

Work-related hand pathology among dentists: A pilot study

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Abstract—The main aim of our study was to evaluate the potential relation between dental instruments and work-related musculoskeletal pathology experienced by dentists during daily practice in long-term follow-up, focusing on hand and wrist involvement. 3-month prospective observational study on 60 age-, gender-, field of practice- and work experience-matched dentists splited in two equal groups based on their work in either an ergonomic or non-ergonomic environment meaning daily practice with classical or ergonomic tools (size, weight, shape, texture, handpiece, types of active extremities). Outcome measures included specific parameters reflecting work-related musculoskeletal pathology - joint pain, swelling, stiffness, paresthesias, grip strength, dentist's physical comfort. A specific questionnaire (Musculoskeletal Disorder Rating Scale) adapted for hand and wrist was applied - socio-demographic parameters (age, gender, field of practice, years in profession, working hours, patients treated per working day) and musculo-skeletal complains. Groups were comparable in terms of socio-demographic parameters ($p > 0.05\%$). Statistical significant more dentists in non-ergonomic group presented with work-related hand problems ($p < 0.05$) resulting in impaired professional involvement and decreased quality of life: hand pain (intensity, location, duration, time of occurrence), swelling, paresthesia, grip force. Musculoskeletal manifestations are recognized to have raised indicators of morbidity among dentists. Ergonomics has a special application in dentistry because it can increase productivity of labor in dental medicine and improve the indicators of incidence and prevalence of musculoskeletal diseases.

Keywords— dental instruments, ergonomics, hand pathology, musculoskeletal disease

I. INTRODUCTION

The professional activity of the dentist is basically a manual activity involving both distal and proximal segments of the upper limb as well as lumbar spine, acting in a specific

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environment meaning prolonged sitting position, excessive stress related to repetitive movements while using either ergonomic or non-ergonomic working tools.

Recent research has focused on the complex interplay between the dentist's hand and the instruments used in its daily practice. This dual relation typically reflect not only physical characteristics, practitioner's skills (anthropometric data) and comorbidities (e.g. rheumatoid arthritis, diabetes), but also different abnormalities of the patient and characteristics of the dental instruments (e.g. diameter, texture, shape, weight) as well. [1, 2, 3, 4]

It is widely recognized that professional activity in dentistry is generally influenced by ergonomics, since it is strongly dependent on distinctive physical and mechanical (strength, accuracy, vibration) settings.

Ergonomics is the science that attempt to adjust the relationship individual-device-environment for the benefit of medical activity and provider. Nowadays, ergonomics focus on the complex hand- instrument-dental alveolar tissue under dental professional activity, aiming to increase efficacy and reduce professional risk factors related to hand musculoskeletal pathology. [5, 6, 7] It is, therefore, mandatory to apply ergonomic principles concerning selection, maintaining and practice with ergonomic instruments and devices (Sanders, 1997). [8] Moreover, certain pathologies of the hand may be reported more frequently in dental professionals including osteoarthritis of the first metacarpophalangeal joint, radio-carpal joint as well as proximal and distal interphalangeal joints (PIP, DIP), carpal tunnel syndrome, bursitis, tenosynovitis, tendinitis of the flexor and extensors. Grip strength, prolonged grasp, repetitive motions and hand postures and, generally, postures adopted by the dentist represent risk factors for the above mentioned hand pathology. [9, 10, 11]

A number of features of dental instruments such as shape, diameter, size, weight, texture of the handle, the presence or absence of the optical fiber, dynamic or static tools may also represent significant factors influencing work-related hand pathology in dentistry. [12, 13, 14]

Finally, the age, sex, general and local comorbidities of the patients may interfere with the short- and long-term outcome of the dentist in routine practice.

Only few studies were specifically designed to analyze the ergonomic relationship between work-related hand pathology in dentists and the dental instruments. [15,16, 17, 18]

II. AIM

The main aim of our study was to evaluate the potential relation between dental instruments and work-related musculoskeletal pathology experienced by dentists during daily practice in long-term follow-up, focusing on hand and wrist involvement.

III. MATERIAL AND METHOD

The study was conducted among 30 on-job dentists (10 men, 20 women) (Group 1) enrolled from different private dental clinics. All subjects have agreed to work for 3 months in a non-ergonomically environment, meaning daily practice with classical instruments with the following features: metal (stainless steel) made handle; small diameter (5-8 mm); hexagonal shape; texture (with and without ribs); heavy (10-15) grams; one active extremity; dynamic handpieces without an optical fiber. (Figure 1)

A control group of 30 (12 men) age-, gender-, field of dental practice- and work experience-matched dentists (Group 2) was considered in order to assess a 3-month work with ergonomic tools (silicon made, resistant to sterilization handle; large diameter, 10-11.5mm; round shape; ribbed texture; low weight, under 10 grams; one or two active extremities instruments; dynamic handpiece with optic fiber; new materials devices). (Figure 1)



Figure1 Dental instruments with different diameter

Subjects were enrolled based on predefined **inclusion** (age between 27 and 45 years, at least 7 hours of daily work in the office) and **exclusion criteria** (history of wrist and/or hand pathology).

Outcome measures included specific parameters reflecting work-related musculoskeletal pathology such as joint pain, swelling and stiffness, paresthesias, grip strength as well as the physical comfort of the dentist.

A specific questionnaire (MDRS) focused on the above mentioned items was applied in all dentists in order to evaluate the usefulness of ergonomics in dental work; the MDRS, Musculoskeletal Disorder Rating Scale, adapted for hand and wrist is a self-administered scale consisting of socio-demographic parameters (age, gender, field of dental practice,

years in profession, average working hours per day and per week, average number of patients treated per working day, height and weight), pain, stiffness and grip force.

Pain and stiffness were evaluated as frequency (categorized as “always”, “sometimes”, or “never felt”) and intensity (assessed by 0–10 Visual Analogue Scale, and considered arbitrary as “no pain” if “0”, “mild” if “1-3”, “moderate” if “4-6” and “severe” pain if “7-10”), while the grip force was tested with a hand dynamometer (kgs) (table 1). In addition, signs and symptoms related to potential median and/or cubital nerve involvement meaning the presence of distal digital paresthesia were checked in all patients and registered as “present” or “absent”.

Table 1. Parameters used for work-related musculoskeletal problems in dental environment

Item	Characteristics
Pain	<ul style="list-style-type: none"> • <i>Location:</i> wrist (palmar and dorsal face, carp edge radial forearm); <i>hand</i> (metacarpophalangeal, MCP; proximal or distal interphalangeal joints, PIP, DIP); • <i>Time of occurrence</i> (during work-time, after ending the working time); • <i>Frequency</i> („sometimes”, „always”, „never”) • <i>Intensity</i>, 0-10 VAS („mild” if 1-3; „moderate” if 4-6; „severe” if 7-10)
Swelling	Wrist, hand joints
Paresthesia	Median nerve involvement – paresthesia in the first three fingers/ cubital nerve involvement - last two fingers
Grip	hand dynamometer for measuring force

A written informed consent was obtained from all the participants on a voluntary basis; the study was approved by local Ethical Committee.

Statistical analysis was performed with the SPSS version 13 statistical package, $p < 0.05$.

IV. RESULTS AND DISCUSSIONS

Baseline characteristics of dental professionals included in the study are summarized in table 2. No statistical significant differences between groups in terms of socio-demographic parameters ($p > 0.05\%$) were reported.

Table 2. Demographic, anthropometric and ergonomic parameters of dentists at baseline

Item	Group 1	Group 2 (control group)	p
Sex ratio female: male	20: 10	18: 12	
Age (years) (mean, range)	33	33,6	p>0.05
Height (cm) (mean, range)	166	172	p>0.05
Weight (Kg)	73 ± 9	75 ± 7	p>0.05
Years of practice 5-10 (n) > 10 (n)	11 19	12 18	p>0.05
Hours of activity 7 hours (n) > 7 hours (n)	22 8	25 5	p>.05 p>0.05

We enrolled experienced dentists, with over 10 years of practice indicating considerable experience, ability in handling tools, but also increased chance for cumulative effect of work-related risk factors. In addition, occupational risk may be reflected by the average working hours per day and per week, but only a few dentists reported more than 7 hours of activity daily or more that 35 working hours per week.

Table 3. The results obtained at the end of 3 months of monitoring, physicians using instruments with design non ergonomic

Items	Group 1	Group 2 (control)	P
Pain (n, %)	22	17	<0.05
Location	(73.3%)	(56.6%)	
wrist (n)			<0.05
MCP1 (n) & MCP 2, 3 (n)	9	7	<0.05
DIP (n) & PIP (n)	4 & 4 (8)	3 & 3 (6)	<0.05
The time of occurrence			<0.05
from the beginning of working day (n)	8	6	<0.05
end of activity (n)	14	11	<0.05
Intensity (0-10 cm VAS)			<0.05
1-3	4	1	<0.05
4-6	5	3	<0.05
7-10	17	14	
Duration			
always			
sometimes			
Swelling			
the palmar or dorsal face of wrist,	4 & 5	4 & 4	
radial edge of forearm	4	2	
	4 & 6	5 & 2	
	5 & 5	4 & 4	

PIP & DIP MCP1 & MCP 2,3			
Paresthesias			
Median (n)	5	4	p>0.05
Cubital (n)	2	1	p>0.05
Grip force	33 ± 4	36 ± 4	
Physical comfort of the dentist			
Limited (n)	22	17	
Favorable (n)	8	13	

Pain. Up to 72.3% dentists (22 cases) from group 1 and more than half (56.6%, 17 cases) of those in group 2 presented with wrist and hand pain, signalling the burden of work-related musculo-skeletal issues in dental professionals, irrespective to the utilization of ergonomic instruments. However, a statistically significant difference was reported between groups regarding wrist and hand pain ($p<0.05$); while wrist involvement was comparable (9 cases vs 7 cases) ($p>0.05$), hand involvement seems to be more frequent reported in dentists known to act with non-ergonomically designed dental instruments (16 cases vs 11 cases) ($p<0.05$).

The majority of dentists working in a non-ergonomic environment were classified as having moderate pain (12 cases), followed by those displaying mild pain (6 cases), and severe pain (4 cases). Looking in group 2, most dentists presented with mild pain (10 cases) and only one featured severe pain.

While hand and wrist pain was typically reported at the end of working day and commonly classified as „sometimes”, differences between groups reached the statistical significance ($p<0.05$).

Swelling. Dentists in both groups presented with wrist and hand joint swelling as well as tenosynovitis, with a slight predominance in patients working non-ergonomically ($p>0.05$ for all sites, unless for wrist involvement, where $p<0.05$).

Paresthesia as a common expression of median and/or cubital nerve involvement were described in one out of four dentists working with non-ergonomic tools, and in 16.6% (5 cases) of dentists working ergonomically ($p>0.05$).

Grip strenght was compromised in dentists with work-related musculo-skeletal complains, mostly in long-term follow up of those using dental instruments with a non-ergonomic design ($p<0.05$) **33 ± 4 to 36 ± 4 kg / s**

Finally, physical comfort of dentist, a comprehensive item describing the well being of the physician, was impaired if persistent pain, swelling, as well as paresthesia defined.

Discussion

Work-related pathology, particularly musculoskeletal items are commonly recognized in dentistry, as a result of a complex interplay between dental professionals, instruments and environment. The significant burden of the relation hand - instrument - dental alveolar tissue typically focus on prolonged forced postures at work as well high precision, force and repetitive tasks and movements.

Our study aimed to demonstrate the influence of different types, either ergonomic or non-ergonomic, of dental instruments used throughout the dental procedures in long-

term follow-up (3 months), as well as musculoskeletal issues in such settings. A dynamic assessment of clinical parameters collected by using the MDRS adapted scale, including pain, swelling, numbness, muscle strength in both groups of dentists classified according to their work definitely showed the role of ergonomics in work-related musculoskeletal pathology particularly in hand. Statistical significant more dentists in non-ergonomic group presented with work-related hand problems resulting in impaired professional involvement and decreased quality of life.

Our data support data reported by Karwaski et al, Rice et al, Lalumadir et al, Shaik et al providing detailed information about the risk factors and occupational health issues involving hand, spine (lumbar and cervical region), and lower limb occurred in daily practice of dental professionals.

Moreover, the study shows clearly that the intervention of an ergonomic factor, which seems to be of minor importance, can lead to prevention of work-related musculoskeletal pathology; in addition, the design of the instrument may also impact the functional capacity of the practitioner, with subsequent joint and muscle complaints.

In the mean time, average working hours per day and working days per week, average number of patients treated daily, years in profession and field of dental practice may adversely impact health and performance at work by affecting dentist's abilities.

Ergonomics as a general determinant of technological actions, modernization of equipment, tools and materials is the element that leads to progress from the results, shorter working time via optimizing workforce and preventing the onset of fatigue and musculoskeletal pathology

V. CONCLUSION

In conclusion, musculoskeletal manifestations are recognized to have raised indicators of morbidity among dentists. Ergonomics has a special application in dentistry because it can increase productivity of labor in dental medicine and improve the indicators of incidence and prevalence of musculoskeletal diseases.

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