REPEATABILITY OF RAMBLING AND TREMBLING AS MEASURES OF STATIC BALANCE

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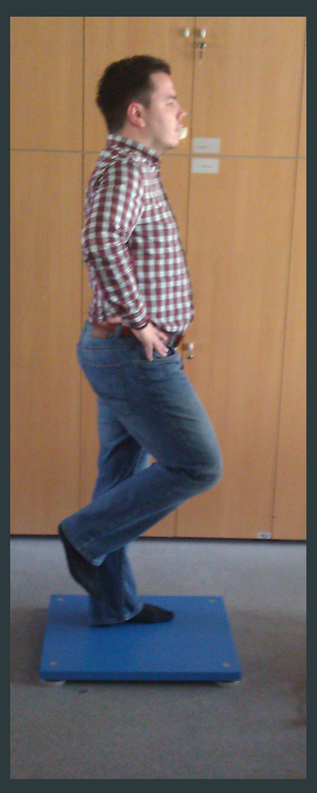
Introduction

In this experiment, we focused on static balance of the human body (quite standing) as the ability to maintain specific posture. The aim of the experiment was to evaluate the repeatability of rambling and trembling approach that was first proposed by Zatsiorsky & Duarte (2000). Repeatability is one of the basic metric characteristics of the test and therefore it is important that we use only highly repeatable parameters for the evaluation of the centre of pressure (COP); otherwise, we may give false or nonreplicable conclusions. Rambling and trembling is one of many possible techniques used to quantify COP trajectory (Panjan & Sarabon, 2010). Basic idea is to decompose COP displacement into two components. The reference point migration is called rambling and the COP migration around the

Methods

- 25 healthy subject between 15 and 55 years of age participated in the study.
- Barefoot parallel stance (PS) with active position in knees, arms on hips and focused view at specified point in front of the subject.
- Barefoot single leg (SL) stance (dominant leg) with active position at the knee, arms on the hips and focused view at the specified point in front of the subject (Figure 1).
- Three 60-second repetitions of each test (six altogether) in random order with 90-second rest interval.
- Analysis was carried out with custom made software based on the description of rambling and trembling in Zatsiorsky and Duarte (1999, 2000).
- 17 parameters for medio-lateral (ML) and anterio-posterior (AP) direction were calculated.
- Mean values and standard deviations of each trial and all trials together, minimum value, maximal value, typical error (TE), coefficient of variation (CV%), single (ICCs) and average (ICCa) intraclass correlation coefficients were calculated for each parameter.



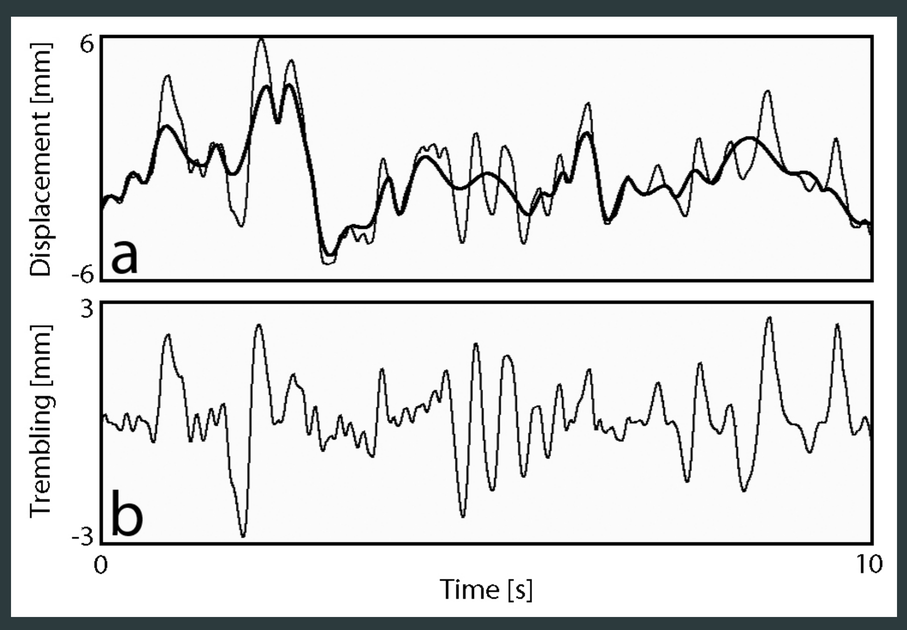


Figure 1: Measurement setup: SL stance (left) and acquired signals (right; a – COP (thin line) and rambling (thick line), b – trembling).

Results

Values of typical error TE were between 0.04 and 54.62, while values of CV% were between 7.12 and 428.24. These two statistics should be considered in the context of mean values because they depend on it. ICCs values (between -0.07 and 0.81) were significantly lower than ICCa values (between -0.26 and 0.88). All ICCa values are

Parameter	PS ML	PS AP	SL ML	SL AP
COP_SD [mm]	0.85	0.85	0.85	0.75
R_SD [mm]	0.36	0.36	0.53	0.10
%_of_R_COP_SD [%]	0.00	0.00	-0.26	-0.01
T_SD [mm]	0.16	0.16	0.34	0.03
%_of_T_COP_SD [%]	0.00	0.00	0.09	-0.02
COP_MF [Hz]	0.65	0.65	0.86	0.76
COP_MeF [Hz]	0.52	0.52	0.73	0.83
COP_PF [Hz]	0.24	0.24	0.58	0.39
R_MF [Hz]	0.36	0.36	-0.20	-0.09
R_MeF [Hz]	0.09	0.09	0.30	0.22
R_PF [Hz]	0.38	0.38	0.55	0.68
T_MF [Hz]	0.69	0.69	-0.23	-0.15
T_MeF [Hz]	0.75	0.75	0.59	0.79
T_PF [Hz]	0.81	0.81	0.63	0.38
COP_F_CC	0.76	0.76	0.88	0.84
R_F_CC	0.45	0.45	0.78	0.35
T_F_CC	0.77	0.77	0.09	0.06

Table 1: ICCa values for PS and SL stance in ML and AP direction. R – rambling, T – trembling, SD – standard deviation, % - percent, MF – mean frequency, MeF – mediane frequency, PF – peak frequency, F – horizontal force, CC – cross correlation.

Discussion

Several studies used rambling and trembling approach to quantify COP trajectory (Bottaro, Casadio, Morasso, & Sanguineti, 2005; Danna-Dos-Santos, Degani, Vladimir M Zatsiorsky, & Latash, 2008), however, none of them provided the repeatability of the parameters derived from rambling and trembling trajectories. Parameters with the most consistent ICCa values in both tests were COP_SD, COP_SD, COP_F_CC, COP_F_CC (all in ML and AP) and T_MeF in AP implying that these parameters could be the best choice for the evaluation of any static balance task. Major difference between ICCs and ICCa values indicates that at least three repetitions of each test must be performed to get reliable results. TE and CV% vales of parameters with the highest repeatability were among the smallest which strengthens our proposal about the parameters to be followed in static balance studies.
In conclusion, the set of parameters with the highest repeatability is the most suitable choice for the evaluation of human static balance as assessed by the quiet stance tasks. It could be used for the evaluation when studying risk of falls of elderly as well as in sports or rehabilitation.

References

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