THE INFLUENCE OF HYPERPRONATION OF THE FEET ON PELVIC ALIGNMENT IN STANDING

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Introduction

Pronation of the foot is an essential motion of the normal function of the lower extremity.
Its main contribution to the gait cycle is shock absorption and adaptation of the weight bearing foot to the surface.
Hyperpronation is defined when hind foot motion is excessive, prolonged, and/ or occurs in inappropriate timing of the stance phase (Donatelli, 1987).

Hyperpronation of the foot may cause mal alignment of the lower extremity and frequently leads to injuries of joints, tendons, knee pain and stress fractures (Tiberio 1988).
There is no evidence documented on the relationship between hyperpronation and pelvic alignment in the sagittal plane although, several researchers do suggest a possible interrelationship (Gross, 1995; Tiberio, 1987; Tiberio 1988).

Aim

The purpose of this study is to examine the effect of hyperpronation of the feet on lower limb alignment and in particular, on the pelvic girdle position.

Method

Thirty five healthy subjects (15 men and 20 women, age 23 - 33 years) were put into hyperpronation in standing position, induced by wedges of different slopes (10º 15º and 20º).

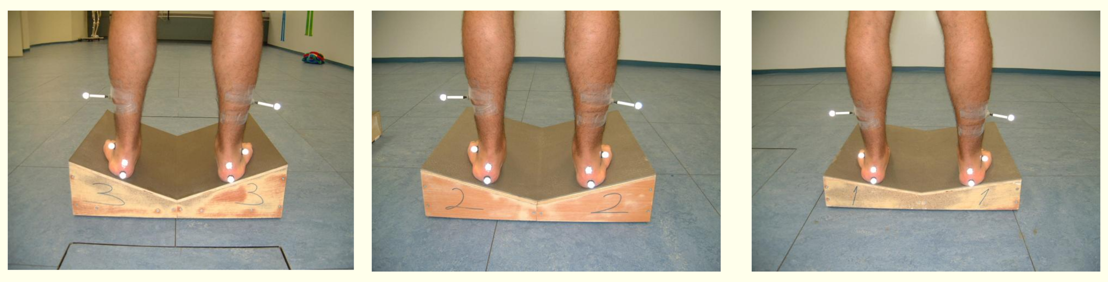


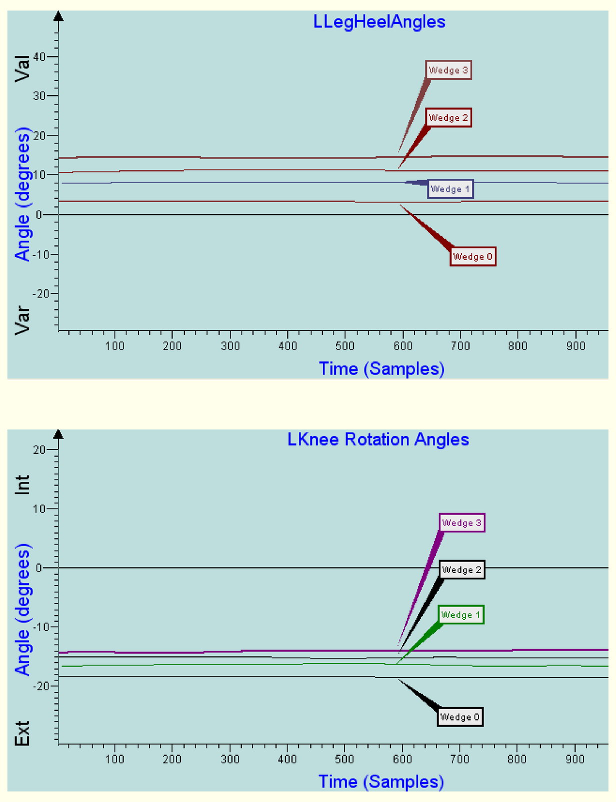
Figure 1

Subject standing on different wedges

The base line for comparison was natural standing position and the sequence of trials was random.
Each setting was maintained for 20 seconds and a random 3 repetitions were made.
A sample of 4 seconds was processed and measured.

Figure 2

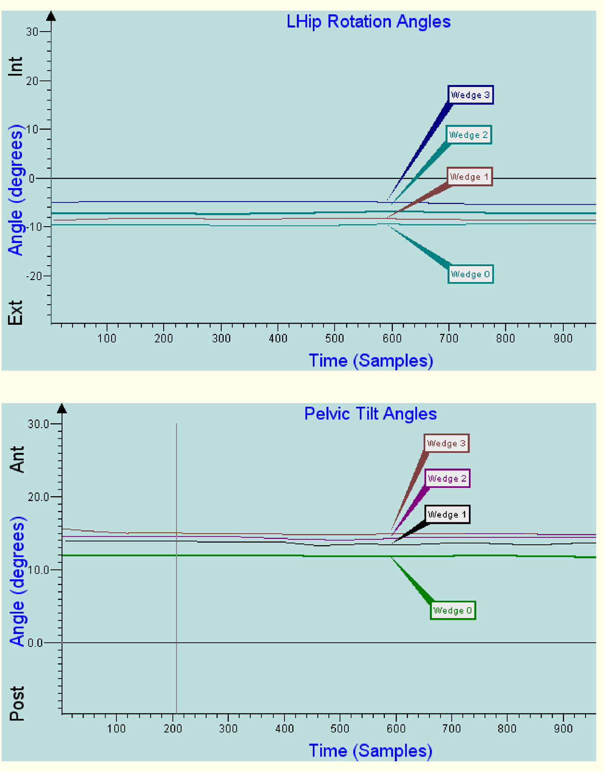
Random trails from natural standing to induced hyperpronation



Changes in the alignment of the lower extremity and the pelvis were measured by a computerized motion analysis system (VICON® 612).

Figure 3

Mean segmental rotation and anterior pelvic tilt during standing on the different wedges . The angles increased with the degrees of the slopes (N=35).



Results

The results indicate that as a consequence of induced hyperpronation, a statistically significant (t-test) increase in calcaneal valgus (p<.000), internal tibial rotation (p<.001), internal femoral rotation (p<.000) and anterior pelvic tilt (p<.009) was found (Fig 4).

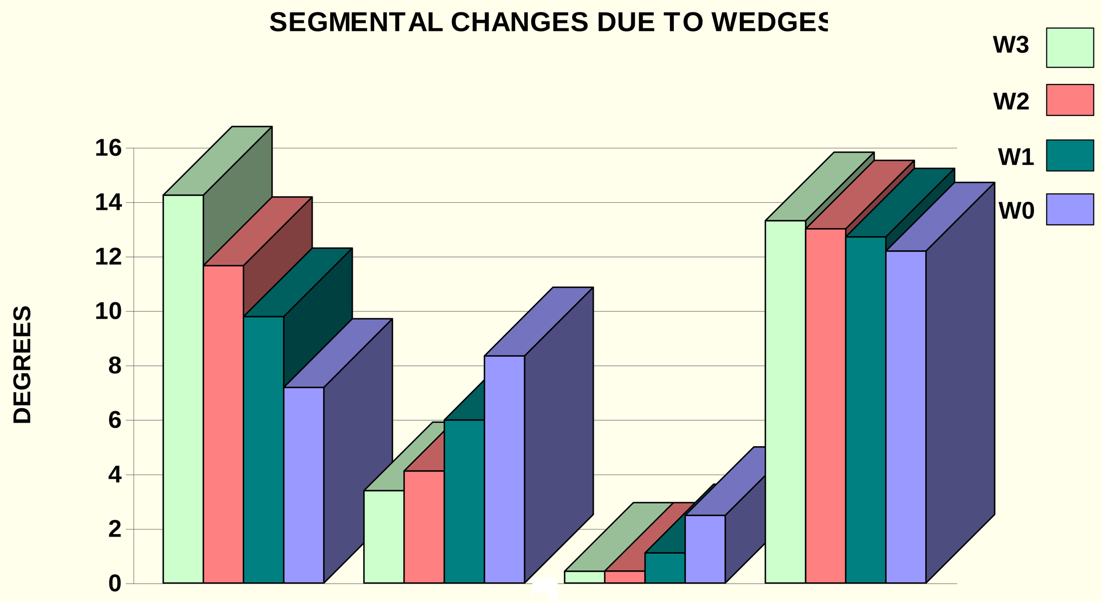


Figure 4

Paired t- test

Segment	Variable	Mean (Std Error)	t	*p*
Foot	W0 vs. W1	-2.597(.55)	-4.67	<.000
	W1 vs. W2	-1.875(.27)	-6.81	<.000
	W2 vs. W3	-2.585(.40)	-6.354	<.000
Shank	W0 vs. W1	-2.354(.26)	-9.03	<.000
	W1 vs. W2	-1.875(.23)	-8.05	<.000
	W2 vs. W3	-.721(.23)	-3.03	.005
Thigh	W0 vs. W1	-1.372(.23)	-5.78	<.000
	W1 vs. W2	-.672(.20)	-3.35	.002
	W2 vs. W3	-.874(.178)	-4.91	<.000
Pelvis	W0 vs. W1	-.517(.15)	-3.44	.002
	W1 vs. W2	-.293(.14)	-2.07	.046
	W2 vs. W3	-.303(.18)	-1.66	.106 ★

Table 1
The significance of the segmental changes due to induced hyperpronation was analysed by paired t-test.. All Changes were significant except for one(★)

A strong correlation (Pearson correlation coefficient) was found between induced hyperpronation of the feet and the rotational motion of the tibia, femur and pelvic tilt (r = .511 up to .950).

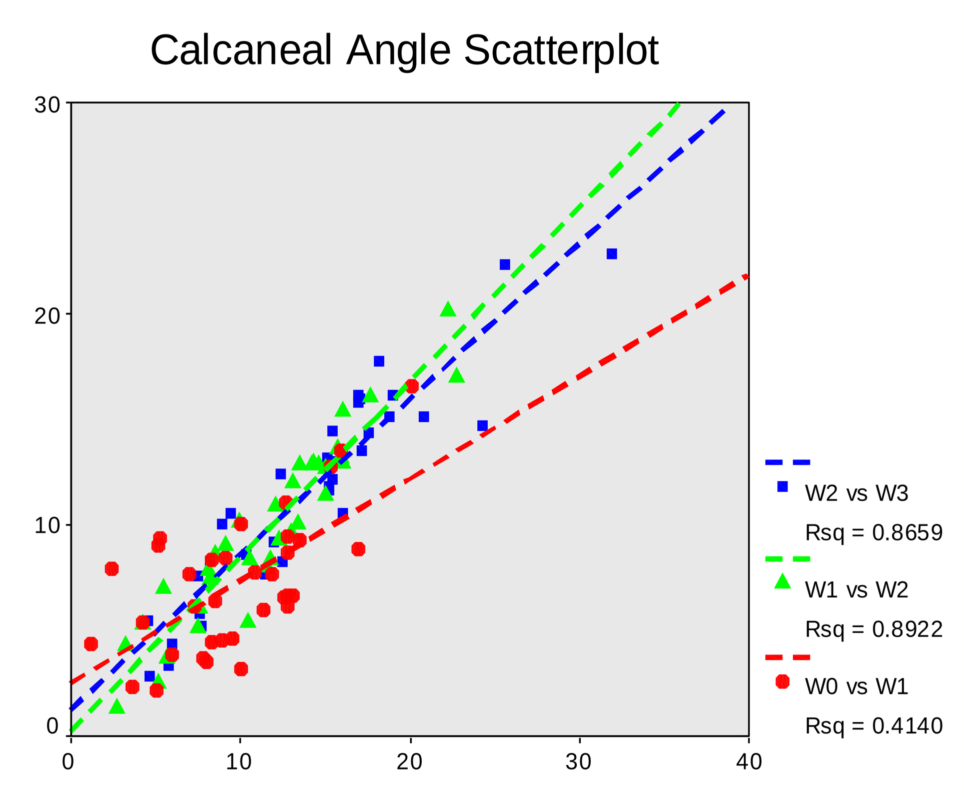


Figure 5

The wedges slope explained 41-89% of calcaneal changes (Rsq =0.892-0.414) during the trials.

Analysis of variance (ANOVA) revealed that the main effect of hyper pronation was on knee rotation.

Anterior pelvic tilt was affected significantly only by knee internal rotation. Stepwise Multiple regression (Fig 6) revealed standardized R square of 0.793.

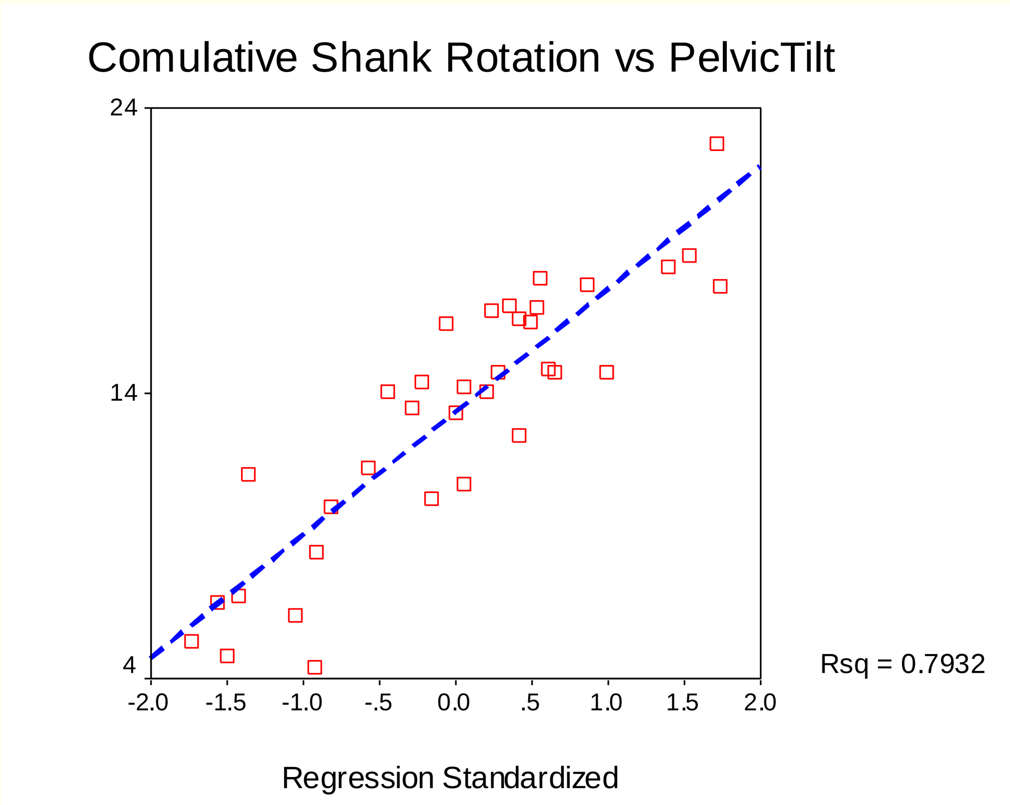


Figure 6

Conclusion

These finding suggest that a correlation exists between motion at the distal segment (the foot) and the proximal segment (the pelvis). Hyperpronation affected mainly shank internal rotation, while latter was highly correlated with anterior pelvic tilt.

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