FUNCTIONAL METATARSAL LENGTH IN PATIENTS WITH MIDFOOT ARTHRITIS

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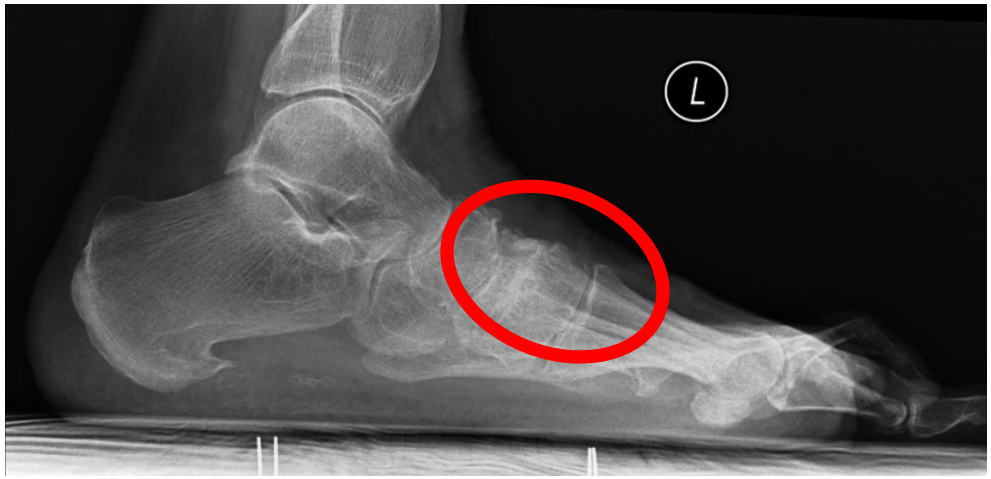
Introduction

- Arthritis: One of the leading causes of disability

  (MWWR, 2006)

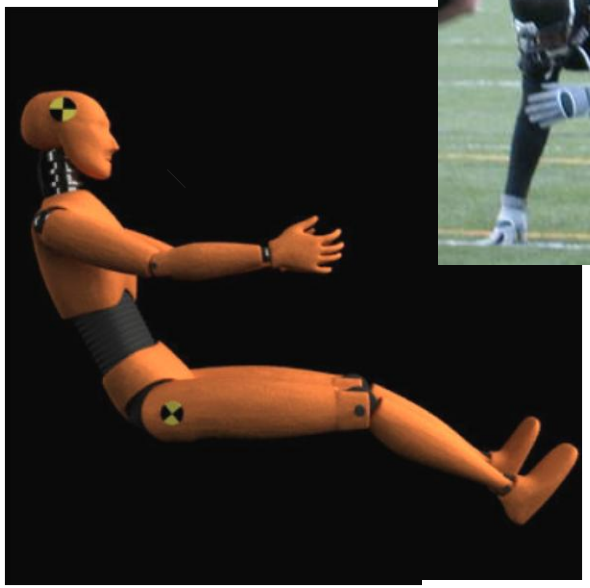
- Midfoot Arthritis: High potential for chronic secondary disability



Incidence and Prevalence

- Athletic population
- Minor twisting injuries
- Midfoot Injuries
  - Secondary to motor vehicle trauma.

(Smith et al. 2005)



Morton's Foot Structure

- Patients with midfoot arthritis have a Morton's foot structure

  (Davitt et al. 2005)

- Postulated to result in:
  - 1st metatarsal hypermobility
  - Overloading of the 2nd metatarsal

  (Morton DJ, 1928)

Morton DJ, The Human Foot,1935

Purpose

- To examine functional first metatarsal length in patients with midfoot arthritis

- To compare regional plantar loading and first metatarsal mobility during walking in patients with midfoot arthritis compared to asymptomatic control subjects

Subjects

- 30 patients
  - Age: 62 (55 - 71) years
  - BMI: 30.4 (19.9 - 38.1)
  - 28 female

- 20 control subjects
  - Matched in age, gender and BMI

Patient Presentation

- Clinical:
  - Pain on dorsum, localized to TMT region
  - Aggravated by walking
  - Stair descent

- Radiographic:
  - Joint space reduction
  - Osteophytes
  - ‘Dorsal bossing’

1. Radiographic Measures

- Ratio of first to second metatarsal length

(Davitt et al, 2005)

1 = Same length

>1 = 1st metatarsal longer

<1 = 1st metatarsal shorter

- Single tester:

(ICC(2,k) = 0.92)

2. Plantar Loading

- Data Acquisition
  - Barefoot
  - EMED^{TM}
- Data Analysis
  - “Masks”
  - Heel, Midfoot, Metatarsals 1-5, Great Toe
  - Dependent Variables:
    - Pressure time integral

http://novel.de/productinfo/systems-emed.htm

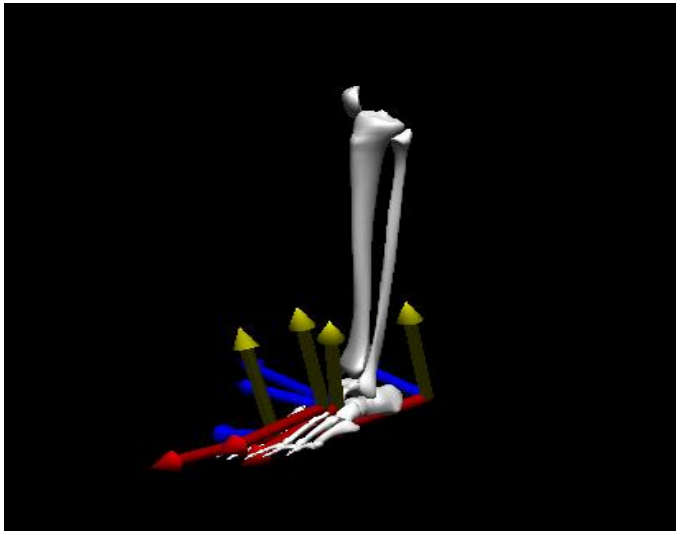
3. Kinematic Data Collection

- Electromagnetic sensors (18 mm x 8 mm x 8 mm) placed over proximal phalanx and first metatarsal
- Anatomically based local co-ordinate systems for each segment

  (Tome et al. 2004, Rao et al. 2009)

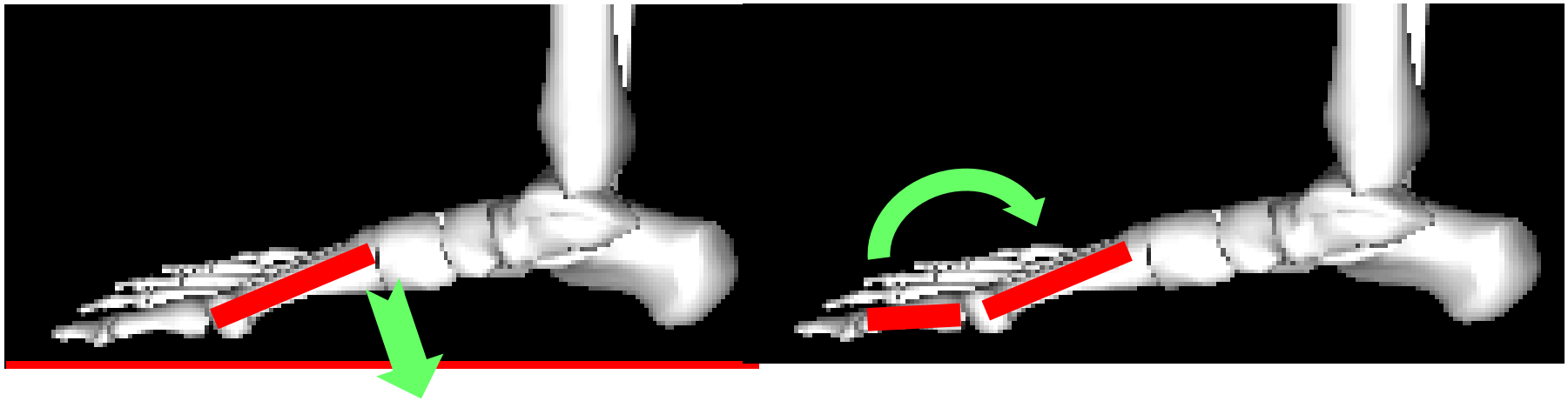
- Reference trial: Subtalar Neutral

  (*Houck et al. 2008)*



Kinematic Dependent Variables

- 1st metatarsal plantarflexion
- 1st Metatarsophalangeal dorsiflexion



Statistical Analysis

- Descriptive statistics were used to summarize radiographic measures.
- Independent *t*-tests were used to assess differences in regional plantar loading and first metatarsal mobility during walking between the two groups.

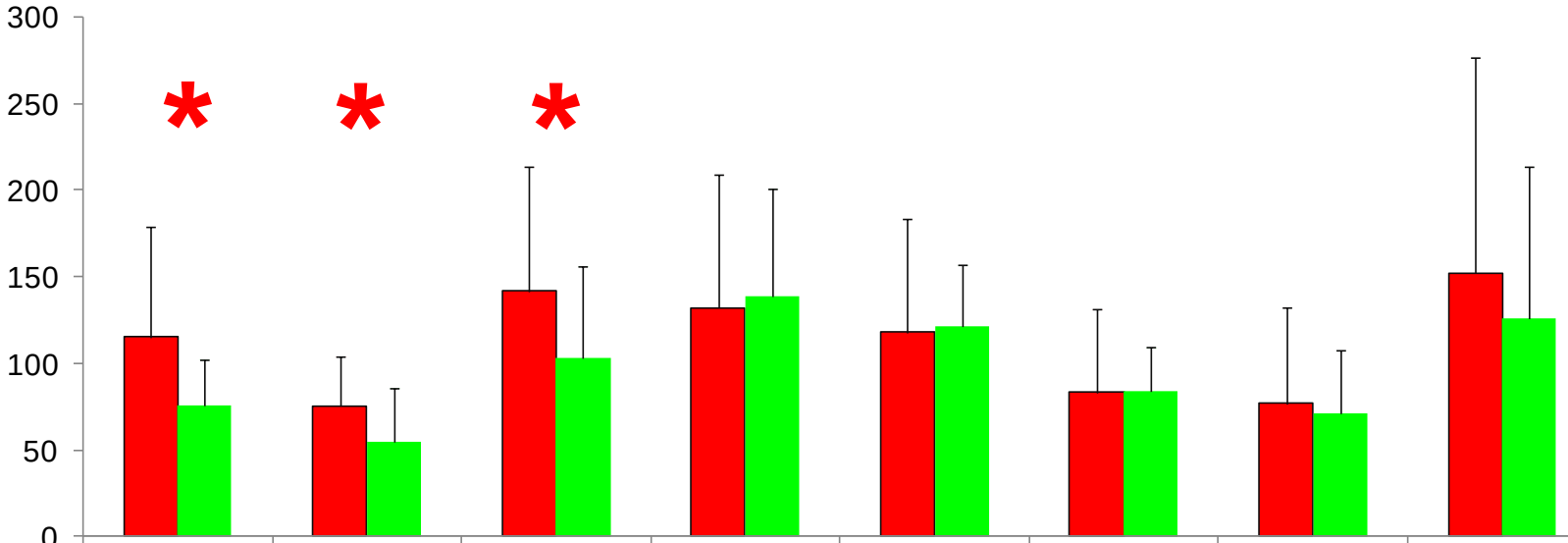
Results: 1. Radiographs

Ratio of first to second metatarsal length

Mean (SD)	Current study	Davitt et al. 2005
MFA	82 (3)	77 (4)
Control		82 (5)

Results: 2. Plantar Loading

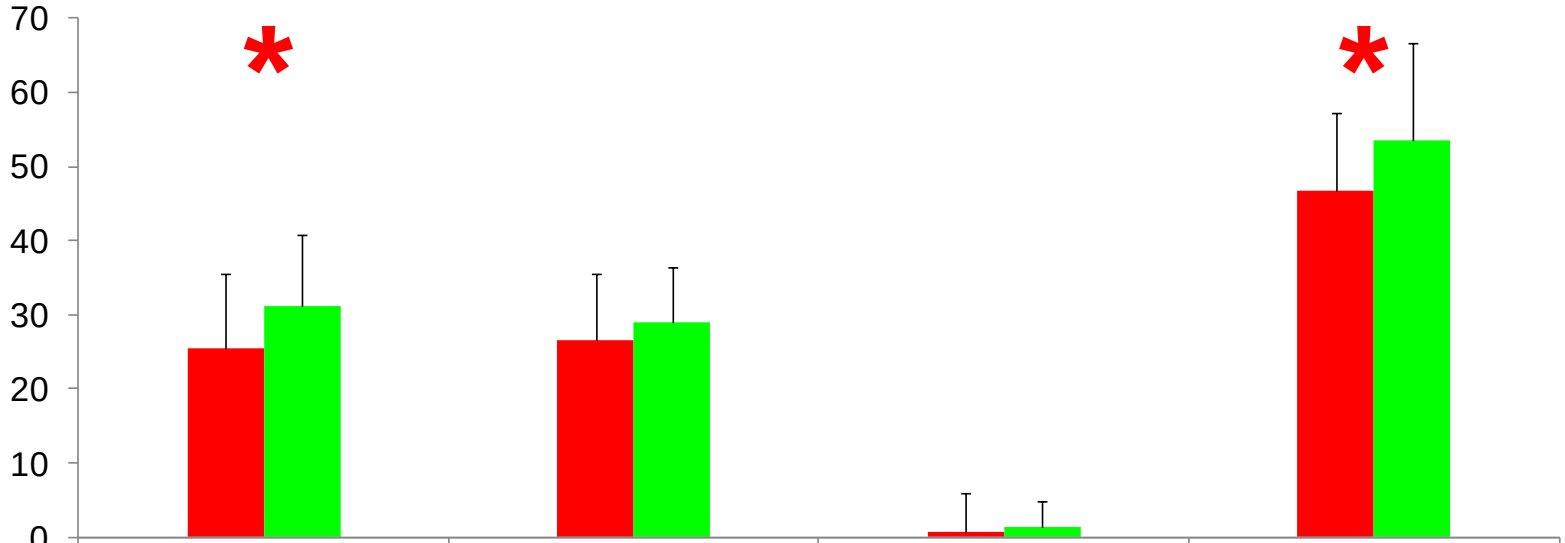
Patients with midfoot arthritis sustained significantly higher pressure time integral at the heel, midfoot, and first metatarsal, compared to matched control subjects.



	Heel	Midfoot	First M	Second M	Third M	Fourth M	Fifth M	Great Toe
Midfoot Arthritis	115.36	75.40	141.88	131.98	117.82	83.33	76.86	152.17
Control	76.15	54.43	102.82	138.76	121.12	84.24	71.32	125.76

Results: 3. First Metatarsal Mobility

Decreased Peak First Metatarsophalangeal (MTP) joint dorsiflexion and First Metatarsal Range of Motion during walking was noted in patients with midfoot arthritis



	Peak First MTP Dorsiflexion	First MTP Range of Motion	Peak First Metatarsal Plantarflexion	First Metatarsal Range of Motion
Midfoot Arthritis	25.5	26.6	0.7	46.8
Control	31.2	28.9	1.4	53.5

Conclusions and Discussion:

- ***Shorter first metatarsal*** in patients with midfoot arthritis.

- ***Decreased first metatarsal motion*** and ***increased heel, midfoot and first metatarsal regional plantar loading*** in patients with midfoot arthritis.
  - In contrast to first metatarsal hypermobility and attendant overloading of the second metatarsal head expected in a Morton's foot structure.

- These findings may reflect potential mechanisms that contribute to the evolution of symptoms in patients with midfoot arthritis.

Acknowledgements

AOFAS Research Grant

Arthritis Foundation

Chapter Grant and Post-doctoral Fellowship