

Oral presentation

Foot motion in children and adults

Sebastian Wolf

Address: Department of Orthopedic Surgery, University of Heidelberg, Germany

Email: Sebastian Wolf - Sebastian.Wolf@ok.uni-hd.de

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Introduction

When studying the function of the human foot, foot pressure measurements offer some insight into the biomechanics of the growing foot [1] and models have been proposed to measure the foot kinematics especially of children [2]. Aside from ankle kinematics however [3], little is known about differences in foot motion between children and adults. This ongoing study therefore examines the foot kinematics of normal subjects in a large age range.

Methods

Normal feet of 30 children aged 4–11 years (mean 7.8 yrs) and of 24 adults aged 19–51 years (mean 32.4 yrs) have been examined by instrumented gait analysis using the Heidelberg foot measurement method (HFMM) [4] with the marker set illustrated in Figure 1. In this method, the motion of the hind foot is described relative to the tibia by tibio-talar (ankle) flexion and subtalar rotation. For mid- and forefoot motion, functional parameters are evaluated which are relevant for a clinical evaluation forming together a standardized set of 12 angles. The ROM in each angle has been determined across the gait cycle as a "dynamic" evaluation. Further, these parameters have been evaluated in mid swing to find "static" differences with respect to age in the geometry of the unloaded foot. A student T-Test was used to evaluate differences between the feet of children and adults.

Results

Data are summarized in Table 1. We find a smaller ROM across the gait cycle in (conventional) ankle flexion for children in agreement with [3] and specifically a smaller

ROM in tibio-talar flexion. Further, children show smaller ROMs in forefoot supination and adduction. Most prominent "static" findings in mid swing were a higher cavus (smaller medial arch angle) and less divergent metatarsals (MT 1–5 angle) with also a smaller ROM in children compared to adults.

Conclusion

In normal walking, foot motion in children differs significantly to foot motion in adults with respect to forefoot and hind foot motion.

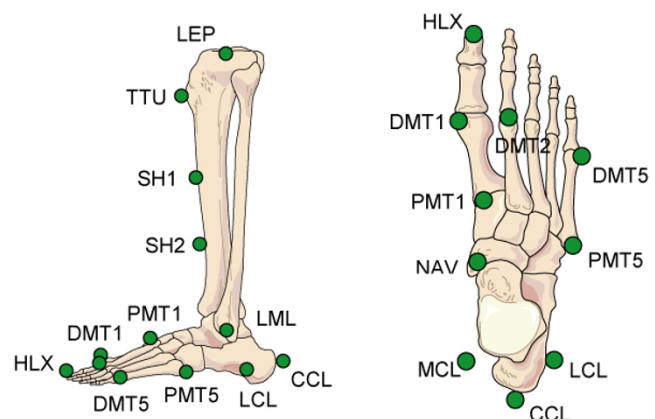


Figure 1
Marker set.

Table 1: Comparison of foot parameters

	Children	Adults	p
ROM Tib.-talar flexion	19 ± 4	25 ± 6	0.000
ROM Ankle flexion	30 ± 5	34 ± 7	0.017
ROM Subtalar evers	11 ± 2	11 ± 3	0.504
ROM Medial arch	17 ± 4	17 ± 4	0.789
ROM Medial arch tilt	19 ± 7	17 ± 7	0.393
ROM Lateral arch	13 ± 3	13 ± 3	0.634
ROM Fore/Hindf. add.	9 ± 3	10 ± 3	0.109
ROM Foref./Ankle add	12 ± 3	14 ± 4	0.042
ROM Foref./Ankle supi	10 ± 2	14 ± 4	0.000
ROM Fore/midf. supin	6 ± 2	6 ± 2	0.463
ROM MT1-5 Angle	10 ± 3	13 ± 4	0.003
ROM Hallux abduct	8 ± 3	6 ± 2	0.029
ROM Hallux extens	46 ± 8	48 ± 8	0.379
ROM Foot Alignment	15 ± 5	13 ± 5	0.377
MSw Subtalar evers	7 ± 6	8 ± 6	0.607
MSw Medial arch	122 ± 8	129 ± 10	0.009
MSw Medial arch tilt	-3 ± 7	0 ± 9	0.131
MSw Lateral arch	-1 ± 7	-4 ± 6	0.119
MSw Fore/Hindf. add.	-13 ± 4	-13 ± 6	0.839
MSw Foref./ankle add.	-6 ± 4	-4 ± 4	0.015
MSw Foref./Ankle supi	7 ± 4	9 ± 4	0.073
MSw Fore/midf. supi	-12 ± 5	-12 ± 4	0.847
MSw MT1-5 angle	0 ± 5	6 ± 5	0.000
MSw Hallux abduct	-14 ± 5	-15 ± 6	0.286
MSw Hallux extens	21 ± 8	19 ± 6	0.430
MSt Foot Align. (ARO)	2 ± 5	5 ± 4	0.008

References

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