THE COMPARISON OF SUPINATED AND PRONATED FOOT IN GROUND REACTION FORCES ATTENUATION DURING SINGLE LEG DROP-LANDING

Ali Abbasi[1], Heydar Sadeghi[2] and Mehdi Khaleghi[3]

[1]Master in Sport Biomechanics, Physical Education and Sport Sciences, Iran, abbasi.bio@gmail.com
[2]Associate Professor, Department of Physical Education and Sport Sciences, Tarbiat Moallem University, Tehran, Iran.
[3]Master in Corrective Exercises and Sport Injuries, Physical Education and Sport Sciences, Iran.

INTRODUCTION

Since the foot is the interface with the ground during activities such as gait, running, landing, structural changes may cause compensatory malalignment and, consequently, mechanical deviations of the entire lower extremity (Williams, McClay, 2001). Supposing that excessive pronation and supination can result in differences in Vertical ground reaction forces (VGRF) and rate of loading (ROL) imposed on lower extremities and consequently injury in the lower extremities, this study accomplished to comparison of peak VGRF and ROL between supinated and pronated and normal foot during single drop-landing.

METODS AND PROCEDURES

30 students from department of physical education and sport science having the weight of 75.27±4.70 kg, height of 176.50±5.30 cm and age of 23±3 yrs participated in this study. Subjects were grouped (n= 10 per group) on the basis of weight bearing navicular drop (ND) (supinated, < 5mm; neutral, 5-10 mm; pronators, >10 mm) (Cote, Brunet, 2005). The subjects positioned barefoot on a box 0.3 m above the landing surface in barefoot situation. Subjects landed on force plate, while the force plate served as the landing surface that placed on the floor 15 cm in front of the box. The vertical ground reaction force (VGRF) determined as the peak vertical force (N) recorded during landing. Data normalized according to body weight (N), and expressed as a multiple of body weight (×BW). Rate of loading (ROL) was calculated as the normalized peak vertical force divided by the time to peak force.

$$ROL = \left[\frac{peakFz(N)/BW(N)}{t}\right] = \frac{BW}{ms}$$

Multivariate analysis of variance used to compare Peak VGRF and ROL between three groups (at the p level of 0.05).

RESULTS

The results of applying MANOVA shown significant differences between three groups of supinated, pronated, and normal ($F_{2,22}$=15.553, Wilks' Lambda = 0.370, P≤0.05). The differences in three groups was due to differences in ROL between them, while differences in VGRF was not significant ($F_{2,22}$ = 2.632, P >0.05).

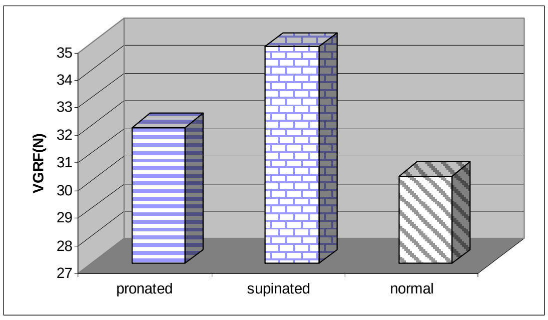

Figure 1: mean and Std. for peak VGRF in supinated, pronated and normal groups

Peak VGRF and ROL in three groups are presented in Figure 1 and Figure 2 respectively. Peak GRF in the supinated group was 14% more than two other groups, though it was not significant. ROL in the supinated group was 28% more than normal group and 31% more than pronated group.

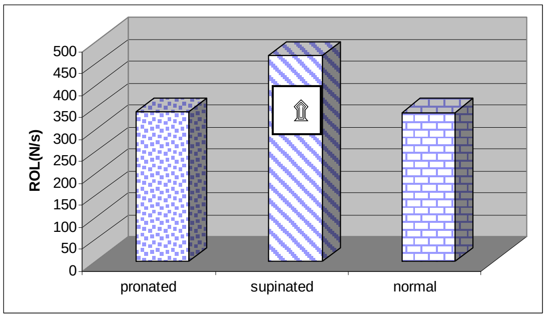

Figure 2: mean and Std. for ROL in supinated, pronated and normal groups, ⇧ significant differences.

The mean and standard deviation of VGRF and ROL and the results of MANOVA in table 1.

Parameter	Groups	Mean±Std.	$F_{2,22}$	P
Peak VGRF (N)	pronated	30.20±4.60	2.632	0.097
	Supinated	34.80±5.50		
	normal	30.10±2.60		
ROL (N/s)	pronated	327.60±31.90	15.553	0.000*
	Supinated	468±93		
	normal	338.20±13.20		

Table 1: mean and Std. for peak VGRF, ROL in supinated, pronated and normal groups, *significant at p level of 0.05

DISCUSSION

The purpose of this study was to examine the differences of maximum VGRF and ROL between supinated and pronated and normal foot during single drop-landing. The supinated group has more ROL during landing in comparison of two other groups. The possible reason for increase of ROL in supinated group can be attributed to the shortening of invertors' foot muscles of in these groups and decrease the ability of these muscles to control pronation of the foot during landing.
Williams and McClay (2001) reported that persons with supinated foot are susceptible for knee and shank injuries, because of increase in ROL. Although previous studies have focused on foot deformities and impact forces on gait and running, this study done during single leg drop-landing, the results for ROL in supinated foot is similar to them. It can be explained that increase of ROL in supinated foot secondary can increase the shank and knee ROL during landing and pose these subjects at risk of knee and shank injuries. Neely (1998) reported that pronation unlocks the midtarsal joint and depresses the medial longitudinal arch of the foot, allowing the foot to become flexible and absorb shock during weight bearing. But with regards to our finding, no significant differences seen in ROL between pronated foot groups with normal groups. The probable reason for it can be attributed to the differences in landing and running mechanics. Ground contact during heel-toe running is normally initiated with the rear foot, whereas ground contact during landing is normally initiated with forefoot. Landing from a jump can involve forces that are 2 to 12 times more than body weight whereas heel-toe running at 4.5 m/s produces forces that are 2.8 times the body weight; yet specific variables affecting the impact forces of the 2 activities have not been clearly distinguished.

SUMMERY

These results suggest that supinated and pronated foot is associated with specific lower extremity kinetics. Differences in these parameters may subsequently lead to differences in injury patterns in supinated and pronated foot in athletes.

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