

The Effects of Supported and Non-Supported Arches of the Foot

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ABSTRACT

Objective: The purpose of the study is to observe a change or lack thereof in the arch of the foot, with support (shoes with orthotics or high arch support) and with no support (bare feet).

Methods: Baseline foot scans were acquired for three consecutive days after non specified amounts of time wearing athletic shoes or casual shoes.

Results: The results of the study conclude that there is a negative change on the arch of the foot when wearing high arch support shoes and there is a positive change with walking bare foot.

Conclusion: The data demonstrates that there is a mild variation with individuals that did not wear arch supporting shoes versus the individuals that did wear arch supporting shoes in this particular study.

INTRODUCTION:

The purpose of the study is to observe a change or lack thereof in the arch of the foot, with support (shoes with orthotics or high arch support) and with bare feet. High arch support is theorized to be a major contributing factor in muscle weakness and arch deterioration leading to decreased arch height and biomechanical instability (1). It is hypothesized that there is an increased incidence of ankle and knee injury in those with excessive arch support in the shoes. The plantar fascia functions as one of the major stabilizing structures of the longitudinal arch of the foot. Repetitive weight bearing activities with improper footwear increases the load applied to the plantar fascia. Over time the fascia will thicken, forming scar tissue and weaken from the chronic cycle of micro-tearing, inflammation and pain. This alters gait patterns and puts abnormal stresses on the foot and ankle complex (5).

Pathology does not always present just within the plantar fascia and the arch of the foot. The ankle, knee, hip, and even the pelvis and low back may be affected secondary to plantar fasciitis as gait is altered. For chiropractic physicians and athletic trainers to make educated recommendations to their patients, it is necessary to begin to look at effects of shoes with high arch support, shoe inserts and how they affect the arch of the foot and foot health. Those that live an active lifestyle are estimated to take over 10,000 steps throughout the day and with each step well over twice their body weight is forced into the foot. Even people who are sedentary complete approximately 3,000 steps per day (5). By consistently wearing shoes with high arch support the muscles that naturally support the arch eventually weaken over time causing a change in structure and decreased ability of the foot to transmit weight properly through the lower kinematic chain (9). This alteration changes the natural shock absorbing function of the

foot, and over time the foot will stiffen causing global dysfunction throughout the musculoskeletal system.

The aim of this research project is to show that by removing arch support there will be an increased demand on the soft tissue supportive structures of the foot/ankle/lower leg complex and increased mobility of the foot all together. This increased demand will result in an overall strengthening of the foot so that the arch is naturally supported. This natural support will allow the structure of the foot to function as it was intended thus reducing frequency and severity of lower extremity musculoskeletal injury.

METHODS:

Baseline foot scans were acquired before barefoot training began for three consecutive days after non specified amounts of time wearing athletic shoes or casual shoes. These scans were used to determine how shoes change the arch of the foot during activity such as walking. Both women and men ages 20-60 with no previous trauma or instability of the ankle or feet were recruited. Participants were also required to be able to maintain an individually based brisk walking speed for 20 minutes and up to the equivalent of 1 miles distance. Those excluded from the study were ages below or above set inclusion criteria, those with recent surgical procedures in the ankle or feet, any presence of instability of the lower extremity, those taking medications such as prescriptions or herbal relaxants, those with previous trauma to the ankle or feet resulting in abnormal biomechanics, those with a history of infection, injury or malignancy of the lower extremity, those with congenital conditions of the lower extremity, history of dizziness or light

headedness with exertion, recent automobile accidents of any mode or anyone not able to complete a 20 minute 1 mile walk.

The data was collected and analyzed by Foot Levelers 3D scanner and computer software. This scanner produces 3D images of the patients feet in full mid-stance weight bearing that are topographical colorized to show excessive supination or pronation of the foot which can lead to overall dysfunction of the normal biomechanics of the foot and gait cycle (Foot Levelers). Thank-you to Foot Levelers and Logan College of Chiropractic Montgomery Health Center for approving the use of the Foot Levelers' Associate Platinum Digital Scanner and V7+ software to track and monitor changes throughout the experiment.

RESULTS:

Figure 1

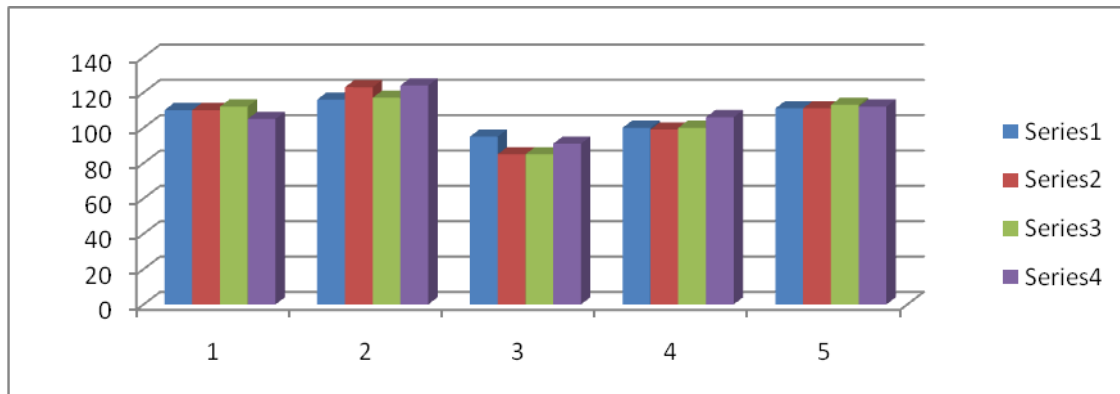


Figure 1: results of pre and post foot scans of five subjects that participated with shoes. Blue: baseline pre scan #1. Red: baseline pre scan #2. Green: baseline scan #3. Purple: post scan. The lower the scan index number (y axis) the greater arch stability and desired foot print.

Figure 2

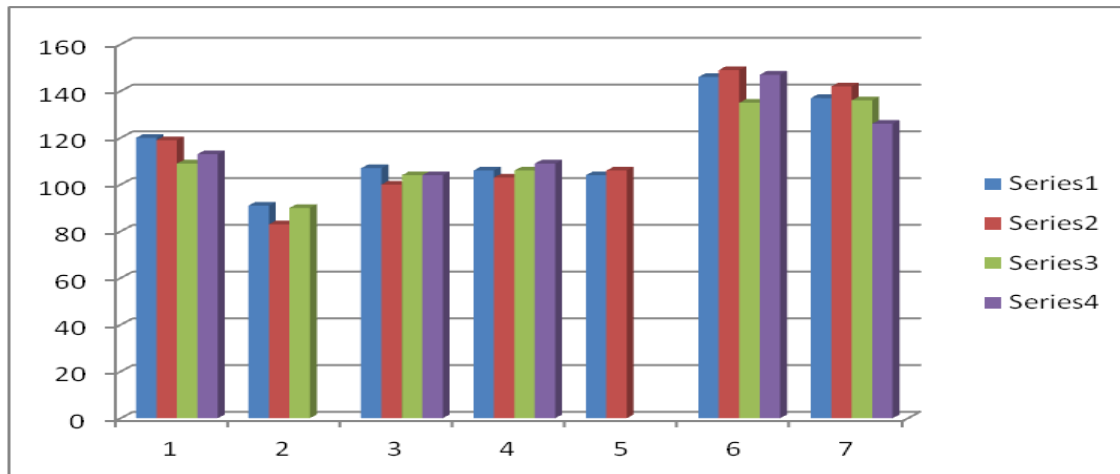


Figure 2: results of pre and post foot scans of seven subjects that participated without shoes. Blue: baseline pre scan #1. Red: baseline pre scan #2. Green: baseline scan #3. Purple: post scan. The lower the scan index number (y axis) the greater arch stability and desired foot print. If all colors are not present it represents a subject that did not maintain full participation.

Preliminary data reveals several important trends that indicate that plantar arches increased in five out of seven participants while walking barefoot (Fig. 2) compared with walking in shoes in which only one out of five got improvements in the plantar arch. (Fig. 1). Data also shows that only two out of seven subjects had worse foot print scan levels compared to those wearing shoes in which four out of five had a higher scan index number (Fig. 1) Also noteworthy that subjects that wore shoes were inconsistent in the type of shoes worn throughout the study and pre-scan shoes were different than shoes used in post scan. These findings are positive in the fact that barefoot walkers have a higher chance of increasing natural arch support than found in those who wear shoes. Note that the statistical significance for each subject with shoes show that four out of five had notable changes in scan index number and arch stability (Fig. 1). The statistical significance for each subject without shoes shows that five out of seven had notable changes in scan index number and arch stability (Fig. 2).

DISCUSSION:

The data demonstrates that there is a mild variation with individuals that did not wear arch supporting shoes versus the individuals that did wear arch supporting shoes. The arch stability in majority of the individuals that participated with shoes had no change, whereas majority of the individuals that participated without shoes had a mild increase in arch stability and desired foot print. It is implied through research that the individuals wearing arch supporting shoes had increased pressure on their arches and plantar fascia due to biomechanical error in the gait. (Sports Med 9.2: 76-85, 2008)

Research states that increased pressure to the arch, as suggested when the individuals were wearing athletic shoes to walk, will lead to changes in the plantar fascia. Degeneration in the plantar fascia will be demonstrated in the scan of the arch due to the arch becoming more planar. By walking without the arch supporting shoes, there was decreased pressure applied to the foot each session and therefore the foot had no additional degeneration on the foot. This was reflected in the foot scan by displaying an increased arch. The subjects that wore their everyday athletic shoes received their typical pressure and strain to the foot and therefore no positive change was noted on the scan. (Journal of the American Podiatric Medical Association 93.3: 234-237, 2003)

The foot relies on an angular foot motion mechanism for a normal gait. While wearing shoes, the angular motion is interrupted; increased pressure is applied to the plantar fascia, and then demonstrated in the arch. It is implied that the subjects wear shoes for a majority of walking and therefore do not get the full advantage of the angular system that is natural to the human biomechanics. During the walking sessions, the subjects that were barefoot concluded

the study with mostly increased arch height. This suggests that by walking for the short amount of time the study took place, it is possible that the angular motion system was in use and the arch was partially restored. (Gait & Posture 2.3: 191-197, 1994)

By comparing the arch stability and foot print of the barefoot subjects to the arch stability and foot print of the subjects wearing shoes, the majority of individuals wearing shoes showed no change or negative change in each individual arch stability index. The majority of subjects that were barefoot during the walking sessions concluded with an overall increase in arch stability and desired foot print. It is fair to say, that the research implies that the biomechanical function of the foot is vital to the arch of the foot and the health of the plantar fascia. By allowing the foot to perform a gait with the true biomechanics of the foot, it produces healthy arch and plantar fascia. Restricting the foot's biomechanics with use of arch support may lead to an altered arch and degenerated plantar fascia.

Due to the unforeseen variations in consistency of participants and availability of venue it is recommended that a repeat of the research study be conducted. The number of participants should be increased. Days of walking need to be within a shorter time, or factors that will influence the participants to continue with the research to decrease risk of drop off by participants. Decrease outside influences on the foot itself, such as shoe type variations and activity level differences between participants would be ideal to increase reliability of the study.

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