Temperature Variations in Plantar Angiosomes are Quantitatively Estimated: A Review

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preparation goes as follows:

Patients are asked to take o their shoes and socks and wipe their feet with a damp cloth. e patient is then placed in the supine position on the examination bed, while the medical professional collects certain data such as name, age, gender, height, and weight and body temperature. A er the rst 15 to 20 minutes of stabilization, an infrared blocker is placed on the patient's leg to prevent external thermal radiation from appearing on the heat chart. e temperature of the insulated foot with the corresponding color chart and temperature scale is obtained using a heat chart. e sensor of a thermal camera is an infrared detector that absorbs infrared energy emitted by an object and converts it into an electrical signal. IR is a technology that uses the law of black body radiation proposed by Max Plank, which states that any object with a temperature above absolute zero emits electromagnetic radiation, also known as infrared radiation or thermal radiation. Later, Hardy proposed that human skin could be thought of as a blackbody radiator, opening the way for the use of IR in medicine. erefore, when the skin surface changes, the emitted thermal radiation will be captured by the infrared sensor and converted into a temperature graph. Each pixel in the heatmap has a speci c temperature value, and the contrast of the image is derived from the di erence in skin surface temperature [10]. In this study, heat histograms were able to represent color and were captured with a FLIR A300 IR camera with a thermal sensitivity of 0.05 at 30°C.

Temperature

e importance of this process is that, in the original image, it is di cult to determine the beginning or end of a color due to the large number of colors. e proposed classi cation process provides an estimate of the number of pixels for each temperature class. Each time a pixel is classi ed as belonging to a class, the counter associated with this class is incremented. Since only the area of the foot is suitable for analysis, the remaining temperatures are considered as background and they are not taken into account in the measurement. So the layers must cover the total surface area of the foot. In this way, the foot is outside the bottom, as can be observed, where the bottom is uniform and the regions are well de ned in their respective layers. In this case, the whole foot was taken as an example and to give a better view of the classi cation process. For convenience, in this method, the pixel classi cation is as follows. A er the feet were separated into their respective images, they were further divided into four subsections, one on each angiosome. Looking at the original image of the MPA angiosome of the le foot, it can be assumed that the color corresponds to the layer with the largest area. However, it is di cult to clearly establish the boundaries between color regions due to the similarity between some colors. A visual comparison between the MPA angiosomes of the two feet could be even more complicated; therefore, it is important to go beyond visual perception and to make quantitative comparisons of temperature distributions. A er pixel classi cation is done, it is possible to clearly observe the area covering a certain temperature associated with a layer.

Discussion

Although there are a considerable number of scienti c reports on temperature analysis in diabetic feet, most of them are based on qualitative analysis. However, it is not always easy to estimate anomalous temperature deviations by visual inspection of the heat chart. e goal of the proposed approach is to provide accurate information about these di erences by facilitating the detection of regions at risk and their evolution for the medical professional. While not all areas with abnormal temperatures develop sores, monitoring them is important because they are high-risk areas. It is important to note that this method is not a diagnostic tool but rather a tool that provides additional information for evaluation by the medical professional to facilitate early detection of ulcer risk.

Conclusion

ermal imaging and image analysis are useful tools in the eld of medicine applied to the study of diseases such as diabetes. e temperature distribution in the soles contains relevant information about the condition of the diabetic foot and the risk of ulcers. In this work, a method was presented that provides quantitative information on anomalous temperature di erences in symmetric regions between the foot and within the same foot. is method took into account the di erence in temperature, their distribution and area. In the rst analysis, the di erence between the symmetrical regions of the two feet was investigated because it was known that the symmetrical regions of the body had similar temperatures. For this, the vegetative zone is divided into four main zones, and the temperatures within these zones are grouped into classes according to the criterion of color similarity. An index based on the relationship between the largest surface layer and its adjacent layers has been proposed to estimate representative temperatures for each angiosome. erefore, it is possible to obtain an estimated di erence between the symmetry regions to obtain an accurate measurement to determine whether there is an outlier di erence. A second analysis was performed to study the temperature inside the angiosomes to detect the presence of unusually small areas. For this reason, he proposed a representative temperature-related hotspot estimator of the angiosome with the highest temperature. is estimator can detect the presence of anomalous regions in the initial phase which, for their small surface, are not detected by the estimator. In this way, it is possible to analyze the entire soleus area providing quantitative information to determine the presence of areas at risk of