

## **The Relationship between Foot Type, Postural Variables, Grip Strength, and Health History in the Elderly**

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### **Abstract**

The purpose of this study was to analyze the relationship between foot type and posture in the elderly. Subjects were 13 males (mean age of 75) and 36 females (mean age of 73) in the Seoul area. There were four elements to this study: a questionnaire (injury history, blood pressure, pain, and for men only: wallet carrying habits), foot type (resting calcaneal stance position or RCSP), grip strength, and postural (sagittal and coronal plane) measurements.

These different elements were measured in different ways. First, subjects filled out a questionnaire, providing information about their injury history, blood pressure, pain, and (for men only) wallet carrying habits. Second, Resting Calcaneal Stance Position (RCSP) was measured along with 3 Dimensional pelvic movement. Third, grip strength was measured. Finally, posture was measured via photographic analysis in the sagittal and transverse plan.

Resting Calcaneal Stance Position (RCSP) was measured by comparing a line bisecting the calcaneus to the ground. The resulting angle was categorized in the following way: An angle of +/- 2 degrees was considered normal, or pes rectus. An angle greater than 3 degree was considered abnormal and is called pes cavus. Finally and angle less than 3 degrees was considered abnormal and called pes planus.

Three dimensional pelvic movement was measured in the sagittal, transverse, and coronal plane. In the sagittal plane, anterior / posterior pelvic tilt was measured. In the transverse plane, clockwise and counter-clockwise rotation was measured. Finally in the coronal plane, left or right pelvic elevation was measured.

Grip strength was measured from standing position utilizing DT S&T. Grip strength provides a reliable assessment of full-body strength potential for the elderly.

Standing posture was measured using the Mzen BodyStyle. The Mzen Bodystyle provided visual landmarks to measure posture from the front, back, and side. In the front of the body, shoulder slope, pelvic slope, lower limb alignment (O type, X type) and knee flexion angle were measured. In the back, spinal angle and inters-scapular angle were measured. Finally, from the side, cervical spine flexion angle, upper body anterior deviation, and anterior / posterior pelvic tilt were measured

SPSS 18.00 was used for statistical analysis. The X<sup>2</sup> test was used with Scheffe for post-hoc. Kendall's tau\_b was used for the correlation.

### **Results**

1. 61% of subjects had normal foot types, while the remaining 39% were abnormal.
2. 14.3% of subjects suffered from pes planus, 61% were normal (pes rectus), while 18.4% had pes cavus.
3. There was no significant differences between men and women for pes planus. A significantly larger

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number of men had pes rectus compared to women, while women had significantly larger numbers for pes cavus than the men.

4. There were no significant differences between the left and right feet. For women however, there was a higher percentage of pes rectus in the left foot and a higher percentage of pes cavus in the right foot.

5. From the front, there were significant differences for shoulder slope, pelvic slope, and left knee flexion angle for women depending on foot type.

6. In men with pes planus and pes rectus, shoulder slope was higher for the right shoulder. In contrast, men with pes cavus had higher shoulder slope in the left shoulder. For women with pes cavus and pes rectus, shoulder slope was higher on the left side than the right.

7. Overall, women had higher knee flexion angles than men. Women with pes cavus had the highest knee flexion angles.

8. Both women and men with pes rectus exhibited spine deviations to the left. Also, shoulder slope and inter-scapular angle were oriented in the same direction for both men and women.

9. Men with pes planus had greater grip strength than other male foot types. There were no differences in grip strength according to foot type for women.

10. Subjects with pes planus in the left foot exhibited a backward-tilted posture along with an elevated right shoulder.

11. Subjects with pes cavus in the right foot exhibited an "o type" knee on the left side of their body along with forward-tilted posture.

12. There was a strong statistical correlation between pelvic elevation, pelvic rotation, and pelvic tilt.

13. Subjects with an elevated left shoulder exhibited several other bodily imbalances. These subjects exhibited forward flexion at the cervical spine, increased scapular and pelvic slope, and O-type knee on the right side.

14. An elevated left hip correlated with cervical flexion, and left-side dominance.

15. O-type knee on the right side correlated with cervical flexion, pelvic and scapular elevation on the left side.

16. As cervical flexion increased, forward tilt in the upper body also increased.

17. An increase in injuries corresponded with diminished grip strength and increased forward pelvic tilt.

18. Exercise corresponded with lowered diastolic pressure.

19. For men, there was a high correspondence between the side men habitually carried their wallets and pelvic rotation to that same side.

## **Conclusion and Suggestions**

For men, the direction of shoulder slope corresponded with scapular slope, but the pelvis usually sloped in the opposite direction.

There was a high correlation between history of physical injuries and muscular strength.

There was a high correlation between upper body tilt and history of physical injury.

Future studies will investigate the relationship between disease, foot type, and posture more deeply. In addition, future studies will investigate how the dominant hand and foot influences foot type, posture, and pelvic movement.