Repetitive strain injury

Sultan T. Al-Otaibi, *MBBS, FRCPC.*

ABSTRACT

Repetitive strain injury is a group of musculoskeletal disorders affecting muscles, tendons, nerves and blood vessels. These disorders could be attributed to occupational causes; however non-occupational causes should be excluded. The management of these cases required a multidisciplinary team approach.

Keywords: Repetitive, injury, occupation.

Saudi Med J 2001; Vol. 22 (5): 398-402

Work-related musculoskeletal disorders are referred to as repetitive strain injuries (RSI) in Canada, cumulative trauma disorders (CTD) in America, cervico-brachial syndrome in Japan and Scandinavia. In other countries it is also known as occupational overuse syndrome, regional musculoskeletal disorder and repetitive motion disorders.[1-4] Unfortunately, there is no agreement on the definition of this condition. RSI and CTD are not a diagnosis but a statement of causation and causation only.[1] When job demands repeatedly exceed the biomechanical capacity of the worker, the activities become trauma inducing.[5-8] RSI consists of a variety of musculoskeletal disorders involving muscles, tendons, nerves and blood vessels that is caused, precipitated, or aggravated by repeated exertion or movements of the body. It generally affects the neck, upper limbs and back, but lower limbs may also be involved.[1,9-13] In the USA, it is estimated that RSI accounted for 65% of all occupational illnesses in 1998. These disorders are compensated in most countries, such as the USA, Canada, UK, etc. For example, the cost of compensation for RSI in the USA exceeds $20 billion per year.[14] RSI is common in industries such as meat processing, motor vehicles, pottery, construction and clerical work.[1,8,15-16] Careful and thorough review of the Saudi literature did not indicate any cases of RSI, which is most likely due to lack of recognition and reporting of these disorders. Furthermore, RSI is not a compensated occupational illness in Saudi Arabia.[17]

Risk factors. If two or more risk factors are present, the risk of RSI increased. However, some investigators are still skeptical about the role of occupation in RSI.[4,5,8]

Occupational risk factors for repetitive stain injury include: Ergonomic factors. In an excellent review and analysis of 54 epidemiological studies, Stock[18] concluded that specific disorders of tendon and tendon sheath together with CTS are causally related to repetitive forceful work. Therefore, the greater the force exerted, the greater risk of developing RSI. In addition, jobs that require repeated motion patterns or prolonged posture within a work cycle, or both, may be repetitive. Furthermore, mechanical stresses (forceful gripping of tools and small diameter handles can produce localized pressure on the underlying tendon and muscles), static and awkward posture (such as excessive shoulder elevation, extreme elbow posture and deviated wrist posture). Local vibration has been reported as a risk factor for RSI. Vibration may cause the worker to use excessive force to hold the vibrating tool and consequently may increase the risk of RSI. Extreme temperatures have also been reported as risk factor for RSI by different investigators.[9-12,20-25]

Psychosocial factors. Psychosocial factors can range from personality factors to the way in which work is organized, and therefore include excessive

From the Department of Medicine, Dhahran Health Centre, Dhahran, Kingdom of Saudi Arabia.

Address correspondence and reprint request to: Dr. Sultan Al-Otaibi, Saudi Aramco, PO Box 11606, Dhahran 31311, Kingdom of Saudi Arabia. Tel. +966 (3) 877 8916 Fax. +966 (3) 877 8841. Email: Otaibist@aramco.com.sa

work rate, duration of work, paced work, monotonous work, limited job control, and low social support. The psychological factors may operate indirectly by altering muscle tension or other physiological processes, thus influencing the perception of pain. Furthermore, elevated urinary catecholamines and stress have been reported in workers with RSI. It may evolve into chronic pain syndrome, and tends to occur more frequently in a work environment where there is little support from coworkers and supervisors.[26-36]

Non-occupational factors. Non-occupational factors[1,4,13,16,19,20] include personal risk factors such as age and gender.[6,37-39] The risk of RSI increases with age and is more common in women because of their smaller frame, lower muscle mass and strength, and due to endocrine influences. It is also related to the difference in the type of work to which men and women are assigned. Furthermore, smoking, sports injuries, strength (mismatch between physical strength and job task), anthropometery (obesity associated with CTS and disc herniation), recreational activities (that require forceful repetitive activities e.g., finger typing in computer work), and coexisting medical conditions (such as rheumatoid arthritis, pregnancy, etc.) are all risk factors for RSI. Some investigators have proposed the size of the carpal canal as a risk factor for CTS.

Pathophysiology of repetitive strain injury. RSI is believed to result from repeated force on soft tissue over a prolonged period. This kind of trauma causes micro-tears to the affected part, hence leading to inflammation and subsequently to the disorder. Furthermore, reduced blood flow to muscle due to tension, and the inflammatory effects from the breakdown of synovial fluid has been proposed by some investigators.[4,8]

Diagnosis. The main characteristic of many cases of RSI is the lack of any objective clinical sign of abnormality. Evaluation of patients with RSI begins with a thorough medical and work history followed by a detailed physical examination. Non-occupational cause of RSI must be excluded. The history should include the patient's age, dominant hand, symptoms (location, radiation, duration, evolution and exacerbating factors), previous illnesses or injuries and their treatments (e.g., fracture, collagen vascular diseases, rheumatoid arthritis, hormonal agents, oophorectomy, diabetes mellitus and pregnancy), and medications taken. RSI may occur as a result of sports and recreational activities, therefore physicians must ask about these activities during the patient interview. Detailed occupational history is required that includes previous and current jobs, onset of symptoms in relation to work task, pace, position and environment. If possible, a visit to the workplace for a walk-through survey in order to become familiar with the demands of the job and to get an idea of how other workers tolerate these demands. Most busy clinicians refer the workplace assessment to occupational health professionals.[1,3] For upper extremity complaints, the examination should begin with the neck and then proceed distally to include the shoulder, arm, elbow, wrist, and hand on both sides. Physical examination should involve inspection, palpation, assessment of range of movement, evaluation of peripheral nerve function and appropriate provocative maneuvers of the upper extremity such as Tinel's and Phalen's tests.[1,4,8,40] The most difficult aspect in diagnosing RSI is determining the relative contribution of occupational factors to the etiology of the disorder. However, the association of these occupational musculoskeletal disorders to workplace exposure can be established if based on three steps:[1,4,18] 1. Determination as to whether or not the patient has a specific disorder; 2. Positive evidence of workplace exposure to a specific occupational risk factor; 3. Consideration of non occupational causes.

Carpal Tunnel Syndrome.[22,40-43] Carpal Tunnel Syndrome is the most common compressive neuropathy associated with repetitive trauma. CTS results from compression of the median nerve as it traverses the carpal tunnel in the wrist. The patient complains of intermittent numbness and paresthesia, which may awaken him or her at night in the first three and a half radial digits, and has trouble holding onto objects with decreased hand strength. When pain is the primary complaint, the likelihood of a diagnosis of CTS decreases. On physical examination of the wrist in cases of suspected CTS, a Tinel's sign (sensitivity 60% and specificity 67%) and Phalen's test (sensitivity 75% and specificity of 47%) are helpful. Inspection for hand muscle atrophy in CTS is recommended. The objective gold standard for CTS is a nerve conduction study (electromyography), a false-negative electro-myography (EMG) test result ranges from 5% to 27% depending on the method used and the normal values selected by the laboratory. It is known that nerve conduction abnormalities do not occur until later in many cases of CTS. Test of grip strength, sensory testing for two point discrimination, studies of vibratory threshold, and Semmes Weinstein testing (for light touch) are complementary to nerve conduction studies, but are not diagnostic. Other causes of CTS, such as pregnancy, menopause, rheumatoid arthritis, gout, diabetes mellitus, hypothyroidism, wrist fracture, cirrhosis of the liver, hand-arm vibration syndrome, masses compressing median nerve at the wrist (such as hematoma, ganglion and osteophytes), and non-occupational activities (sport and leisure) should be ruled out.[1,5,8] Of patients with work-related CTS, 25% have accompanying conditions such as ulnar neuropathy at

the wrist, trigger finger, De Quervain's tenosynovitis, or arthritis of the basal joint of the thumb.[8,13]

Other nerve entrapment syndromes.[1,5,6,15,16] The ulnar nerve may become entrapped at the elbow (cubital tunnel syndrome) or at wrist (Guyon tunnel syndrome). This is caused by external mechanical pressure when individuals rest their elbow on a hard surface. At the wrist, it results from prolonged flexion and extension of the wrist or repeated pressure on the hypothenar eminence. It is less common than CTS. Patients complain of numbness and pain in the ring and little fingers, and pain in the hypothenar area. Patients have positive Tinel's sign over the ulnar nerve (which may be misleading as it is positive in thin people), and finger clawing may be present. The diagnosis is confirmed by nerve conduction study.

Radial nerve. The radial nerve may be injured at its bifurcation to the posterior interosseus nerve as it passes under the fibrous edge of the extensor carpi radialis and supinator muscle. Patients complain of numbness and tingling in the distribution of the superficial radial nerve. The diagnosis is confirmed by nerve conduction study.

Tendon-related disorders.[3,6,9,15,16] Chronic tendenitis and tenosynovitis of the upper extremity are common types of RSI. If the patient presents with localized pain on active or passive motion of the tendon sheath, a diagnosis of tenosynovitis can be made. For example, patients with De Quervain's tenosynovitis (inflammation occurs in the abductor pollicis longis and extensor pollicis brevis tendons of the thumb where they share common sheath) can be diagnosed using the Finkkelstein's test. In cases of trigger finger tenosynovitis, patients complain of snapping, locking or propping of the involved digit as a result of tenosynovitis of the flexor tendons of the digits. Pain, mainly at PIP joints, is also a frequent complaint. The diagnosis is made by history, and tenderness over the affected digit. Several specific tendon sites are more susceptible to RSI. These include medial and lateral epicondylitis, shoulder tendonitis (rotator cuff syndrome and bicipital tendinitis) and acromioclavicular joint synovitis. The diagnosis of these conditions is made from the history, localized tenderness and restricted motion of the joint on physical examination. Other disorders thought to be associated with RSI include ganglion, neck tension syndrome, trapezius myalgia and thoracic outlet syndrome. Some authors classify hand-arm vibration syndrome under RSI.

Management. Symptomatic relief to reduce soft tissue inflammation is provided by rest. Resting the symptomatic part of the upper extremity for at least 2 weeks is the most important part of the treatment program. This can be achieved by minimizing exposure to risk factors in the workplace. In addition to engineering control, restricted duties, job rotation and temporary job transfer may be effective. The benefit of rest has been linked to the seasonal nature of RSI, where the number of reported RSI cases has been found to drop in July and August, which are the peak vacation months in the northern hemisphere. Splints and other immobilization devices are helpful in resting the symptomatic part of upper extremity. However, prolonged immobilization and resting should be discouraged to avoid muscular atrophy. Splints should not be worn at work unless the worker's job does not require bending or deviation of the splinted part. On the other hand, splints are effective in relieving symptoms when away from the workplace, particularly during sleep.

Physical therapy is also useful to restore normal joint motion and reconditioning of the affected muscle after periods of rest and reduced use. Application of cold compresses is useful to induce vasoconstriction and hence reduce inflammation of the affected part and relieve pain. The use of anti-inflammatory medications is helpful to reduce inflammation in RSI. Steroid injections are also helpful to reduce tendon attrition, but no more than three injections should be given at any site. If patients show no improvement with conservative treatment, surgical treatment can be helpful. Surgical decompression of carpal tunnel in cases of CTS usually relieves a significant amount of pain, although the numbness may persist. Surgical intervention may be ineffective if patients return to their previous job without any effort made to minimize occupational exposure.[44-49]

Frequent follow up is desirable for repetitive strain injury. Many of these conditions will resolve within a few weeks with early treatment. The prognosis of RSI is generally good with early treatment and reduction in job exposure. A small minority of cases can become chronic and very difficult to treat. In such cases, the physical capabilities of the patient, work demands and psychosocial factors are all important in determining whether he or she can successfully return to work.[50] Physicians should also be alert to the potential for secondary gain by the patient. It is recognized that psychosocial factors, such as job satisfaction or patient negative self-belief, the support of the employer and healthcare provider, are important, but one should not ignore the role of occupational exposure. Educational programs are also used as a treatment and prevention strategy for workers with RSI of the upper extremity. There are three levels of preventive strategies that can be applied to minimize the incidence of RSI:[51-52] A. Primary prevention, through ergonomic intervention, work practice, rest breaks, health education, and administrative measures. Pre-employment screening is not recommended and may constitute discriminatory action. B. Secondary prevention, to minimize the

development of impairment through early detection and treatment C. Tertiary prevention, through rehabilitation and disability management to prevent recurrence of RSI.

In summary, there is strong evidence that occupational risk factors are linked to the causation of RSI. The management of these disorders needs a multidisciplinary team approach involving the participation of occupational physicians, neurologists, orthopedic surgeons, neurosurgeons, physiotherapists, occupational therapists, kinesiologists and ergonomists to provide patient treatment, rehabilitation and education.

References

1. Yassi A. Repetitive strain injury. Lancet 1997; 349: 943-947.
2. Stock SR, Cole DC, Tugwell P, Striener D. Review of applicability of existing functional status measures to the study of workers with musculoskeletal disorders of the neck and upper limb. Am J Ind Med 1996; 29: 679-688.
3. Nainzadeh N, Malantic-Lin A, Alvarez M, Loeser AC. Repetitive strain injury (cumulative trauma disorder): causes and treatment. Mt Sinai J Med 1999; 66: 192-196.
4. Gun RT, Jezukaitis PT. RSI: A perspective from its birthplace. Occup Med 1999; 14: 81-95.
5. Chatterjee DS. Repetition strain injury – a recent review. J Soc Occup Med 1987; 37: 100-105.
6. Guidotti TL. Occupational repetitive strain injury. Am Fam Phys 1992; 45: 585-592.
7. Yassi A, Sprout J, Tate R. Upper limb repetitive injuries in Manitoba. Am J Ind Med 1996; 30: 461-472.
8. Ranney D. Work-related chronic injuries of the forearm and hand: their specific diagnosis and management. Ergonomics 1993; 36: 871-880.
9. Diwaker HN, Stothard J. What do doctors mean by tenosynovitits and repetitive strain injury? Occup Med 1995; 45: 97-104.
10. Polanyi MF, Cole DC, Beaton DE, Chung J, Wells R, Abdolell M. Upper limb work-related musculoskeletal disorders among newspaper employees: cross-sectional survey results. Am J Ind Med 1997; 32: 620-628.
11. Quintner J. The RSI syndrome in historical perspective. International Disability Studies 1991; 13: 99-104.
12. Miller MH, Topliss DJ. Chronic upper limb pain syndrome (repetitive strain injury) in the Australian workforce: A systematic cross sectional rheumatological study of 229 patients. Journal of Rheumatology 1988; 15: 1705-1712.
13. Higgs PE and Young VL. Cumulative trauma disorders. Clinics in Plastic Surgery 1996; 23: 421-33.
14. Bureau of Labor Statistics. Occupational injuries and illnesses in the United States by industry, 1998. Washington DC: US Department of Labor.
15. Gerr F, Letz R, Landrigan PJ. Upper extremity musculoskeletal disorders of occupational origin. Annu Rev Public Health 1991; 12: 543-566.
16. Rempel DM, Harrison RJ, Barnhart S. Work-related cumulative trauma disorders of the upper extremity. JAMA 1992; 267: 838-842.
17. General Organization for Social Insurance, Riyadh. Regulation for rules and procedures for implementation of the occupational hazards branch and implementing decisions. 1st Ed. Kingdom of Saudi Arabia: 1404 H. – 1984 G.
18. Stock SR. Workplace ergonomic factors and the development of musculoskeletal disorders of the neck and upper limbs: a meta-analysis. Am J Ind Med 1991; 19: 87-107.
19. Williams R, Westmorland M. Occupational cumulative trauma disorder of the upper extremity. Am J Occup therapy 1994; 48: 411-420.
20. Vender M, Kasdan M, Truppa K. Upper extremity disorders: a literature review to determine work-relatedness. Journal of Hand Surgery 1995 (American Volume); 20: 534-541.
21. Silverstein BA, Fine LJ, Armstrong TJ. Hand wrist cumulative trauma disorders in industry. Br J Ind Med 1986; 43: 779-784.
22. Silverstein BA, Fine LJ, Armstrong TJ. Occupational factors and carpal tunnel syndrome. Am J Ind 1987; 11: 343-358.
23. Cherniack MG. Epidemiology of occupational disorders of the upper extremity. Occup Med 1996; 11: 513-530.
24. Wells R, Moore A, Potvin, Norman R. Assessment of risk factors for development of work related musculoskeletal disorders (RSI). Applied Ergonomics 1994; 25: 157-164.
25. Greening J, Lynn B. Vibration sense in the upper limb in patients with repetitive strain injury and a group of at risk office workers. International Archives of Occupational and Environmental Health 1998; 71: 29-34.
26. Faucett J, Rempel D. VDT-related musculoskeletal symptoms: interactions between work posture and psychosocial factors. Am J Ind Med 1994; 26: 597-612.
27. Rosa RR, Bonnet MH Cole LL. Work schedule and task factors in upper extremity fatigue. Hum Factors 1998; 40: 150-158.
28. Brogmus GE, Sorock GS, Webster BS. Recent trends in work-related cumulative trauma disorders of the upper extremities in the United States: an evaluation of possible reasons. J Occup Environ Med 1996; 38: 401-411.
29. Strasser PB, Lusk SL, Franzblau A, Armstrong TJ. Perceived psychological stress and upper extremity cumulative disorders. AAOHN J 1999; 47: 23-30.
30. Marcus M, Gerr F. Upper extremity musculoskeletal symptoms among female office workers: associations with video display terminal use and occupational psychosocial stressors. Am J Ind Med 1996; 29: 161-70.
31. Ireland DC. Psychological and physical aspects of occupational arm pain. Journal of Hand Surgery 1988; 13: 5-10.
32. Bernard B, Sauter S, Fine L, Peterson M, Hales T. Job task and psychosocial risk factors for work-related musculoskeletal disorders among newspapers employees. Scand J Work Environ Health 1994; 20: 417-426.
33. Bongers PM, de Winter CR, Kompier MA, Hildebrandt VH. Psychosocial factors at work and musculoskeletal disease. Scand J Work Environ Health 1993; 19: 297-312.
34. Ryan GA, Bampton M. Comparison of data process operators with and without upper limb symptoms. Community Health Studies 1988; 12: 63-68.
35. Smith MJ, Cohen BG, Stammerjohn LW. An investigation of health complaints and job stress in video display operations. Hum Factors 1981; 23: 387-400.
36. Leino PI, Hanninen V. Psychosocial factors at work in relation to back and limb disorders. Scand J Work Environ Health 1995; 21: 134-142.
37. Ashbury F. Occupational repetitive strain injuries and gender in Ontario 1986 to 1991. J Occup Environ Med 1995; 37: 479-485.
38. Helme RD, LeVasseur SA, Gibson SJ. RSI revisited: evidence for psychological and physiological differences from an age, sex and occupation matched control group. Aust NZ J Med 1992; 22: 23-29.
39. Baxter J, Lynch-Blosse M, Western J. Gender differences in work satisfaction. Aust J Soc Issues 1991; 31: 291-309.
40. Katz JN, Larson MG, Fossel AH, Liang MH. Validation of a surveillance case definition of carpal tunnel syndrome. Am J Public Health 1991; 81: 189-193.
41. Silverstein BA, Fine LJ, Armstrong TJ. Occupational factors and carpal tunnel syndrome. Am J Ind Med 1987; 11: 343-358.

42. Katz JN, Larson MG, Sabra A, Krarup C, Stirrat CR, Sethi R, et al. The carpal tunnel syndrome: diagnostic utility of the history and physical examination findings. Ann Int Med 1990: 112: 321-327.
43. Delgrosso I, Boillat MA. Carpal tunnel Syndrome: role of occupation. Int Arch Occup Environ Health 1991; 63: 267-270.
44. Melhorn JM. The impact of workplace screening on the occurrence of cumulative trauma disorders and workers' compensation claims. J Occup Environ Med 1999; 41: 84-92.
45. Kilbom A. Intervention programs for work-related neck and upper limb disorders: strategies and evaluation. Ergonomics 1988; 31: 735-747.
46. Melhorn JM, Wilkinson L, Gardner P, Horst WD, Silkey B. An outcomes study of an occupational medicine intervention program for the reduction of musculo-skeletal disorders and cumulative disorders in the workplace. J Occup Environ Med 1999; 41: 833-846.
47. Fildes PG. RSI can be curable. The use of psychotherapy and hypnosis. A personal viewpoint. Aust Fam Physician 1988; 17: 84-88.
48. Sikorski JM. The orthopedic basis for repetitive strain injury. Aust Fam Physician 1988; 17: 81-83.
49. Cook J. Work related repetitive movement problems. A successful management plan. Aust Fam Physician 1988; 17: 104-105.
50. Cole DC, Hudak PL. Prognosis of nonspecific work-related musculoskeletal disorders of the neck and upper extremity. Am J Ind Med 1996; 29: 657-668.
51. Stien SA, Haselkorn JK, Peters DJ, Goldstein B. Rehabilitation intervention for patients with upper extremity dysfunction: challenges of outcome evaluation. Am J Ind Med 1996; 29: 590-601.
52. Fisher TF. Preventing upper extremity cumulative trauma disorders. An approach to wellness. AAOHN J 1998; 46: 296-301.