Hallux Motion: Using Electromagnetic Sensors to Measure Range of Motion Under Immobilization Devices on the Foot
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Introduction/Purpose: Immobilization is required for management of acute and chronic pathologic states of the hallux metatarsophalangeal (MTP) joint. Traditionally, this was performed using physician applied custom splint or cast and achieved a high degree of immobilization. Braces and orthotics are becoming less expensive and have several advantages, such as light weight and convenience in removal. However, this may come at the expense of ability to restrict movement. We hypothesize that generic braces will provide as much immobilization as custom applied plaster splints.

Methods: Healthy volunteers were instrumented with electromagnetic sensors over bony prominences of the right foot. Range of motion exercises and activities of daily living were performed without an immobilization device. The same procedure was repeated with each of three immobilization devices: a post-operative shoe, a walking boot, and a custom applied plaster splint. Position and angular data were collected to determine range of motion primarily of the hallux MTP joint. This study was approved by the hospital IRB.

Results: Compared to baseline, all three immobilization devices significantly reduced range of motion at the MTP joint in non-weight bearing with the ankle in dorsiflexion and plantarflexion (p<0.05). There was no significant difference detected between the devices. There was no significant difference in hallux motion during the standing exercise in any of the immobilization devices compared to baseline. During stance phase of gait, all three devices reduced range of motion at the MTP joint compared to baseline (p<0.05), though there was no statistically significant difference between devices.

Conclusion: Consistent with the hypothesis, data from this study show that all both generic devices and the physician applied splint reduced range of motion compared to baseline. Unfortunately, the study was not powered enough to detect significant differences between the devices, though there was a trend towards the walking boot providing more immobilization.

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