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).

The correct working posture for dentistry is the balanced or neutral posture. 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. Video cameras were was used to record the procedures from 3 different angles: 2 lateral views (right and left) and a front view, 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 cameras was standardized relative to the operator 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. The RULA scores and spinal compression forces for each working position were plotted.

3. Results & Discussion

RULA scores and Spinal compression force predicted by 3DSSPP are presented in figures 1 and 2. Working at the 9 o'clock position requires bending, twisting, and tilting of the trunk and neck, which varies to a greater or lesser extent depending on the postural awareness of the operator. On the other hand, working at the 12 o'clock position allows the operator to sit in an upright, balanced posture, which may explain, in part, the results observed.
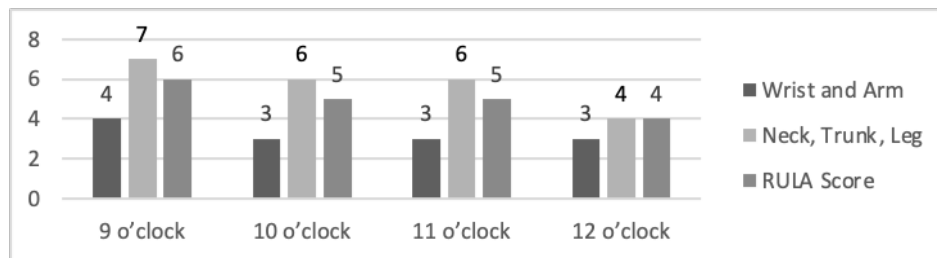

Figure 1. Scores for Wrist and Arm; Neck, Trunk and Leg and total RULA score according to working position.
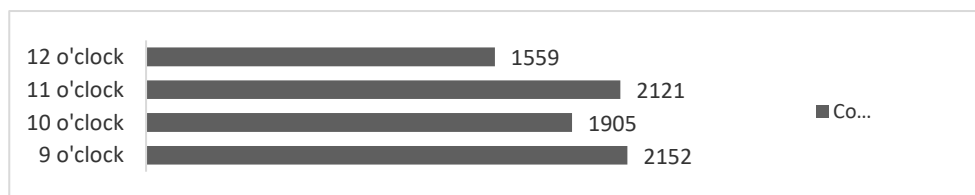

Figure 2. Spinal compression force (N) on L4/L5 predicted by 3DSSPP according to working positions.

4. Conclusions

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. Further research on operators with varying years of working experience and specialties is warranted.

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