



# Upper Extremity Musculoskeletal Disorders in Dental Hygiene: Diagnosis and Options for Management

## Abstract

Dental hygienists can be debilitated by musculoskeletal disorders of the upper body. Symptoms range from occasional and mild to frequent and severe, and develop from a complex mix of health factors and physical activity issues. Resolution depends first on obtaining an accurate diagnosis, followed by

daily management derived from a solid understanding of the health-body-environment relationships involved. This article's goal is to educate and inform dental hygienists by promoting early intervention and treatment.

Dental hygienists often complain about pain in their hands, arms, neck, shoulders, and upper back. This proverbial pain in the neck" tends to follow—and interrupt—the demands and patterns of daily work. Clinically, these pains are known as upper extremity musculoskeletal disorders. These disorders are not the result of a single event, but develop over time from the chronic use of repetitive, forceful, and awkward movements or postures at work or at home.

Hygienists are not the only workers afflicted with musculoskeletal disorders; many occupations report workers with chronic musculoskeletal disorders and pain. The impact of the problem is significant. According to the Bureau of Labor Statistics, chronic musculoskeletal disorders represent over 60% of occupational disease.<sup>1</sup> A recent study noted that back pain and musculoskeletal pain accounted for over a third of lost productive time in workers afflicted with pain.<sup>2</sup> The cost of this lost productivity can be staggering, and is estimated to exceed \$60 billion per year.<sup>2</sup>

We may think that musculoskeletal disorders afflict modern workers, but this is hardly true. Bernardino Ramazzini, a 17th century physician and the founder of occupational medicine, wrote about "workers in whom certain morbid affections gradually arise from some particular posture of the limbs or unnatural movements of the body." He described "chair-workers" who "become bent, hump-backed, and hold their heads down," a description that easily matches dental hygiene today.<sup>3</sup>

In Ramazzini's *De Morbis Artificum Diatriba (Diseases of Workers)*, he characterized the diseases and work of countless occupations (including health care), firmly establishing the link between the work hazard and occupational injury. He also promoted worker education and awareness as an essential component of prevention.<sup>3</sup>

Unfortunately, modern medicine has yet to establish definitive diagnostic criteria for many

musculoskeletal disorders.<sup>4</sup> Overall, risk factors and activities associated with musculoskeletal disorders may be better documented than effective means of treatment and management because of a complex mix of risks, symptoms, and health factors related. Job demands and work environments that are not ergonomically sound can contribute to musculoskeletal disorders. A worker's physical and psychological health may impact development, treatment, and resolution of musculoskeletal disorders. Symptoms also vary widely, from mild and intermittent to severe and chronic. Consistent with Ramazzini's original goals, this article aims to educate dental hygiene professionals about the symptoms, risk factors, management, and potential prevention strategies for the most common upper extremity musculoskeletal disorders.

## Musculoskeletal Disorders Defined

Typical work-related musculoskeletal disorders encountered in dental hygiene affect the soft tissues of the upper extremities, including nerves, tendons, and muscles. These musculoskeletal disorders include tendonitis, carpal tunnel syndrome (CTS), De Quervain's disease, ulnar and radial nerve entrapment syndromes, and various shoulder, neck, and upper back injuries (Table 1). Symptoms may include pain, swelling, burning sensations, cramping, blanching, decreased range of motion, stiffness, muscle weakness, and sensory nerve disturbances like tingling and numbness.

The key to preventing musculoskeletal disorders is to understand potential risk factors (Table 2). Work- or activity-related risk factors associated with upper extremity musculoskeletal disorders include repetitive movement, forceful exertion, physical contact stress, poor posture, temperature extremes, and vibration (Table 2).<sup>5</sup> Many of these risk factors can be found in a dental hygienist's daily routine. Dental instruments may cause vibrational or contact stress in the hand or forearm.<sup>6</sup> Repetitive movement and awkward positions for

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prolonged time periods may create problems for the hands, forearms, shoulders, and necks of dental hygienists.<sup>7,8</sup>

A few studies have attempted to quantify the

## Learning Objectives

After reading this article, the reader should be able to:

- identify at least 5 upper extremity musculoskeletal disorders likely to affect dental professionals.
- discuss common health-related, work-related, recreational, and psychosocial risk factors for musculoskeletal disorders.
- describe the differences between carpal tunnel syndrome and tendinitis, as well as the frequency with which they occur in dental hygiene.
- identify key strategies for preventing and managing musculoskeletal disorders in dental hygiene.

muscle force required to sustain postures and movements in dentistry.<sup>6,7,9</sup> Because of the small numbers and diverse movements studied, no clear relationships have been established between activity, force, and injury. The limited research suggests that stress from vibration and poor hand posture may be low, but the load placed on arms, shoulders, backs, and necks during dental patient care may be high.<sup>6,7,9</sup>

Some individuals are at greater risk for the development of musculoskeletal disorders based on their personal health history. Female gender is a risk factor for the development of CTS, one of the most commonly reported musculoskeletal disorders, although the basis for this association is still unclear.<sup>5</sup> Localized physical trauma, tumors and cysts are associated with an increased risk of musculoskeletal disorders.<sup>5</sup> Conditions associated with increased inflammation or swelling, such as arthritis, gout, and autoimmune diseases increase worker risk for musculoskeletal disorders. In addition, diabetes, alcoholism, increased age, pregnancy, obesity, hormonal changes, and use of certain medications (over-the-counter, herbal, and prescription) can create further stress on the musculoskeletal system and increase the risk of musculoskeletal disorder development.

High-risk activities and movements also can occur outside of work and at home (Table 2). Recreational activities use similar muscles and movements as those used in meat-packing, construction, or agricultural work. Even the use of musical instruments can be repetitive and stressful. Therefore, it is important to evaluate the presence of activity-based risk factors in both environments.

Increased psychological stress has been associated with an increased risk of musculoskeletal disorders (Table 2).<sup>10,11</sup> This does not imply that these injuries are psychosomatic; instead, research suggests that the increased stress adds to the overall physiological burden to which the body is exposed. Environmental and psychological stress leads to a plethora of metabolic changes, so it is not surprising that these psychological factors are related to the frequency and reporting of occupational injury. They also may affect the rate of worker recovery.<sup>12</sup>

### **Carpal Tunnel Syndrome or Tendonitis?**

Of the various upper extremity

musculoskeletal disorders, CTS has been the most studied and reported on in the medical literature as well as the mass media. The syndrome is named for the tunnel-like passage created by the bones and connective tissues of the wrist.<sup>5</sup> Through this tunnel passes the median nerve, which provides sensation to the thumb, forefinger, middle finger, and

part of the fourth finger of the hand. When the tunnel is compressed from swelling or other processes, the median nerve is also compressed. Although the details are still unclear, this compression is thought to deprive the nerve of oxygen and other nutrients, leading to nerve dysfunction and, ultimately, nerve death.<sup>5</sup>

The typical symptoms of CTS include numbness, tingling, or pain in the area of the hand innervated by the median nerve. Usually, the palm-side surface of the thumb, index, and middle finger is affected. The symptoms are often worse at night, or with repetitive movement and activity.

Tendonitis usually involves the shoulder, elbow, wrist and/or hand.<sup>1</sup>

Circle x on Reader Service Card

**Table 1—Symptoms, Possible Causes, and Treatment Options for Common Musculoskeletal Disorders<sup>1-3</sup>**

DISORDER		SYMPTOMS	POSSIBLE CAUSES	TREATMENT OPTIONS
Hand	Carpal tunnel syndrome	Numbness, pain, tingling, clumsiness; reduced muscle/grip strength, dexterity; symptoms may be worse at night	Compressed median nerve in the wrist	Night splint; increased frequency of rest/breaks; change work patterns; use large-handled instruments; anti-inflammatory drugs, B <sub>6</sub> , diuretics; steroid treatment; surgical intervention as a last resort
Hand	Cubital tunnel syndrome	Pain, numbness, tingling in 4th and 5th fingers, the side and back of the hand; reduced dexterity and grip	Compressed ulnar nerve in the elbow	Avoid extreme elbow flexion and extension; ergonomic intervention; physical therapy; surgical intervention as a last resort
Hand	De Quervain's disease	Pain around thumb with grasping, pinching, twisting; swelling of the thumb area; decreased and painful thumb motion	Swelling/thickening of the tendons at base of thumb	Thumb spica wrist splint; hand rest; physical therapy; NSAIDs*; steroid injection; surgical intervention
Hand & Arm	Tenosynovitis	Pain, stiffness, swelling at the wrist, shoulder, elbow, hand, or finger joints; painful gripping or grasping; difficulty straightening	Swelling/thickening of tendons and related structures	Worksite ergonomic interventions; NSAIDs; minimize aggravating movements; physical therapy; steroid injections, surgical intervention as a last resort
Arm	Epicondylitis	Pain or tenderness on either side of the elbow; pain increases during activities	Tearing of the tendons from overuse of the forearm muscles	Worksite ergonomic interventions; NSAIDs; physical therapy; acupuncture; steroid injections; surgical intervention as a last resort
Arm	Radial tunnel syndrome	Dull aching pain below the elbow and on outside upper forearm; may be worse at night; may include hand pain	Compressed radial nerve	Worksite ergonomic interventions; NSAIDs; steroid injections; surgical intervention as a last resort
Shoulder	Rotator cuff problems	Pain, stiffness in shoulder with backward and upward arm movements; weakness of the rotator cuff muscles	Swelling or tearing of rotator cuff soft tissue; shoulder joint bone spurs or abnormalities	Worksite ergonomic interventions; NSAIDs; steroid injections; surgical intervention as a last resort
Shoulder	Thoracic outlet syndrome	Pain in the shoulder, arm and/or hand; numbness and tingling of fingers; muscle weakness and fatigue; cold arm or hand	Compressed nerves or blood supply passing to the arms	Worksite ergonomic interventions—avoid working with hands above chest; Avoid surgery due to high rate of complications
Hand Arm Shoulder	Tendonitis	Localized and/or diffuse pain; loss of strength and motion	Irritation and inflammation of tendons	NSAIDs; minimize aggravating movements; physical therapy, massage; steroid injections; surgical intervention as a last resort
Neck Back	Myofascial pain syndrome	Pain in neck, shoulder and arm; painful "trigger points"; restricted range of motion	Overloaded neck and shoulder muscles	Mechanical, thermal, and chemical (eg, botulinum toxin) treatments to reduce pain and restore muscle function; muscle strengthening and stretching

\*NSAIDs=nonsteroidal anti-inflammatory drugs, such as aspirin or ibuprofen.

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Individuals often complain of pain that is reproduced with palpating the tendon or by activating the muscle that attaches to the tendon. Common types of tendonitis include rotator cuff strain (shoulder), lateral and medial epicondylitis (elbow), and De Quervain's tenosynovitis (wrist).

However, many symptoms of CTS and tendonitis are similar, if not identical (Table 1).

The best diagnosis of CTS is based on history and symptoms, with tests of nerve functionality used to confirm an injury to the median nerve.<sup>13</sup> Median nerve function is assessed by

measuring its ability to conduct a signal as it passes through the wrist, which is then compared with that of the ulnar nerve in the hand, which passes outside the carpal tunnel.<sup>13</sup> If the median nerve conducts a signal disproportionately slow, it is considered damaged, a condition known as

*median mononeuropathy*. A clinical diagnosis of CTS requires the presence of both hand pain or tingling and median mononeuropathy.

As a result of these distinctions, many workers complain of hand pain and tingling, but few are simultaneously diagnosed with median mononeuropathy. In addition, not everyone with median mononeuropathy has clinical symptoms of CTS.<sup>14,15</sup> Whether these individuals will later develop CTS is still debated.<sup>14,16</sup>

Survey-based studies conducted over the last 20 years found that 7% to 12% of dental hygienists reported symptoms consistent with CTS.<sup>17-21</sup> Because few studies included confirming nerve conduction tests, the true prevalence of CTS in dental hygiene was not well defined. We (Werner, Hamann, and colleagues) recently screened over 300 dental hygienists for the presence of CTS and tendonitis.<sup>22</sup> Screening included median nerve conduction testing for CTS, physical exams for tendonitis, and health history questionnaires covering musculoskeletal disorder-related symptoms, and work-related risk factors.

We found that 39% of the participating dental hygienists reported painful symptoms such as hand/finger cramping, aching, burning, numbness, or tingling.<sup>22</sup> Nearly 10% of participating dental hygienists were diagnosed with median mononeuropathy, but only 3% were clinically diagnosed with it. This percentage is similar to that found in the general population, as well as in dentists.<sup>17,23</sup>

We continued to monitor the occurrence of CTS in dental hygienists for an additional 2 years (Table 3, unpublished data). Hand pain was reported in well over a third of the participating dental hygiene professionals, but on average, only 3.3% were diagnosed with CTS during the 3-year study.

More importantly, 23% of dental hygienists who participated in the first year of the study were diagnosed with tendonitis, over half of which were accounted for by shoulder tendonitis.<sup>22</sup> This frequency of tendonitis is comparable to that of industrial workers and is twice as high as clerical workers.<sup>24</sup> Although few dental hygienists lift objects weighing more than a few ounces, they may generate high contact stress and increase muscle tension and loading with bent postures during dental procedures.<sup>7,22</sup>

Although this was a relatively small cross-sectional study, it would suggest that tendonitis is potentially far more common and relevant in dental hygiene than CTS. Overall, the data emphasized the need for changes in work patterns and improved implementation of ergonomic strategies in dental hygiene.

### Musculoskeletal Disorder Management

It is essential to obtain an accurate diagnosis from a qualified physician—recurrent or persistent symptoms of pain, numbness, tingling, or loss of control should be evaluated by your health care provider. Because of the complex origins of musculoskeletal disorders and the broad range of symptoms expressed, self-diagnosis and treatment is not advised. Moreover, continued abuse can make the condition worse.

A clinical diagnosis should be made based on your symptoms, test results, medical history, and work-related risk factors. Testing may include physical exams, provocative tests (such as Phalen's, Tinel's, and Finkelstein's), x-rays, magnetic resonance imaging, ultrasound, and electrodiagnostic testing (electromyography). Unfortunately, for many musculoskeletal disorders, definitive clear-cut criteria for diagnosing musculoskeletal disorders have not yet been established.<sup>4</sup> Therefore, an experienced physician is needed to correctly assign a diagnosis. Occupational medicine or physical rehabilitation specialists are most likely to be familiar with the current consensus on diagnostic and treatment strategies.

Early recognition of the symptoms of musculoskeletal disorders and education about work-related risk factors are invaluable for optimal recovery. When recognized early, most musculoskeletal disorders can be treated successfully with conservative (non-surgical) approaches. Personal health conditions and activities outside the workplace also can contribute to recovery or exacerbate symptoms. Therefore, these issues should be assessed with workplace factors in preventing and managing musculoskeletal disorders. Implementing the key elements described below can help prevent and manage existing musculoskeletal disorders:

- Use ergonomically correct body posture at work and at home.
- Modify the duration, frequency, and/or intensity of movement dur-

ing all activities.

- Exercise and stretch daily.
  - Redesign work environments to be appropriately proportioned.
  - Use correctly adjusted, sized, cushioned, or weighted tools and equipment.
  - Adjust work schedules and manage time effectively.
- Consider your body posture when

moving, standing, or sitting; have someone photograph or videotape you working. Most modern ergonomic guidelines stress the importance of varied movement as well as "correct" posture. Extreme or static (rigid) body postures are associated with an increased risk of neck, shoulder, and back musculoskeletal disorders. Dental hygienists should

aim for neutral (natural, normal, and unstressed) and relaxed wrist, hand, arm, and back postures, avoiding extreme or awkward positions as much as possible.

For example, to help reduce static postural strains, dental workers can alternately sit, stand, and move around a patient, or change the patient's body or head position.

Wider cushions around patients' heads may also help support hygienists' wrists and hands. Ergonomically designed and appropriately adjusted chairs may also reduce postural strain. To reduce pressure on the spine while seated, dental hygienists can sit upright with their hip angle between 90 degrees (back straight) and 130 degrees (leaning slightly backward). Leaning forward should be avoided because it creates strain on the lower back. When turning, hygienists should rotate their entire bodies not just the upper extremities. When using the phone at work or at home, hygienists can use a hands-free headset to help reduce neck and shoulder strain and improve neck posture.

Varying your movements is equally important; changing the speed, force, or direction of a task also may reduce hand and arm fatigue. Other alternatives include rotating sides or quadrants during patient treatment, changing your grip on an instrument, using external fulcrums, changing movement patterns (rotating vs up and down) and allowing yourself more time to complete patient care.

Dental work environments (and home environments) include laboratories or kitchens, and desks or counter spaces. These areas can be very differently configured depending on the task, their intended function, and individual requirements or preferences. Workstations should be modified or designed so that hygienists can maintain correct postures, avoid awkward angles and positions, reduce contact stress, and minimize the number of repetitive movements by:

1. adjusting chair or stool heights for patient procedures or counter-top work.
2. adding arm supports to chairs.
3. moving all tools and equipment within easy reach of patient treatment.
4. removing obstructions to countertops and knee spaces.
5. relocating electrical cords, extension cords, or tubing that interfere with worker movements.
6. using rubber floor mats while standing.
7. adjusting computer monitors and keyboards to an appropriate and comfortable position.
8. adding magnification and auxil-

iary lighting to better visualize work and the treatment field.

Specialized tools and equipment are required for many dental procedures such as scaling and root planing. To better manage or prevent musculoskeletal disorders, select lighter, well-balanced instruments with thicker, larger handles and textured or cushioned grips to reduce the force needed in dental procedures. Vary the shank diameter of the instruments used to change the grip force. Choose instruments with longer cords, tubing, and attachments to provide greater mobility, flexibility, and decreased resistance during use. Minimize the vibration generated by some tools (eg, handpieces, lathes, and ultrasonic cleaners) to reduce hand and arm symptoms. Appropriately sized and fitted (right/left-handed) gloves also may reduce fatigue and tension across the wrist, thumb, and palm. Also, wearing gloves with textured fingers can reduce instrument slipping and may reduce the pinch pressure required for fine control. Modify procedures to reduce the repetitive force and pressure exerted when using tools

and equipment.

Exercise and fitness is an important element of overall health and prevention of musculoskeletal disorders. Research has shown that increased stress can have negative physiological consequences, possibly increasing the risk of injury or impeding recovery.<sup>11,12</sup> Include a routine and balanced fitness regimen and stress reduction programs or techniques such as massage, yoga, and physical therapy. Muscle stretching can be effective in reducing muscle fatigue and painful symptoms. Morning warm-ups and taking regular breaks to stretch the hands, arms, neck, and shoulders can relieve symptoms and reduce stress. Regular exercise and self-care programs also help manage stress levels and improve psychological perspective. Before you undertake a new exercise program or significantly modify your existing regimen, however, be sure to check with your physician—particularly if you have an existing musculoskeletal disorder.

To reduce the risk of musculoskeletal disorders, dental hygienists also can explore modifying patient and personal scheduling by:

- developing a regular pattern of stretching and relaxation breaks during the day.
- alternating intense or lengthy procedures with less rigorous ones.
- reducing the number of daily strenuous procedures.
- breaking up treatment time with lab work.
- reducing total work hours.
- increasing the amount of relaxation time.
- improving time management at home and at work, thereby improving efficiency and yielding more relaxation time.

Management strategies should focus on modifying personal habits and ergonomic factors at work and home and recommended treatments ranging from rest and pain-relieving medication to surgery (Table 1). Common conservative treatments include physical therapy, ultrasonic stimulation, massage, exercise, stretching and acupuncture. For example, CTS treatment includes the use of a nighttime wrist splint as a common intervention to promote neutral wrist positioning during rest, decreasing pressure on the median nerve. Other potential therapies

include vitamin supplements, nonsteroidal anti-inflammatory drugs, and diuretics. If conservative measures are unsuccessful, steroids may be injected to reduce inflammation and pain. Surgery for musculoskeletal disorders should be reserved only for those individuals whose symptoms do not respond to conservative therapies and for conditions where surgery has already been successfully used.

### Conclusion

The potential for developing certain musculoskeletal disorders in dental hygiene may be similar to that of industrial workers. Dental hygienists should be proactive by adopting good ergonomic practices. Recognizing symptoms early permits successful treatment with conservative strategies, including a slower pace of work-related or recreational activities, and the reduced use of ergonomic stressors (instruments, gloves, etc.) and awkward hand, arm, and neck postures.

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- Who is considered the founder of occupational medicine?
  - Halstead
  - Ramazzini
  - Harvey
  - Semmelweis
- Typical work-related musculoskeletal disorders encountered in dental hygiene include:
  - tendonitis.
  - carpal tunnel syndrome.
  - De Quervain's disease.
  - all of the above
- Some individuals are at great risk for the development of musculoskeletal disorders based on their personal health history, including:
  - female gender.
  - localized physical trauma, tumors, and cysts.
  - obesity.
  - all of the above
- Research suggests that increased psychological stress adds to:
  - hyperimmune syndrome.
  - overall physiological burden.
  - increased periodontal pocketing.
  - decreased periodontal pocketing.
- Chemically activated systems require up to:
  - two 30 to 60 minute applications.
  - three 15 to 20 minute applications.
  - four 20 to 45 minute applications.
  - five 10 to 15 minute applications.
- Median mononeuropathy occurs when:
  - the median nerve conducts a signal disproportionately slow.
  - the ulnar nerve is not functioning appropriately.
  - an individual has ulnar tunnel syndrome because the median nerve is damaged.
  - lymphatic drainage of the median and ulnar nerve is increased.
- Werner and colleagues found that 39% of participating dental hygienists reported pain symptoms such as hand/finger cramping, aching, burning, numbness, or tingling. However, only \_\_\_\_\_% were clinically diagnosed with carpal tunnel syndrome—pain and median mononeuropathy.
  - 10%
  - 3%
  - 15%
  - 23%
- Diagnostic testing for musculoskeletal disorders may include:
  - physical exams.
  - x-ray and/or magnetic resonance imaging.
  - electrodiagnostic testing.
  - all of the above
- Implementing which of the following key elements can help prevent and manage musculoskeletal disorders?
  - Use ergonomically correct body posture at work and at home.
  - Modify the duration, frequency, and/or intensity of movement during all activities.
  - Exercise and stretch daily.
  - all of the above
- What treatment for musculoskeletal disorders should be reserved only for those individuals whose symptoms do not respond to conservative therapies?
  - steroid treatment
  - surgery
  - electrostimulation
  - splints or braces

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- Clarity of objectives . . . . .  3  2  1
- Usefulness of the content . . . . .  3  2  1
- Benefit to your clinical practice . . . . .  3  2  1
- Usefulness of the references . . . . .  3  2  1
- Quality of the written presentation . . . . .  3  2  1
- Quality of the illustrations . . . . .  3  2  1
- Clarity of review questions . . . . .  3  2  1
- Relevance of review questions . . . . .  3  2  1

- Did the lessons achieve their educational objectives?  Yes  No
- Did the articles present new information?  Yes  No
- How much time did it take you to complete the CE? \_\_\_\_\_ min

#### PRACTICE INFORMATION

- Full-time registered Hygienist  Dental Asst.  Part-time registered Hygienist

DEADLINE FOR SUBMISSION OF ANSWERS IS 12 MONTHS AFTER THE DATE OF PUBLICATION.