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Management and outcomes of patients with diabetic foot ulcers during the Sudan war

Mohamed Mergani Elkhair[1], Fadwa Ismail Guma Kortukala[2], Nada MohammedSalih Omer Adam[3], Rabaah ALadawya Mohammed Salih Elbasheri Gadkreem[4], Balgis Elhag Ibrahim Tager[5], Galeela Abdalgader Salem[6], Mohamed Mahgoub Hassan Khalifa[4], Adam Ahmed Ishag younis[7], Abdulrahman Mohammed Abdulrahman Abouh[1], Sara Adam Mohammed Adam[8], Marwah Abdelrahman Alasha[9], Hussain Gadelkarim Ahmed[10,11].

[1]Department of Surgery, El-Obeid Teaching Hospital, El-Obeid, NK, Sudan.

[2]Department of Histopathology and Cytology, Faculty of Medical Laboratory Sciences, University of Kordofan, El-Obeid, NK, Sudan.

[3]Department of Dermatology, El-Obeid Teaching Hospital, El-Obeid, NK, Sudan.

[4]Department of Histopathology and Cytology, Faculty of Medical Laboratory Sciences, University of Kordofan, El-Obeid, NK, Sudan.

[5]Department of Histopathology and Cytology, Faculty of Medical Laboratory Sciences, University of West Kordofan, El-Nuhood, WK, Sudan.

[6]El-Obeid Histopathology Center, NK, Sudan.

[7]El-Obeid Police Hospital, El-Obeid, NK, Sudan.

[8]El-Obeid International Hospital, El-Obeid, NK, Sudan.

[9]El-Obeid Histopathology Center, NK, Sudan.

[10]Prof Medical Research Consultancy Center, El-Obeid, NK, Sudan.

[11]Department of histopathology and cytology, FMLS, University of Khartoum, Sudan.

Abstract

Background: Diabetic foot ulcers are a serious consequence of diabetes that necessitates specialized medical and personal care. This study intended to evaluate the care and results of diabetic foot ulcer patients in Sudan. **Methodology**: This prospective descriptive analysis comprised 64 diabetic foot ulcer patients admitted to El-Obeid Teaching Hospital between May 2023 and May 2024. The study solely included diabetic foot ulcer patients. Hospital records provided demographic and clinical data. **Results:** Imputation was performed on 70.3% of patients, with 64.4% males and 35.6% females. Rays' amputation was the most common type, followed by below knee and above knee amputations, which accounted for 65.4%, 23%, and 11.5%, respectively. Plastic surgery is indicated for 23.4% of patients, including 21.6% of men and 26% of women. Amputation was the most prevalent negative consequence, accounting for 28%, followed by recurrence and persistence, accounting for 6.3% and 1.6% respectively. Out of the 18 amputated instances, 35% were men and 18.5% were women. Of the four recurrence cases, 25% were men and 75% were women. **Conclusion:** Diabetic foot ulcers are a prevalent presentation among diabetic patients in western Sudan during the 2023 war. A large percentage of patients underwent amputations.

Keywords: Diabetic, foot ulcer, Amputation, Sudan, plastic surgery

Correspondence to: Dr. Mohamed Mergani Elkhair. El-Obeid Teaching Hospital, El-Obeid, NK, Sudan. Email: merghani901@gmail.com

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Introduction

Diabetes mellitus is becoming more common, and it frequently causes substantial metabolic illness with serious consequences [1]. Type 2 diabetes (T2D) is a common condition that raises the risk of vascular, renal, and neurological problems. T2D prevention and treatment, as well as its consequences, are critical. Many advances in T2D care have

occurred in the last five years, including a better understanding of the importance of early intensive glycemic control, mental health, social determinants of health, healthy eating habits, continuous glucose monitoring, and the benefits of some drugs in preventing cardiorenal disease [2]. Despite the successful development of many antidiabetic medications in recent years, such as GLP-1 receptor agonists and SGLT-2 inhibitors, individual variability, pathogenesis diversity, and organismal resistance are gradually causing single-target drugs to fail to meet therapeutic needs. Therefore, we need to conduct more research on the pathophysiology of T2DM, identify various treatment targets, and develop new glycemic control solutions [3]. Ischemic diabetic foot ulcers are one of diabetes's most serious complications. The high amputation rate, recurrence rate, and treatment costs have imposed a significant burden on both patients and society [4]. Despite the established higher risk of cardiovascular disease in people with type 2 diabetes, the pathogenesis and effective management of diabetic foot ulcers (DFUs), a major diabetes consequence, are complex and evolving [5]. Diabetes affects 7.7% of Sudanese adults and is anticipated to rise to 10.8% by 2035 (8). Diabetes mellitus imposes a considerable burden, resulting in increased morbidity and mortality, lower life expectancy and quality of life, as well as economic losses for individuals and governments. Early detection and good treatment slow the onset and progression of problems. However, there is a scarcity of data on diabetic foot ulcer care. As a result, the current study sought to evaluate the therapy and outcomes of individuals with diabetic foot ulcers in Sudan.

Materials and Methods

This study is a prospective descriptive study that included 64 patients with diabetic foot ulcers who were admitted to El-Obeid Teaching Hospital due to diabetes complications between May 2023 and May 2024. The study only included participants who had diabetic foot ulcers. We acquired both clinical and demographic data from the hospital records.

Informed Consent

We asked each patient to sign a written ethical consent.

Results

The study included 64 diabetic foot ulcer patients aged 21 to 64 years, with a mean age of 58 years. The majority of patients were between the ages of 56 and 65 (32.8%), with 46 and 55 accounting for 30%. Of the 64 patients, 37 (58%) were men and 27 (42%) were women. Of the 64 patients, 43 (67%) lived in urban regions, while the remaining 21 (33%) lived in rural areas. Approximately 60 (93.8%) patients had type 2 diabetes. Three of the four patients with type 1 diabetes were males, and one was female, as shown in Table 1 and Figure 1.

Table 1. Distribution of patients by demographic characteristics and diabetes type.

Variable	Males	Females	Total
Age			
<45 years	5	4	9
46-55	8	11	19
56-65	14	7	21
66-75	5	2	7
75+	5	3	8
Total	37	27	64
Residence			
Rural	12	9	21
Urban	25	18	43
Total	37	27	64
Type of DM			
Type 1	3	1	4
Type 2	34	26	60
Total	37	27	64

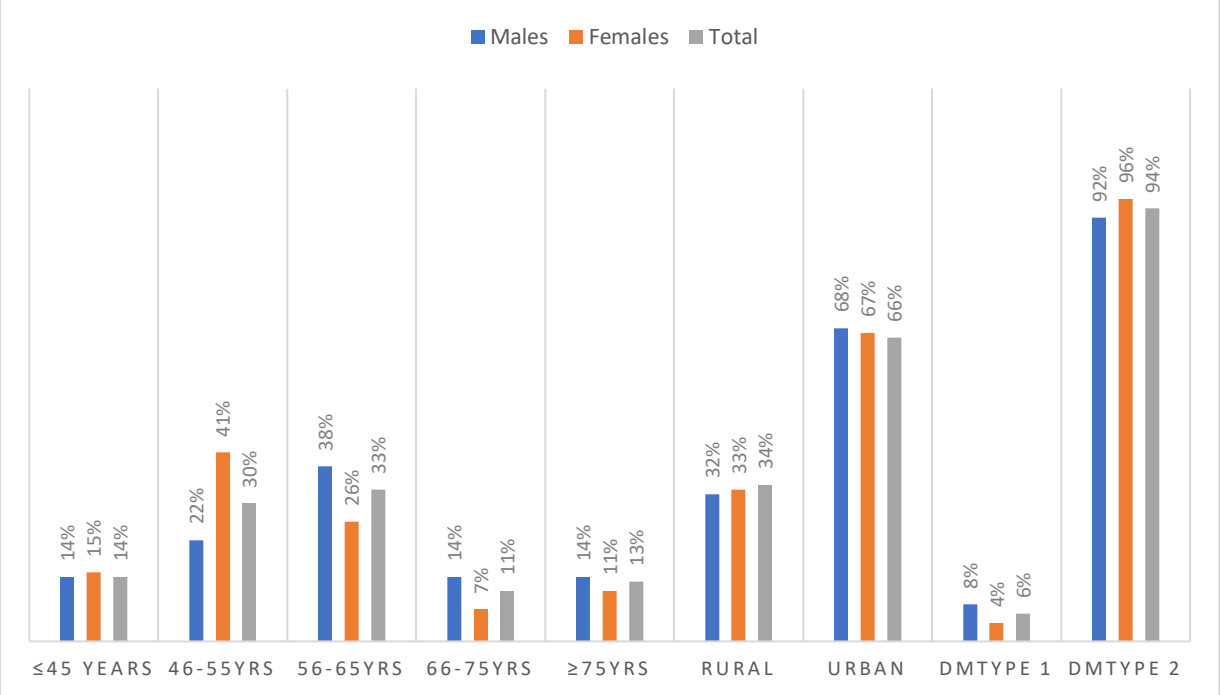

Figure 1 provides a description of the patients based on their demographic characteristics and type of diabetes.

Plain X-ray data revealed osteomyelitis in 44/64 patients (68.8%), including 29/37 (78.4%) males and 15/27 (55.6%) females. We diagnosed atherosclerosis in 26 cases, with 15/26 (58%) men and 11/26 (42%) females. Five patients (four males and one female) received a diagnosis of diabetic ketoacidosis (DK). 59 patients, comprising 33

(56%) males and 26 (44%) females, indicated the Insulin Sliding Scale (ISS). All patients had surgical debridement. All patients received a saline-soaked gauze (SSG) dressing with antibiotics. Table 2 and Figure 2 demonstrate the absence of any offloading technique.

Table 2. Patients' distribution by sex and initial management

Variable	Males n=37	Females n=27	Total n=64
Plain X-Ray			
Normal	8	12	20
Osteomyelitis	29	15	44
Duplex Scan			
Normal	21	15	36
Atherosclerosis	15	11	26
Swab for Culture and Sensitivity			
Not Done	37	27	64
Initial Management			
Management of DKA	4	1	5
Insulin Sliding Scale	33	26	59
Types of Debridement			
Surgical	37	27	64
Types of Dressing			
Saline-Soaked Gauze	37	27	64
Use of Antibiotics			
Yes	37	27	64
Offloading Techniques			
No	37	27	64

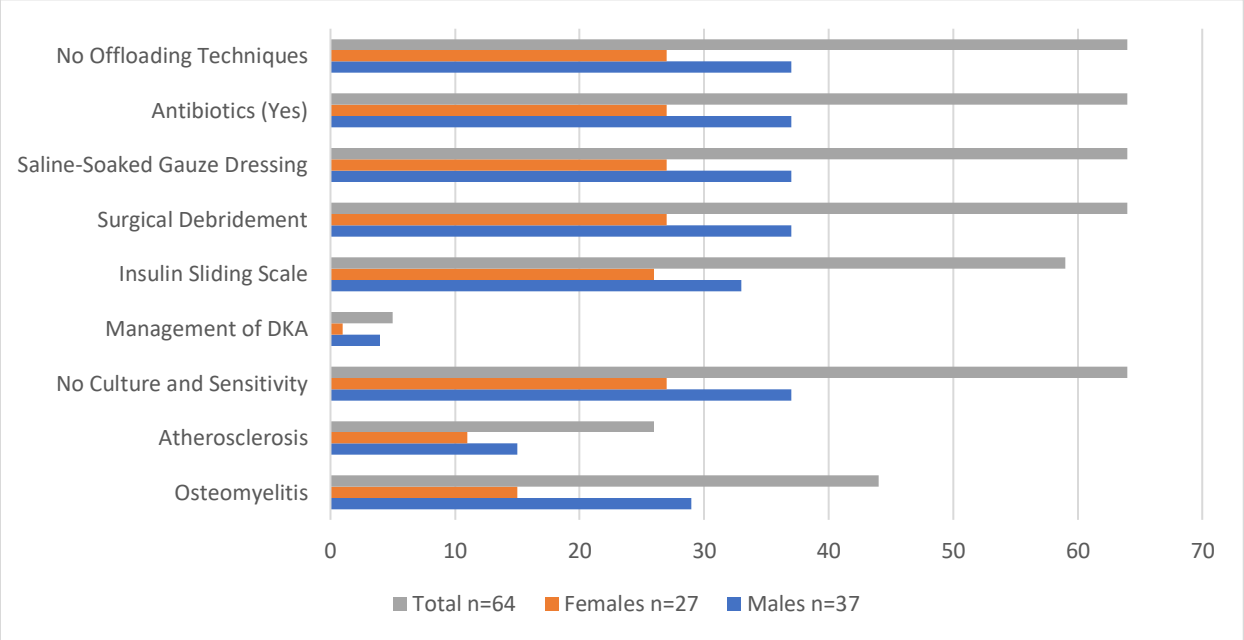

Figure 2. Description of the patients by sex and initial management

Table 3 and Figure 3 describe the patient distribution by sex, treatment, and end outcomes. Imputation was performed on 45/64 (70.3%) patients, with 29/45 (64.4%) men and 16/45 (35.6%) females. Rays' amputation was the most common type, followed by below knee and above knee amputations, which accounted for 34/52 (65.4%), 12 (23%), and 6 (11.5%), respectively. Plastic surgery was indicated for 15/64 (23.4%) patients, 8/37 (21.6%) males, and 7/27 (26% females). Amputation was the most prevalent adverse outcome, accounting for 18/64 (28%), followed by recurrence and persistance, accounting for 4 (6.3%) and 1 (1.6%), respectively. Of the 18 amputated instances, 13/37 (35%) were male and 5/27 (18.5%) were female. Of the four recurrence instances, one (25%) was male and three (75%) were females.

Table 3. Distribution of patients by sex, treatment and final outcomes

Variable	Males n=37	Females n=27	Total n=64
Amputation			
No	8	11	19
Yes	29	16	45
Type of Amputation			
No	4	8	12
Rays	21	13	34
Below Knee	7	5	12
Above Knee	5	1	6
Need for Plastic Surgery			
No	29	20	49
Yes	8	7	15
Plastic Surgery Type			
No	29	19	48
Skin Graft	8	7	15
Flap	0	1	1
Final Outcomes			
Cured	23	18	41
Persist	0	1	1
Recurrence	1	3	4
Amputation	13	5	18

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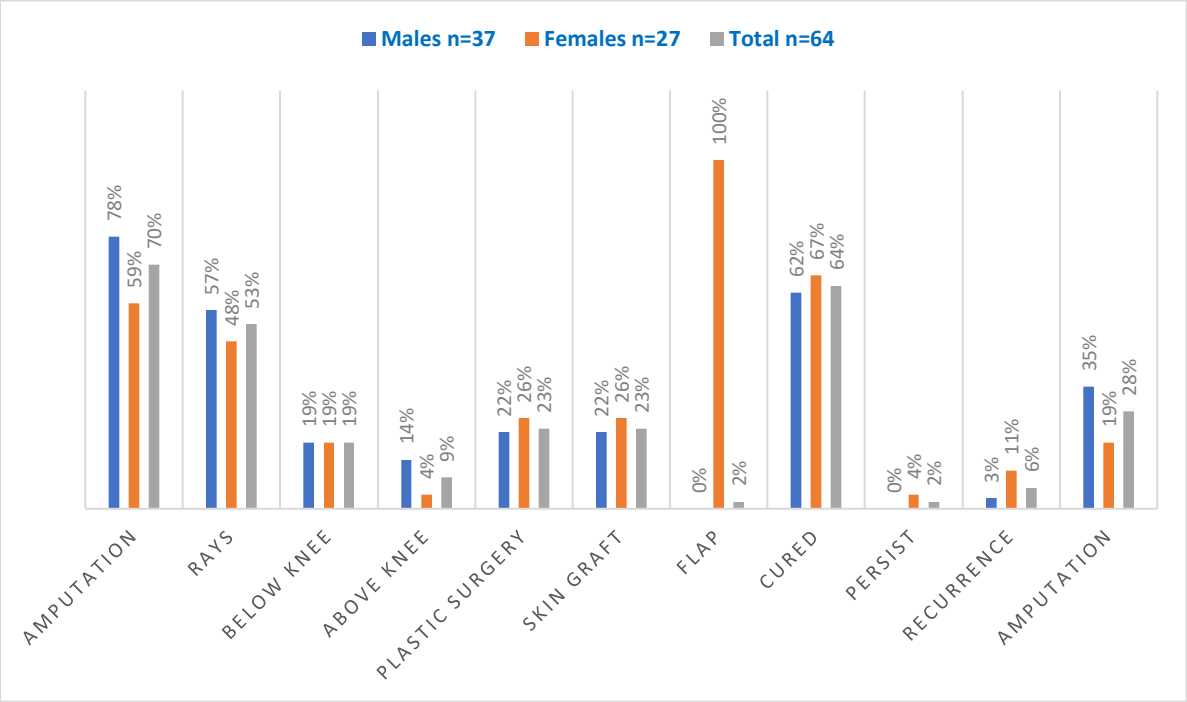

Figure 3. Description of the patients by sex, treatment, and final outcomes

Discussion

The 2023 Sudan conflict presents unforeseen obstacles in all aspects of life, including a serious disruption to the country's health-care system. Many people with chronic diseases perished as a result of a lack of health care or the inability to re-learn the location of facilities. The impact is particularly severe on individuals in the advanced stages of diabetes. Therefore, we conducted this investigation to evaluate the treatment of patients suffering from diabetic foot ulcers during the conflict. 68.8% of diabetic foot ulcer patients received an osteomyelitis diagnosis, with males making up the majority. Diabetic foot osteomyelitis (DFO) is frequently associated with lower-extremity amputations. Previous reports have reported similar findings, indicating that males are more susceptible than females. A previous study looked at 583 amputations in 344 patients (78 females and 266 males). Of the 583 incidents, 87.8% had DFO in the forefoot, 7.4% in the midfoot, and 4.8% in the hindfoot. Overall, DFO performed 84.1% of the 63 major amputations, with peripheral artery disease being the predominant indication. Overall, DFO observed limb loss in 6.1% of the forefoot, 20.9% of the midfoot, and 46.4% of the hindfoot. 41.5% underwent primary treatment, while 58.5% had previously failed minor amputations. In this latter group of secondary major amputations, the DFO was located in the forefoot (3.9%), the midfoot (0.7%), and the hindfoot (0.7%). In multivariate logistic regression analysis, initial hindfoot localization was a significant predictor (P <.05), while peripheral artery disease, smoking, and a midfoot DFO were not revealed to be risk factors. [7]. DFO can be challenging to treat, and achieving optimal clinical outcomes necessitates a multidisciplinary strategy that includes a wide range of medical, surgical, and other health care providers, as well as the patient [8]. When treating diabetic foot osteomyelitis (DFO), it is difficult to detect the existence of residual infection and determine the best course of action following bone excision. The most common infections were Staphylococcus aureus (17%) and Pseudomonas species (14%). 62% of the patients recovered gram-

negative bacteria [9]. However, all the patients in this trial received different types of antibiotics.

40.6% of the patients in the current study, 58% men and 42% women, had atherosclerosis. Peripheral arterial disease (PAD) is a risk factor for diabetic foot ulcers. PAD pathophysiology includes atherosclerosis and weakened immunity [10]. PAD is associated with a poor prognosis; patients with diabetic foot ulcers have a poor prognosis for PAD [11]. Not only does it affect a large proportion of diabetic foot ulcer patients, but it also has a poor impact on limb salvage [12]. Diabetes and peripheral arterial disease (PAD) are common in developed countries, with around 50% of the population affected. Non-healing ulcers, severe amputations, cardiovascular disease, and mortality are all associated with PAD. Researchers project a 50% 5-year mortality rate for people with diabetes, foot ulcers, and PAD [13].
In this study, Ray's amputation was the most common type of amputation, followed by below the knee amputation. A ray entails the removal of the toe and a portion of the metatarsal, leaving a stump [14].
In the current study, 35.5% of patients underwent plastic surgery. Plastic surgeons have the capacity to improve healing through soft tissue manipulation while following a reconstruction algorithm to control and salvage diabetic foot ulcers. Plastic surgeons may play an important role in limb salvage. Autologous skin grafts are one of the most popular ways that plastic surgeons offer coverage. Plastic surgeons can use the skin as complete or partial-thickness grafts, but they require a well-vascularized, bacterial-free recipient bed. Lower extremity problems remain one of the most common reasons for hospitalization in diabetes patients. An experienced plastic surgical team can perform soft tissue repair to help retain as much of the residual limb as possible. In rare circumstances, it may be possible to save the foot rather than have it amputated completely [15].
The current study's findings revealed that the majority of patients (64%) developed treated ulcers. However, 28% underwent an amputation. According to new data, total amputation rates have climbed by up to 50% in some locations in recent years, following a lengthy period of reduction, particularly among young people and racial and ethnic minorities. DFU is a common and serious consequence of diabetes. We are well aware of the road to ulceration, which includes loss of feeling, ischemia, and mild trauma [16]. Diabetes significantly increases the risk of lower-extremity amputations (LEAs), with relative risk estimates ranging from 7.4 to 41.3 in those with and without diabetes. Diabetic foot ulcers (DFUs) continue to be the most common cause of LEA, accounting for around 80% of cases and resulting in amputation in 15% [17].
In conclusion, diabetic foot ulcers are a common presentation for diabetic patients in western Sudan during the 2023 conflict. A large percentage of patients underwent amputations.

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References

1- Cloete L. Diabetes mellitus: an overview of the types, symptoms, complications and management. Nurs Stand. 2022 Jan 5;37(1):61-66. doi: 10.7748/ns.2021.e11709.
2- Crawford AL, Laiteerapong N. Type 2 Diabetes. Ann Intern Med. 2024 Jun;177(6):ITC81-ITC96. doi: 10.7326/AITC202406180.

3- Su J, Luo Y, Hu S, Tang L, Ouyang S. Advances in Research on Type 2 Diabetes Mellitus Targets and Therapeutic Agents. Int J Mol Sci. 2023 Aug 29;24(17):13381. doi: 10.3390/ijms241713381.

4- Yuan Y, Ding X, Jing Z, Lu H, Yang K, Wang Y, Xu H. Modified tibial transverse transport technique for the treatment of ischemic diabetic foot ulcer in patients with type 2 diabetes. J Orthop Translat. 2021 May 26;29:100-105. doi: 10.1016/j.jot.2021.04.006.

5- Gallagher KA, Mills JL, Armstrong DG, Conte MS, Kirsner RS, Minc SD, Plutzky J, Southerland KW, Tomic-Canic M; American Heart Association Council on Peripheral Vascular Disease; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; and Council on Lifestyle and Cardiometabolic Health. Current Status and Principles for the Treatment and Prevention of Diabetic Foot Ulcers in the Cardiovascular Patient Population: A Scientific Statement From the American Heart Association. Circulation. 2024 Jan 23;149(4):e232-e253. doi: 10.1161/CIR.0000000000000119.

6- Noor SKM, Bushara SOE AA, Sulaiman WMY, Elmadhoun and Ahmed MH. Undiagnosed diabetes mellitus in rural communities in Sudan: prevalence and risk factors. Eastern Mediterranean Health Journal 2015; 21(3):1-3.

7- Winkler E, Schöni M, Krähenbühl N, Uçkay I, Waibel FWA. Foot Osteomyelitis Location and Rates of Primary or Secondary Major Amputations in Patients With Diabetes. Foot Ankle Int. 2022 Jul;43(7):957-967. doi: 10.1177/10711007221088552.

8- Lipsky BA, Uçkay İ. Treating Diabetic Foot Osteomyelitis: A Practical State-of-the-Art Update. Medicina (Kaunas). 2021 Apr 1;57(4):339. doi: 10.3390/medicina57040339.

9- Baek YJ, Lee E, Jung J, Won SH, An CY, Kang EM, Park SY, Baek SL, Chun DI, Kim TH. Diabetic Foot Osteomyelitis Undergoing Amputation: Epidemiology and Prognostic Factors for Treatment Failure. Open Forum Infect Dis. 2024 Jul 9;11(7):ofae236. doi: 10.1093/ofid/ofae236.

10- Hammad R, Abdel Wahab MA, Farouk N, Zakaria MY, Eldosoky MA, Elmadbouly AA, Tahoun SA, Mahmoud E, Khirala SK, Mohammed AR, Emam WA, Abo Elqasem AA, Kotb FM, Abd Elghany RAE. Non-classical monocytes frequency and serum vitamin D_3 levels are linked to diabetic foot ulcer associated with peripheral artery disease. J Diabetes Investig. 2023 Oct;14(10):1192-1201. doi: 10.1111/jdi.14048.

11- Orioli L, Hammer F, Vande Berg B, Putineanu D, Maiter D, Vandeleene B. Prevalence, Characteristics, and Prognosis of Peripheral Arterial Disease in Patients With Diabetic Charcot Foot. J Foot Ankle Surg. 2021 Nov-Dec;60(6):1158-1163. doi: 10.1053/j.jfas.2021.04.021.

12- Azhar A, Basheer M, Abdelgawad MS, Roshdi H, Kamel MF. Prevalence of Peripheral Arterial Disease in Diabetic Foot Ulcer Patients and its Impact in Limb Salvage. Int J Low Extrem

Wounds. 2023 Sep;22(3):518-523. doi: 10.1177/15347346211027063.

13- Marco M, Valentina I, Daniele M, Valerio DR, Andrea P, Roberto G, Laura G, Luigi U. Peripheral Arterial Disease in Persons with Diabetic Foot Ulceration: a Current Comprehensive Overview. Curr Diabetes Rev. 2021;17(4):474-485. doi: 10.2174/1573399816999201001203111.

14- Lawrence R, Kirby RX, Ikeokwu AE. Ray Amputation in a Traumatic Diabetic Foot. Cureus. 2022 Apr 24;14(4):e24444. doi: 10.7759/cureus.24444.

15- Joon Pio (Jp) Hong, Hyunsuk Peter Suh. Role of the Plastic Surgeon in Diabetic Foot Care chapter 29. Book Editor(s):Andrew J. M. Boulton, Gerry Rayman, Dane K. Wukich. The Foot in Diabetes, Fifth Edition. First published: 24 April 2020. https://doi.org/10.1002/9781119445821.ch29

16- McDermott K, Fang M, Boulton AJM, Selvin E, Hicks CW. Etiology, Epidemiology, and Disparities in the Burden of Diabetic Foot Ulcers. Diabetes Care. 2023 Jan 1;46(1):209-221. doi: 10.2337/dci22-0043.

17- Boyko EJ, Zelnick LR, Braffett BH, Pop-Busui R, Cowie CC, Lorenzi GM, Gubitosi-Klug R, Zinman B, de Boer IH. Risk of Foot Ulcer and Lower-Extremity Amputation Among Participants in the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study. Diabetes Care. 2022 Feb 1;45(2):357-364. doi: 10.2337/dc21-1816.