Reducing Fatigue and Musculoskeletal Burden while Improving Clinician Comfort and Efficacy during Ultrasonic Scaling using a Novel Wristband Cord-Holder

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Introduction

- Dental hygiene ranks first of all U.S. occupations for prevalence of carpal tunnel syndrome, musculoskeletal diseases (MSDs) & upper extremity disorders.[1]
- In one study, 64-96% of hygienists experienced symptoms of MSDs within a 12-month period.[2]
- 2/3 of dental clinicians report occupational musculoskeletal pain.[3]
- One third of dental clinicians retire early due to MSDs.[4]
- Ultrasonic scaling, and many forms of dental instrumentation are related to a wide range of musculoskeletal diseases, as well as intra- and postoperative discomfort and fatigue.[5]

Goal: to evaluate the effect of a novel wearable cord-holding device on muscle work, fatigue, musculoskeletal symptoms and comfort related to ultrasonic scaling.

Materials and Methods

- Protocol granted exempt status by University of California Irvine IRB.
- Randomized, controlled, crossover study design.
- 5 hygienists served as testers: age 32-54 years; mean 41 years.
- 2 testers had 5-10 years of clinical experience; 3 testers 11-20+ years.
- Testers performed standardized ultrasonic scaling task twice: with and without use of wearable cord-holding device (Cordeze^{R}, Veil Products, Phoenix, AZ 85087) (Figure 1). Cord-holder attaches to ultrasonic scaler cord to serve as stress-breaker for pullback.
- Using dental typodont with standardized calculus load, testers scaled each lingual or buccal surface of each quadrant for 2 minutes.
- Four wireless surface electromyography (sEMG) electrodes were attached to hands and arms of tester's dominant limb to measure activity in 4 muscles: *extensor digitorum communis, flexor digitorum superficialis, extensor carpi radialis brevis, first dorsal interosseous.*
- Evaluation criteria:
  1. Hand, wrist, arm fatigue & comfort: (visual analog scale (VAS) recorded immediately post-scaling; 0-10 scale; 0 best, 10 worst).
  2. Muscle work: sEMG traces analyzed using BTS EMG analyzer^{R} software (FREEEMG, ©BTS Engineering, Quincy, MA).
  3. Cord pullback force: tensional dynamometer each site (N force).
  4. Efficacy: percent of each buccal or lingual quadrant surface scaled within 2 minutes

Statistical Analysis: sEMG trace data were analyzed using multivariate ANOVA and Bonferroni post-hoc tests; t- tests were used for the remaining analyses.Significance level set at $p<0.05$.

Results and Discussion

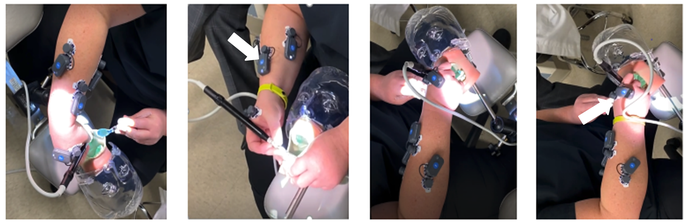

Figure 1: sEMG electrodes and wristband cord-holder (white arrow) *in situ*

1. Combined mean fatigue in all 4 muscles was reduced by 60% using the wristband; mean comfort was improved by a factor of 3 (sig., $p<0.05$) (Figure 2).

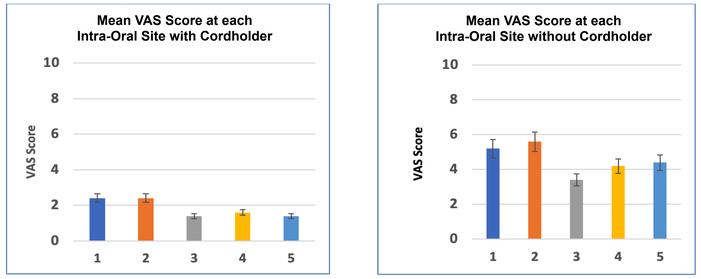

Figure 2: Mean VAS Scores: 1= overall fatigue in hands, fingers,wrists, 2= comfort in thumb, 3= comfort in wrist, 4= comfort in fingers, 5= comfort in palms

2. Mean VAS score for each of the 5 evaluation categories was sig. better when cord-holder was used ($p<0.05$), demonstrating that user fatigue and comfort at all sites (thumb, wrist, finger, palms) were significantly improved during wristband cordholder use (Fig. 2).

3. Based on sEMG measurements, work/s during scaling was reduced by 30% and total work to complete the scaling task by 25% using the wristband (sig., $p<0.05$) (Fig. 3).

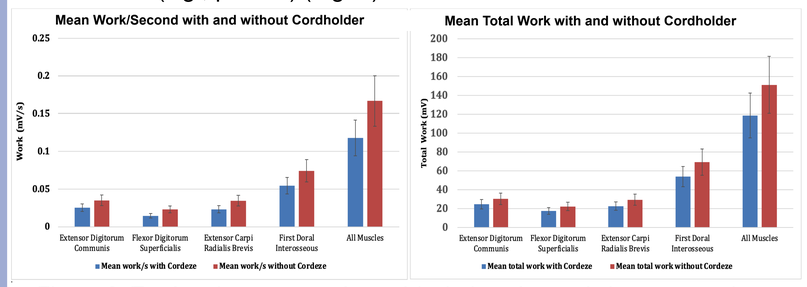

Figure 3: Total and mean muscle work/s during ultrasonic instrumentation

4. Hygienists registered significantly fewer complaints related to discomfort or pain ($p<0.05$) when working with the wristband (Table 1).
5. Testers also remained symptom-free during scaling for a significantly longer period of time ($p<0.05$) using the wristband (Table 2).
6. Testers recorded significantly fewer complaints ($p<0.05$) at each anatomical site when working with the wristband vs. without (Table 3).

Results and Discussion (Continued)

	Number of Complaints	
	w/ Cordeze	w/o Cordeze
TG	4	12
LB	3	19
RS	0	14
RV	4	13
YH	4	14
Total	**15**	**72**
Mean	**3**	**14.4**

Table 1: Number of Complaints

	Timepoint of first complaint (min)	
	w/ Cordeze	w/o Cordeze
TG	4.1	4.1
LB	3.05	0.05
RS	none	2.15
RV	8.07	2.37
YH	4.15	1.5
Total	**19.37**	**8.67**
Mean	**3.87**	**2.03**

Table 2: Time until First Complaint

	Total number of complaints by site	
	w/ Cordeze	w/o Cordeze
Purlicue	5	8
Wrist	2	4
Index finger	1	14
Palm	2	8
Forearm	1	14
Thumb	3	18
Hand	0	2
Upper arm and neck	1	4
Total	**15**	**72**

Table 3: Total Number Complaints/Site

7. Cord pullback force was eliminated when scaler cord was attached to wristband, while measuring 2.3 N when wristband was not used (Fig 4).

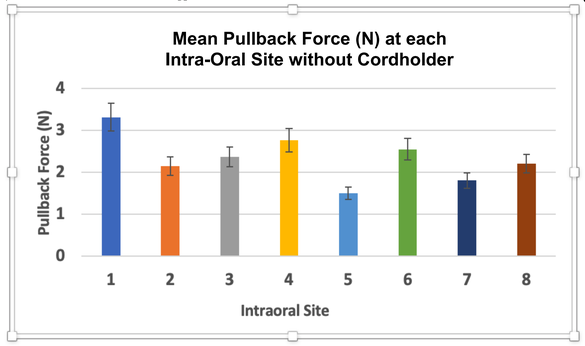

Figure 4: Mean pullback force without wristband for 8 intraoral sites scaled: 1-URQ Buccal, 2-ULQ Buccal, 3-ULQ Lingual, 4-URQ Lingual, 5-LRQ Buccal, 6-LLQ Buccal, 7-LLQ Lingual, 8-LRQ Lingual. Pullback force at all 8 sites with wristband in place measured 0 N.

8. While wearing the wristband, all testers completed cleaning all surfaces during the given time allotment. Without the wristband, 1 hygienist did not complete scaling in 2 areas, and another hygienist failed to scale 1 surface within the 2-minute time allotment.

Conclusions and Clinical Relevance

The results of this pilot study indicate that a novel wristband cord-holder may improve ergonomics & reduce musculoskeletal burden of ultrasonic scaling while supporting efficient instrumentation.

Acknowledgements

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