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Managing Type II Work-related Upper Limb Disorders in Keyboard and Mouse Users Who Remain at Work: A Case Series Report

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ABSTRACT: Work-related upper limb disorders (WRULDs) are difficult to diagnose due to the limited availability of recognized objective assessment methods. This case series report demonstrates the use of the "typing capacity cycle" test and standardized clinical tests as outcome measures to assess work capacity in four high-intensity keyboard and mouse users who remain at work before and after the implementation of a six-month treatment program.

Pain intensity, the duration of pain before treatment, the duration of treatment, type of work, and the location of the pain were recorded for each patient. Function was assessed before and after treatment using the Functional Grading Scale. The assessment results were analyzed to determine any improvements made after rehabilitation.

The outcomes indicate that all patients improved their resting pain and work capacity with the three-phase rehabilitation program.

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Work-related upper limb disorders (WRULDs) continue to be problematic as the use of keyboard- and mouse-based work dominates the 21st century workforce. These disorders are difficult to diagnose partly due to the fact that there is no clear biomedical etiology[1] or available specific clinical or objective tests. WRULDs can be categorized into two types. Type I WRULD refers to localized, clearly defined syndromes such as Carpal Tunnel Syndrome, de Quervain's Syndrome, and Lateral Epicondylitis.[2] This is the largest group and is relatively easy to diagnose and treat. Hutson[3] defined Type II WRULD as nontraumatic upper limb pain of unclear cause. It is far more difficult to diagnose as regional pain syndromes, which have vague definitions, for example, Regional Allodynia or Hyperalgesia, characterize it. As Type II WRULDs are difficult to diagnose, there is often a delay in the diagnosis resulting in the development of a chronic condition. Although the etiology of WRULDs is unknown, certain physical, psychosocial, and ergonomic risk factors contribute to the development of Type II WRULD. Recent studies have shown that psychoneurotic and neurotic perfectionism personality traits are additional risk factors that may contribute to the etiology of WRULDs.[4]

In addition to the difficulties in diagnosing Type II WRULDs, there are few guidelines as to how to effectively manage work-related pain while remaining at work. As a result, employers are reluctant to allow an employee to continue working for fear of possible legal consequences if their symptoms are exacerbated by work. Conversely, employees may be reluctant to reveal their symptoms to their employer for fear of losing their position in their corporation.

There is general consensus in the literature that individuals who use a keyboard and mouse for extended periods of time experience musculoskeletal symptoms.[5–7] However, there is a difference in opinion with regard to the duration of keyboard and/or mouse use being associated with the incidence of hand–arm symptoms. Anderson et al.[6] reported that the prevalence and incidence of Carpal Tunnel

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Syndrome in individuals who are high-intensity mouse users (more than 20 hours per week) are higher than high-intensity keyboard users. Whereas, Lassen et al.[7] established that mouse and keyboard time predicted elbow and wrist/hand pain from low exposure levels without a threshold effect, but mouse and keyboard time were not predictors of clinical conditions.

Ijmker et al.[8] performed a systematic review of the literature to establish what evidence existed for a relationship between the duration of work time spent using the computer and the incidence of upper extremity disorders. Strong evidence was found that suggests a positive association between the duration of mouse use and hand−arm symptoms, thereby indicating the need to identify safe levels of computer use and to objectively differentiate between total computer use, mouse use, and keyboard use.

With regard to assessing the work capacity of individuals with Type II WRULD, most reported investigations have done so by questionnaires, video filming, or muscular force recording.[9−15] In our opinion, individuals need to be assessed in realistic test conditions using a simple, reproducible, and cost-effective assessment tool. In addition, individuals should receive a thorough standardized clinical examination, with additional pain and functional outcome measures.

In 2004, Povlsen et al.[16] developed the ''typing capacity cycle'' test. The test was developed in an attempt to create a simple, reproducible ''off-site'' tool to enable hand surgeons and hand therapists to objectively assess keyboard users' work capacity after they had developed WRULD. The test was used to study both healthy keyboard-based users and those suffering from WRULD to establish a normative baseline between healthy and nonhealthy individuals. The test did not include a specific functional mouse use component and therefore did not provide an evaluation of the impact of computer mouse use on pain. The results of the study indicated that the ''typing capacity cycle'' test did not induce pain in normal healthy individuals or individuals with Type II WRULD and was within the guidelines for Display Screen Equipment (DSE) workers in England as outlined by the Health & Safety Executive.[17]

The purpose of this article is to present a series of case reports on the assessment and treatment of individuals who perform keyboard and high-intensity mouse-based work as defined by Anderson et al. (2003)[6] who developed Type II WRULD but wanted to remain at work during their six-month treatment and follow-up period.

METHOD

The standardized clinical examination consisted of subjective and objective assessments. The subjective assessment included a description of their symptoms and an assessment of pain intensity using the Visual Analogue scale (VAS) and the adapted Functional Grading Scale.[18] The Functional Grading scale was first described by Fry in 1986[19] to grade the severity of overuse syndromes in orchestral musicians. The severity scale is reported to correspond well with overuse injuries from other occupations such as keyboard and mouse users, writing, and pottery making and has subsequently been adapted to rate the severity of Type II WRULDs.[18,20] The adapted Functional Grading Scale[18] that is used with Type II WRULD patients consists of five grades, which describe the location of pain and the effect that pain is having on work performance in association with objective findings (Table 1).

The objective assessment included a series of standardized clinical assessments and a ''typing capacity cycle'' test before and after six months of rehabilitation. Risk factors for the development of Type II WRULD were identified (Table 2).

Clinical Assessment

The standardized clinical assessment included a cervical screening to identify neck stiffness and pain, a postural analysis, active range of motion (AROM) assessment of the of the upper extremity to identify the presence of joint stiffness, or hypermobility.[20] In the presence of joint stiffness, standardized Goniometer measurements were taken to assess AROM. The Phalens[20] and Tinnel tests[20] were performed to identify nerve entrapment, and Hunters

TABLE 1. **Functional Grading Scale**

Grade I	Pain after activity; resolves quickly with rest. No decrease in the amount of speed of work. Objective findings usually absent.
Grade II	Pain in one site while working. Pain is consistent while working but resolves when activity stops. Productivity may be mildly affected. May have objective findings.
Grade III	Pain in one or more sites while working. Pain persists after the activity is stopped. Productivity affected and multiple breaks may be necessary to continue working. May affect other activities away from work. May have weakness, loss of control and dexterity, tingling, numbness, and/or other objective findings. May have latent or active trigger points.
Grade IV	All common uses of hand/upper extremity cause pain, which is present 50−75% of the time. May be unable to work or works in a limited capacity. May have weakness, loss of control and dexterity, tingling, numbness, trigger points, and/or other objective findings.

Adapted from Lowe C: *J Hand Ther* 5:84, 1992; modified from Fry HJH: Med Probl Perform Art 1:51, 1986.

TABLE 2. **Type II WRULD Risk Factors**

Physical Risk Factors	*Psychosocial Risk Factors*
Repetitive job	Psychoneurotic and neurotic perfectionism personality traits.
Prolonged static positioning	Poor coping strategies
Awkward postures	Unsupportive working environment
Direct pressure	High levels of work stress
Vibration	
High Force	
Ergonomics	
- Poor workstation setup	
- Excessive use of personal digital assistants	
- Use of a laptop	
Sedentary lifestyle	

Abduction test was used to identify radial, median, and ulnar nerve sensitivity.[21] Grip strength was tested using the Jamar Dynamometer as described by Coldham et al.[22] If swelling was present, circumferential measurements of involved joints were taken.[20]

It is essential to assess for the presence of trigger points in ''painful weak grip'' muscles as they can refer patterns of pain that are mistaken for other conditions such as Carpal Tunnel Syndrome, Thoracic Outlet Syndrome, and de Quatrain's stenosing tenosynovitis.[23] These muscles primarily include the extensor carpi radialis longus and brevis, extensor digitorum, brachioradialis, and supinator muscles. Active trigger points are localized by feeling for a tender nodule within the muscle or through pincer palpation of the Brachioradialis and flat palpation of the other forearm muscles.[23] Nodules that arise as a result of increased muscle tension, which are not trigger points, are recorded. These nodules tend to occur in the trapezius muscles and contribute toward the presence of neck stiffness.

The "typing capacity cycle" Test Method

The typing test was carried out in a hand therapy treatment room at a designated desk 73 cm high and 73 cm deep with a designated height adjustable chair with the use of a standard 12-inch monitor and a standard keyboard. The test did not involve the use of a mouse. Patients were instructed to only use the keyboard during the test and to ignore errors that required the use of the mouse for correction. They were at liberty to adjust the chair and the positioning of the monitor, keyboard, and manuscript to suit their personal preference at that specific time. The subjects were first asked to score their resting pain, termed ''start level,'' on a VAS (0–10).

They would then start to type a standard document at their own speed for a maximum of 30 minutes or until the VAS reached 5. If they managed the 30 minutes, the typing component of the test was considered completed. If however, while typing their pain reached a VAS level of 5, they were instructed to stop typing and the length of the typing period was recorded. After the first typing period, all participants would carry out stretching exercises until the pain level returned to the start level and the time for this to take place was recorded. Once this had occurred those who did not manage 30 minutes in the first period would then start typing the second period until they again reached VAS 5, and this second typing period duration was also recorded. The relative typing speed, taking the length of the recovery period into consideration, was then calculated.

The Case Series

Three patients who were referred by their General Practitioner to the Specialist Orthopedic Hand Clinic will be presented. On the basis of the clinical presentation, each patient was diagnosed with Type II WRULD as a result of using the keyboard and mouse for more than 60% of their working day and presented with the common risk factors for developing Type II WRULD namely leading a sedentary lifestyle and engaging in repetitive work with poor posture and maintaining prolonged static positions. Patients were advised to inform their employer about the diagnosis and request a workstation assessment and modification to comply with guidelines as recommended by the Health and Safety Executive. The patients were then referred to a specialist Occupational Therapist for a series of standardized clinical examinations and a ''typing capacity cycle'' test[16] to establish the levels of pain and functional impairment. The duration of pain before treatment, the duration of treatment, type of work, and the location of the pain were recorded for each patient. Patients then participated in a conservative treatment program while remaining in full-time work, which is described below. The results of the ''typing capacity cycle'' tests and the outcomes of the physical examination at referral and at six months were analyzed to determine any improvements made after rehabilitation. Table 3 provides an overview of the patient synopsis and summary of the results of the impairment and functional limitations before and after treatment.

CASE STUDY 1

History

A 53-year-old female presented with a six-month history of persistent pain in her right and left upper limbs as a result of excessive keyboard and mouse use. She was right-hand dominant, worked full time as an administrative assistant in a publishing company, and tended to lead a sedentary lifestyle.

TABLE 3. **Patient Synopsis**

Case Study	*Sex*	*Dominance*	*Past Medical History*	*Occupation*	*Impairment and Functional Limitations*		*Remission*	*Duration of Treatment*	*No of Sessions*
					Pre treatment	*Post treatment*			
Case Study 1	Female	Right	Six month history Stiff & swollen L & R wrists Normal blood tests Type I excluded	Admin, Assistant	*Nodules*: Upper Trapezius Muscle *Pain*: L & R upper limbs Resting pain: VAS: 4 *Sensation*: Numbness L MF *Swelling*: L & R wrist *AROM*: ↓ L wrist *Grip strength*: L: 9 kg R: 8 Kg *Functional limitation*: Grade II *Relative typing speed*: 12.1 wpm	*Nodules*: Improved *Pain*: Mild discomfort VAS 0 *Sensation*: L forearm tingling *Swelling*: None *AROM*: Normal *Grip strength*: L: 11 kg R: 11 kg *Functional limitation*: Grade II *Relative typing speed*: 19.9 wpm	Yes	Six months	13
Case Study 2	Female	Right	Eight-month history R upper limb pain Normal blood tests Type I excluded	Information technology	*Pain*: R wrist radiating to elbow: VAS 4 *Grip strength*: L: 17 kg R: 22 Kg *Functional limitation*: Grade III *Relative typing speed*: 14.9 wpm	*Pain*: None: VAS 0 *Grip strength*: L: 19 kg R: 22 kg *Functional Limitation*: Grade I *Relative typing speed*: 34.1 wpm	Yes	Six months	10
Case Study 3	Female	Right	Twelve-month history R wrist pain Normal blood tests Type I excluded	Solicitor	*Pain*: R wrist: VAS 2 *Grip strength*: L: 28 kg R: 20 Kg *Functional limitation*: Grade II *Relative typing speed*: 15.9 wpm	*Pain*: None: VAS 0 *Grip strength*: L: 28 kg R: 20 Kg *Functional limitation*: Grade I *Relative typing speed*: 23.5 wpm	Yes	Five months	4

L = left; R = right; MF = middle finger; AROM = active range of motion; wpm = words per minute.

Clinical Assessment

At the initial clinic appointment, the patient presented with stiff and mildly swollen left and right wrists. Provocative tests for Type I WRULDs including Carpal Tunnel Syndrome were negative. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) blood test results were normal. The patient was therefore diagnosed with Type II WRULD.

Clinical Presentation

The patient presented to Occupational Therapy with pain in the upper Trapezius muscles of the shoulders, bilateral upper limb pain, numbness in the left middle fingers, and mild swelling over the carpal tunnel area in the left and right wrists. Phalens and Tinnel tests were negative, which was consistent with negative Hunters Abduction test for the median nerve sensitivity. Swelling, nodules, and trigger points were absent in both upper extremities. AROM in the left wrist was reduced: extension/flexion: 52 degrees/60 degrees. Grip strength was weak in the left (9 kg) and right (8 kg) hands. The Functional Grading score was III. The initial ''typing capacity cycle'' test result for relative typing speed was 12.1 words per minute. The patient was treated over a period of six months and received 13 treatments sessions of 60-minute duration.

Summary of Treatment Outcome

Before treatment, the patient reported VAS 4 resting pain bilaterally but after treatment this was reduced to VAS 0. Range of motion in the left wrist improved to normal range ($70^{\circ}/70^{\circ}$). Swelling over the carpal tunnel was absent in both wrists. The relative typing speed increased by 67% and during the same period the grip strength increased by 27% and 18% in the left and right hands, respectively. The functional grading score was reduced from III to II after treatment and she reported leading a more active lifestyle. The ''typing capacity cycle'' test results improved by 64% (12.1—19.9 wpm).

CASE STUDY 2

History

A 41-year-old lady worked full time in Information Technology and presented with an eight-month history of pain and discomfort in the right upper extremity, which was as a result of excessive keyboard and mouse use at work. Over time, the pain became more severe and occurred during most functional tasks. She tended to lead a sedentary lifestyle, preferring not to exercise regularly.

Clinical Assessment

Provocative testing during the initial clinical assessment excluded Type I disorders such as tendonitis, De Quervain's tenosynovitis, and Thoracic Outlet Syndrome as being a cause for the pain. ESR and CRP blood results were normal. The patient was therefore diagnosed with Type II WRULD.

Clinical Presentation

The patient presented at Occupational Therapy with a pain score of VAS 4 in the right wrist, radiating from the wrist to the elbow. Pain was present during most functional tasks. There were no pins and needles or numbness in either upper limb, which was consistent with a negative Phalens and Tinnel test as well as a negative Hunters Abduction test for the median nerve sensitivity. Swelling, nodules, and trigger points were absent in both upper extremities. AROM was normal in the right upper extremity. Grip strength was normal in the left (25 kg) and right (26 kg) hands. The initial Functional Grading score was III. The initial ''typing capacity cycle'' test result for relative typing speed was 14.9 words per minute.

Summary of Treatment Outcome

Before treatment, the patient presented with VAS 4 resting pain in the right hand, which was reduced to VAS 0 after treatment. The Functional Grading score improved significantly from III to I. Relative typing speed improved by 129% (14.9—34.1 wpm). The patient was treated over a period of six months and attended ten sessions of 60-minute duration each.

CASE STUDY 3

History

A 28-year-old lady who works as a solicitor presented with a 12-month history of pain in the right wrist as a result of excessive keyboard and mouse use, which did not impact on her ability to perform functional tasks. Long working hours meant she tended to lead a sedentary lifestyle.

Clinical Assessment

X-rays of the right wrist were normal. Provocative tests for Type I WRULDs including Carpal Tunnel Syndrome were negative. ESR and CRP blood test results were normal. A diagnosis of Type II WRULD was therefore made.

Clinical Presentation

The patient presented with an initial pain score of VAS 2 in the right wrist. Pain was present when holding items or performing resisted tasks. There were no pins and needles or numbness in either upper limb, which was consistent with a negative Phalens and Tinnel test as well as a negative Hunters Abduction test for the median nerve. There was no radial or ulna nerve sensitivity. Swelling, nodules, and trigger points were absent in both upper extremities. AROM was normal in the right upper extremity. Grip strength in the right hand was normal (20 kg). The functional Grading score was II at the onset of treatment. The initial ''typing capacity cycle'' test result for relative typing speed was 15.9 words per minute.

Summary of Treatment Outcome

Before treatment, the patient had VAS 2 resting pain but after treatment this was reduced to VAS 0. Strength remained the same but she had less pain during functional activities. The Functional Grading score improved significantly from II to I. The treatment program enabled her to participate in an exercise regime during her working day. Relative typing speed improved by 48% (15.9–23.5 wpm). The patient was treated over a period of five months and attended four sessions each of 60-minute duration.

DISCUSSION

A diagnosis of WRULD does not identify a specific neuromusculoskeletal lesion or an algorithmic management approach to follow. Rather it encompasses wide variety of pathology and symptoms. The nature of any therapeutic intervention should therefore relate to impairments, functional limitations, and disabilities.[24]

In this case series, our primary role has been to motivate and encourage the patient to gain control of their symptoms by learning about correct posture and normal patterns of movement. This enabled patients to identify areas of the body or upper quadrant that were under strain and required immediate attention to counteract the effects of prolonged static positioning and limited normal movement patterns. Once empowered with this knowledge, they proved to be better equipped to incorporate other aspects of the treatment regime. Pursuit of a sedentary lifestyle and the limited experience of being exposed to the feeling of normal body movement patterns and postural techniques was a common trait among the patients in this report.

A three-phase conservative treatment program was adopted.[20] Table 4 presents an overview of the conservative treatments used in relation to the impairments during each rehabilitation phase and Table 5 provides details of the exercise prescription and precautions.

Treatment sessions occurred on a one-to-one basis with a specialist Occupational Therapist. Splints were not advocated as they interfere with muscle rebalancing, strength, soft tissue alignment, and joint or bone composition.[25]

Each patient was provided with a rehabilitation manual, which included a detailed diagrammatic home exercise program designed to increase circulation, reduce stiffness or cramping, and encourage normal movement patterns.

During the first phase, the patients were encouraged to limit caffeine and nicotine intake and increase light aerobic exercise.

The second phase of treatment commenced once the patient had gained control of their symptoms and progressed the patient toward a strengthening program to rebalance muscles, improve joint function, soft tissue extensibility, muscle tone, and nerve mobility. Patients were taught to adapt to neurovascular changes to decrease the risk of injury.

The final conditioning phase of treatment aimed at maintaining the new health-promoting lifestyle and the application of the correct principles during a working day. The support, empowerment, and encouragement to adopt health-promoting behavior had a positive impact on the patient's ability to return to work.

The fear of the possible damage to one's career as a result of WRULD can hinder treatment, as patients will tend to work through pain to remain productive. Support and advice in dealing with conflicts at work while recovering were the important aspects of the treatment. We attempted to promote a strong work ethic to encourage patients to remain in the workplace rather than embark on prolonged periods of absence from work.

Principal Findings

Each patient in this case series presented with resting pain levels VAS 2–4 for six to 12 months before treatment and all worked with keyboard and PC mouse for more than 50% of the day. All the patients continued to work during the five- to six-month treatment program and achieved normal resting pain levels (VAS 0). During the same period, they also achieved a 48–129% increase in their typing productivity.

Strengths and Weaknesses

The author's acknowledge the limitations that a small case series report imposes. To our knowledge, there are no previous reports of high-intensity

TABLE 4. **Overview of Conservative Treatments Used**

Rehabilitation Phase	*Education*	*Ergonomic Adaptations or Principles*	*Joint Mobilization*	*Nerve Glide Exercises*	*Tendon Glide Exercises*	*Muscle Stretching*	*Graded Strengthening Program*	*Heat*	*Ice*	*Vibration or Massage*	*Rest*	*Pacing*	*Psychological Referral*
Phase I: Symptom Control													
Psychosocial - Stress - Anxiety	✓												✓
Insight into WRULD	✓												
Poor flexibility			✓		✓	✓		✓					
Poor ergonomics	✓	✓											
Poor posture	✓	✓				✓	✓					✓	
Joint stiffness	✓		✓					✓			✓	✓	
Inflammation	✓								✓		✓	✓	
Trigger points	✓					✓			✓	✓			
Nodules (muscle tension)	✓									✓			
Swelling	✓								✓	✓	✓	✓	
Peripheral nerve sensitivity	✓	✓		✓							✓	✓	
Tendon pain	✓				✓				✓		✓	✓	
Phase II: Strengthening													
Poor strength	✓						✓						
Muscle fatigue	✓	✓				✓	✓	✓	✓	✓	✓	✓	
Phase III: Conditioning													
Increase intensity and duration of exercises	✓	✓	✓	✓	✓	✓	✓				✓	✓	

TABLE 5. **Therapeutic Exercise and Modality Prescription**

	Frequency	*Intensity (Resistance)*	*Duration*	*Precaution*
Treatment Technique				
Joint mobilization	2–3 ×/day	N/A	As required.	Swelling, inflammation and pain.
Nerve glide exercises	1 ×/day	N/A	Hold for 5 sec.	Avoid nerve stretch if symptoms are exacerbated.
Tendon glide exercises	1 ×/day	N/A	Perform complete set each time.	Pain or inflammation.
Muscle stretching to encourage warm up through passive muscle elongation	Every 20 min for 20 sec perform one stretching exercise while working on the computer.	N/A	Hold for 10 sec.	Compensatory movement patterns.
Isotonic strengthening program Concentric contraction, e.g., theraband/ theraputty Eccentric contraction, e.g., theraband/ dumbells Constant loading, e.g., dumbbells Plyometric loading, e.g., catching then throwing a ball	3–4 ×/day	Initially, 3–5 repetitions of static exercise at low resistance and progress as pain allows. Grade dumbbell weight, Theraband, and theraputty resistance as required.	5 min every 2 h.	Significant swelling. Significant and specific pain. Limitations in ROM.
Treatment Modality				
Heat	Preceding mobilization; during treatment; for pain relief or to improve mobility.	N/A	20 min	Red, hot, or swollen joints.
Ice	3–6 ×/day after exercise or to decrease swelling, inflammation, spasm, and nodules.	N/A	10 min	Sensory or vascular problems. Check skin every 5 min to avoid redness.
Vibration	After exercise to reduce muscle tension and/ or pain.	Low	15 min	Lubricate to protect skin. Identify nodules and hardened tissue.
Massage	After exercise to reduce muscle tension and/ or pain.	Apply light pressure in the presence of oedema. Firm pressure when massaging muscles.	15 min	Lubricate to protect skin. Identify nodules and hardened tissue.

keyboard and mouse users with longstanding WRULDs who have remained at work during their rehabilitation. Therefore, these findings are significant as they have important implications for the clinician. The ''typing capacity cycle'' test is a tool that can be used to provide patients and their employers with guidelines on safe keyboard and mouse use within the workplace while individuals participate in their rehabilitation program. This is important as it may reduce the fear of litigation and prevent lengthy periods of absence from work, which can compromise an individual's career.[11] Finally, the described treatment program provides the clinician with an overview of how to address a variety of complexed symptoms effectively, in a manner which is reassuring and empowering for the patient, without the need for regular, ongoing treatment sessions.

Interpretation of Results

The described case reports suggest that it is possible with a conservative treatment program to both normalize resting pain and improve work capacity with relatively few outpatient appointments depending on the severity of the presenting symptoms. This is an important finding as the most comprehensive literature review of WRULD treatment by Verhagen et al. in 2003[26] concluded that there was limited evidence of effectiveness for individual exercises for treating such cases.

The described treatment approach aimed to facilitate an awareness of how to normalize abnormal, repetitive postural patterns through the use of exercise to prevent dysfunction and the onset of a chronic condition as well as to maintain the new health-promoting lifestyle and the application of

the correct principles during a working day. The support, empowerment, and encouragement to adopt health-promoting behavior had a positive impact on the patient's ability to return to work.

Lowe[18] described using a similar four-phase rehabilitative approach to treat Musicians with overuse syndrome who presented with disruption at several levels of function. The aim of the described treatment program was to restore form and balance and apply principles of good posture, flexibility, physical conditioning, and pacing in all activities of daily living to treat distal upper extremity injuries. It was highlighted that a successful treatment outcome depended upon lifestyle modification and an increase in self-knowledge.

Fry[19] noted an impressive clinical finding in his work with musicians who had overuse syndrome in that musicians tended to accept that their pain was normal one and therefore underestimated their problems and often continued to play with Grade IV injuries. We have observed that individuals with Type II WRULD tend to be less accepting of the presence of pain and therefore more likely to seek medical advice and comply with treatment at an earlier stage, thereby limiting the severity of the injury. However, there are individuals who will work through pain if their career is threatened and are likely to present with a Grade IV injury.

Mouse use is prevalent in most computer tasks and is associated with more constrained and nonneutral postures of the wrist and shoulder compared to keyboarding.[15] Our results suggest that the degree of mouse may not necessarily determine the severity of resting pain levels and functional capacity or influence the treatment outcome after the rehabilitation program described above. This finding can be reassuring for patients who present with high levels of resting pain as a result of excessive mouse use, who are assessed using the ''typing capacity cycle'' test and would like to have some indication of the impact this will have on their treatment outcome. Although the ''typing capacity cycle'' test does not have supportive psychometric data associated with it and does not include the mouse, it does provide useful information with regard to ascertaining levels of functional performance without increasing pain beyond VAS 5.

Questions and Future Research

Due to the limitations that a small case series imposes, the question remains whether or not the positive trend would emerge if the techniques used were repeated in a larger study. It would be preferable to perform a prospective randomized, controlled trial as no such comparable study is available to date.[26]

CONCLUSION

Treatment results of patients with longstanding WRULD who have high-intensity mouse use and who want to remain in work during treatment have to our knowledge not previously been reported. This case series report suggests that it is possible with a conservative treatment program to both normalize resting pain and improve work capacity. We therefore conclude that the test method and proposed treatment program can provide significant benefit with minimal risk of causing symptom aggravation in this highly selected group.

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JHT Read for Credit
Quiz: Article # 081

Record your answers on the Return Answer Form found on the tear-out coupon at the back of this issue. There is only one best answer for each question.

#1. The subjects in this case series all suffered from
   a. either lateral epicondylitis, carpal tunnel, or DeQuervains disease
   b. non-traumatic upper limb pain of unclear cause
   c. RSD
   d. type I WRULD

#2. One of the primary outcome instruments utilized in the series was
   a. a modified Moberg pick up test
   b. the Sollerman Hand Function Test
   c. the Purdue Peg Board Test
   d. a Functional Grading Scale

#3. The ''Typing Capacity Cycle'' test did **not** include
   a. bilateral key board operation
   b. use of a standard Dell key board
   c. use of a computer mouse
   d. a 30 minute typing session

#4. The primary therapeutic intervention offered to this series of patients was
   a. key board modification
   b. behavior modification
   c. mouse modification
   d. monitor placement modification

#5. The results can be summarized as
   a. decreased pain and increased work capacity
   b. increased work capacity, but unchanged pain levels
   c. decreased pain, but unchanged work capacity
   d. increased work capacity, decreased pain, and increased pay grade

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