Abstract Template for ISB2025 in Stockholm

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Summary

We were able to successfully apply Dynamic Surface Topography (DST) of the dorsal trunk in back pain patients while walking at different speeds. Due to the need to walk on a treadmill without holding on during the measurement, the application was limited to a subgroup of the total collective. On average, the differences in the measurement findings for rotation in the transverse plane between back pain patients and healthy ones are small, and the standard deviation is large in both groups and all speeds. Thus, no characterizing differences between the groups, but a great individuality in the results could be observed. These patient-specific data could provide a helpful hint for the appropriate therapy. However, the influence of muscle activity and soft tissue displacement on the data is still unclear. The integration of more parameters into the analysis could be a chance to increase the value of the analysis.

Introduction

Current diagnostic methods in back pain patients mainly focus on static spine analyses. This procedure ignores the dynamic aspects of the spinal system. DST might be an easy to use, radiation- and contact-free addition, allowing spine analyses also while walking. Corresponding reference data are already available for a healthy cohort, but so far not for patients with back pain. In addition, it is not yet known whether this method is applicable for patients with back pain, as the participants have to walk on a treadmill without using the handrails. This report presents our experiences from an initial study in which we have tried to carry out DST measurements in back pain patients while walking. The measured rotational movement of the painful spinal region is compared with the equivalent movement of a healthy reference population.

Methods

In the observational cohort study, 32 patients with thoracic or lumbar back pain were examined while walking on a treadmill with a DST measuring device (DIERS 4D motionlab). Subjects with acute fractures, balance disorders or severe gait disorders were excluded. If they were able to, the participants randomly walked at four different walking speeds (2, 3, 4, and 5 km/h). We calculated the segmental rotational motion for all segments from vertebra prominens to the pelvis. Time-synchronized data from an embedded foot pressure plate (100 Hz) enabled the generation of data for standardized gait cycles (SGC; 0–100%). The absolute values of rotational movement in transversal plane of all partial intervals of a SGC were added together to a sum of motion per gait cycle. The results of the back pain patients were compared with those of the healthy reference group. The data were processed in the same way as in the study to determine the reference values.

Results and Discussion

Recruitment of suitable patients with back pain was challenging due to widespread fear and lack of confidence in their ability to walk on a treadmill. Of the finally 32 included patients (age (mean (range)): 44.5 (19-68); 14 males, 18 females), 28 subjects walked on 5 km/h.

At speeds of 2-4 km/h, our results indicate greater overall segmental rotation in patients with back pain compared to the healthy reference group. At a speed of 3 km/h, our data pointed to more movement in the patients with more pain. The standard deviations were high in both cohorts and in all walking speeds.

Overall, in our analysis, the mean difference between the back pain patients and the healthy subjects is small at all speeds, especially in relation to the standard deviation in both groups. This is to be expected for the group as a whole, as the variability is already high in the healthy group and the group of back pain patients in our study was small and is not uniform. Based on the proven reliability, reproducibility of DST measurements, however, useful information can be obtained from the surface of the back. It can be determined for the individual patient whether he/she uses the spine more or less intensively. This could be a valuable hint for the therapeutic process of Clinical Reasoning. It objectively represents the movement information that is currently usually collected subjectively in the visual examination, also of the back surface. The information could become much more valuable if numerous parameters are included in the analysis at the same time in the future, resulting in a movement pattern. AI could play an important role in this.

Conclusions

In general, performing DST for back pain patients is possible, assuming the patients feel confident enough to walk on a treadmill. On average, only small differences between the groups can be observed in the non-uniform patient cohort. It remains to be seen whether other results emerge in defined back pain subgroups. The analysis of single parameters can already provide insights into movement behavior for individual patients. The technology could become more valuable if more parameters can be included in the analysis at the same time.