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Short communication

O 007 - How do postural parameters vary during walking in asymptomatic adults? A registration technique of subject-specific 3D skeletal reconstruction during gait

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1. Introduction

Postural skeletal alignment is altered with age due to intervertebral disc and joint degeneration, consequently affecting quality of life (QoL) and activities of daily living, such as gait. Postural alignment parameters of the spine, pelvis, hips and lower limbs, measured on static standing radiographs, have been widely studied in asymptomatic subjects and subjects affected by various pathologies. However, while most of these parameters are positional and could vary during gait, there are currently no studies investigating how they are modified during walking.

2. Research question

How do postural alignment parameters vary during gait in asymptomatic adults?

3. Methods

85 asymptomatic adults (age: 29 ± 4.9 years [18–59]) underwent gait analysis using the modified Davis protocol [1] with additional markers on the thighs, shanks and C7 spinous process. Subjects then underwent low dose biplanar X-rays in standing position with subsequent subject-specific 3D reconstructions of the spine, pelvis, and lower limbs and calculation of the following 3D radiological postural parameters in the static position: pelvic tilt (PT), sagittal vertical axis (SVA), acetabular abduction (Acet_Abduction), anteversion (Acet_Anteversion) and tilt (Acet_Tilt) as well as the anterior (Ant_Cov) and posterior (Post_Cov) coverage of the femoral head by the acetabulum [2,3]. The 3D bones were registered on each frame of the gait cycle [4] (Fig. 1). A new technique developed for the purpose of this study, utilizing finite element modeling, was used to reduce soft tissue artefacts. The postural parameters were then computed during the gait cycle, using the 3D registered bones, at each time frame: means and ranges of motion (ROM) were calculated.

4. Results

Some of the parameters exhibited large ROM during the gait cycle such as: SVA (23.3 ± 7.2 mm), Acet_tilt (17.8 ± 7.3°), Acet_Abduction (10.9 ± 3.5°), and coverage of the femoral head anteriorly and posteriorly (9.3 ± 1.7%). Acet_Anteversion had a lower ROM (3.4 ± 1°). Fig. 2 shows the variation of the postural parameters during the gait cycle as corridors of normality (mean ± SD) with the value of the static radiological parameter represented for comparison. During walking, all the parameters varied around their standing posture value, except for the SVA which was shifted anteriorly (25 mm) and PT which was slightly increased by 2°.

5. Discussion

This is the first study to describe variation of postural parameters

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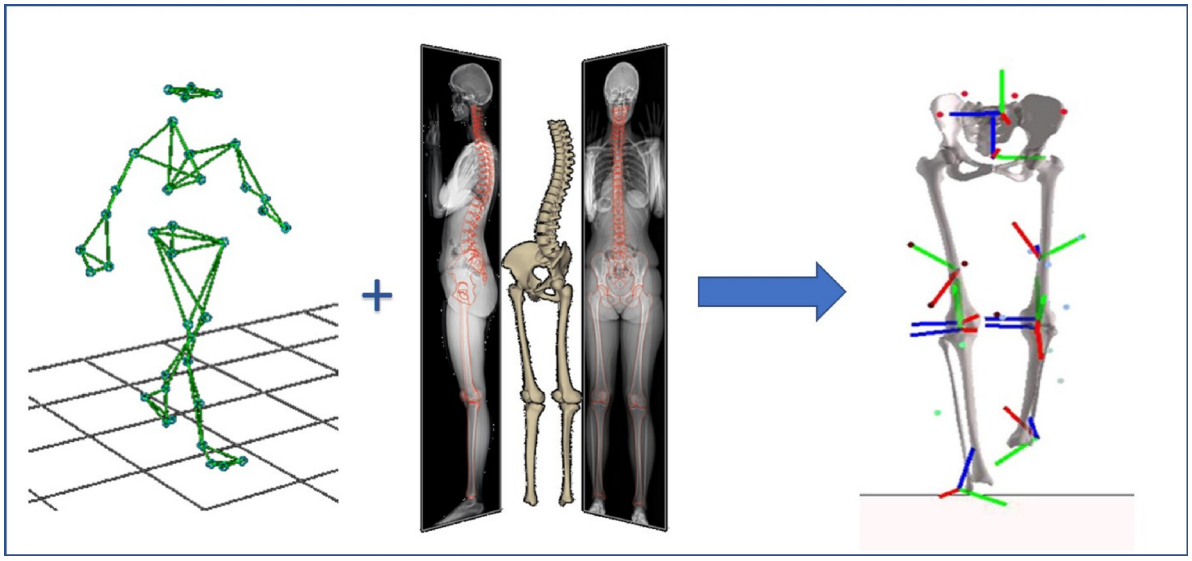

Fig. 1. Registration technique of 3D skeletal reconstruction from biplanar x-rays with gait analysis.

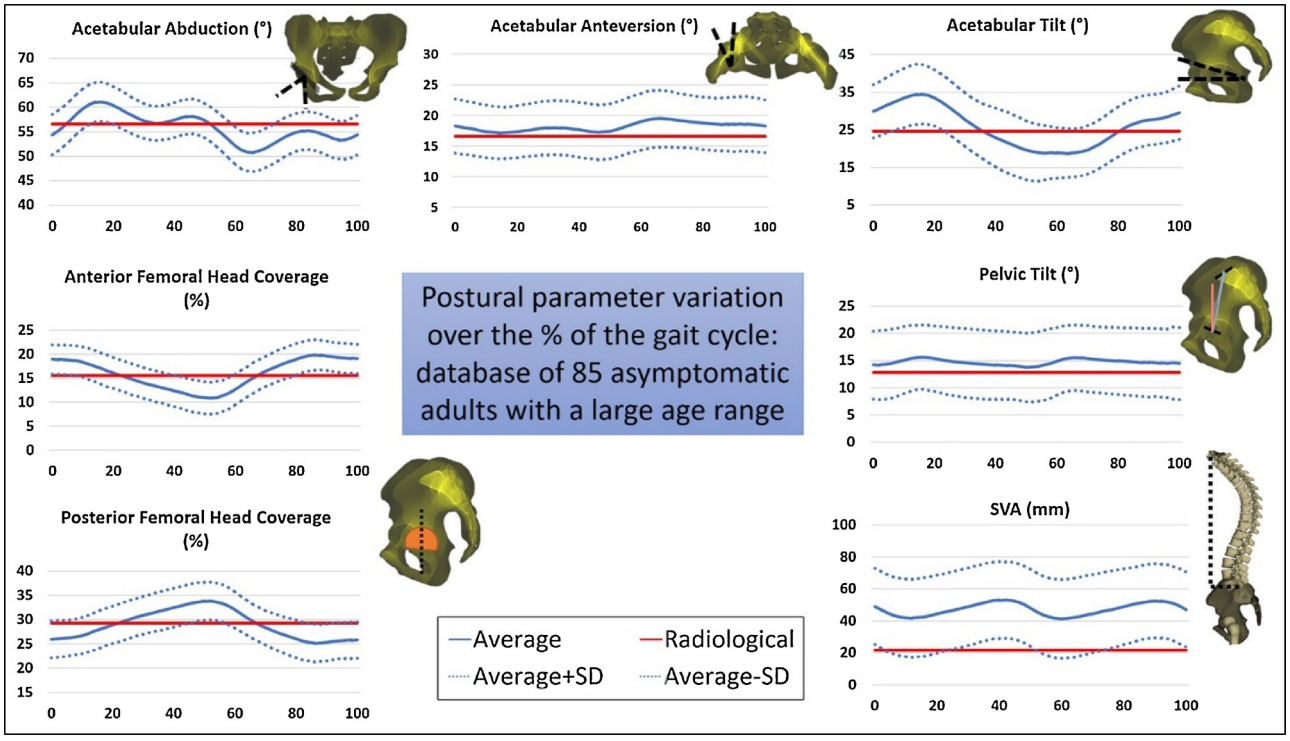

Fig. 2. Variation of 3D postural parameters during gait.

during walking. The variation of acetabular parameters during gait is indicative of the potential change of acetabular cup positioning in total hip replacement during walking. Furthermore, the anterior shift and large ROM of SVA during walking emphasizes the importance of considering the dynamic variation induced by gait when planning surgical re-alignment of the spine. The findings of this study could also provide quantitative data for gait biomechanical modelling.

References

[1] Davis et al., 1990.
[2] Ames et al., 2012.
[3] Ghostine et al., 2016.
[4] Söderkvist et al., 1993.