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Research Article

Estimation of Moments in Simulated Dental Cleaning Task in Four Working Positions.

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1. Introduction:

Musculoskeletal disorders (MSD) are described as a group of diseases and complaints that impact one or more structures of the musculoskeletal system of humans (Lietz, Ulusoy, and Nienhaus 2020). They are work-related when the environment and work performance contribute significantly to the disorder, which, due to the working conditions, is made worse or persists longer, or both. MSDs represent a significant occupational health problem among dental practitioners and have been attributed to deteriorating quality of life, often resulting in stressed-related illnesses, and premature retirement (Burke, Main, and Freeman 1997).

The prevalence of general musculoskeletal pain in oral health professionals (dentists and dental hygienists) ranges between 62% and 93% (Hayes, Cockrell, and Smith 2009). A recent review (De Sio et al. 2018) identified static working posture as the main risk factor for the development of MSD. Common MSDs affecting dental workers were neck, shoulder and lower back (Gupta, Ankola, and Hebbal 2013), but elbow-forearm and wrist-hand were also reported (Ramírez-Sepúlveda et al. 2020).

According Kulkü et al It has been demonstrated that tensely maintained asymmetric body posture is a risk for low back pain (LBP) among other factors related to the work practices in naked eye dentistry without high magnification. (Comes et al 2010)

The correct working posture for dentistry is the balanced or neutral posture, and can be affected by the operator´s position according to Chaikumarn, (Chaikumarn , 2004). This posture is an unforced, natural, and symmetrical seated posture, which assumes minimal contractions and muscular tensions and stable for all body segments and joints (Pîrvu et al. 2014). However, a constrained environment such as the intraoral working field imposes postural demands on oral health professionals who can adopt many working positions with the intent of minimizing deviations from the balanced position—the greater the deviations, the greater the risk for MSDs.

This study aimed to evaluate four working positions used during routine dental polishing.

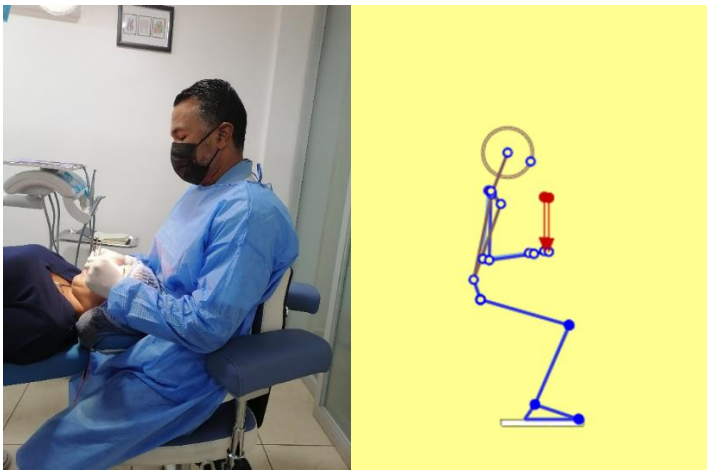
2. Methodology:

In this preliminary study, routine tooth polishing was performed on four patients seated in the dental chair in a supine position. The procedures were performed from 4 different working positions: nine (9) o'clock (The operator is seated precisely right of the patient), ten (10) o'clock, eleven (11) o'clock,

and twelve (12) o'clock (The operator sits directly behind the patient). The average duration of the procedures was 15 min.

All procedures were performed using an ergonomic chair (Dynamic model, Back Quality Ergonomics, The Hague, Netherlands) with telescopic and revolving arm rests by the same operator, the operator reported no vision issues and no recent history of MSD. Each endodontic access procedure took between 8 – 10 min. A video camera was used to record the procedures from 3 different angles (2 lateral views (right and left) and a front view) in three different patients following the National Institute for Occupational Safety and Health (NIOSH) protocol for video recording for jobs analysis and assessment for risk factors. The position of the camera was standardized for all the recordings. In addition, the working posture adopted during the procedures was recorded by a mobile phone camera (Model STK-LX3, HUAWEI Technologies Co. Ltd., China) and evaluated using Rapid Upper Limb Assessment (RULA).

The same procedures evaluated by RULA were entered into the 3DSSPP model to predict the compressive load at L4/L5 at each working position. Again, descriptive statistics and charts are used for data presentation.



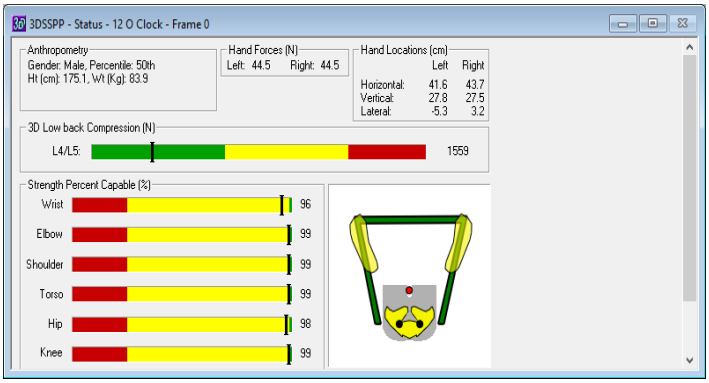
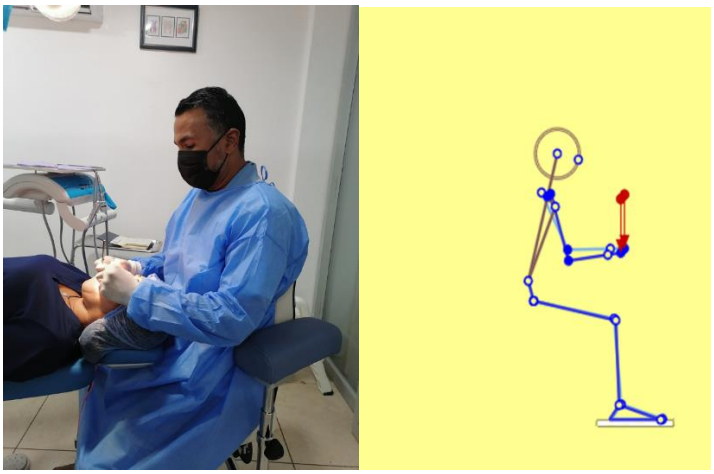


Figure 1: 12 o´clock lateral view, 3DSSPP analysis postural symmetric diagram, and compression forces chart.



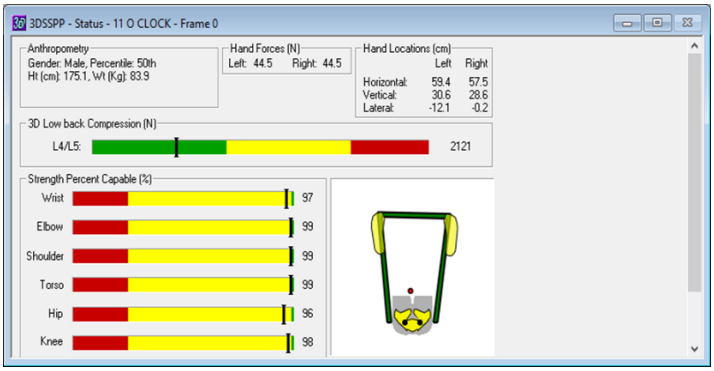
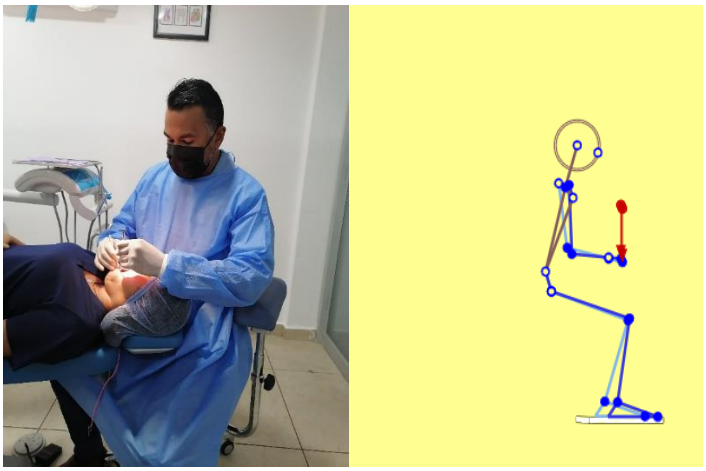


Figure 2: 11 o´clock lateral view, 3DSSPP analysis postural symmetric diagram, and compression forces chart



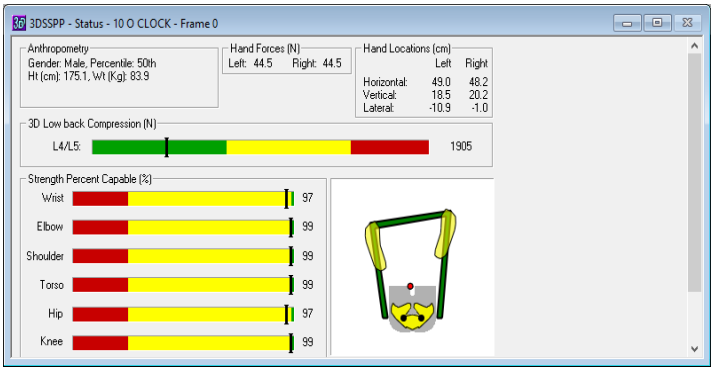
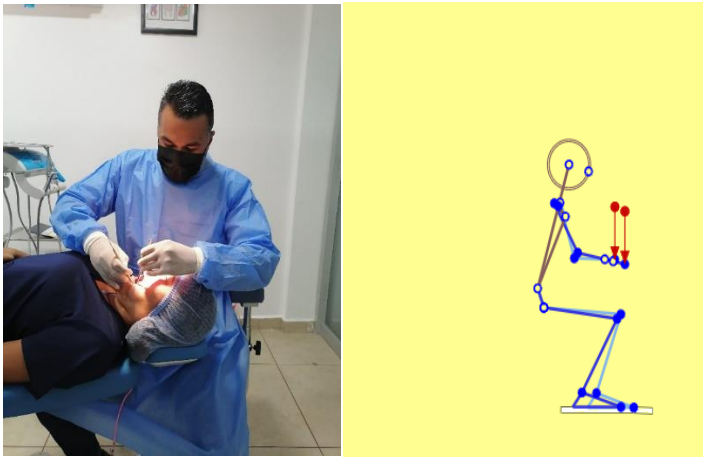


Figure 3: 10 o´clock lateral view, 3DSSPP analysis postural symmetric diagram and compression forces chart.



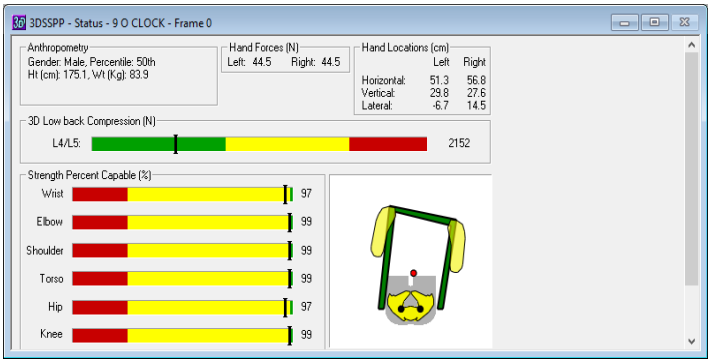


Figure 4: 9 o´clock lateral view, 3DSSPP postural symmetric diagram, and compression forces chart.

3. Results & Discussion:

RULA scores and Spinal compression force predicted by 3DSSPP are presented in figures 5 and 6.

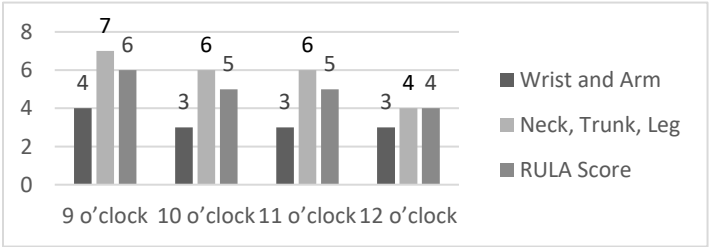


Figure 5: Scores for Wrist and Arm; Neck, Trunk and Leg and total RULA score according to working position.

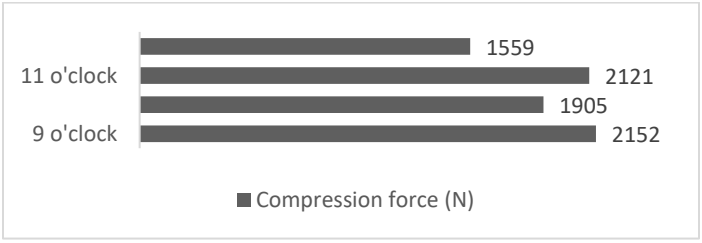


Figure 6: Spinal compression force (N) on L4/L5 predicted by 3DSSPP according to working positions.

4. Conclusions:

Dentistry is a highly physically demanding profession, with multiple risks for MSD development, such as prolonged sitting static postures, awkward postures, and repetitive motions. According Elfeituri et al ,the maximum compression forces permissible limit for the low back is 3400 N, although in this study case, performed in a single individual highly trained in applied ergonomics, the maximum compression forces predicted by the 3DSSPP was 2152 N on the nine clock position, the risk modifiers of duration and motions during the working time are cumulative over time, and hazards for MSD development.

Overall RULA scores and neck, trunk and leg RULA scores decreased from 9 to 12 o'clock working positions. In addition, increasing postural asymmetry was observed from 12 to 9 o'clock working positions, and the lower compression forces predicted by the 3DSSPP were on the 12 o clock position.

Collecting data from a larger population is a suggestion to provide more information about this study in future studies.

Authors note:

Dr. Juan Carlos Ortiz Hugues is a dental surgeon and an endodontist specialist. President of the Academy of Microscope Enhanced Dentistry (AMED) with a certification in Advanced Occupational Ergonomics (Colorado State University) and CEAS I -II (The Back School, Atlanta, GA). Author of the book: Ergonomics Applied to Dental Practice. Quintessence Publishing, 2023.

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Dr. Gabriel Ibarra-Mejía has an MD and MS degree from Universidad Autonóma de Ciudad Juárez. He also has an M.S. degree in Ergonomics from Lulea Tekniska Universitet, Sweden, and a Ph.D. in Environmental Science and Engineering from The University of Texas at El Paso. He is currently part of the Public Health Sciences department at The University of Texas at El Paso.

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