Journal of Foot and Ankle Research

BioMed Central

Oral presentation

Open Access

Plantar fascia thickness and first metatarsal mobility in patients with diabetes and neuropathy

Smita Rao*[1], Charles L Saltzman[2] and H John Yack[3]

Address: [1]Ithaca College-Center for Foot and Ankle Research, Rochester, NY, USA, [2]Department of Orthopaedics, University of Utah School of Medicine, Salt Lake City, UT, USA and [3]Department of Physical Therapy and Rehabilitation Science, The University of Iowa, IA, USA

Email: Smita Rao* - srao@ithaca.edu

* Corresponding author

from 1st Congress of the International Foot & Ankle Biomechanics (i-FAB) community
Bologna, Italy. 4–6 September 2008

Published: 26 September 2008

Journal of Foot and Ankle Research 2008, **1**(Suppl 1):O4 doi:10.1186/1757-1146-1-S1-O4

This abstract is available from: http://www.jfootankleres.com/content/1/S1/O4

Introduction

Individuals with Diabetes Mellitus and Neuropathy (DN) are at increased risk for ulcer development at sites exposed to repetitive, high plantar loading. Limited joint mobility may contribute to increased forefoot loading by limiting foot flexibility and restraining the forward progression of body weight during the stance phase of gait. However data substantiating the causes and consequences of limited mobility in forefoot loading is limited. The purpose of this study was to compare plantar fascia thickness, passive and active 1st metatarsal (Met) mobility and loading in patients with and without DN.

Methods

All procedures were approved by the Institutional Review Board at the University of Iowa Hospitals and Clinics. 15 subjects with DN and 15 non-diabetic, age and gender matched control subjects participated in this study. Sagittal T1 scans were acquired using a 3T Trio scanner (Siemens Corp). Plantar fascia thickness was measured using ImageJ. Passive 1st Met mobility and stiffness were measured using the device described by Glasoe et al. [1] Foot mobility during walking was captured using a two-segment model tracking the 1st Met and calcaneus. Kinematic data were collected at 120 Hz, using 3 iReds on each segment (Optotrak, NDI, CAN), plantar loading data were collected at 50 Hz using a pedobarograph (EMed, Novel Inc). Kinematic data were low-pass filtered using a fourth order butterworth filter with cut-off frequencies of 6 Hz and processed using Visual3D (C-motion Inc., MD). Motion of the distal segment was expressed relative to the proximal segment using Euler angles. For kinematic data, stance phase mean was subtracted from pattern to correct for systematic offsets.

Statistical Analysis

A two sample t test was used to assess differences between the two groups ($\alpha = 0.05$). Pearson product moment correlation (r) was used to assess the relationship between variables of interest.

Results

Subjects with DN showed increased plantar fascia thickness, decreased passive 1st Met mobility and increased passive 1st Met stiffness. Subjects with DN showed reduced 1st metatarsal sagittal, transverse and frontal motion and increased medial forefoot loading (Table 1).

Plantar fascia thickness was negatively associated with passive 1st Met mobility ($r = -0.40$, $p < 0.05$) when considering both groups together ($n = 30$). In subjects with DN, 1st Met sagittal motion was negatively associated with peak pressure sustained under the medial forefoot (r = -0.42 and -0.06, DN and Ctrl respectively, $p = 0.02$).

Conclusion

Our results indicate that increased plantar fascia thickness limits passive first Met mobility. However we did not find evidence that passive 1st Met mobility or stiffness influences 1st Met mobility during gait. In individuals with DN,

Table 1: Plantar fascia thickness, foot mobility and loading, expressed as. Mean (SD)

Dependent Variable	*DN*	*Ctrl*	P value
Plantar fascia thickness (mm)	2.78 (0.64)	1.51 (0.33)	*<0.001*
Passive 1st Met mobility (mm)	3.78 (0.63)	5.54 (2.13)	*0.004*
Passive 1st Met Stiffness (N/mm)	10.69 (1.63)	8.13 (2.67)	*0.003*
1st Met sagittal motion (deg)	13.0 (2.5)	15.8 (3.3)	*0.047*
1st Met transverse motion (deg)	7.1 (3.1)	9.6 (3.6)	*0.026*
1st Met frontal motion (deg)	9.8 (3.6)	12.3 (3.1)	*0.029*
Medial forefoot peak pressure (N/cm^2)	82.4 (29)	49.8 (10)	*<0.001*

loss of sagittal 1st Met mobility correlated with increased medial forefoot loading, highlighting the importance of 1st Met mobility during functional activities.

References

1. Glasoe , *et al.*: *Foot Ankle Int* 2000, **21(3):**240-6.