BILATERAL POWER DEFICIT IN HUMAN VERTICAL JUMP PERFORMANCE

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INTRODUCTION

It is well known that maximum voluntary force production of bilateral actions is generally lower than the sum of unilateral force productions. This phenomenon is known as the bilateral deficit. Several studies have also reported that a jump height in one-legged jump is higher than a half of the jump height in two-legged jump. The bilateral deficit of jump performance can be explained by the force-velocity relations [1], although the explanation of the bilateral deficit has mainly focused on the neural components. However, no studies have been conducted how the force-velcity and force-power relations of leg multi-joint movements related to the bilateral deficit in human jump performance. Therefore, the purpose of this study was to investigate the contribution of the force-velocity relations and power outputs of the knee-hip extension movements to the bilateral deficit in human vertical jump performance.

METHODS

Twelve healthy young women (age 19-31yrs, height 158.1±4.5cm, mass 52.2±5.3kg, means±S.D.) performed bilateral and unilateral maximum vertical jump on a jump gauge. They were attempted to jump as high as possible and performed three trails of each type of vertical jumps with sufficient time for recovery between attempts. The highest trial of each type of jump was recorded. Also, they performed isotonic knee-hip extension movements on the dynamometer against loads controlled by the servo system [2], and the force-velocity and force-power relations of the knee-hip extension movements were determined. Data were presented as means±S.D. The level of statistical significance was set at $p<0.05$. Bilateral index (BI) was used to evaluate the bilateral deficit: BI (%) = 100[bilateral/(right unilateral+left unilateral)]-100.

RESULTS AND DISCUSSION

The height of unilateral vertical jump was significantly lower than that of the bilateral vertical jump (bilateral = 33.5±3.4cm, right unilateral = 22.8±2.9cm, left unilateral = 22.6±3.0cm) and the sum of right and left unilateral jump heights was significantly higher than the bilateral vertical jump height, as shown in Figure 1. Bilateral deficit was observed and the mean magnitudes of BI were -25.7%.

It was also shown that the bilateral jump using own bodyweight was performed at the ascending phase of parabolic force-power relations of the bilateral knee-hip extension movements, while the unilateral jump using own bodyweight was performed nearly at the peak of power output of force-power relations of the unilateral bilateral knee-hip extension movements. This is because external applied loads (i.e., body mass) used for the bi- and unilateral vertical jump performances were not relatively same. According to the force-power relations of the knee-hip extension movements, bodyweight used for bilateral jump was about 33% of the extrapolated maximum force (Fmax), whereas that used for unilateral jump was about 52% (right leg) and 54% (left leg) of Fmax.

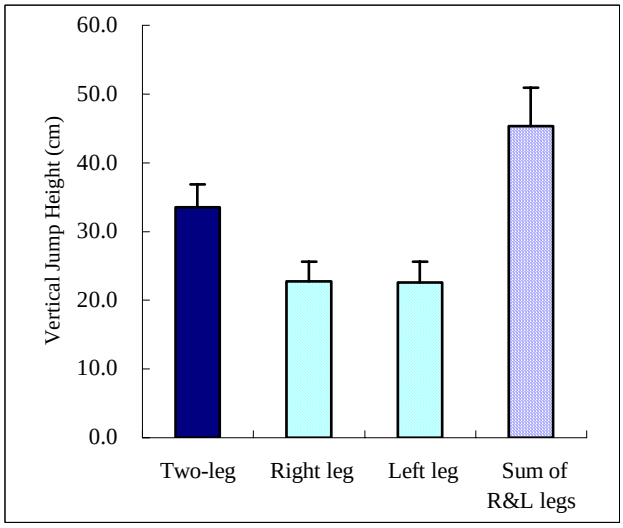

Figure 1:The height of vertical jump performance in bilateral, right unilateral, left unilateral trials and the sum of right and left unilateral jump heights.

CONCLUSIONS

The results indicate that the bilateral power deficit in vertical jump performance is due to the force-velocity and force-power properties of muscles that control in the leg multi-joint movements. A discordance of applied load for bi- and unilateral vertical jump performance causes different generation phase of power outputs of muscles in leg multi-joint movements.

REFERENCES

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