Repetitive Strain Injury (Cumulative Trauma Disorder):

Causes and Treatment

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Abstract

Background: The computerization of the workforce in the last two decades has led to increases in the incidence of repetitive strain injury (RSI). U.S. Workers' Compensation claims made by persons disabled in the upper extremities in 1989 were estimated to be $563 million.

Method: Through an investigation of factors that increase the likelihood of contracting an RSI in various industries, the authors suggest a relation between workplace conditions, lack of education about causes of RSI and improper use of equipment among contemporary workers.

Results: A medical term which analyzes the unique history and mechanism of the injury and offers a unique regimen of exercise, education, modalities and some pain management has proven to be the most effective treatment for RSI. Damage to muscle and tendon due to RSI generally cannot be surgically repaired. However, specific nerve-related disorders can be treated with surgery if other more conservative treatments prove ineffective.

Conclusion: Through foresight and education, industries in which specific factors render workers more likely to contract RSI can begin to take steps to minimize worker susceptibility to the disorder. Those industries will face large losses due to Workers' Compensation claims, disability pay, lawsuits and ultimately lower productivity. **Key Words:** Repetitive strain injury, cumulative trauma disorder.

Repetitive strain injuries (RSI) are defined as cumulative trauma disorders (CTD) resulting from prolonged repetitive, forceful or awkward movements. These movements result in damage to the muscles, tendons and nerves. RSIs are referred to as repetitive stress injuries, CTDs, repetitive motion disorders, occupational overuse injuries and work-related musculoskeletal disorders. RSIs also can refer to well-defined disorders such as carpal tunnel syndrome (CTS) and tendinitis; or to clinically less well-defined conditions such as tension neck syndrome.

An increasing number of RSIs has occurred during the past two decades. These inquiries now account for more than 50% of all workers' compensation claims, at a cost of about $20 billion a year. The Bureau of Labor Statistics estimates that more than 332,000 cases of disorders were caused by repeated trauma in 1994 (1). From 1984–1994, the incidence rate of these disorders increased from 5.1 to 39 cases per 10,000 full-time workers. These increases may be related to the rapid computerization of the American work force and the rapid increase in industries in which data entry jobs predominate. In 1984, fewer than 25% of workers used computers on their jobs; however, by 1994, more than 47% of workers used computers.

In the workplace, upper extremity RSIs outnumber lower extremity injuries. In 1989, the total U.S. Workers' Compensation costs for upper-extremity CTDs was estimated to be $563 million (2).

The prevalence of neck symptoms, including pain, stiffness and discomfort, affects 10–20% of the adult population annually (3–7). Tension neck syndrome is defined as pain, fatigue and stiffness in the neck muscles. The prevalence of tension neck syndrome ranges from 5% in slaughterhouse workers to 80% of office workers and 100% of film-rolling workers (8). Several studies

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have shown that workers in forceful, repetitive, hand-intensive jobs requiring static neck muscle contraction have a higher prevalence of neck RSIs than workers with less forceful, repetitive jobs (9–12). Other studies revealed that there was an association with an increase in the percent of time typing at video display terminal (VDT) keyboards and the prevalence of neck symptoms (13–14).

Spine-related problems occur with greater frequencies in professions that require lifting and repetitive activity. The prevalence of cervical spondylosis ranges from 14% in dentists, carriers and miners to 84% in meat carriers (8). The annual incidence of cervical syndrome (cervical disk disease) is 5.5 per 100,000 (15). An increased risk of cervical herniated disks is seen with frequent lifting and operating vibrating equipment (16). A significantly increased odds ratio is also seen in slaughterhouse workers, scissor makers and civil servants (8).

Allander (3) reported prevalences of painful shoulder ranging from less than 10% to more than 20%, depending on the age group. Workers exposed to inclement temperatures, such as meat carriers, are consistently more likely to develop shoulder tendinitis. Risk factors most strongly associated with shoulder tendinitis include working at or above shoulder height, heavy lifting and carrying loads supported by the shoulder, maintaining static postures and using implements that cause hand-arm vibration (8). A strong association with shoulder tendinitis is also seen with repetitive movements. Odds ratio ranged from 2.2–10 for studies of heavy lifting and repeated loading of the shoulders in letter carriers (11) and construction workers (17). There was a 1% prevalence seen in sign language interpreters (18) and 31% in sewing machine operators (7).

The prevalence of thoracic outlet syndrome, due to repetitive elevation of upper extremities overhead and/or forward posturing of shoulders, ranges from 1% in slaughterhouse workers to 32% in cash register operators and 44% in assembly line workers (8).

The prevalence of rotator cuff tendinitis ranges from 1% in data entry operators to 69% of industrial workers who work at shoulder level (8).

There are relatively few studies which have looked at the prevalence of epicondylitis in the work place. Current medical research relates this condition to occupations which require overexertion of the finger and wrist extensors while the elbow is in extension. Workers considered at high risk includes garment workers (19), construction workers (20), meat processors (21) and grocery checkers (22).

A review of European literature by Spaans (23) revealed an association between ulnar neuropathy and occupational activities of brass workers, crystal grinders, diamond cutters, enamelers, glass cutters, gold beaters, rollers, telephonists, locksmiths, mechanics, plumbers, stonecutters, and joiners (23). An association was seen in chess players (24), telephonists (25) and clerical occupations (26).

There is consistent evidence from many studies which reveals an association of repetitive hand motions, forceful manual exertions and hand-arm vibration with CTS and hand-wrist tendinitis (27–32). The prevalence of CTS ranged from 0.6% to 61% depending on the occupational group studied (17, 19, 33–36). Studies have revealed odds ratios for CTS and certain jobs range from 1–34 (grocery checkers, such as supermarket checkout cashiers) (37–39). Evidence also suggests that the presence of two or more risk factors can have a highly synergistic effect; e.g., workers who perform repetitive and forceful activities have higher rates of hand-wrist disorders than those who perform either repetitive or forceful activities alone (34–36).

The 1989 National Institute for Occupational Safety and Health Review revealed that only 9 out of 52 cross-sectional studies reported a prevalence rate lower than 20% among workers exposed to hand-arm vibration (40). Odds ratio of greater than 5 was frequently reported for workers exposed to inclement conditions as well as hand-arm vibration (41). Incidence in lumberjacks was 30.6% (42). There is substantial evidence linking the intensity and duration of exposure to vibrating tools, and the risk of developing hand-arm vibration syndrome (43–46).

A common misconception is that RSI is synonymous with CTS. However, in the computer workforce, CTS is found less frequently than deQuervain's tenosynovitis. According to the National Institute of Occupational Safety and Health's study of RSI at US West Communications, 15% of all employees had tendon-related disorders, but only 1% had CTS.

Therapeutic Management

In the treatment of patients with RSI, a team approach is used at Mount Sinai. The team consists of the doctor, occupational and physical therapists, ergonomist and the RSI support group. The goals of management of patients with RSI are: (1) patient education, (2) reduction of pain, (3) home exercise program, and (4) lifestyle

changes. Patients are educated about their specific condition and the mechanism that contributes to the injury. Reduction of pain is achieved by several techniques, including modalities such as ice packs and self-monitoring of posture and body alignment. These will be discussed later in this article. The patient is taught how to avoid positions which may exacerbate pain, and to correct body mechanics for performing activities. All patients are instructed in a home exercise program individually tailored to their diagnosis. Home exercise program increases the patients' awareness of their body and enables them to avoid continued injury. It is effective in reducing pain and treatment time in the therapy. An aerobic exercise program is also tailored to their specific medical conditions. In addition, the patient is educated about ways to improve lifestyle so as to prevent further injury. Adequate rest and recovery are necessary to prevent further inflammation.

Another goal is to learn how to perform work activities while supporting a healing process and preventing a recurrence of the injury. This is done with patient education, task analysis, trials of positioning strategies, equipment trials, work behavior and technique retraining, simulation of work activities, and generation of complete specifications and resources. Various equipment is tried, such as split keyboards (fixed and flexible) and track balls of different shapes and sizes. Computer access can be achieved with alternative input devices such as voice recognition and the use of other body parts.

Furthermore, the patient's expectations and goals are established. Dialogue between worker and employer is encouraged in order to set realistic goals. The patient agrees to comply with a plan that is satisfactory and realistic, and a reasonable recommendation is given to the employer.

A comprehensive evaluation is done to document the patient's condition and to plan the appropriate treatment. This evaluation includes past and present medical illnesses; physical activity levels; daily routines and hobbies; a thorough work history with special attention as to when symptoms appeared, and a history of any trauma. Level of pain is documented with pain scales and diagrams. This evaluation enables the patient to discuss his or her pain in an objective manner and allow comparison before, during and after treatment.

A physical exam, which includes range of motion of joints, soft tissue palpation, manual muscle testing, sensory screens, and evaluations of sitting and standing postures are performed. Specific tests for presenting conditions are used to verify diagnosis or objectively document patients' symptoms. For example, to test for tendinitis, the tendons are tested in both lengthened and shortened positions, such as by reaching for the floor and/or ceiling.

A work station assessment is an essential component of treatment of the individual with RSI. An assessment of how the individual performs in the work environment can reveal factors contributing to the injury. Patients are asked to bring photographs or videotapes of themselves while performing duties at their work station, for evaluation. The patient also completes a work sheet of the dimensions of the work space. Positions of pain and of comfort are identified. The majority of patients participating in the Mount Sinai Medical Center assistive technology work station assessment program are office workers who had become injured while using computers. A list of tasks and job description is correlated with short- and long-term vocational goals. This includes identifying the computer tasks, as well as those tasks that support the computer work such as paper management, writing, reading and telephone correspondence.

The acute phase of the RSI is characterized by inflammation and pain with activity, and occasionally, pain at rest. The goal is to decrease edema, reduce pain and educate the patient in proper body mechanics to deter further injury. The patient is educated about his symptoms and the management of his symptoms, the healing process and activity modification. Positioning during sleep is also evaluated and modified, if needed.

Splints may be used to immobilize the involved body part(s) in a position of rest, thus allowing the healing process to occur. If the injury is acute, splints are worn at all times except for periods of exercise and self care. As the pain decreases, the time the splint is worn during pain-free intervals is decreased and functional use of the involved extremity is encouraged. The type of splinting material used varies from thermoplastic to soft, flexible splints. Thermoplastic materials are rigid and used in the acute phase to provide immobilization. Flexible splints are used with patients who are recovering and have a decreasing amount of pain.

Modalities such as heat- and cold-packs are used to decrease pain and edema. Electrical modalities such as transcutaneous electrical nerve stimulation may also decrease pain. Galvanic stimulation and iontophoresis are used to decrease edema and inflammation. Moist heat increases circulation to specific areas and reduces joint stiffness. Ultrasound is used to heat deep muscle groups and large joints.

Additionally, manual techniques are used to reduce edema, decrease myofascial pain, restore normal range of motion and decrease muscle spasm. The patient can be instructed in gentle mas-

sage techniques to reduce pain, and range of motion and stretching exercises to assist in improving posture and alignment. Patients are encouraged to take short breaks of about 1–10 minutes, 3–4 times each work day to perform these exercises.

In the chronic phase of RSI, the emphasis of treatment is on education regarding management of symptoms, exercises to increase cardiovascular fitness, and strengthening exercises for proximal and postural muscles. Work and lifestyle changes are encouraged to promote healing throughout the treatment. Patient education continues with instructions on activity modification to prevent overuse and reinjury. Activities are analyzed and simulated in the clinic to determine which ones exacerbate injury. An aerobic exercise program is recommended to improve cardiovascular fitness. Patients are gradually started on a program of aerobic exercise, beginning with a 10 minute regimen. As fitness improves, they are encouraged to gradually increase to 20–30 minutes three times a week, as tolerated.

Medications are used to reduce the pain and inflammation associated with RSI. Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly prescribed for the pain and inflammation caused by RSI. Commonly prescribed NSAIDs include ibuprofen and fenoprofen. More potent and less commonly prescribed NSAIDs are butazolidin, indocin and voltaren. Since side effects can be serious, especially for people over 40. Aspirin and acetaminophen are also used to treat the pain of RSI. Narcotic analgesics are rarely required and should never be continued beyond the first two weeks.

Injections of cortisone are used to treat RSI, but they should be used sparingly, if at all. They are helpful in reducing local pain and inflammation, but can cause tendons to rupture. Cortisone also can be applied in other ways, such as in creams and sprays. It also can be applied via phonophoresis (ultrasound) or iontophoresis (low voltage and low amperage), which allows the cortisone to penetrate through the skin into the soft tissue to reduce inflammation. Trigger point injections with anesthetic have been advocated by some physicians, yet clinical trials demonstrating their efficacy are lacking.

In most cases of RSI, the damage to the muscle and tendon cannot be surgically repaired. However, there are surgical procedures for certain RSI diagnoses (e.g., CTS, Dupuytren's contracture, deQuervain's disease and ulnar nerve entrapment). Surgery is sometimes necessary to preserve nerve function, and when conservative treatments fail.

In an effort to promote their ability to cope with their temporary or potentially life-changing injuries, the patients are referred to the Mount Sinai Medical Center RSI support group, which includes social workers. In addition, they are referred to clinical psychologists.

Conclusion

RSI affects a large percentage of the workforce. People develop RSI because they do not know how to or are unable to protect their muscles, tendons and nerves. The workstation may not be set up properly; they may have never been trained to use their hands properly, or they may be unable to pace themselves. To reverse the damage of RSI, the patients and their work environment need to change; the process begins in rehabilitation therapy. Patients are taught how to pace themselves in order to allow their muscles, tendons and nerves to rest. Pain-induced immobility is replaced by gentle stretching and strengthening exercises. Deep tissue massage breaks down scar tissue built up with overuse. Retraining stops the cycle of reinjury. Therapists can use several techniques to assist in recovery, which include workstation assessment and modification, posture and positioning modifications, exercise programs, patient education, splinting and modalities. Medical management includes pain and anti-inflammatory medications.

With planning and foresight, RSI can be prevented. People who can control their environment and the pace of their work can protect themselves. When there is no control of the pace of one's work, environment or workstation, negotiations with one's employer about safe working conditions must occur. By redesigning jobs, educating the work force about RSI, investing in ergonomic equipment and training employees how to use it can prevent RSI from occurring. However, if factors which contribute to RSI are ignored, industries will face large losses due to Workers' Compensation claims, disability pay, lawsuits and ultimately, lower productivity.

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