MODULE 1

# Ergonomics and Periodontal Instrumentation

## Module Overview

This module introduces the principles of positioning for periodontal instrumentation. Correct positioning techniques help to (1) prevent clinician discomfort and injury, (2) permit a clear view of the tooth being worked on, (3) allow easy access to the teeth during instrumentation, and (4) facilitate efficient treatment of the patient. **Prior to beginning this module, readers should review the online resource: *Getting Ready for Instrumentation: Mathematical Principles and Anatomical Descriptors.***

## Module Outline


Access the online module, *Getting Ready for Instrumentation: Mathematical Principles and Anatomical Descriptors*.
This module can be viewed online.

## Key Terms

Ergonomics
Musculoskeletal disorder
Posture
Neutral posture
Static posture
Force
Repetitive task
Supine position
Semi-supine position
Chin-up position
Chin-down position
Coaxial illumination sources
Dental headlights
Magnification loupes
Working distance
Angle of declination
Depth of field
Field of view
Blind zone

## Learning Objectives

- Define the term ergonomics and discuss how ergonomic principles are helpful in the practice of dental hygiene.
- Define the term musculoskeletal disorder (MSD) and discuss the significance of MSDs in the practice of dental hygiene.
- Name four ergonomic hazards for dental hygienists.
- Develop an understanding and appreciation for ergonomic guidelines to minimize the exposure of dental hygienists to musculoskeletal stress.
- Identify musculoskeletal disorders commonly experienced by dental health professionals, their causes and prevention.
- Discuss and demonstrate the elements of neutral seated posture for the clinician.
- Demonstrate correct patient position relative to the clinician and positioning of dental equipment so that it enhances neutral clinician posture.
- State the reason why it is important that the top of the patient's head is even with top edge of the chair headrest. Demonstrate how to correctly position a short individual and a child in the dental chair so that (1) the patient is comfortable and (2) the clinician has good vision and access to the oral cavity.
- In the preclinical or clinical setting, self-evaluate to identify the use of incorrect ergonomic principles and demonstrate how to correct the problem(s).

## Section 1
# Ergonomic Risk Factors Associated with Periodontal Instrumentation

## WHAT IS ERGONOMICS AND WHY SHOULD HYGIENISTS CARE?

1. **Ergonomics** is an applied science concerned with the 'fit' between people and their technological tools and environments (1).
   - **A.** In application, ergonomics is a discipline focused on making products and tasks comfortable and efficient for the user.
     1. A primary ergonomic principle is that equipment—such as computer keyboards and workstations—should be designed to fit the user instead of forcing the user to fit the equipment.
     2. Ergonomics is the science of making things efficient. Efficiency is quite simply making something easier to do.
   - **B. Poor Ergonomic Working Conditions and Working Practices.** When the fit between an individual and his or her tools and working environment is less than optimal studies show that worker comfort, productivity, and workplace safety all suffer (1). For dental hygienists the work environment includes the dental office layout, dental equipment, and instruments.
2. **Musculoskeletal Stresses and the Dental Professional.** The dental literature indicates that both dentists and hygienists are exposed to ergonomic risk factors that often lead to discomfort, pain, and even disability.
   - **A.** A **musculoskeletal disorder (MSD)** is a condition where parts of the musculoskeletal system—muscles, tendons, nerves—are injured over time.
     1. MSDs occur when too much stress is exerted on a body part resulting in pain. When a body part is overused repeatedly the constant stress causes damage.
     2. Almost all occupations require workers to use their arms and hands. Therefore, most MSDs affect the hands, wrists, elbows, neck, and shoulders.
   - **B. Prevalence of Musculoskeletal Problems in Dental Professionals**
     1. Many studies have investigated the prevalence of MSDs among dental professionals. A systemic review on this topic found that the prevalence of MSDs ranged as high as 64% to 93% (2).
     2. Despite this high prevalence, there is a lack of evidence regarding the efficacy of preventive measure for MSDs for the dental hygiene profession (3). A complete understanding of the progression of MSDs in dental hygienists is still far from being realized, due to the lack of longitudinal studies and standardized research techniques (3–5).
   - **C. Causes of Musculoskeletal Pain in Dental Professionals**
     1. The literature indicates that the causes of MSDs among periodontists and dental hygienists include excessive use of small hand muscles, forceful repetitive motions while maintaining muscles in same position during application of force, tight grips, and a fixed work position (maintaining the body in one position for extended periods) (2–13).
     2. The result is injury to the muscles, nerves, and tendon sheaths of the back, shoulders, neck, arms, elbows, wrists, and hands that can cause loss of strength, impairment of motor control, tingling, numbness, or pain.

3. Given the high incidence of musculoskeletal pain, it is important for clinicians to understand the causes of MSDs and to take actions to prevent them.

D. Ergonomic Guidelines in Dentistry

1. It is important that dental hygiene students complete instructional modules on ergonomic principles during their education and training (3,5).
2. Research shows that among practicing hygienists, education on patient and clinician positioning can help reduce the risk of MSDs (4,14,15).
3. It is possible to define ergonomic guidelines to minimize exposure of dental healthcare providers to musculoskeletal stress.

## ERGONOMIC HAZARDS FOR DENTAL HYGIENISTS

Four significant ergonomic hazards during periodontal instrumentation are (1) awkward clinician posture, static (fixed) working position, the force placed on a body part, and (4) repetitive movements. Figure 1-1 summarizes these hazards that can lead to musculoskeletal injury.

1. **Awkward Postures.** **Posture** is a term for the position of various parts of the body during an activity.
   A. For most joints, ideal or **neutral posture** means that the joint is being used near the middle of its full range of motion.
   B. The further a joint moves away from neutral posture, the more strain is placed on the muscles, tendons, and ligaments around the joint (37). For example, if an individual stands with his or her arms outstretched in front of the body, the elbow and shoulder joints are at their range of motion. If the individual pulls or lifts repeatedly in this outstretched position—versus held close to the body—there is a high risk of injury.
   C. The literature confirms the presence of awkward postures specifically in the neck, shoulders, back, wrist, and hand for dental hygienists. Awkward postures often are adopted due to improper adjustment of the clinician's chair, improper patient position in relation to the clinician, and poor work techniques.
   D. When dental hygienists use their bodies in awkward positions, the muscles must generate higher forces to accomplish a task than when muscles are used in a neutral position (38).
   E. A common awkward posture in dental hygienists is wrist flexion, which results in stress to neurovascular structures and ligaments. Poor wrist positioning can diminish grip strength (39). Figure 1-2 shows the reduction in strength that occurs as the wrist deviates further away from its neutral posture (37).

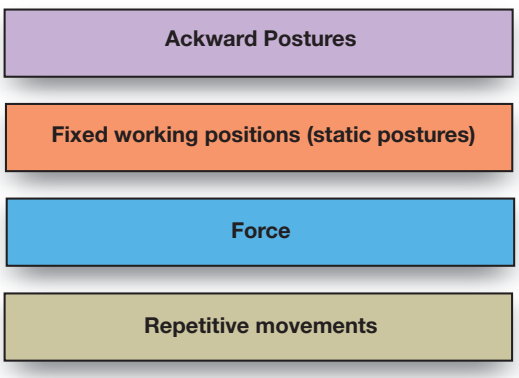



**Figure 1-1. Ergonomic Hazards for Dental Hygienists.** The dental hygienist has a high risk of musculoskeletal injury when awkward postures, static postures, and repetitive motions are combined with forceful movements (42–45).

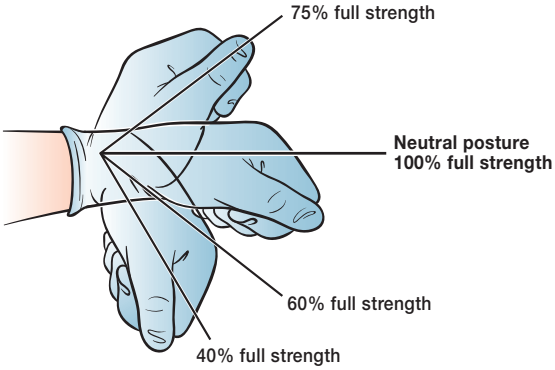



**Figure 1-2. Effect of Poor Positioning on Wrist Strength.** This illustration shows the reduction in strength that occurs as the wrist deviates away from its neutral position (37).

2. Static Postures
   - A. A **static posture** is defined as a fixed working position (maintaining the body in one position for an extended period of time) (1). The human body was not designed to maintain the same body position—prolonged static posture—hour after hour, day after day. In a static position, tensed muscles compress the blood vessels and reduce blood flow decreasing the oxygen and energy supply to the muscles. Waste products from the muscles accumulate causing muscle fatigue and eventually pain (1).
   - B. Dental clinicians have been observed statically holding postures that require greater than 50% of the body's musculature to contract (37).
   - C. Static gripping of instrument handles for durations exceeding 20 minutes is common during periodontal instrumentation (40).
3. Force
   - A. **Force** refers to the amount of effort created by the muscles, as well as, the amount of pressure placed on a body part.
   - B. Holding a small instrument for a prolonged period of time is an example of a gripping task requiring high force application. This task is commonly performed with a pinch grip where the fingers are on one side of the object and the thumb is on the other. This form of gripping is undesirable, as it requires a much greater force application than holding an object in the palm of the hand.
   - C. Researchers suggest that excessive use of a pinch grip is the greatest contributing risk factor in the development of MSDs among dental hygienists (40,41).
4. Repetitive Movements
   - A. Silverstein (42), in an article in the British Journal of Industrial Medicine, defined a **repetitive task** as a task that involves the same fundamental movement for more than 50% of the work cycle. Periodontal instrumentation would certainly be categorized as a repetitive task under this definition.
   - B. The human body was not designed to engage in fine hand movements hour after hour, day after day. The risk of developing an MSD increases when the same or similar parts of the body are used continuously, with few breaks or changes for rest (37).
   - C. Periodontal instrumentation requires excessive upper-body immobility while the tendons and muscles of the forearms, hands, and fingers overwork. Three critical components to consider with repetitive motions include:
     1. Frequency: how many times an action is repeated; such as how many instruments are gripped by one hand throughout the day.
     2. Duration: how long an action is performed; such as the length of time sitting in a static posture during the workday.
     3. Recovery time: periods of rest that break a repetitive cycle, such as time spent doing muscle stretches between patients.

## MUSCULOSKELETAL PROBLEMS COMMON IN DENTAL HYGIENISTS

MSDs commonly experienced by dental hygienists and periodontists are illustrated in Figures 1-3 to 1-10.

**Figure 1-3. Thoracic Outlet Syndrome**

**1. Definition**

A painful disorder of the fingers, hand, and/or wrist due to the compression of the brachial nerve plexus and vessels between the neck and shoulder

**2. Causes**

Tilting the head forward, hunching the shoulders forward, and continuously reaching overhead

**3. Symptoms**

Numbness, tingling, and/or pain in the fingers, hand, or wrist

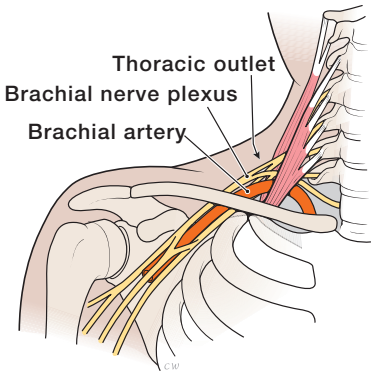



**Figure 1-4. Rotator Cuff Tendinitis**

**1. Definition**

A painful inflammation of the muscle tendons in the shoulder region

**2. Causes**

Holding the elbow above waist level and holding the upper arm away from the body

**3 . Symptoms**

Severe pain and impaired function of the shoulder joint

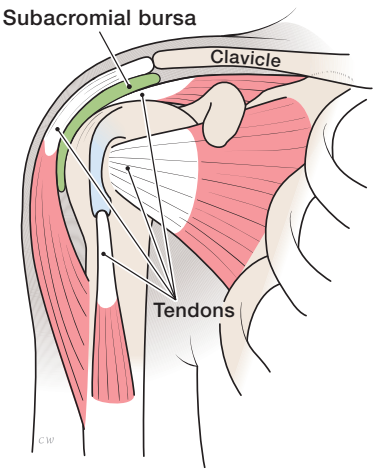



**Figure 1-5. Pronator Syndrome**

**1. Definition**

A painful disorder of the wrist and hand caused by compression of the median nerve between the two heads of the pronator teres muscle

**2. Causes**

Holding the lower arm away from the body

**3. Symptoms**

Similar to those of carpal tunnel syndrome

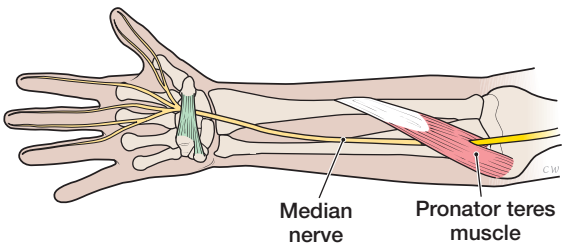
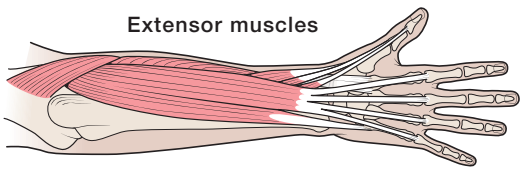


**Figure 1-6. Extensor Wad Strain**




### 1. Definition

A painful disorder of the fingers due to injury of the extensor muscles of the thumb and fingers

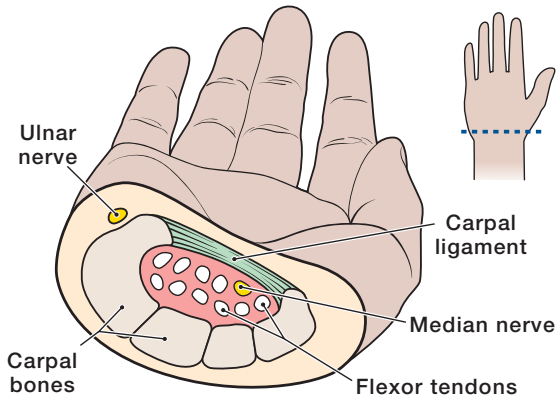
### 2. Causes

Extending the fingers independently of each other

### 3. Symptoms

Numbness, pain, and loss of strength in the fingers

**Figure 1-7. Carpal Tunnel Syndrome (CTS)**




### 1. Definition

A painful disorder of the wrist and hand caused by compression of the median nerve within the carpal tunnel of the wrist

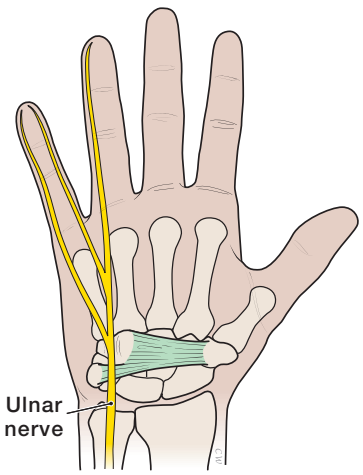
### 2. Causes

The nerve fibers of the median nerve originate in the spinal cord in the neck; therefore, poor posture can cause symptoms of CTS. Other causes include repeatedly bending the hand up, down, or from side-to-side at the wrist and continuously pinch-gripping an instrument without resting the muscles

### 3. Symptoms

Numbness, pain, tingling in the thumb, index, and middle fingers

**Figure 1-8. Ulnar Nerve Entrapment**




### 1. Definition

A painful disorder of the lower arm and wrist caused by compression of the ulnar nerve of the arm as it passes through the wrist

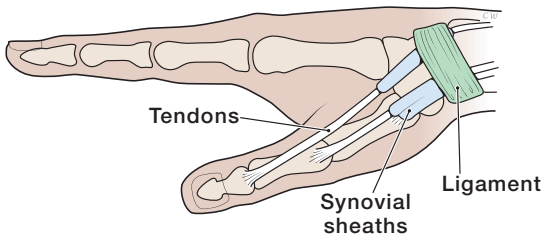
### 2. Causes

Bending the hand up, down, or from side-to-side at the wrist and holding the little finger a full span away from the hand

### 3. Symptoms

Numbness, tingling, and/or loss of strength in the lower arm or wrist

**Figure 1-9. Tenosynovitis**




### 1. Definition

A painful inflammation of the tendons on the side of the wrist and at the base of the thumb

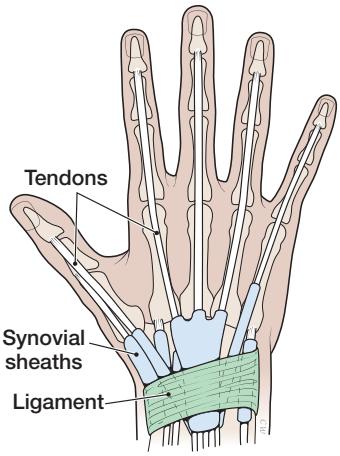
### 2. Causes

Hand twisting, forceful gripping, bending the hand back or to the side

### 3. Symptoms

Pain on the side of the wrist and the base of the thumb; sometimes movement of the wrist yields a crackling noise

**Figure 1-10. Tendinitis**




### 1. Definition

A painful inflammation of the tendons of the wrist resulting from strain

### 2. Causes

Repeatedly extending the hand up or down at the wrist

### 3. Symptoms

Pain in the wrist, especially on the outer edges of the hand, rather than through the center of the wrist

## Section 2
# Foundational Skills for Periodontal Instrumentation

***Periodontal instrumentation is a complex psychomotor skill that involves the precise execution of many individual component skills.*** Swinging a golf club is an everyday example of a complex psychomotor skill that involves many component skills, for example, proper stance, grip on the club handle, position of the golfer's head, and movement to swing the golf club.

1. **Foundational Building Blocks of Periodontal Instrumentation.** Many building blocks—individual skill components—are involved in periodontal instrumentation. These building blocks are discussed below and illustrated in Figure 1-11.
   - A. **Building Block 1: Position.** The building block of "positioning" entails the proper use of equipment, as well as, positioning the patient and clinician.
   - B. **Building Block 2: Instrument Grasp.** This building block involves the way in which the clinician holds a periodontal instrument.
   - C. **Building Block 3: Mirror Use.** A dental mirror allows a clinician to view tooth surfaces or other oral structures that are obscured from direct viewing.
   - D. **Building Block 4: Finger Rests.** This building block entails the manner in which the clinician stabilizes his or her hand in the oral cavity during periodontal instrumentation.
   - E. **Building Block 5: Stroke Production.** This building block refers to the manner in which the working-end of a periodontal instrument is moved against the tooth surface. Stroke production is a complex skill that involves several smaller component skills—activation, adaptation, and angulation—that are discussed later in this book.

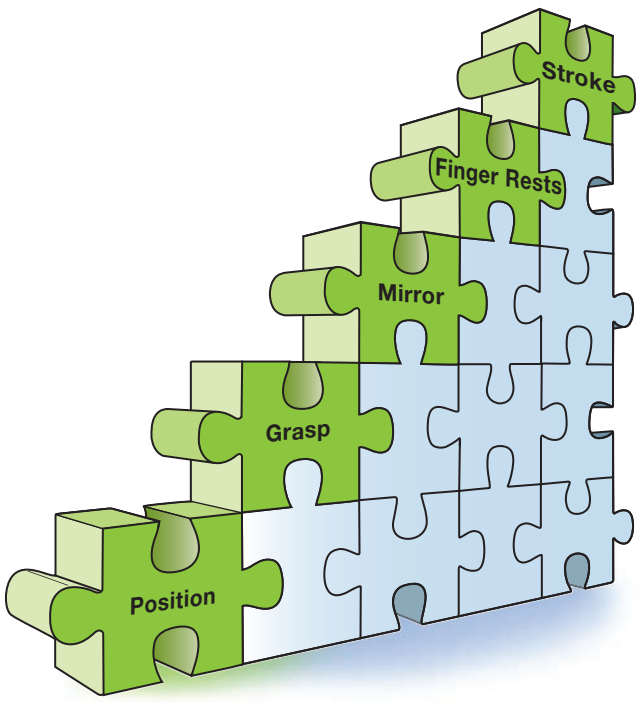



**Figure 1-11. Building Blocks for Periodontal Instrumentation.** Successful periodontal instrumentation requires the mastery the individual skill components of position, grasp, mirror use, finger rests, and stroke production.

2. **Significance of the Building Blocks for Periodontal Instrumentation**
   - A. **Precise Performance.**
     1. Precise, accurate performance of the building blocks is essential if periodontal instrumentation is to be effective, efficient, safe for the patient, and comfortable for the clinician.
     2. Research on psychomotor skill acquisition indicates that a high level of mastery in the performance of skill building blocks is essential to successful mastery of periodontal instrumentation.
        - a. The building block skills are the foundation that "supports" successful periodontal instrumentation.
        - b. These skills should be mastered one-by-one.
        - c. ***Each skill should be overlearned until it can be performed easily and without hesitation. It is impossible to devote too much time to the practice of these building block skills.***
        - d. If the building block skills are mastered, then the use of any periodontal instrument will be relatively easy to learn. The building block skills are the same no matter which periodontal instrument is used.
   - B. **Faulty Performance.** Incorrect performance of even one of the building blocks means that at the very least periodontal instrumentation will be inefficient. Most likely faulty performance results in ineffective calculus removal, unnecessary discomfort for the patient, and musculoskeletal stress to the clinician.
3. **Sequencing of Building Block Skills**
   - A. The modules (chapters) in this book are sequenced to allow beginning clinicians to practice the building blocks to periodontal instrumentation one-by-one.
   - B. ***Each building block should be practiced until it is easy to perform from memory before attempting the next building block in the skill sequence.***


**BUILDING BLOCK SKILLS.** The puzzle piece shown here appears throughout the book to alert clinicians to the individual skill components of periodontal instrumentation.

## Section 3
# Ergonomic Dos and Don'ts for Seated Posture

## NEUTRAL POSITION FOR THE CLINICIAN

1. Ergonomic Do's and Don'ts
   - A. Ergonomic Don'ts
     1. When a dental hygienist alters his or her body position or equipment in a manner that is uncomfortable or painful just to "get the job done," musculoskeletal stress is the result.
     2. A mindset that it is acceptable to assume an uncomfortable position "just for 15 minutes while performing periodontal instrumentation on these two teeth" is destined to lead to MSDs.
     3. Pain and injury results when the body's natural spinal curves are not maintained in a seated position.
   - B. Ergonomic Do's
     1. ***For a healthy and productive career, first, the dental hygienist assumes a neutral, balanced body position and then alters the patient's chair and dental equipment to complete periodontal instrumentation.***
     2. Good posture requires the seated dental hygienist to use a neutral spine position that maintains the natural curves of the spine (Fig. 1-12).
2. Neutral Body Position
   - A. Spine Basics: The Curves of a Healthy Back
     1. The spine is made up of three segments: the cervical, thoracic, and lumbar sections.
     2. The spine has three natural curves that form an S-shape (46). When the three natural curves are properly aligned, the ears, shoulders, and hips are in a straight line.
        - a. When viewed from the side, the cervical and lumbar segments have a slight inward curve (lordosis).
        - b. When viewed from the side, the thoracic segment of the spine has a gentle outward curve (kyphosis).
   - B. Neutral Body Position for the Clinician. Figures 1-13 to 1-19 illustrate the characteristics of neutral body position for the clinician.

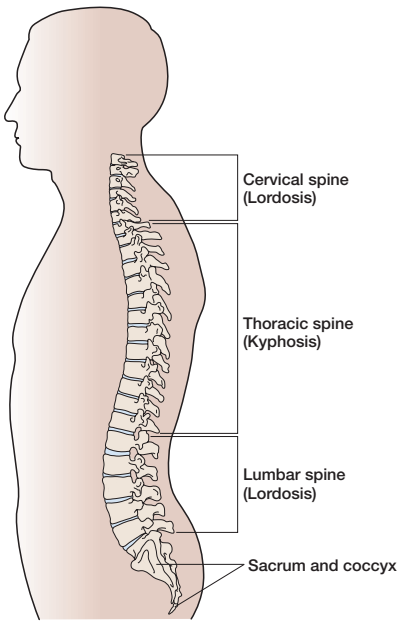



**Figure 1-12. Three Curves of a Healthy Back.** The spine has three natural curves: cervical, thoracic, and lumbar curves. The cervical and lumbar segments have a gentle inward curve. The thoracic segment has a slight outward curve.

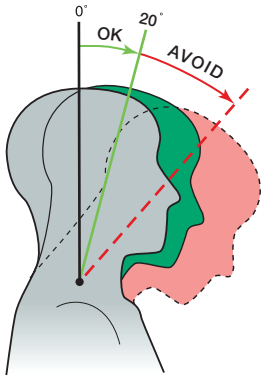



**Figure 1-13. Neutral Neck Position**

Goal:
- Head tilt of 0 to 20 degrees
- The line from eyes to the treatment area should be as near to vertical as possible

Avoid:
- Head tipped too far forward
- Head tilted to one side

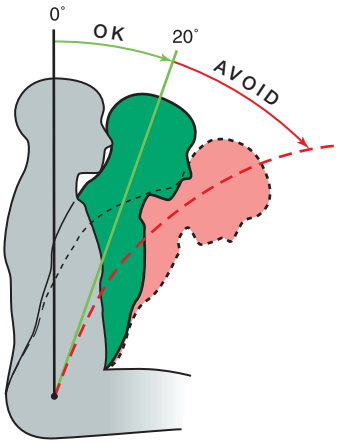



**Figure 1-14. Neutral Back Position**

Goal:
- Lean forward slightly from the hips (hinge at hips)
- Trunk flexion of 0 to 20 degrees

Avoid:
- Over flexion of the spine (curved back)

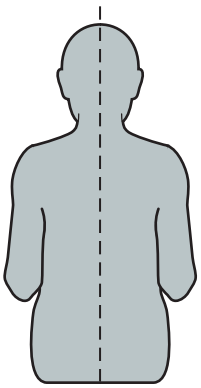


**Figure 1-15. Neutral Torso Position**

Goal:
- Torso in line with long axis of the body

Avoid:
- Leaning torso to one side
- Twisting the torso

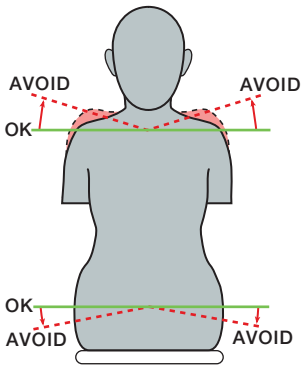
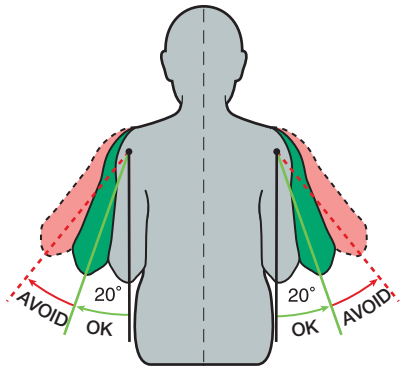



**Figure 1-16. Neutral Shoulder Position**

Goal:
- Shoulders in horizontal line
- Weight evenly balanced when seated

Avoid:
- Shoulders lifted up toward ears
- Shoulders hunched forward
- Sitting with weight on one hip

**Figure 1-17. Neutral Upper Arm Position**



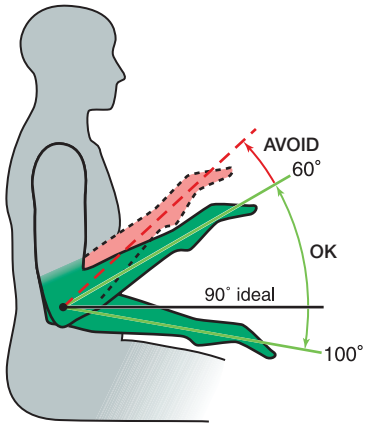

**Goal:**

- Upper arms hang parallel to the long axis of torso
- Elbows at waist level held slightly away from body

**Avoid:**

- Greater than 20 degrees of elbow abduction away from the body
- Elbows held above waist level

**Figure 1-18. Neutral Forearm Position**



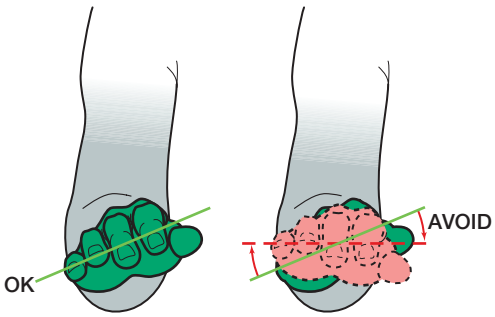

**Goal:**

- Held parallel to the floor
- Raised or lowered, if necessary, by pivoting at the elbow joint

**Avoid:**

- Angle between forearm and upper arm of less than 60 degrees

**Figure 1-19. Neutral Hand Position**




**Goal:**

- Little finger-side of palm is slightly lower than thumb-side of palm
- Wrist aligned with forearm

**Avoid:**

- Thumb-side of palm rotated down so that palm is parallel to floor
- Hand and wrist bent up or down

## Section 4
# Application of Ergonomic Principles: Seated Posture

Ergonomic principles can reduce the risk of developing an MSD by reducing muscle forces during periodontal instrumentation. Attention to the principles for neutral seated clinician posture can minimize the amount of physical stress that occurs during instrumentation.


**SKILL BUILDING**
**Neutral Seated Posture for the Clinician**

**Directions:** Practice the neutral clinician posture by following the steps 1 to 9 as illustrated in Figures 1-20 to 1-28.

The ideal seated position for the clinician is called the **neutral seated position**. ***Adjust the clinician stool first. A common mistake clinicians make is positioning the patient first and then adjusting the clinician stool to accommodate the patient.***

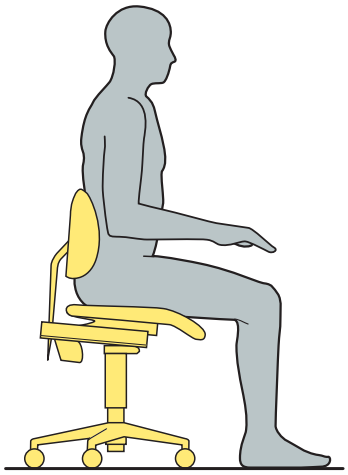


**Figure 1-20. Step 1.**
- Position the buttocks all the way back in the chair. Distribute the body's weight evenly on both hips.

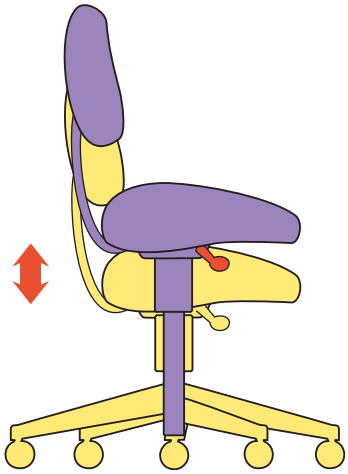


**Figure 1-21. Step 2.**
- Adjust seat height so the feet rest flat on the floor. Establish a "wide base of support" with feet on floor at least shoulder-width apart and in front of the hips (19).
- Legs should not dangle or be crossed at the knees or ankles. Dangling legs or crossing them puts pressure on the back of the thighs and restricts blood flow.

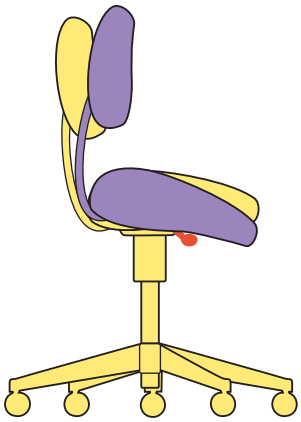


**Figure 1-22. Step 3.**
- Adjust the seat tilt so that the back is about an inch higher than the front (hips slightly higher than the knees) (16,17,19,20,22–24).
- The seat tilt helps to maintain the natural lower curve of the spine and relaxes the bend of the knees. The seat tilt should only be about 5 degrees; overtilting it can cause too much low back curve.
- **Note:** Chairs without a tilt feature can be retrofitted with an ergonomic wedge-shaped cushion.

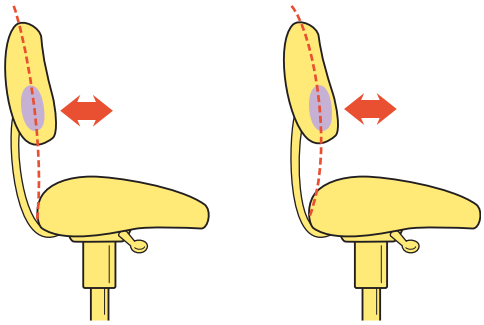


**Figure 1-23. Step 4.**
- With buttocks seated all the way back in the chair, adjust the lumbar depth by moving the backrest closer or farther from the seat pan until the backrest nestles against the lower back.
- The unsupported lower back tends to straighten rather than maintain a healthy curve (21,24).

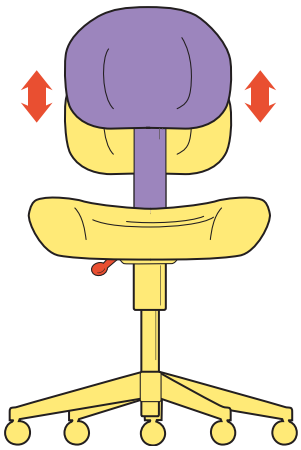


**Figure 1-24. Step 5.** Adjust the lumbar height by moving the backrest up or down until it nestles in the natural lumbar curve of the lower back. This helps to support the natural curve of the spine (21).

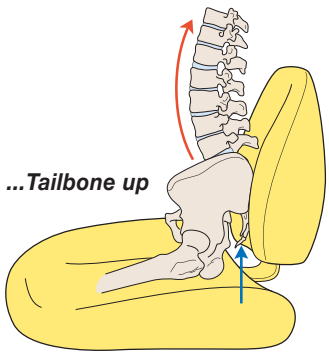



**Figure 1-25. Step 6.**
- Raise the tailbone up to establish correct spinal curves. All three normal back curves should be present while sitting.
- Studies of the seated body show that the position of the pelvis determines the shape of the spine (23).

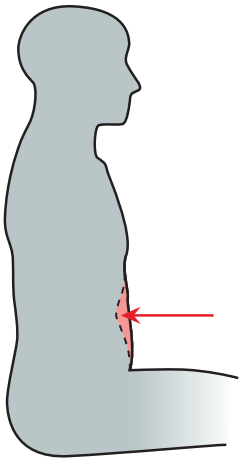


**Figure 1-26. Step 7.**
- Stabilize the low back curve by pulling the stomach muscles toward the spine (25).

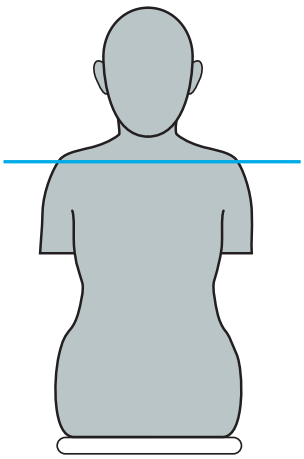


**Figure 1-27. Step 8.**
- Relax your shoulders so that they are down and back (16).
- If your stool has armrests, adjust the height of each arm so the arms are supported. This helps take the weight off the shoulders.

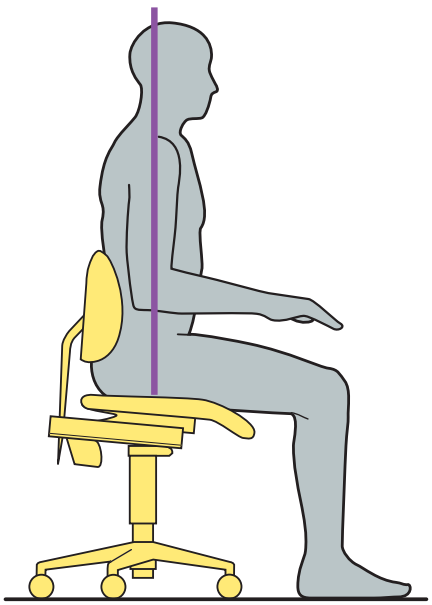


**Figure 1-28. Step 9.**
- Position the upper arms parallel to the long axis of the torso with elbows held near the body.
- Maintain a trunk position such that an imaginary straight line can be drawn connecting from the ear, shoulder, and hips (19).


## SKILL BUILDING
### The Masking Tape Trick

An easy way to monitor back position while practicing instrumentation in a preclinical setting is to use the "masking tape trick." While sitting with your back in a neutral position, have a friend apply a strip of masking tape down the center of your back, along your spinal column. Figure 1-29 shows how the masking tape will appear when a clinician is seated in neutral position. If a clinician bends forward, out of neutral position, the masking tape breaks as shown in Figure 1-30.

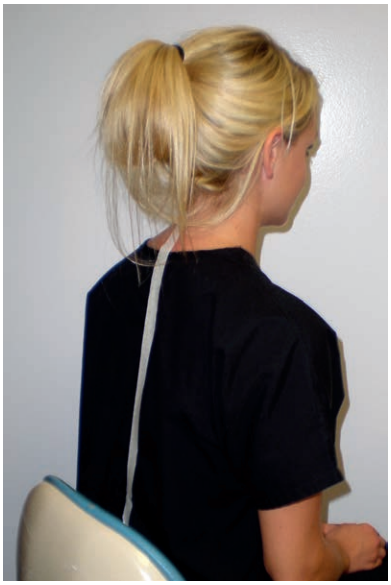


**Figure 1-29. Correct Position—Neutral Back Position.** Maintain a neutral back position while practicing positioning or periodontal instrumentation and the strip of masking tape remains intact and straight. (Photo courtesy of Dr. Richard Foster, Guilford Technical Community College, Jamestown, NC.)

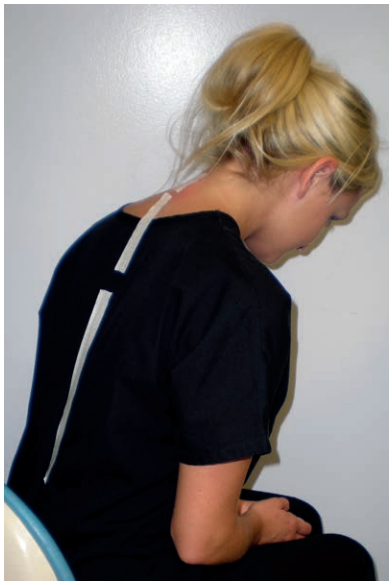


**Figure 1-30. Incorrect Position—Rounded Back Position.** The masking tape strip will tear if you bend over, rounding your back while practicing positioning or periodontal instrumentation. Torn masking tape will alert you to problems with your seated position. (Photo courtesy of Dr. Richard Foster, Guilford Technical Community College, Jamestown, NC.)

## IMPORTANT ELEMENTS OF THE SEATED POSITION

Figures 1-31 and 1-32 depict important elements of the seated clinician position.

**Figure 1-31. Correct Feet Position.** The feet should be positioned to create a "wide base of support" for the seated clinician. That is, the feet should be flat on the floor about a shoulder's width apart for ideal balance while seated.

**Figure 1-32. Incorrect Feet Position for Seated Clinician**
**A. Narrow Base of Support.** A narrow base of support with the feet together or tucked under the chair interferes with the clinician's balance and can limit his or her range of motion during instrumentation.
**B. Crossed Legs.** Crossing the legs at the knees or ankles restricts blood flow to the legs and feet. In addition, this position places more weight on one side of the hip and interferes with the clinician's balance during periodontal instrumentation. (Photos courtesy of Dr. Richard Foster, Guilford Technical Community College, Jamestown, NC.)

## Section 5
# Application of Ergonomic Principles: Positioning the Patient

## SUPINE AND SEMI-SUPINE PATIENT POSITION

The recommended patient position for dental treatment is with the patient lying on his or her back. For maxillary treatment areas, the back of the dental chair is nearly parallel to the floor in a **supine position** (Table 1-1, Fig. 1-33). For mandibular treatment areas, the back of the dental chair is slightly upright in a **semi-supine position** (Table 1-2, Fig. 1-34).

**TABLE 1-1. POSITION FOR MAXILLARY TREATMENT AREAS**

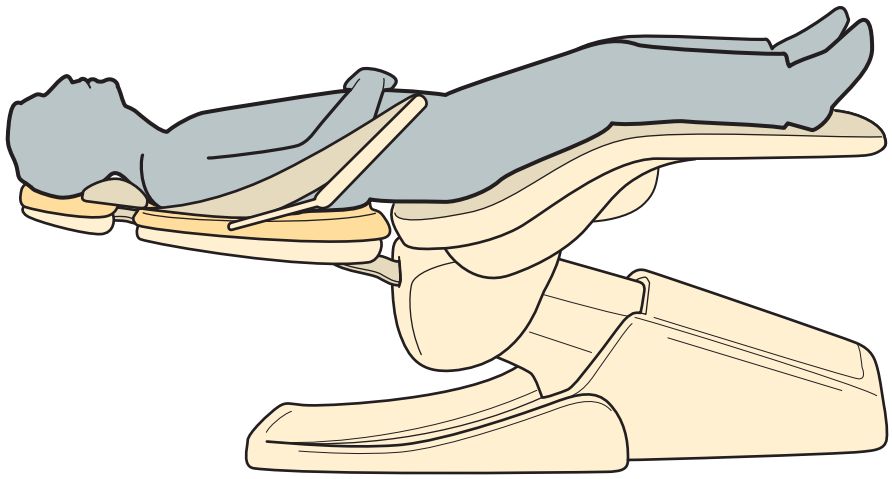


**Figure 1-33. Patient Position for the Maxillary Arch.**

| | |
|---|---|
| **Body** | The patient's **feet should be even with or slightly higher than the tip of his or her nose**. |
| **Chair Back** | The chair back should be nearly **parallel to the floor** for maxillary treatment areas. |
| **Head** | The **top of the patient's head should be even with the upper edge of the headrest**. If necessary, ask the patient to slide up in the chair to assume this position. |
| **Headrest** | Adjust the headrest so that the patient's head is in a **chin-up position**, with the patient's nose and chin level. Patient head position is discussed in more detail later in this chapter. |

## TABLE 1-2. POSITION FOR MANDIBULAR TREATMENT AREAS

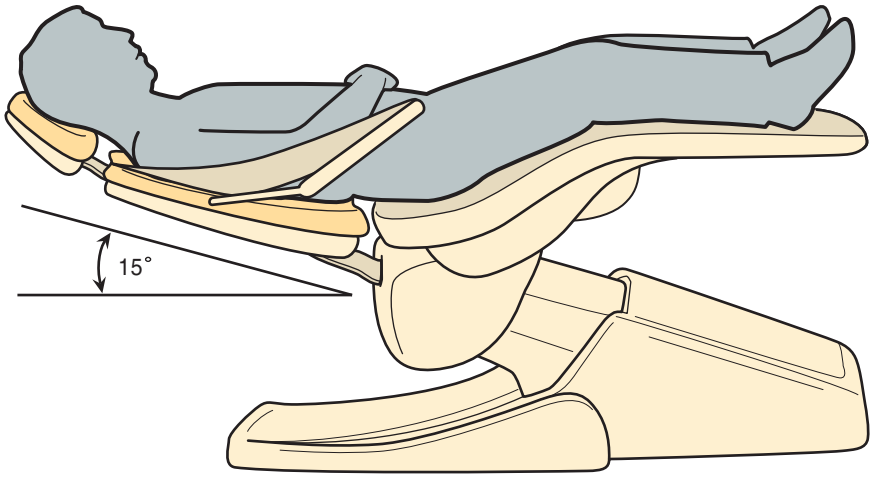



**Figure 1-34. Patient Position for the Mandibular Arch.**

| | |
|---|---|
| **Body** | The patient's **feet should be even with or slightly higher than the tip of his or her nose**. |
| **Chair Back** | The chair back should be **slightly raised above the parallel position** at a 15- to 20-degree angle to the floor (24) |
| **Head** | The **top of the patient's head should be even with the upper edge of the headrest**. If necessary, ask the patient to slide up in the chair to assume this position. |
| **Headrest** | Raise the headrest slightly so that the patient's head is in a **chin-down position**, with the patient's chin lower than the nose. Patient head position is discussed in greater detail later in this chapter. |

## PATIENT HEAD POSITION

The patient's head position is an important factor in determining whether the clinician can see and access the teeth in a treatment area.

- Unfortunately, a clinician may ignore this important aspect of patient positioning, contorting his or her body into an uncomfortable position instead of asking the patient to change head positions. Working in this manner not only causes stress on the musculoskeletal system, but also makes it difficult to see the treatment area.
- Remember that the patient is only in the chair for a limited period of time while the clinician spends hours at chairside day after day. The patient should be asked to adjust his or her head position to provide the clinician with the best view of the treatment area.
- The patient's head should be positioned at the upper edge of the headrest. This position permits maximal visibility and access to the oral cavity. Figure 1-35A and B depicts correct patient head position for an adult and a young child. Incorrect head position is shown in Figure 1-36.

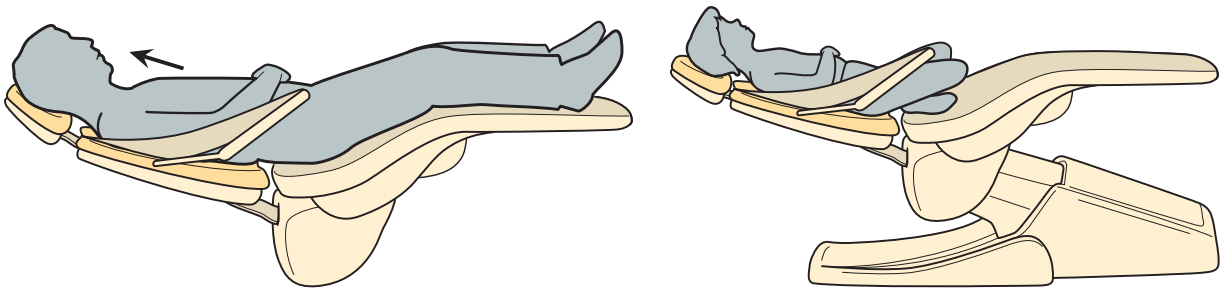


**Figure 1-35. Correct Position.**
**A. Adult Patient.** Once the patient chair is in a supine or semi-supine position, ask the patient to slide up until his or her head is even with the top edge of the headrest.
**B. Young Child.** Asking a young child to bend the knees and cross the legs may be helpful in keeping him or her from sliding down in the chair.

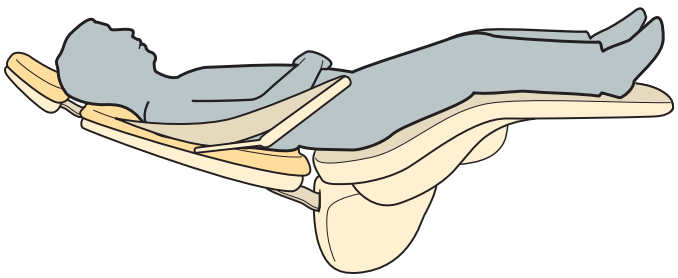


**Figure 1-36. Incorrect Position.** The patient may slide down in the chair when the patient chair is reclined. If patient's head is not even with the upper edge of the headrest, access and visibility of the oral cavity is restricted.

## PATIENT HEAD ADJUSTMENT FOR OPTIMAL VISIBILITY

Once the patient is comfortably lying in a reclined position, the next objective is to ask the patient to adjust his of her head position to attain an optimal view of the treatment area. The patient can (1) tilt the head up or down, (2) rotate the head toward or away from the clinician, and (3) bend the head to the side (Figs. 1-37 to 1-40). ***Articulating (adjustable) headrests facilitate adjustment of the patient's head.*** Cervical rolls can be used with nonarticulating headrests to maintain patient head position.

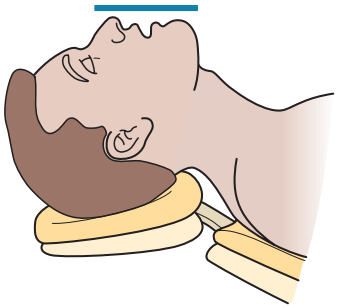


**Figure 1-37. Patient Head Tilt for Maxillary Arch.**
- Angle the headrest up into the back of the patient's head (occipital area) so that the nose and chin are approximately level (48).
- The upper arch needs to be angled backward past the vertical plane.
- This patient head position is known as the **chin-up position**.

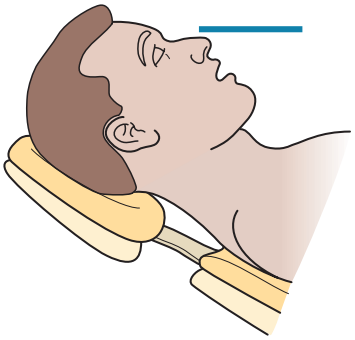


**Figure 1-38. Patient Head Tilt for Mandibular Arch.**
- Angle the headrest forward and down, so that the chin is lower than nose level (48).
- The occlusal or incisal surfaces of the treatment area should approximately parallel to the floor.
- This patient head position is known as the **chin-down position**.

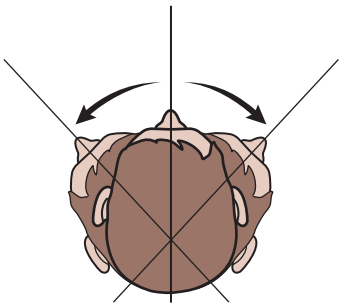


**Figure 1-39. Patient Head Rotation for Both Arches.**
- Ask the patient to rotate his or her head for easy access to the treatment area.
- Positions include turning toward the clinician, looking straight ahead, and turning slightly away from the clinician.

**Figure 1-40. Bending the Head to the Side.**
- If the patient chair has a flat, nonarticulated headrest, it is helpful to ask the patient to side-bend the head toward the clinician and then turn his or her head for the treatment area.
- This technique can position the oral cavity 2 to 3 in closer to the clinician and enhance viewing of the treatment area.

## Section 6
# Application of Ergonomic Principles: Adjusting the Overhead Light and Instrument Tray

## POSITIONING THE OVERHEAD DENTAL LIGHT

***Ideally, the overhead dental light is positioned so that the light beam is parallel to the clinician's line of sight*** (22,24,49).

- For mandibular treatment areas, the overhead dental light is positioned so that the light beam is approximately perpendicular to the floor (Fig. 1-41).
- For maxillary treatment areas, it usually is not possible to direct the light beam identically to the clinician's line of sight. For maxillary areas, it often is necessary to move the dental light above the patient's neck and angle the light beam into the mouth (Fig. 1-42). It is significant to note that dental hygienists whose overhead dental lights are positioned farther away from their sight lines (toward the patient's waist) are more likely to experience lower back pain (22,24,49).
- It is necessary to make tiny adjustments to the light throughout periodontal instrumentation—seldom is the light positioned for an arch and left in the identical position until moving to the opposite arch. As the clinician works around a dental arch and as the patient looks toward or away from the clinician, the dental light requires minor adjustments.

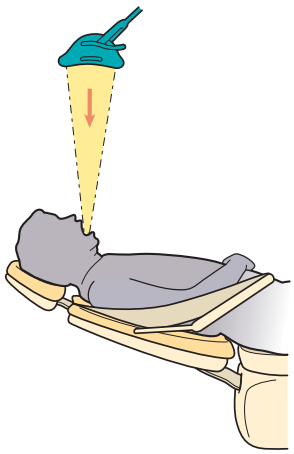


**Figure 1-41. Light Position for Mandibular Arch.**
- For the mandibular treatment areas, the overhead dental unit light is positioned directly over the oral cavity.
- Position the light at **arm's length within** comfortable reach. Avoid positioning the light close to the patient's head.
- The patient is in a chin-down head position.
- The light beam is directed approximately perpendicular to the floor.

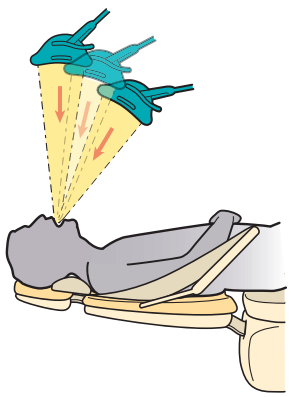


**Figure 1-42. Light Position for Maxillary Arch.**
- The maxillary treatment areas, the position of the overhead dental unit light ranges from being directly over the oral cavity to a position over the patient's neck.
- Position the light **at arm's length** within comfortable reach.
- Ideally, the light beam always would be perpendicular to the floor, but this is not always possible using an overhead dental light. This is why a coaxial illumination source is ideal. Coaxial illumination is discussed later in this chapter.
- The patient is in a chin-up position.
- The direction of the light beam ranges from perpendicular to the floor to a 60- to 90-degree angle to the floor.

## POSITIONING THE INSTRUMENT TRAY

The instrument tray should be positioned within easy reach of the clinician's dominant hand as shown in Figure 1-43. Incorrect positioning of the instrument tray as depicted in Figure 1-44 places unnecessary stress on the clinician.

**Figure 1-43. Correct Positioning of the Instrument Tray.**
**A. Front/Side Delivery.** Instrument tray positioned correctly for front or side delivery within easy reach of the clinician's dominant hand.
**B. Rear Delivery.** Instrument tray positioned correctly for rear delivery within easy reach of the clinician's dominant hand.

**Figure 1-44. Incorrect Positioning of Instrument Tray.** A combination of positioning errors is demonstrated in this photo.

- The patient's oral cavity is positioned too high at midsternum level, instead of at the clinician's waist-level.
- The bracket table is positioned too far from the clinician. She would have to stretch to reach the instrument.

## Section 7
# Application of Ergonomic Principles: Adjusting the Patient to Facilitate Clinician Posture

A major component in avoiding fatigue and injury is proper positioning of the patient and dental equipment in relation to the seated clinician.

- While working, the clinician must be able to gain access to the patient's mouth and the dental unit without bending, stretching, or holding his or her elbows above waist level.
- ***The neutral seated position is established first, and then everything else—the patient chair, the patient's head, the dental unit light, and other dental equipment are adjusted to facilitate maintenance of the neutral seated position.***
- Box 1-1 (Fig. 1-45) provides an overview of the relationship of the patient chair to the seated clinician while Figures 1-46 and 1-47 demonstrate correct and incorrect positioning.

**Box 1-1**

## Overview: Patient Chair Position Relative to the Seated Clinician

**Figure 1-45**

- Clinician assumes a neutral seated position.
- The clinician establishes a "wide base of support" with feet on floor at least shoulder-width apart and in front of the hips.
- The patient chair is lowered until the tip of the patient's nose is below the clinician's waist.
- The clinician should position his or her stool close to the patient to enhance vision of the treatment area and to minimize forward bending.
- Whenever possible, the clinician should straddle the headrest to facilitate neutral position.

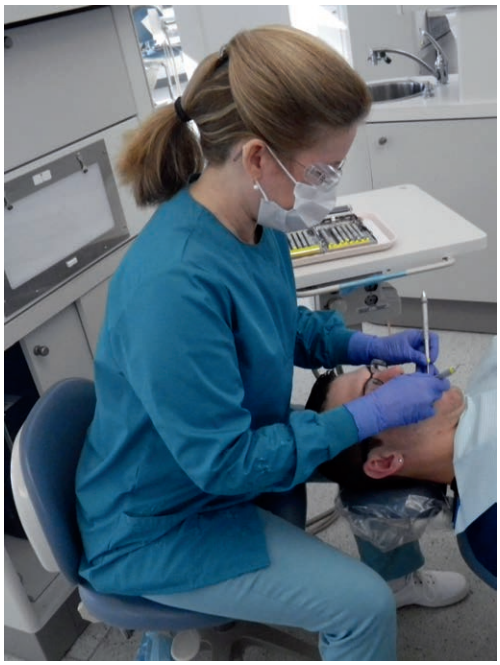


**Figure 1-46. Correct Positioning.** Here the patient chair and patient's head are positioned at the correct height in relation to the clinician. Note that the clinician holds her upper arms parallel to her torso, her arms are not raised, and her shoulders are relaxed.

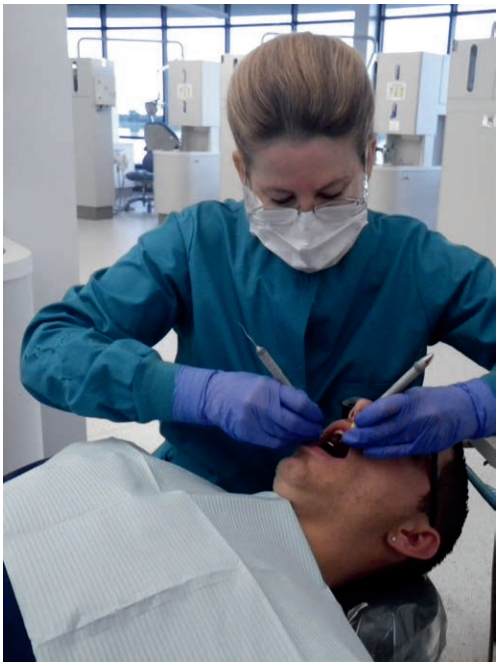


**Figure 1-47. Incorrect Positioning—Patient Too High.**

**A.** Note how this clinician must hold her elbows up in a stressful position in order to reach the mouth because she has positioned the patient's chair too high. This error is often due to the misconception that the clinician sees better if the patient is closer to the clinician's eyes. Actually, the reverse is true; the clinician has improved vision of the mouth when the patient is in a lower position.

**B.** In this example, the patient is positioned too high for the clinician. As a result, the clinician's chair is raised so the clinician can reach the mouth. The high chair position causes her to rest her feet on the rungs of the chair because she cannot touch the floor with the soles of her shoes.


## SKILL BUILDING
### Establishing the Height of the Patient Chair

**Directions:** Follow steps 1 to 5 below to practice establishing the correct height of the patient chair in relation to the seated clinician (Fig. 1-48).

1. Assume a neutral seated position. Sit next to the patient with the forearms crossed at your waist with your hand at the side at waist, not at your midsection (Fig. 1-48).
2. Position the patient chair for the treatment area (maxillary: supine; mandibular: semi-supine).
3. Position the patient's head for the treatment area (chin-up or chin-down).
4. The patient's open mouth should be ***below*** the point of the clinician's elbow.
5. In this position, the clinician will be able to reach the treatment area without raising his or her elbows above waist level.

**Figure 1-48**

## Section 8
# Ancillary Equipment

Ancillary equipment that may be helpful to the clinician during periodontal instrumentation includes a coaxial illumination source and magnification loupes.

## DENTAL HEADLIGHTS: COAXIAL ILLUMINATION

Adequate light must be present for human eyes to function effectively. In many instances, the clinician's hands or instruments block the light from the overhead dental light causing the clinician to crane the neck and assume a poor working posture. Instead of using the overhead dental light for illumination, many clinicians use a light source attached to a headband or mounted to magnification loupes (Fig. 1-49).


**Figure 1-49. CoAxial Illumination Source.** A headlight mounted to eyeglass frames. Note also that magnification loupes are mounted to the lenses of the glasses. The battery power source for headlight is shown on the left-hand side of this photo. (Courtesy of SurgiTel/General Scientific Corporation.)

1. Coaxial Illumination
   - **Coaxial illumination sources** are spectacle-mounted or headband-mounted miniature lights that provide a beam of light that is parallel to the clinician's sight line (Figs. 1-50 to 1-52). In everyday terms, coaxial illumination sources are called **dental headlights**.
2. Advantages of Dental Headlights
   - Coaxial illumination provides a light source that is parallel to the clinician's line of vision that eliminates shadows produced by hands and instruments. Dental headlights provide the clinician with shadow-free light and facilitate improved posture (50).
   - Dental professionals spend many hours per year adjusting traditional overhead dental lights. Dental headlights improve productivity because time is not wasted adjusting a traditional overhead dental light (50).
   - Recently, Dr. Janet Harrison researched ocular hazards from dental headlights (51). Although most manufacturers advertise that their devices emit "white" light, some dental headlights have a strong blue-light component versus the green-light component. Blue light is highly energized and is close in the color spectrum to ultraviolet light. The hazards of retinal damage with the use of high-intensity blue lights have been well-documented. There is limited research regarding the possible ocular hazards of usage of high-intensity illuminating devices. Another unexamined component is the effect of high-intensity light reflective glare and magnification back to the practitioner's eyes due to the use of water during dental procedures.

**Figure 1-50. Dental Headlight.** A dental hygienist wearing a spectacle-mounted dental headlight.

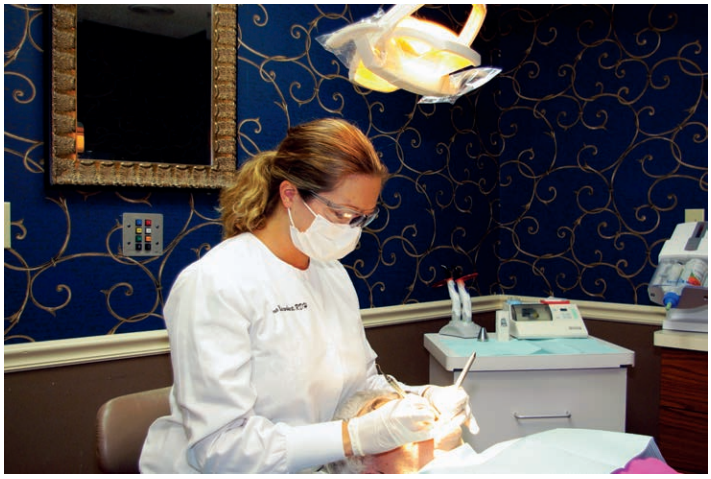


**Figure 1-51. Illumination with an Overhead Light.** Often, it is difficult to position an overhead light to achieve good illumination of the maxillary arch. Note that the hygienist's head is blocking the light beams.

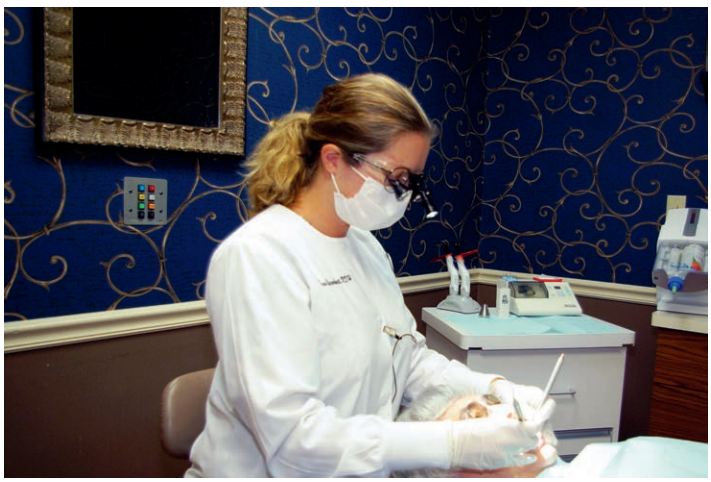


**Figure 1-52. Coaxial Illumination.** The dental headlight provides a beam of light that is parallel to the clinician's line of sight. The headlight provides good illumination of maxillary and mandibular treatment areas. And, there is no need to reach up to adjust an overhead light!

## MAGNIFICATION LOUPES

1. **Magnification Loupes: Ergonomically Helpful or Harmful?** Magnification through surgical telescopes—known as **magnification loupes**—may be a technological aid during periodontal instrumentation (Fig. 1-53).
   - **A. Research Evidence Concerning Magnification Loupes**
     1. While the use of loupes is often promoted as an ergonomic intervention, there is little published research to support this claim (8).
        - **a.** A study by Hayes et al. (8) suggests that wearing loupes has both positive and negative effects on upper extremity MSDs among dental hygienists (22,50,53). ***Additional research is needed to assess the long-term effects of loupes wear, over an extended period of time.***
        - **b.** A study by Hoerler et al. (52) shows no statistically significant data to support the use of magnification loupes to enhance indirect vision skills among dental hygiene students.
     2. Magnification may reduce the tendency to lean forward in an attempt to obtain a better view of the treatment area and therefore, reduce musculoskeletal strain to the clinician's neck, back, and shoulder muscles.
   - **B. Problems Associated with Loupes**
     1. As with most equipment, how the loupes are used determines whether this equipment is beneficial in reducing musculoskeletal strain (Fig. 1-54). ***A poorly fitted or incorrectly used magnification system is more likely to exacerbate musculoskeletal problems than to solve them*** (54–57). It is important to make sure that the magnification system is properly fitted to the clinician.
     2. According to Chang (55), President and Chief Scientist of SurgiTel/General Scientific Group, "Many clinicians think loupes solve ergonomic problems, but loupes can create ergonomic problems. The key is to find loupes that meet their ergonomic requirements."
        - **a.** Loupes with improper working distances and declination angles can actually cause chronic neck and upper back pain (55,57–59).
        - **b.** Misalignment of the two oculars can cause eyestrain, double vision, and headaches. Clinicians should try loupes before they buy and ensure the loupes are custom-fit.


**Figure 1-53. Flip-Up Style.** Flip-up styles have the magnification telescopes attached to the eyeglasses by a hinged bracket. The bracket allows the clinician to obtain nonmagnified vision by rotating the telescopes above the eyewear. (Courtesy of SurgiTel/General Scientific Corporation.)

**Figure 1-54. Loupes and Posture.** As, this clinician's poor position clearly demonstrates, there is no "magic, easy fix" for maintaining neutral posture. As with most equipment, how the loupes are used determines whether this equipment is beneficial in reducing musculoskeletal strain.

2. **Magnification Loupes for Periodontal Instrumentation**
   - A. **Ergonomic Criteria for Loupes Selection.** Three essential considerations when selecting loupes are working distance, declination angle, depth of field, and frame size and weight (55,59).
     1. **Working distance** is the distance measured from the eyes to the teeth being treated. If the working distance measured for the loupes is too short, the clinician needs to assume a head-forward or hunching posture to see the treatment area.
     2. **Angle of declination** is the angle between the temple piece of the spectacle-mounted magnification system and the actual line of sight chosen by the clinician (Fig. 1-55).
        - a. Each clinician has a unique optimal declination angle determined by the individual's most balanced seated position (55,59).
        - b. If the declination angle of the loupes is too small, the clinician will have to tip the head forward or use a hunching posture to view the treatment area through the loupes. If the declination angle is too great, the clinician will have to tilt the head backward in order to view the treatment area through the loupes.
     3. **Depth of Field. Depth of field** is the distance range within which the object being viewed remains in sharp focus.
        - a. Adequate depth of field allows the clinician to move his or her head without the treatment area going out of focus.
        - b. Inadequate depth of field may cause the clinician to assume an awkward head position in order to clearly view the treatment area.
     4. **Sizes and Weight of Spectacle Frame**
        - a. Large frames that sit low on the cheek allow better placement of the telescopes than narrow, oval frames. In general, the lower the telescopes are in relation to the clinician's pupils, the better the declination angle.
        - b. The dental professional may wear magnification loupes for many hours each day. It is important, therefore, that the frames be as light and comfortable as possible.

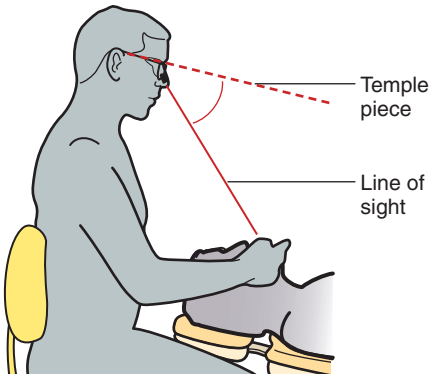



**Figure 1-55. Declination Angle.** The declination angle is the angle formed between the temple piece of spectacle-mounted magnification system and the clinician's actual line of sight.

### 3. Important Considerations for Preclinical Periodontal Instrumentation

#### A. Limitations on What Can Be Seen with Magnification

1. **Limited Field of Vision with Magnification.** The **field of view** is the total size of the object that can be viewed through the loupes. The most popular magnification strengths for periodontal instrumentation are 2.0×, 2.5×, and 2.6× (55). The lowest level of magnification required should be selected. Lower magnification levels increase the depth of field and minimize the blind zone.
2. **Blind Zone with Magnification.** The **blind zone** is an area of vision between the unmagnified peripheral field of vision and the magnified center of the field of vision.
   a. The blind zone presents the most difficulty when an instrument is being moved into or out of the magnified field of view. Injury to the patient or the clinician is a possibility as the instrument is moved through the blind spot. Most clinicians simply move the loupes aside until a stable fulcrum has been established with the instrument.
   b. The lowest magnification should be selected to minimize the size of the blind zone.

#### B. Criteria for Use of Magnification Loupes in Preclinical Setting

1. **Ability for Student Self-Assessment**
   a. When learning the skills of clinician position, patient position, clock positions, mirror use, and finger rests it is vital that the student clinician is able to continuously self-assess the positioning of his or her body, arms, hands, and fingers.
   b. ***Self-assessment of these skills during the learning process means that the student clinician must have a visual field that includes the patient's head and the clinician's arms, hands, and fingers as well as the oral cavity.***
   c. Figure 1-56 shows the minimum field of vision needed by the student clinician while practicing and mastering the fundamental skills of patient position, clock positions, mirror use, and finger rests.
   d. Magnification loupes limit the clinician's field of vision to the oral cavity (60). Figure 1-57 shows the clinician's field of vision using with 2.5× magnification loupes. Once a clinician has mastered the fundamental skills of patient position, clock positions, mirror use, and finger rests, the loupes provide a field of vision that is adequate for instrumentation.
   e. ***This magnified field of vision, however, is too restrictive to permit self-evaluation of skills when acquiring the fundamental preclinical skills of positioning and finger rests.***

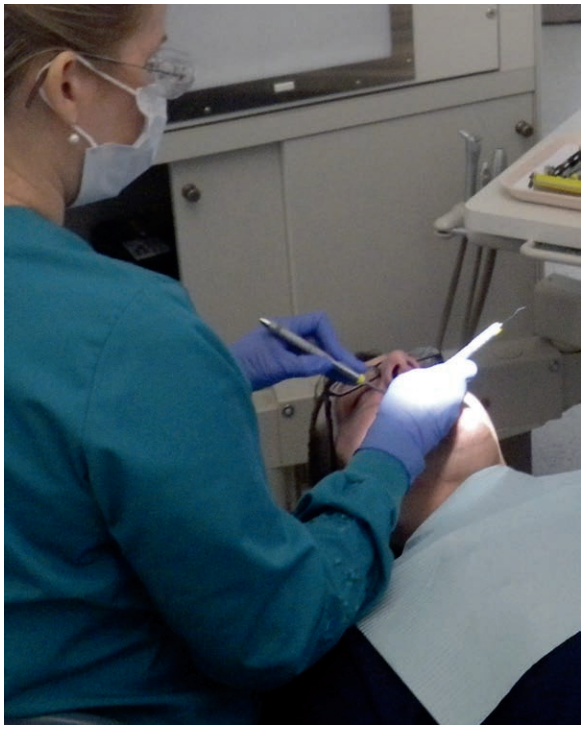


**Figure 1-56. Field of Vision without Loupes.** When learning and mastering the fundamental skills of positioning, mirror use, and finger rests, the student clinician needs a field of vision that allows him or her to continuously self-evaluate these skills.

**Figure 1-57. Limited Field of Vision with Loupes.** When wearing magnification loupes, the clinician's field of vision is limited to the oral cavity. This field of vision is too restrictive when practicing and perfecting the fundamental skills of positioning, mirror use, and finger rests (Box 1-2).

## Box 1-2 No Magnification, Please

Magnification loupes should not be worn when practicing and perfecting certain fundamental skills of periodontal instrumentation. The limited field of vision created by magnification loupes make it impossible for student clinicians to self-evaluate fundamental skills such as positioning, grasp, and finger rests. Self-assessment of these skills requires an unlimited field of vision.

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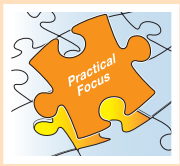
## Section 9
# Skill Application




### PRACTICAL FOCUS
**Selecting A Clinician Stool**

Dental professionals spend long hours sitting. Clinician stools cannot be a "one size fits all" design. Dentists and dental hygienists come in all sizes: tall or short with a delicate or round physique. A dental hygienist who is 6′4″ in height certainly needs a different chair than a dental hygienist who is 5′1″ in height. A stool that is adjusted correctly for clinician A may be uncomfortable for clinician B. Just as each driver of the family car must change the position of the driver's seat and mirrors, ***each clinician should adjust the stool height and seat back to conform to his or her own body proportions and height.*** Properly designed clinician seating is the foundation for a healthy neutral sitting position (18,19,22,47). Table 1-3 provides evaluation criteria for assessment of clinician seating.

**TABLE 1-3. ERGONOMIC SEATING EVALUATION FORM**

| Evaluation Criteria | Scale: U = Unacceptable A = Average E = Excellent |
|---|---|
| **A. Legs**<br>1. Five legs for stability<br>2. Large casters for easy movement | |
| **B. Stool Adjustments**<br>1. Stool seat height, backrest, and seat pan adjust independently to allow for comfortable seating.<br>2. Stool seat height, backrest, and seat pan adjust easily while in a seated position.<br>3. Seat height easily adjusts to accommodate both tall and short clinicians (range of 14–20 in).<br>4. Seat pan tilts slightly so that the seat back is an inch or so higher than the front. | |
| **C. Seat Comfort**<br>1. Seat pan depth is comfortable and supportive. Seat pan is large enough to support the clinician's thighs and buttocks.<br>2. Front edge of the seat pan has a waterfall shape (rounded front edge).<br>3. When the clinician is seated with his or her back against the backrest, the seat pan does not impinge on the back of the clinician's knees, but allows a couple of inches between the edge and the back of the knee. | |
| **D. Backrest Comfort**<br>1. The backrest adjusts in a vertical direction—up and down—to provide support to the lumbar region of the back for both short and tall clinicians.<br>2. The backrest adjusts in a horizontal direction—closer or farther away from the seat—to provide lumbar support. | |

## ONLINE MODULE SKILL EVALUATIONS


Module Skill Evaluations for instructor use can be downloaded online.

Module skill evaluations may be downloaded for use on a computer (Fig. 1-58) or printed out as paper copies.

- These computerized module evaluations automatically tabulate the percentage grade for each module evaluation.
- The computerized evaluation forms may be customized to meet each individual dental hygiene program's needs by adding or deleting criteria.
- In addition to the individual module evaluation forms, a summative evaluation form for use as a psychomotor final examination is available online.
- For details see the Instructor Resources section of the online materials through the Navigate 2 Advantage Access website.

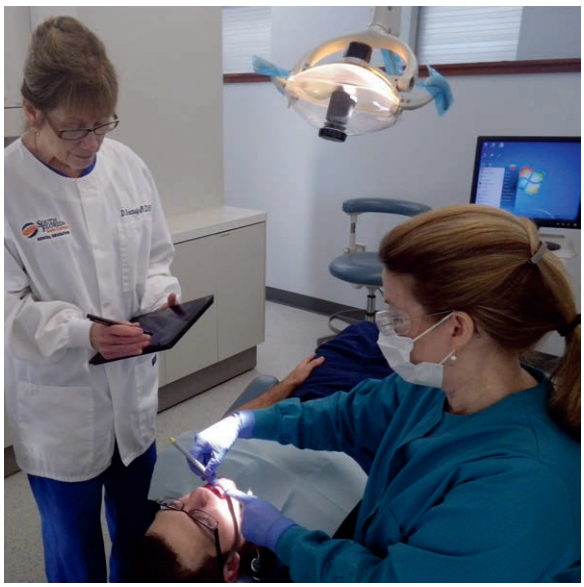


**Figure 1-58. Computerized Skill Evaluation Forms.** Skill Evaluation forms downloaded from thePoint website may be used on a computer during the preclinical evaluation process.


## Student Self-Evaluation Module 1: Position

Student: _____

Date: _____

**DIRECTIONS:** Self-evaluate your skill level in each treatment area as: **S** (satisfactory) or **U** (unsatisfactory).

| Positioning/Ergonomics | Self Evaluation |
|---|---|
| Adjusts clinician chair correctly | |
| Reclines patient chair and assures that patient's head is even with top of headrest | |
| Positions instrument table within easy reach for front, side, or rear delivery as appropriate for operatory configuration | |
| Positions unit light at arm's length or dons dental headlight and adjusts it for use | |
| Positions backrest of patient chair for the specified dental arch | |
| Adjusts height of patient chair so that clinician's elbows remain at waist level when the clinician's fingers are touching the teeth in treatment area | |
| Maintains neutral seated position | |