Determining the location of the body’s centre of mass (COM)

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Introduction

Probably the most frequently referred paper in the motion analysis studies has been the cadaver study of Dempster (1955) which gave the basis of the body segment inertial parameters (BSIPs) for years. Since then these parameters have been adjusted by several authors due to the fact that these samples represent a fairly small population and many individuals differ significantly from the subjects from whom the regression equations were derived. Zatsiorsky & Seluyanov (1983) determined the BSIPs of more than 100 living subjects by using a gamma-ray scanner. However, the data have been rarely preferred to cadaver data probably because the used bony landmarks are remarkably distant from the centers of the neighboring joints. Therefore these BSIPs were adjusted later by de Leva (1996) whose findings provide one of the most suitable models for different populations. The purpose of the present study was to compare the location of the body COM determined by using a high accuracy reaction board and two different segment parameter models, which were digitized and calculated with Motus software (Peak Performance Technologies, Inc.).

Methods

Figure 1 shows the reaction board set-up. The body COM (expressed as percentage of the total body height) was determined from several subjects including athletes as well as the students and sedentary people. Preliminary results of selected subjects are presented in this abstract. Three DV cameras were used to record the image from above and both sides. Calibration of the board was done by measuring the location of the COM of a homogenous steel bar (1.59 m, 34.5 kg) in 15 different places (5 cm distances) along the board. Body segment models of Dempster and de Leva (adjusted from Zatsiorsky & Seluyanov) were used for comparison.

Results

Calibration of the reaction board showed the location of the COM of the calibration bar ranging from 49.60 to 50.04 % average being 0.2 % (3 mm) off the true location. Figure 2 presents the locations of the body COM for different subject groups. Two selected subgroups (HJ and Gym) showed large differences in the reaction board measurement (56.37 and 58.07 %, respectively). The Dempster model seemed to fit the gymnasts better than high jumpers while the model of deLeva agrees fairly well with the reaction board result of HJ group.

Discussion/Conclusion

Calibration confirmed well the accuracy of the reaction board used in the present study. The result of students in the reaction board of the present study (57.09 ± 0.34 %) seem to represent well the often referred average of male population (~57 %). According to figure 2 the model of de Leva “favoring” the lower body and therefore many athletes should not be used with the athletes having exceptionally strong upper body as compared to the lower extremities (e.g. GYM). It can be concluded that careful attention must be paid while selecting the BSIPs for different populations especially when including athletes such as high jumpers and gymnasts.

References