THE GROUND REACTION FORCE PATTERNS AND IMPACT SHOCK IN DIFFERENT SLOPE LOCOMOTIONS

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INTRODUCTION

More people like cross country jogging than running on a circle track, but the effect of inclined and declined road on the joggers are still unclear. Thorough understanding of the ground reaction force patterns for inclined and declined running could provide useful information for the joggers to prevent lower extremity injury and enhance their performance. Numerous previous studies have demonstrated that the ground reaction force patterns of walking and running on horizontal surface. The typical vertical ground reaction force contained two peaks, the first peak – impact force peak – occurred when the heel strikes ground, the second peak – active force peak – occurred when the toe off the ground.

METHODS

Treadmill were often used to simulate overground walking and running indoors. In order to understand the ground reaction force patterns for inclined and declined running. Load cells were placed under a treadmill to simulate the different slope surface in this study. A male runner (25 years, 1.8 m, 72 Kg) was asked to walk and run on the treadmill with 3 slopes (inclined, level, declined) at 4 different speeds (1, 2, 3, and 4 m/sec). Two tri-axial accelerometers were attached on the subject’s sacrum and right tibia to measure the impact on the lower extremity and trunk. Both load cell and accelerometer signals were recorded by a data acquisition system at a sampling rate equal to 1000 Hz.

RESULTS AND DISCUSSION

The vertical ground reaction force patterns for three slopes in running are displayed in figure 1. The results show similar pattern in three slope conditions in running except the impact force peak was affected by the changes of the slope conditions. Downhill running produced greater impact force peak than level and uphill running.

Figure 1: The ground reaction force patterns in running.

Figure 2 demonstrated the impact force peak and active force peak for all the speeds in three slopes locomotion. As speed increased, both impact force peak and active force peak increased for all slope conditions. When the slope changed, the impact force peak increased with the slope changed to downward direction. This finding is not too surprising considering in a series of previous papers. The active force peak had only slight change which is very interesting and need more study to understand the inside mechanism. The sacrum impact acceleration was not very sensitive to the speeds (Figure 3), but walking and running made difference on the impact. The impact shock of sacrum and tibia in walking has shown considerably lower than running. (walking: 1 m/s, and 2 m/s, running: 3 m/s, 4 m/s)

Figure 2: The impact force peak and active force peak in different slopes and speeds locomotion.

Figure 3: The integral impact acceleration on sacrum in different slopes and speeds locomotion.

SUMMARY

The goal in this study was to compare the impact shock between the different speed and slope locomotion. Each subject ran at four speeds in the conditions of uphill, level, and downhill. The ground reaction force data were collected from load cell and two accelerometers recordings triaxial accelerations on sacrum and tibia. The results shown that downhill running produced greater impact force peak than level and uphill running.

REFERENCES