

Ergonomics for Healthy Orthodontic Practice

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ABSTRACT

Every occupation has its associated risks known as occupational hazards, which brings ergonomics into play. It is the applied science of equipment design, design for the workplace and the design for the operator, intended to maximize productivity by reducing operator fatigue and discomfort. Orthodontists are at a higher risk and the main reason for this is long stretched appointments and difficult techniques like the newly introduced lingual system. This article reviews three main categories of hazards that are - A) Ergonomics for the operator and patient position, B) Ergonomics for equipment/instrument design, C) Ergonomics for the workplace.

KEYWORDS: Ergonomics, Orthodontics

INTRODUCTION

In orthodontic practice, there is a good social interaction between patient and assisting staff because of long stretched appointments. In our profession performance is restricted to an area covering only a few millimeters (the mouth), and requires repeated and precise force applications.¹ A healthy orthodontist is of prime importance in a successful practice. We can, and do experience illnesses and problems that can disrupt or impair a practice.² There are growing evidences suggesting increased vulnerability within the profession to certain disorders and afflictions which are only practice related, to avoid these problems there must be increase in-awareness of the proper armamentarium, correct postures during work, designing the workstation to promote neutral positions and correct use of instruments for a healthy work practices to reduce the stress of work on the practitioner's body.^{3,4}

Recently, "Ergonomics in Orthodontics" has become a popular term. It is a science that deals with orthodontists and their relationship to their occupational environment.

In Greek, "Ergo," means work and, "Nomos," means natural laws or systems. Therefore, it is an applied science of designing products and procedures for maximum efficiency and safety. Also a study of the relationship between the personnel, equipment and environment in the workplace.^{5,6} Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. Figure 1, counts the factors that can lead to ergonomics in orthodontic practice.

Orthodontists along with supporting dentists and dental hygienists are at a greater risk of work-related musculo-

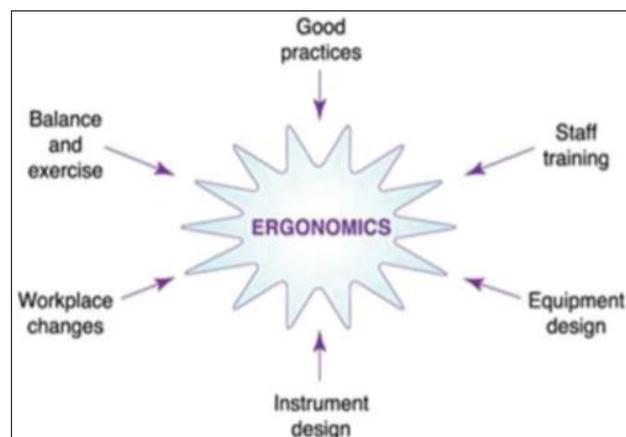


Figure 1: Factors affecting ergonomics for orthodontic practice

skeletal disorders (MSDs) than the general population.

These disorders can result in pain and dysfunction of the neck, back, hands and fingers. Estimated work related musculoskeletal injuries occur in 54% to 93% of professionals, with most frequent injuries occurring in the spine (neck and back), shoulders, hands and elbows which if ignored, that this physiological damage will lead to an injury or a career-ending disability.⁷

Many work related MSDs are building up over years or decades and a poor ergonomic choice may not have an impact today but over a time, it could result in pain or injuries, affecting the productivity and earning potential. Good habits adopted early, are the best strategy when it comes to posturedontics (Ergonomics).³ Table 1 shows various causes, signs, symptoms and risk factors of musculoskeletal disorders.

How to cite this article:

Thakral R, Shukla P, Kapoor S, Jaiswal RK, Bhagchandani J, Warsi F. Ergonomics for Healthy Orthodontic Practice. *Int J Oral Health Med Res* 2016;2(6):110-114.

ERGONOMICS IN POSTURE

More than 70 percent of dental students reported neck, shoulder and lower back pain by their third year of dental school. Dentists and dental students often assume awkward physical positions while providing treatment to (a) get a better view of the intraoral cavity; (b) provide a more comfortable position for the patient; and (c) operator reach for instruments and supplies.⁸

Importance of Posture: The elements of an improper workstation setup force the dental practitioner to assume many harmful postures when performing various procedures on the patient (Figure.2) which put pressure on nerves and blood vessels, cause excessive strain on muscles, decrease circulation and cause wear and tear on the joint structures.



Figure.2 - Improper and Proper Posture

Tips For Working With Good Posture

- 1. Maintaining an Erect Posture:** position the chair close to patient, minimize forward bending or excessive leaning over the patient, place the feet flat on the floor for a neutral or anterior tilt to your pelvis, which keeps back aligned and promote its natural curvature (Figure. 2).
- 2. Use an adjustable chair with lumbar, thoracic, and arm support.**
- 3. Work close to your body:** does not overextend to reach the patient or instruments, putting excessive stress on back, shoulders and arms. Think of having elbows, hips, knees, and ankles all at 90° angle.
- 4. Minimize excessive wrist and finger movements:** Try to keep them in a neutral position (palms facing each other, shoulder width apart with wrists straight), which puts wrist, fingers, muscles and tendons in a much better relationship to perform the work.
- 5. Alternate work positions between sitting, standing, and side of patient:** Switching positions allows certain muscles to relax while shifting the stress onto other muscles and increasing your circulation.
- 6. Adjust the height of your chair and the patient's chair to a comfortable level:** too low dentist's chair than patient's chair causes elevation of shoulders leading to neck problems and can pinch nerves. Alternately, too high causes flexion of neck down and can lead to neck and hand problems.

Some Improper Postures are:

- Working with the neck in flexion and tilted to one side.
- Working with elevated shoulders.
- Left or right side bending.
- Excessive twisting movements.
- Elbows flexed greater than 90°.
- Wrists flexed/deviated in grasping.
- Same position maintained for more than forty minutes per patient.

Five different types of movement in ergonomic studies

- **TYPE I** – Fingers Only
- **TYPE II** – Fingers and Wrists
- **TYPE III** – Fingers, Wrists and Elbows
- **TYPE IV** – The Entire Arm from the Shoulder
- **TYPE V** – The Entire Arm and Twisting of the Body.

Time and motion efficiency in an orthodontic office is only achieved with the elimination of the type IV and V movements and the reduction of type III movements.

Body Strengthening Exercises:

- While sitting, extend one leg forward; bend and stretch hands as far as possible without bending the knee and repeat with the another leg.
- Stretch one leg and put the other leg over the stretched leg; turn around as far as possible without changing the position of the legs and repeat on the another side.⁸ (Figure 3)

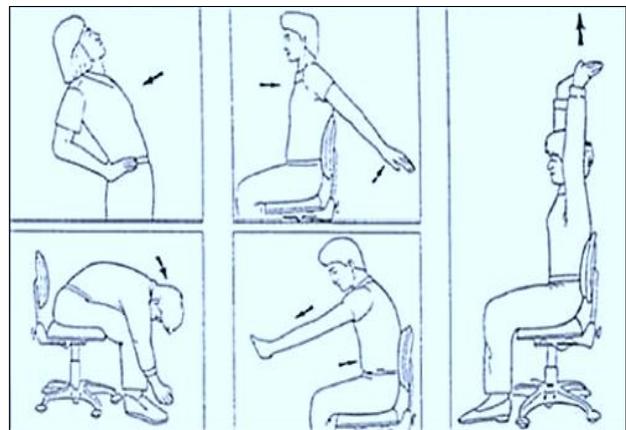


Figure.3- Body stretching exercises

Periodic Breaks and Stretching

- Chairside directional stretching
- Stretching during microbreaks
- Releasing trigger points

Neck Exercises:

- Relax shoulders and tuck the chin into the neck and then slowly raise the head back.
- Tilt the head to left and right side as if trying to touch ear to the shoulder.⁵

Shoulder Exercises:

Raise shoulders up towards the ears and rotate the head in both clockwise and anti-clockwise directions.⁹

Hand Exercises:

- Slowly open and close hands from a complete open to a closed position ending with your fingers tucked into your palm (Figure 4a, 4b).
- Now, press the palms of your hands together and then relax them (Figure 4c).
- Gently pull and relax each finger on each hand separately (Figure 4d).⁵



Figure 4a-4d: Various Hand Exercises Slowly open and close hands from a completely open position (Figure 4a), to a completely closed position (Figure 4b); gently pull and relax each finger on each hand separately (Figure 4c); cross the wrists and gently stretch and relax (Figure 4d).

Back Exercises:

Relax the neck and roll down slowly letting the arms and head fall between the legs, hold position for a while and then raise slowly by contracting stomach muscles rolling up and bringing the head up last (Figure 5a, 5b).⁵

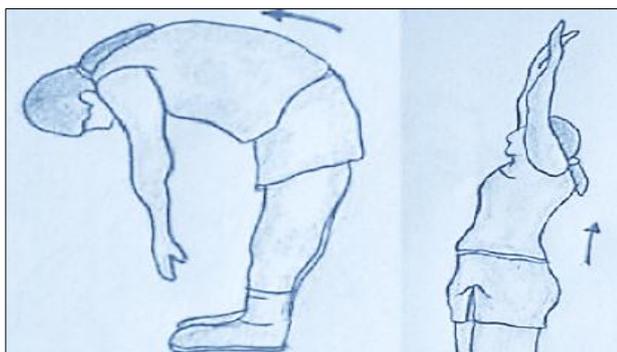


Figure.5A,5B- A "full back release" should be practiced. Relax the neck, roll down slowly letting the arms and head fall between the legs (Figure 5a); hold position for a while; raise slowly by contracting stomach muscles and rolling up, bringing the head up last (Figure 5b).

ERGONOMICS IN EQUIPMENT DESIGN

True four-handed dentistry is not hurry up dentistry but

based on principles that define the conditions under which efficiency can be attained.

Evaluating Equipment Designs: Schematic examples of the four common dental unit styles and applying these styles will help to determine the benefits of modifying and upgrading clinical facility. (Figure 6)

The basic dental unit designs available include transthorax, side delivery, rear delivery, and split unit/cart. An often overlooked factor while choosing dental unit is the assistant as a primary focus.

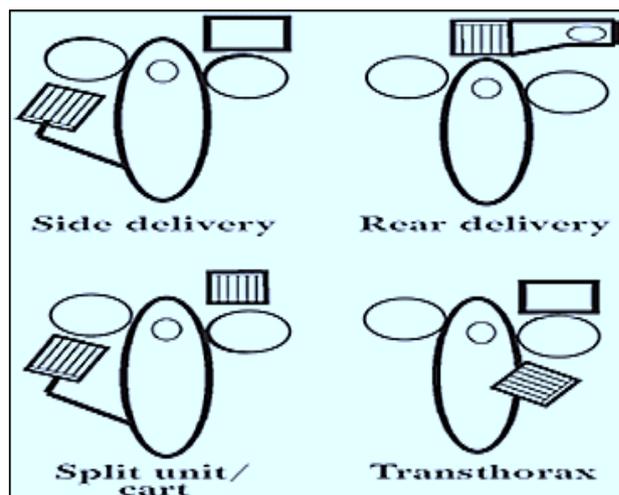


Figure 6: Schematic examples of the four common unit styles.

Transthorax Unit: This design meets time and motion requirements and promotes good ergonomic positioning. With the unit over the patient's thoracic area, assistant can easily retrieve the handpieces and deliver them to the doctor without much interference at operating site.

Side Delivery: This unit has been a popular concept for many decades and most schools use this style of unit, often supplied with a bracket tray. Requires the dentist to pick up the handpieces, which forces him or her to remove eyes from the operating site, twist and turn to grasp the instrument, and then refocus resulting in stress and fatigue.

Rear Delivery: The doctor must pick up the handpieces, which requires severe twisting and turning, as well as eye strain. Air/water syringes are permanently affixed to an assistant's work area, since it is in the rear; it requires the assistant lean forward and take undue stress and strain for increased productivity.

Split Unit/Cart: This concept places part of the dental unit on the operator's side and air/water syringe on the assistant's mobile cabinet. As in the side delivery unit, it requires the dentist to grasp the handpieces and makes them inaccessible to the assistant, thus reducing productivity. The split unit design can limit the assistant's working space and requires that back-up instruments be in tubs on the fixed cabinetry.⁹

Equipment Selection: Selection of equipment in four-handed dentistry is important for its success and over the

years manufacturers are attempting to meet the criteria.

Criteria For Equipment Selection

- The design of the product should make intuitive sense given the goal of the design.
- The product should feel comfortable to use.
- The product should put the user into a more neutral posture.
- The manufacturer/designer should clearly articulate what the ergonomic objectives are for specific design elements.
- The manufacturer must have research evidence to demonstrate that their product works and one should check How good is the evidence?

Dental Unit Components

- Each component should contain lightweight, smooth, flexible delivery.
- They should be easy to use.
- Their position should allow assistant to readily pass them to the operator without infringing on the patient.
- The attachments to the hoses should be sterilizable.
- The handpieces should provide a range of speeds and lock mechanisms for hoses to prevent tug back.
- The air/water syringe should retain an angled tip.

Mobile Cabinet

- It should be stable and easy to move with easy access to instruments and materials and ample storage.
- There should be adequate work surface within 1 to 2 inches of the elbow.
- It should provide a movable work surface that can be positioned over the assistant's lap or knees.

Patient Chair

- A thin, narrow back with a concave seat and lower lumbar support as wide wings prohibit the assistant and operator from being seated close to the patient.
- It should provide a programmable, automatic, preset positioner that places the patient in supine position.
- It should be free of protrusive devices on the back and provide neck and head support for the patient.

Dental Stools

- It should have a stable base with four or five casters with well padded flat or contoured easily adjustable seats. Stool with back and abdominal support that adjusts vertically and horizontally are better.

Fixed Cabinetry

- Minimum fixed cabinetry provides maximum floor space and 12 o'clock position of cabinet is good for easy access to assistant.¹⁰

ERGONOMICS IN OFFICE DESIGN

In designing your office, the designer and architect will use ergonomic standards to locate everything like height of the electrical outlets, wall-mounted cabinets.

Use a designer or architect familiar with orthodontics and ergonomics and should relate the specific procedures

performed in different areas of the office to improve the patient flow, staff flow, and instrument flow. The reception counter will range from 30 inches up to 42 inches high as thirty inches is standard desk height as well as handicapped accessible while 32 inches is standard vanity height for a tooth brushing area, thirty-six inches height is the standard for countertop height for most cabinetry and forty-two inches high is the standard for a check-writing counter.

Treatment Area: It is the largest room in orthodontic office where you, your staff and most of your patients spend the greatest amount of time. A designer familiar with the ergonomics of orthodontic-specific patient chairs and delivery systems will position the equipment to eliminate all excess movement. The additional cabinetry must not interfere with the procedures performed chairside. Being able to work ergonomically makes you and your staff more efficient and will reduce the stress in an office.

Chairside on a patient, adjust the height of the stool so it feels comfortable. Positioned correctly, your legs should be parallel to the floor, your upper legs and backside should be completely supported by the seat with your back firmly against the lumbar support. This gives a natural relaxed position to your spine and helps to reduce the additional twisting. Rear delivery and over-the-patient-type delivery systems are not primarily designed for procedures like bonding or other four-handed procedures causing the additional class III, IV and V movements.

Push everything closer and together restricts your workspace and causes additional reaching and twisting movements. Proper clearance will cause the smooth patients, staff and instrument traffic.

Lighting: Class III, IV and V movements in the clinic by lighting or lack thereof twist your neck or back to try to see inside the patient's mouth. A good quality ambient light source will help to eliminate these movements. An outside light source is good but it should not affect the ambient light in your clinic.

Sterilization and Lab: Ergonomics in your sterilization help to enhance the instrument flow by locating storage for sterile and used instruments at eye level will permit staff members to reach the instruments without stretching. The ultrasonic cleaner should be recessed into the counter top or, if a tabletop ultrasonic cleaner is used, you may want to consider lowering the cabinet it sets on by 12 inches or so. This increases the ergonomic efficiency of the instrument flow. Additionally, locating a pull-out work surface within arm's reach of sterilizer will add to the efficiency of instrument flow.¹¹

CONCLUSION

Ergonomics has come a long way into the profession of dental with a coherent vision of healthy future. Repetitive strain injuries are on the rise in dentistry with MSDs, and majority being pain in their shoulders and neck, hands

and wrists, low back, or forearms and elbows. Now is the time to assess importance of following proper ergonomics for a healthy and prolong orthodontic career.

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Source of Support: Nil
Conflict of Interest: Nil