Different Surgical Modalities for Reconstruction of Soft Tissue Defects in Diabetic Foot Ulcers; A Metaanalysis

A Systematic Review / Meta-Analysis
For Partial Fulfillment of Master Degree In General Surgery

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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Ahmed Abd Elmonsef Abd Elalim

List of Contents

Title	Page No.

List of Tables

List of Figures

List of Abbreviations

Abb.	Full term
ABPI	Ankle brachial pressure index
ALT	Anterolateral thigh
DIEP	Deep inferior epigastric perforator flap
EDB	Extensor digitorum brevis
ESRD	End stage renal disease
FDMT	First dorsal metatarsal flap
HBA1c	HemoglobinA1c or Glycated hemoglobin
IHD	Ischemic heart disease
IWGDF	International working group on the diabetic foot
LD	Latissimus dorsi
NPWT	Negative pressure wound therapy
PAD	Peripheral arterial disease
PVD	Peripheral vascular disease
STSG	Split thickness skin graft
TCPO2	Transcutaneous oxygen tension
TMJ	Tarso-metatarsal joint

INTRODUCTION

Diabetic patients' feet are prone to development of dreadful complications including infected simple ulcers and up to osteomyelitis and gangrene. Improvements in the diagnosis and treatment of diabetes mellitus and its complications have allowed the patients to have better quality of life. It is well established that about 25% of people with diabetes develop a foot ulcer during their lifetime and 20% of all diabetic patients who enter the hospital are admitted for foot problems ***(Colen, 1994)***.

The etiology and risk factors of a diabetic wound is generally attributable to the triad of neuropathy, Ischemic changes and increased susceptibility to infections. Neuropathy plays the major role in the development of diabetic foot ulcers through decreased protective pain sensation and impaired balance secondary to poor proprioception resulting from sensory neuropathy as well as decreased trophic factors. Motor neuropathy causes intrinsic muscle wasting in the foot, while autonomic neuropathy causes alteration of the blood flow with arteriovenous shunting and distended foot veins. Minor traumas to the foot (e.g. ill- fitting shoes) which are repetitive due to foot deformities caused by joint stiffness and decreased range of motion attributed to glycation of soft tissues worsen the condition as they pass unnoticed due to loss of the protective sensation and poor vision because of retinopathy and also abnormal foot arches with changes in pressure points ***(Reiber et al., 1999)***.

The evaluation and classification of diabetic foot ulcers are essential in order to organize the appropriate treatment plan and follow up. During the past years, several foot-ulcer classification methods have been proposed, however, none of the proposals have been universally accepted. The University of Texas system grades the ulcers by depth and then stages them by the presence or absence of infection and ischemia. More specifically, grade 0 in the Texas System classification represents a pre- or postulcerative site. Grade 1 ulcers are superficial wounds through either the epidermis or the epidermis and dermis without penetrating to tendon, capsule or bone. Grade 2 wounds penetrate to tendon or capsule, but the bone and joints are not involved. Grade 3 wounds penetrate to bone or into a joint. Each wound grade is subdivided into 4 stages: clean wounds (A), non ischemic infected wounds (B), ischemic wounds (C), and infected ischemic wounds (D) ***(Armostrong et al., 1998).***

Similarly, the International Working Group on the Diabetic Foot has proposed the PEDIS classification which grades the wound on a 5-feature basis: perfusion, extent, depth, infection, and sensation. Finally, according to the Infectious Diseases Society of America guidelines, the infected diabetic foot is subclassified into the categories of mild (restricted involvement of only skin and subcutaneous tissues), moderate (more extensive or affecting deeper tissues), and severe (accompanied by systemic signs of infection or metabolic instability) ***(Lipsky et al., 2012)***.

Treatment cornerstones for diabetic foot ulcers include general measures done in all patients as pressure offloading, cleanliness of the feet and keeping them dry, avoiding excessive trimming of the nails, wearing comfortable, well fitting or custom made shoes in addition to control of diabetes keeping random blood sugar below 200mg / dl and glycated hemoglobin (HBA1c) less than 6 mg /dL as well as using antiplatelet medications. Surgical management includes debridement (the most important measure in wound bed preparation) and wound closure according to the reconstructive ladder beginning from simple dressings till wound healing by secondary intention, split thickness skin grafts, local fasciocutaneous flaps (advancement, rotational or transpositional flaps), regional flaps (e.g. reversed hemisoleus muscle flap, distally based sural flap & medial plantar artery flap) ending with free tissue transfer. ***(Attinger et al., 2006).***

Also the role of vascular surgery is of vital importance for correcting arterial ischemia resulting from the co-existing PAD in diabetic patients. Hence, improving healing power and lowering the risk for further foot ulceration or recurrence.This may include angioplasty & vascular stenting as well as arterial bypass procedures ***(Norgren et al., 2007).***

AIM OF THE WORK

The aim of this study is to compare between different surgical options for reconstruction of soft tissue losses in the feet of diabetic patients. Highlighting the effectiveness, postoperative complications and mortality.

Chapter 1

ANATOMY OF THE FOOT

Skeletal anatomy

The skeleton of the foot from behind forward is composed of tarsal bones, metatarsal bones and phalanges. Tarsal bones include Talus, Calcaneus, Cuboid, Navicular and Cuneiform bones. **Talus** is the second largest bone of the foot situated on the upper surface of the anterior two thirds of calcaneus. Its upper surface articulates with the lower end of the tibia forming the ankle joint. **Calcaneus** is the largest bone of the foot and it forms the prominence of the heel. Its long axis is directed upwards forwards and laterally. It is roughly cuboidal and has six surfaces. **Cuboid bone** lies in front of the calcaneus and behind the fourth and fifth metatarsals. **Navicular bone** is boat shaped and situated anterior to talus and behind cuneiforms. **Cuneiforms** (medial, intermediate and lateral) are wedge shaped bones articulating anteriorly with the medial three metatarsals ***(Standring, 2008).***

Metatarsal bones are Arranged as first, second, third, fourth and fifth from medial to lateral. The first is the thickest one. The Bases of the medial 3 metatarsals articulate with the cuneiforms while the bases of the fourth and fifth ones articulate with the cuboid bone ***(Christman, 2015a).***

The phalanges include 14 bones, 3 for each toe (proximal, middle and distal) except the big toe which has only two phalanges (proximal and distal) ***(Christman, 2015b).***

Figure (1): Skeleton of the foot.

The foot has three arches: two longitudinal (medial and lateral) arches and one anterior transverse arch. They are formed by the tarsal and metatarsal bones, and supported by ligaments and tendons in the foot. Their shape allows them to act in the same way as a spring, bearing the weight of the body, absorbing the shock produced during locomotion and accommodating irregular ground surfaces. The flexibility conferred to the foot by these arches facilitates functions such as walking and running. They are categorized as longitudinal and transverse arches ***(Singh, 2014a)***.

Longitudinal arches can be divided into medial and lateral ones. The medial arch is the highest and the most important of the three foot arches. It is made up by the calcaneus, the talus, the navicular and the three cuneiforms together with the medial 3 metatarsals. Its summit is at the superior articular surface of the talus, and its two extremities, on which it rests in standing, are the tuberosity on the plantar surface of the calcaneus posteriorly and the heads of the medial three metatarsal bones anteriorly. The chief characteristic of this arch is its elasticity, due to its height and the number of small joints between its component parts. The arch is further supported by the plantar aponeurosis, the small muscles in the sole of the foot (short muscles of the big toe), the tendons of the Tibialis anterior and posterior and peroneus longus, the flexor digitorum longus, the flexor hallucis longus and the ligaments of all the articulations involved. The lateral arch is lower and flatter than the medial one and is composed of the calcaneus, the cuboid, and the lateral two metatarsals. Two strong ligaments, the long plantar and the plantar calcaneocuboid, together with the Extensor tendons and the short muscles of the little toe, preserve its integrity ***(Singh, 2014a)***.

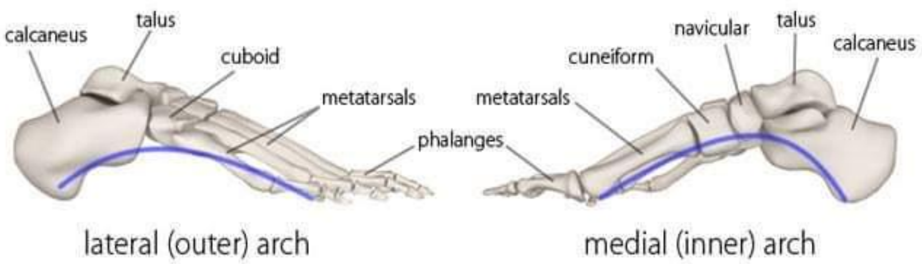

Figure (2): Longitudinal arches of the foot.

The transverse arch is located in the coronal plane of the foot and it is composed of the three cuneiforms, the cuboid, and the five metatarsal bases. The transverse arch is strengthened by the interosseous, plantar, and dorsal ligaments, the short muscles of the big and little toes (especially the transverse head of the Adductor hallucis), and the Peroneus longus muscle ***(Chummy, 2011).***

Figure (3): Arches of the foot.