



Ergonomic Considerations in Periodontal Practice- A Mini Review

Ruthali Vithal Kamat^{1*}, Mala Dixit Baburaj² and Sandeep Pimple³

¹Post-Graduate Student, Department of Periodontics, Nair Hospital Dental College, Mumbai, Maharashtra, India

²Professor and Head, Department of Periodontics, Nair Hospital Dental College, Mumbai, Maharashtra, India

³Assistant Professor, Department of Periodontics, Nair Hospital Dental College, Mumbai, Maharashtra, India

***Corresponding Author:** Ruthali Vithal Kamat, Post-Graduate Student, Department of Periodontics, Nair Hospital Dental College, Mumbai, Maharashtra, India.

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Abstract

Much of a dentist's work has to do with performing repeated fine-tuned actions. The muscles of the hands and fingers play a key role in performing these maneuvers. Scaling, root planing, and even periodontal surgeries if not performed using correct techniques, can take a serious toll on these often neglected small muscle groups. The effects of the resultant damage are long-standing and may seriously impair dental practice. Maintaining good health and function of these muscles is therefore of pivotal importance. This may be accomplished by applying correct working techniques, ranging from ideal seating posture, up until instrument selection and proper instrument manipulation. Incorporation of few physical exercises would go a long way in strengthening these muscles and increasing productivity. This mini-review aims to touch upon the hazards of incorrect hand and finger ergonomics, ways to avoid them and improve clinical outcome.

Keywords: Fine-Motor Skills; Neutral Body Position; Instrumentation Strokes; Ergonomic Instrument Design; Magnification; Finger Stretches

Abbreviations

MSD: Musculoskeletal Disorders; CTS: Carpal Tunnel Syndrome; SRP: Scaling and Root Planning

Introduction

Dentistry is a profession wherein performance is restricted to an area covering only a few tens of millimeters of the mouth, requiring repeated and precise force applications [1]. Dental literature indicates that both dentists and dental hygienists are exposed to occupational risk factors that often lead to musculoskeletal disorders. (MSD) [2].

The work of a dentist revolves majorly around the efficient use of his/her "fine motor skills". Hence these MSDs do not remain limited to areas such as the back, neck, shoulders, arms etc., but they also find their way into the relatively smaller muscles groups as those in the hands and fingers- which in fact are directly involved in holding a dentist's tools and working in the oral cavity!

Today the scope of ergonomics is no longer limited to back and neck posture. The importance of performing repetitive fine-tuned actions (esp. scaling and root planing) ergonomically cannot be over-emphasized. Thus, this review article aims to throw light on newer strategies that can help prevent muscle tension and pain as far as performing dental fine motor skills is concerned and suggests ways to employ them in daily practice.

Ergonomics- What Does it Mean?

Ergonomics is essentially the science of making things efficient. The word ergonomics is derived from the Greek words "ergon" (work) and "nomos" (natural laws). It is the science of refining the design of products to optimize them for human use, which concentrates on the physical aspects of work and human capabilities such as force, posture, and repetition.

In simple terminology, ergonomics is a way to work smarter- not harder, by designing tools, equipment, work stations and

tasks to fit the job to the worker- and not the worker to the job. [3] Good working ergonomics lies at the heart of a successful clinical practice, so that work capability, efficiency and high level of treatment can be maintained throughout the working life of dental professionals.

Musculoskeletal Disorders- Why is an Ergonomic Practice Essential?

The thenar muscles comprise of 3 short muscles located at the base of the thumb- namely the Opponens Pollicis, Abductor Pollicis Brevis and the Flexor Pollicis Brevis, all innervated by the median nerve. These muscles are responsible for the fine movements of the thumb. They not only aid in grasping the dental instruments, but also provide precision and finesse during dental procedures [4]. Since performing scaling and root planing with non-powered hand instruments may involve high muscle loads on these muscles, it is essential to develop techniques to prevent musculoskeletal injuries early in the career of the dental practitioner [5]. An MSD is a condition wherein parts of the musculoskeletal system - muscles, tendons, nerves - are injured over time, resulting in pain.

The prevalence of musculoskeletal pain in dentists, dental hygienists and dental students ranges between 64% to 93% [6] 23% to 40% of dentists and nearly 75% of dental hygienists experience hand and wrist pain, [7-11] which is nearly 4 times the prevalence found in the general working public. The percentage of dental professionals who fully recover from hand pain syndromes is much lower than those that do from neck, shoulder and elbow pain [12]. Therefore, prevention strategies and early attention to warning signs of MSD of the hand and arm, are imperative to the dental professional's health and career longevity.

There are numerous causes of hand, wrist and arm pain, including tendonitis (e.g., De Quervain's tenosynovitis), arthritis (e.g., osteoarthritis of the basilar joint), nerve compression (e.g., thoracic outlet syndrome, carpal tunnel syndrome), trigger points (e.g., radial tunnel syndrome) and equipment issues (e.g., non-ergonomic tools, poorly fitted gloves). The most commonly diagnosed MSD of the hand, wrist and arm among dentists and hygienists remains Carpal tunnel syndrome (CTS).

CTS is the most commonly reported peripheral nerve entrapment in the arm [13,14]. It is caused by compression of the median nerve at the wrist [15]. The symptoms include numbness, pain or tingling in the thumb, index finger, middle finger and half of the ring finger. One study found that while 71 percent of dentists experienced one or more CTS symptoms, only 7 percent were actually

diagnosed with CTS [16]. This should prompt dental professionals with CTS-type symptoms to educate themselves on all possible etiologies and further adopt measures to minimize the damage, avoid unnecessary surgery or ineffective therapies [17].

4 primary risk factors for CTS in dental professionals

- o Flexing the wrist forward
- o Gripping a small instrument forcefully
- o High repetition (as in manual scaling) and
- o Duration (e.g., scheduling heavy calculus patients back-to-back).

These risk factors cause micro-trauma in the carpal tunnel; thereby leading to fibrosis and edema of the lining of the tendons at the wrist. The increased pressure causes reduction of blood flow to the median nerve within the tunnel and swelling. It is this swelling and pressure on the median nerve that causes numbness and/or tingling in the fingers and weakness of the muscles at the base of the thumb [17].

Ergonomic Applications in Periodontal Instrumentation

Clinician's Position [2]

For a healthy and productive career, the dentist first maintains a neutral, balanced body position and then alters the patient's chair and dental equipment to suit this position. Neutral position would be defined as the position of an appendage which is neither moved away from nor directed toward the body's midline, nor laterally turned or twisted.

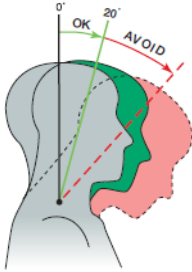
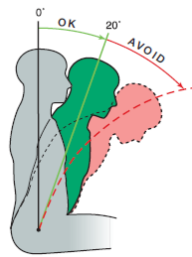
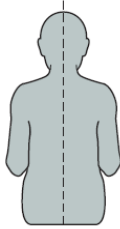
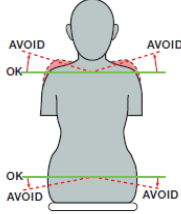
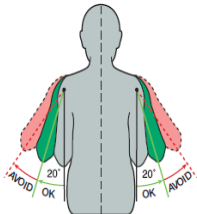
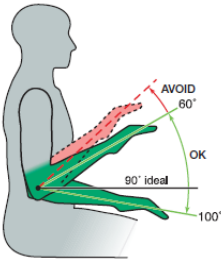
Correct feet position

The feet should be flat on the floor; about a shoulder's width apart for ideal balance. This helps to create a "wide base of support" for the seated clinician.

Patient position [2]

For the maxillary arch

- o **Body:** The patient's feet should be at the level of or slightly higher than the tip of his/her nose.
- o **Chair Back:** Almost parallel to the floor for maxillary treatment areas.
- o **Head:** The top of the patient's head should be even with the upper edge of the headrest.
- o **Headrest:** To be adjusted so that the patient's head is in a *chin-up* position, with the patient's nose and chin at the same level.

Sr. No.	Body Position	Goals	Pictorial Representation
1.	Neutral Neck Position	<ul style="list-style-type: none"> • Head tilt of 0° to 20° • The eyes should be in a vertical line with the treatment area as much as possible 	
2.	Neutral Back Position	<ul style="list-style-type: none"> • Trunk flexion of 0° to 20° • Slight forward bend with hinge at hips 	
3.	Neutral Torso Position	<ul style="list-style-type: none"> • Torso should be in line with long axis of the body 	
4.	Neutral Shoulder Position	<ul style="list-style-type: none"> • Shoulders to be placed in a horizontal line • Weight evenly balanced when seated 	
5.	Neutral Upper Arm Position	<ul style="list-style-type: none"> • Upper arms must remain parallel to the long axis of torso • The elbows at waist level are held slightly away from body 	
6.	Neutral Forearm Position	<ul style="list-style-type: none"> • Forearms are held parallel to the floor • Forearm raised or lowered, if necessary, by pivoting at the elbow joint 	

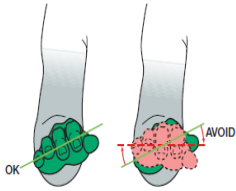
7.	Neutral Hand Position	<ul style="list-style-type: none"> • The little finger-side of palm is slightly lower than thumb-side of palm • Wrist is aligned with forearm 	
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Table 1

For the mandibular arch

- o **Body:** The patient’s feet should be at the level of or slightly higher than the tip of his/her nose.
- o **Chair Back:** To be slightly raised above the parallel position at a 15°-20° angle to the floor.
- o **Head:** The top of the patient’s head should be even with the upper edge of the headrest.
- o **Headrest:** To be adjusted (slightly raised) so that the patient’s head is in a chin-down position, with the patient’s chin lower than the nose.

Positioning the light source [2]

Position the light at arm’s length within comfortable reach. The light must not be placed too close to the patient’s head.

For mandibular arch

- o The overhead light source is positioned directly over the oral cavity.
- o Light beam is directed approximately perpendicular to the floor.

For maxillary arch

- o The position of the overhead dental unit light ranges from being directly over the oral cavity to a position over the patient’s neck.

Co-axial illumination may also be used in addition to the overhead light. It provides a light source that is parallel to the clinician’s line of vision thus eliminating shadows produced by the hands and instruments.

Utilization of magnification aids

Optical magnifications have literally widened the scope for what is possible in dentistry. There are many ergonomic advantages of magnification, and this is increasingly being recognized as an

important reason to invest in them. Studies have shown that most dentists and dental hygienists operate with a forward head posture of at least 30° for 85% of their operating time [18]. When operating without magnification aid, the head and neck tend to be held in an un-balanced forward position, causing shoulder and neck muscles to fatigue quickly.

Properly designed magnification systems can enhance operator working posture by maintaining a set focal range (as with loupes) or by location of fixed binoculars (microscope) or an LCD screen (procedure scopes). Magnification supports the operator in head postures of about 0° to 25° forward [18]. This results in a more relaxed operating posture.

There are 3 principal reasons for adopting magnifying loupes for dentistry:

- o To enhance visualization of fine detail
- o To compensate for the loss of near vision (presbyopia) and
- o To ensure maintenance of correct posture.

Valachi and Valachi [19,20] highlighted the need for good posture when carrying out dental procedures, as it is understood that poor posture can contribute to the development of back and neck pain. Adopting a correct operating posture becomes even more important for the dentist who uses magnification, as maintenance of the transverse axis of the eye in the horizontal plane is essential in order to avoid disorientation.

Role of magnification in periodontal surgery

Periodontal microsurgery is commonly performed with loupes at 10x to 20x magnification. With normal vision, the highest possible visual resolution is 0.2 mm [21]. At this level of visual acuity, the greatest accuracy possible for the human hand movement is 1 mm [22]. Physiologic tremor can further reduce the accuracy of

movement to 2 mm [23] Under 20x magnification that loupes provide, the accuracy of hand movement approaches 10 μ and visual resolution approaches 1 μ [24].

Under magnification, proprioceptive guidance comes to be of little value [25]. Instead, visual guidance is used to accomplish mid-course correction of the hand to accomplish the finest movement with skill and dexterity [26,27]. This means that incisions are more accurate, flaps are elevated with minimal damage, debridement is more thorough, and the wound is closed precisely and without tension. As the resultant tissue damage is minimized, postoperative morbidity can be substantially reduced.

Loupes permit a less traumatic and less invasive surgery. Using micro-sutures allows more precise wound closure. This encourages healing through primary intention, which is rapid and results in less formation of granulation tissue. Post-surgical inflammatory component and pain is lowered to a minimum. Overall a better outcome is expected, with improved patient compliance and clinician's satisfaction [28,29].

Ergonomic Instrument Design

Proper instrument design and instrument selection are imperative when implementing protective scaling techniques. The use of rigid shank instruments to remove heavy tenacious calculus will help reduce repetitive motion since the shank would not flex as much as non-rigid instruments [30].

In selecting an instrument handle, three factors to be taken into consideration are weight, diameter and texture. [30]. Lightweight handles (15.0g) [31] are less likely to place stress on the muscles of the hands and fingers. Larger diameter handles (10mm) [31] reduce stress and pinch strength required to hold the instrument. Textured or serrated instruments facilitate instrument grip and control, thereby reducing muscle fatigue [2].

Sharp, properly maintained instruments are very important for effective periodontal debridement. A sharp cutting edge permits the clinician to make fewer and better-controlled strokes with improved tactile sensitivity. Calculus is removed more efficiently with no need to apply added lateral pressure. This minimizes clinician stress and fatigue and increases patient comfort and satisfaction [30].

Instrument grasp [2]

The modified pen grasp is the recommended method for holding a periodontal instrument. The correct instrument grasp requires precise finger placement on the instrument.

Thumb and index finger

- The finger pads must rest opposite each other at or near the junction of the handle and the shank
- The fingers do not overlap each other; there is a tiny space between them.
- The fingers hold the handle in a relaxed manner, with no blanching of skin evident.
- The index finger and thumb curve outward from the handle in a convex shape.
- The index finger and thumb must not collapse inward toward the handle in a concave manner, as this would cause the finger pads to lift off of the handle, making it difficult to roll the instrument during instrumentation.

Middle finger

- One side of the finger pad (on the side of the index finger) rests lightly on the instrument shank. The other side of the finger pad rests against or slightly overlaps the ring finger.
- The middle finger is not used to hold the instrument, but to enable gentle maneuvering and enhance tactile sensitivity. To check if the instrument is correctly grasped, one must be able to lift the middle finger off of the shank without dropping the instrument.

Ring finger

- Fingertip of the ring finger (and not the pad) balances firmly on a tooth to support the weight of the hand and a periodontal instrument-serving as the rest finger.
- When grasping a dental mirror, the ring finger may rest on a tooth or against the patient's lip or cheek area.
- The ring finger of the dominant hand remains positioned ahead of the other fingers in the grasp. It must be held straight and upright to act as a strong support for the hand. The finger should neither feel tense nor be held limply against the tooth.

Little finger

- The little finger is held in a relaxed manner close to the ring finger.

Finger rests and fulcrum techniques

A fulcrum is a finger rest used to stabilize the clinician's hand during periodontal debridement. A well-established finger rest is essential for stability, unit control, prevention of injury, patient comfort and control of length of stroke [30].

Intraoral fulcrum

The standard intraoral fulcrum is established when the clinician's dominant hand is stabilized by placing and maintaining the pad of the ring finger on a tooth surface adjacent to or close to the tooth being instrumented.

Extraoral fulcrum

The extraoral fulcrum requires stabilization of the clinician's dominant hand outside the patient's mouth against the cheeks, jaws and chin. Extraoral fulcrums differ from intraoral fulcrums because the front or back of the fingers and hand provide the support rather than the tips or pads of the fingers as with intraoral finger rests.

Reinforced fulcrum

The reinforced fulcrum scaling technique has been used to gain additional stability, and control of the instrument when scaling with both the intraoral and extraoral fulcrum. The non-dominant hand is used for extra support of the instrument (instead of holding the mouth mirror). The index finger and thumb from the non-dominant hand helps support the shank or instrument handle by placing pressure on it during a working stroke, so as to acquire additional lateral pressure [30].

Instrumentation strokes

Instrumentation strokes are used to assess the character of the calculus and tooth surface, and to remove calculus deposits from the tooth surfaces [2].

Vertical and oblique instrumentation strokes always should be made in a coronal direction away from the base of the sulcus or periodontal pocket.

Horizontal instrumentation strokes are most useful when working around the line angles of a posterior tooth or at the mid-line of an anterior tooth.

A calculus removal stroke is a type of instrumentation stroke used with sickle scalers and universal/area-specific currettes to remove calculus deposits from the tooth.

- Characterized by a short, controlled, biting stroke made with moderate pressure of the cutting edge against the tooth surface.
- The initiation of a stroke, the clinician presses the fulcrum finger down against the tooth.
- For each stroke the working-end moves only a few millimeters.

The root debridement stroke is a type of instrumentation stroke used to remove residual calculus deposits, bacterial plaque, and by-products from root surfaces exposed due to gingival recession or within deep periodontal pockets.

1. A root debridement stroke is characterized by a shaving stroke made with light pressure.
2. The stroke is slightly longer than a calculus removal stroke.

Stretching for optimal health and career longevity

Performing exercises that stretch and lengthen the major muscle groups is an easy and efficient way for dentists to reduce the likelihood of injury. It only takes a few minutes to stretch if discomfort is experienced from muscle strain. Including functional training exercises as part of the daily regimen, such as Pilates or Yoga, can address weak core musculature and restricted joint movements that occur from sitting for prolonged periods of time. Core strengthening increases the length in the spine and improves musculoskeletal balance and health. Yoga assists in balancing musculature and also to stretch, strengthen and lengthen the muscles. This type of flexibility training reduces tight muscles, improves posture, balance and function [30].

In a recently conducted study [32] it was found that a set of pre-procedural finger stretches helped in warming up the finger muscles and also increased their range of motion which could in turn increase the efficacy of SRP. A few of them are as follows:

- **Rubber band finger stretch:** A rubber band is extended between the fingers of hand and gently stretched till resistance is felt. This position is held for three seconds and then fingers relaxed back to rest position.
- **Tendon glide:** Keeping the right hand wrist relaxed and following the line of the fingers and thumb, fingers are pointed straight up. The fingers are curled so that the top two joints are bent and wrapped with the fingertips touching the base of the fingers. The fingers are then advanced to making a fist by bending the knuckles and finally relaxed so that the fingertips touched the base of the palm.

- **Finger flexion and extension:** The left thumb is used to extend the fingers of right hand while keeping the fingers of left hand cupped behind them over the dorsum to flex them.
- **Thumb flexion:** The fingers of left hand are cupped around the radial border of the thenar eminence of the right thumb and the left thumb is placed along the palmar surface of the right thumb to extend it. To flex and oppose the thumb, the left hand is cupped around the dorsal surface of the right hand pushing the thumb towards the little finger.
- **Finger webbing:** The right hand is positioned flat on a hard surface. The fingers are fully extended, touching each other. The fingers are then spread as far apart as possible with the help of two digits of the left hand. This position is held for two seconds and then released.

Conclusion

A major contribution to a dentist's skill lies in the way he/she maneuvers the hands and fingers. Hence maintaining good health of the muscles therein, is of crucial significance. The eyes only see what the mind knows- which is why it is essential that dentists be aware of the right working techniques and consequences of working using incorrect postures and finger grasps. It is also necessary to stay abreast with the pool of knowledge and more importantly apply it in daily practice. Performing functional exercises and finger stretches are simple and efficient ways, taking only a few minutes' time to avoid MSD. Incorporating these small changes in daily routine would certainly go a long way in having a sound and long-standing dental practice. And it is never too late to change!

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