

Oral presentation

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## In-vivo first metatarsophalangeal joint mechanics following cheilectomy: MRI and gait alterations

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### Introduction

Cheilectomy surgery has been shown to provide pain relief for patients with hallux rigidus [1], however limited data exists regarding the effectiveness of this surgery in re-establishing normal first metatarsophalangeal (1<sup>st</sup> MTP) joint kinematics. A recent dynamic gait study has reported only modest improvement in 1<sup>st</sup> MTP motion following surgery, thus implicating the persistence of altered joint mechanics [2]. The purpose of this study was to evaluate *in vivo* joint motion changes using MRI under 1<sup>st</sup> MTP loaded conditions in patients who received cheilectomy surgery. These data were compared to dynamic alterations during gait measured in a second cohort of subjects who previously underwent surgery.

### Methods

20 subjects were enrolled for the MRI analysis. Pre- and post-operative data of 10 subjects with hallux rigidus (HR) were compared to a healthy control group of 10 subjects. Using a validated loading harness, all subjects underwent an MRI evaluation at varying angles of 1<sup>st</sup> MTP dorsiflexion, pre and post surgery (>3 months). Image J

software was used to derive MRI measurements: 1<sup>st</sup> MTP dorsiflexion, instant centers of rotation, and sagittal translations of the proximal phalanx/1<sup>st</sup> metatarsal. Outcome measures were assessed using the Foot Function Index (FFI). MRI changes were compared to 3D gait analysis previously acquired on a second cohort of 20 surgical subjects using a magnetic tracking device.

### Results

All subjects had a significant decrease in FFI scores indicating an improvement in pain relief and function ( $p < .01$ ).

Table 1 shows pre- and post-op data compared to the control subjects. No significant differences were found between pre- and post-op measures for peak 1<sup>st</sup> MTP dorsiflexion, instant center of rotation (ICR), and sagittal translations of the hallux relative to the first metatarsal. Values for the cheilectomy group all remained significantly different from the control group ( $p < 0.001$  for all variables).

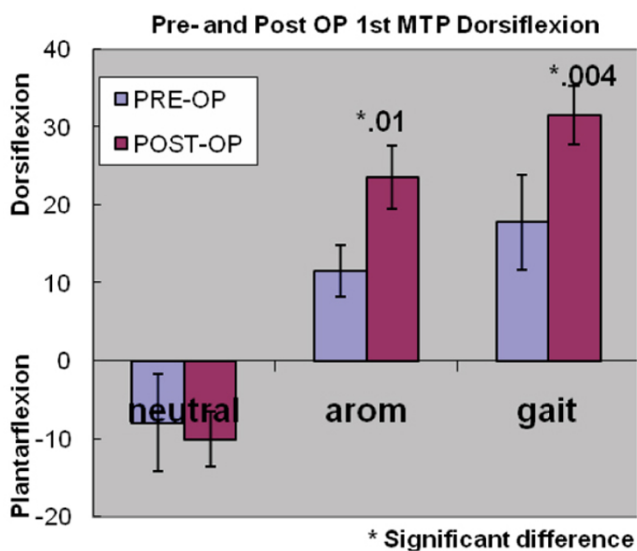
**Table 1: Controls, Pre- and post-op MRI values**

Variable	Pre-op	Post-op	Controls
1 <sup>st</sup> MTP dorsiflexion	35.0° ± 8.8°	31.3° ± 10.0	64.4° ± 7.8°
ICR	8.9 ± 1.3 mm	8.6 ± 1.6 mm	4.2 ± 0.6 mm
Sagittal translation	1.6 ± 0.8 mm	1.5 ± 0.7 mm	5.5 ± 0.9 mm

These data can be compared to kinematic changes during gait, measured on a second cohort of subjects. Differences were found between pre- and post-op values, although still significantly less than normative values for 1<sup>st</sup> MTP motion [2]. Figure 1.

**Conclusion**

Joint mechanics are significantly altered in patients with hallux rigidus. Although cheilectomy resulted in favorable outcomes as measured by FFI scores, surgery did not re-establish normal 1<sup>st</sup> MTP joint kinematics. Long term follow up of these patients will determine if altered kinematics lead to progressive arthritis over time and may suggest alternative intervention strategies.



**Figure 1**  
1<sup>st</sup> MTP dorsiflexion during neutral/rest, active motion and gait.

**References**

1. Coughlin , et al.: *J Bone Jt Surg* 2003.
2. Nawoczenski , et al.: *Foot Ankle Int* 2008.

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