

ARE THE KINETIC AND KINEMATIC CHANGES TO GAIT CAUSED BY FOOT ORTHOTIC USE IN A PRONATED POPULATION PERMANENT, OR MITIGATED DURING A ONE-MONTH PERIOD OF ADAPTATION

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INTRODUCTION

Foot orthotics are used commonly by a variety of medical practitioners to reduce pronation or alter improper foot biomechanics that are thought to increase mechanical stresses and contribute to overuse injuries of the foot. Researchers have gathered qualitative data from patient surveys to offer proof of foot orthotic efficacy (Gross et al.,1991; Orteza et al.,1992; Sperryn and Restan,1983). Surveyed patients either have completely or partially recovered from injuries such as shin splints, plantar fasciitis, stress fractures and inversion ankle sprains while using prescribed foot orthotics. In addition there have been several quantitative studies that demonstrated foot orthotics affect both the kinetics and kinematics of gait when used by pronated subjects (Johanson et al.,1994; Nawoczinski et al.,1995; Novick and Kelley,1990) . Unfortunately, the repeatability of quantitative results has been poor. Many researchers have been unable to confirm quantitative orthotic effects, or have found significant variations in effects. Foot orthotic therapy is therefore controversial, since quantitative researchers have been unable to repeatably determine kinetic or kinematic effects.

Unexpected results from past related research have led some to speculate; that human adaptation may play some role in kinetic and kinematic studies. Cavanagh and Edington (Cavanagh and Edington,1997) used 5 and 10° medial and lateral heel wedges to simulate the effect of a posted foot orthotic. Despite the fact that a 10° wedge angle is greater than typically prescribed for functional orthotics, they determined that very little change in the rearfoot leg relationship occurred. Therefore, it can be concluded that in a similar experiment with actual foot orthotics, Cavanagh would also have been unable to determine changes. The researchers reasoned that „the subject ... compensated such that and [sic] any consistent trends were eliminated“ and further that „the effect of habituation to the device on this compensation remains to be determined“.

In a study on the effects of sneaker midsole hardness on ground reaction forces during running, researchers determined ground reaction forces did not increase significantly as sole hardness was increased (Nigg et al.,1987). A mechanical system would have had an opposite result. Nigg speculated that increased initial speed of pronation was responsible for the surprisingly small change in impact force peaks when midsole hardness was increased. He was unable to conclude whether this change in pronation speed was caused solely by mechanical changes to the midsole (variation of hardness), or by the combination of mechanical changes and internal adaptation of the neuromuscular control system.

The knowledge gap created by the variability of study results leaves us in an unusual predicament. Despite the fact that foot orthotics remain widely used, to the extent they are even used prophylactically in forms with functional purposes similar (motion control and stability sunning shoes), their mechanical function, consistency and permanence of effects are not specifically known. It has been proposed, human adaptation may play some role in the variance of results. Yet no one has conducted a quantitative experiment applicable to a general pronated patient population.

Therefore, the purpose of this proposed research is to determine whether initial orthotic effects (kinetic and kinematic) are constant or varied over a one-month adaptation period. It is anticipated results from this research will help answer and further open dialogue on such questions as:

1. Are the initially reported effects of foot orthotics the true effects and should they be reported as such?
2. Does human adaptation over time impact biomechanic device effects?

PROCEDURES

Fifteen subjects (≥ 12 degs. calcaneal eversion during relaxed stance, ≥ 18 yrs. old, with no current gait affecting injuries) will be given appropriately sized identical test shoes (ECCO Canada) and identically posted (4° medial rearfoot + 2° medial forefoot) custom firm shoe inserts (Amfit Corp., Colman Prosthetic and Orthotic). These will be worn as a unit 8 hrs/day, 6 days/wk. for the length of the study, with the exception of a, shoes only, first week for the purposes of separating shoe adaptation from insert adaptation (Fig. 1). A five-camera array (Motion Analysis Corp.) and forceplate (Kistler Corp.) will be used to collect motion data, 10 trials/condition for each scheduled week. A calcaneal mold glued to the calcaneus with an externally visible marker triad will be used to display calcaneal motion. An ANOVA will be used to calculate changes in dependent variables (calcaneal angle at heel strike, velocity of eversion, acceleration of eversion, maximum angle of eversion, % of stance phase at maximum eversion angle, tibial rotation, heel strike force and COP).

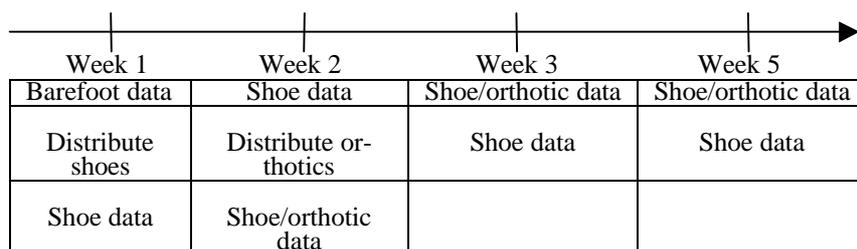


Fig. 1 Schedule time line. Data will be collected ten trials each condition at the beginning of each week.

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