

Postural and kinematic alterations in the paediatric asymptomatic plano-valgus foot joints

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INTRODUCTION: Plano-valgus (PV) is a common alteration of foot posture present in the paediatric population, characterized by valgus rearfoot, foot pronation and drop of the medial longitudinal arch (MLA). If misdiagnosed, this condition has the potential to cause pain and discomfort, and may hinder the lower limb kinematic chain. While a number of studies have investigated the kinematics of the paediatric PV foot, e.g. [1], no information is thus far available on postural and kinematic alterations of the major joints spanning the MLA - i.e. midtarsal and tarso-metatarsal.

METHODS: 20 children (13 M, 7 F; 13 ± 1 years) with bilateral asymptomatic PV foot were recruited in the study. Radiological indicators of PV condition, such as the calcaneal pitch, lateral talo-first metatarsal angle, and talo-navicular coverage, were measured from weight bearing X-rays. Gait analysis was conducted on the childrens' feet with the Rizzoli Foot Model [2, 3]. This was applied to measuring double-leg support upright static posture and gait kinematics of the main foot joints, including midtarsal and tarso-metatarsal joints, along with MLA deformation. Range of motion and temporal profiles of joint rotations were compared to those from a control group of age-matched children with normally-developed (ND) feet (4 M, 6 F; age 13 ± 1 years). Mann-Whitney U test was used to assess differences in static posture and kinematic global parameters between PV and control. One-dimensional statistical parametric mapping was used to determine differences in stance-normalized foot joint rotations between PV and control. Acknowledgement of the Hospital's IRB was granted (protocol n° 7/17) and parents' informed consent was obtained for all children recruited in the study.

RESULTS: The PV midtarsal joint was more dorsiflexed, everted and abducted than that in the control group, but showed reduced median sagittal-plane ROM (PV= $15.9 [12.1 19.2]$ deg; ND = $22.2 [19.5 24.9]$ deg; $p < 0.01$). The tarso-metatarsal joint was more plantarflexed and adducted, and showed larger frontal-plane ROM. The MLA showed larger ROM (PV= 58 ± 18 deg; ND = 37 ± 9 deg; $p < 0.05$) and was more dropped throughout gait duration. A diagrammatic representation of sagittal-plane orientation of foot segments in static posture and at push-off in stance is shown in figure 1.

DISCUSSION: Similar to what reported in previous studies, the PV hindfoot resulted significantly everted and plantarflexed with respect to the tibia, and the MLA was more collapsed throughout stance duration. In addition, the Rizzoli Foot Model allowed investigation of the postural and kinematic alterations at the midtarsal and tarso-metatarsal joints. It should be highlighted that children with PV foot walked more slowly and with a reduced stride length than control, and this might have – albeit marginally - affected the differences observed in the joint rotation profiles.

SIGNIFICANCE/CLINICAL RELEVANCE: In the paediatric plano-valgus foot, a hindered windlass mechanism and/or insufficient activation of the intrinsic plantar muscles [4] may be responsible for larger dorsiflexion of midfoot joints and greater collapse of the MLA during gait. A better understanding of PV midfoot joints postural and kinematic alterations is necessary to improve diagnosis and treatment of PV condition.

REFERENCES:

1. Hosl M, et al. Gait & Posture 2014; 39:23-8.
2. Leardini et al. Gait Posture 2007; 25(3):453-62
3. Portinaro et al. J Foot Ankle Res. 2014 20;7(1):754.
4. Angin S, et al. Gait & Posture, 2014; 40:48:52.

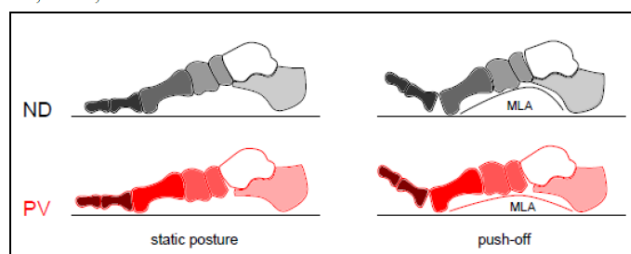


Figure 1 Diagrammatic representation of the sagittal-plane intersegmental orientation in double-leg support static posture (left), and at push-off (right) for the normally-developed (top) and plano-valgus (bottom) feet according to the average intersegmental rotations from the two groups.