDY DESIGN: LONGITUDINAL STUDY

b) STUDY PERIOD: 1 YEAR, JANUARY 2021-DECEMBER 2021

c)SAMPLE SIZE: Sample size calculated using statistical software R. Here we assume that, there is a strong association present between SINBAD Score and outcome of the wound.

Here we assume the single proportion-Absolute proportion

Expected proportion = 0.49(49%)

Precision (%) =9(margin of error)

There is a chance of lost to follow up cases in the study. here we assume 10% loss of follow up.

Sample size is calculated using formula

Z=95%confidence interval (1.96)

$n = Z^2pq/d^2$

n=1.96x1.96x1.1/0.1x0.1

n=116

Considering the loss of follow ups, this number is rounded off to 120 patients with diabetic foot ulcers.

d)INCLUSION CRITERIA:

Patients with type 2 diabetes mellitus, a wound or callus on one foot, and hemoglobin > 9 gm% [if not-then optimized before the study] will be included in the study if they are willing to provide written and informed consent.

e) EXCLUSION CRITERIA:

Patients with psychiatric disorders, prior low extremity amputations, and HIV, Hepatitis B, or Hepatitis C positivity.

f) INVESTIGATIONS:

The following investigations were done for all patients in intervention and control group

1) Complete blood picture.
2) Renal function test.
3) Liver enzymes and total bilirubin levels.
4) Blood sugar levels.
5) Urine routine and microscopy.
6) Urine ketone bodies.
7) HbA1c.
8) Wound swab for culture and sensitivity on day 0.
9) Xray Foot- Antero-posterior and lateral view.
10) Color Doppler of lower limb (as and when was required).
11) ECG.
12) Chest X Ray (postero-anterior view).
13) HIV and HbsAg.

Following written informed consent and institutional ethical committee approval, a thorough history and examination results are obtained. Following that, patients with foot ulcers were categorized using the SINBAD classification system.

In the event that a patient has multiple ulcers at once, the most significant typically the largest ulcer had been chosen as the index ulcer for the study.

Ankle reflexes, point pressure with 10g monofilament at 9 sites, and vibration perception (128 Hz tuning fork) at 2 positions were used to identify the presence of neuropathy.

The area of the ulcer is measured by using the imito measure app. This software is developed by company Tech Stack by G2 Stack. Photographs of the wound is taken using a smartphone and measurements using the imito Measure application (imito AG, Zurich, Switzerland First, the segment of the leg was selected in the imito app).

The camera of the smartphone was positioned ~20 to 30 cm away from and parallel to the wound. The calibration marker (quick response [QR] code) was positioned next to and in the same plane of the wound, and a photograph was taken after recognition of the QR code by the imito app. The operator's finger was used to select the borders of the wound through the photograph of the wound. The imito app reported the results of the area, width, height, and circumference. This is software which efficiently document, categorise and precisely measure acute and chronic wounds directly at point of care (width, length, circumference and area of wound).

To evaluate the arterial insufficiency, the dorsalis pedis and posterior tibial artery pulses were felt. Ulcer characteristics were graded according to SINBAD classification system. Patients had been followed up every second week for at least 2

months to assess healing followed by Debridement. Healing of ulcers is assessed by Bates Jansen wound scoring system.

The Bates Jansen wound scoring system is a 15-item objective measure designed to assess wound size and track healing. It serves to assess the progression of wound healing. 15 items assessed by wound measurement and observations were performed.

It consists of 13 Scored items: size, depth, edges, undermining, Necrotic tissue type, exudate type and amount, skin colour and surrounding area, peripheral tissue edema and induration, granulation tissue and epithelialisation. 2 non Scored items: location and shape of the wound.

RESULTS:

The present study is conducted in KLE'S Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi, from January 2021 to December 2021,

In total, 120 patients with diabetic foot ulcers are evaluated and determined based on the SINBAD scoring system.

Data collected was included into spreadsheets of Microsoft excel. The data was analysed and the results obtained were tabulated as represented below.

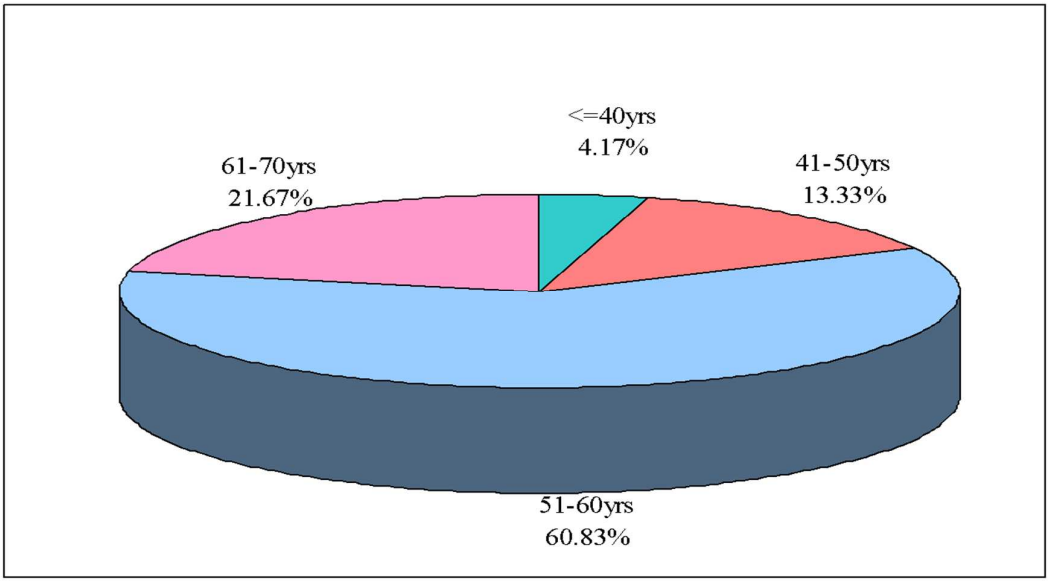
'P' value less than 0.05 considered statistically significant.

Results: A total of 120 subjects were present in final analysis

Table 14: Age Wise Distribution of Patients

Age groups	No of patients	% of patients
<=40yrs	5	4.17
41-50yrs	16	13.33
51-60yrs	73	60.83
61-70yrs	26	21.67
Total	120	100.00
Mean age	56.73	
SD age	7.01	

Graph 1: Age Wise Distribution of Patients

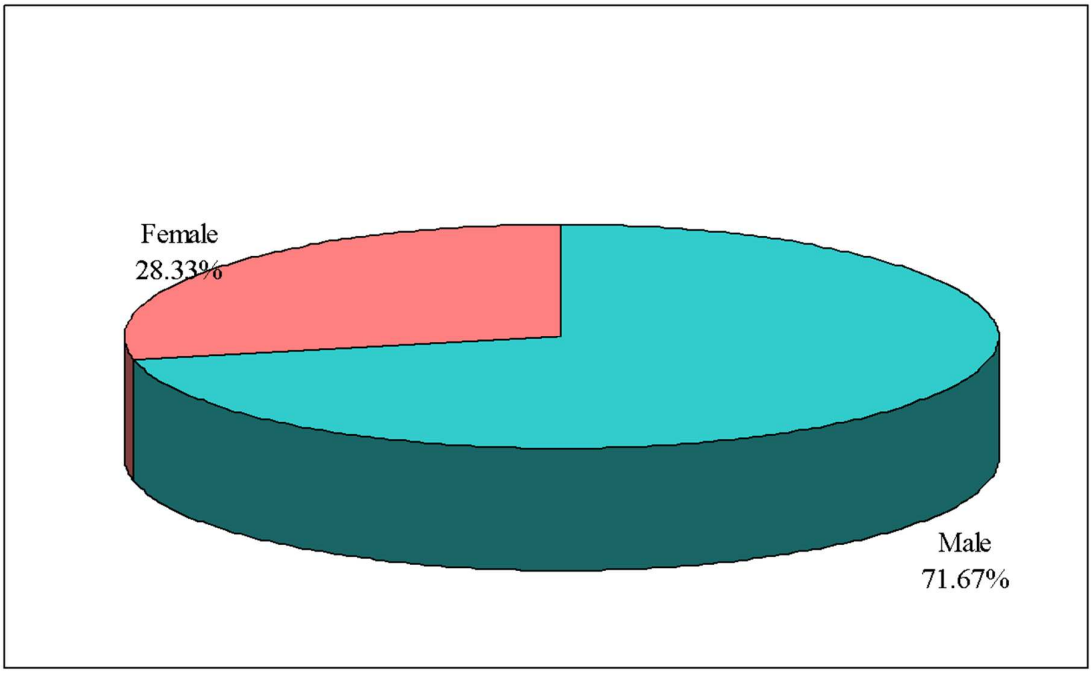


Among the study population 5(41.7%) were less than 40 years ,16(13.33%) were between years,73 (60.83%) were between 51-60 and 26 were between 61-70 years. The mean age was 56.73.

Table 15: Gender Wise Distribution of Patients

Gender	No of patients	% of patients
Male	86	71.67
Female	34	28.33
Total	120	100.00

Graph 2: Gender Wise Distribution of Patients

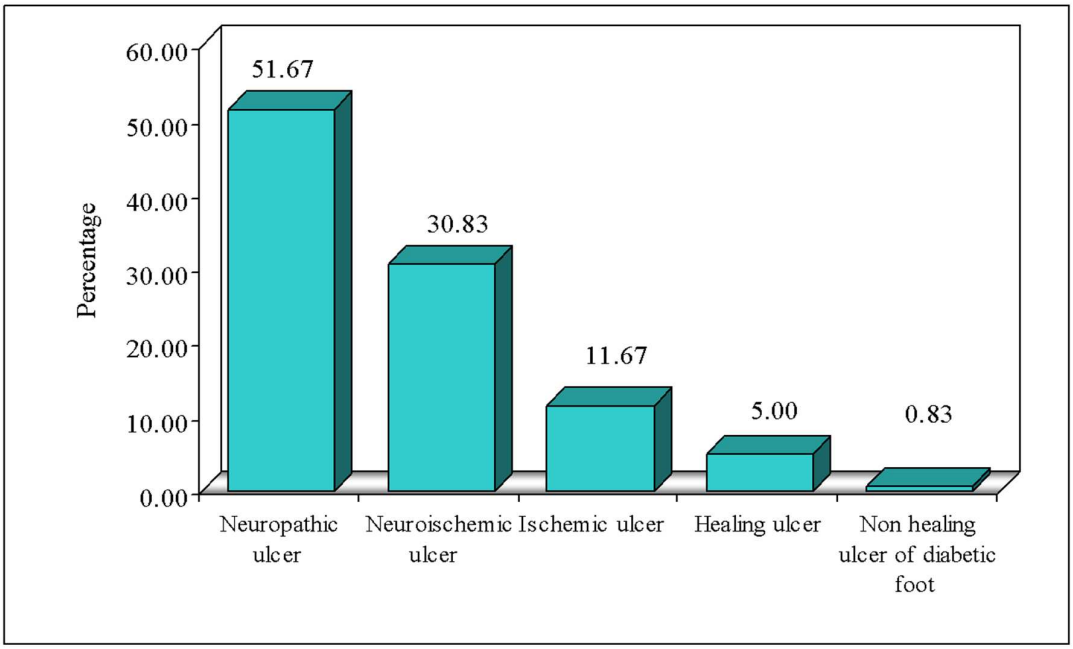


Out of total 120, 86(71.67%) subjects are male and 34 (28.33%) subjects are female.

Table 16: Diagnosis Wise Distribution of Patients

Diagnosis	No of patients	% of patients
Healing ulcer	6	5.00
Ischemic ulcer	14	11.67
Neuroischemic ulcer	37	30.83
Neuropathic ulcer	62	51.67
Non healing ulcer of diabetic foot	1	0.83
Total	120	100.00

Graph 3: Diagnosis Wise Distribution of Patients

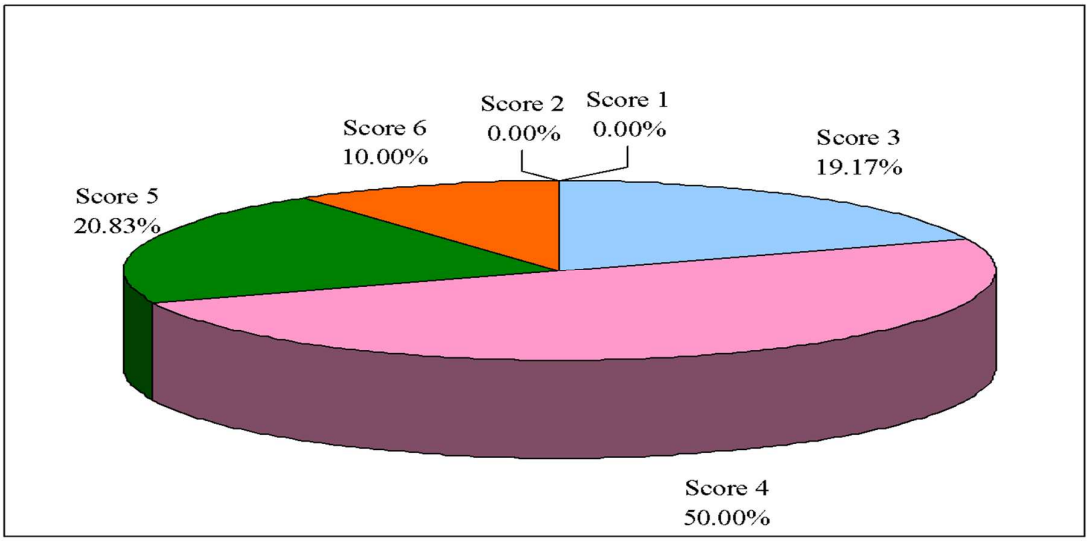


Among 120 subjects, 6(5%) had healing ulcer, 14(11.67%) had ischemic ulcer and 37 (30.83%) had Neuroischemic ulcer,62 (51.67%) had Neuropathic ulcer and 1(0.83%) had chronic non healing ulcer.

Table 17: SINBAD Scores Wise Distribution of Patients

SINBAD Scores	No of patients	% of patients
Score 1	0	0.00
Score 2	0	0.00
Score 3	23	19.17
Score 4	60	50.00
Score 5	25	20.83
Score 6	12	10.00
Total	120	100.00

Graph 4: SINBAD Scores Wise Distribution of Patients

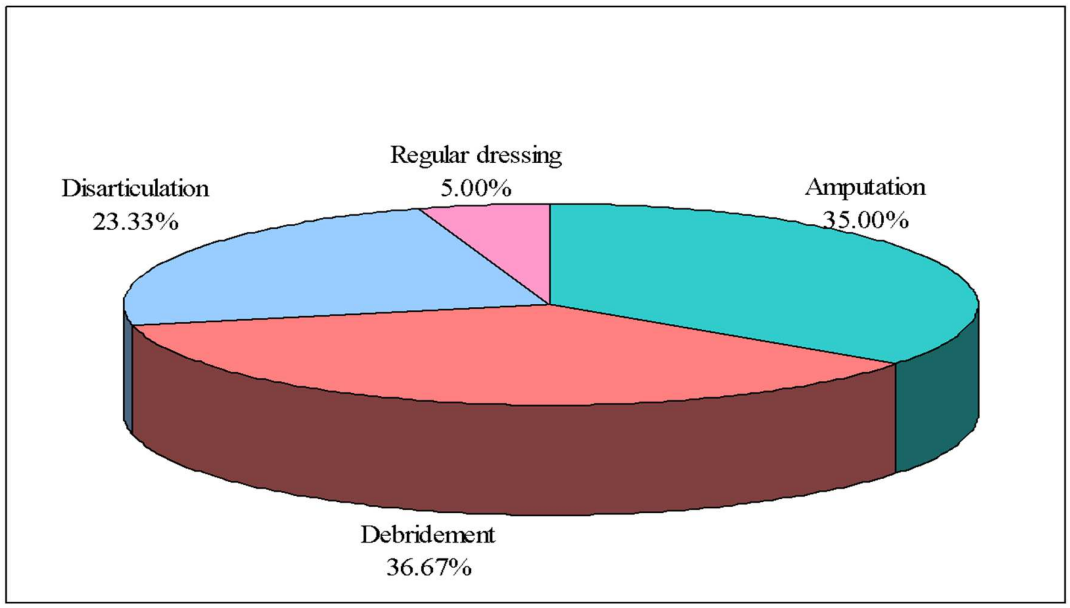


Among 120 subjects, 23(19.17%)were graded as Score 3, 60(50%) as grade 4 and 25 (20.83%) as grade 5 and 12(10%) as grade 6.

Table18: Procedures Underwent Wise Distribution of Patients

Procedures underwent	No of patients	% of patients
Amputation	42	35.00
Debridement	44	36.67
Disarticulation	28	23.33
Regular dressing	6	5.00
Total	120	100.00

Graph:5: Procedures Underwent Wise Distribution of Patients

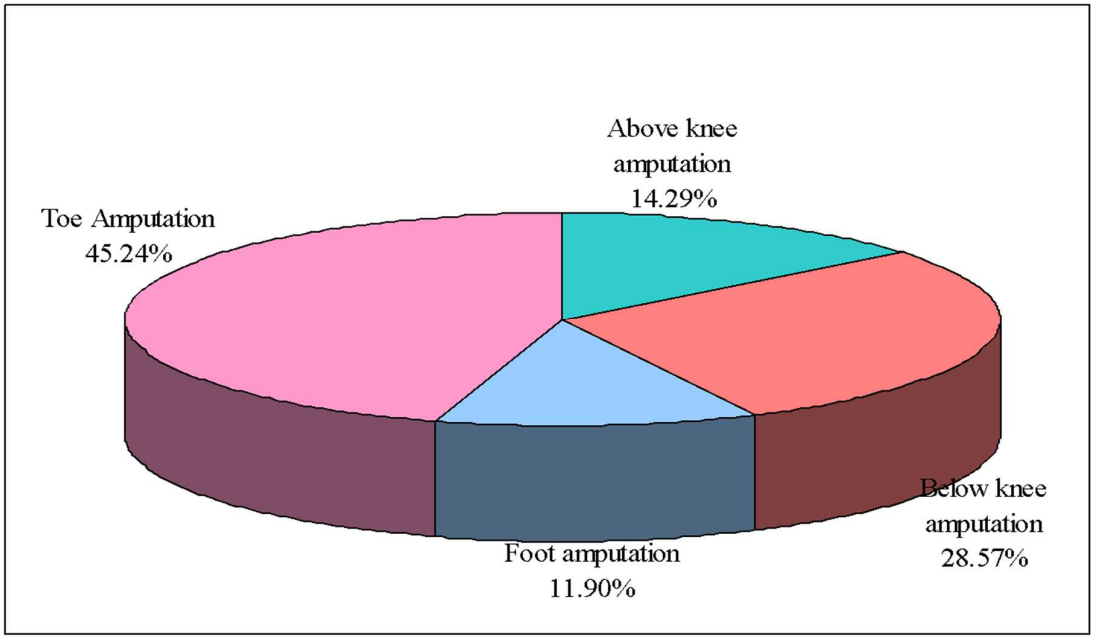


Amongst 120, 42 (35%) underwent amputation,44(36.67%) underwent Debridement, 28 (23.33%) underwent disarticulation,6 (5%) were managed with regular dressings.

Table19: Amputation Types Wise Distribution of Patients (n=42)

Amputation types	No of patients	% of patients
Above knee amputation	6	14.286
Below knee amputation	12	28.571
Foot amputation	5	11.905
Toe Amputation	19	45.238
Total	42	100.00

Graph 6: Amputation Types Wise Distribution of Patients (n=42)

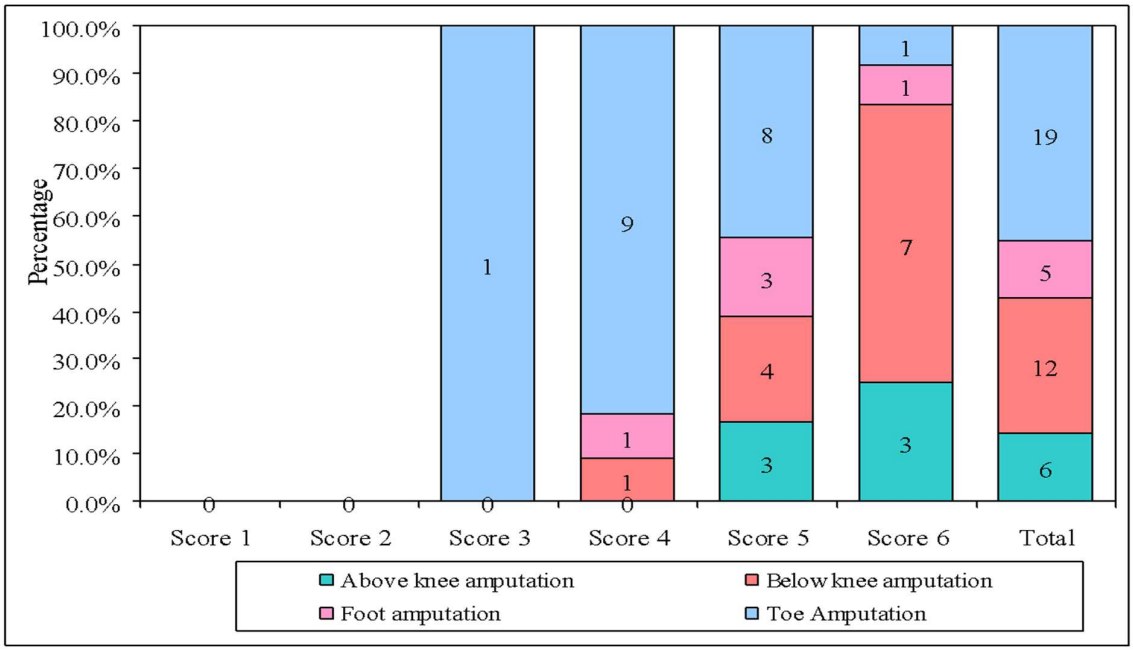


Amongst 42 subjected to amputation,6 (14.29%) underwent above knee amputation,12 (28.57%) underwent below knee amputation,5(11.9%) foot amputation,19(45.24%) toe amputation.

Table 20: Association Between Amputation Types With SINBAD Scores

Amputation types	SINBAD Scores						
	Score 1	Score 2	Score 3	Score 4	Score 5	Score 6	Total
Above knee amputation	0	0	0	0	3	3	6
Below knee amputation	0	0	0	1	4	7	12
Foot amputation	0	0	0	1	3	1	5
Toe Amputation	0	0	1	9	8	1	19

Graph 7: Association between Amputation types with SINBAD Scores

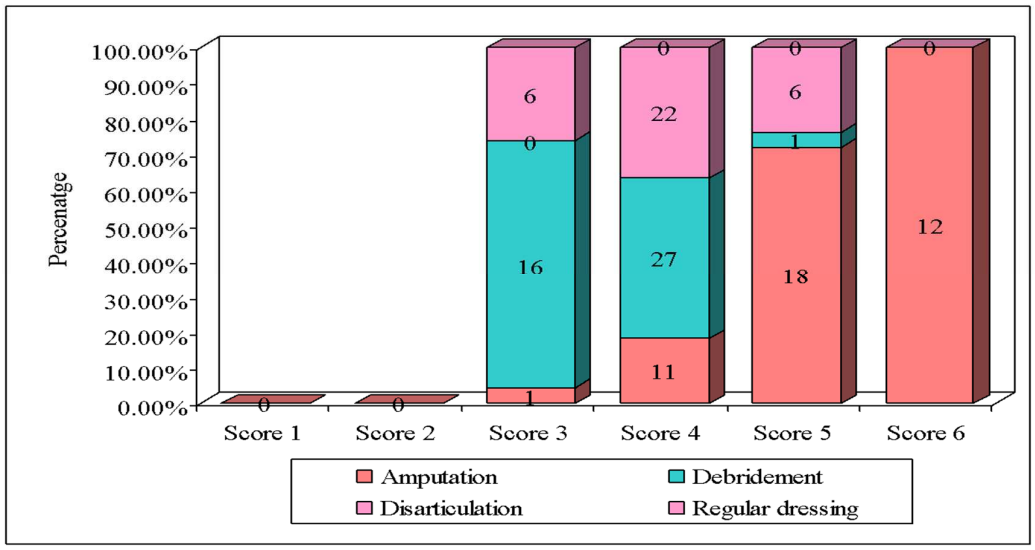


Among subjects with Score of 3, only one underwent amputation (toe), Score of 4, (11) underwent amputation (9-toe,1-foot,1-below knee),Score of 5, (18) underwent amputation (8- toe,3-foot,4-below knee,3-Above knee) Score of 6, (12) underwent amputation (1-toe,1-foot,7-below knee and 3 above knee).

Table 21: Association Between SINBAD Scores and Procedures Underwent

SINBAD Scores	Amputation	%	Debridement	%	Disarticulation	%	Regular dressing	%	Total
Score 1	0	0.00	0	0.00	0	0.00	0	0.00	0
Score 2	0	0.00	0	0.00	0	0.00	0	0.00	0
Score 3	1	4.35	16	69.57	0	0.00	6	26.09	23
Score 4	11	18.33	27	45.00	22	36.67	0	0.00	60
Score 5	18	72.00	1	4.00	6	24.00	0	0.00	25
Score 6	12	100.00	0	0.00	0	0.00	0	0.00	12
Total	42	35.00	44	36.67	28	23.33	6	5.00	120
Chi-square=92.8490, p=0.0001, S									

Graph 8: Association Between SINBAD Score and Procedures Underwent



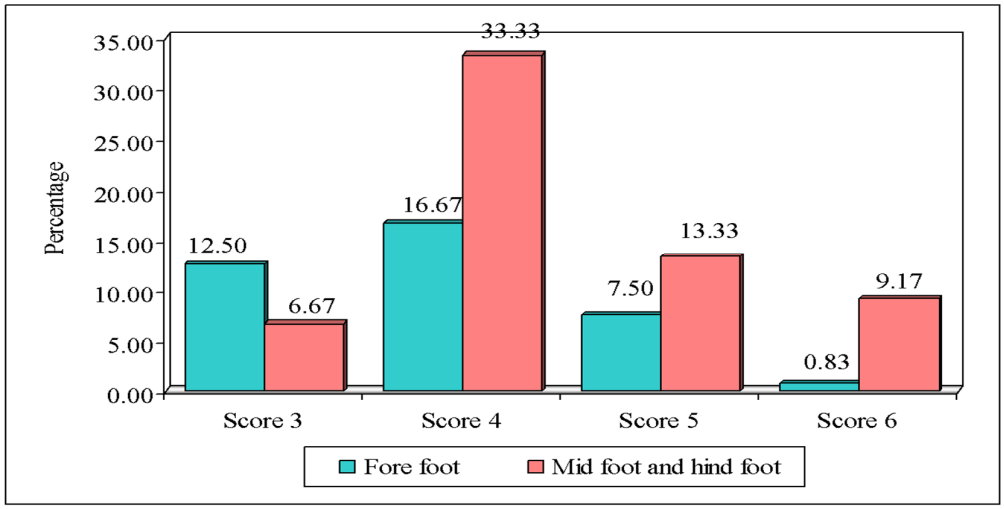
Amongst subjects Scored as 3 ,1 (4.35%) had undergone amputation,16 (69.57%) undergone Debridement, 6 (26.09%) had undergone regular dressings. subjects of Score 4, 11 (18.33%) underwent amputation, 27 (45%) had undergone Debridement, 22 (36.67%) had undergone disarticulation. subjects of Score 5,18 (72%) underwent amputation,1 (4%) underwent Debridement, 6 (24%) underwent disarticulation. subjects of Score 6, all 12 (100%) patients underwent amputation.

Table 22: SINBAD Scores vs Site of Ulcer

SINBAD Score	Site of ulcer	Number of patients	% of patients
Score 3	Fore foot	15	12.50
	Mid foot and hind foot	8	6.67
Score 4	Fore foot	20	16.67
	Mid foot and hind foot	40	33.33
Score 5	Fore foot	9	7.50
	Mid foot and hind foot	16	13.33
Score 6	Fore foot	1	0.83
	Mid foot and hind foot	11	9.17
Chi-square=8.0076, p=0.0458*			

*p,0.05

Graph 9: SINBAD Scores vs Site of Ulcer



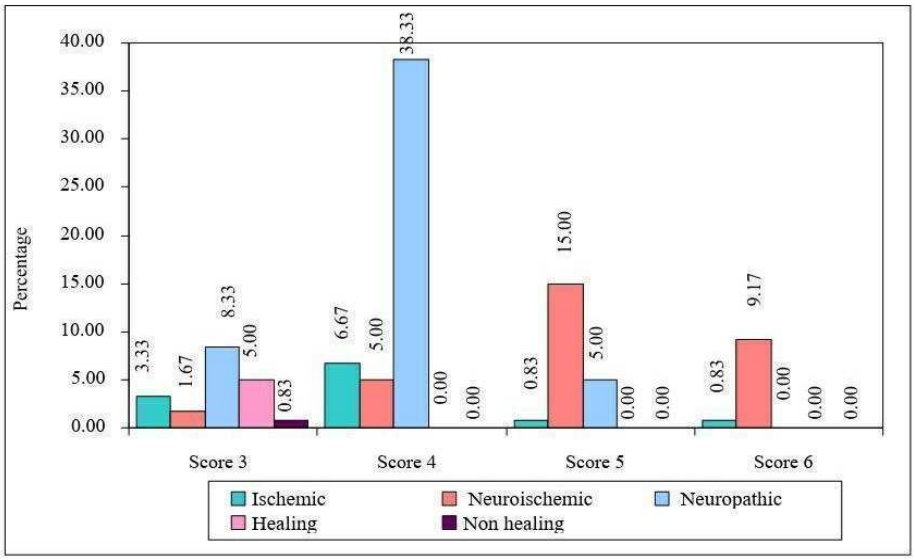
Amongst the subjects Scored of 3, 15(12.5%) had fore foot ulcers and 8(6.67%) had mid foot -hind foot ulcers. subjects with Score of 4, 20(16.67%) had forefoot ulcers and 40 (33.33%) had mid foot-hindfoot ulcers. subjects with Score 5, 9(7.5%) had fore foot ulcers and 16 (13.33%) had mid foot- hindfoot ulcers. Subjects with Score 6,1(0.83%) had forefoot and 11(9.17%) had mid foot- hindfoot ulcer.

Table23: Diagnosis vs SINBAD Score

Diagnosis	SINBAD Score	Number of patients	% of patients
Ischemic	Score 3	4	3.33
	Score 4	8	6.67
	Score 5	1	0.83
	Score 6	1	0.83
Neuroischemic	Score 3	2	1.67
	Score 4	6	5.00
	Score 5	18	15.00
	Score 6	11	9.17
Neuropathic	Score 3	10	8.33
	Score 4	46	38.33
	Score 5	6	5.00
	Score 6	0	0.00
Healing	Score 3	6	5.00
	Score 4	0	0.00
	Score 5	0	0.00
	Score 6	0	0.00
Non healing	Score 3	1	0.83
	Score 4	0	0.00
	Score 5	0	0.00
	Score 6	0	0.00
Chi-square=86.9643, p=0.0001*			

*$p<0.05$

Graph10: Diagnosis vs SINBAD Score

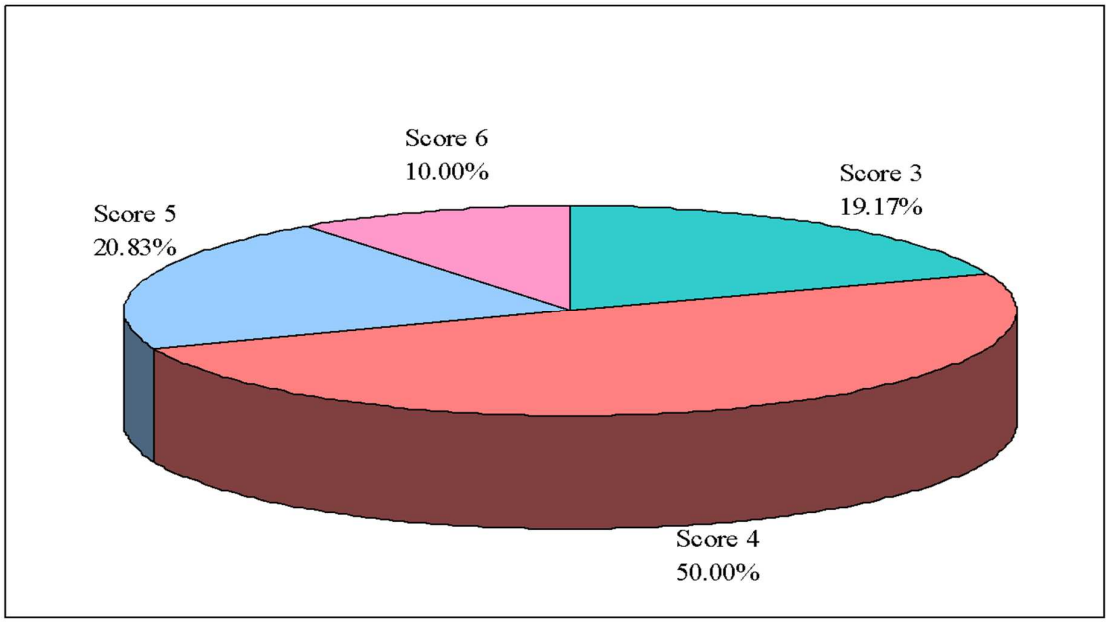


Based on subjects diagnosed as ischemic ulcer,4 patients are of Score-3(3.33%),8 (6.67%) patients are of Score 4,1(0.83%) in each Score 5 and 6. subjects diagnosed with neuroischemic ulcer,2(1.67) patients are of Score 3, 6(5%) patients are of Score 4,18(15%) patients are of Score 5,11(9.17) patients are of Score 6. subjects diagnosed with neuropathic ulcer,10(8.33) patients are of Score-3,46(38.33%) patients are of Score 4,6(5%) patients are of Score 5,0(0%) patients with Score-6.6(5%) patients with Score 3 diagnosed as healing ulcers and 1(0.83%) patient of Score 3 diagnosed as non healing ulcer.

Table 24: Bacterial infection vs SINBAD Score

SINBAD Score	Bacterial infection with number	% of patients
Score 3	23	19.17
Score 4	60	50.00
Score 5	25	20.83
Score 6	12	10.00
Total	120	100.00

Graph 11: Bacterial infection vs SINBAD Score

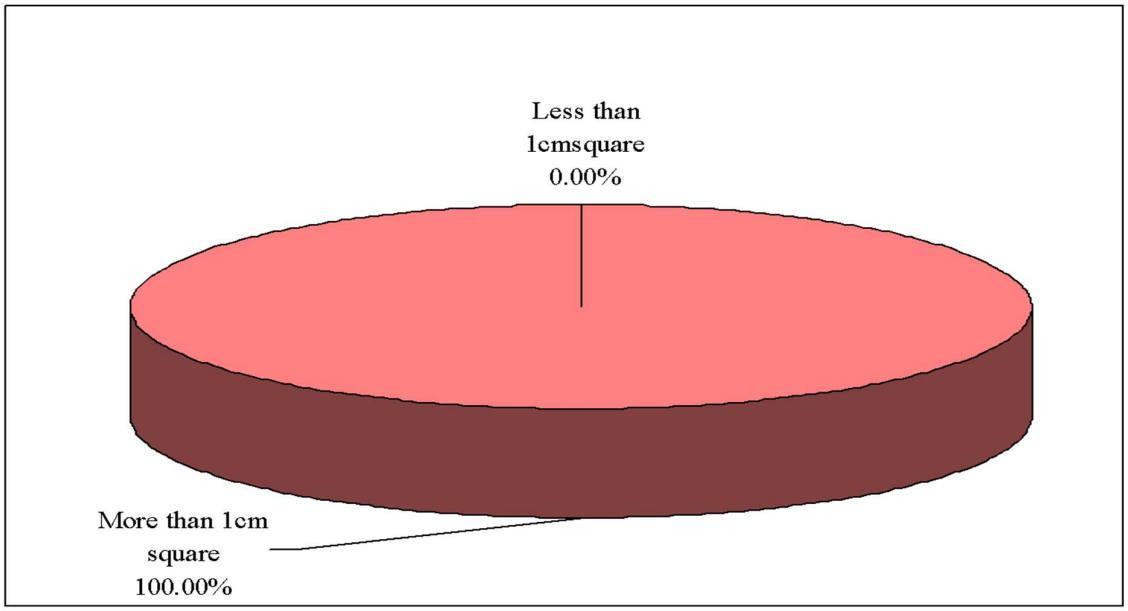


Amongst the subjects Scored with 3,23(19.17%) had bacterial infection over the ulcer, subjects Scored of 4,60(50%) had bacterial infection, subjects Scored of 5 ,25(20.83%) had bacterial infection, subjects Scored of 6,12(10%) patients had bacterial infection.

Table 25: Area wise distribution

Area	Number of patients	% of patients
Less than 1cmsquare	0	0.00
More than 1cm square	120	100.00
Total	120	100.00

Graph 12: Area wise distribution



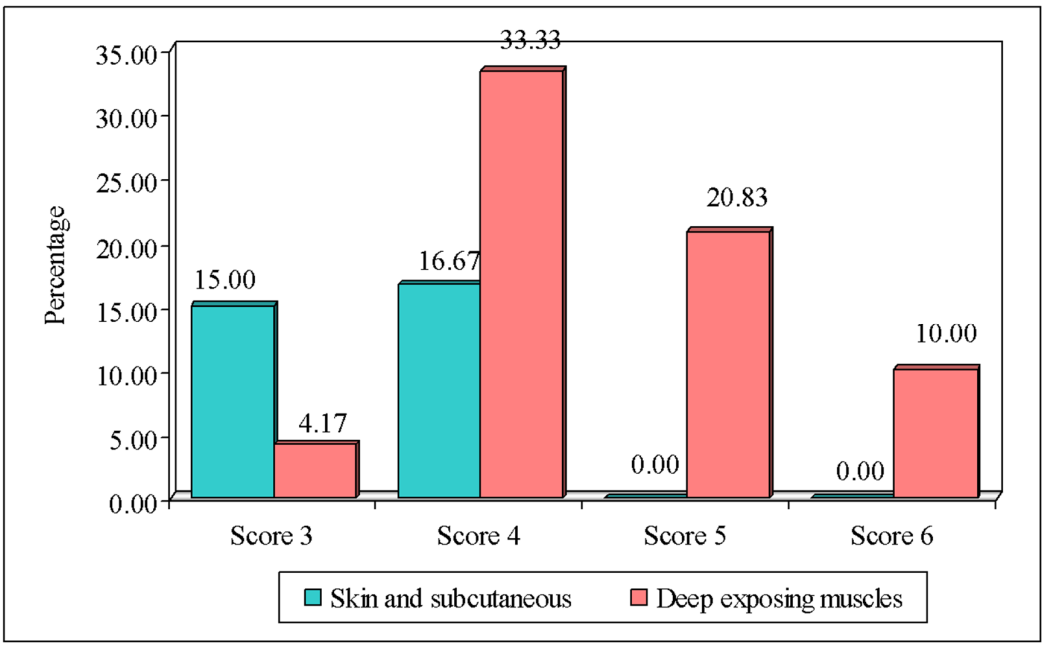
All the 120 patients' ulcer size area was more than $1cm^2$.

Table 26: Depth vs SINBAD Score

SINBAD Score	Depth	Number of patients	% of patients
Score 3	Skin and subcutaneous	18	15.00
	Deep exposing muscles	5	4.17
Score 4	Skin and subcutaneous	20	16.67
	Deep exposing muscles	40	33.33
Score 5	Skin and subcutaneous	0	0.00
	Deep exposing muscles	25	20.83
Score 6	Skin and subcutaneous	0	0.00
	Deep exposing muscles	12	10.00
Chi-square=34.7382, p=0.0001*			

*p<0.05

Graph 13: Depth vs SINBAD Score

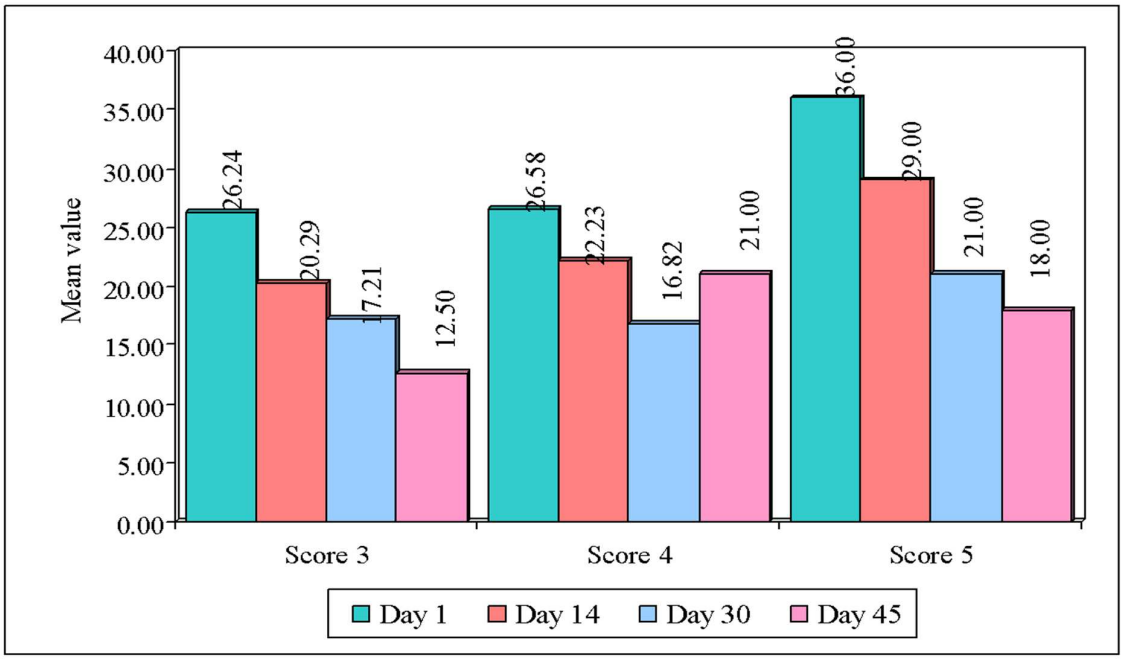


Amongst the subjects, Scores of 3,18(15%) patients had superficial ulcer and 5 (4.17%) patients had deep ulcer. Subjects with a Score of 4,20 (16.67%) had superficial ulcer and 40(33.33%) had deep ulcer. with Score of 5 and 6 all 25(20.83) and 12 (10%) patients had deep ulcers.

Table 27: SINBAD Scores vs Bates Jensen Wound Healing Score

SINBAD	Day 1		Day 14		Day 30		Day 45	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Score 3	26.24	2.97	20.29	3.69	17.21	3.12	12.50	2.65
Score 4	26.58	4.72	22.23	6.46	16.82	4.03	21.00	0.00
Score 5	36.00	0.00	29.00	0.00	21.00	0.00	18.00	0.00

Graph 14: SINBAD Scores vs Bates Jensen Wound Healing Score



Subjects Scored with 3 has mean bates Jansen wound Score of 26.24 on day 1, and on day 14, on day 30, on day 4, with Score of 4 had mean bates Jansen wound Score of 26.58 on day 1, 22.23 on day 14, 16.82 on day 30, 21 on day 45. with a Score of 5 had Bates Jansen wound Score of 36 on day 1, 29 on day 14, 21 on day 30 and 18 on day 45.

DISCUSSION

Diabetes is one of the major non-communicable diseases with an ever rising prevalence both worldwide and in India. One of the most serious complications of diabetes is diabetic foot ulcer, which affects 15 to 25 percent of people with diabetes[46].

Diabetic foot ulcers pose a major challenge to the treating surgeon by virtue of its complex pathophysiology and presence of multiple interconnected factors which impair wound healing. To achieve optimum results in wound healing, it is important to acquire a balance between the patient's glycemic status and local wound environment.

Over the decades, various newer advances have been attained for the local wound care of diabetic foot ulcers. Due to the rising antibiotic resistance and possibility of adverse effects with other treatment options, there has always been a search for an all rounder modality that could be therapeutically effective, inexpensive, accessible with minimal or no side effects[47].

Wound healing in diabetic foot ulcers involves a complex interplay of numerous factors, both intrinsic and extrinsic to the patient. Only proper tackling of all these factors such as neuropathy, vasculopathy, local infection, immunity can guarantee an optimum healing of the ulcer. Since the beginning, management of diabetic wounds involves an apt glycemic control with anti-diabetic medication, antimicrobial treatment and local dressing.

Improper or inadequate treatment of diabetic foot ulcers carry a major risk of amputation of the lower limb and can even lead to mortality[48].

Many scoring systems are present for classification of diabetic foot ulcers, but SINBAD scoring is one of the feasible scoring systems to evaluate the patients on an Out Patient Department basis and to determine the management based on the scoring system.[49]

People with established ulcers are categorised for two main reasons: (a) to summarise the clinical information for communication and to highlight the management strategies for specific cases; and (b) to assign ulcers to various broad groups so that any attempt to show variations in outcome between populations takes into account potential population differences.[50]

The first of these will probably concentrate on subspecialty care, such as the control of infection, particular kinds of wounds, and in particular the diagnosis and treatment of PAD.

The second is most likely to be utilised when making past comparisons of results between various centres and regions (comparative audit). Though different clinicians may use them in different ways, some classifications may be better suited for one of these two goals than the other.

According to Maltide et alarticle,"Diabetic foot ulcer classification: A critical review," one purpose of a classification for already-existing ulcers is to assign a DFU to a specific group (primarily based on defined causes) in order to promote more efficient communication between medical professionals.[50]

Although there is a place for additional classifications within more specialised groups, in general clinical practise there should only be one classification used.

Thus, The dominant factors, such as peripheral artery disease (PAD), infection, and loss of protective sensation (LOPS), are therefore likely to be the basis of a classification used in general clinical practice.

According to a critical review of diabetic foot ulcer classifications by Maltide et al., SINBAD is the most widely validated system, based on the quantity of participants it has included, the variety of validation research contexts it has been conducted in, and the degree of consistency of its findings.[50]

Among the study population of 120, 5(41.7%) were less than 40 years ,16(13.33%) were between 41-50 years,73(60.83%) were between 51-60 and 26 were between 61-70 years. The mean age was 56.73.

This clearly signified the prevalence of the majority of the diabetic foot ulcers in patients who were more than 50 years of age.

This was in agreement with the study done by Yazdanpanah et al that signified increasing age as a key risk factor for diabetic foot ulcer.[1]

Out of 120, 86(71.67%) subjects are male and 34 (28.33%) subjects are female. This emphasized the male predisposition for diabetic foot ulcers in this study. Thanh Dinh et al in his study proved that men have a higher risk for foot ulceration due to them being at risk of more severe neuropathy, decreased joint stability and higher foot pressures. However, the presence of risk factors such as neuropathy nullified this difference between the two genders.[51]

Among 120 subjects, 6(5%) had healing ulcer, 14(11.67%) had ischemic ulcer and 37 (30.83%) had Neuroischemic ulcer,62 (51.67%) had neuropathic ulcer and 1(0.83%) had chronic non healing ulcer. So diabetic neuropathy leads to loss of sensation leads to development of foot ulcers. In our study, most of the subjects who had diabetic foot ulcers had neuropathy.

Among 120 subjects, 23(19.17%) were graded as score 3, 60(50%) as grade 4 and 25 (20.83%) as grade 5 and 12(10%) as grade 6. Majority of patients in our study we encountered are of grade 4 which we found is a very crucial step in making decisions of management.

Amongst subjects scored as 3, 1 (4.35%) had undergone amputation, 16 (69.57%) undergone Debridement, 6 (26.09%) had undergone regular dressings. subjects of score 4, 11 (18.33) underwent amputation, 27 (45%) had undergone Debridement, 22 (36.67%) had undergone disarticulation. subjects of score 5, 18 (72%) underwent amputation, 1 (4%) underwent Debridement, 6 (24%) underwent disarticulation. subjects of score 6, all 12 (100%) patients underwent amputation.

So in our study we had observed that subjects who had scored 3, majority of the patients were treated with Debridement and of score 5 and 6 majority were subjected to amputation. So hence again it proved that higher the score, more chance for the limb to go for amputation.

Among subjects with score of 3, only one underwent amputation (toe), score of 4,11 underwent amputation (9-toe,1-foot,1-below knee), score of 5,(18)underwent amputation (8- toe,3-foot, 4-below knee,3-Above knee) score of 6,(12) underwent amputation (1-toe,1-foot,7-below knee and 3 above knee).In our study, we observed that if score is on higher side, amputation subjected is on higher level.

This was in agreement with Venkataraman et al that as of increasing scores, most of the patients are subjected to amputation due to involvement of both ischemic and neuropathic components and due to impending gangrene.[12]

PAD is a significant risk factor for diabetic foot lesions, according to numerous studies.[52,53]Additionally, our analyses confirmed that in patients with DFW, the presence of PAD was a significant risk factor for major amputation.[54] The major

amputation group had higher rates of multiple arterial stenotic/occlusive lesions in multiple locations and at different PAD severity levels.[55]

Amongst the subjects scored of 3, 15 (12.5%) had fore foot ulcers and 8 (6.67%) had mid foot -hind foot ulcers. subjects with score of 4, 20 (16.67%) had forefoot ulcers and 40 (33.33%) had mid foot-hindfoot ulcers. subjects with score 5, 9 (7.5%) had fore foot ulcers and 16 (13.33%) had mid foot- hindfoot ulcers. Subjects with score 6, 1 (0.83%) had forefoot and 11 (9.17%) had mid foot- hindfoot ulcers.

In our study, ulcers of the midfoot-hindfoot are dominant in all scores which are statistically significant. The location of the wound had a significant impact on healing, according to Ince et al. and Beckert et al.[56,57]

Amongst the subjects scored with 3,23(19.17%) had bacterial infection over the ulcer, subjects scored of 4, 60(50%) had bacterial infection, subjects scored of 5 ,25(20.83%) had bacterial infection, subjects scored of 6, 12 (10%) patients had bacterial infection. Bacterial infection also determines the healing of ulcer. According to Ince et al. and Beckert et al., a wound infection delays the healing process[56,57].

Amongst the subjects, scores of 3,18(15%) patients had superficial ulcer and 5 (4.17%) patients had deep ulcer. Subjects with a score of 4, 20 (16.67%) had superficial ulcer and 40(33.33%) had deep ulcer. With scores of 5 and 6 all 25 (20.83%) and 12 (10%) patients had deep ulcers.

We had observed as in progression of grades, depth plays an important role, which signifies, most of the patients with high scores had deeper ulcer in which of score 6 patients,100% of them have deep ulcers which is to be strong agreement with the Wagner classification system, which emphasizes penetration depth and changes ulcer management.

The Wagner ulcer classification system is the most widely used method for categorizing diabetic foot lesions and ulcers. It is based on the presence of osteomyelitis or gangrene, and the degree of tissue necrosis and depth of penetration.

Only Grade 3 (out of the 6 grades) of the Wagner's classification system has a shortcoming in that it doesn't adequately address all diabetic foot ulcerations and infections.[58]

A multicenter study by Ince et al. in 2008 compared the system's capacity to predict healing times in four distinct nations. The results varied by country, but in every setting, a score of equal to or higher than 3 predicted a worse prognosis. In our study also, we found that scores higher than 3 were associated with a poor prognosis.[56]

Additionally, this system is unable to classify superficial wounds that are dysvascular or infected. The SINBAD classification somewhat mitigates these issues.

In our study, as per SINBAD scoring system, individual criteria never determine the management of ulcer, its whole score or in combination will evaluate and determine the management of ulcer.

Therefore, in our study, each of the criteria in SINBAD scoring has its own significance and importance, or when combined, determines the management. For example, when both Ischemia and Neuropathy are present, the majority of patients require amputations.

Very few studies were done in evaluation of diabetic foot ulcers with the help of SINBAD scoring system. So In need of more studies, This study was an attempt to provide necessary knowledge regarding the SINBAD scoring system to evaluate and determine the management of diabetic foot ulcers.

CONCLUSION

In developing countries, due to the substantial number of cases of Diabetes and Diabetes foot ulcers, Effective classification systems are required for quick management that complies with patient needs as well as cost-effective treatments and also prevents undergoing for amputation.

There are benefits and drawbacks to each of the current classification systems that are in use. SINBAD scoring system is one of the effective classification systems in evaluation and early management of diabetic foot ulcers and reduces the rate of amputations by early assessment and intervention. Based on the score, treatment plans can be chosen.

The system is simple to use in everyday practice and to score with. SINBAD is easier to use in daily practice, more effective at describing the disease processes, and helps with management and early intervention.

Additionally, it demonstrates that these traits can be quantified as an overall SINBAD score, with a score of three or higher being intertwined to a longer time to healing and a greater likelihood of failing to heal in the end. Because of this, the SINBAD score might stand in for a system that could be used to categorize ulcer types all over the community.

SUMMARY

Diabetic foot and its complications are troublesome, source consuming and producing disability, morbidity and mortality.

PREVENTION IS THE BEST TREATMENT

Grading of the Diabetic foot lesions according to SINBAD Score helps in choosing appropriate treatment to the grade. Patient education and strict glycemic control can reduce the burden of diabetic foot. Early diagnosis and hospitalization, appropriate treatment including medical and surgical treatment according to the grade can reduce the morbidity mortality and improve the outcome of the disease

SINBAD Scoring is easier to use in daily practice. it is more effective & helps with management and early intervention of Diabetic foot ulcers and reduce the rate of amputation by early assessment.

SINBAD score of ≥ 3 takes more time in healing of ulcers and had a greater likelihood of failing to heal in the end. It is helpful in Categorizing ulcer types all over the community can be used in diabetic foot audits

Hence there is a requirement of more studies on this scoring system with large number of population with Diabetic foot ulcer.

LIMITATIONS

LIMITATIONS:

1. Single center study.
2. Only 120 pts were included. Need for more subjects.

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ANNEXURE – I -

CONSENT FOR PARTICIPATION IN RESEARCH STUDY

Mr/Mrs/Miss. _____, we are requesting you to enroll yourself in study titled **"LONGITUDINAL STUDY TO DETERMINE THE APPLICATION OF SITE, ISCHEMIA, NEUROPATHY, BACTERIAL INFECTION, AREA AND DEPTH [SINBAD] SCORING IN THE OUTCOME AND MANAGEMENT OF DIABETIC FOOT ULCERS** conducted by

REG NO: BH0120008 Post Graduate in M.S. General Surgery under the guidance of Dr. _____, Department of General Surgery, J.N. Medical College, Belagavi under KAHER, Belagavi.

Respected Sir/Madam,

We request you to participate in our study. Your participation in the research is voluntary. Your decision to participate in the study or otherwise will not affect the relationship with KLES Prabhakar Kore Hospital. If you decide not to participate, you are free to withdraw at any time. During the study, your operative outcome will be assessed by some questions.

Purpose of the study:

This research is intended to assess the diabetic ulcers based on SINBAD classification system and to determine the management based on SINBAD Score. The principal investigator of the study is REG NO: BH0120008 , under the guidance of Dr._____

.

Procedure I

If you agree to enroll yourself in this study, your detailed history will be taken and you will be clinically examined in detail. Investigations like hemoglobin is required. Wound is Scored according to SINBAD classification system If multiple ulcers present at the same time, the most significant [generally the largest] will be selected as the index ulcer forthe purpose of the study.

The presence of neuropathy will be determined using vibration perception [128 Hz tuning fork] at two sites hallux pulp and malleolus, point pressure using 10gmonofilament at 9 sites and ankle reflexes. The adequacy of arterial blood supply will be determined by the palpation of dorsalis pedis and posterior tibial artery pulsations.

Follow up will be done for every 2 weeks up to 3 months.

Risks and Benefits:

There is no increased risk involved in being a part of this study and the complications are those which are normally anticipated. This study will help to estimate the outcome of the ulcer and manage accordingly and to know efficiency of SINBAD scoring system to assess and manage diabetic foot ulcer. The results derived at the end of the study will possibly benefit all similar patients admitted in this hospital and elsewhere.

Withdrawing/removal from the study:

The participant has freedom to withdraw from the study whenever he/she wishes and without any prior notice. Even if you decline to participate, there will not be any change in the line of your management or the relationship with your doctor. You will be told

about all the information that affects your decision to participate in the study. The investigator may also exclude a participant from the study at any point of time.

Privacy and Confidentiality:

The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to other without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law.

Institutional/sponsors policy:

If any unforeseen complications or injury occurs during the period of study, the participant will be given treatment within the limitations of KLES Prabhakar Kore Hospital.

Financial Incentives for participation:

The participant neither gets any financial incentives during the period of study nor will be asked to pay for this study.

Authorization to Publish Results:

When the results of the research are published, or discussed in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in this study that can be associated with your identity will remain confidential.

Institutional Policy:

In case you have any questions related to the study, in future or in case of study related injury, you can contact:

Dr. HARSHA HEGDE,

CHAIR PERSON,

JNMC, IEC & SCIENTIST D.

NATIONAL INSTITUTE OF TRADITIONAL MEDICINE, BELAGAVI.

REG NO: BH0120008	**Dr._____**
Post-Graduate, General Surgery,	Professor, General Surgery,
J. N. Medical College, KAHER,	J. N. Medical College, KAHER,
Belagavi	Belagavi

CONSENT STATEMENT

I, Mr/Ms/Mrs. _____ voluntarily agree for the participation as a subject of study. By signing this consent form, I am not giving up any of my legal rights. I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in my vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name : _____

Signature or Left Thumb Print of Subject: _____

Witness Name: _____ Signature: _____

Investigators Name: _____ Signature: _____

Date: _____

Place: _____

ANNEXURE - II – PROFORMA

PROFORMA / QUESTIONNAIRE TO BE USED FOR DATA COLLECTION

The proposed proforma / questionnaire to be used for data collection for the study titled **"LONGITUDINAL STUDY TO DETERMINE THE APPLICATION OF SITE, ISCHEMIA, NEUROPATHY, BACTERIAL INFECTION, AREA AND DEPTH [SINBAD] SCORING IN THE OUTCOME AND MANAGEMENT OF DIABETIC FOOT ULCERS is as:**

Group:

Name:

IP no.:

Sex:

Age:

Address:

Religion:

Education:

Date of admission:

Occupation:

Date of discharge:

CHIEF COMPLAINTS:

HISTORY OF PRESENTING COMPLAINTS:

PAST HISTORY:

PERSONAL HISTORY:

FAMILY HISTORY:

GENERAL PHYSICAL EXAMINATION:

Built and Nourishment:

Weight:

Pallor / Icterus / Cyanosis / Clubbing / Edema / Lymphadenopathy

Vital Signs: PR: /min; BP: mm Hg; RR: /min; Febrile/Afebrile

SYSTEMIC EXAMINATION:

Abdomen:

Inspection:

Palpation:

Percussion:

Auscultation:

Cardio Vascular System:

Respiratory System:

INVESTIGATIONS:

Hemoglobin:

CLINICAL IMPRESSION:

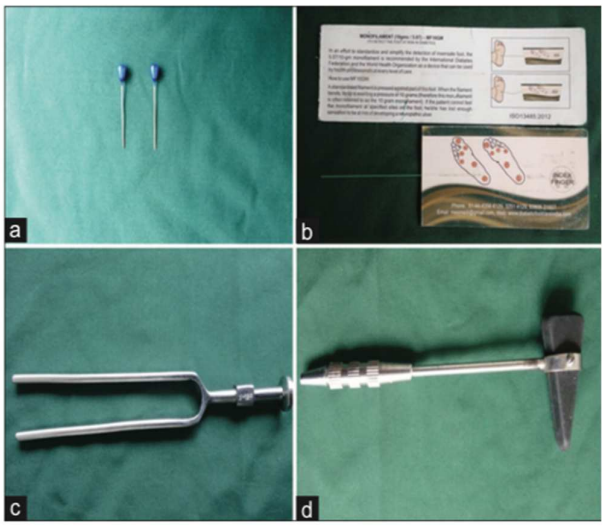
ASSESSMENT OF WOUND SCORING

Site	**Forefoot**	**SINBAD SCORE**
	Midfoot and hind foot	
Ischemia	**Pedal blood flow intact,one pulse palpable**	
	Clinical evidence reduced pedal blood flow	
Neuropathy	**Protective sensation intact**	
	Protective sensation lost	
Bacterial infection	**None**	
	Present	
Area	**Ulcer< 1cm square**	
	Ulcer> 1 cm square	
Depth	**Ulcer confined to skin and subcutaneous tissue**	
	Ulcer reaching muscle, tendon, or deeper	

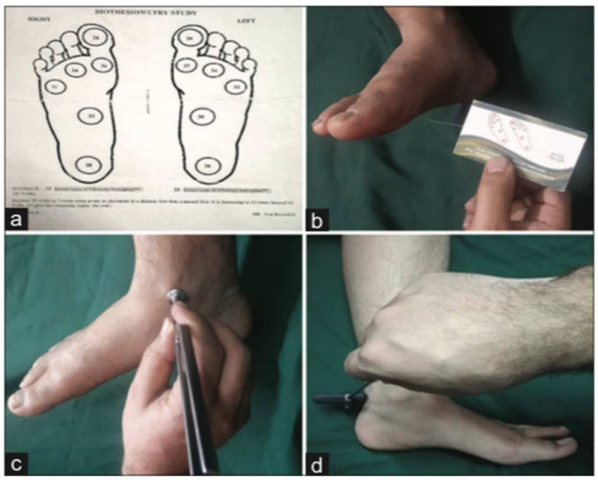
ANNEXURE – III-

PHOTOGRAPHS

Photograph 1: Instruments used for Assessment of Neuropathy

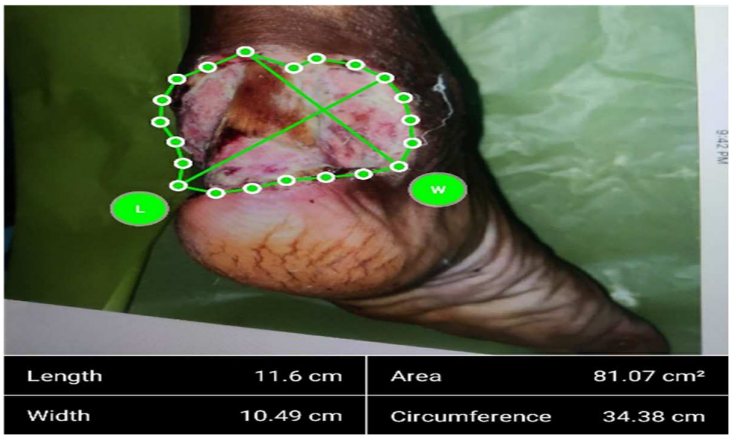


Photograph 2: Assessment of Neuropathy



Photograph 3: Assessment of Vasculopathy

Photograph 4: Measurement of area of ulcer using imito measure app.



Photograph 5: Score 3 on diagnosis and post Debridement with healing.

Photograph 6 : Score of 6 on diagnosis and post amputation with wound gape.

Table 1

Hospital ID	Age	Sex	Diagnosis	Hemoglobin	SINBAD score	Procedure underwent	Comorbidites and other procedures	Other specific investigations	Bates Jensen wound assessment tool
1022433	62	Female	Neuroischemic ulcer with gangrene	10gm	5	Right fore foot amputation	Type2 diabetes since 2 months on insulin.	Nil	
1033788	53	Male	Neuropathic ulcer	13gm	4	Right 2nd,3rd and 4th toe disarticulation	Type2 Dm since 18yrs and Type 2 HTN since 18yrs on medication. K/c/o ischemic heart disease with s/p PTCA in 2018.	Nil	
1037546	53	Male	Neuropathic ulcer	10.3 gm	4	Debridement of ulcer	Type2 DM and HTN since 18 yrs , on medication , angioplasty done in 2018 and urolithotripsty.	Nil	Score of 25 on day 1 and score of 15 on day 14 and score of 12 at the end of one month..underwent skin grafting .
1048814	64	Female	Neuropathic ulcer with foot gangrene.	12.2gm	4	Rays amputation of right great toe	Type 2 DM since 15 yrs on medication , k/c/o PTCA for iHD 6 yrs back	Nil	
1050095	55	Male	Neuropathic ulcer with toe gangrene.	11 gm	4	Right great toe amputation	Type 2 DM since 15 yrs on medication	Nil	
1053320	1053320	Male	Neuropathic ulcer	11.4gm	4	Debridement of ulcer	Type2 diabetes since 8years on medication, k/c/o psoriasis since 3yrs on medication	Nil	Score of 20 on day 1 post Debridement and score of 13 on the day of 14 and score of 9 by the end of one month.
1050456	51	Male	Neuropathic ulcer	10.8gms	4	Debridement of ulcer	Type 2 DM since 4 years on medication	Nil	Score of 23 on day 1 and underwent Debridement and score of 18 on day 14 and score of 13 by the month end ..underwent skin grafting.
1039530	54	Female	Neuropathic ulcer with great toe gangrene.	10.1gm	4	Amputation of left great toe	Type 2 DM since 25 yrs on medication,HTN since 12 yrs on medication, k/co ant wall myocardial infarction with EF -45, endovascular recanalisation of right SFA by atherectomy and balloon angioplasty in 2021.	Nil	
1031098	62	Male	Great toe gangrene with neuropathic ulcer.	10gm	4	Rays amputation of left great toe	Type 2 DM since 10 years on medication ,HTN since 5 years on medication.	Nil	
10526414	46	Female	Neuroischemic ulcer with toe gangrene.	12.7gm	4	Right great toe rays amputation	Type 2 Diabetes on irregular medication since2 years...	Nil	
1042183	60	Male	Neuropathic ulcer with toe gangrene.	10.6 gm	4	Right great toe disarticulation	Type 2 diabetes on regular treatment	2D echo: ef:60 percent ,mitral valve annular calcification, aortic valve thickened.	
1047358	62	Male	Ischemic ulcer with gangrene of toes.	14.5 gm	4	Right 2 nd,3rd and 5th toes amputation.	Type 2 diabetes since 20 years on treatment , cardaiac pacemaker insertion 20years ago.endovascular recanalisation of right sfa,PTA, tibio perineal trunk by per cutaneous trans luminal angioplasty +stenting.	Ct angiogram- concentric calcified atheromatous plaque in right SFA resulting in 70-80 percent stenosis in its proximal portion.concentric calcified athermatous plaque in left SFA resulting in 60-70 stenosis in its proximal portion and 50-60 percent in its mid portion,2D echo - EF-60 percent; aortic valve thickened , trivial MR	
1043117	60	Male	Neuroischemic with diabetic foot wet gangrene.	12.2gm	4	Below knee amputation of left lower limb	Type 2 diabetes mellitus since 10years on medication..	2D echo- EF -60percent, valves normal, colour Doppler - varicose veins present.	

1049735	54	Female	Neuroischemic ulcer with gangrene.	12.2gm	5	Below knee amputation of left lower limb	Diabetes mellitus since 25 years on medication,HTN since 12 years on medication, ballloon angioplasty of right foot stenting, k/c/o IHD anterior wall mi with EF - 45 percent..	Nil	
1039193	60	Male	Neuroischemic ulcer with osteomyelitc changes.	11gm	5	Amputation of right 2nd toe	Diabetes since 10 years on insulin , previously history of amputation of rt and left great toe 5 years back, history of 3rd to 5 th toe 3 months back...stenting done for right lower limb 3 months back...	Nil	
1077548	68	Male	Ischemic ulcer.	10	4	Debridement of ulcer	Diabetes and hypertension since 20yrs on medication,k/c/o ischemic heart disease underwent angiography..	CT angiogram- diseased bilateral peroneal trunk,and rt PTA due to atheromatous calcification Colour Doppler- diseased posterior tibial and distal anterior tibial artery.	Score on day 1- 28 underwent Debridement score on day 14 - 25 underwent amputation
1085603	56	Female	Neuropathic ulcer	12.3	4	Debridement of ulcer	Diabetes and HTN on medication,	Nil	Score on day -1 is 19 underwent Debridement,score on day 14 is 13 underwent skin grafting
1074263	58	Male	Neuropathic ulcer with fore foot gangrene.	10.6gm	4	Rt forefoot amputation	DM since 15 years...	Nil	
1059403	52	Female	Traumatic diabetic foot ulcer.	11.2	3	Debridement of ulcer	Diabetes since 6years on medication History of previous debridement done of left foot traumatic ulcer 2 years back.	Nil	Score on day 1-20 and Debridement on day of 14 - score of 14 and at the end of one month-9 after lost to follow up
1071306	62	Male	Diabetic foot ulcer with infection.	10	3	Debridement of left diabetic ulcer..	Type2 DM since 10 yrs and on treatment. History of left great toe amputation on 28/6/21.	Nil	Score on day 1 -25 underwent Debridement on day 14 score is 15underwent skin grafting
1042183	60	Male	Great toe dry gangrene.	10.6gm	4	Right great toe disarticulation.	Diabetes mellitus on treatment	2D echo: EF: 60. Mitral valve calcification Aortic valve thickened.	
1068410	65	Male	Neuroischemic ulcer with gangrene	10.8gms	6	Below knee amputation of Rt lower limb.	Dm since 20 years on medication. Left below knee amputation done 4 years ago in view of peripheral vascular disease .	Nil	
1071527	55	Female	Diabetic foot ulcer with infection.	10.4	4	Debridement of left diabetic foot ulcer	Dm since 8 years on medication,HTN since 1year on medication. Debridement of ulcer.	Nil	On day 1 - score is 18 and day 14 score is 13 after that lost to follow up
1067847	60	Male	Neuroischemic limb with wet gangrene.	11gm	5	Above knee amputation of left lower limb	Diabetes and hypertension since 15 years..	Nil	
1068912	45	Female	Diabetic foot gangrene.	10gm	6	Below knee amputation of left lower limb..	Diabetes since 8years on medication.	Nil	
1068410	65	Male	Neuroischemic with infection and gangrene.	10	6	Right Great toe amputation with debridement . Recanalisation of superficial femoral artery.	Diabetes mellitus since 20 years on insulin, left below knee amputation done 4 years ago in view of pvd..	Nil	
1072723	68	Male	Diabetic foot gangrene.	11gms	5	Fore foot amputation of left lower limb	HTN and Diabetes since 15 years on medication	Nil	
1071933	60	Male	Ischemic ulcer with gangrene of foot.	10gm	6	Below knee amputation of right lower limb..	Diabetes since 15 years..		

1071616	60	Female	Neuropathic ulcer with 2 nd toe gangrene.	10.2 gm	4	Left 2 nd toe disarticulation...	Diabetes mellitus since 16 years,HTN since 16 years on medication, underwent coronary angioplasty and triple vessel disease.op/c/o right great toe amputation 3years back...	Nil	
1040465	37	Male	Diabetic foot ulcer with infection.	10.4gms	3	Debridement	Diabetes mellitus since 2 years on medication,HTN since 2years.. amputation done for 2nd,3rd,4th toe amputation..done 8 months back..	Nil	On day 1 ,score of 28,on day 14 score of 21 and score of 15 on day 30..and 9 at the end of 45 day...
797358	70	Male	Ischemic ulcer with infection.	10.3gms	4	Debridement of right diabetic foot ulcer	Nil		On day 1 score of 28 and day 14 score of 26 and one month score of 21 skin grafting done.
1075217	41	Female	Neuropathic ulcer.	10 gm	3	Debridement of left foot ulcer	HTN and DM since 4 years on medication	Colour Doppler- varicose veins noted,arteries are normal.	On day 1 score of 30 and day 14 score of 25 and on day 30 score of 21 skin grafting done.
1075040	60	Female	Neuroischemic ulcer .	10.4gms	4	Debridement of left foot ulcer.	Diabetes and hypertension since 3 months on treatment	Colour Doppler: left sfa, popliteal artery biphasic flow,focal calcified plaque in left popliteal,ATA,PTA,dorsalis pedis no flow, right SFA popliteal,ATA ,PTA shows biphasic flow.. 2d echo- resting LV systolic function,no regional wall abnormality,trivial MR,trivial TR, mild PAH, Grade 1DDF	On day 1-34,on day 14 -38 underwent forefoot amputation.
1075040	60	Female	Diabetic foot dry gangrene with neuroischemic ulcer.	11.4gms	5	Left lower limb below knee amputation	Diabetes and hypertension since 6 months on medication	Nil	
1071027	68	Male	Neuroischemic ulcer with foot gangrene	12gms	6	Below knee amputation of right lower limb.	HTN and asthma on medication.op/c/o Debridement of right fore foot.	Nil	
1069830	65	Male	Neuroischemic ulcer with foo gangrene.	10.8gms	5	Below knee amputation	No other comorbidities.	Nil	
1077354	62	Male	Neuropathic ulcer	10.5gms	3	Debridement of ulcer.	Amputation of left great toe in 2019.	Nil	Score on day 1-26,on day 14-21,on day 30-18 skin grafting done.
1071027	70	Male	Diabetic foot gangrene with maggots infestation.	14gms	3	Debridement of Rt fore foot	HTN and asthma on medication.	Nil.	Score on day 1 -28, score on day 14 - 24, score on day 30- 21 and skin grafting done.
1075217	68	Female	Left diabetic foot gangrene with neuroischemic ulcer	11gms	5	Below knee amputation of left lower limb	HTN since 4years	Nil	
1056863	66	Male	Neutropathic ulcer with gangrene with 1st head of metatarsal osteomyelitis	13.5	4	Debridement with disarticulation of 1st toe.	HTN with h/o fracture of 2nd and 3rd metatarsal.	Nil	On day 1 score 23, day 14 - score of 19 and skin gra done.
1057864	68	Male	Neuroischemic ulcer over left 2nd toe	11	5	Rays amputation of the left 2nd toe	Right lower limb stenting done for Rt lower limb 3 month back.. H/o amputation of right great toe 5 years back and 2nd to 5 th toe 3 months back	Ct angiography: occlusion of Rt and left distal superficial femoral,popliteal and tibio peroneal trunk..	
1068165	40	Female	Neuropathic ulcer over right foot.	10.9	3	Debridement of ulcer	Nil	Nil	Score on day 1-27,score on day14 score of 23 on one month score of 19 and score on 45-15.
1074263	58	Male	Neuropathic ulcer over right foot s/p amputation site.	10.8	4	Debridement of ulcer	Nil	Nil	Score on day 1-26,score on day 14 - 21 after that lost to follow up.

1042183	60	Male	Neuropathic ulcer over the left 2nd toe with osteomyelitic changes.	10.6	4	Disarticulation of left 2nd toe.	Nil	2Decho: EF:60 , mitral valve annular calcification,aortic valve thickened.	
1071306	58	Male	Neuroischemic ulcer over the left great toe.	11	3	Left great toe amputation	Nil	Nil	
1050095	55	Male	Neuropathic ulcer with osteomyelitic changes.	11	4	Right great toe amputation.	Nil	Nil	
1039193	65	Male	Neuroischemic ulcer over the right foot 2nd to 5 th toes	12	5	Right 2nd to 5th toes amputation	Endovascular recanalisation Rt superficial femoral,popliteal and other vessels	Ct angiography- occlusion of right and left distal Superficial femoral,popliteal,tibio peroneal trunk, with atheromatous wall calcification of all arteries of bilateral lower limbs.	
1059636	60	Male	Diabetic foot ulcer over the right sole of foot	10	3	Debridement of ulcer	Nil	Nil	Score on day 1 - 24, score on day 14- 19 and at one month 13
1059474	68	Male	Neuropathic ulcer over the medical aspect of right great toe.	12.4	3	Debridement of ulcer of right great toe	Nil	Nil	Score on day 1 -30;score on day 14 -25 and score on day 30- 21 ,and score on 45 - 15 after akin grafting raw area of ulcer.
1064682	60	Male	Neuropathic ulcer over great toe with extension todorsum of all toes	14.4	4	Debridement of Rt foot	Op/c/o right little toe amputation for gangrene 2years back..	Nil	Score on day 1 - 28,on day 14 score of 23 and on day 30- 19 skin grafting done.
1063125	35	Female	Neuroischemic ulcer over the left foot with gangrene	10	5	Left above knee amputation	Op/c/o left femoral embolectomy 2yrs back,op/c/o thrombectomy of ileo femoral artery with end arterectomy with fasciotomy.	Nil	
1067427	55	Female	Neuropathic ulcer over the base of great toe	12	3	Debridement of ulcer	K/c/o HTN, H/o right great toe disarticulation 4 years back,H/o trauma over left sole 2 years ago.H/o disarticulation of left great toe 6 months back	Nil	Score on day 1 -29,on day 14 -23,on day 30- 18 skin grafting done.
1072723	66	Male	Neuroischemic ulcer over the left foot 4 th toe with gangrene	11	5	Left 4 th toe disarticulation	K/c/o HTN since 15 years on medication	Nil	
1062226	60	Male	Ischemic ulcer with pus discharge of 1st web space extension to dorsum of left foot	13.2	4	Debridement of ulcer	K/c/o HTN since 5 years	Nil	Score on day 1 - 28: on day 14-33 and on day after one month -amputation underwent.
1058708	65	Male	Ischemic Ulcer over the plantar aspect of foot	12.3	3	Debridement of ulcer.	K/c/o HTN since 10 years on medication.	2D echo- hypokinesia of left ventricle, post PTCA status.LVEF-30%	Score on day 1- 26, on day 14 score of 21 and on day 30 score of 17 and on one and half month score of 12.
1058442	65	Male	Left diabetic foot neuropathic ulcer over dorsum of foot	11	4	Debridement of left diabetic foot ulcer	K/c/o HTN since 15 years on medication	Nil	Score on day 1 30,on day 14-25 and on day 30- 21 and skin grafting done
1049452	58	Female	Neuropathic ulcer over right heel	11	3	Regular dressing.	Nil	Nil	Score of 24 after 1 week,15 after 2 nd week and 6 after 1 month follow up
1041225	58	Male	Neuropathic ulcers with gangrene of right little toe	10.6	5	Right little toe amputation.	K/c/o HTN since 5 years on medication.	Nil	
1075217	50	Female	Neuroischemic ulcer with gangrene of left lower limb.	11.6	5	Below knee amputation of left lower limb.	K/c/o HTN since 4 years and underwent Debridement of ulcer 1 month back.	Nil	
1071027	56	Male	Neuroischemic ulcer with myasis with gangrene of Rt foot extension to leg	12.1	6	Right below knee amputation	K/c/o HTN since 6 years on medication and op/c/o Debridement of Rt fore foot 1 month back	Nil	

1085868	60	Male	Neuropathic ulcer over the left foot	11.6	4	Debridement of ulcer of left foot	K/c/o HTN since 5 years on medication	Nil	Score on day 1 - 28,score on 14-25 and score on 1month- 20 and skin grafting done.
1048042	56	Male	Neuropathic ulcer with left great toe gangrene	11	4	Left great toe disarticulation	Nil	Nil	
1078310	56	Female	Neuropathic ulcer over Rt fore foot	11.1	4	Debridement of ulcer	K/c/o HTN since 6 yrs on medication.	Nil	Score on day 1 - 29 and score of day 14 - 23 and one month -19 and skin grafting done.
1058360	55	Female	Ischemic ulcer with left 2nd toe gangrene	12	4	Disarticulation of left 2nd toe with Debridement.	K/c/o CAD s/p PTCA	2Decho- normal resting systolic volume;mild TR,PR noted,EF-60%	
1085581	56	Female	Neuropathic with 2nd,3rd and 4th toes gangrene.	12.3	4	Rt 2nd,3rd,4th toes Rays amputation.	K/c/o HTN since 10 years on medication	Colour Doppler of Rt lower limb- diffuse atheromatous calcification of anterior and posterior tibial arteries.	
1072683	48	Male	Neuropathic ulcer over base of left great toe with gangrenous changes	11	4	Left great toe disarticulation	K/c/o HTN on medication	Nil	
1071617	50	Female	Neuropathic ulcer over left foot	10.6	4	Debridement of ulcer of left foot	K/c/o HTN on medication	Nil	Score on day -1 36, score on day 14 - 29 and 1 month score of 24 and after one and half month - 21 and at 2 months score of 15.
1048081	56	Male	Neuroischemic ulcer with Rt 5 th toe gangrene.	11	5	Amputation of Rt 5 th toe	K/c/o HTN on medication.	Nil	
1078210	60	Male	Neuropathic ulcer of left foot.	10.8	4	Debridement of left foot ulcer.	K/c/o HTN on medication.	Nil	Score on day -1 25 and score on day 14 is 21 and score after one month 15.
1058683	56	Female	Neuropathic ulcer over the Rt great toe	11	3	Regular dressing	Nil	Nil	
1058680	50	Female	Neuropathic ulcer with Rt 5 th toe gangrene	10.5	5	Rt 5 th toe disarticulation done.	Nil	Nil	
1086450	56	Male	Neuropathic ulcer over Rt foot	10.6	4	Debridement of ulcer over Rt foot	K/c/o HTN and IHD on medication	Nil	Score on day -1 28,score on day 14 is 23 score on day 30 is score 19 and skin grafting done.
1072685	57	Male	Neuropathic foot with Rt 3rd toe gangrene.	11	4	Disarticulation of Rt 3rd toe.	Nil	Nil	
1061417	48	Male	Neuropathic ulcer over Rt foot	13	4	Debridement of ulcer over Rt foot	K/c/o HTN on medication	Nil	Score on day 1-30, on day 14 score of 23 after one month score of 19 and skin grafting done
1070265	56	Male	Neuroischemic foot with 1st and 2nd toe gangrene of Rt foot	11	5	Disarticulation of 1st and 2nd toes of Rt foot.	K/c/o HTN on medication	Nil	
1072367	52	Male	Neuropathic ulcer over Rt heel.	11.1	3	Regular dressing	K/c/o HTN since 3years on medication.	Nil	
1070225	56	Male	Neuroischemic ulcer with left foogangrene	11	6	Left below knee amputation done.	K/c/o HTN and IHD on medication.	Colour Doppler-diffuse narrowowing present in ATA and PTA,2D echo- normal with mild mr and EF-50	
1068255	52	Female	Neuropathic ulcer with left 5th toe gangrene.	12	5	Left 5 th toe disarticulation	Nil	Nil	
1070225	60	Male	Ischemic ulcer with 1st and 2nd toe gangrene.	11.1	4	Left 1st and 2nd toe disarticulation	K/c/o HTN on medication	Colour Doppler- diffuse atheromatous calcification present over distal pta and ATA with distal run off with formed collateral.	
1072367	46	Male	Neuropathic ulcer over the left foot	10.6	3	Regular dressing	Nil	Nil	

1070225	56	Male	Neuropathic ulcer over left foot	11.6	5	Debridement of ulcer over left foot	Nil	Nil	Score on day 1 -36 and score on day 14 is 26 and score after one month -21 and score after one and half month is 18 and at the end of 2months 13 with skin grafting.
1062854	56	Male	Neuropathic ulcer with 4 th and 5 th toes gangrene	11.1	5	RYs amputation of left 4th and 5 th toes	K/c/o HTN since 6 yrs on medication	Nil	
1052854	52	FeMale	Left great toe gangrene with neuropathic foot	11	4	Disarticulation of left great toe	K/c/o HTN since 3yrs	Nil	
1068205	48	Male	Neuropathic ulcer over right foot	13	3	Debridement of right foot ulcer	K/c/o IHD on medication science 2 years	Nil	Score on day 1is 25 and score on day 14 is 19 and day 30 is score of 15
1060284	56	Male	Neuropathic ulcer with 4 th and 5 th toes gangrene of right foot	12.3	4	Disarticulation of 4th and 5th toes of right foot	K/c/o HTN since 3 years on medication	Nil	
1085603	68	Male	Neuropathic ulcer over right foot	11	4	Debridement of right foot diabetic ulcer	K/c/o IHD since 2 yrs	2D echo normal resting volume, normal ejection volume (60%)	Score of day 1 - 21 and day 14 is 16 and day 30 -12
1084263	59	Female	Neuropathic ulcer with left great toe gangrene	11	4	Disarticulation of left great toe	Nil	Nil	
1085580	54	Male	Neuropathic ulcer with right great toe and second toe gangrene	12	4	Disarticulation of right great toe and second toe	K/c/o HTN on medication since 5 yrs	Nil	
1072683	53	Male	Neuropathic foot with gangrene	11	4	Disarticulation of right great toe gangrene	K/c/o HTN on medication since 3 yrs	Nil	
1086248	56	Female	Neuropathic foot with Rt great toe gangrene	11	4	Disarticulation of right great toe gangrene	K/c/o HTN since 2yrs on medication	Nil	
1048081	54	Female	Neuroischemic ulcer over left foot	10.6	6	Left lower limb above knee amputation	K/c/o HTN on medication	Colour Doppler of left lower limb-diffuse atheromatous calcification involving superficial femoral artery,popliteal and ATA and PTA .	
1072682	60	Male	Neuropathic foot with 4 th toe gangrene	12	4	Disarticulation of left 4 th toe	K/c/o HTN on medication	Nil	
1071615	48	Male	Neuropathic ulcer over right foot	12	4	Debridement of Rt foot ulcer	K/c/o HTN on medication	Nil	Score on day 1 -28 and day-14 score of 19 and one month score is 15...
1078310	50	Male	Neuroischemic ulcer with right fore foot gangrene	13	6	Right fore foot amputation	Nil	Nil	
1058877	60	Male	Neuroischemic ulcer of right toes with foot gangrene	11	6	Right below knee amputation	K/c/o HTN on medication	CT angiogram-diffuse atheromatous wall calcification with 90%luminal narrowing in popliteal and ATA and PTA.	
1072682	52	Male	Neuropathic ulcer over left foot	12	4	Debridement of left foot ulcer	K/c/o IHD with DCM	2D echo- normal;dilated right atrium and ventricle.EF-30	Score on day 1 -25 and on 14 score is 20 and on one month score is 17 lost to follow up.
1083300	67	Male	Neuropathic ulcer over right foot	11	4	Right great toe disarticulation	Nil	Nil	
1085603	56	Female	Neuropathic ulcer over left foot	12.3	4	Debridement	Nil	Nil	Score of 32 and patient underwent Debridement and on day 14 score 36 underwent amputation.
1075560	50	Male	Neuropathic ulcer over right foot	12	3	Debridement	K/c/o HTN since 3yrs on medication	Nil	Score of 30 on day 1 underwent Debridement and on day 14 score of 23 and day 30 score of 19 and underwent skin grafting.
1068165	40	Female	Neuropathic ulcer over left foot	11.6	3	Debridement	Nil	Nil	Score of 21 on day 1 Debridement and then after 14 days 15 lost to follow up

1075560	50	Male	Neuroischemic ulcer with gangrene of footwith osteomyelitic changes	12	6	Rt below knee amputation	K/c/o HTN on medication since 2 years...k/c/o IHD on medication	Nil	
1058857	50	Male	Neuroischemic ulcer with gangrene of left great toe with osteomyelitic changes	13	5	Left toe rays amputation	K/c/o HTN since 4years on medication,k/c/o IHD s/p PTCA 4 years back.	Nil	
1072367	40	Male	Neuropathic ulcer of Rt foot	12	3	Debridement of ulcer over Rt foot	K/c/o HTN since 4years on medication	Nil	Score on presentation- 28,Debridement done score on 14- 23 and one month score is 19...underwent Debridement and after one and half month score of 14 underwent skin grafting.
1060284	56	Male	Neuropathic ulcer over left heel	12	3	Regular dressing	Nil	Nil	
1058853	60	Male	Ischemic ulcer with osteomyelitc changes	11.6	4	Disarticulation of Rt great toe	Nil	Nil	
1064231	56	Female	Neuroischemic ulcer	12	5	Left 4 th ,5 th toe disarticulation with Debridement of ulcer.	K/c/o HTN on medication	Nil	
1056035	60	Male	Neuroischemic foot with ulcer of left foot.	10.6	6	Left above knee amputation	K/c/o HTN and IHD on medication.	Nil	
1090056	52	Male	Neuropathic ulcer over left foot	12	3	Debridement done	K/c/o HTN since 2years on medication	Nil	Score on day 1 -25, then score on day 14 - 19 then score of one month -13
1060356	56	Female	Neuroischemic foot with right 3rd toe gangrene.	10.9	5	Disarticulation of Rt 3rd toe	K/c/o HTN on medication and s/p IHD on medication	Nil	
1060526	56	Male	Neuropathic foot with left great toe gangrene	10.6	4	Disarticulation of left great toe done.	Nil	Nil	
1076532	54	Male	Neuropathic ulcer over Rt foot	10.9	4	Debridement of Rt foot ulcer	K/c/o HTN on medication	Nil	
1083978	60	Male	Neuropathic ulcer over Rt 3rd toe gangrene	11	4	Rt 3rd toe disarticulation	K/c/o right 3rd toe disarticulation	Nil	
1085810	60	Male	Left neuropathic ulcer	11.2	4	Debridement of left neuropathic ulcer	Nil	Nil	Score on day 1 -25 and score on day 14 - 19 and score at one month -13 skin grafting done on day 20
1071862	68	Male	Neuroischemic foot with gangrene	11	5	Rt fore foot amputation	K/c/o HTN on medication	Nil	
1075030	50	Male	Right neuropathic ulcer over the 1st and 2nd toes with osteomyelitic changes.	11.9	4	Right 1st and 2nd toes gangrene	K/c/o HTN on medication	Nil	
1060076	52	Male	Non healing ulcer of diabetec foot	10.6	3	Regular dressing	K/c/o HTN on medication	Nil	
1071862	56	Male	Neuropathic ulcer with 3rd and 4th toe gangrene	10.8	4	Disarticulation of 3rd and 4th toes	K/c/o HTN on medication	Nil	
1076532	56	Male	Neuropathic ulcer	10.9	4	Debridement of ulcer done	K/c/o HTN on medication	Nil	Score of 30 on day 1 Debridement done on day 14 score of 23 and at the end of one month score of 18 skin grafting done.
1087863	56	Male	Neuroischemic ulcer over the left foot	12	4	Debridement of ulcer done	K/c/o HTN since 5 yrs on medication	Nil	Score of 28 on day 1 underwent Debridement on day 14 score of 20 underwent Debridement again and after one month score of 15 skin grafting done
1068410	65	Male	Ischemic ulcer with 2nd,3rd,4th toes	12.1	5	Rt 2nd,3rd,4th,5th toes amputation done			