Implementation of a Remote Temperature Monitor for the Prevention of Diabetic Foot Ulcers
A Case Series of Two Patients

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Introduction

Diabetic Foot Ulcers (DFU) are known to be associated with increased morbidity, mortality, and healthcare resource utilization. Monitoring plantar foot temperature has previously been demonstrated effective for preventing DFU when used to prompt timely, non-invasive interventions. An in-home, telemedicine, thermometric mat (the Podimetrics system) has recently been studied as part of a multi-center cohort trial to assess its usability and accuracy in predicting plantar DFU [15]. We are implementing this system in a veteran population as a tool for primary and secondary DFU prevention.

Methods

Through October 1, 2016, we have issued the Podimetrics system to 98 veterans at our clinic and have collected nearly 10 year-patients of thermometric data. Veterans were instructed to use the device daily, which requires that the patient stand on it for approximately 20 seconds while it completes a non-invasive thermometric scan of the feet.

Consistent with previous research [12-14], we considered temperature differences between six contralaterally-matched locations on the left and right plantar foot surfaces: the hallux, first, third, and fifth metatarsal heads, arch, and heel. If the temperature difference at one or more location exceeds 2.2 degrees Celsius (4 degrees Fahrenheit) over two or more consecutive scans, the veteran is deemed to have a “hotspot” and is instructed to reduce step-count by 50% for a week. In response to a hotspot and at the discretion of the clinician, a patient may also be referred to schedule an appointment for foot examination.

We present a case series consisting of the two patients who as of October 1, 2016 have most recently presented with hotspots. Each has history of diabetes mellitus, neuropathy, and recently-healed DFU.

Case 1

Patient 1 is a 64 year old male with history of diabetes mellitus and elevated HbA1c (8.6% at last reading). The patient has absent protective sensation diagnosed via Semmes Weinstein monofilament exam (0/10 bilaterally). The patient has history of left foot Charcot arthropathy involving the mid and distal tarsal bones as well as the area of tarsometatarsal joints for which he has been prescribed custom Charcot shoes.

The patient presented approximately 5 weeks prior to receiving the Podimetrics system with bilateral xerotic skin and severe, diffuse hyperkeratosis with hemosiderin deposits bilaterally at the sub-hallux and at the left 3rd distal tip. Upon debridement of the right sub-hallux, a DFU measuring 0.3 x 0.3 x 0.1 cm was discovered. The wound was absent of drainage and malodor.

The patient was examined again on 4 days before receiving the Podimetrics system and was noted to have hyperkeratosis at the left medial plantar hallux, right medial plantar hallux, and left sub 3rd metatarsal head. The patient’s wound was found to be epithelialized and he was issued the Podimetrics system. The patient has exhibited excellent adherence in the daily use of the mat, averaging 6.4 uses/week over three weeks.

Case 2

Patient 2 is a 71 year old diabetic male with elevated HbA1c (7.1% at last reading) and was noted to have a hotspot at the sub 3rd metatarsal head. The patient’s peak temperature difference was 2.8 degrees Celsius. The veteran was notified and instructed to reduce step count, to continue using the mat daily, and to make an appointment for a foot exam. He reported he was unaware of any emergent changes in his feet. The patient’s next scheduled appointment was more than two months later, but the hotspot prompted an interim clinical visit 12 days later. Diffuse hyperkeratosis was noted during examination. Upon debridement, a superficial wound with thick hyperkeratotic covering measuring 0.2 cm x 0.3 cm was identified; it was absent of malodor and drainage. The wound was dressed with Betadine.

Almost two weeks after receiving the mat, the patient was found to have a hotspot at the hallux. The patient’s peak temperature difference was 2.8 degrees Celsius. The veteran was notified and instructed to reduce step count, to continue using the mat daily, and to make an appointment for a foot exam. He reported he was unaware of any emergent changes in his feet. The patient’s next scheduled appointment was more than two months later, but the hotspot prompted an interim clinical visit 12 days later. Diffuse hyperkeratosis was noted during examination. Upon debridement, a superficial wound with thick hyperkeratotic covering measuring 0.2 cm x 0.3 cm was identified; it was absent of malodor and drainage. The wound was dressed with Betadine.

Figure 1 (a) thermogram from Patient 1 on day 12 showing elevated right medial forefoot temperature extending through hallux (b) thermogram on day 22 after patient was asked to reduce step count (c) image of hallux DFU post debridement on day 24 (d) time progression of temperature asymmetry at hallux

Conclusions

Two patients with hotspots have been described. Use of the Podimetrics system enabled timely and inexpensive treatment of DFU that otherwise would not have been identified as early under standard preventative care. Early detection may have the potential to limit further tissue damage as well as minimize the risk of infection. Continued implementation of the system may have a significant impact on DFU-related morbidity, mortality, and resource utilization.

These innovations in remote plantar temperature monitoring illustrate an important transfer in diabetic foot care from subjective to objective evaluation of the high-risk patient. They demonstrate clinical value and a large potential to help in reducing the patient and economic burden of diabetic foot ulcerations.

References


The patient was issued the Podimetrics mat to monitor his closed wound for signs of inflammation. Over the three months the patient has had the mat, he has averaged 4.0 uses/week.

Five weeks later, the patient was found to have a hotspot with a peak temperature difference of 3.4 degrees Celsius. Serendipitously, the patient was in the clinic for a routine foot exam on that day. The clinician debrided hyperkeratosis at the right sub 5th metatarsal head and sub 1st metatarsal head.

A month later, the patient again developed a hotspot with a peak temperature difference of 3.8 degrees Celsius. The patient was seen in clinic eight days later for an interim visit due to the hotspot. The clinician again noted a hyperkeratotic right forefoot, and upon debridement, a superficial recurrent DFU at the 5th sub metatarsal head was discovered. The wound was measured to be approximate 0.4 cm in diameter with no sign of infection or drainage. Notably, the clinician reported no increased temperature upon manual palpation despite the large asymmetries measured by the Podimetrics system. This observation is consistent with previous research [4].

The wound was dressed with Betadine and TELFA. The patient’s right insert was customized to offload pressure to the 5th and 1st metatarsophalangeal joint. The patient was reminded to use the diabetic shoes and custom inserts at all times when ambulating. In a recent follow visit, the clinician noted reduced callous.

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