

ERGONOMICS AND PREVENTION OF MUSCULOSKELETAL – WORK RELATED PATHOLOGY IN DENTISTRY: A PILOT STUDY

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ABSTRACT

Dentistry is acknowledged as an outstandingly practical domain of medicine, with an excessive and extensive role of the hand acting in a professional dental environment, with specific working postures, repetitive movements and using different dental instruments. The main objective of our study was to evaluate occupational-hand pathology in dentists and potential trigger factors and to highlight the role of physical therapy in preventing and management of different musculoskeletal issues in dentistry settings. We performed a prospective 12-months study on 30 dentists (20 women), aged between 30 and 60 years, working in private practice aiming to assess professional hand involvement. Enrolled dentists were classified in two equal groups, according to their participation in a kinetic program: group A, dentists performing an individual kinetic program on a daily basis, and group B, dentists without being involved in a physical therapy program. All subjects were followed-up for 12 months. A specific questionnaire derived from the Cornell Musculoskeletal Discomfort Questionnaire was applied in all cases, evaluating different musculoskeletal items such as pain, paresthesias, muscle spasm and amyotrophy, but also joint mobility (wrist, metacarpophalangeal joints). Work-related hand pathology is widely confirmed among dentists, specifically connected to different professional factors such as working postures and movements, number of working hours, cumulative time and experience, as well as type of devices and tools handled. Moreover, dentistry performed according to ergonomic settings is essential in order to reduce the burden of musculoskeletal features and to improve related disability and working performance. Work-related hand pathology accounts for significant morbidity and physical discomfort among dental professionals. With a multifaceted pathobiology ranging from inflammatory to degenerative damage of both soft tissue, nerve and joints (wrist and fingers), musculoskeletal issues are typically linked to professional triggers during routine practice in dentistry.

Key words: dentist hand disease, work-related musculoskeletal disorders, ergonomics, kinetotherapy

INTRODUCTION

Dentistry is acknowledged as an outstandingly practical domain of medicine, with an excessive and extensive role of the hand acting in a professional dental environment, with specific working postures, repetitive movements and using different

dental instruments.

The complicated osteo-articular structure of the hand typically allows specific movements during working in daily dental practice. Furthermore, the two main functions of the distal segment of upper limb, namely the grip prehension and finger-to-finger

prehension, independently each other, lead to working performance in such population.

In this background, the dentist's hand symbolizes more than a common anatomical segment, being considered as a concept of major importance; various mechanical risk factors negatively act on musculoskeletal and nervous structures shaping pathological entities. [1,2]

It is, therefore, mandatory to preserve both structural and functional, biomechanical, integrity of the hand, avoiding joint overloading and promoting an ergonomic working environment (correct working posture, ergonomic devices and dental tools, ergonomic dental chair) with substantial control of musculoskeletal complains (e.g. pain, limited range of motion, disability) and working performance. Moreover, the burden of dentist's hand pathology is significantly improved by a complex clinical and imagistic assessment with subsequent classification of work-related hand pathobiology, allowing a specific prevention and/or management protocol. [3-7]

While implementing in routine dental practice various ergonomic recommendation, additional procedures are required for upholding physical comfort of the dentist and delaying or preventing pathological work-related events. Physical therapy by relaxation techniques, postures and mobilization represents one of key points in precluding and managing musculoskeletal issues in dentistry. [8-14]

The main objective of our study was to evaluate occupational-hand pathology in dentists and potential trigger factors and to highlight the role of physical therapy in preventing and management of different musculoskeletal issues in dentistry settings.

MATERIAL AND METHODS

We performed a prospective 12-months

study on 30 dentists (20 women), aged between 30 and 60 years, working in private practice, aiming to assess professional hand involvement.

Subjects were selected based on several inclusion criteria (regular professional activity, encompassing for all types of dental duties; common framework of at least 6 hours per day; 10 years or more of practice of dentistry) and exclusion criteria (previous diagnosis of either hand, elbow or shoulder pathology e.g. epicondylitis, scapulo-humeral soft tissue issues; cervical spine surgery; fractures of the upper limb; inflammatory rheumatic diseases focusing on hand involvement such as rheumatoid arthritis, psoriatic arthritis).

Finally, enrolled dentists were classified in two equal groups, according to their participation in a kinetic program: group A, dentists performing an individual kinetic program on a daily basis, and group B, dentists without being involved in a physical therapy program. All subjects were followed-up for 12 months.

A specific questionnaire derived from the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was applied in all cases, evaluating different musculoskeletal items such as pain (meaning location, intensity, potential irradiation, mechanical or inflammatory rhythm), paresthesias, muscle spasm and amyotrophy, but also joint mobility (wrist, metacarpophalangeal joints).

Several other parameters were also included in our analysis, comprising grip force, types of dental tools used in routine practice (ergonomic or non-ergonomic), a complex imagistic (ultrasonography, X-ray) assessment of the hand, as well as the daily kinetic program.

All subjects consented their enrolment in the study and the project has received local Ethical Committee approval.

RESULTS AND DISCUSSIONS

Demographics (gender, age), anthropology (weight, height) and professional parameters (years of employment and experience,

Pain. Documented as a key musculoskeletal complain, generating significant physical and psychosocial discomfort, impaired working productivity and modified quality of life, pain was recorded in all subjects according to a specific protocol including location (wrist, metacarpophalangeal, proximal and distal interphalangeal joints), irradiation (forearm, arm), intensity (mild +, moderate++, severe+++), rhythm (mechanical, meaning pain increased with work; inflammatory, meaning pain at night).

6 dentists reported pain at wrist level, 8 in their metacarpophalangeal had no pain; 11 cases presented with forearm irradiating pain, while 4 with arm pain. The majority (13) of dentists described mild pain, 5 moderate and only 3 of them severe pain.

Paresthesias. Another essential and very disabling symptom, commonly related to nerve involvement and predominantly with distal expression, paresthesias were reported only in 3 cases. Although, paresthesias may account for either median, cubital or cervical spine nerve roots involvement, all 3 cases had a typical median nerve involvement.

Muscle spasm. Muscle spasm is commonly responsible for excessive pain and impaired working capacity; we evaluated the muscles of the hand, forearm and arm and revealed 8 dentists with brachial biceps spasm as well as hand flexors contractures.

Amyotrophies. Amyotrophy expressing a dual morphological and functional damage of the muscle accompanied by decreased muscle force with significantly impaired specific dental duties and activities was demonstrated particularly in the thenar region. In fact all 3 subjects with thenar amyotrophies presented also with paresthesia reflecting the median

number of working hours per day) were typically recorded in all cases, emphasizing the role of overlapping risk factors for work-related musculoskeletal pathology. nerve pathology.

Range of motion (ROM). Clinical exam paid also particular attention to hand biomechanics and specific ROM of wrist, metacarpophalangeal and interphalangeal joints, as a functional ROM is always required for suitable dental activities in routine care. To remember, wrist mobility typically account for 60-70 degrees of flexion/ 80-90 degrees of extension and laterality, while fingers for 90 degree of flexion/ zero degrees extension. (Fig.1)

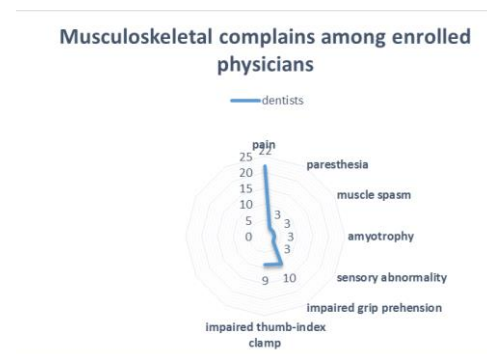


Figure 1. Musculoskeletal complains among studied dentists

Grip was tested, particularly for the thumb-index clamp (Fig. 2a, b, c, d), while sensitivity was also evaluated following typical signs of nerve damage in the thenar and hypothenar eminence. 5 dentists had a sensory disturbance, mainly in the median nerve territory.





Figure 2. Normal aspects of fineness prehension (a, b, c, d)

Hand X-ray revealed different stages of degenerative joint involvement, as follows: trapezio-metacarpal osteoarthritis in 9 dentists, with advanced modifications, even subluxation in 4 of them; osteoarthritis of the wrist in another 8 dentists with cuboid-scaphoid osteoarthritis in 4 subjects; proximal interphalangeal joint osteoarthritis (Bouchard's nodules) were registered in 8 dental professionals, while distal interphalangeal osteoarthritis (Heberden's nodules) in 5 subjects. Just to remember, all subjects diagnosed with degenerative joint pathology recognizing as trigger professional routine activity in dentistry presented with typical radiological lesions such as subchondral bone sclerosis, narrowing joint space, and osteophytes.

Ergonomic analysis A specific ergonomic analysis meant to support the role of specific risk factors for work-related musculoskeletal and, particularly, hand pathology, was performed in all cases. We were mainly interested in evaluating 3 main features: (i) the working posture (orthostatic, sitting and mixed positions) with repetitive tasks and specifying the type of ergonomic chair (with lumbar support, with armrests); (ii) ergonomic evaluation of the biomechanical hand function and posture during work (correct position of the little finger below the thumb, with a flexion-extension range of motion of the wrist under 10 degrees); (iii) types of dental instruments used (ergonomic or non-ergonomic). Finally, we point on the following data:

-working posture during routine practice in our dentists was typically a sitting one for 7

cases, predominantly standing in 9 cases, while the remaining cases preferred a mixed posture meaning half of time seated, half standing;

-about one third (28%) of dentists worked on ergonomic chairs with both lumbar support and armrests, while the majority (72%) only with lumbar support;

-up to 35% dentists do not know the correct/protective range of motion for flexion-extension wrist amplitude during working;

-75% of dentists do not work with ergonomic handle tools.

The second objective of our study was to evaluate the role of an individual kinetic program aiming to either prevent or manage work-related hand pathology. As already mentioned subjects were classified in two main groups according to their involvement in a specific physical training and followed-up for 12 months. Based on a complex biomechanical analysis of hand during specific activities in dentistry we formulated and applied a kinetic program inspired from the general physical therapy targeting the relaxation of all segments of the hand, mobility-training using the normal range of motion, muscle stretching and toning. A specific kinetic program was designed for each individual case; in addition to classic exercises (forearm pronation / supination, flexion / extension of the wrist and fingers), dentists have also used various rigid, elastic or plastics devices.

The kinetic exercises were performed by dentists included in group A at least 30 minutes daily, 5 days weekly during a 12 months interval of follow-up, except holydays. All subjects were available for a final visit at the end of training period.

Main exercises are presented figures below. (Fig. 3-9)

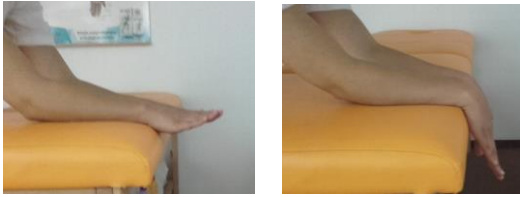


Figure 3. Flexion/extension

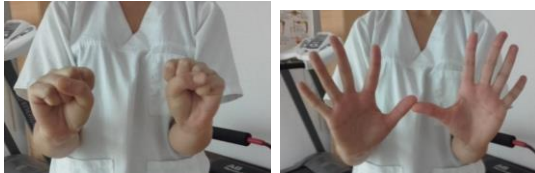


Figure 4. Make a fist



Figure 5. DIP (a), PIP (b) MCP (c) flexion

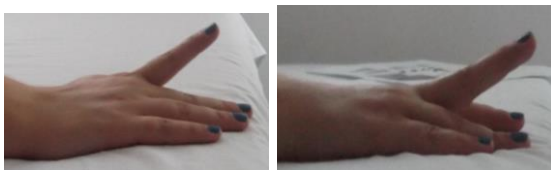


Figure 6. Finger lift



Figure 7. Thumb extension

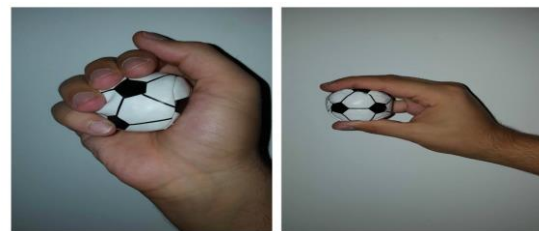


Figure 8. Grip strengthener (a), Pinch strengthener (b)



Figure 9. Grip strengthener

At the end of the study, significant more subjects in group A (performing physical therapy) as compared to group B (without physical therapy) displayed no musculoskeletal complains and discomfort, improved working performance and quality of life.

Work-related hand pathology is widely confirmed among dentists, specifically connected to different professional factors such as working postures and movements, number of working hours, cumulative time and experience, as well as type of devices and tools handled. Moreover, dentistry performed according to ergonomic settings is essential in order to reduce the burden of musculoskeletal features and to improve related disability and working performance.

Firstly, the current study focus on various musculoskeletal complains defining hand-pathology related to precise dental activities; although heterogeneous from pathobiological and clinical picture, dentist's hand represents more than a concept in dentistry. Furthermore, musculoskeletal comfort questionnaire is a self-administered survey adapted for hand involvement and is able to consolidate and homogenize the information on various musculoskeletal problems.

Besides, a complex imagistic assessment based on both hand X-rays and ultrasound if the hand performed in all dentists enrolled in the study highlighted the specific substrate responsible for musculoskeletal complains.

In the majority of cases, the exact etiology of work-related hand pathology was the degenerative damage in at least one joint – trapezio-metacarpal (10), proximal interphalangeal (9), medio-carpal (9), distal interphalangeal (7). Flexor tendons sufferance may also account for clinical signs and symptoms, although with a lower frequency.

Secondly, our study bring into attention a detailed ergonomic analysis of working settings (positions, devices, tools, chairs), hand biomechanics, working performance, stressing the significance of working in an ergonomic environment.

And thirdly, we were interested in evaluating a specific kinetic program adapted to each individual based on its own work-related hand complains, with a long-term (12 months) followed-up. Beneficial aspects of

physical therapy performed on a regular basis were directed towards an improvement of hand involvement during professional routine practice, with subsequent upgrade of disability and quality of life.

CONCLUSIONS

1. Work-related hand pathology accounts for significant morbidity and physical discomfort among dental professionals. With a multifaceted pathobiology ranging from inflammatory to degenerative damage of both soft tissue, nerve and joints (wrist and fingers), musculoskeletal issues are typically linked to professional triggers during routine practice in dentistry.
2. Working posture (sitting, standing, mixed positions), repetitive movements, dental tools (design, size, handles, material) and chairs (lumbar support, armrest) as well, should promote ergonomic principles in order to minimize work-related musculoskeletal complains and to optimize professional activities.
3. An adequate kinetic sequence based on relaxation, stretching, toning and mobilization performed on short periods (10 minutes) during working time should be implemented in daily professional program, as specific exercised lead to improvement of musculoskeletal symptoms, restoration of functional ability, and advance working performance.

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