

# Thermography and Diabetic Neuropathy: A Clinical Perspective

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Contributions: AI-Assisted Research Compilation

## Abstract

Diabetic peripheral neuropathy is a progressive and widespread complication of diabetes mellitus, impacting millions of individuals globally. It manifests with varying degrees of sensory loss, pain, and risk of infection, often culminating in foot ulcers and, in severe cases, limb amputations. Thermography—a non-invasive infrared imaging technique—has emerged as a promising modality to aid in the detection and monitoring of neuropathic changes, particularly in the feet. This paper consolidates clinical evidence supporting the use of thermography to visualize changes in microvascular circulation and skin surface temperatures, both of which are disrupted in early neuropathic development. Unlike traditional tests that require subjective feedback or specialized equipment, thermography offers a rapid, painless, and visually intuitive map of potential dysfunction. Its ability to identify subtle asymmetries or abnormal heating patterns in the extremities makes it particularly suitable for screening at-risk populations. Integrating thermography into diabetic care pathways, in conjunction with conventional assessments, has the potential to significantly improve early detection and patient outcomes.

## Introduction

Diabetic neuropathy is a complex and multifaceted disorder that arises due to prolonged exposure to elevated blood glucose levels, leading to metabolic and vascular damage to the peripheral nervous system. Among the most prevalent types is distal symmetric polyneuropathy, which typically begins in the feet and progresses proximally. Early signs may be subtle—occasional tingling, numbness, or burning sensations—but these can escalate to profound sensory loss and motor deficits. Importantly, this loss of protective sensation greatly increases the risk for foot trauma, ulcer formation, and eventual amputation. The socioeconomic burden of diabetic foot complications is substantial, often involving frequent hospitalizations and long-term rehabilitation. There is a growing consensus that early detection, combined with ongoing monitoring, is critical to mitigating these outcomes. Therefore, the development and implementation of objective, easy-to-use diagnostic tools—such as thermography—are vital to improving the standard of care for diabetic patients worldwide.

## Methodology

This research synthesis draws upon an extensive review of clinical studies, systematic reviews, and relevant case reports sourced from internationally recognized databases, including PubMed, ScienceDirect, and SpringerLink. Studies included in this review span the last two decades and focus specifically on the application of infrared thermography in detecting changes associated with diabetic peripheral neuropathy. Keywords utilized during

the search phase included 'diabetic neuropathy', 'infrared thermography', 'temperature asymmetry', 'diabetic foot screening', and 'non-invasive diagnostics'. To ensure clinical relevance, priority was given to peer-reviewed publications that compared thermographic findings to traditional diagnostics like monofilament testing, nerve conduction studies, or clinical scoring systems such as the Michigan Neuropathy Screening Instrument. This approach provided a balanced view of thermography's strengths and limitations while highlighting real-world applications.

#### Discussion: Clinical Effectiveness of Thermography

Infrared thermography offers a distinct advantage in that it translates physiological dysfunction into visible heat patterns on the body's surface. In diabetic neuropathy, the autonomic nerves controlling skin blood flow and sweat gland function are often impaired. This dysfunction leads to changes in skin temperature that are not always perceptible by touch but are detectable via thermal imaging. Numerous studies have shown that areas of increased temperature may signal inflammation or pre-ulcerative changes, while cooler areas may reflect vascular insufficiency or ischemic risk. An especially noteworthy thermographic marker is interdigital temperature asymmetry: when a difference greater than 0.4°C is observed between adjacent toes, it often correlates with early neuropathic or microvascular compromise. When integrated into clinical workflows, thermography can assist clinicians in identifying at-risk feet before tissue breakdown occurs. It also provides an excellent modality for longitudinal monitoring of patients undergoing treatment or lifestyle modification, allowing changes in temperature regulation to be objectively tracked over time.

#### Conclusion

Thermography stands at the intersection of clinical insight and technological innovation, offering a non-invasive, highly visual, and efficient method for enhancing diabetic neuropathy care. Its application in detecting early microvascular and autonomic abnormalities—often before structural damage manifests—represents a significant leap forward in proactive medicine. Though it should not replace established diagnostics, its integration as a complementary tool holds promise for refining risk stratification and guiding preventive interventions. As with any diagnostic technology, its effectiveness hinges on proper training, standardization, and contextual interpretation. With further validation and broader accessibility, thermography could play a critical role in transforming diabetic foot care from reactive treatment to proactive preservation.

#### References

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