

# THE EFFECTIVENESS OF THE KINETIC WEDGE FOOT ORTHOSES MODIFICATION TO IMPROVE GAIT POSTURE

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## INTRODUCTION

Humans are the only species to successfully walk using an erect bipedal posture. The unique design of human feet, more so the first metatarsophalangeal (MTP) joint allows us to walk in a relatively upright position, to facilitate the efficiency of the inverted pendulum (Winter, 1995). An obstruction, inability or delay of the inverted pendulum to move through the sagittal plane is referred to as sagittal plane blockage. One source of sagittal plane blockage is the inability or delay of the first MTP joint to permit adequate dorsiflexion from late stance phase, to toe-off during gait. This condition is referred to as **Functional Hallux Limitus (FHL)**. Podiatric clinicians suggest that FHL can result in slight disruptions of the inverted pendulum's centre of gravity (CoG) through the sagittal plane (Winter, 1995; Dananberg, 1986, 1993). According to clinicians, FHL leads to compensatory postural changes such as a forward lean to restore the pendulum. Clinicians suggest this FHL compensatory action may be a contributor to low back pain.



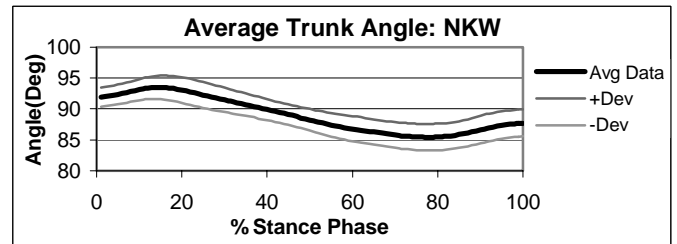
**Figure 1:** Compensatory forward trunk lean due to FHL (Dananberg, et al., 1996)

## METHODS

Fifteen subjects found having moderate to severe FHL by a chiropodist were included in the study. Each subject was supplied a pair of CFOs manufactured with the Amfit CAD/CAM system. Sagittal plane videographic gait data at 60 fps were collected. Subjects completed trials at a self-selected pace. Each subject was tested with the CFO without the Kinetic Wedge modification (NKW) and with the CFO plus the Kinetic Wedge modification (KW). Data for KW were collected after 30 minutes of practice. Kinematic data of the trunk segment for both conditions (NKW and KW) were compared. The minimal angle achieved by the trunk at the end of stance was used to represent forward trunk lean.

## RESULTS AND DISCUSSION

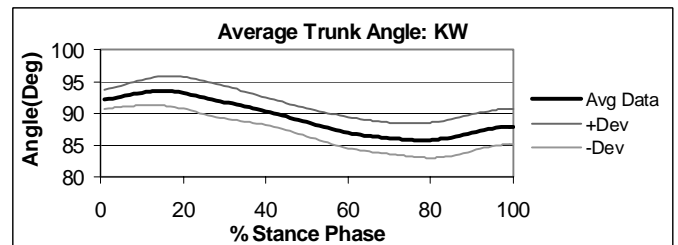
Unlike studies performed by the podiatric community instant changes in gait posture were not noted (Dananberg, 1995). The average maximum forward trunk lean achieved by subjects during NKW was 85.2 degrees ( $\pm 2.09$ ). The average maximum forward trunk lean achieved by subjects during KW was 85.5 degrees ( $\pm 2.76$ ). Nine subjects showed an improvement in trunk posture (trunk angle increased)



**Figure 2:** Ensemble averaged trunk segment kinematics during stance for NKW condition

during condition KW. One subject had an average increase of 1.60 degrees. Five subjects showed a decline in trunk

posture (trunk angle decreased) during condition KW. One subject had an average decrease of 1.90 degrees. Application of the Kinetic Wedge modification to custom foot orthoses resulted in a decrease ( $M = 0.212 \pm 0.99$ ) in maximal forward trunk lean at the end of stance phase. The decrease in forward trunk lean at the end of stance was not statistically significant ( $p > 0.05$ , two-tailed). Since there was no significant effect at the trunk, the investigators decided to consider whether or not there were changes lower in the kinetic chain. However, there were no significant changes during stance at the hip, knee or ankle joints. No significant change between treatments may have been related to the amount of practice time provided to subjects before KW data collection. Perhaps months, weeks, or even days of modified CFO use may have caused significant kinematic changes along the kinetic chain.



**Figure 3:** Ensemble averaged trunk segment kinematics during stance for KW condition

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