Kinematic Analysis of Forefoot Deformity in the Diabetic Neuropathic Foot

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**Kinematic Analysis of Forefoot Deformity in the Diabetic Neuropathic Foot**

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Diabetes mellitus and peripheral neuropathy (DMPN) can result in biomechanical impairments of the foot that may contribute to joint deformity, ulcer formation, and amputation. Current three-dimensional kinematic models used to study foot motion are limited to rearfoot, forefoot, and great toe comparisons, yet much of the forefoot deformity resulting in ulcer formation is related to second metatarsal movement. The purpose of this study is to build a multi-segment foot model that incorporates the metatarsal bone to further explore kinematic differences in people with DMPN and forefoot deformity.

An eight-camera, Vicon 3D motion capture system and force plate were used to track 28 reflective markers on key joints and anatomical landmarks on the foot, establishing axes to determine relative segment motions. Vis3D software was used to define the motion segments of the leg, foot, and toes which allows us to graph joint motion through space during activity performance (e.g. walking, heel rise).

During recorded activities, we observed that forefoot (hammer toe) deformity was associated with several biomechanical impairments: metatarsophalangeal joint flexion and ankle dorsiflexion range of motion deficits, a sustained supinated foot type, and decreased ankle power generation. This data with additional analysis allows us to form a model that will help us understand where high plantar pressures are most likely to occur. Future plans include integrating kinematic data with plantar pressure data and engineering a streamlined process to export data from Vis3D software into graphing templates and statistical software making data analysis more efficient and user-friendly. This knowledge can help clinicians develop strategies to prevent ulcers that otherwise may require amputation.