The effects of excessive foot pronation on lower extremity ground reaction forces and kinematic joint angles

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Background: Athletes with pronated feet may experience decreased hip muscle activation associated with increased vertical ground reaction forces. Reduced dynamic stability may increase risk of sports injury. Excessive pronation of the foot is associated with valgus collapse at the knee joint, increased vertical ground reaction forces on medial knee joint structures, and increased patellofemoral joint loading rates. The purpose of this study is to determine the effects of foot pronation during gait on medial ground reaction forces in college-aged females. We hypothesized that the subject with excessive pronation at the ankle will demonstrate increased medial ground reaction forces and valgus at the knee.

Methods: Two female graduate students served as the subjects. One subject acted as the control and the second subject demonstrated excessive foot pronation. The subjects have no history of medial knee pain. Physiological measurements were obtained using an average of three trials. Reflective markers were applied to bilateral ASIS, PSIS, greater trochanter, lateral thigh, lateral shank, lateral malleolus, medial malleolus, dorsum of feet, and calcaneus. The position of the right foot was observed as the subjects walked over a force plate and data was analyzed using 3D motion capture analysis. Vertical, anterior-posterior, and medial-lateral ground reaction forces and joint angles and joint moments were calculated for each subject.

3. Results: A graph displaying the medial/lateral ground reaction forces of the two subjects during the stance phase of gait shows the subject with excessive pronation with increased medial forces immediately following heel strike and abrupt flat footing when compared to the control. The pronated subject increased medial force throughout the entirety of the stance phase, while the control approached a neutral ground reaction force. These are consistent with excessive pronation findings. The second piece of data to support our hypothesis was the graph displaying the frontal knee moments of the two subjects. The subject with excessive pronation displayed a greater knee abduction moment during stance phase, and reaches about 0.76 degrees of difference, which is consistent with valgus findings.

4. Discussion and Conclusions: The findings of the study show that the subject with pronated feet demonstrated both increased medial ground reaction forces and valgus knee joint angles throughout stance phase. More research is necessary regarding the effects of foot pronation on knee pain, as neither subject has a history of sport injury at the knee. Foot kinematics affect joint angles proximally at the knee and hip as demonstrated by the differences noted in the frontal plane angles in the subject with pronated feet. Due to the study design, we were unable to incorporate additional bipedal movements and motions such as running, squatting, and jumping that occur in a regular occurrence, this study cannot accurately predict the risk of medial knee structure injuries.

5. Bibliography/Works Cited

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