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CLINICAL CARE UPDATE

TECHNIQUE ADDRESSES COMPUTER-RELATED RSI

This is the first part of a two-part article.

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In 1996, the U.S. Bureau of Labor Statistics reported that repetitive strain injury (RSI) had become the nation's leading work-related illness, accounting for nearly two-thirds of all workers' compensation claims, many of them associated with computer use.

While educational programs, medical intervention and physical therapy programs have helped reduce – and in many cases eliminate – computer-related RSIs, the incident rate still continues to rise. Why? Because we do not address the heart of the matter: How we type.

In my practice, Sports and Occupation Medical Associates, Cupertino, CA, we responded to the needs of Silicon Valley employers and their employees by developing a mouse and keyboard training program called MouseKeyDo.™ The program features a new method for using the mouse and keyboard that takes into consideration the body in motion relative to the computer workstation. We have found that computer users who employ certain techniques simultaneously reduce, or even eliminate, their pain while increasing their endurance and lowering their risk of injury.

Understanding the Problem

The first step in keyboard and mouse retraining is to identify faulty and awkward movements made at the computer. They include:

Finger flexion, extension and abduction: These are the primary sources of stress and discomfort at the keyboard. By using a fixed point of reference, such as the home key row, or resting the wrist or elbows on a surface, the typist keeps the forearm, upper arm and shoulder static, leaving fingers to do all the work.

Wrist extension (dorsiflexion): Poor keyboard and/or mouse placement are among the causes of wrist extension. The position of hands in a "waiting" mode and the way fingers curl at the keyboard also contribute to dorsiflexion.

Twisting at the wrist (ulnar deviation): Associated movements include use of the enter key, backspace, shift keys, CTRL/ALT key combinations, the tab key, and orientation to the home row of keys.

Thumb extension: There are several causes for isolated and over-extended movements of the thumbs: use of the space bar, typing with excessive force, reaching for keys either by flexing or extending fingers, and wrist extension at greater than a 20º angle.

Mouse Movements: Regardless of the style of mouse in use, red flags include fingers that leave the mouse button, fingers that "wait" in the air, excessive grip force, dorsiflexion, maneuvering with the fingers, ulnar and radial deviation, lifting the mouse, and reaching for the mouse by extending the arm and shoulder away from the body.

Successful retraining and injury prevention also depends on an understanding of common computer-related injuries and their associated movements. Twelve of the most common conditions are listed below, with corresponding corrective actions taken from the MouseKeyDo™ training manual.

Myofascial neck pain: This condition usually occurs at the base of the neck and above and/or between the scapulae. Symptoms include neck pain, headaches, difficulty sleeping, and numbing in the upper extremities. Associated movements include poor posture, neck flexion, and far reaching with the arms. Possible causes may include poor placement of the keyboard and/or mouse, poor placement of the computer monitor, and poor vision or the use of bifocals.

Guidelines: Unsupported sitting. Sit balanced with 75% of weight over ischial tuberosities and 25% weight transferred to the feet and thighs for support. Neck flexion less than 15º with axis of rotation at mastoid. Utilize coordinated movements of the upper limb and torso.

Shoulder impingement/bursitis/tendonitis: Inflammation of the muscle tendons and/or the bursae between these muscles and the acromion is usually caused by extreme repetitive reaching in flexion or abduction of the arm at the shoulder joint. Symptoms include shoulder pain, weakness of the arm and shoulder, and inability to lift the arm above shoulder height. Associated movements include reaching overhead and arm extension. Possible causes include poor keyboard and/or mouse placement, arm rests too high, and overhead reaching for materials.

Guidelines: Shoulder abduction less than 20º from the body. Shoulder flexion less than 25º forward from the body. Upper arm swings as a clock pendulum.

Lateral epicondylitis: The muscle tendons attached to the lateral epicondyle are involved in extension of the wrist and fingers, as well as hand supination. Symptoms include pain and tenderness over the lateral epicondyle, and pain/fatigue over the extensor wad. Associated movements include dorsiflexion and ulnar de-

viation at the wrist, extension and flexion of fingers, and excessive lifting and dropping of the fingers. Possible causes include excessive typing force, use of home row and shift/enter/backspace keys, resting on wrist rest while typing, and excessive mouse grip force.

Guidelines: Avoid repetitive finger and wrist extension, supination, and prolonged isometric grip. Elbow angle 60-70º flexed from full extension; wrist angle, 5-10º extension; finger MCP/PIP joint, 45º flexion; thumb pad faces index finger.

Medial epicondylitis: Fatigue and/or tearing of the muscle tendons attached to the medial epicondyle involves flexion of the wrist and fingers, and pronation of the arm. Symptoms include pain and tenderness over the medial epicondyle and radiating pain along the palm side of the forearm. Associated movements include dorsiflexion of the wrist, over-curling of the fingers, and fixation of the fingers. Possible causes include excessive typing force, resting on the wrist, use of home row, and excessive mouse grip force.

Guidelines: Avoid repetitive finger and wrist flexion, pronation, and prolonged isometric grip. Utilize a light grip and minimize fingertip force.

DeQuervain's Tenosynovitis: This condition involves swelling of the abductor pollicis longus and abductor pollicis brevis as a result of excessive repetitive frictional and tractional force placed on tendon units. The tendon becomes pinched within its sheath, making thumb movements painful and limited. Symptoms include thumb pain, wrist pain on the thumb side, stiffness and achiness over the thumb and thumb side of the wrist, and numbing over the back of the hand. Associated movements include dorsiflexion and ulnar deviation at the wrists, and abduction of the thumb. Possible causes include resting the wrist while typing, excessive typing force (especially on the space bar), use of home row and shift/enter/backspace keys, and excessive mouse grip.

Guidelines: Avoid repetitive ulnar deviation, pinch grip, and extension and abduction of thumbs.

Stenosing tenosynovitis: Also know as trigger finger, the affected tendon swells and cannot slide through its tendon sheath, most commonly occurring in the thumb, middle or ring fingers. The tendon may become thickened near the joint pulley. Symptoms include pain along the affected finger(s) on the palm side, finger stiffness, and snapping and/or locking of the finger. This condition is associated with excessive finger flexion. Possible causes include excessive typing force, use of home row, using the wrist rest while typing, and excessive mouse grip.

Guidelines: Avoid repetitive finger flexion.

Ganglion cysts: These fluid-filled lumps that generally appear on the wrist originate from the wrist joint capsule or tendon sheath, making movements of the hand, wrist or fingers difficult and painful. Associated movements include repetitive wrist extension and flexion, and repetitive finger extension and flexion. Possible causes include resting on the wrist while typing and using home row.

Guidelines: Avoid extreme wrist angles (ulnar and radial deviation, extension, and flexion).

Thoracic outlet syndrome: Compression of the nerves and/or arteries and veins in the region of the neck and shoulder produces a variety of symptoms including neck pain; shoulder pain; pain in the upper chest; numbing and tingling along the hand and arm; pain in the fingers, hand and arm; and weakness, swelling or coolness in the hand and arm. Associated movements include poor posture, neck flexion, and far reach. Possible causes include poor key placement, arm rests and/or or work surfaces that are that are too low or too high, and cradling the telephone between neck and shoulder while typing.

Guidelines: Unsupported sitting. Sit balanced with 75% of weight over ischial tuberosities and 25% weight transferred to the feet and thighs for support. Neck flexion less than 15º; shoulder abduction less than 20º; shoulder flexion less than 25º. Utilize coordinated movements of the upper limb and torso.

Cubital tunnel syndrome (ulnar nerve entrapment): The ulnar nerve is susceptible to compression at the elbow. Symptoms of nerve entrapment include elbow and/or shoulder pain, pain in the hand and forearm, wrist pain, numbness in the back of the hand, and numbing and tingling in the ring and little fingers. Associated movements include dorsiflexion or ulnar deviation at the wrist, over-curling the fingers, and elbow angle at greater than 90º. Possible causes include elbow pressure (leaning on the arm rest), extreme abduction of shoulder, using home row and shift/enter/backspace keys, and striking multiple keys with the same hand.

Guidelines: Elbow flexion less than or equal to 70-80º from full extension; shoulder abduction less than 20º; minimize FCU contraction and wrist ulnar deviation. No direct pressure over the cubital tunnel.

Carpal tunnel syndrome (median nerve entrapment): Nine flexor tendons and the median nerve pass through the carpal tunnel. Problems may occur when too much pressure is placed on the nerve, causing compression. Symptoms include numbing and tingling in the thumb, index, middle and ring fingers, or in all four fingers at once; grip weakness; radiating pain up the arm and into the shoulder; symptomatic pain in the wrist and fingers at night. Associated movements include finger flexion and extreme dorsiflexion or ulnar deviation at the wrist, greater than 20º. Possible causes include resting the wrist while typing; striking keys with excessive force; using home row, shift/enter and backspace keys; striking multiple keys with the same hand, and excessive mouse grip force.

Guidelines: Maintain wrist angle range within 20º from neutral for wrist extension, radial and ulnar deviation; 30º for wrist flexion; finger MCP/DIP joint, 45º angle. Minimize pinch grip and fingertip pressure. Encourage brief and intermittent active flexion and extension movements of the wrists and fingers.

Radial Nerve Entrapment and Superficial Radial Nerve Entrapment: The posterior interosseous (radial) nerve innervates the muscles in the forearm. The radial nerve's superficial sensory branch provides sensation to three-fourths of the back of the hand on the thumb side. Pain in the back of the fingers, hand and elbow is a symptom of nerve entrapment. Numbness, tingling and/or pain on the back of the hand over the thumb area are symptoms of superficial radial nerve entrapment. Movements associated with radial nerve entrapment include extension and abduction of the thumb, extension at the CMP joints, dorsiflexion at the wrist, ulnar deviation at the wrist, and repeated supination of the arm. Movements associated with superficial entrapment include supination of the arm and hyper-pronation of the forearm. Possible causes of radial nerve entrapment include resting on the wrist, using the shift/enter/backspace keys, and striking multiple keys with the same hand. Possible causes of superficial radial nerve entrapment include resting the wrist while typing and excessive mouse grip.

Guidelines: Avoid repetitive finger and wrist extension and supination, as well as pronation and supination of the forearm.

Carpometacarpal joint arthritis: Inflammation of the joint space at the base of the thumb can progress to a degenerative state over time. Symptoms include pain and swelling at the base of the thumb. Associated movements include dorsiflexion and ulnar deviation at the wrist, abduction of the thumb, and axial compression of the thumb. Possible causes include resting the wrist while typing, excessive typing force and grip on mouse, and using home row and shift/enter/backspace keys.

Guidelines: Avoid repetitive ulnar deviation, pinch grip, and extension and abduction of the thumb.

Summary

Once one learns how to touch type, it seems that little thought is given to the actual act of typing. While typing movement may feel familiar and comfortable, there is a strong likelihood the user is at risk for developing computer-related RSI.

For practitioners involved in the prevention and treatment of computer-related RSI, it is helpful to first make the patient aware of what their hands are doing and how they feel while typing. One way to accomplish this is through an exercise in which the computer user's awareness of tension and other sensations in the hands is heightened.

For example, computer users may be advised to imagine that they are sitting in a chair at the computer with their arms hanging at their sides. The objective is for users to notice the soft quality of their muscles, the natural curve of their fingers, and the alignment of their wrists when they are relaxed. It should be relatively easy for them to quickly flutter their fingers.

In contrast, when computer users are advised to curl their fingers in toward their palms (the "claw" position), they should feel increased tension when wiggling their fingers. Users also should try moving their fingers while bending back their wrists with their palms facing the floor. It is precisely these kinds of movements that can be correlated to computer-related RSI.

Although movements vary, most individuals type with their fingers curling, reaching, and moving at extreme ranges of motion that can cause excessive tension and strain. The MouseKeyDo™ training program provides computer users with ergonomic guidelines and techniques to help them establish a safe workstation and good work habits. These include:

- proper placement of the keyboard, mouse, computer monitor, chair, arms, and wrist rests;
- using a new "home row" orientation and spotting
- keys as "coordinates;"
- using upper limbs, rather than fingers, wrists or arms alone when typing;
- ensuring correct posture and balance;
- learning how to rest the hands when not typing;
- maneuvering the mouse with ease and comfort.

When performed appropriately and consistently, certain techniques help prevent and reduce pain associated with improper keyboard and mouse use, improve overall keyboard function and safety, and increase productivity and endurance during the work day. These will be discussed in the second part of this article.

Norman J. Kahan, M.D., director of Sports and Occupation Medical Associates, Cupertino, CA, is board certified by the American Academy of Physical Medicine and Rehabilitation. Dr. Kahan will speak on mouse and keyboard training techniques at the American Occupational Health Conference, April 17 in Chicago. For more information, contact Dr. Kahan at njkahan@yahoo.com, or call 408-725-7277.

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