

## A NOVEL ARCH HEIGHT INDEX ASSESSMENT: INTRA-RATER RELIABILITY

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### INTRODUCTION

The purpose of this study was two fold: (1) to develop a simple mechanical instrument to measure arch height index for all foot types, and (2) to demonstrate the intra-rater reliability.

Assessment of the longitudinal arch of the foot has long been recognized as an important parameter in the classification of foot type. It has implications in research, as well as in the clinical prediction and treatment of pathology. Due to varying degrees of repeatability and reliability however, no single method or definition has been accepted as the standard for arch assessment

This study demonstrates a clinical method to objectively quantify the osseous structure and function of the longitudinal arch for all foot types, through a range of weight bearing conditions and cases.

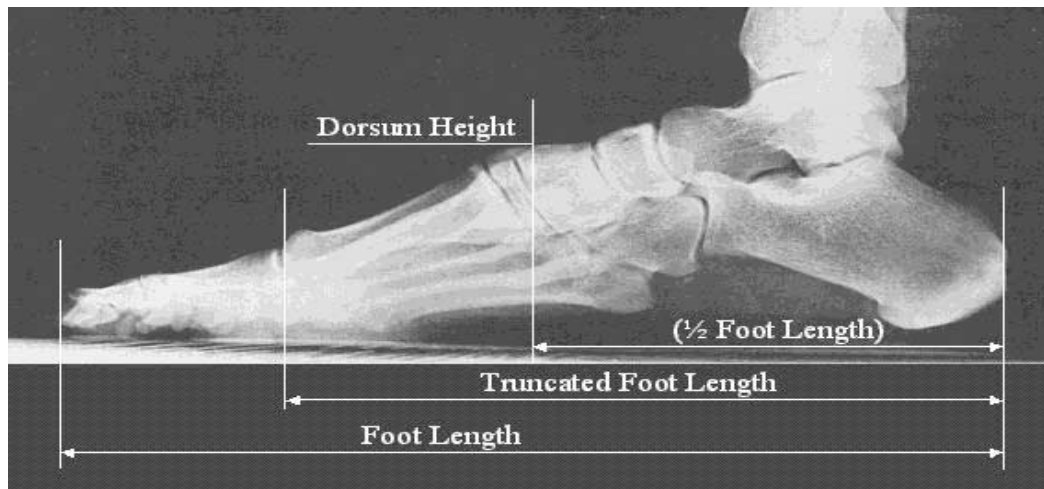
### METHODS

To evaluate intra-rater reliability, ten feet (the right foot of 10 subjects) were measured on three occasions by a single rater using the Arch Height Index Measurement System (AHIMS, see Figure 1.). On each occasion, 35 measurements were made in order to determine the most valuable parameters to arch flexibility. Measurements were recorded at each of three loading conditions: sitting (~10% body weight), comfortable bilateral stance (~50%bw), and unilateral stance (~100%bw). Values investigated include total foot length, truncated foot length and arch height at the dorsum, as indicated in Figure 2.

- To measure arch height, a horizontal bar, in the frontal plane, was suspended at one half the total foot length from the heel. The bar was then lowered, allowed to rest with its own weight on dorsum of the foot. The height, with respect to heel and forefoot height, was recorded.
- The effect of foot elongation during load bearing was addressed by recording arch height at both  $\frac{1}{2}$  the sitting foot length, and  $\frac{1}{2}$  the foot length measured during the current standing trial.
- To accommodate the possibility of encountering extremely flexible feet, weight-bearing measurements were recorded with the mid-foot supported and unsupported (removing the middle third of the floor support from beneath the foot).
- In addition to making measurements at the subject's comfortable, resting calcaneal stance position, the effect of excessive pronation or supination of the foot was assessed. Subjects were asked to first twist their upper bodies clockwise and then counter-clockwise approximately  $45^\circ$  during observation of the 50% BW condition.



**Figure 1. Arch Height Index Measurement System (AHIMS)**



**Figure 2. Radiographic correlation of arch height index measurements**

## RESULTS AND DISCUSSION

Parameters were measured for multiple conditions and cases with intent to find the most reliable, salient and objective assessment of arch height. Table 1 summarizes the results.

- The variability introduced during pronation and supination demonstrates the importance of having the patient maintain a comfortable, repeatable base of support, angle of stance and foot angle.
- Comparing supported and unsupported trials, an additional drop in arch height is observed in the latter. Thus, the unsupported condition should be used to properly identify and observe the morphology of highly flexible feet.
- Little additional deformation is noted when loading beyond 50%BW. Due to the unsteady posture required for such measures, observation of 100%BW is deemed unnecessary.
- To compare arch height between subjects of varying size, arch height measurements are normalized by the truncated foot length to give an Arch Height Index (AHI).

**Table 1. Parameters of Arch Height: Measurements and their Intra-Rater correlation values. \*For the AHI, use AH@ 1/2 sitting FL**

	FL		TrFL		AH at 1/2sittingFL		AH at 1/2currentFL		AHI: AH/TrFL*	
	ICC(2,1)	mean	ICC	mean	ICC	mean	ICC	mean	ICC	mean
<b>SUPPORTED(10%)</b> Sitting	<b>0.996</b>	<b>26.10</b>	<b>0.993</b>	<b>18.93</b>	<b>0.980</b>	<b>6.87</b>	<b>0.980</b>	<b>6.87</b>	<b>0.981</b>	<b>0.36</b>
<b>SUPPORTED(50%)</b> RCSP	<b>0.998</b>	<b>26.66</b>	<b>0.988</b>	<b>19.46</b>	<b>0.984</b>	<b>6.47</b>	<b>0.988</b>	<b>6.34</b>	<b>0.960</b>	<b>0.33</b>
Pronated	0.920	26.70	0.920	19.54	0.993	6.41	0.878	6.24	-	0.33
Supinated	0.971	26.37	0.950	19.20	0.970	6.62	0.962	6.56	-	0.34
<b>SUPPORTED(100%)</b> RCSP	<b>0.998</b>	<b>26.67</b>	<b>0.913</b>	<b>19.53</b>	<b>0.979</b>	<b>6.41</b>	<b>0.977</b>	<b>6.29</b>	<b>0.953</b>	<b>0.33</b>
<b>UNSUPPORTED(50%)</b> RCSP	<b>0.999</b>	<b>26.68</b>	<b>0.879</b>	<b>19.55</b>	<b>0.984</b>	<b>6.42</b>	<b>0.985</b>	<b>6.28</b>	<b>0.960</b>	<b>0.33</b>
Pronated	0.999	26.73	0.882	19.60	0.992	6.37	0.992	6.20	-	0.33
Supinated	0.977	26.42	0.942	19.21	0.954	6.54	0.945	6.49	-	0.34
<b>UNSUPPORTED(100%)</b> RCSP	<b>0.829</b>	<b>26.36</b>	<b>0.973</b>	<b>19.51</b>	<b>0.930</b>	<b>6.40</b>	<b>0.910</b>	<b>6.26</b>	<b>0.867</b>	<b>0.33</b>

## SUMMARY

A portable, intuitive, low-maintenance instrument for quantification of the arch height was designed and built with the unique ability to accommodate all foot types. Multiple parameters were polled and found to be intra-rater reliable. Currently, inter-rater reliability is being investigated.

## REFERENCES

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