

**PATHOKINESIOLOGY LABORATORY
RANCHO LOS AMIGOS NATIONAL REHABILITATION CENTER**

ABSTRACTS FROM CONFERENCE PRESENTATIONS (2003 – 2005)

Longitudinal effectiveness of custom molded inserts at reducing walking plantar pressures in persons with Partial foot amputation secondary to diabetes mellitus. Burnfield JM, Few CD, Whitney JA, Taji S, Perry J. Clinical Gait and Movement Analysis Society: April 2005, Portland, OR

Introduction

The risk of ulceration and amputation in persons with diabetes mellitus (DM) increases when walking plantar pressures are elevated.¹ While custom shoe inserts are frequently prescribed to reduce abnormal pressures,² little attention has been directed towards determining how pressure relief capability changes over time with use. The purpose of the current study was to determine if the effectiveness of custom molded inserts changed over a six month period for a cohort of persons with partial foot amputations secondary to diabetes mellitus.

Statement of Clinical Significance

Minimization of skin ulceration is essential for preventing amputations, preserving maximum independence in living and employment, and decreasing the negative emotional and financial consequences associated with diabetes mellitus.

Methods

Ten persons at risk for diabetic ulcers due to a previous history of unilateral partial foot amputation participated (4 transmetatarsal, 3 ray, 3 toe; mean age=53 yrs). Each subject was provided with a new pair of custom molded tri-laminate inserts fabricated from Plastazote, PPT, and XPE. Bilateral plantar pressures were recorded simultaneously (PEDAR by Novel) as subjects walked at a self-selected speed in their new custom inserts, and again after they had worn their inserts for 3 and 6 months. The anatomical region of the foot (medial arch, lateral arch, medial metatarsal, central metatarsals, lateral metatarsal, great toe, little toes) with the highest Maximum Mean Peak Pressure (MMPP) was identified for each condition (Initial, 3 Month, 6 Month) for both the involved and uninvolved limbs.³ To determine the influence of time on MMPP, a one way analysis of variance with repeated measures across testing sessions (Initial, 3 Month, 6 Month) was performed. Additionally, for each condition, the number of subjects exceeding the clinically defined "safety" threshold of 21 N/cm² was quantified.² As faster walking velocities have been associated with an increase in pressure,⁴ a separate one way analysis of variance with repeated measures also was performed to determine if velocity varied significantly across the testing sessions.

Results

WALKING VELOCITY: Walking velocity did not vary significantly between the 0, 3 and 6 month assessments (60.7 vs. 63.8 vs. 59.9 m/min).

INVOLVED LIMB (Figure 1): An overall trend for maximum mean peak pressure to increase across testing sessions was identified ($p= 0.12$; Figure 1). While only a 2% increase was documented between the initial and 3 month assessments (21.1 vs. 21.6 N/cm²), the average maximum mean peak pressure increased 23% between the initial and 6 month measurements (21.1 vs. 26.0 N/cm²). MMPP values under the involved limb exceeded the 21 N/cm² safety threshold in half of the subjects ($n=5$) at each test interval.

UNINVOLVED LIMB (Figure 2): The maximum mean peak pressure under the uninvolved limb did not vary significantly across testing sessions when averaged among subjects (Figure 2). The initial, 3 month, and 6 month pressure values varied less than 2% (23.4 vs. 23.0 vs. 23.2 N/cm²). MMPP values under the uninvolved limb exceeded the 21 N/cm² safety threshold in 60% of subjects ($n=6$) at the initial test interval, 40% ($n=4$) at the 3 month assessment, and 70% ($n=7$) at the 6 month interval.

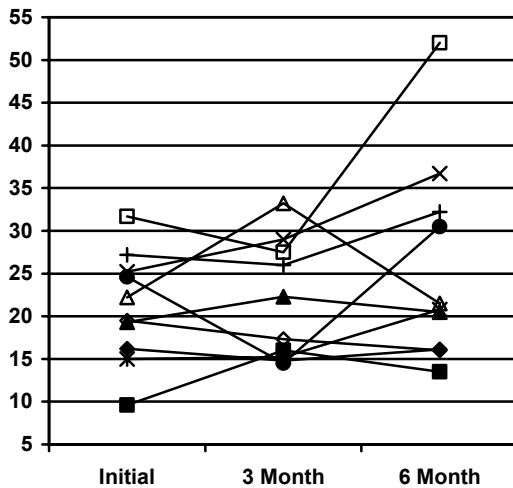


Figure 1. Comparison of maximum mean peak pressures under the *involved* limb while walking in custom inserts when initially received and after wearing for 3 and 6 months (6 Month > Initial, $p=0.12$).

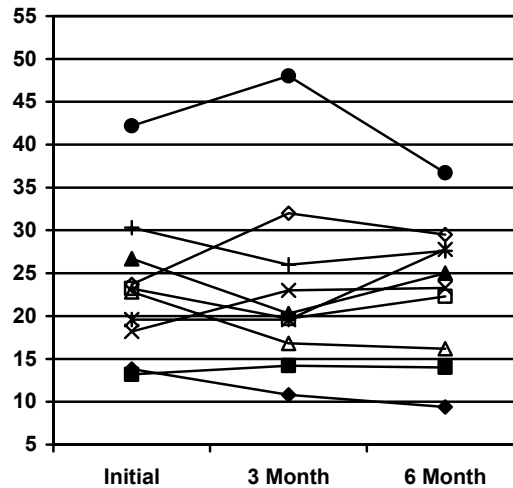


Figure 2. Comparison of maximum mean peak pressures under the *uninvolved* limb while walking in custom inserts when initially received and after wearing for 3 and 6 months.

Discussion

Tri-laminate custom molded inserts were less effective at reducing potentially injurious pressures under the residual limb of persons with partial foot amputation after 6 months of use than when initially fabricated. Despite the presence of higher average pressures under the sound limb at the initial and 3 month assessments, no significant decrement in insert function was documented under the sound limb across time. Continued monitoring of these participants and the assessment of additional subjects over the next year will contribute to a better understanding of the influence of insert longevity on plantar pressure reduction and ulcer prevention.

References:

1. Frykberg RG et al (1998). *Diabetes Care*, 21 (10), 1714-1719.
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3. Bontrager EL et al (1997). *Gait & Posture*, 5, 167-168.
4. Burnfield JM et al (2004). *Clinical Biomechanics*, 19 (1), 78-84.

Acknowledgements

Funded by the National Institute on Disability and Rehabilitation Research grant
#H133G020002
