TRUNK POSTURE AND STATICO-DYNAMICAL SPINE ANALYSIS– COMPARING ULTRASOUND BASED VS. OPTICALLY BASED MEASUREMENT SYSTEM

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The purpose of this study was to compare two different methods measuring trunk posture and statico-dynamical spine analysis. 32 patients participated in this cross sectional study. Comparing measured values a wide congruence could be demonstrated with marginal underestimating in kyphosis and lordosis data for the ultrasound based system. The largest deviation could be shown for pelvic obliquity measured in mm. Trunk inclination, vertical deflection and pelvic obliquity measured in degree showed proper analogy for both measuring systems. Validity, reliability based on particular technical principles could be verified.

KEY WORDS: trunk, posture, spine analysis

INTRODUCTION: Posture relevant parameters can be measured by numerous measuring systems using different technologies and allow the registration of asymmetries in skeleton-axis. There is a lack of comparison of different technologies in the literature. The aim of the study was to evaluate different methods (ultrasound based versus optically based) in statico-dynamical spine analysis and posture (zebris® CMS HS versus Formetric®) regarding accuracy and elaborate benefits as well as disadvantages in application.

METHODS: 32 patients (17 male; 15 female) within the age of 27.7(± 6.2) years participated in this cross sectional study. Anamnesis' questionnaires were used to assess information on sport injury as well as pain. Patients were measured thrice with both systems. Statistic evaluation was done according to Bland/Altman (1986) as well as Spearmans correlation calculation using SPSSv11.5 and Excel 2003.

Table 1. Anthropometric data

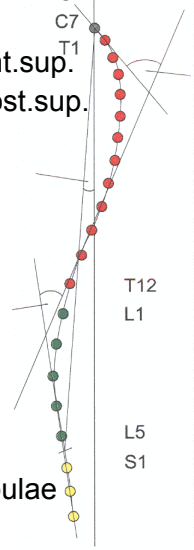
	Age	*Height*	*Mass*
Male	*27.4 y*	*1.83 m*	*79.1 kg*
(n=17)	*(±6.8)*	*(±0.1)*	*(±8.8)*
Female	*28.1 y*	*1.72 m*	*63.9 kg*
(n=15)	*(±5.6)*	*(±0.1)*	*(±8.1)*
Total	*27.7 y*	*1.78 m*	*72.0 kg*
(n=32)	*(±6.2)*	*(±0.1)*	*(±11.3)*

There is no comparison possible to radiologic data for the ZEBRIS® System. Objectivity (r=0.93-0.98) as well as retest-reliability (r=0.97-0.99) has been evaluated (Asamoah 2000; Himmelreich et al. 1998). The Formetric® system with its triangular principle is a fully developed method with a close match to radiograph. It is free of retroactivity but poor on distinctive muscle relief and obesity. At the moment the „gold standard" in non invasive spine analysis. (Drerup et al 2001; Hackenberg and Hierholzer 2002; Lilienquist et al. 1998).

RESULTS: Comparing measured values a wide congruence could be demonstrated with marginal underestimating in kyphosis and lordosis data for the ultrasound based system. The largest deviation could be shown for pelvic obliquity measured in mm. Trunk inclination, vertical deflection and pelvic obliquity measured in degree showed proper analogy for both measuring systems. Validity, reliability based on particular technical principles could be

verified. The Bland & Altman plot (Bland & Altman, 1986 and 1999) is a statistical method to compare two measurements techniques. In this graphical method the differences (or alternatively the ratios) between the two techniques are plotted against the averages of the two techniques.

Palpation and marking of:
- acromii
- spina iliacae ant.sup.
- spina iliacae post.sup.
- cristae iliacae
- C7
- Th3
- Th6
- Th9
- Th12
- L3
- L5
- S2
- anguli inf. Scapulae



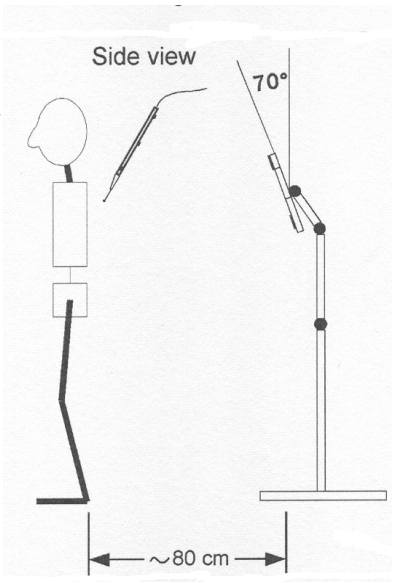
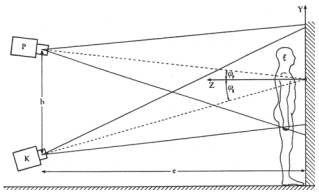


Figure 1. Static spinal column and back measurements using Zebris CMS HS



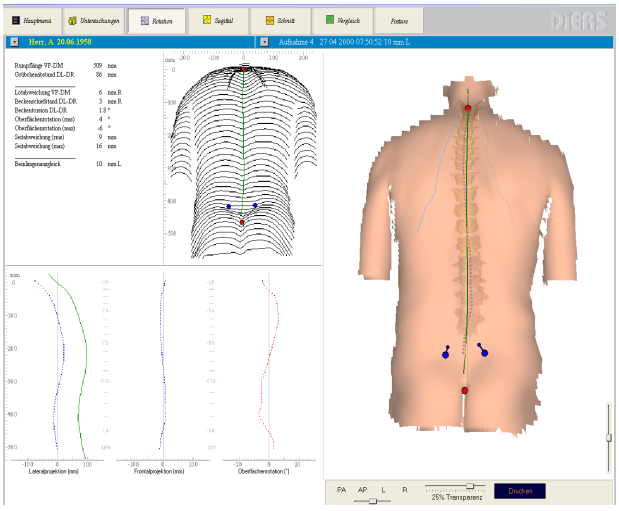
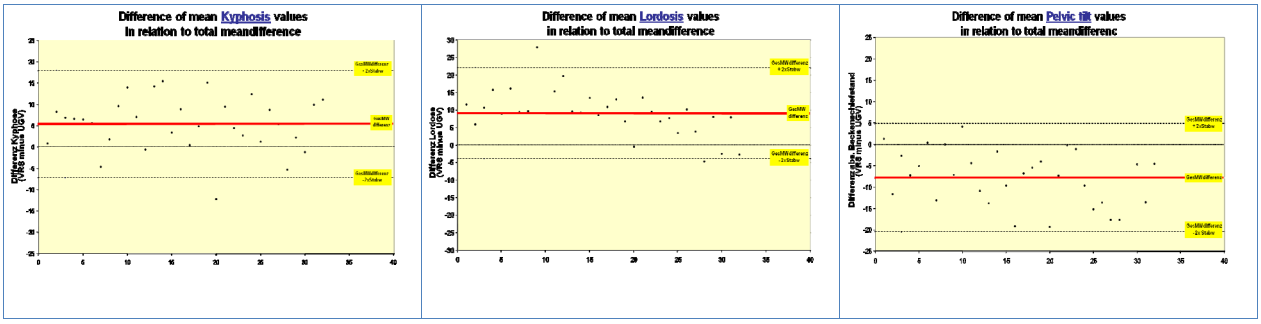


Figure 2. Formetric® optical based measuring system. Patient positioning and calculating of parameters.(Screenshot)



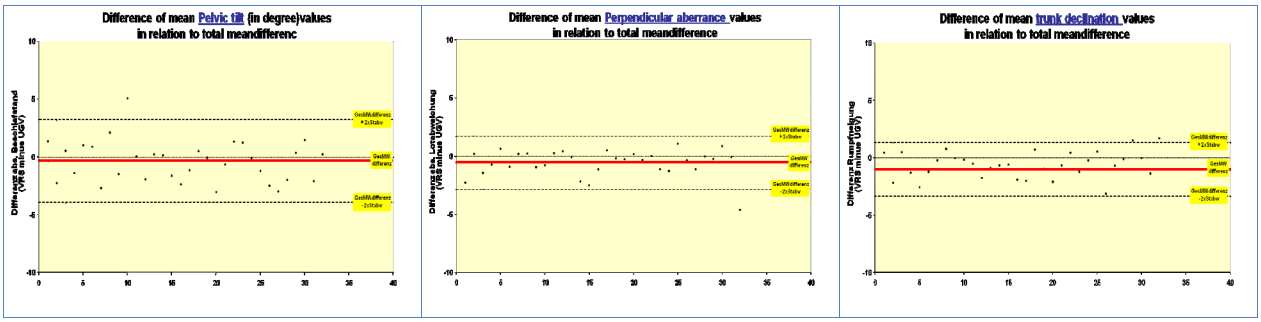


Figure 3. Bland & Altman plots of kyphosis, lordosis, pelvic tilt, perpendicular aberrance and trunk declination values of both measurement techniques.

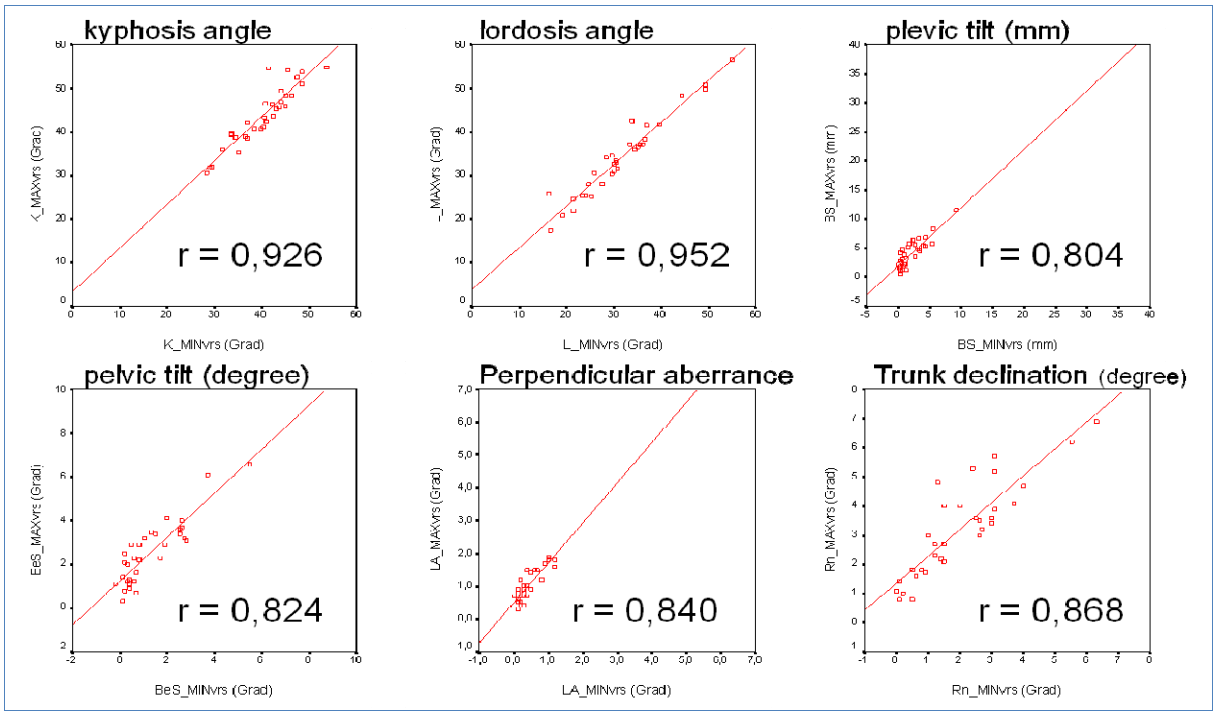


Figure 4. Reliability of the Formetric ® System

DISCUSSION: In summary both systems revealed usable quality in specific applications. The manual performance in using the ultrasound based system bears the risk of cumulated errors during measurement. The analysis of system-quality produced an error in measurement of 0.65% (0.58 +/- 1.29 mm). Himmelreich et al. described the ultrasound based system as a screening method which is not a substitute for case-history or classical anthropometry, but it offers useful parameters which facilitate decision making for further diagnostic procedures. (Himmelreich et al. 1998)

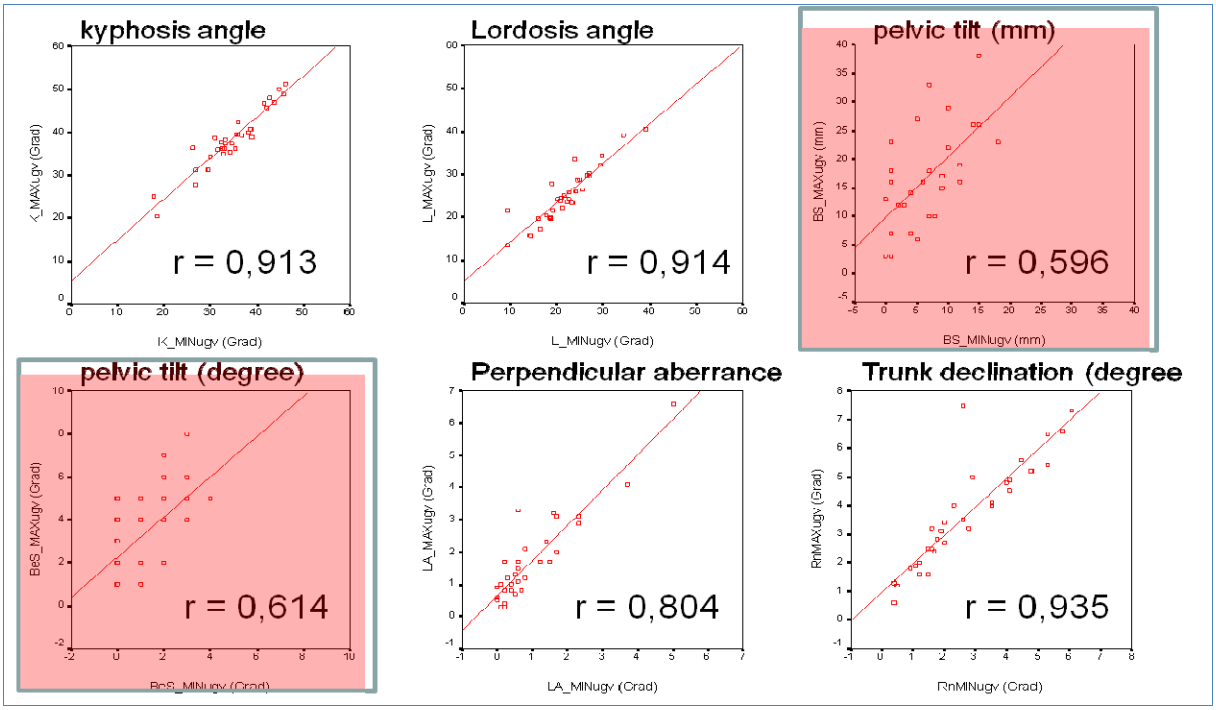


Figure 5. Reliability of the Zebris ® System

Working with the ultrasound based system, pelvic oblique is an accident-sensitive parameter. Versatile applications such as static or dynamic measurements could be done with the ultrasound based system.

Differences in axial balance in the range of physiologic motion can be calculated under dynamic conditions, and compared to normative data. The contact free and quick done rasterstereography allows with the help of surface back analysis to supplement radiological and clinical examinations of the spine in orthopedic and biomechanics questions.

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