Measuring Joint Flexibility in Hallux Rigidus Using a Novel Flexibility Jig

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Disclosures

No conflicts to disclose

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Our disclosures are in the AOFAS Mobile App
We have no potential conflicts with this presentation

Measuring Joint Flexibility in Hallux Rigidus
Background

- Range of motion (ROM) measurements of the first metatarsophalangeal (MTP) joint play a major role in assessing hallux rigidus
  - However, they provide little information about joint function and are limited by variability in technique
  - Measuring joint flexibility can characterize intrinsic properties of the joint that may prove more clinically meaningful.
Background

- No prior study has assessed hallux MTP joint flexibility in patients with hallux rigidus
- We aimed:
  1. to assess the reliability of a custom flexibility device in patients with and without hallux rigidus and
  2. to compare flexibility between hallux rigidus patients and controls
Methods

• 15 patients with Coughlin stage II or III hallux rigidus indicated for cheilectomy and 20 healthy controls were recruited prospectively

• Each of 2 raters performed a series of seated and standing tests on each subject using the flexibility jig
Methods

Dorsiflexion angle and applied torque were plotted against each other to generate a flexibility curve, from which 5 flexibility parameters were defined:

- **Early flexibility**: slope in the first 25% of motion
- **Late flexibility**: slope in the last 25% of motion
- **Laxity torque**: torque value at which early and late flexibility curves intersect
- **Laxity angle**: angle value at which early and late flexibility curves intersect
- **Torque angle**: angle at which the average laxity torque value of the control patients intersects a given patient’s flexibility curve
Methods

• Differences between (1) hallux rigidus patients and controls and (2) sitting and standing testing positions were assessed with t-tests

• Intra-rater test-retest reliability, remove-replace reliability, and inter-rater reliability were assessed with intraclass correlation coefficients (ICCs)
Results

- Compared to controls:
  - Hallux rigidus (HR) patients were older (average age 53 vs 32 years, \( p < 0.001 \))
  - HR patients had less dorsiflexion (\( p < 0.001 \))
  - **HR patients were less flexible** as measured by 3 of the 5 flexibility parameters:
    - Early flexibility (\( p = 0.027 \))
    - Laxity angle (\( p < 0.001 \))
    - Torque angle (\( p = 0.002 \))

First MTP flexibility in the sitting position. Solid lines represent the mean (thick line) and ±1.0 standard deviation (thin lines) of the control group flexibility. The dashed lines represent the HR group flexibility. Torque is normalized to each cycle maximum as a percentage.
Results

- After controlling for age, only laxity angle and max dorsiflexion differed significantly between HR patients and controls (p < 0.001).
- Generally, patients were more flexible in the seated position than in the standing position.
  - *This difference was more marked in hallux rigidus patients.*
- All flexibility parameters had good or excellent intra- and inter-rater reliability (ICC ≥ 0.60).
Results

Early flexibility and laxity angle measurements are shown for the control group compared to the HR group, in sitting and standing positions.

R1 = Rater 1; R2 = Rater 2.

*Note the difference in flexibility between sitting and standing positions, for both HR patients and controls. *p<0.05
Conclusions

• This is the first study to demonstrate a reliable method of measuring first MTP joint flexibility in patients with hallux rigidus.

• Flexibility, even early in the arc of motion, is impaired in patients with HR.

• Significant differences between sitting and standing measurements suggest that soft tissue tension may be a major contributor to decreased flexibility.
Future Directions

• Further research will be required to determine the clinical utility of flexibility measurements
  • May be used by physical therapists; if flexibility can be improved through therapy, it is possible pain might improve as well
  • May be used by surgeons to predict which patients will benefit most from cheilectomy
• Future studies needed to compare flexibility before and after surgery
  • Need to correlate improvement in flexibility parameters with standardized clinical outcome scores