Chapter 5.7 : Occupational therapy and ergonomy

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THE ROLE OF THE OCCUPATIONAL THERAPIST & ERGONOMY

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Introduction

Of all soft tissue complaints, occupational therapists treat soft tissue disorders of the upper limb most frequently, and in particular those considered to be Work Related Upper Limb Disorders (WRULDS). This is therefore the main focus of this chapter. There is considerable debate about the aetiology of upper limb pain and whether this is related to frequent repetitive movements of the upper limb (which can occur occupationally as well as in other daily activities) or at the other extreme is a localised form of a fibromyalgia type syndrome of multiple aetiology. A recent population based study of working individuals with forearm pain identified a multifactorial aetiology for forearm pain (McFarlane et al, 2000) (Table One).

Table One: Factors implicated in occupational forearm pain

Mechanical factors: repetitive movements of the artns and wrists; lifting and carrying weights
Work related psychosocial factors (poor levels of satisfaction with support from supervisors and colleagues primarily, as well as rarely being able to make one's own decisions)
Presence of other painful areas (eg shoulder, back pain or widespread pain)
Illness behaviour

Different upper limb disorders can varyingly be attributed to physiological, mechanical, psychosocial and/ or environmental factors. Rehabilitation should therefore be within a biopsychosocial model - assessing the individual's problems holistically and addressing all these potentially contributory factors.

LEVEL A –

Definitions

As will be discussed, occupational therapy focuses on *rehabilitation* of the individual with a disability or illness back, within their normal environment(s), to maximum independence in activities of daily living, leisure and work.

The Occupational Therapist assesses the physical, psychological and social functions of the individual, identifies areas of dysfunction and involves the individual in a structured programme of activity to overcome disability. The activities selected will relate to the consumer's personal, social, cultural and economic needs and will reflect the environmental factors which govern his/ her life (College of Occupational Therapists, 1994).

There is a growing interface between the two professions of occupational therapy and ergonomy, with common ground in "health care ergonomics" (Berg Rice 1998), to maximise preventative and rehabilitative strategies to reduce both the occurrence and severity of soft tissue disorders. Increasingly, occupational therapists specialising in hand therapy have undertaken postgraduate training in ergonomics and are able to combine the approaches of the two professions in assessment and treatment.

Ergonomy

Ergonomics *(ergon = work, nomos =* law: also called *human factors engineering)* is the study of work performance. "Human factors (ergonomics) is a body of knowledge about human abilities, human limitations and other human characteristics that are relevant to design. Human factors engineering (ergonomics implementation) is the application of human factors information to the design of tools, systems, tasks, jobs and environments for safe, comfortable and effective human use" (Chapanis 1991). It is concerned with humans' interactions with their environments, which can include psychological and social factors affecting work performance within organisations, as well as physical factors (such as vibration, climate - indoor and outdoor, lighting, noise and the effects of contaminants), and organisational factors (such as shift work, workloads, management styles, accidents, safety, motivation and alienation). Good ergonomic design optimises the relationship between the person and their environment and so works preventatively (Table Two). Ergonomists are increasingly becoming involved in the modification and design of equipment, buildings, vehicles and systems for people with disabilities and the elderly, to enhance quality of life and potential for independent living (Nickerson, 1992).

Table Two: Ergonomic concerns

Design of work stations, seating, person-machine interfaces (displays and controls), tools and products to fit the normal anthropometric dimensions for the population under consideration, as well as for the range of normal visual, auditory, cognitive and other physical abilities. **Design** of instructional manuals, signs and warning systems. **Evaluation** of the work postures, muscle activity and speed of work required in specific work tasks, to assess whether they are within normal human work capacity **Evaluation** of the working environment and organisation to identify stress factors. **Design** of tasks, equipment and systems to meet Health and Safety legislation **Identification** of actual and potential hazards in the workplace and conduction of risk or safety assessments.

Level A

Approaches used in Occupational Therapy and Ergonomy

Level B

Occupational Therapy approaches

Treatment is implemented using appropriate frames of reference, the *biomechanical and rehabilitative* being the most commonly used in the treatment of soft tissue disorders. The biomechanical frame of reference is applied to improve active and passive range of movement, strength, stability, and endurance through the use of graded physical activity. The rehabilitative frame of reference is applied during both the treatment stage to facilitate independence and when the individual is making no further gains in physical ability, to maximise independence through adapted activity, assistive equipment or physical assistance. A cognitive behavioural approach may also be used to assist people to cope with pain and to alter behaviour patterns (both physical and psychosocial) which may be precipitating and exacerbating the conditions.

Occupational Therapists involved in the treatment of soft tissue disorders will apply these principles during assessment and treatment. Occupational therapy intervention is centred on the individual's roles, occupations and activities to enable the individual to become a confident performer in his/her daily life (Hagedorn 1997). Interventions are focused on maximising abilities in work, recreational pursuits, self-care and domestic activities, and psychosocial status. They also focus on modifying tasks and the person's environment in relation to their abilities and enabling the person to interact successfully in their sociocultural environment.

The patient forms a partnership with the therapist and intervention is jointly directed (Hagedorn 1997). Occupational therapists may apply a variety of client centred models of Occupational Therapy (OT) in their assessment and treatment. The primary aim is to help the person gain their highest functional level, i.e. to maximise their occupational performance, to their satisfaction. Strategies can include: education, modification of occupation(s) and environment(s), exploration of alternative tasks/ life roles, provision of aids and equipment and management / supervision of others completing difficult occupations. Treatment programmes are graded and dependent on the individual, the nature of the disorder, the treatment being carried out by other professions, the priorities identified by the individual, and the facilities within the department. Interventions include everyday activities (simulation of activities of daily living, work and leisure appropriate to the individual), purposeful activity and creative activities and non-purposeful, preparatory activities to maximise ability.

Ergonomic approaches

A number of approaches are applied in ergonomics, based upon biomechanical principles. There are two broad approaches:

- Injury prevention approaches focus on ensuring the worker, task and environment are matched in order to prevent or limit the development of soft tissue and other injuries. For example, one of these is the Occupational Biomechanics approach which aims to improve workers' occupational performance whilst achieving the organisation's goals (Chaffin and Anderson,1991). This includes personnel selection criteria and training, hand tool design guidelines, workplace and machine control layout guidelines, seating design guidelines and materials handling limits. Another is the Ergonomic Tool Kit Approach (Burke, 1998) which focuses on work place based ergonomics of workstation design and modification, altering work processes and considers organisational factors as well as workers' stress levels, comfort and safety (Jacobs, 1999).

- Vocational rehabilitation approaches which treat people who have already developed injuries and disabilities. These reflect the merging of ergonomics and rehabilitation. For example, the Functional Approach (Isernhagen 1995) encompasses both preventative and rehabilitative approaches. This includes work analysis, functional capacity evaluation, injury prevention education, pre-work screening, ergonomic adaptations, modified work and retum-to-work programs and injury management and prevention.

Level A

Assessment

Level B

Occupational Therapy Assessment

Therapists assess the person's physical, functional, cognitive, psychological and social abilities, within the context of their physical and sociocultural environment and the requirements of their roles and occupations (ie everyday activities). The assessment procedure used by occupational therapists working with musculoskeletal disorders is the same regardless of the location of the disorder, although specific tests may vary according to its nature and location. The assessment procedure described below focuses on the upper extremity.

Level C

Sources

The majority of individuals with soft tissue disorders referred to an occupational therapist will be treated as out patients, and are referred from orthopaedic, rheumatology or hand clinics or by General Practitioners.

Level C

Gathering information

Prior to the initial assessment, the occupational therapist should supplement the information provided in the referral from both medical notes and multidisciplinary team members on the person's medical history and previous and concurrent treatment.

Level C

Initial Assessment

This allows the therapist to establish a rapport with the person. This is essential as the quality of the therapeutic relationship can impact on the success of the intervention strategy, which may extend over many weeks. The initial assessment provides an opportunity to gain insight into the individual's perspective of their disorder, how it presents, and its effect on physical, psychological and social aspects of their lifestyle. Both affected and unaffected upper limbs are assessed to allow comparison of what normal function and appearance is for the individual.

The history of onset and the nature of the condition are discussed. A description of the nature of the pain including the distribution, severity, type, aggravating factors and strategies which provide relief should be discussed. Visual analogue pain scales may be used before and after treatment and provide subjective information on the amount of pain experienced. The McGill Pain Scale (short form) (Melzack, 1987) incorporates 15 descriptors of the sensory and affective dimensions of pain. A visual analogue scale and present pain intensity provide a measure of the intensity of the pain experienced. The scale takes between two to five minutes to complete.

Physical examination commences with observation. The patient is observed in relation to how the patient is responding to the presence of the condition and their posture. The condition and colour of the skin may indicate if the limb has been used normally. For example, a person with a manual occupation may have calluses over the metacarpal heads, which may be less pronounced on the affected limb suggesting an interference with activities at work. The condition of the nails, hair and pulps of the fingers, the location and extent of deformity and muscle wasting and whether the circulation is intact or compromised are all evaluated.

Palpation and handling of the patient should be gentle and slow. A verbal commentary on the assessments and movements conducted should precede any examination. The temperature of the skin, which may indicate infection or poor circulation, sweat pattern and condition of any scars are also noted during examination.

Range of movement is then evaluated. Active and passive range of movement of the upper limb are assessed using a goniometer following standardised methods, with proximal joints supported as necessary and preferably performed by the same therapist at each assessment to maximise reliability. Sensory examination should record responses as intact and accurate, impaired, or absent (Boscheinen- Morrin, 1992). This includes assessment of light touch, presure, pain, temperature, two point discrimination, proprioception and stereognosis (ie the ability to identify objects from touch alone). Findings can be recorded on outline drawings of the upper limb.

Light touch and pressure can be tested using cotton wool and the fingertip or using Semmes - Weinstein monofilaments. The original Semmes Weinstein Kit includes 20 monofilaments, and there is also a "Mini Kit" which has a five-filament hand set. The reliability of the test has been established and it is considered to yield sensitive and accurate results. The monofilaments provide a method of determining normal versus abnormal sensibility at the sensitivity threshold (Bell- Krotoski and Tomancick, 1987; Bell-Krotowski, 1999).

Manual muscle testing is assessed using the Oxford Grading Scale to test muscle power (Boscheinen- Morrin, 1992). Various forms of grip strength are assessed in the patient with an upper limb disorder, including power grip, tip, tripod and lateral pinch. The Jamar Dynamometer and B + L hydraulic pinch gauge have high calibration and accuracy and are the instruments of choice (Mathiowetz et.al., 1984; Bohannon, 1986; Solgaard et.al., 1984). The American Society of Hand Therapists (ASHT) have developed a standardised arm position for use with the Jamar Dynamometer which should be used to ensure consistency of results (Solgaard et. al., 1984). Each grip should be repeated three times with 15 seconds inter trial rest to avoid fatigue. The mean for each grip is then calculated.

The location, extent, classification (primary or secondary) and duration of oedema need to be established (Palmanda et.al., 1999). A visual record of any oedema can be recorded on a simple line drawing of the upper limb. A tape measure or volumeter using water displacement can be used to measure oedema in the hand. The involved and uninvolved hand should be assessed. The dominant hand will displace 15 - 20 mls more than the nondominant hand.

Functional assessment is then performed. The impact of the disorder on the individual's ability to carry out activities of daily living should be evaluated, including personal and domestic activities, work, and leisure. The affected areas will be dependent on the individual, their roles, responsibilities and occupations. Environmental factors may also influence the individual's performance. Assessment may be specific targeting the area of dysfunction for example, a work assessment. Alternatively, standardised assessments may be used, as described in Table Two.

Table 3: Standardised Assessments suitable for use with WRULDS

Assessment	Type	Description	Time to complete (mins)	Validity	Reliability
Disabilities of Arm, Shoulder and Hand Shoulder and Hand Questionnaire (DASH) (Hudak et al, 1996)	Self-report	30 compulsory items: including functional, physical, social and psychological items Additional optional section for sports and performing arts. Five point Likert scale each item. Gives a total score.	10	Yes	Yes
Neck and Upper Limb Index (NULI) (Stock et al, unpublished)	Self-report	20 items: physical task ability, effect of disorder on work, psychosocial impact, sleep, and negative effects of condition. .Seven point Likert scale each item. Gives a total score and four sub-scales-	10	Yes	Yes

		physical, psychosocial, work and sleep status.			
Sollerman Hand Function Test (SFHT) (Sollerman and Ejeskar, 1995)	Observation of performance	20 simulated activities of daily living (eg opening door, fasten zip, pour water). Scoring is a combination of time taken to perform each task and quality of grip used (rated on a 0-4 scale).	30	Yes	Yes
Sequential Occupational Dexterity Assessment (SODA) (van Lankveld et al, 1996)	Observation of performance	12 simulated activities of daily living (eg writing, pick up envelope, use a telephone). Six are unilateral and 6 bilateral. Scoring is based on quality of grip function (rated on a 0-4 scale), plus person’s perceived	30	Yes Yes	

		difficulty and pain level during performance.		
Jebsen Hand Function test (JHFT) (Jebsen et al, 1969)	Observation of performance	Seven grip activities (eg pick up small objects, writing, stacking checkers). Each sub-test performed separately with left and right hands. Score is the time taken to perform test	10	Yes Yes

McPhee (1987) reviewed hand function tests concluding that 82 % used time as the critical measure. However, this was not considered to be an accurate indication of hand function. Relatively few tests examine the method of task completion or simulate heavier activities reflective of a work environment. He recommended no one test can be used exclusively for all conditions but each test must be evaluated to ensure the most appropriate test for that diagnostic group and person is used.

Psychosocial assessment should be conducted, as the psychological impact of any disorder is not always proportional to the extent of the injury. Psychological effects can determine the success of a treatment programme especially if motivation, confidence and self esteem are affected. Cultural and religious background may also affect the individual's reaction to the disorder. Methods of assessment include: informal psychological assessment during the initial assessment, for instance noting the person's reaction to their injury, assessing motivation, confidence and self esteem through therapist-patient interaction. Standardised assessments measuring anxiety may also be used when necessary, such as the Hospital Anxiety and Depression scale (HAD) (Zigmond and Snaith, 1983). This is a 14 item scale with seven items relating to anxiety and depression respectively. It is a self report scale and uses a 4 point Likert scale with responses ranging from "none" to "unbearable."

Work Assessment (or Functional Capacity Evaluation) is commonly conducted with people returning to work. This should include a work site job analysis (see ergonomic assessment) to identify the job requirements the person is being rehabilitated back to, eg. the need for manual dexterity, balance or repetitive reaching. Without a job-site evaluation to investigate the cause or factors contributing to the condition, therapy may just be treating the symptoms not the cause. The work assessment can also include a wide range of activities conducted in the occupational therapy department to simulate the person's normal task demands. For example their ability to: handle objects; reach; push; pull; lift; carry; perform twisting movements; feel objects; crawl and climb; manual dexterity and eye-hand -foot coordination is tested (Schultz-Johnson, 1995). Activities may be simulated using a variety of methods:

- Tasks available in the department: eg printing, woodwork, the Baltimore Therapeutic Equipment (BTE). The BTE machine has a range of interchangeable handles and tools attached to a lever arm allowing a variety of hand and arm actions to be exercised using increasing ranges of movement, levels of resistance and speed. The integral computer enables a varying programme of activity to be set and analysis of progress.
- VALPAR Corporation Work Samples (VCWS). This includes a series of activities. For example, VCWS 1 tests the person's abilities to work with small tools (screwdrivers, pliers) during six timed exercises - five assembly and one disassembly. This allows the therapist to evaluate: motor co-ordination, manual dexterity, tolerance of frustration and performance in repetitive tasks. VCWS 9 evaluates the person's ability to work at four different heights: overhead, shoulder, waist and crouching.- and involves transferring items and screwing these into place at these heights. This allows observation of ability to reach, handle, co-ordinate, dexterity and moving between different heights.

This information will be used to formulate a treatment plan and act as a baseline against which repeat assessments are compared until discharge. Where it is suspected or known that the disorder is caused or exacerbated by work activities, the OT assessment should be supplemented by more detailed ergonomic assessment.

Level B

Ergonomic Assessment

Ergonomists and occupational therapists interested in work rehabilitation are skilled in applying ergonomic principles for both injury prevention and the modification of work for the injured worker. A work site job analysis is essential to identify what may be potential stresses promoting upper limb disorders. Data is obtained through observation, interview with workers and managers, organisational documentation and consideration of Health & Safety at Work legislation.

Level C

Factors to be considered in an ergonomic assessment

Numerous factors are considered in any assessment. These include force, frequency and duration of specific tasks, postures, stress and personal factors.

The force required to be applied during a heavy or difficult task can result in physical strain as the required force may be either beyond what a muscle can apply or because limb or equipment positioning means the muscle cannot exert its strength effectively. Inadequate tool or equipment design can also result in excessive force being applied, particularly if the working posture necessary does not allow easy application of force. If the muscle's maximum tolerance is exceeded at one event or with repeated exposure, damage to tissues can occur.

Frequency and duration of task performance also affect ability. Performing certain actions repeatedly or for long durations can result in muscle fatigue. This is relieved by rest, but if this is insufficient and actions are continuously repeated, then pathological changes can occur. Pain may then recur more frequently and so require longer rest periods for recovery.

Certain postures can occlude blood flow, increase pressure on nerves and other tissues, stress joints or require high muscle force to be maintained. Workers with neck and shoulder pain have been found to perform shoulder abduction and forward neck flexion more frequently and for longer (Sakakibara et al 1987). Postures potentially causing discomfort include: extreme postures at the end of range of the joint; postures allowing gravity to act about a joint and so further increasing load on muscles and tissues (eg working in elevation); and non-extreme postures that affect normal musculoskeletal geometry and thus increase stress on tendons (eg working in ulnar or radial deviation of the wrist, which reduces the efficiency of wrist muscles). Examples of potentially harmful postures include: over-reaching; loading in an uneven manner; wrist extension/ flexion; reaching behind or above shoulder level or behind the torso and performing static work above the level of the heart. The layout of the workplace may also cause postural constraints. Marras and Schoenmarklin (1993) identified risk factors for carpal tunnel syndrome based on frequency of wrist flexion/ extension, angular velocity and acceleration.

Stress can generate muscle tension which can add to the physical demands already placed on muscles from jobs. For example, tasks requiring greater cognitive or visual demands can increase neck and shoulder muscle activity (Westgard and Bjorklund, 1987). There is a higher incidence of musculoskeletal pain amongst those with lower job satisfaction and higher work and life stress. Stress factors related to workload can cause pain as well as inter-personal relationships and social structures within the work environment. A climate of distrust, fear of being inadequate and unwanted overtime can all increase stress and thus muscle tension.

A variety of personal factors can also increase the risk of musculoskeletal disorders, as described in Table Four.

Table Four: Personal factors affecting risk of musculoskeletal disorders

Previous injury or illness affecting tissues. Poor levels of physical fitness. Increasing age. Anthropometric characteristics of the individual (eg. height, weight and reach in relationship to the work environment, seating and equipment). Training provided - which can help increase strength and endurance for the task. Personality and psycho-social factors: those with a higher external locus of control and depression have been found to experience musculoskeletal discomfort more frequently. Leisure pursuits: causative factors can arise from hobbies involving repetitive actions eg running, knitting, playing musical instruments. Other factors: eg smoking has been associated with musculoskeletal discomfort, which may be because it correlates with other associated factors such as poor physical fitness.

These factors will all be considered during the formal assessment of the following:

Level D

Job purpose and task analysis.

This includes identification of the requirements of a job. For example, the purpose of a check-out operator's job is to ensure the speedy sale of products. It includes welcoming customers, moving items across a conveyor belt, scanning bar codes, weighing goods, working on a till, packing items, ensuring correct payment (including credit card authorization and signature checking) and providing correct change and receipts. All of this is carried out whilst maintaining a friendly approach to the customer, and working at speed to reduce customer waiting time and queues. In task analysis, each task in the job must be analysed to identify work positions and potentially stressful movements. Details of task analysis methods are provided later.

Level D

Job organization and structure

This includes identifying hours per shift; the shifts worked; breaks; rest periods; job rotation; piece work; job-rate quotas (eg output per hour); production incentives; work pace and frequency of work cycles (ie the number of times per hour a job task is performed); and work schedule. Excess speed of work and long shifts with inadequate rest breaks can cause and exacerbate injuries.

Level D

Tools and equipment

Tools and equipment should suit the anthropometric dimensions and strength of the individual. This includes assessing the weight and size of tools and considering the use of power tools to reduce the force needed, along with evaluating the even balance of tools in the hand. The friction and slip resistance of grasping surfaces, size, shape and thickness of handles, their surface materials and compressibility, the hand-tool position and resultant posture of tools in the hand should all be assessed, as appropriate designs can reduce force and torque requirements necessary to operate these. Safety glove use and fit should be considered, as poorly fitting or cumbersome gloves can increase risk of injury. The ability to use both hands to operate equipment will reduce force requirements. The edges and corners of tools and equipment and the provision of padding should be considered to prevent injuries from catching these.

Level D

Manual materials handling

This includes lifting of loads - their force, size, weight and stability; location of loads in relation to the worker; the amount of twisting, bending and overhead reaching required; location of handles; lifting frequency and mechanical aid availability. Manual handling regulations should be followed to reduce injury risk.

Level D

Workstation design

This includes evaluating the location, height and adjustability of tables, work surfaces and shelving which should be within the person's "reach envelope" (ie the space within which the upper limb can be comfortably extended and used). The freedom of the worker's movements, and positioning of controls, tools and equipment within the work area, should be such that the visual and physical reach (forward flexion and elevation of the upper limb) and postures required during work are within the person's capacity. Workstation design should reduce or eliminate bending and twisting at the wrist, reaching above the shoulder, static muscle loading, full extension of the arms and raised elbows. Barriers or obstacles in the work area should be absent.

Level D

Working position

For seated work the chair should be adjustable in height to suit the person, the depth and width of the seat pan should fit their dimensions and arm and foot rests be provided. The chair should be manoeuvrable and comfortable with lumbar support with an adjustable back rake angle. The workstation should be evaluated in relation to the chair.

For standing work, the type of standing surface should be assessed. The use of cushioned shoes and antifatigue mats should be considered to reduce pressure, and workstation design in relation to the standing position should be assessed. Rails and sit-stand chairs with footrests can help reduce pressure when standing. The inclusion of stretch breaks and analysis of work postures to avoid over-reaching in the work station design are needed.

Level D

Physical demands

The physical demands of a job must be analysed. The following should be recorded: work postures, frequency and repetitiveness of movements, frequency of bending of specific joints, the maximum reach required, the forcefulness and suddenness of movements, frequency of finger pinching, sustained muscle contraction, and the need to maintain specific postures for long periods.

Level D

Environmental factors

Poor lighting and illumination, vibration, excess temperature and humidity, high noise levels, poor air quality and circulation can all influence stress levels and discomfort during work, which increase muscle tension.

Level D

Controls and displays

The ease of use, reach, size, shape and colour of controls and display boards must be considered. Placement of guards to prevent accidental use and feedback mechanisms available to indicate if these are activated should be recorded, as should the viewing distance and angle to see controls and quality of lighting levels.

Level D

Psychosocial environment

This also influences stress levels. Thus job complexity; monotony and repetition, peer and social support, worker autonomy, accuracy requirements, excessive task speed or load, sensory deprivation or isolation should all be evaluated;

Further details and specific checklists are available (see Jacobs 1999; Ranney, 1997).

LEVEL C

Task Analysis

There are several methods of task analysis, including hierarchical, verbal and a variety of others.

a) Hierarchical task analysis

In this form of analysis, the main objective(s) of the worker (or system) is identified. Observation of the worker(s) (or system) is conducted to identify and describe the tasks involved to achieve this objective. The sub-tasks required for each are also identified, providing a detailed plan of each task in terms of work conditions, skills and equipment required, actions required, complexity, timing and order and the tasks' relationships to each other. Decomposition analysis can also be used to identify categories within tasks, such as cues for initiating actions, controls used, decisions made, actions taken dependent on differing decisions, feedback given and common errors made, with repeat or correcting actions necessary (Kirwan and Ainsworth 1992). A flow diagram is produced linking each task to gain an overview of the job being analysed. Work cycles are timed to identify the speed with which each task must be done, the frequency of tasks within a given time period or work day and the frequency and duration of rest periods (scheduled and non-scheduled). Each task and sub task can then be analysed in terms of force, repetition, duration, speed and posture required to identify any potentially causative or exacerbatory factors.

Examples of structured methods of analysing work positions, posture and movement are (i) the Ovaco Working Posture Analysis System (OWAS) developed by the Finnish Institute of Occupational Health. This classes postures in four categories based on the positions of back, arms and legs and (ii) The Rapid Upper Limb Assessment (McAtamney and Corlett, 1993), where postures are classified into categories using a checklist and weighted in terms of forces used and frequency of posture adoption. These are both best applied by video-recording workers performing the activity and later analysing the types of postures and percentage of time spent in each (eg bent/ twisted posture; fixed posture; extreme reach of limbs; static muscle work above heart level; repetitive force applied with extremities; extreme range of motion of wrists etc).

- Verbal Protocol Analysis: this explores the mental processes required during tasks and is more difficult to assess. It requires the worker to "think out loud" and explain the cognitive tasks and decisions made with each sub-task of the activity (Militello and Hutton, 1998). This can help explain why certain postures and repetitions are performed.

- Others: A variety of rating scales can be used alongside task analysis to obtain workers' opinions on: pain experienced during tasks eg Borg's Perceived Pain Scale (Borg, 1982); body mapping to identify location of pain; perceived exertion eg Borg's Perceived Exertion Scale (Borg, 1985); and occupational stress indicators, eg the Demand/Control Questionnaire (Karasek, 1979), which evaluates job psychological demands and personal authority over decisions to give a psychosocial stress index.

LEVEL A

Recommendations for referral to an occupational therapist or ergonomist

Occupational therapists focus on the individual and maximising their physical, functional, psychological and social abilities in order to assist people in managing their everyday activities successfully (activities of daily living (ADL), work and leisure). The appropriate problems for referral to an OT or ergonomist specialising in vocational rehabilitation of injured workers are described in Table Five.

Table 5: Indications for referral to an OT/Ergonomist

Problem area:

- **Physical changes**

Deformity

Decreased range of movement

Sensory changes

Decreased muscle strength

Oedema

- **Psychological changes**

Pain

Loss of confidence/ self esteem

Anxiety/ depression as a result of the disorder

c) **Functional changes**

Loss of ability to perform:

- self care activities
- domestic activities
- work activities
- leisure activities
- life roles

Referral for ergonomic assessment and intervention is appropriate when the soft tissue disorder is suspected as either being caused or exacerbated by the person's work and it is considered that modification of the work environment or work practices will enable the worker to function more effectively without recurrence of the condition.

LEVEL A

Treatment approaches used by Occupational Therapists in soft tissue disorders

Occupational Therapists use a range of treatment approaches for soft tissue disorders. The approach used is dependent on the nature and extent of the disorder, medical management including any protocols for treatment, and intervention being carried out by other professions. An outline of the common approaches used is provided below.

Level B

Use of Splints

Occupational therapists provide a range of splints. These may be either prefabricated or custom made for the individual. The majority of splints provided for soft tissue disorders are static, ie without any moving parts. The purpose of splinting is highlighted in Table Six.

Table Six: Static splinting

The purpose of static splinting is to:

- immobilise or limit joint activity
- provide protection
- position and maintain correct joint alignment
- maintain improvement gained through passive stretching or activity
- provide stability to joint(s), therefore facilitating function and
- arrest developing contractures.

(Canon, et.al, 1985, Barr & Swann, 1988, Boscheinen- Morrin et.al., 1992).

Custom made static splints are usually made from low temperature thermoplastics, for example Easi-form, Aquaplast and Orthoplast. The material is heated and then moulded to the individual, and secured using straps, (eg using Velcro). The individual is given instructions regarding when the splint should be worn, how to remove and replace it, and how to check the skin for any pressure areas. The splint is usually checked at each out-patient appointment to ensure it fits correctly. Precise alterations can be made to thermoplastic splints using spot heat if necessary.

Prefabricated splints are usually made from soft materials, for example neoprene. They are commercially manufactured in standard sizes and in a wide variety of designs. Minor adjustments can be made if necessary to maximise comfort. Again instructions on use, removal, reapplication and likely complications should be discussed with the individual. These splints should also be reviewed at out patient appointments for comfort and fit. See Table Seven for a summary of splints used.

Table 7: Summary of examples of splints used for soft tissue disorders:

Splint	Classification	Disorder
Wrist immobilisation splint	Static	WRULD
		Carpal tunnel syndrome
		Reflex sympathetic dystrophy
		Wrist extensor tendinitis
Hand immobilisation splint	Static	WRULD
		Tenosynovitis
Thumb immobilisation splint	Static	Soft tissue inflammation
		De Quervain's disease
		Gamekeeper's thumb
Hand based splints	Static	Trigger finger
Counter force bracing	Static	Lateral epicondylitis
Drop-out splint	Static	Ulnar nerve entrapment
Semi flexible support	Static	Tenosynovitis
		Tendonitis
		Carpal Tunnel Syndrome
		Gamekeepers thumb

Level B

Management of Oedema

An inactive hand left in a dependent position is likely to become oedematous (Palmanda et.al., 1999). If oedema persists for more than two or three weeks scarring may become extensive as all tissues, vessels, nerves, joints and intrinsic muscles are exposed to reduced nutrition and elasticity (Hunter et.al., 1995). It is therefore essential that oedema is treated effectively and efficiently in the early stages. Occupational therapists utilise a number of strategies such as patient education, elevation, compression, massage, exercise and splinting.

Patient education is provided to increase the individual's awareness of the effects of persistent oedema. The importance of movement and compliance with a 'home programme' of activity and exercise are discussed. Elevation can be achieved by encouraging the individual to position the hand above shoulder height when possible, for example, at night in bed. External compression therapy is one of the commonest strategies for treating oedema (Newman, 1988). The compressive force exerted pushes the fluid proximally into the venous and lymphatic system (Hunter et al, 1995). Methods of compression include: Coban wrapping, ace bandaging, string wrapping, lycra gloves, and custom made garments (Hunter et al, 1995). Exercise increases the blood flow and therefore reduces oedema by facilitating venous return (McMeeken, 1994). The activity based 'exercise' chosen will use creative and therapeutic activities and be appropriate and meaningful to the individual. This may address more than one aim of treatment. Retrograde centripetal massage increases venous and lymphatic drainage (Hunter et.al., 1995). The pressure exerted should be released at the end of each stroke to maximise effectiveness (Downer, 1988). Brennan and Weitz (1992) consider that if this is coupled with compression effectiveness is increased. Splinting may be used if a 'rest / activity' regime is necessary. Periods of activity are alternated with rest periods during which a static splint would be used to 'rest' the hand.

Level B

Activity based approaches

Occupational therapists use a variety of techniques to achieve the overall aim of treatment which is to restore the individual to their previous level of independence. These techniques include: everyday activities and purposeful and non-purposeful activity.

Level C

Everyday activities

These include those activities which are part of the individual's normal lifestyle and are incorporated in to the occupational therapy treatment programme. These can include self care and domestic tasks, work and leisure activities. They should be familiar, meaningful and purposeful to the individual and completed in the appropriate environment with attention to context. Examples are domestic tasks performed in the individual's home environment, and work hardening carried out at work. These may also be performed in a simulated setting, such as an occupational therapy department, although it is preferable when possible to do this in the environment and context familiar to the person.

Level C

Purposeful and non-purposeful activity

These include the use of creative activities (eg woodwork, pottery, computing, exercises for leisure, printing, gardening, decorating, repair work, office work). The purposeful activities selected for use are those which support the person’s life roles and increase their ability to perform everyday activities, for example simulation of aspects of work in the occupational therapy department. This method of treatment is used extensively as it does not require the occupational therapist to treat the individual in their own enviromnent, reducing costs and increasing the range of available activities.

Non-purposeful activities includes the use of preparatory techniques which may be used by occupational therapists as a 'warm up' to the treatment programme. Techniques included are: use of therapeutic putty, massage, active and passive range of movement exercises, progressive resistive exercises and “remedial games” (eg adapted solitaire which has larger pieces and/or a Velcro base attaching to the game board, which increases resistance requied to move pieces). These techniques are often used as a precursor to purposeful and everyday activities as the person is building up their dexterity and muscle strength.

A carefully formulated programme of activity is developed to increase duration, repetition and resistance in the range of activities used, based on detailed activity analysis of the selected activities and the person’s own interests. Strength, endurance and range of movement are built up and/or alternative methods of task performance identified when necessary.

LEVEL B

Joint Protection /Ergonomic modifications

Repetitive action may contribute to soft tissue disorders such as tenosynovitis, carpal tunnel syndrome, tennis elbow (lateral epicondylitis), De Quervain's disease and some injuries to the shoulder (English et al, 1995). In a case control study of 580 people with upper limb soft tissue disorders, thumb conditions were significantly associated with higher rates of pinching, wrist flexion and maintaining a fixed bent thumb position at work. Other movements and postures associated with upper limb conditions were higher rates of repetitive palmar gripping, repeated elbow flexion accompanied by the use of force, and repeated shoulder rotation with an elevated arm (English et al, 1995). Such movements can equally occur during household, DIY and leisure activities, as well as at work, and thus non-occupational factors can also cause and contribute to these conditions.

During upper limb and work assessments, the therapist can identify if there are specific movements involved in work, leisure and activities of daily living exacerbating pain and contributing to sustaining the condition. Joint protection is an approach, applying ergonomic principles, originally developed for arthritic conditions (Cordery and Rocchi, 1999; Melvin 1989), which can be applied to soft tissue disorders (Sheon, 1985; Sheon, 1997). Strategies are described in Table Eight.

Table 8: Joint protection / ergonomic modification strategies

Respect for pain, ie using this as a warning sign to either modify or cease activity as appropriate
Modifying movement patterns and postures which are precipitating and/or exacerbating symptoms (see below)
Use of assistive devices or labour-saving gadgets to reduce muscular effort and stress on tissues
Work simplification: modifying activities to alter task structure (eg task components, repetition and force) and/ or the environment, eg the location of the activity/ objects in relation to the person
Energy conservation: balancing work and rest and light with heavy activities; taking regular short rest breaks during activity (eg 2 minutes in every 10- 20 depending on the activity); and ensuring a good sleep regime.
Maintaining strength and range of movement through regular aerobic exercise and prescribed exercises appropriate to the condition.

The aim is to reduce pain and improve other symptoms, such as fatigue, to maintain or improve function and to improve or limit progression. By providing the person with practical strategies to manage their condition, it should also assist in improving psychological aspects, such as self efficacy and perceived control. The strategies described in Table 8 can be illustrated by protection measures commonly recommended for soft tissue injuries. For example protection measures for the hand and wrist include (Cordery and Rocchi, 1999; Melvin 1989; Sheon, 1985; Sheon 1997; Sheon, Moskowitz and Golberg, 1996).

:

Biomechanics and weight distribution

The patient should use stronger, larger muscles and joints to perform activities, distribute weight of items over the palms (preferably of both hands) rather than using lateral or pulp pinch grips if possible and use the palms and forearms rather than fingers to carry heavy items. Objects should be grasped with the whole hand and fingers.

Avoiding strain

For example by avoiding heavy lifting and strong grips by pushing, sliding, using trolleys or wheeled equipment, padding items and using a relaxed grip where possible instead. This avoids sustained or repetitive postures and intrinsic-plus grasp (eg as in holding a book or writing) and keeping the fingers flexed. For example, a steering wheel can be padded with a texturised wheel cover to both enlarge grip, enable a more relaxed grip and reduce slippage between the wheel and the hands. The person should avoid staying in one position for too long, eg by bending and straightening the wrists and fingers often during use. They should rest the hand in an open not a clenched position.

Tools and aids

These include kitchen assistive devices, power tools, office aids, expanded and textured handles to avoid repetitive hand clenching or strong gripping actions. These can help reduce the use of the fingers in pinching, hitting, moving and pulling actions.

Similarly, protection measures for the neck and shoulders can include for example;

Biomechanics and weight distribution

The person should avoiding jutting of the head, particularly when at visual display units (VDU), when watching television or doing close work. The body and work activities should be positioned so as to to keep the neck straight. Using high back chairs with adequate head and shoulder support and avoiding stressful neck positions (eg using one pillow, sleeping on the side or back; using cervical rolls to support the neck whilst sleeping) all help. Over-reaching should also be avoided by positioning objects nearer to hand and using step-stools for higher items.

Use of tools and aids

Using speaker phones or headsets for telephone calls reduces neck strain, as does ensuring VDUS, desks and chairs are correctly positioned and at correct height to maintain correct alignment (Keller et al, 1998).

A variety of texts provide further advice on, for example, VDU assessment and modification (Keller et al, 1998).

LEVEL B

Patient Education and Rehabilitation Programmes

Making the lifestyle and ergonomic changes recommended by occupational and physiotherapists are not easy. People are being advised to use strategies such as joint protection, energy conservation, work simplification and activity modification, exercise (upper limb specific and aerobic), as well as other lifestyle changes (such as eating a healthier diet and stopping smoking, which can also help). The Health Belief Model (Rosenstock et al, 1988; Innes, 1997) suggests that people are unlikely to make major changes in their health behaviours unless they perceive sufficient "perceived threat" from the condition, that is, symptoms are sufficiently interfering in their current lifestyle to limit or prevent meaningful and necessary activities and will continue to do so in future. Even with sufficient threat, there may be a range of barriers limiting change. Psychological factors, such as insufficient self-efficacy, use of negative coping strategies and poor perceived control of the condition, all limit adherence. Other factors playing a role include lack of social support from others, educational limitations and other practical issues such as the time to practice and develop sufficient skills, the ability to develop new daily routines to accommodate behaviours, conflicting demands on time and the pace of activity at work, leisure or home.

Education is most commonly provided individually using a combination of verbal instructions, written support information with discussion, demonstration and practice Lawler et al (1996). Patient education by the OT is focussed upon patient insight and motivation into the need and mechanisms for change, initiating these alterations and integrating them into daily life. This may require a range of other cognitive and psychological strategies to manage stress, time and assertiveness training to communicate effectively with others in their environment. It will include information on the aetiology, clinical features and presentation of the disorder as well as known factors causing or exacerbating the condition and the theoretical basis behind the recommended treatment strategies.

Educational interventions have been demonstrated to alter the frequency of 'risk' movements in the industrial setting, at least over the short term (Dortch and Trombley (1990). Poor compliance with educational programmes in such settings is associated with difficulty with integrating changes such as postural alterations into the work setting although this is less of a problem in those with ergonomic equipment and adapted work stations. Job demands may also prevent implementation of changes.

There is considerable evidence that work-related soft tissue injuries are not wholly or solely due to physical factors. Work based and personal stress may be both causative and exacerbatory. Education programmes should therefore also include strategies to identify causes of and how to manage stress through using cognitive approaches. Whilst much education and training is individually based, group education programmes have the potential to maximise providing this range of approaches cost-effectively and to facilitate improving self-efficacy through modelling. Peer reinforcement also encourages greater adherence with goal-setting and homework programmes and there is evidence from arthritis education research that the longer the group programme, the more effective it will be in facilitating behavioural change and improving outcome.

Few studies have been conducted of educational and rehabilitation programmes in soft tissue disorders. Barthel et al (1998) conducted a retrospective case review with 24 people with "upper extremity repetitive use syndrome." They received between one to 33 OT sessions (treatment was usually two to three times per week) consisting of ergonomic training, (joint protection, energy conservation and work simplification), stretching, soft tissue mobilizations, graded therapeutic exercise, work simulation with graded work hardening, use of heat and ice, and home exercise programmes. A few with substantial tenderness were provided with resting splints, although these were mainly avoided. A job site evaluation with ergonomic modifications was conducted. Psychological pain management was provided to 7 patients and drug therapy as necessary. Six patients were rated by a physician and an OT as having resolved symptoms, 13 as having moderate improvement and five had minimal or no improvement. Thus 19 of the 24 participants had some improvement.

Feuerstein.et al (1993) evaluated a 4 - 6 week daily therapy programme in a non-randomised controlled trial. This included: warm up and daily physical conditioning exercises aimed at improving aerobic capacity, muscle strength and flexibility, particularly in the upper limb (1.5 hours); work hardening simulating the individual's job demands (1 hour); pain and stress management and an ergonomic analysis. In comparison to a control group receiving usual care, those attending the programme had significantly higher return to work rates 18 months later. However, the design used a control group not eligible for the programme (due to attending other programmes, lack of insurance cover, refusal to participate or high levels of illness behaviour) and follow-up points varied between 3 - 35 months in both groups.

Cognitive behavioural therapy (CBT) intervention including goal setting, cognitive restructuring, relaxation and assertiveness training has also been evaluated in soft tissue upper limb disorders. A two year follow-up of a randomised controlled trial of individual CBT, group

CBT and wait list control groups identified no differences in return to work rates, although there was significantly improved ability to cope with pain in both CBT groups (Spence 1991; Spence 1998).

LEVEL B

Provision of orthoses

A variety of splints can be provided, some examples of which are given below:

a) Ulnar Nerve Entrapment at the Elbow

A "drop out" splint has been developed for the treatment of ulnar nerve entrapment at the elbow. 'Drop out' means that the splint allows movement into extension but restricts flexion. Its purpose is to immobilise the elbow in moderate extension, whilst preventing flexion greater than 45 degrees. Prolonged or repetitive elbow flexion aggravates the source of compression, therefore splinting in extension reduces the nerve irritation (Harper, 1990).

The splint was designed because patient acceptance of the long arm splint also used in this condition has been poor, especially if the patient is required to wear it during daily activities. The drop out splint allows some elbow extension, forearm rotation, and wrist movement is not restricted (Harper, 1990). This splint has been evaluated with 51 patients over two years: 24 % experienced complete resolution of symptoms; 33% were still wearing the splint; 24% required surgical intervention and 19% were lost to follow up. The results identified that patient compliance improved by 50% and need for surgery reduced by 50% (Harper, 1990).

In addition to provision of a drop-out splint, patients would also participate in a structured programme of intervention including: activities to maintain range of movement, strength and endurance, activity modification and activities of daily living which may include tasks carried out at home, work or during leisure pursuits.

b) Semi flexible support splints

This splint was designed to limit extremes of motion and provide support to soft tissues. It was originally designed for soft tissue disorders such as tenosynovitis and tendinitis but has been used with carpal tunnel syndrome and is therefore a useful adjunct to occupational therapy intervention for any soft tissue disorders (Henshaw et.al., 1989). The splint ensures 'safe wrist motion' is maintained and allows 5 degrees of flexion, 30 degrees of extension, 10 degrees of radial deviation and 15 degrees of ulnar deviation. These ranges of motion have been determined as "functional wrist motion" in a study to measure the range of movement necessary to perform activities of daily living (Palmer et.al., 1985).

The splint was evaluated with 73 patients, 41 of whom completed a self-report questionnaire. Of these, 92% considered the support useful during work and non-work activities, and it was especially useful when writing and driving. It therefore provides additional support for an injured worker who is able to return to work before full resolution of symptoms has occurred (Henshaw et.al., 1989). Additional therapy intervention will include: activity to maintain and improve range of movement, strength and endurance, activities of daily living including home, work, and leisure, activity modification and patient education.

Summary

The limited research of occupational therapy programmes suggests that for those with upper limb disorders (which may be work related) a combined approach of patient education, exercise, work assessment and work hardening, joint protection, energy conservation and work simplification training, ergonomic adaptations at home and work, splinting and cognitive-behavioural therapy improves coping with pain, return to work rates and ability to continue in work. However, there has been little research into the effectiveness of such programmes and good quality randomised controlled trials are required.

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