

Contributions to the assessment of postural stability and dynamic balance in some neurological dysfunctions, in human normality or performance

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Abstract

Background. Postural stability and dynamic balance can be the gradual indicators of some neurological dysfunctions, the normality, or of some exceptional aptitudes (performance shooting, circus arts etc.), provided that they are objectively assessed.

Aims. To identify the marks, the deviations and the way of scaling the frequency spectrums of the gravity center projection oscillations on the postural sustentation surface, in subjects apriorically representing different categories (from the postural stability and the dynamic balance points of view).

Methods. Complex podometric investigations, on platforms and on carpets with pressure sensor matrices (about 10,000 sensors and a processing software), of the mechanogram and frequency density of the gravity center projection oscillations. Subjects were divided into four samples, as follows: a non-randomized sample made up of 30 subjects belonging to the statistical population called “healthy youth practicing sports (but not at the performance level) on a regular or moderate basis”; a sample of 30 “shooters (performance athletes)”, with a rich experience in sports training and competitions; a sample of 30 persons diagnosed with sight impairments and a sample of 30 persons with dental pathology aspects. The standard postural indicators, with and without visual control, the balance dynamics in normal walking and the pressure distribution on soles (with a topographic scanning) were recorded. The computer-based processing assessed 18 intrinsic or relative parameters of postural stability and dynamic balance in normal walking.

Results. Significant differences, at an acceptable threshold ($p > 0.05$), among the investigated samples, regarding the postural stability classes (normostability, hyperstability, hypostability and instability), were obtained only for the histograms of the frequency density of the control and regulation feed-back systems.

The synthetical indicators, the most relevant for the dynamic balance labeling, particularly the walking ones, seemed to be the gravity center projection trace on the sustentation surface and the gravity center position changing speed.

Conclusions. There was a significant negative correlation (Cohen large coefficient = -0.65) between the frequency density in the somesthetic zone and the postural stability quality. In other words, the significant improvement of the postural stability quality is associated with the diminution of the low frequency oscillation incidence, which is probably due, to a great extent, to the somesthetic feed-backs, and less to the causal relation. The graphs of the frequency density show that the visual feedback has a tendency to increase its role in the postural stability adjustment in athletes, as compared to the control group, and a tendency to diminish its role in subjects with sight impairments or with dental pathology aspects. There are not significant statistical differences regarding the density of the oscillations controlled at the vestibular level, among the analyzed categories of subjects. It is hypothesized therefore that the postural stability degradation tendency is greater on the anterior-posterior plan than on the lateral one.

Key words: postural stability, dynamic balance, neurological dysfunctions, normality, performance.