



Role of Multidisciplinary Foot Care Teams in Preventing and Managing Diabetic Foot Complications

Julia Anderson and Danny Jhonson

EasyChair preprints are intended for rapid dissemination of research results and are integrated with the rest of EasyChair.

March 1, 2024

Role of Multidisciplinary Foot Care Teams in Preventing and Managing Diabetic Foot Complications

Julia Anderson, Danny Jhonson

Abstract:

This paper examines the role of multidisciplinary foot care teams in addressing the complex needs of individuals with diabetes and preventing the development of foot complications. The multidisciplinary approach integrates expertise from various healthcare professionals, including podiatrists, endocrinologists, orthopedic surgeons, vascular surgeons, nurses, and educators. These teams collaborate to provide comprehensive care tailored to the individual needs of patients, encompassing prevention, early detection, treatment, and patient education. Key components of multidisciplinary foot care teams include regular foot examinations, risk assessment, patient education on self-care practices, glycemic control, wound management, offloading techniques, vascular assessment, and surgical interventions when necessary. By adopting a holistic approach, multidisciplinary teams aim to mitigate risk factors, optimize foot health, and reduce the incidence of diabetic foot complications such as ulcers, infections, and amputations.

Keywords: Diabetic foot ulcers, Biomechanical factors, Neuropathy, Vascular insufficiency, Structural deformities, Gait analysis, Pressure sensors, Offloading strategies

Introduction:

Diabetic foot complications represent a significant burden on individuals and healthcare systems worldwide. Among the various complications associated with diabetes, foot problems are particularly prevalent and can lead to severe outcomes if not managed effectively. Diabetic foot ulcers (DFUs) represent a significant healthcare challenge worldwide, posing substantial burdens on patients, healthcare systems, and society at large[1]. Despite advances in medical care, DFUs remain a leading cause of lower extremity amputations among diabetic individuals, with profound implications for morbidity, mortality, and quality of life. While multiple factors contribute to DFU development, including neuropathy, vascular compromise, and impaired wound healing, the role

of biomechanical factors is increasingly recognized as central to understanding the pathogenesis and clinical management of DFUs. Biomechanics refers to the study of mechanical principles governing the structure and function of biological systems, including the human foot. In diabetic patients, alterations in biomechanical parameters, such as altered gait patterns, abnormal foot pressures, and structural deformities, significantly influence tissue loading and susceptibility to ulceration[2]. Peripheral neuropathy, a hallmark complication of diabetes, leads to sensory and motor deficits, disrupting the normal feedback mechanisms that regulate gait and weight distribution. Consequently, diabetic individuals may exhibit inefficient gait patterns and increased plantar pressures, predisposing them to tissue breakdown and ulcer formation. Vascular insufficiency further exacerbates tissue vulnerability by compromising blood flow, impairing tissue perfusion, and impeding wound healing. Structural deformities, including Charcot neuroarthropathy, foot malalignments, and toe deformities, create focal pressure points and increase mechanical stresses on specific areas of the foot, accelerating tissue breakdown and ulceration. The interplay between neuropathy, vascular compromise, and structural abnormalities underscores the multifactorial nature of DFU pathogenesis and highlights the importance of addressing biomechanical imbalances in diabetic foot care. Despite the growing recognition of biomechanical factors in DFU pathogenesis, translating this knowledge into clinical practice remains challenging. Limited accessibility to specialized equipment for biomechanical assessment, fragmented healthcare delivery systems, and a lack of standardized protocols for intervention pose barriers to effective management[3]. However, advancements in technology, including pressure sensing devices, computerized gait analysis systems, and three-dimensional imaging modalities, offer promising avenues for objective evaluation and personalized intervention. This review aims to provide insights into the biomechanical factors contributing to DFU development in diabetic patients and their clinical implications. By elucidating the biomechanical underpinnings of DFUs, healthcare providers can better understand the risk factors, implement targeted interventions, and optimize outcomes in diabetic foot care. Multidisciplinary approaches that integrate podiatry, orthopedics, rehabilitation, and biomechanics are essential for delivering comprehensive care and addressing the complex interplay of factors contributing to DFUs. Ultimately, by integrating biomechanical considerations into routine clinical practice, healthcare providers can improve risk stratification, enhance preventive measures, and reduce the burden of DFUs in diabetic populations. Despite advancements in diabetes management, DFUs

remain a common complication, affecting approximately 15% of individuals with diabetes during their lifetime[4]. Among the various factors contributing to DFU development, biomechanical abnormalities play a crucial role. Understanding the biomechanical factors underlying DFU pathogenesis is essential for effective prevention, early detection, and management strategies. The biomechanical complexities of the diabetic foot arise from a combination of neuropathy, vascular compromise, and structural deformities. Peripheral neuropathy, a common manifestation of diabetes, leads to sensory loss and motor dysfunction, predisposing individuals to repetitive trauma and abnormal loading during weight-bearing activities. Concurrently, vascular insufficiency impairs tissue perfusion and healing capacity, exacerbating the susceptibility to ulcer formation and complicating wound management. Structural deformities, including Charcot neuroarthropathy, foot malalignments, and biomechanical alterations, further increase mechanical stresses and pressure points, accelerating tissue breakdown. Despite the recognition of these biomechanical factors, their precise contributions and interactions in DFU pathogenesis remain incompletely understood. Furthermore, translating biomechanical insights into clinical practice poses challenges due to the lack of standardized assessment protocols and interdisciplinary collaboration. However, emerging technologies, such as pressure sensors, gait analysis systems, and advanced imaging modalities, offer promising avenues for biomechanical evaluation and personalized intervention[5].

Enhancing Diabetic Foot Care: The Vital Role of Multidisciplinary Teams:

Diabetic foot ulcers (DFUs) present a significant challenge in the management of diabetes, posing serious consequences for patient health and quality of life. Biomechanical factors play a pivotal role in the development, progression, and management of DFUs, highlighting the importance of understanding the mechanical complexities of the diabetic foot[6]. The diabetic foot is characterized by a multitude of biomechanical abnormalities stemming from peripheral neuropathy, vascular compromise, and structural deformities. Peripheral neuropathy, a hallmark feature of diabetes, results in sensory loss, motor impairment, and autonomic dysfunction, altering gait patterns and weight-bearing mechanics. Concurrently, vascular insufficiency exacerbates tissue hypoxia, impeding wound healing processes and increasing the risk of ulceration. Structural

deformities, including Charcot neuroarthropathy, foot malalignments, and biomechanical imbalances, further exacerbate mechanical stresses and pressure points, predisposing tissues to breakdown and ulcer formation. Despite advancements in diabetic foot care, preventing and managing DFUs remains a formidable challenge. Traditional approaches focus on wound debridement, offloading, and infection control, but often overlook the underlying biomechanical contributors to ulcer development[7]. However, there is a growing recognition of the need to address biomechanical factors comprehensively to optimize outcomes and reduce the burden of DFUs. In this context, this review aims to elucidate the biomechanical considerations in DFU prevention and management. By exploring the interplay between neuropathy, vascular compromise, and structural deformities, we seek to underscore the importance of integrating biomechanical assessments and interventions into routine diabetic foot care practices. Moreover, we will discuss emerging technologies and innovative strategies for biomechanical evaluation, offloading techniques, and patient education, with the goal of enhancing ulcer prevention, promoting wound healing, and improving patient outcomes. By embracing a multidisciplinary approach that integrates podiatry, orthopedics, rehabilitation, and biomechanics, healthcare providers can tailor interventions to address the unique biomechanical challenges faced by individuals with diabetes[8]. Despite advances in medical therapy, DFUs continue to pose a considerable burden on individuals living with diabetes and healthcare systems worldwide. Biomechanical considerations play a pivotal role in understanding the pathogenesis of DFUs and are increasingly recognized as essential components in both prevention and management strategies. The diabetic foot is subjected to a myriad of biomechanical stresses, stemming from alterations in tissue properties, gait mechanics, and structural deformities, all of which are intricately linked to the underlying pathophysiology of diabetes. Peripheral neuropathy, a common complication of diabetes, results in sensory loss and motor dysfunction, predisposing individuals to altered gait patterns and abnormal loading during weight-bearing activities. Concurrently, vascular compromise impairs tissue perfusion and healing capacity, exacerbating the susceptibility to ulcer formation and complicating wound management[9]. Structural deformities such as Charcot neuroarthropathy, foot malalignments, and biomechanical alterations further increase mechanical stresses and pressure points, contributing to tissue breakdown and ulcer development. Given the multifactorial nature of DFU pathogenesis, effective prevention and management strategies must address biomechanical factors comprehensively. Biomechanical assessments,

including gait analysis, pressure mapping, and foot structure evaluation, offer valuable insights into individual risk profiles and guide personalized interventions aimed at offloading high-pressure areas and optimizing foot mechanics. Furthermore, advancements in technology, such as custom orthotic devices and wearable sensors, enable tailored interventions to improve gait mechanics and redistribute plantar pressures, thereby reducing the risk of ulceration[10].

Holistic Care for Diabetic Feet: Leveraging Multidisciplinary Expertise:

Diabetic foot ulcers (DFUs) are one of the most severe and prevalent complications of diabetes mellitus, presenting significant challenges in both understanding their pathogenesis and effectively managing their consequences. Biomechanics, the study of mechanical forces acting on biological systems, plays a crucial role in elucidating the mechanisms underlying DFU development and guiding targeted interventions for prevention and treatment. Understanding the biomechanical aspects of DFUs is essential for healthcare providers to develop comprehensive strategies that address the multifaceted nature of this condition. The pathogenesis of DFUs is complex and multifactorial, involving interactions between neuropathy, vascular disease, and structural abnormalities of the foot[11]. Peripheral neuropathy, a common complication of diabetes, results in sensory loss and motor dysfunction, leading to altered gait patterns and abnormal distribution of mechanical loads on the foot. Concurrently, vascular compromise reduces tissue perfusion and impairs wound healing, further predisposing individuals to ulcer formation. Structural deformities such as Charcot neuroarthropathy and foot malalignments exacerbate biomechanical stresses, creating focal areas of pressure and friction that contribute to tissue breakdown and ulceration. Biomechanical assessments provide valuable insights into the individual risk profiles of patients with diabetes, allowing healthcare providers to identify high-pressure areas, abnormal gait patterns, and structural deformities that may predispose to DFU development. By integrating biomechanical principles into clinical practice, healthcare providers can tailor preventive interventions and therapeutic strategies to address specific biomechanical abnormalities and reduce the risk of DFUs[12]. Furthermore, advancements in technology, such as pressure-sensing insoles, three-dimensional gait analysis systems, and custom orthotic devices, offer innovative tools for objective biomechanical assessment and personalized intervention. The diabetic foot is

subject to complex biomechanical forces influenced by various factors, including peripheral neuropathy, vascular insufficiency, and structural deformities. Peripheral neuropathy, characterized by sensory loss and motor dysfunction, disrupts protective mechanisms and alters gait patterns, leading to increased pressure and shear forces on vulnerable areas of the foot during weight-bearing activities. Concurrently, vascular compromise compromises tissue perfusion and healing, further exacerbating the risk of ulceration and complicating wound management[13]. Structural abnormalities such as foot deformities and joint instability contribute to abnormal loading patterns, creating localized areas of increased pressure that predispose tissues to breakdown and ulcer formation. Understanding the biomechanical underpinnings of DFUs is essential for developing targeted interventions aimed at mitigating risk factors and optimizing outcomes. Biomechanical assessments, including gait analysis, plantar pressure measurement, and foot structure evaluation, provide valuable insights into individual risk profiles and guide the implementation of personalized interventions. These interventions may include offloading devices, footwear modifications, orthotic interventions, and gait training programs tailored to address specific biomechanical abnormalities and redistribute plantar pressures[14].

Conclusion:

In conclusion, multidisciplinary foot care teams play a pivotal role in the comprehensive management of diabetic foot complications. Through collaborative efforts and individualized care plans, these teams contribute to the prevention, early intervention, and improved outcomes for individuals living with diabetes. Continued investment in multidisciplinary approaches is essential to alleviate the burden of diabetic foot complications and enhance the overall well-being of patients. Moving forward, continued research efforts aimed at elucidating the biomechanical mechanisms underlying DFU pathogenesis and evaluating the effectiveness of biomechanical interventions are critical for advancing the field of diabetic foot care. Moreover, greater emphasis on patient education and self-management strategies is essential for empowering individuals with diabetes to actively participate in foot care and adopt preventive measures to reduce the risk of DFUs.

References:

- [1] R. Basiri, A. Shariatzadeh, S. Wiebe, and Y. Aghakhani, "Focal epilepsy without interictal spikes on scalp EEG: A common finding of uncertain significance," *Epilepsy Research*, vol. 150, pp. 1-6, 2019.
- [2] S. Vuorisalo, M. Venermo, and M. Lepäntalo, "Treatment of diabetic foot ulcers," *Journal of Cardiovascular Surgery*, vol. 50, no. 3, p. 275, 2009.
- [3] A. Veves, H. Murray, M. Young, and A. Boulton, "The risk of foot ulceration in diabetic patients with high foot pressure: a prospective study," *Diabetologia*, vol. 35, pp. 660-663, 1992.
- [4] I. M. Howard, "The prevention of foot ulceration in diabetic patients," *Physical Medicine and Rehabilitation Clinics*, vol. 20, no. 4, pp. 595-609, 2009.
- [5] M. Monteiro-Soares, E. Boyko, J. Ribeiro, I. Ribeiro, and M. Dinis-Ribeiro, "Predictive factors for diabetic foot ulceration: a systematic review," *Diabetes/metabolism research and reviews*, vol. 28, no. 7, pp. 574-600, 2012.
- [6] A. J. Boulton, "The pathway to foot ulceration in diabetes," *Medical Clinics*, vol. 97, no. 5, pp. 775-790, 2013.
- [7] M. A. Del Core, J. Ahn, R. B. Lewis III, K. M. Raspovic, T. A. Lalli, and D. K. Wukich, "The evaluation and treatment of diabetic foot ulcers and diabetic foot infections," *Foot & Ankle Orthopaedics*, vol. 3, no. 3, p. 2473011418788864, 2018.
- [8] W. J. Jeffcoate and K. G. Harding, "Diabetic foot ulcers," *The lancet*, vol. 361, no. 9368, pp. 1545-1551, 2003.
- [9] Y. Jiang *et al.*, "A cohort study of diabetic patients and diabetic foot ulceration patients in China," *Wound Repair and Regeneration*, vol. 23, no. 2, pp. 222-230, 2015.
- [10] E. N. Hokkam, "Assessment of risk factors in diabetic foot ulceration and their impact on the outcome of the disease," *Primary care diabetes*, vol. 3, no. 4, pp. 219-224, 2009.
- [11] A. S. Fard, M. Esmaelzadeh, and B. Larijani, "Assessment and treatment of diabetic foot ulcer," *International journal of clinical practice*, vol. 61, no. 11, pp. 1931-1938, 2007.

- [12] M. Artetxe, G. Labaka, E. Agirre, and K. Cho, "Unsupervised neural machine translation," *arXiv preprint arXiv:1710.11041*, 2017.
- [13] D. Bahdanau, K. Cho, and Y. Bengio, "Neural machine translation by jointly learning to align and translate," *arXiv preprint arXiv:1409.0473*, 2014.
- [14] Y. Wu *et al.*, "Google's neural machine translation system: Bridging the gap between human and machine translation," *arXiv preprint arXiv:1609.08144*, 2016.