OVERWEIGHT AND OBESITY IN POSTURE: A BIOMECHANICAL EVALUATION OF POSTURAL STABILITY

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INTRODUCTION

The loading condition of the spine in obese subjects results certainly excessive and sometimes it can lead to biomechanical modifications and pathological alterations of the musculo-skeletal system. A quantitative assessment of the postural stability during quiet standing in normal and overweight subjects provides useful biomechanical information about the effect of an anomalous body weight increasing on the spine. Moreover it permits to evaluate the stability of a selected patient and give indications on the effectiveness of rehabilitative treatments.

Main aim of this study was to examine postural stability in obese subjects in comparison to normal subjects using a biomechanical approach.

METHODS

We analyzed a total number of 26 women (mean age 32.5 s.d. 5.91 years) divided into 4 subgroups in relation to BMI value:
1) underweight, mean BMI 19.81, s.d. 0.86 2) normal weight, mean BMI 22.33 s.d. 1.55 3) overweight, 26.21 s.d. 1.09 4) obese mean BMI 38.94 s.d. 8.99 The selection criterion for patients was no suffering from musculo-skeletal pathology.

A motion measurement system (ELITE, bts$^{@}$, IT) provided the 3D coordinates of reflective passive markers and a force platform (AMTI, Newton, MA) provided the ground reaction forces and the trajectory of the Centre of Pressure (COP). In particular, 11 markers were placed over the spinosus processes every two vertebrae from c7 to sacrum. Each subject was asked to stand on the force platform in orthostatic indifferent position with eyes open for three successive acquisition trials. Each trial was 30 secs long. Kinetic indexes were extracted mainly taking into consideration the trajectory of COP in anterior-posterior (A/P) direction. The indexes are defined as follows: total excursion index (E_{tot}) is the spatial difference between the absolute maximum and the absolute minimum of the COP trajectory vs. time (E_{tot} = max(COP)-min(COP)); the mean excursion velocity (v_m) is defined as the mean calculated on the ratio between the difference between maximum and minimum of each oscillation (E_i) and the time interval in which the oscillation occurs (t_{i+1}-t_i)

$$v_m = \left(\frac{\sum_{i=1}^{n-1}\left(\frac{E_i}{t_{i+1}-t_i}\right)}{n-1}\right).$$

To allow a comparison between different subjects, these parameters have been multiplied for a normalization factor (NF) that takes into account the different body heights of the analysed subjects: NF=1000/height (mm).

RESULTS AND DISCUSSION

We found statistically significant correlations between variations of the calculated parameters and increasing of the BMI value. It is to observe that the control group of normal weight women shows the minimum value of E_{tot}, underweight women overweight and obese women show a higher value of this parameter (see Figure 1). We obtained the same result for v_m. E_{tot} is the parameter that most characterises the general imbalance during the 30 sec of quiet standing trial. The fact that women characterised by normal weight reach the minimum of this parameter is a proof that both increasing and decreasing weight beyond certain thresholds lead to a general loss of stability during standing. The same consideration can be done for v_m: overweight women and even more obese women show values of v_m higher than normal-weight women and this fact contributes to a decrease of postural stability.

In general, there is a strong correlation between increasing BMI and increasing imbalance during quiet standing in anterior-posterior direction.

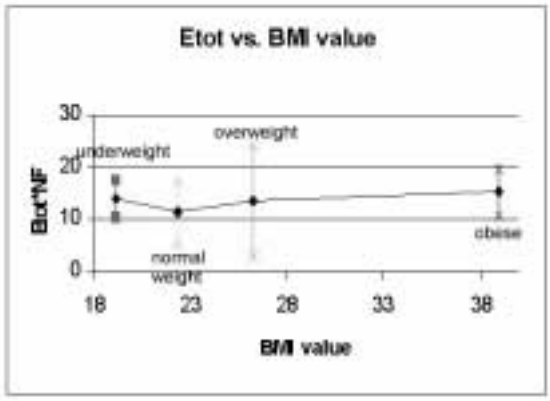

Figure 1: COP maximum excursion in relation to BMI value

SUMMARY

In conclusion, posturographic analysis gives further information on the role of weight in postural stability and a simple acquisition protocol, as the one we used in this study, could be very helpful in the assessment of postural imbalance due to overweight or obesity and could be used as a control tool after an appropriate rehabilitation program.

REFERENCES

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