Chronic Metatarsalgia: What happens to peak plantar pressure during walking?

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Summary
Chronic metatarsalgia (CM) is defined as persistent pain beneath one or more metatarsal heads. Although a plausible relationship exists between increased plantar pressure under the forefoot and CM, no study has quantified or clearly defined these increases, to our knowledge. The results of peak plantar pressure differences between individuals with CM and healthy controls are presented.

Introduction

Foot musculoskeletal disorders cause significant impairments and disabilities in affected individuals [1]. Chronic metatarsalgia (CM), defined as persistent pain beneath one or more metatarsal heads, represents up to 88% of all causes of foot pain. The treatment of CM is based on the reduction of the mechanical overload of the metatarsal heads (MH) during locomotion [2]. However, no study has quantified or clearly defined the increases in Plantar Pressure (PP) under the forefoot associated with CM. The main objective of the study was to compare PP during walking between individuals with CM and individuals without lower limb pain.

Methods

Twenty-three individuals with CM and 12 controls were recruited to participate in this case study. All participants were aged between 18 and 65 years (Table 1.). Participants in the CM group were recruited if they had unilateral or bilateral CM for at least 3 months (pain score of ≥ 4 out of 10 on the Visual Analogue Scale) and were able to walk without an assistive device. Exclusion criteria for both groups were: (1) if they had lower limb arthritis, (2) neurological diseases (e.g., Morton's neuroma) or other mechanical pain, (3) plantar corns, (4) and a history of orthopedic foot surgery. Controls were eligible for inclusion if they had no lower limb pain. For the CM group, the most painful leg was evaluated. The participant had to walk down an aisle as naturally as possible. To quantify peak PP, we used a Pedar-X in-shoe pressure measurement system (Novel Corporation, Munich, Germany, 100Hz). The peak PP during the Stance Phase (SP) was normalized with the weight and calculated by dividing the foot into nine regions using masks: lateral heel, medial heel, lateral midfoot, medial midfoot, 1st MH, 2nd and 3rd MH, 4th and 5th MH, hallux, second to fifth toes. Peak PP was statistically compared between different group with independent t tests using a statistical parametric mapping approach.

Results

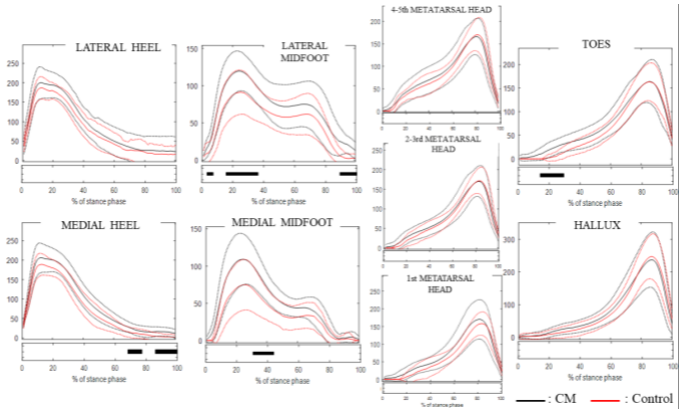

Figure 1: Peak plantar pressure (kPa) during the stance phase (%): CM (black) and control (red). Black = significant differences.

During walking, greater peak PP were observed under the medial heel (from 85-100% of SP, p=0.006), under the medial midfoot (31-44%SP, p=0.016), under the lateral midfoot (4-8%SP, p=0.012, 17-37%SP, p=0.006, 88-100%SP, p=0.002) and under toes (15-30%SP, p=0.002) in individuals with CM compared to controls (Fig. 1.).

Discussion & Conclusions

Greater peak PP under certain parts of the foot of individuals with CM compared to control was observed. No significant differences were found under the MH, but we observed a smaller peak PP under 1st MH of control group compared to individuals with CM. The results showed that there is a relationship between PP hyperpressure and individuals with CM.

Acknowledgments

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Reference

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	Gender (M/F)	Studied limb (R/L)	Age (years: mean±sd)	Mass (kg: mean±sd)	Height (cm: mean±sd)	Body mass Index (kg/m^2: mean±sd)	Duration of symptoms (months: mean±sd)
CM	17/6	8/15	50.5±9.4	85.2±20.6	167.6±8.0	30.3±6.82	81.5±118.5
CONTROL	3/9	5/7	49.2±13.1	73.6±19.3	166.4±8.4	26.6±6.6	/

Table 1. Demographic data (CM: Chronic Metatarsalgia, SD: standard deviation, M: Male, F: Female, R: Right, L: Left).