Uncovering the Effect of Foot Orthoses in Patients with Midfoot Arthritis

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Introduction

- Arthritis: One of the leading causes of disability (CDC, 2007)

- Midfoot Arthritis: High potential for chronic secondary disability
Incidence and Prevalence

• Midfoot Injuries

  – Alarming increase in incidence secondary to motor vehicle trauma.  
    (Smith et al. 2005)
  
  – As many as 20% are missed or misdiagnosed.  
    (Goossens and De Stoop 1983)

Fig. 1: Injury origin

  (Richter et al. 2001)
Surgical Management

- Operative intervention
  - Challenging!
  - Complex anatomy and function

- Surgical outcomes
  - Decreased pain
  - Only modest improvements in function

*(Teng and Pinzur, 2002)*
• Complications following surgery
  – Non-union, broken screws and wound problems
  – May necessitate further surgery involving revision, arthrodesis, hardware removal

Arthrodesis of the TMT joints
Conservative Management

• Orthotics
  – Viable alternative
  – Goal: Pain relief by modifying load at the tarsometatarsal complex

• Little objective evidence to guide prescription
  – Selection often a matter of trial and error
  – Increased expense
  – Equivocal outcomes
Custom molded three quarter length (3Q) orthoses

- Recommended treatment
- Clinical experience suggests variable efficacy
Full Length carbon graphite orthoses as an alternative

- Recent retrospective review
  - 56 patients with MFA
  - previous 3Q users with persistent midfoot complaints
  - 2 year follow-up

(Pletka et al 2006)
63% reported a significant decrease (greater than 50%) in pain within four weeks of using the full length carbon foot plate (FL).

However, mechanisms underlying pain relief unknown.
Purpose:

1. Assess the effect of 4 week intervention using the FL on pain and functional outcomes

2. Examine the effects of foot orthoses on segmental loading in patients with midfoot arthritis
   - Shoe alone
   - Shoe with 3Q insert
   - Shoe with FL insert
Subjects

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

- 13/17 used 3Q with persistent midfoot complaints

- Sought care at the University of Rochester’s Outpatient Orthopedic Foot and Ankle Clinic

- Fellowship trained Foot and Ankle Orthopaedic Surgeon
Patient presentation

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

- **Radiographic:**
  - Joint space reduction
  - Osteophytes
  - ‘Dorsal bossing’
Functional Outcomes

• Foot Function Index – Revised (FFI-R)
  – Pain
  – Stiffness
  – Disability
  – Activity Limitation
  – Social

(Budiman-Mak, E et al, 2006)
Plantar Loading

• Data Acquisition
  – Pedar™
  – Mid gait protocol
  – Patient-preferred walking speed
  – 15 steps collected for each condition
  – Same shoes for all walking conditions

➢ Shoe alone
➢ Shoe with 3Q
➢ Shoe with FL
Plantar Loading Analysis

- Masks
  - Midfoot
  - Forefoot and Rearfoot

- Dependent variables
  - Average Pressure
  - Duration of Loading (Contact Time)
Statistical Analysis

- 5 steps analyzed for each condition
- Repeated measures ANOVA with Bonferroni post-hoc tests
- 3 subjects lost to follow-up
Results
Pain and Functional Outcomes

Significant symptomatic improvement
Plantar Loading

Reduction in Medial Midfoot Average Pressure with FL when compared to 3Q

Average Pressure

kPa

62.0

45.6

52.8

Medial Midfoot

p=0.01

3Q

FL

SHOE

ITHAÇA
Medial midfoot average pressure

Compared to the Shoe Condition:

FL = 14% decrease
3Q = 17% increase
Contact Time

Reduction in Medial Midfoot Contact Time with FL compared to 3Q

Contact Time

\[ p = 0.06 \]
Variability of Patient Response to Orthotic Intervention

- Pain decreased: 67%
- Activity limitation decreased: 67%
- Total FFI-R score decreased: 75%
- Average Pressure decreased: 85%

Percent of subjects who responded favorably
Factors contributing to Baseline Pain

Baseline average pressure explained 50-70% of the variance in pain ($p = 0.03$)

$R^2 = 0.70$

![Graph showing the relationship between baseline average pressure and pain severity.](image)

- Baseline Avg Pressure (N/cm²)
- Worse
- Better
Load Redistribution with Orthoses Use
Key Findings

• FL effective in reducing magnitude and duration of medial midfoot loading in patients with MFA

• Reduction in loading accompanied by pain relief and improved functional outcomes

• Effective in over 75%
Discussion

- Load redistribution
- Differences in loading may stem from design features
Discussion

• Implications for Costs
  $30-70 for FL
  $300-400 for 3Q

• Early effective intervention may delay the progression of degenerative symptoms
Limitations and Future Studies

• Research Design
• $n = 17$, enrollment continues
• Longer term follow-up
• Alternative hypotheses
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