

Gait Analysis for the Quantification of Neuropathic Foot Pain: A Step in the Right Direction

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Background

Evaluation of pain often relies on subjective patient-reported outcomes (PROs) such as the Brief Pain Inventory. Supplementing such measures with objective endpoints can provide a deeper assessment of acute and chronic pain. In the present study, we evaluate quantitative gait analysis using a podiatric walkway that records pressure measurements and spatiotemporal parameters during a full gait cycle. We hypothesized that patients with neuropathic foot pain due to Morton neuroma (MN) would have abnormal gait and altered pressure loading from the affected foot detectable using these methods.

Methods

We recruited healthy volunteers (HV) and patients with symptomatic MN pain (MN) from the local community to form a normative dataset and an investigational pain cohort, respectively. Gait measurements were taken using the Tekscan StridewayTM walkway and standard-of-care pain questionnaires including the Manchester Foot Disability Index (MFDI), the Foot & Ankle Outcome Score (FAOS), and PainDetect were used to confirm absence of painful conditions in healthy controls and to quantify pain severity and disability in pain patients.

Results

Gait measurements from 42 HV and 10 MN revealed stability of gait parameters among HV and divergence of gait patterns in MN. The variance of metatarsal peak pressure (MPP) across all steps stabilized at 11 steps (CV=13.54%) for HV and 15 steps (CV=12.76%) for MN, indicating reliability of the measurement. We observed significantly lower MPP in the affected feet of MN (588 ± 40.23 kPa) compared to non-affected MN feet (642.16 ± 30.17 kPa); $p=0.02$. MN demonstrated reduced step length ($p=0.01$), stride length ($p=0.03$), and single support time ($p=0.05$).

Conclusions

We detected significant differences in spatiotemporal parameters of gait between HV and MN, and asymmetry of pressure loading between affected and non-affected feet in MN. Further, HV data demonstrate validity of pressure measurements and stable phenotyping of normative gait. Future directions will seek to correlate gait measurements with PROs. These observations support application of gait analysis as a surrogate measure of pain, which may enhance objective endpoints in future clinical evaluations of functional outcomes in pain management.