In the past decade, occupational therapists involved with the rehabilitation of work-related musculoskeletal injuries have seen an astounding rise in the number of upper-extremity disorders. Various names have been given to these disorders, including repetitive strain disorder, cumulative trauma disorder, and overuse syndrome. All describe physical symptoms of persistent pain in joints, muscles, tendons, or other soft tissues of the upper extremities. Many of these cases manifest themselves during work or leisure activities involving upper-body repetitive motions (Kroemer, 1989). A review of the literature reveals three main causes of occupationally induced overuse syndrome: (a) rapid repetitive movements; (b) less-frequent forceful movements; and (c) static loading, which is defined as the work the muscles must do to hold body parts in certain positions (Bammer & Blignault, 1987).

Repetitive motions of the upper extremity occur frequently at the workplace. A data-entry operator may perform 20,000 keystrokes an hour, an assembly line worker may raise the dominant shoulder above acromion height 7,500 times per day, and a meat cutter may perform an average of 12,000 knife cuts per day (Snook, Fine, & Silverstein, 1988). Recent changes in industrial production methods may have precipitated the dramatic increase of overuse syndrome. For example, in the meat-packing industry, butchers used to work individually on carving whole carcasses. Several types of knives and knife strokes were used, thus providing variety in body movements and hand-grip specifications. Over the last two decades, however, the process of butchering cattle and hogs has been transformed into a high-speed assembly-line approach. Each worker makes the same knife cut several thousand times a day, resulting in a dramatic increase in production as well as a significant rise in overuse syndrome (Roel, 1989).

Occupational therapists use a variety of intervention strategies to treat overuse syndrome, including splinting or casting for immobilization, education in proper body mechanics and anatomy to minimize risk of reinjury, pain management techniques such as ice massage and pain medication, home modifications, and relaxation or stress management techniques. None of these treatment techniques, however, will help an injured employee return to his or her work environment unless modifications are made to the physical parameters of the job or the employee is allowed to modify his or her work behaviors. The present report describes occupational therapy intervention in the workplace with a printing company employee with bilateral upper-extremity overuse syndrome.

Case History
Kathy M., a 32-year-old employee of a local printing company, has overuse syndrome of her left upper extremity.
At the time of the diagnosis, symptoms included pain and weakness of her left arm with diminished fine motor coordination of her left hand. Kathy is strongly left dominant but had begun to rely more on her right upper extremity to perform the repetitive upper-body movements required at work. When her right arm began to show early signs of overuse syndrome a month later, she was assigned to light duty. She did not, however, work full-time due to the inconsistent availability of light-duty assignments. She was receiving individual physical therapy treatments at a private-practice clinic but rarely had the same therapist from session to session. Because of her lack of progress with physical therapy and diminishing ability to handle light duty, Kathy’s employer requested a rehabilitation consultant be assigned to manage her case. Four months after the initial diagnosis, the rehabilitation consultant referred Kathy to occupational therapy for an assessment of vocational options.

As Kathy’s occupational therapist, I conducted her initial evaluation over two 60-min sessions. While gathering information for the occupational therapy database, I identified the following problems in the area of situational coping:

1. Having recently moved to the area, Kathy lacked a broad network of community and family support. Her only contacts were at work, which complicated the obvious decision that she switch to a less physical job environment.
2. Kathy was experiencing significant financial distress after several months of part-time work. She thought that she was ineligible for workers’ compensation benefits until she had been out of work for 3 consecutive days; her employer, however, carefully scheduled her to never miss more than 2 days of work at a time.
3. Kathy’s feelings of hopelessness and depression about her prognosis were accentuated by her lack of a consistent physical therapist from session to session.

A call to the Vermont Labor and Industry Department resulted in an investigation of Kathy’s rights under workers’ compensation laws, and she subsequently received a check covering missed days at work. Her rehabilitation consultant was alerted to her fragile psychological status and agreed to follow her closely as well as support the recommendation that Kathy be followed by the same physical or occupational therapist.

At the second appointment, I focused on an assessment of Kathy’s work capacity status using the following objective evaluation tools: (a) hand-grip and prehension measurements with comparison to sex and age-appropriate normative data, (b) maximum lifting and carrying capacity with the use of boxes and weights, and (c) functional strength and endurance in upper-body tasks, as measured on the Baltimore Therapeutic Equipment Work Simulator.¹

Although specifics will not be discussed, the general finding of the evaluation was that the client’s dominant upper extremity was limited by as much as 75% as compared with her nondominant upper extremity. Kathy was issued an elastic wrist support to remind her to keep her wrist in a neutral position during functional tasks. Because Kathy was also having difficulty writing, rubber tubing was used to build up the handles of her writing utensils for easier gripping. A work-site evaluation was indicated for an assessment of the client’s ability to return to bindery work as well as to recommend modifications to specific job tasks to minimize upper-extremity repetitive movements.

**Work-Site Evaluation**

The work-site evaluation was conducted a few weeks later in the bindery room of the printing company. Those present were the client, her occupational therapist (the author), her rehabilitation consultant, her direct supervisor in the bindery room, and a representative from the company’s human resources department. The entire evaluation, including a tour of the facility and analysis of each workstation, took approximately 90 min to complete. Data analysis and the report write-up took me an additional 60 min.

Each workstation was assessed for physical stresses with regard to lifting activities according to the criteria developed by the National Institute of Occupational Safety and Health (NIOSH). Because great variability exists among workers regarding lifting performance capability and risk of injury, NIOSH established two limits with which to assess job safety—the maximum permissible limit (MPL) and the action limit (AL). Findings on the MPL show that (a) musculoskeletal injury rates and severity rates have increased significantly in populations when work is performed above the MPL and (b) only about 25% of men and less than 1% of women workers have the muscle strength to work above the MPL. Findings concerning the AL show that (a) musculoskeletal injury incidence and severity rates increase moderately in populations exposed to lifting conditions described by the AL and (b) more than 75% of women and 99% of men could lift loads described by the AL.

Properly analyzed lifting tasks are then described in one of the following three ways: (a) those above the MPL, which should be viewed as unacceptable and require engineering controls for job redesign; (b) those between the AL and the MPL, which are unacceptable without engineering or administrative controls; and (c) those

¹Available from Baltimore Therapeutic Equipment, 7455-1, New Ridge Road, Hanover, MD 21076.
below the AL, which are believed to represent nominal risk to most industrial work forces.

To assess safe conditions at Kathy's work setting, my role as occupational therapist was to calculate the AL of each job task. The MPL can then be found by multiplying the AL by 3. The formula used to define the AL of each task is as follows:

\[ AL = 90(h/3)(1 - 0.1|v - 30|)(D/3)(1 - F_{\text{max}}) \]

where H is the horizontal distance from the hands at the origin of the lift to the center of the body; V is the vertical distance measured from the hands to the floor at the origin of the lift; D is the vertical travel distance from the origin to the destination of the lift; F is the average number of lifts per min; and Fmax is the duration of lifting in an 8-hr workday. (For specific instructions on how to implement the above formula, see Work Practices Guide for Manual Lifting [NIOSH Technical Report, 1981].) Of the eight workstations reviewed, four (i.e., 50%) were found to be unsafe. The following is a discussion of the four unsafe workstations and the concomitant recommendations.

Each workstation in the bindery room is named according to the machine to be run. At the collus workstation, the workers are required to lift bundles of printed material from four stacked rows on a pallet to the level of the machine. When a worker lifts from the bottom row of the pallet, AL = 6 lb, MPL = 18 lb. From the top row, AL = 9 lb, MPL = 27 lb. The actual bundle weight of 30 lb is greater than the MPL of either pallet row, thereby making all aspects of the job unsafe. This workstation is difficult to redesign because the lifting of objects from pallets requires a long arm reach. Thus, in order to accommodate how far away the object is from the body, the weight of the object needs to be reduced to make the lift safe. One practical solution is for the workers to cut the bundle cord while on the pallet, then lift the bundle in pieces to the shelf of the collus machine. Although taking time to cut the bundle cord slows production, other benefits could be found through reduction of the lift frequency. For example, reduction of the frequency of lift from 8 lifts per min to 2 lifts per min would result in the raising of the AL of the bottom row to 15 lb and the raising of the AL of the top row to 17 lb.

The other three workstations could be similarly modified to benefit bindery machine operators by providing safer work situations. At the saddle-stitch machine, loose pages of printed material are moved down a conveyor belt and bound into a magazine format. I recommended that the workers never lift the paper directly from the pallet, but instead always work from the 3-ft-high shelf available near the conveyor belt. The signature leader workstation, where the worker lifts the printed material from the pallet to the shelf, could be made safer through the reduction of the weight of the board bundles to 15 lb as they come out of the printing room or by the cutting of the bundles when on the pallet to decrease the weight of the lift. At the mailing machine workstation, workers were recommended to slow down the frequency of lift to reduce musculoskeletal stresses resulting from fast production rates.

General observations of the work setting that were noted during the on-site evaluation include the following:

1. The workers performed the same job for most of the 8-hr shift, with one 20-min dinner break and two 5-min rest breaks.
2. Some ergonomic tools were available to the workers, such as an electric jogger. This device shuffles the printed materials before placing them on the binding machine, thus preventing the workers from having to perform repetitive arm movements. The two electric joggers were made available the day we were present after great difficulty was taken to locate them on the work floor.  
3. The supervisor of Kathy's shift commented that he thought he would have difficulty convincing his workers to slow down, because they liked to work as quickly as possible. Additionally, they frequently voted as a group to work at a certain speed or to stay at the same machine the entire shift rather than changing machines every few hours. This democratic process makes individual differences and preferences difficult to assess.

In summary, the four workstations described above indicate that unsafe and potentially hazardous conditions exist at this company for the client as well as for other employees working in the bindery room. My report recommended that the work setting be modified according to the load lift recommendations established by the NIOSH action limit formula. In addition, I recommended that all of the machine operators and supervisors be educated in techniques to prevent overuse syndrome and other musculoskeletal injuries.

Early warning signs of overuse syndrome include pain, tenderness, weakness, numbness, swelling, and temperature change in affected areas. The onset of symptoms may be gradual or sudden and, in the early stages, occur in coordination with repetitive movement tasks. Generally, if no action is taken, symptoms may persist even when the affected part of the body is at rest.

Techniques used to prevent the development of overuse syndrome include avoidance of the following job conditions:

1. Repetitious job activities.
2. Use of vibratory tools.
3. Holding the same body posture for long periods of time.
4. Twisting body segments in extreme positions.
5. Prolonged exertion of muscles using more than 30% of strength available for an activity.
6. Exposing body parts to cold temperatures (Kroemer, 1989).
7. Beginning any task without adequate stretching to warm up performing muscle groups.

The following workplace modifications could be easily incorporated without interfering with production rates:

1. Workers should change workstations every few hours during their shift to avoid repetitive movements.
2. Workers should use the ergonomic tools available to them. For example, the electric jogger should be used to avoid the rapid repetitive movements involved in manual paper jogging.
3. Workers should be educated in the early signs and symptoms of overuse syndrome so they can seek appropriate treatment before irreversible damage is done.

**Client Outcome**

Kathy was allowed to participate in a month of occupational therapy programming to prepare her for the transition back to work. The first 2 weeks of this program consisted of rest from all repetitive movement activities, with the focus on inflammation reduction through positioning. The client was given a wrist support to position her left wrist in neutral and to remind her to avoid deviating her hand for functional tasks. I monitored Kathy's symptoms while she performed light functional activities of daily living at home in addition to a range of motion and stretching program for both upper extremities. During the next 2 weeks, she participated in activities designed to strengthen upper-body function and endurance activities in the clinic, with emphasis on movements she would have to perform at work. She performed a repetitive lifting program and simulated machine operator tasks on the Baltimore Therapeutic Equipment Work Simulator. She made the transition back to work by initially working three shifts per week and was assigned to be the break person. In this role, she would work at a machine for only 15 min at a time before changing positions. Meanwhile, the vice-president of the printing company called me to discuss specifics of the work-site evaluation. He planned to review the NIOSH standards for possible implementation throughout the entire plant. Unfortunately, the changes did not come soon enough for Kathy. She suffered an acute exacerbation of symptoms 3 months after returning to work and was forced to stop working. She participated in 8 weeks of occupational therapy in a work-hardening program several months later and is now looking for less repetitive work.

**Summary**

The incidence of overuse syndrome is increasing due to changes in industry, the popularity of computer terminals, and an increasing public awareness of overuse disorders. Traditionally, techniques for the rehabilitation of musculoskeletal upper-extremity injuries have been successful through focused treatment within the clinical setting. However, comprehensive therapeutic intervention with overuse syndrome must include a thorough job analysis to clarify the etiology of the injury as well as to provide recommendations for workstation modifications. On-site job analysis is the preferred method for the obtaining of a more complete assessment of the physical and psychological work environment. In addition, by interacting with other employees at the workplace, the occupational therapist or work-site evaluator can convey educational material that may reach those workers who are at risk for overuse syndrome.

This case report described 9 months of occupational therapy intervention with a young woman with overuse syndrome of the bilateral upper extremity. Although the client was not successful in returning to her job, she achieved satisfactory outcomes in other areas. She now has a better understanding of overuse syndrome and has learned how to live with this disorder by combining pain management techniques with daily stretching exercises and proper body mechanics. She is hopeful that as a consequence of her injury, other employees at the printing company where she worked may avoid overuse syndrome through education and work-site modifications. In addition, the client will return to competitive employment with knowledge of her vocational strengths and limitations. Kathy is permanently limited in her ability to perform the repetitive wrist and hand movements needed for many well-paying manufacturing jobs. However, her vocational strengths include good strength throughout the rest of her body, a repetitive lifting and carrying ability of 25 lb, and a strong work ethic that will always make her a reliable employee.

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**References**


Editor’s Note: To continue the Case Report department, we need and welcome reports that document the practice of occupational therapy for specific clinical situations. Guidelines for writing case reports are available from the Editor.

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