QUANTIFYING LEG ELASTICITY IN MALE VETERAN RUNNERS

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INTRODUCTION

Biological changes during aging that are related to running form six categories. They are cartilage, ligament and tendon, muscle, the nervous system, bone and the cardiovascular system. Within these categories one may see a reduction in elasticity, muscle mass, reaction time to stimuli, bone mass and the efficiency of the cardiovascular system. A reduction in elasticity is a result of muscle lengthening, loss of contractile properties, tendon and ligaments' lengthening and stiffening [1]. To quantify leg elasticity a linear spring model has been applied effectively to symmetrical rebound jumping and hopping [2].

The purpose of this study was to determine whether a linear spring model can be applied to a modified asymmetrical rebound jump for the quantification of leg elasticity in veteran runners.

METHODS

A seven camera infra red system (Vicon 512) operating at 120Hz was synchronised with a force platform (Kistler 9281B11) operating at 1080Hz to obtain kinematic and kinetic data. A static calibration procedure for the identification of the position of the force platform and a dynamic (wand) calibration for 3-D reconstruction of body markers throughout the measurement volume. 36 reflective markers were used to create a full body model for each subject. Davis, R.B. et al (1990) developed the model with normal subjects and based on marker placements and static anthropometric measurements. Quintic spline filtering based on Woltring's method was applied to the real marker trajectory data prior to the modelling of upper and lower body kinematics and kinetics. The kinematic model allowed for point displacement and angles of and between segments to be determined. The kinetic models used mass and moment of inertia of the segments to facilitate the calculation of segmental 'reactions'.

Six veteran (V60) runners (mean mass = 74.66 kg, height = 1.74 m) performed two sets of five modified vertical jumps from which six were selected for analysis for each subject. The approach to the jump was from a step-in, to a two-footed landing on the force platform followed by a maximal vertical rebound, termed a Step in Jump (SIJ). All subjects signed a consent form and were given a familiarisation period prior to data collection.

RESULTS AND DISCUSSION

The linear least square values were greater than 0.9 for all subjects indicating that a linear spring model can be used when evaluating leg elasticity of the veteran runner when performing a modified asymmetrical SIJ. This is because the horizontal displacement during the step-in phase is small. If this were to increase the asymmetry would increase hence making the linear spring model unsuitable for such a movement.

Leg elasticity (Kleg) values are quite high for the veteran runner. This is mainly due to the small amount of leg compression (ie leg flexion) during the ground contact phase of the SIJ, since the force values at minimum leg compression (F peak) are similar to those previously reported. The reduced leg compression in turn influences a veteran athlete's ability to jump. This is shown by the reduced rise in the centre of mass (CM Rise) compared to the literature [3].

CONCLUSIONS

A linear spring model can be used to evaluate leg elasticity of the veteran runner. Their leg stiffness effects their ability to jump mainly because there is in reduction leg flexion during the ground contact phase of the jump.

REFERENCES

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Table 1: Mean and standard deviation for each subject.

Subjects	1	2	3	4	5	6
Linear least squares value	0.94 ± 0.01	0.98 ± 0.01	0.94 ± 0.02	0.98 ± 0.01	0.94 ± 0.02	0.97 ± 0.02
Kleg (BW/s)	56.1 ± 9.50	33.15 ± 16.86	17.54 ± 5.52	28.36 ± 3.85	11.65 ± 3.43	46.33 ± 23.91
Spring Compression (m)	0.09 ± 0.02	0.12 ± 0.04	0.17 ± 0.05	0.12 ± 0.01	0.21 ± 0.05	0.08 ± 0.03
F peak (BW)	4.66 ± 0.29	3.38 ± 0.28	2.68 ± 0.21	3.44 ± 0.25	2.29 ± 0.22	3.12 ± 0.33
CM rise (m)	0.26 ± 0.05	0.26 ± 0.06	0.34 ± 0.06	0.19 ± 0.02	0.23 ± 0.05	0.15 ± 0.04