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### THE ROLE OF PAPAYA DRESSINGS IN THE MANAGEMENT OF DIABETIC FOOT ULCERS: A PROSPECTIVE STUDY

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**ABSTRACT: OBJECTIVES:** To determine the role of grated papaya fruit dressings in the management of diabetic foot ulcers. **STUDY DESIGN:** In our study, all the patients with diabetic foot ulcers (n=94) were included. The initial management was control of hyperglycemia, surgical debridement, antibiotics and then wound care with the help of grated papaya dressings. In this study, dressings were changed every 24 hours. The wound was considered healthy, when it was covered with healthy granulation tissue and had epithelial growth on wound edges. **RESULTS:** In this study, results reveal that majority (83.0%) of the patients were male. Among them, surgical debridement was done for sixty three patients (67.2%) and thirty one patients (33.8%) required amputation. After the initial surgical debridement papaya dressings were needed in about 89.0%. Six patients (7%) needed further surgical debridement and four (4.0%) required amputations. Duration of healing was 17 to 28 days. Mean healing period was 21.56 days. **CONCLUSION:** Topical grated papaya dressings provide good enzymatic wound debridement. It is cost effective, reduces the duration of healing time, number of surgical debridements required and reduces the incidence of amputation.

**KEYWORDS:** Diabetic foot ulcer, Papaya dressings, Enzymatic micro-debridement, Wound healing.

**INTRODUCTION:** The incidence of diabetes mellitus (DM) is assuming epidemic proportions in the world, particularly in India. Lower extremity disease, including peripheral neuropathy, foot ulceration, peripheral arterial disease and lower extremity amputation, is twice as common in diabetic persons compared to non-diabetic persons. It affects 30 per cent of diabetic persons who are older than 40 yrs. In persons with diabetes mellitus, the annual population-based incidence of foot ulcer ranges from 1.0% to 4.1% and the prevalence ranges from 4% to 10%. This suggests that the lifetime incidence of diabetic foot ulcer may be as high as 25%.<sup>[1]</sup> Plantar ulceration often leads to amputation.<sup>[2]</sup> Diabetic foot ulcer precedes almost 85% of amputation.

Diabetic foot ulcer is characterised by a classical triad of neuropathy, ischemia, and infection. Due to the metabolic mechanisms in DM, there is an increased risk of infections and poor wound healing due to a series of mechanisms which include decreased cell and growth factor response, diminished peripheral blood flow and decreased local angiogenesis. Thus the feet is predisposed to peripheral vascular disease, damage of peripheral nerves, deformities and gangrene.<sup>[3]</sup> Loss of sensation due to peripheral neuropathy may result in painless injuries. Intrinsic foot muscle atrophy can lead to foot deformities and an abnormal distribution of weight

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while walking, producing increased plantar pressures. Autonomic neuropathy causes dry skin which can crack and arteriovenous shunting causes altered skin and bone perfusion. These factors may lead to foot deformities with disruption of the normal bony architecture and with plantar ulcers. While there are no randomized controlled trials, careful daily inspection, trimming of nails and proper footwear appear beneficial.<sup>[4]</sup> More than one third of diabetic patients were found to be at high risk for further foot ulceration.<sup>[5]</sup> Diabetic foot disease frequently leads to substantial long-term complications, imposing a huge socioeconomic burden.<sup>[6]</sup> In the management of diabetic foot early recognition of infections, control of diabetes, appropriate and effective antibiotic selection, early surgical intervention and debridement, wound washing, appropriate dressings and definitive wound closure are the key components.<sup>[7]</sup> Safe and effective debridement method for the patient with a chronic diabetic wound is yet to be elucidated. Different strategies including honey dressings, medicated dressings, povidone iodine dressings, platelet rich plasma dressings, saline dressings, vacuum dressings and papaya dressings are available in the management of diabetic foot.<sup>[8]</sup> Clinical experience strongly favors the combined therapy, such as initial surgical debridement followed by serial debridement using an enzymatic agent which is more effective for many patients with chronic, indolent, or non-healing wounds.<sup>[9]</sup>

Carica papaya is well known for its nutritional and medicinal properties throughout the world. Since ancient times the whole papaya plant (leaves, seeds, ripe and unripe fruits and juice) is used as a traditional medicine. The fruit has a large oval shape, yellowish green skin and yellow flesh. Carica papaya is widely known as a medicinal fruit.<sup>[10]</sup> Several observations point to the hypothesis that treatment with papaya preparations may help facilitate wound-healing responses.<sup>[11]</sup> Papaya has been studied from a pharmacological perspective. Green papaya is rich in two enzymes (papain and chymopapain) that have very strong digestive properties, with an ability to dissolve dead tissue and also have anti-inflammatory activity.<sup>[12]</sup> The extracts of ripe and unripe papaya fruit and seeds are active against gram-positive bacteria. Higher doses are effective against gram negative bacteria also.<sup>[13]</sup> Flavanoids, which are the naturally occurring phenolic compounds present in papaya, are the potent free radical scavengers.<sup>[14]</sup> Papaya is a good source of vitamins A, C, E, and K, as well as important minerals like calcium, potassium, magnesium, iron, copper, zinc and manganese.

**PATIENTS & METHODS:** This study was conducted in the surgical units of the department of General Surgery, Mahatma Gandhi Memorial Hospital/Kakatiya Medical College, Warangal, Telangana State, India, from July 2014 to June 2015. Patients (n=94), with diabetic foot of all grades were included. Majority of the wounds were badly infected ulcers exposing the tendons and extending deep up to bone, and with wide area of gangrene (Grade-II). Age of the patients ranged from 40 to 65 years. Patients with co-morbid conditions like peripheral arterial disease, chronic renal failure, ischemic heart disease, hepatitis and malignancy were excluded from this study. Wagner's classification of Diabetic Foot Grading was taken into account (Table 1). Initial management included empirical antibiotics, surgical wound debridement or amputation and control of glycemic levels. Further the wound care was with the help of papaya dressings, which was easily available in the premises of the institute. It is being performed in our hospital for more than three decades. Superficial layer and seeds of the papaya were removed and the flesh of the

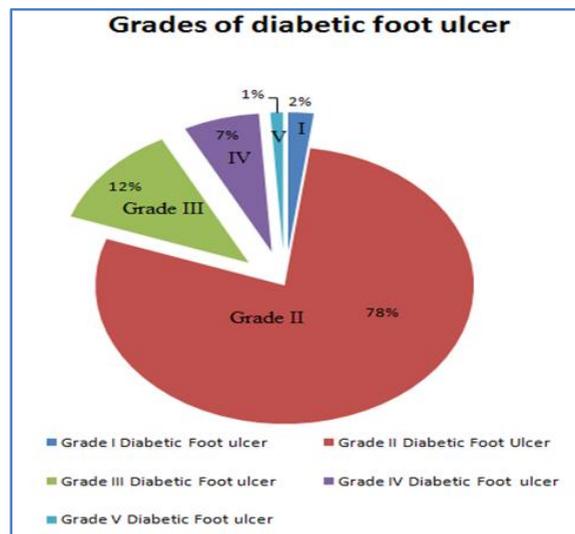
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raw fruit is grated. The grated fruit is prepared freshly every day and applied to the wounds and covered with sterile gauze pieces for dressing. We educated the patients and also the attendants for the dressing. Dressings were changed every 24 hours. The wounds were considered healthy when they were covered with healthy granulation tissue and had epithelial growth on their edges. Once the wound was healthy, grated papaya dressing was discontinued and simple saline dressing without any medication was carried out till the complete healing of the wound. Some patients with large ulcers underwent skin grafting as a part of further management.

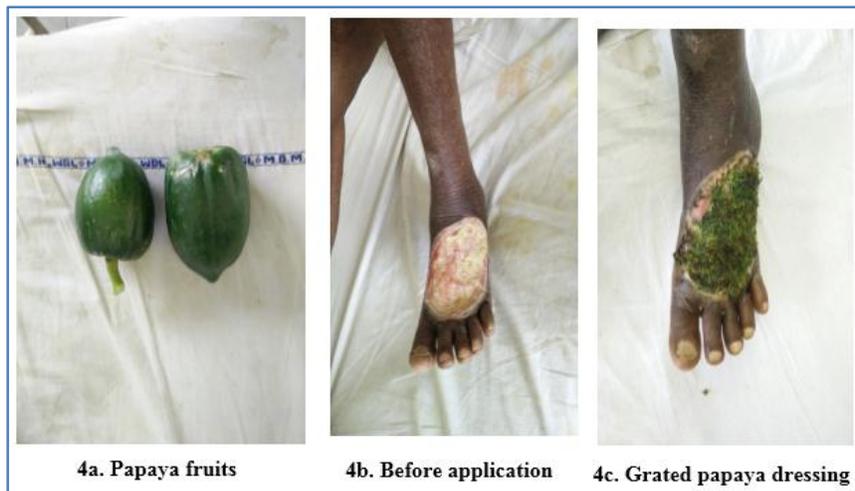
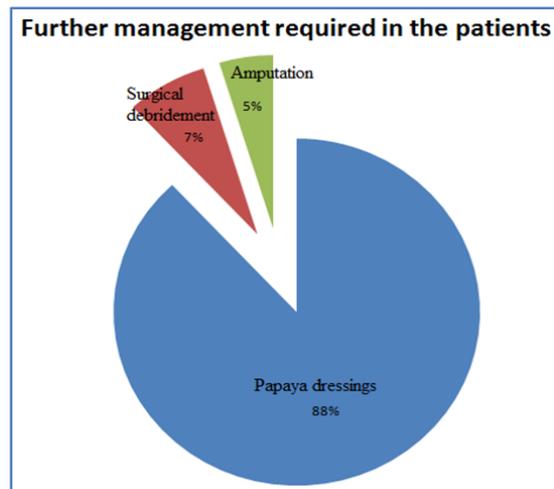
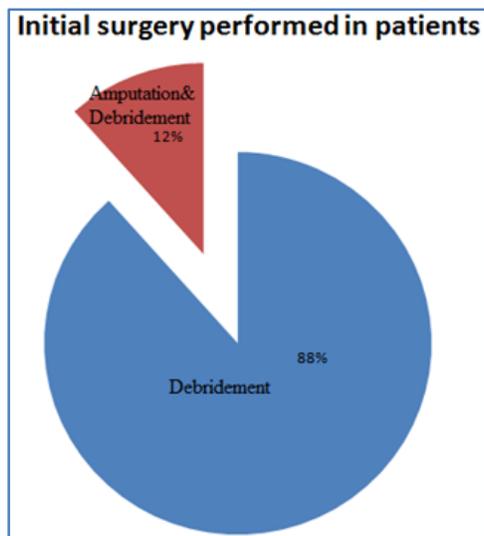
Grades	Lesions
Grade 0	Foot symptoms like pain, only
Grade 1	Superficial ulcers
Grade 2	Deep ulcers
Grade 3	Ulcer with bone involvement
Grade 4	Forefoot gangrene
Grade 5	Whole foot gangrene

**Table 1: Wagner- Maggot Classification of Diabetic Foot <sup>[15]</sup>**

**RESULTS:** Age ranged from 40 years to 65 years. Maximum number of patients was in the age group of 45 to 60 years. Majority were males (83.2%) with male to female (16.8) ratio of 5:1. 78% of patients had grade II diabetic foot (Fig. 1). In the initial surgical treatment eighty three patients (88%) required debridement and 11 patients (12%) needed amputations (Fig.2). After the initial surgical treatment, dressings were done with papaya in 74(89.0%) patients. Six patients (7%) required further surgical wound debridement and 3(4.0%) patients required amputation (Fig. 3). Before and after grated papaya application over the foot ulcers was observed that there is gradually appearance of healthy granulation tissue which is represented in Fig. 4. Healing time ranged from 17 to 28 days.



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**DISCUSSION:** The neuropathy and changes in the macro and micro vasculature contributed to the diabetic foot. The major factor was sensory neuropathy, which led to painless trauma, ulceration and infection. Macro vascular and micro vascular changes produce tissue damage and change in the skin structure that causes ulceration and infection, preventing healing. All these factors result in gangrene and ultimately leads to amputation.<sup>[16]</sup> In the present study the mean age was 52.5 years, showing that diabetic foot is most common in the 6th decade of life which is comparable with other studies.<sup>[17]</sup> The most common Grade of diabetic foot, in our study was found to be grade II which was 78.0% followed by grade III (12.1%) and grade IV (7%). In this study majority of patients (89.0%), required only single surgical debridement when compared to another study of the patients where repeated debridement was required.<sup>[18]</sup> One of the studies reported that high percentage of patients (40%) needed multiple surgical interventions like debridement & amputation.<sup>[19]</sup> The grated papaya dressings in our study significantly ( $p < 0.001$ ) reduced the risk of multiple surgical interventions and amputations. The mean healing duration of diabetic foot in our study was 21.56 days. The wound was considered healthy when covered with healthy granulation tissue and growing epithelium on their margins. The papaya dressing had shown significantly fast enzymatic debridement and fast healing. It decreased the healing time. The decreased need for subsequent surgical intervention could be ascribed to enzymatic micro-debridement effect of the papaya dressings. Many studies suggested the use of papaya for wound bed preparation because of the micro-debridement effect of its enzymes, anti-fungal and its antibacterial activity.<sup>[20,21]</sup> The wound healing was enhanced by Vitamin A, C, E and minerals like Zinc, Magnesium etc. which are present in the papaya fruit. The clinical observational support for the hypothesis that papaya dressings facilitate healing by causing vasodilation of the blood vessels around the wound.

**CONCLUSION:** The papaya fruit is easily available everywhere including the rural and urban areas. It provides favorable results in patients with diabetic foot ulcer by reducing duration of healing and surgical interventions due to the enzymatic micro-debridement; it also has wound healing property and is cost effective in the management of diabetic foot ulcer.

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