

## INTRODUCTION

- Motion capture systems are used for gait analysis and provide quantitative data that is key for clinical decision making and orthopedic surgical planning for Cerebral Palsy (CP).
- Modeling the motion of the foot can be challenging and therefore it is represented as a single segment:

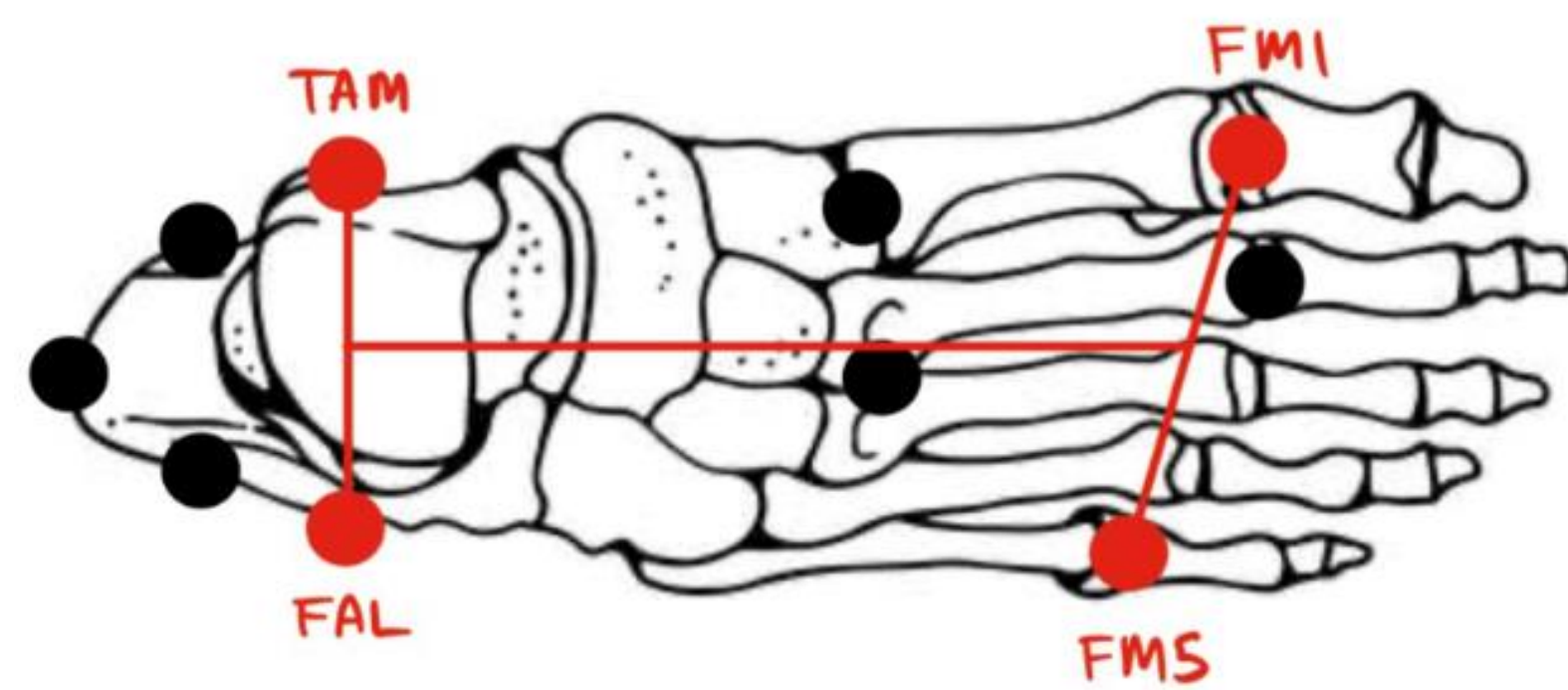


Figure 1. Established Rady Single Segment Model.

- Oversimplification of the foot model may fail to capture motion of the foot in complex foot deformities, such as children with CP.

## PROBLEM

The current single segment foot model used in gait analysis for children with CP fails to distinguish between hindfoot and forefoot movement, inadequately capturing the complex motion of the foot, which reduces its ability to help quantify deformities and inform treatment decisions for patients.

## 2-SEGMENT DEVELOPMENT

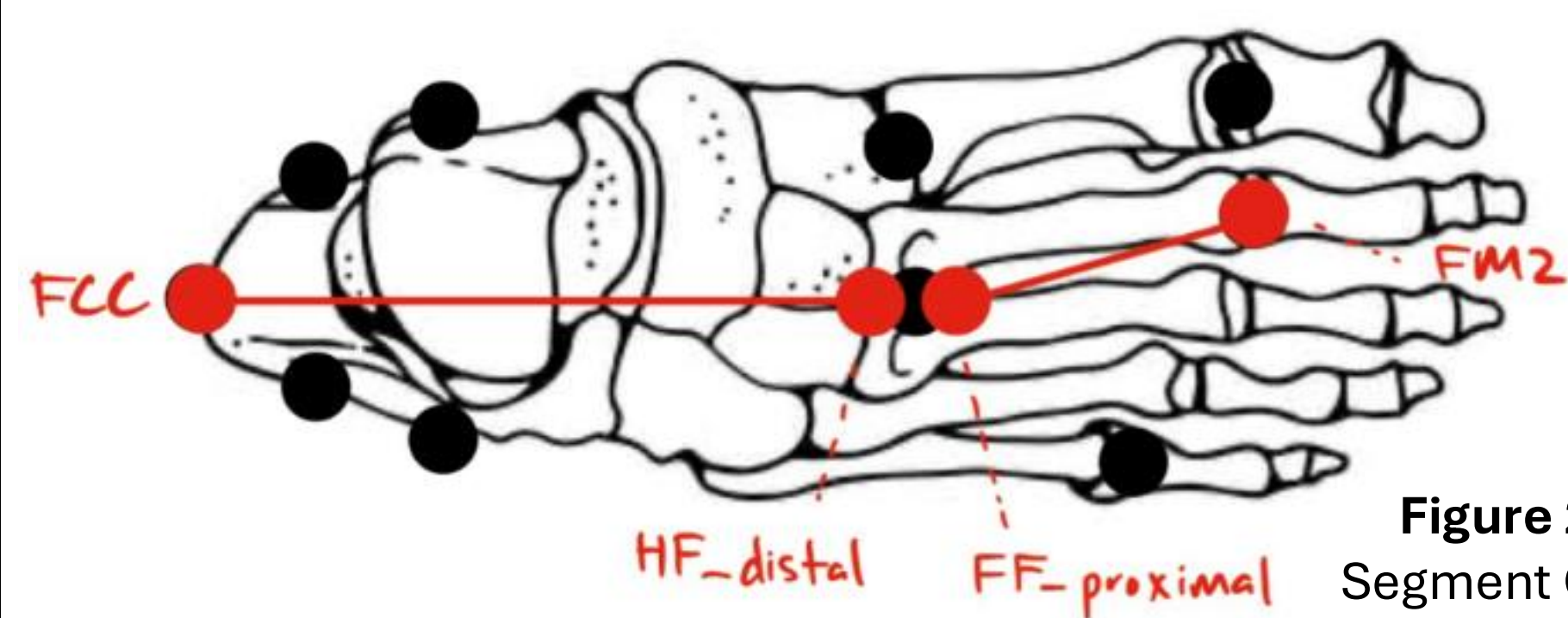


Figure 2. Rady A Segment Creation.

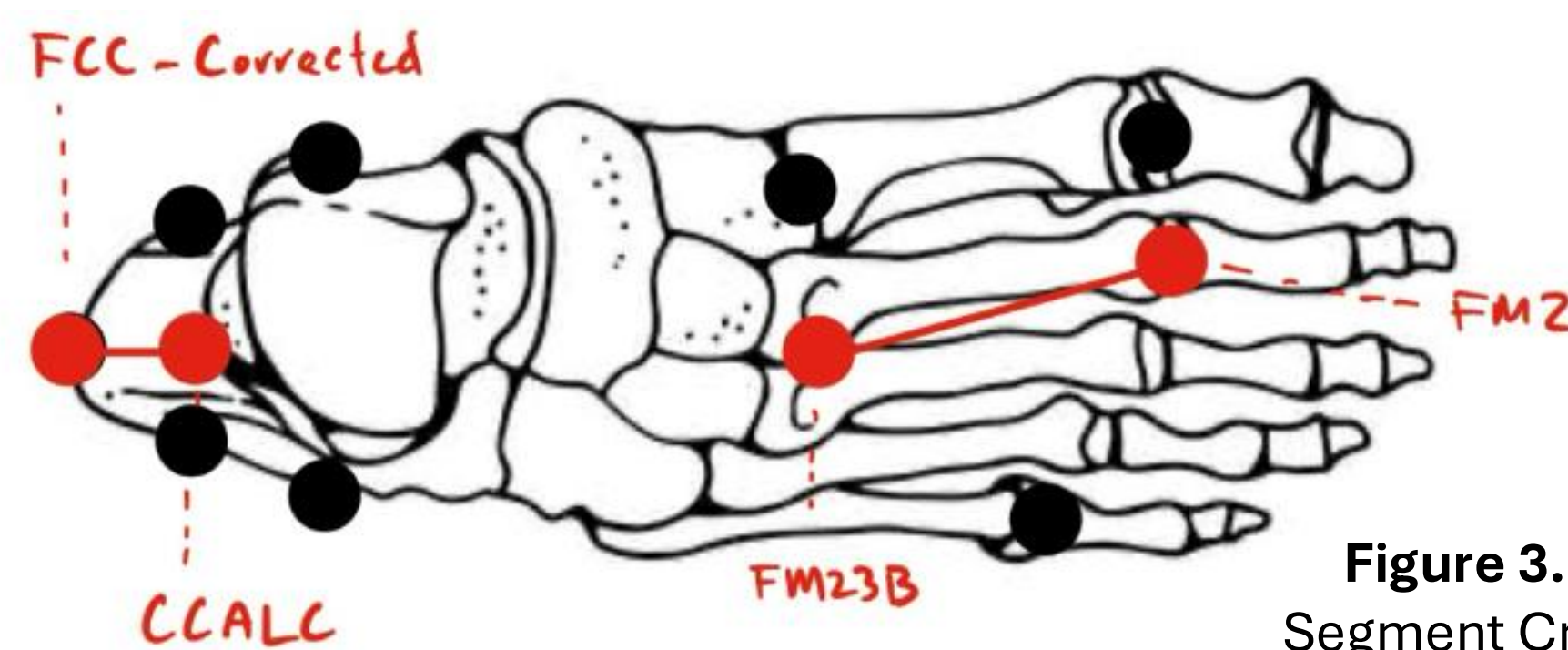


Figure 3. Rady B Segment Creation.

## METHODS: VALIDATION TEST

Controlled validation using 3D Printed Foot Models to determine whether each virtual model produces consistent, repeatable responses to known 10° angular increments

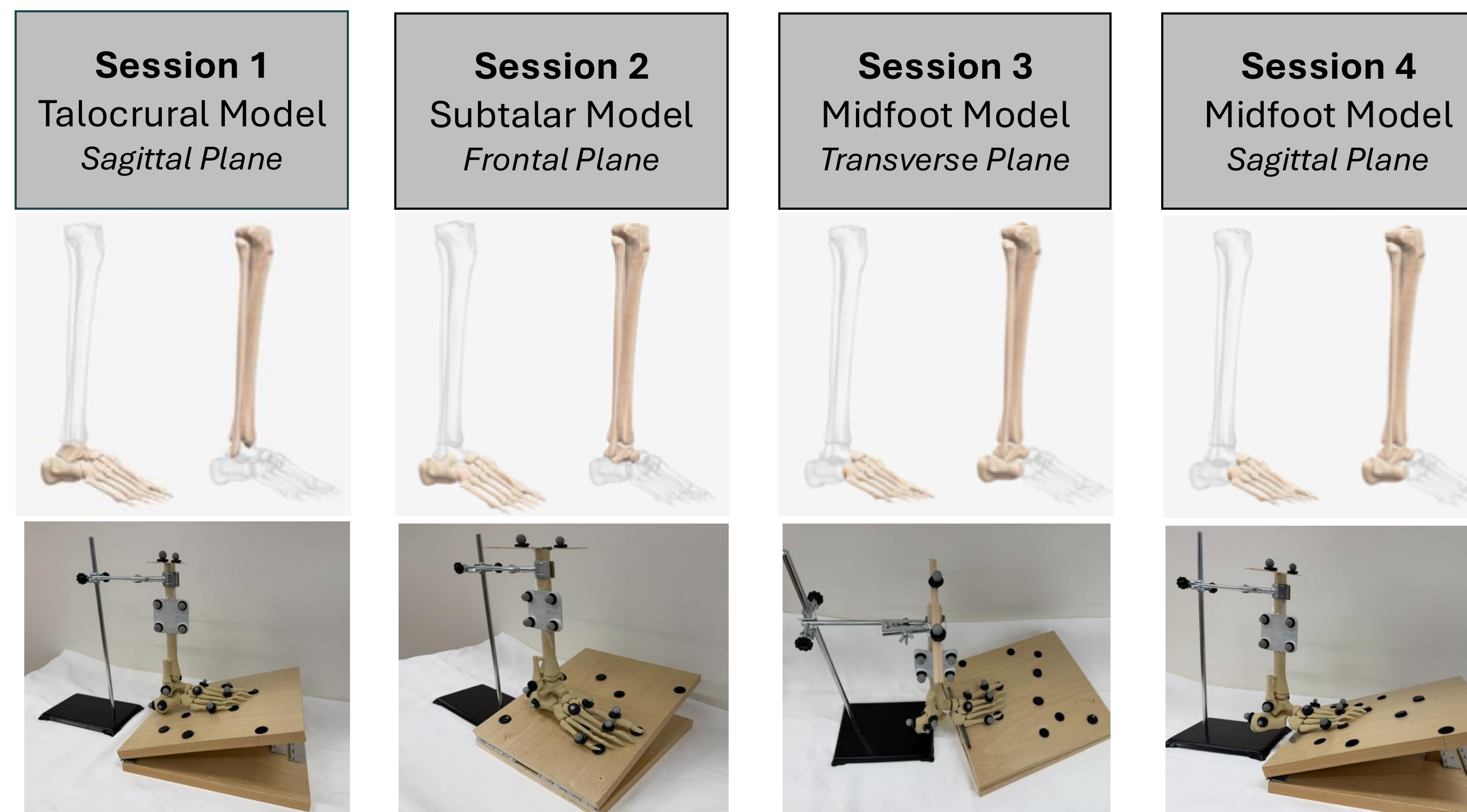


Figure 4. Three Physical Foot Models positioned on the Degree Board for respective movements.

## RESULTS: VALIDATION TEST

Joint angle change between two trials with known 10° difference (Flux)

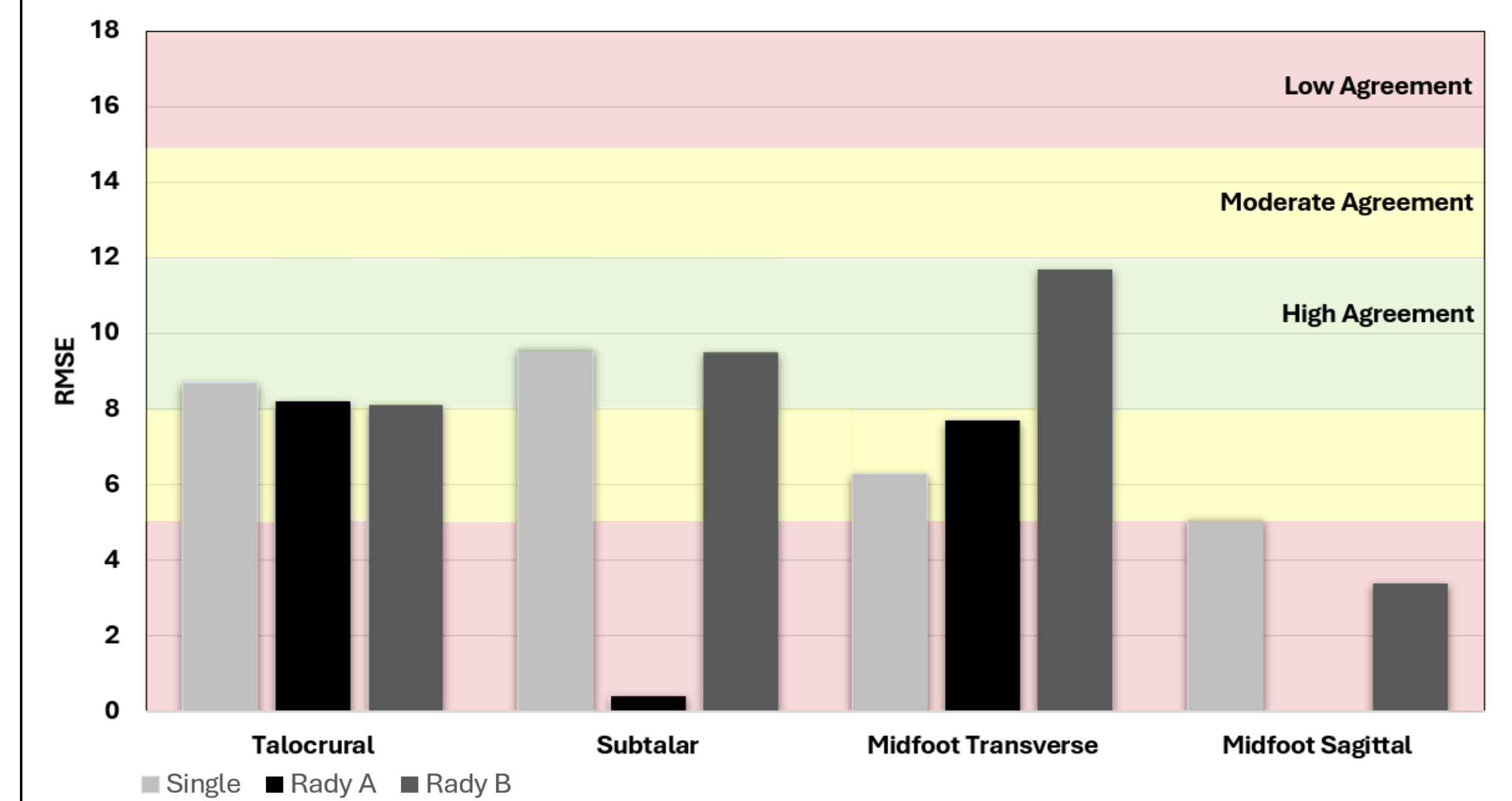


Figure 5. Root Mean Square Error of the Single Segment, Rady A, and Rady B Foot Models from the Validation Test.

## DISCUSSION

- Rady A did not effectively model the Subtalar Joint for the frontal plane or the Midfoot for the sagittal plane.
- Rady B had high agreement for three out of four testing sessions and therefore was applied for normative patient testing.

## NORMATIVE PATIENT KINEMATICS

Single Segment and Rady B applied to 14 Normative Patients to use as Reference for CP Patients

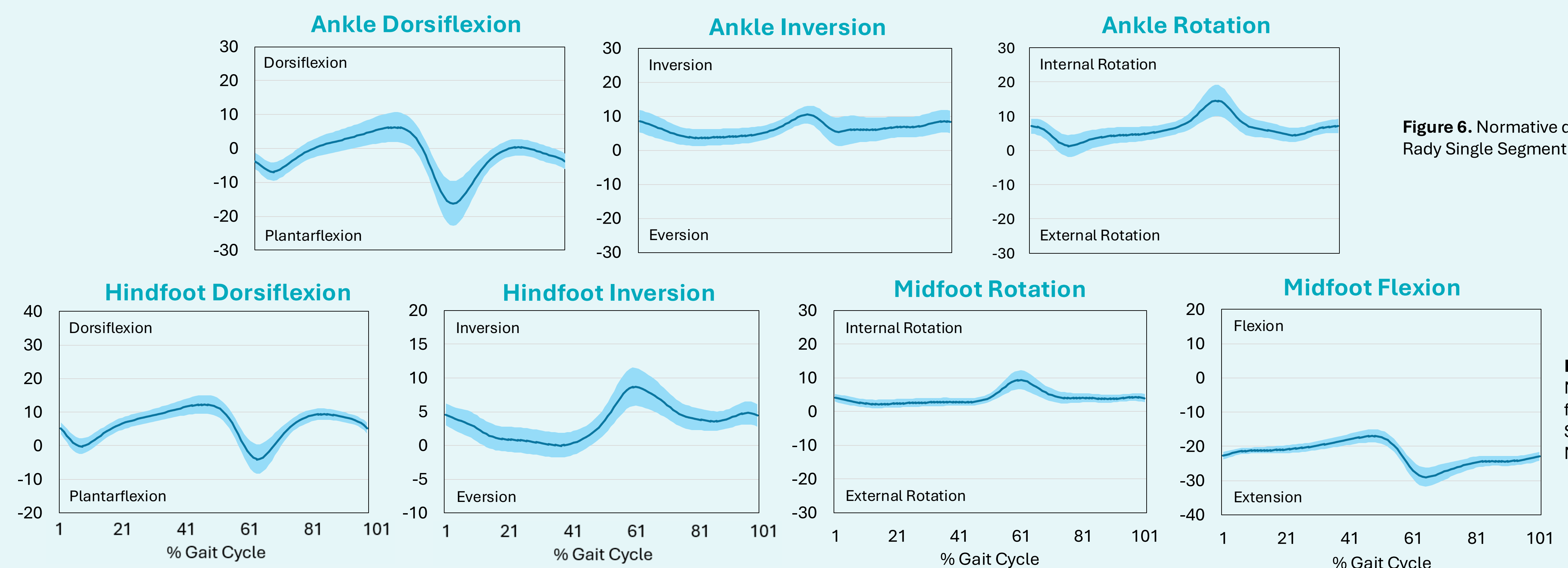


Figure 6. Normative data for the Rady Single Segment Foot Model

Figure 7. Normative Data for the Rady B 2-Segment Foot Model

## CONCLUSION

- Rady B provided normative kinematics for the hindfoot and midfoot within ranges found in literature that can now be used as a reference in clinical CP patients (Yoo).
- Midfoot rotation and flexion kinematics provide new clinical information from a biomechanical modeling standpoint, which the single segment can not calculate.