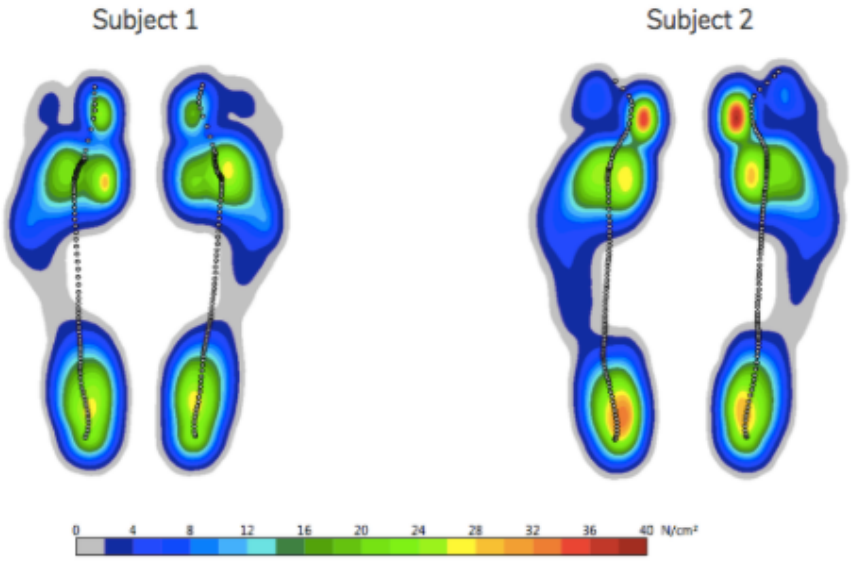
Lower Extremity Changes During Gait and the Contribution to Future Injury in Asymptomatic Pes Planus

Introduction: Pes planus is a common diagnosis seen in the clinic. Pes planus is a postural abnormality of the foot, defined by the excessively low navicular bone that leads to the sole of the foot nearing or touching the ground. Its association with pain and movement, and its effects on the alignment of all lower extremity joints has been highly researched. The purpose of this study was to identify changes throughout the lower extremity kinetic chain in an individual with asymptomatic pes planus when compared to a typical arch, and determine any associated injury risk secondary to pes planus.

Methods: Two subjects were entered into this study. Both subjects were female, college-age students with an athletic history. Subject 1 had a typical arch and subject 2 had pes planus. Markers were placed on the lower extremity of both participants for a 3D analysis that measured joint angles, joint moments and ground reaction forces (GRF) during self-selected gait. Other measurements included arch height in normal stance and in subtalar neutral, ankle varus/valgus, and foot pressure mapping in both static stance and during self-selected gait using an instrumental treadmill.

Results: Following the 3D analysis on joint angles, the following results were obtained: subject 2 demonstrated increased peak hip flexion (35.9° vs. 27.1°) and decreased peak hip extension (-13.3° vs. -32.8°) throughout the entire gait cycle. In the ankle joint, subject 2 had increased peak plantarflexion (PF) (-30.4° vs. -31.6°). This resulted in more PF at early stance, a similar pattern but delayed execution in late stance to early swing, and more PF at the end of the gait cycle. In the frontal plane, subject 2 demonstrated increased peak hip abduction (-6.4° vs. -3.4°) throughout the entire swing phase. The knee joint showed prolonged and increased peak genu varum (12.2° vs. 8.8°) in swing phase and the ankle joint demonstrated overall decreased variability. In the transverse plane, subject 2 was found to have decreased peak hip internal rotation (IR) (5.3° vs. 10.0°) and increased peak knee IR (21.3° vs. 14.0°). Results for joint moments indicated that subject 2 demonstrated limited offloading compared to subject 1 in the frontal plane for both hip abduction (-0.22 Nm vs. -0.09 Nm) and ankle inversion (0.22 Nm vs. 0.42 Nm). Lastly, the foot pressure mapping revealed that subject 2 demonstrated overall increased foot contact and a more medially distribution of the center of pressure. See graph below.



Discussion: When preparing for this study, many conflicting articles were found in the literature regarding the causes and treatments of pes planus. While an abundance of articles are available for the pediatric and geriatric population, the authors of this study found a gap in the literature for pes planus in the young adult age range. It was hypothesized that this trend may be related to the combination of the fact that young children often grow out of this condition, teens and young adults who do present with pes planus are often asymptomatic, and that overuse and compensatory injuries that are correlated to pes planus often appear in older adult populations. Therefore, the findings of this study will help to fill this gap in the literature.

Conclusion: The increased PF seen in subject 2 as compared to subject 1 may be indicative of a dorsiflexion limitation. Limited offloading in frontal plane joint moments for subject 2 suggest decreased power generation and increased stance time during gait. The decreased trough visible in the vertical GRF graph further supports this assumption for subject 2.

Clinical Implications: It is estimated that 20-30% of the population presents with pes planus, therefore the likelihood of seeing this condition in the clinic is highly probable. When treating a patient for this condition, it is important to look at the joints above and below the injured segment to ensure we fix the root of the problem. Furthermore, consideration should be given to the movement variability an individual presents with, as the likelihood of injury increases with repetitive loads on tendons, ligaments and cartilage. Strengthening the intrinsic musculature of the foot and recommending orthotics are two possible treatment options for this condition.

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