The difference of net muscle torque of lower extremity by using different body segment parameter in gymnast

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INTRODUCTION

Body segment parameter (BSP) is an important data of biomechanics research, due to the difference of races, age, sex, fitness level, sports event and other factors of subjects, which would lead to disparity between reality and research results. Consequently, the purpose of this study is to compare and discuss the difference caused by using different body segment parameters models and ground reaction force to calculate net muscle torque during gymnasts during vertical jump.

METHODS

Four Taiwanese elite (2 male and 2 Female) participated in this study. Kistler force platforms and Kodak high speed video camera (10K Hz) were used to obtain the ground reaction force and kinematics data during vertical jump, then inverse dynamics formula (Enoka,2000) and three BSP models were applied to calculate the net muscle torque of joint of lower extremity. Three BSP models included cadaver method (Dempster, 1955), gamma-ray method (Zasiorsky 1983), and young Taiwanese male from MRI method（Ho, 2002）, and the subject's individual BSP which also established by MRI method.

$$SEE = \sqrt{\frac{\sum (x' - x)^2}{n}} \quad \text{..... (1)}$$

Those subjects individual BSP was used as the standard to calculate Standard Estimate Error (SEE) value and compare the difference of ankle, knee and hip joint kinetic data among the BSP models (equation 1).

RESULTS AND DISCUSSION

Table 1 show that the male and female gymnast SEE value of ankle, knee and hip joint net muscle torque during vertical jump. The joint net muscle torque of lower extremity determined from MRI method and gamma-ray method was similar. But, the joint net muscle torque determined from the cadaver method was obviously larger than other BSP models. Especially, the SEE of hip joint net muscle torque was 7.4902 and 6.4252 for both male subjects. In the past, the most often used approach to establish segment inertial properties was the data obtained from elderly male cadavers (e.g. Dempster, 1955 et al.). But the results of this study show that Dempster's cadaver model has the largest SEE value when determine the joint net muscle torque. Therefore, appropriate BSP model should be chosen when the subjects' individual BSP is not available.

CONCLUSIONS

It is very important to choose the appropriate BSP model when doing human subject study which can reduce the inaccuracy of results. Researches should consider the similarity between the subjects of study and the subjects of BSP model, such as sex, age, race, living style, diet, fitness level, and representative of samples.

REFERENCES

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Table 1: The comparison of SEE value of ankle, knee and hip joint net muscle torque among different BSP models.

Variables	Researcher	Method	Male 1	Male 2	Female 1	Female 2
Ankle joint net muscle torque	Dempster(1955)	Cadaver	1.0934	0.4616	0.7889	0.2823
	Zatsiorsky(1983)	Gamma ray	0.0713	0.1066	0.0472	0.0566
	Ho(2004)	MRI	0.0911	0.1705	0.0521	0.1194
Knee joint net muscle torque	Dempster(1955)	Cadaver	1.9306	1.6489	1.0374	0.8853
	Zatsiorsky(1983)	Gamma ray	0.0503	0.1535	0.3602	0.1048
	Ho(2004)	MRI	0.0909	0.1775	0.2787	0.0965
Hip joint net muscle torque	Dempster(1955)	Cadaver	7.4902	6.4252	2.9255	4.5742
	Zatsiorsky(1983)	Gamma ray	0.7052	0.3849	0.7386	0.4083
	Ho(2004)	MRI	1.0394	0.5931	0.8005	5.6605