Musculoskeletal Disorders and Ergonomics in Dentistry: An Introduction

Musculoskeletal Disorders (MSDs)
- Include a group of conditions that involve nerves, tendons, muscles, and supporting structures such as intervertebral discs

Severity of Symptoms
- Mild periodic
- Severe chronic & debilitating conditions
MSDs ≠ Ergonomics

- Musculoskeletal problems are the problem and ergonomics is a solution.

Types of MSDs

- Neck and Shoulder Disorders
  - Myofascial Pain Disorder
  - Cervical Spondylolysis
  - Thoracic Outlet Syndrome
  - Rotator Cuff Tendinitis/Tears

- Back Disorders
  - Herniated Spinal Disc
  - Lower Back Pain
  - Sciatica

- Hand and Wrist Disorders
  - DeQuervain’s Disease
  - Trigger Finger
  - Carpal Tunnel Syndrome
  - Guyon’s Syndrome
  - Cubital Tunnel Syndrome
  - Hand-Arm Vibration Syndrome
  - Raynaud’s Phenomenon
**MSDs**

**Signs**
- Decreased range of motion
- Deformity
- Decreased grip strength
- Loss of muscle function

**Symptoms**
- Pain
- Numbness
- Tingling
- Burning
- Cramping
- Stiffness

**Contributing Factors for Work-Related MSDs (WMSD)**
- Routine exposure to:
  - Forceful hand exertions
  - Repetitive movements
  - Fixed or awkward postures
  - Vibrating tools
  - Unassisted frequent or heavy lifting
What Factors Contribute to WMSDs?

- Forceful hand exertions
  - Grasping small instruments for prolonged periods
  - Forceful squeezing/ release of instruments
- Repetitive movements—e.g., scaling, root planing, polishing

What Factors Contribute to WMSDs?

- Fixed or awkward postures
  - Neck, back, shoulder posture
  - Hand/ wrist positions
  - Standing/ sitting
  - Operatory organization
  - Patient positioning
What Factors Contribute to WMSDs?

- Prolonged use of vibrating hand tools—dental handpieces, laboratory equipment

Contributing Factors for WMSDs

- A risk factor is not always a causation factor
- The level of risk depends on
  - Length of time a worker is exposed to these conditions
  - How often they are exposed
  - Level of exposure
- Usually a combination of multiple risk factors (vs. a single factor) contributes to or causes a MSD
Contributing Factors for WMSDs

- Do not focus solely on the workplace
  - Risk factors may be experienced during non-occupational activities (e.g., certain sports, exercising, working with computers, needlework, playing musical instruments)

- Not everyone exposed to any or all of the risk factors will develop a MSD
- Individuals do not respond to them in the same way
- Predisposing factors such as age, arthritis, renal disease, hormonal imbalances, diabetes, and hypothyroidism may play a role
Neck and Shoulder Disorders

- Risk factors associated with dentistry
  - Prolonged static neck flexion and shoulder abduction or flexion
  - Lack of upper-extremity support
  - Inadequate work breaks

- Dental health-care personnel (DHCP) commonly assume awkward work postures
  - To obtain better views of the intraoral cavity
  - To provide a more comfortable position for the patient
  - To coordinate their position relative to the dentist or assistant
  - While operating equipment and reaching for instruments and supplies
Neck and Shoulder Disorders

Examples
- Myofascial Pain Disorder
- Cervical Spondylolysis
- Thoracic Outlet Syndrome
- Rotator Cuff Tendinitis/Tears

Myofascial Pain Disorder
- Pain and tenderness in the neck, shoulder, arm muscles
- Painful trigger points—may twitch upon touch or massage
- Restricted range of motion
- Possible causes: overloaded neck/shoulder muscles
Neck and Shoulder Disorders

Cervical Spondylosis

- Intermittent/chronic neck and shoulder pain or stiffness
- Headache
- Hand and arm pain, numbness, tingling, clumsiness may occur
- Possible causes: age-related spinal disc degeneration leading to nerve compression and spinal cord damage; arthritis

Neck and Shoulder Disorders

Thoracic Outlet Syndrome

- Pain in the shoulder, arm or hand (can be all three)
- Numbness, tingling of fingers
- Muscle weakness/fatigue
- Cold arm or hand
- Possible causes: compressed nerves or blood vessels passing into arms; trauma; slouching forward or dropping shoulders
Neck and Shoulder Disorders

Rotator Cuff Tendinitis/ Tears

- Pain and stiffness in the shoulder associated with backward and upward arm movements
- Weakness of rotator cuff muscles
- Possible causes: swelling or tearing of rotator cuff soft tissue; shoulder joint bone spurs/abnormalities; poor shoulder posture

Hand and Wrist Disorders

- Risk factors associated with dentistry
  - Chronic repetitive movements of the hand and wrist
  - Abnormal or awkward positions of the wrist
  - Mechanical stresses to digital nerves such as sustained grasps on instrument handles
  - Forceful work
  - Extended use of vibratory instruments
  - Inadequate work breaks
**Hand and Wrist Disorders**

- **Examples**
  - DeQuervain’s Disease
  - Trigger Finger
  - Carpal Tunnel Syndrome
  - Guyon’s Syndrome
  - Cubital Tunnel Syndrome
  - Hand-Arm Vibration Syndrome
  - Raynaud’s Phenomenon

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**Hand and Wrist Disorders**

**DeQuervain’s Disease**

- Pain in thumb and wrist area when grasping, pinching, twisting
- Swelling in thumb area
- Decreased range of motion of thumb with pain
- Possible causes: synovial sheath swelling; thickening of tendons at base of thumb; repeated trauma or twisting hand/wrist motions
**Hand and Wrist Disorders**

**Trigger Finger (Tenosynovitis)**

- Pain during movement that place tendons in tension
- Warmth, swelling, tenderness of the tendon when palpated
- Possible causes: sustained, forceful powerful grip and/or repetitive motion

**Hand and Wrist Disorders**

**Carpal Tunnel Syndrome**

- Hand or finger numbness, pain, tingling, burning, clumsiness
- Eventual muscle weakness and atrophy
- Symptoms often worse with increased activity
- Pain or tingling that awakens the patient at night with relief via shaking/massaging the hand is considered a hallmark symptom for diagnosis
- Possible causes: compressed median nerve in wrist via trauma, forceful exertion, repetitive and awkward movements that deviate from near-neutral positions
Hand and Wrist Disorders

Carpal Tunnel Syndrome

- All hand pain does not mean carpal tunnel syndrome
- DHCP do not appear to be at greater risk compared to the general population for developing carpal tunnel syndrome


Hand and Wrist Disorders

Guyon’s Syndrome

- Pain, weakness, numbness, tingling, burning in the little finger and part of the ring finger
- Symptoms may worsen at night or early morning
- Possible causes: compressed ulnar nerve in Guyon’s canal at the base of the palm; repetitive wrist flexing; excessive pressure on palm/ base of hand
**Hand and Wrist Disorders**

### Cubital Tunnel Syndrome
- Pain, numbness, tingling and impaired sense of touch in the little and ring fingers, side and back of hand
- Loss of fine control
- Reduced grip strength
- Possible causes: compressed ulnar nerve in elbow due to trauma or repeated use; prolonged use of elbow while flexed

### Hand and Arm Vibration Syndrome
- Intermittent or chronic finger and hand numbness and blanching
- Reduced dexterity, grip strength, and sensation
- Greater sensitivity to cold
- Possible causes: vibrations may injure nerves leading to decreased blood flow and lower oxygen supply to surrounding tissues
Hand and Wrist Disorders
Raynaud’s Phenomenon

- Intermittent spasm of finger and toe blood vessels causing blanching, numbness, and pain
- Increased sensitivity to cold temperatures
- Possible causes: carpal tunnel syndrome, connective tissue diseases, repeated vibration or use of tools that vibrate

Back Disorders

- Risk factors associated with dentistry
  - Awkward posture
- Examples
  - Herniated Spinal Disc
  - Lower Back Pain
  - Sciatica
**Back Disorders**

**Herniated Spinal Disc**
- Back and leg numbness, tingling, pain, weakness
- Worsens with coughing, sneezing, sitting, driving, bending forward
- Possible causes: bulging or fragmenting of intervertebral discs into spinal canal compressing and irritating spinal nerves; excessive heavy lifting without adequate rest

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**Back Disorders**

**Lower Back Pain**
- Pain
- Stiffness in lower spine and surrounding tissues
- Possible causes: heavy lifting and forceful movements; whole body vibration; bending/ twisting; awkward static postures
Back Disorders

Sciatica

- Pain from lower back or hip radiating to the buttocks and legs
- Leg weakness, numbness, or tingling
- Possible causes: prolapsed intervertebral disc pressuring the sciatic nerve; worsened with prolonged sitting or excessive bending/ lifting

Treatment and Management of MSDs

- Obtain an accurate diagnosis from a qualified health-care provider
  - Early intervention is key
- Self-diagnosis is not recommended
  - MSD origins are complex with a broad range of symptoms
Treatment and Management of MSDs

- Diagnostic tests may include physical exams, provocative tests, and electromyography
- Treatment may range from pain-relief medications and rest to surgery, and ergonomic interventions both at work and home

What is Ergonomics?

“Ergo” means work
“Nomos” means natural laws or systems

- Ergonomics is the science of work
- Ergonomics is much broader than preventing work-related musculoskeletal disorders
- Ergonomics plays an important role in preventing injury and illness
What is Ergonomics?

- An applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely

"fitting the job task to the person performing the job"

Consequences of Poor Design

- Fatigue
- Discomfort
- Illness/Injury
- Absenteeism
- Errors
- Lower productivity
- Customer dissatisfaction
Ergonomic Design Goals

- Enhanced performance by eliminating unnecessary effort
- Reduce opportunities for overexertion injury
- Improve comfort by curtailing the development of fatigue

"fitting the job task to the person performing the job"

Goals

- Improved Productivity
- Safety
- Health
- Job Satisfaction

"fitting the job task to the person performing the job"
Dental Ergonomic Stressors

- Sustained/awkward postures
- Repetitive tasks
- Forceful hand exertions
- Vibrating operational devices
- Time pressure from a fixed schedule
- Coping with patient anxieties
- Precision required with work

Preventing Ergonomic Injuries

- Identify risk factors
- Educate DHCP about ergonomic hazards and preventing MSDs
- Identify symptoms as soon as they become apparent
- Intervene quickly
Preventing Ergonomic Injuries

- Change human behavior
- Consider ergonomic features for dental equipment (e.g., patient chairs, operator stools, hand/foot controls, instruments) when purchasing new equipment
- Modify working conditions to achieve optimal body posture
- Achieve optimum access, visibility, comfort, and control at all times

Workplace Intervention

- “Make the job fit the person” not vice versa
- Minimize extreme joint position
  - Keep wrist in neutral (i.e., straight) position
  - Keep joints held at midpoint of range of motion
- Reduce the use of excess force
- Reduce highly repetitive movement
Applying Ergonomics to Dentistry

Provide Sufficient Space

- Awkward bending, twisting, and reaching places stress on the musculoskeletal system and can lead to discomfort

Applying Ergonomics to Dentistry

Provide Sufficient Space

- Permanently place equipment used in every clinical procedure within comfortable reach (within 20 inches of the front of the body)
- Use mobile carts for less commonly used equipment
  - Allows convenient positioning when required
Applying Ergonomics to Dentistry
Provide Sufficient Space

- Provide a clear line of sight to the oral cavity and all required equipment
- Maintain a neutral, balanced position—position of an appendage when it is neither moved away from nor directed toward the body’s midline; it also should not be laterally turned or twisted

Applying Ergonomics to Dentistry
Accommodate Individual Preferences

- Individuals vary in size, shape, training, and experience
- Ensure equipment and work areas allow flexibility; examples may include:
  - Allows right- or left-handed use
  - Allows different working postures
  - Provides a choice in methods used
Applying Ergonomics to Dentistry

Reduce Physical Effort

- Avoid bent or unnatural postures
- Ideally, equipment should allow work in a relaxed and well-balanced position
  - DHCP should adjust equipment to the appropriate height
  - Position the patient to allow easy access from the desired position

- Use reasonable operating forces and minimal repetitions reduces overall physical effort required by a task
- Minimize sustained effort
  - Brief but frequent rest pauses can minimize fatigue and enhance productivity
  - Try to incorporate a variety of different activities to shift musculoskeletal demands from one part of the body to another
Applying Ergonomics to Dentistry

**Instrument Design**

- **Goal:** reduce force exertion; maintain hand/wrist in neutral position (no wrist bend)
- **Considerations**
  - Overall shape/size
  - Handle shape/size
  - Weight
  - Balance
  - Maneuverability
  - Ease of operation
  - Ease of maintenance

Applying Ergonomics to Dentistry

**Hand Instruments**

- When selecting instruments look for
  - Hollow or resin handles
  - Round, textured/ grooves, or compressible handles
  - Carbon-steel construction
  - Color-coding may make instrument identification easier
Applying Ergonomics to Dentistry

**Dental Handpieces**

- When selecting handpieces look for:
  - Lightweight, balanced models
  - Sufficient power
  - Built-in light sources
  - Angled vs. straight-shank
  - Pliable, lightweight hoses (extra length adds weight)
  - Swivel mechanisms
  - Easy activation
  - Easy maintenance

Applying Ergonomics to Dentistry

**Syringes and Dispenser**

- When selecting look for:
  - Adequate lumen size
  - Ease in cleaning
  - Textured/ grooved handles
  - Easy activation and placement
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**Lighting**

- Goal: produce even, shadow-free, color-corrected illumination concentrated on operating field
- Overhead light switch readily accessible
- Hand mirrors can be used to provide light intraorally
- Fiberoptics for handpieces add concentrated lighting to the operating field

**Magnification**

- Goal: improve neck posture; provide clearer vision
- When selecting magnification systems consider:
  - Working distance
  - Depth of field
  - Declination angle
  - Convergence angle
  - Magnification factor
  - Lighting needs
Applying Ergonomics to Dentistry

Operator Chair

- Goal: promote mobility and patient access; accommodate different body sizes
- Look for:
  - Stability
  - Lumbar support
  - Hands-free seat height adjustment
  - Fully adjustable

Patient Chair

- Goal: promote patient comfort; maximize patient access
- Look for:
  - Stability
  - Pivoting or drop-down arm rests (for patient ingress/egress)
  - Fully adjustable head rest
  - Hands-free operation
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**Posture/Positioning**

- **Goal:** avoid static and/or awkward positions
- **Potential strategies**
  - Position patient so that operator’s elbows are elevated no more than 30 degrees
  - Adjust patient chair when accessing different quadrants
  - Alternate between standing and sitting

**Work Practices**

- **Goal:** maintain neutral posture; reduce force requirements
- **Potential strategies**
  - Ensure instruments are sharpened, well-maintained
  - Use automatic handpieces instead of manual instruments wherever possible
  - Use full-arm strokes rather than wrist strokes
Applying Ergonomics to Dentistry

**Scheduling**

- Goal: provide sufficient recovery time to avoid muscular fatigue
- Potential strategies
  - Increase treatment time for more difficult patients
  - Alternate heavy and light calculus patients within a schedule
  - Vary procedures within the same appointment
  - Shorten patient’s recall interval

**Personal Protective Equipment**

- Glasses
  - Lightweight, clean, well-fitted
  - Magnifying lenses and head lamps are encouraged
- Clothing
  - Fit loosely, lightweight, pliable
Applying Ergonomics to Dentistry
Personal Protective Equipment

- Gloves
  - Be of proper size, lightweight, and pliable
  - Should fit hands and fingers snugly
  - Should not fit tightly across wrist/forearm

- Gloves
  - Ambidextrous (i.e., non-hand specific): exert more force than fitted gloves across palmar region of hand and may exacerbate symptoms of carpal tunnel syndrome
  - Hand-specific (i.e., right vs left) is recommended
    - Fit better
    - Place less force on hand
References

- Grant KA. Ergonomics: is it optional? PowerPoint presentation.