Dynamic sitting posture-analysis: A Pilot Study

Sarah Mingels, M PT[1,2], Wim Dankaerts, PhD[2], Ludo van Etten, PhD[3], Dennis Odekerken, MSc[3], Toine Diederen, BSc[3] & Marita Granitzer, PhD[1]

1. REVAL Rehabilitation Research Centre, Biomedical Research Institute, Faculty of Medicine and Life Sciences, Hasselt University, Belgium
2. Musculoskeletal Research Unit, Department of Rehabilitation Sciences, Faculty of Kinesiology and Rehabilitation Sciences, Leuven University, Belgium
3. Department of Biometrics, Zuyd University, Heerlen, The Netherlands

Background

Physiotherapists are regularly consulted by headache-patients. Some of these headaches are provoked by specific sitting postures. Previously, analysis of sitting posture was limited to a sagittal, static and instantaneous picture-analysis of the cervical spine with little attention to postural variations. The current study focusses on a longitudinal 3D-Vicon-analysis of the total segmental spine while performing a typing task. Converting such analysis into spinal angles might assist physiotherapists to objectively evaluate sitting posture. It is hypothesised that several clusters of sitting profiles exist in patients with posture-related headache. By using this real-life approach a posture-related diagnosis could be proposed. Therapy could then be oriented to a specific profile.

Methodology

The Bonita Vicon Motion System (Bonita, ©Vicon Motion Systems Ltd. UK) with 2 video-and 8 optical cameras with a sample rate of 100Hz was used. Fifteen reflective markers (14 mm) were placed on anatomical landmarks to determine 1) cervical, thoracal, lumbar and pelvic angles (neutral/habitual), 2) inter-angle relation and 3) angular variation during a 30-minute typing task. Every minute, 10 seconds of the habitual sitting posture was recorded. Data were filtered using a Woltring-filter. Continuous spinal angles between two segments in three dimensions were calculated from the dataset (Nexus Software & Matlab).

Procedure. A UHasselt-prototype, consisting of 15 marker locations, was developed. The markers were fixed via double sided adhesive tape on anatomical landmarks. The cameras were mounted around the perimeter of the workspace (desk + chair).

Marker location. Bilateral tragus, canthus, acrominion, spinous processus C7, T6, T10, T11, T12, L1, Spina iliaca posterior superior and anterior superior, inion

Subjects and Location. Twelve participants (28.6±16.8 y) were analysed between September 2016 and May 2017 at Hogeschool Zuyd Heerlen (The Netherlands)

Ethics approval. Approved by the 'Medisch Ethische ToetsingsCommissie' (NL. 55720.09615)

Results

Problem Inventory - September 2016	Solutions - May 2017
Standard marker set of the Vicon System did not allow tracking of the spinal curvature; no quantification	Development of a 'UHasselt-prototype' with markers at the bilateral tragus, canthus, acrominion, spinous processus C7, T6, T12, L3, S2, spina iliaca posterior superior and anterior superior, inion
Recording of 10 sec every minute during 30 minutes resulted in too many data	Reduction to 5 sec recording
Inconsistent visibility of the markers at the SIPS and SIAS	Addition of 4 extra 'low' optical cameras to capture the markers at the SIPS and SIAS
Impossible to assemble data to compose the lumbo-pelvic angle (L3-S2)	Placement of a new marker at S2 and addition of 4 extra cameras to capture the marker at S2
Markers (14mm) at the tragus and lateral canthus were hard to discriminate	Replacement of the markers through smaller markers (8mm)
C7-invisibility during cervical extension	Cervical pro-and retraction referred to C7

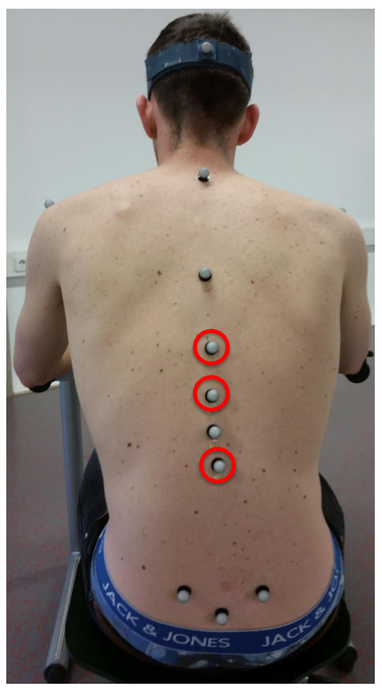
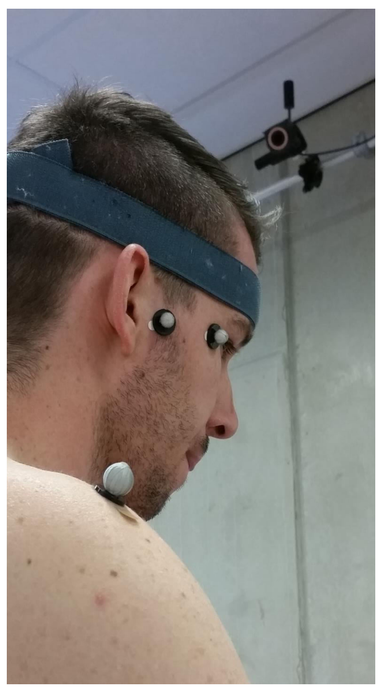


Figure 1. Marker location (markers circled in red were removed in May 2017)



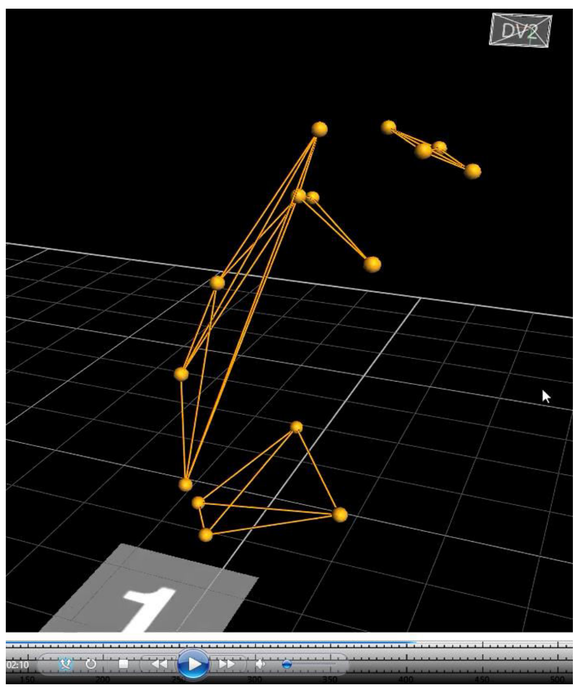


Figure 2. The 'UHasselt-model' (From Zuyd Hogeschool Heerlen)

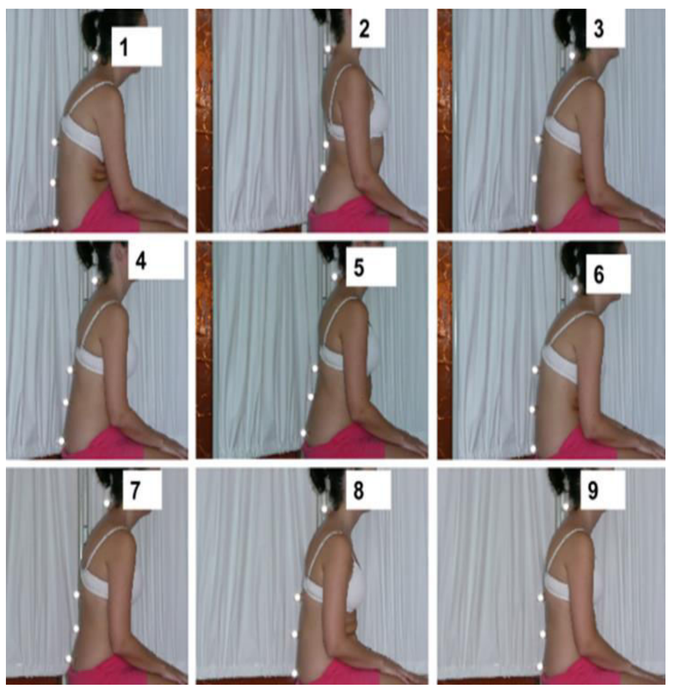


Figure 3. Posture-related classification (With permission of O'Sullivan K et al. 2012)

Conclusion

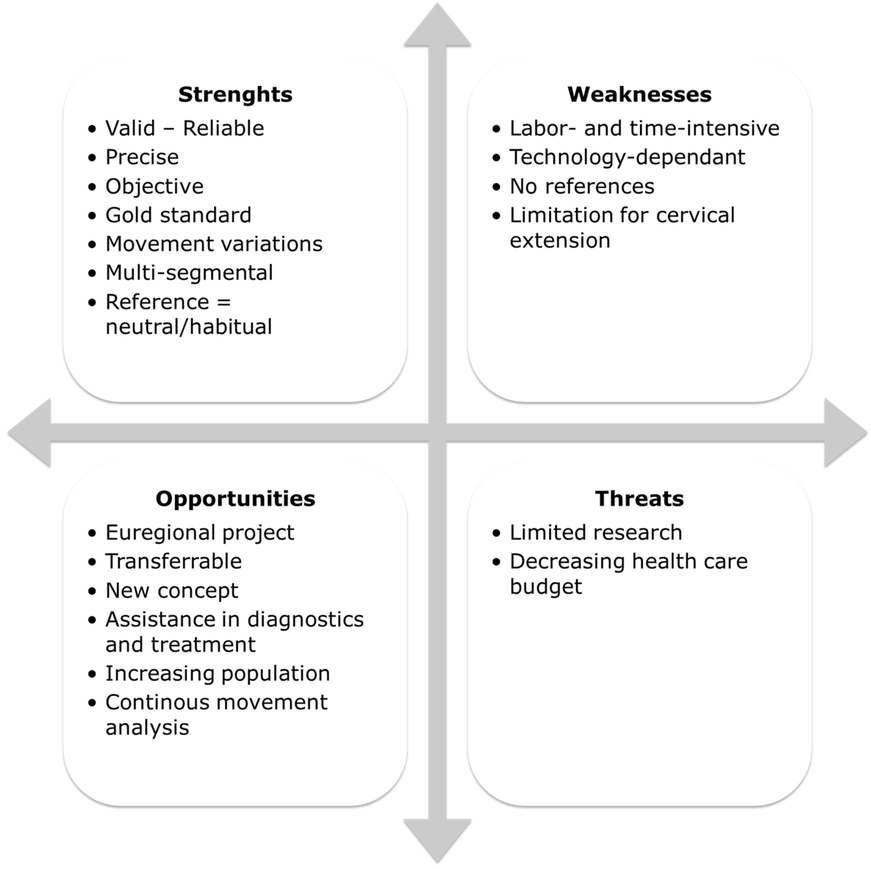
❑ Four adjustments caused a 100% visibility of every marker during 30 minutes:
- Four optical cameras were added to the original set
- Sixteen reflective markers were placed on anatomical landmarks
- Concerning the tragus and lateral canthus smaller markers (8 mm) were used
- Cervical spine evaluation through pro-and retraction

❑ Simplifications
- Data-reduction through shortening of the recording time

Clinical Implication

❑ First phase
- Standardisation of a functional posture-analysis
- Development of posture-related diagnostic criteria
- Therapy kick-off

❑ Second phase
- Translation of the Vicon motion analysis to a clinical setting



Correspondence

Sarah Mingels. Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Life Sciences, Hasselt University, Hasselt (BE).
☎ +32 11 268 509 - sarah.mingels@uhasselt.be