Using Work Simulation to Treat Adults With Back Injuries

(backache; pain; services, occupational therapy; work)

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Occupational therapy at the Liberty Mutual Medical Service Center, Boston, Massachusetts, offers a diverse variety of modalities for the treatment of patients with low back pain. Treatment may include the use of a balance monitor, a multiwork station, a pneumatic lifting-lowering device, a computerized upper extremity work simulator, and a truck-driving simulator. The primary objective of occupational therapy in this setting is to provide a supportive environment where patients can practice and improve the execution of the work-related activities they need to perform their jobs while they are learning to live with or control their symptoms.

Since 1943, Liberty Mutual Insurance Company has provided outpatient rehabilitation services for those policy-holding employees who have suffered an injury in the workplace. Referrals are made to the Liberty Mutual Medical Service Center by a nationwide network of 150 rehabilitation nurses who identify patients who would benefit from treatment at the center's rehabilitation program. These patients generally have suffered orthopedic injuries, including fractures, soft tissue injuries, back and neck injuries, or limb amputations.

The treatment services available to the patient include occupational therapy, physical therapy, general body fitness (coordinated with the particular injury being treated), psychological counseling, vocational counseling, cardiovascular conditioning, and, if necessary, nutrition and weight reduction. Along with these services, patients are educated about their disability in an intensive program that includes booklets, movies, and sound-slide shows. This paper focuses on the role of the center's occupational therapy department in rehabilitating workers suffering from either chronic or acute back pain. The goal of the occupational therapist, working in cooperation with members of other disciplines, is to help patients increase their level of function and return to productive employment.

Literature Review

Low back pain is a pervasive health problem (1, 2). Aside from being a common medical complaint, it is the leading cause for compensation payments in the United States. As the leading

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Low back pain is an all-encompassing disability that can interfere with all aspects of daily living. The Ecological Frame of Reference developed by occupational therapists Howe and Briggs (5) demonstrates how the interruption of an individual's activity by low back pain affects his or her job status and role as a member of a family, community, and culture.

Low back pain is generally the result of a series of insults to the spinal structure (6). The spinal column has little inherent support other than from the abdominal muscles and the paraspinal muscles of the back. A major cause of back injury is improper use of body mechanics.

Individuals commonly injure their backs as a result of an uneven distribution of loading to the structural components (i.e., vertebrae) of the spine (6). These vertebrae then may lose their stability, which results in the clinical symptoms expressed by the patient. Following diagnosis, surgery may be necessary. However, most chronic back problems are resolved without surgery (4, 7).

Caldwell and Chase (8) researched low back pain and found that as patients experience pain they generally become more tense and sensitive to even small body movements. In addition, they found that fear lowers the pain threshold. Pain once experienced may become a conditioned response to movement. Patients may then envision losses in terms of decreased activity, change of lifestyle, and financial problems.

Depression is often an emotional response to these changes (8). Sternbach (4) found, however, that when patients know what to expect with their disability, the emotional response to a certain level of pain is reduced.

It is important for patients to receive authoritative reassurance regarding their low back pain. Donovan and others (9), found that a clear explanation of the disability helped to lessen the confusion and fear associated with low back pain. Fear of activity not only increases the physical and emotional pain experienced by the patient, but also can cause the patient to play the "sick role." To become an independent, active member of society, the patient with low back pain must be given alternatives to the role of "disabled patient," as well as opportunities to engage in functional activities in a nonthreatening atmosphere. With less pain and fear, patients usually experience diminished depression (9–11). Fear reduction then is an important part of treatment and often results in increased activity, self-esteem, and, therefore, productivity (8–12).

The goal of an interdisciplinary program for back pain is to elicit productive behavior rather than sick behavior (13). Research of programs for low back pain shows that the interdisciplinary approach that addresses the whole person achieves greater rehabilitative success than an exclusively medical approach (2, 4, 12–16). Latimer (17) and Robinson (2) found that occupational therapy programs using activity-directed treatment provide the most successful results for patients with low back pain. Such therapy includes reinforcing well-behaviors and discouraging pain-centered behaviors while patients engage in work and social activity.

There are several other research findings that were important in conceptualizing the occupational therapy program. Treatment before the onset of learned pain behavior was found to prevent physical anomalies and poor muscle tone from worsening. It also promotes awareness and reinforcement of well behaviors (12, 18, 19). Also, as a treatment, exercise alone has revealed no evidence of improvement in patients with low back pain (12, 18, 19). Cairns and others (18) reported that "shifting one (patient) from a passive role to becoming an active participant in his own rehabilitation must receive careful attention" (p. 303). These authors also suggested that a program's success is measured by greater functional activity and less pain-centered talk and movement and that patients must ultimately assume responsibility for effective results in their own rehabilitation.

Evaluation

The initial low back evaluation begins with a description of the injury responsible for the patient's disability and a complete medical history, showing allergies and use of medication. This information is obtained both from an interview with the patient and from the medical record. The patient's activities of daily living (ADL) status is then evaluated to determine functions that may be difficult or impossible to perform because of back discomfort. Such ADL functions may include self-care, household chores, sexual relations, and avocational interests. A patient may also be evaluated for adaptive equipment such as bathtub seats and safety railings, reachers, long-handled sponges, and lumbar support cushions. Psychological issues and concerns, such as anxiety related to alterations in daily routines, family relationships, fear of pain, and so-
cial and work roles, are also discussed.

A thorough job description and history are also obtained during the initial interview. The job description includes the physical demands, mental activities, and other responsibilities that the job may entail. This description is necessary to organize an effective work simulation program. A job history informs the therapist of other skills and abilities a patient possesses in the event that the patient cannot return to past employment because of physical limitations.

Next the patient fills out a body chart, a schematic diagram that illustrates any pain or discomfort being experienced. The chart may be used in subsequent evaluations to note changes in pain or discomfort distribution, location, magnitude, and frequency.

A balance monitor (see Figure 1) may be used to register the percentage of weight a patient may be bearing on a given extremity. Throughout the evaluation, the therapist notes the patient’s sitting and standing posture, as well as his or her mobility and tolerance for these activities. These continuous observations are especially pertinent for evaluating body mechanics. The patient is asked to perform a series of functional activities that entail movements such as bending, pushing, and reaching. These activities allow the therapist to observe and evaluate body mechanics. Observations are focused on the presence or absence of lordosis, kyphosis, pelvic tilt, waist bending, lower extremity weight bearing, and similar problems. The therapist also notes the patient’s level of coordination, facial expressions, shortness of breath, and pain reports.

Following the initial evaluation, the therapist and patient together establish treatment priorities to determine short- and long-term goals. This allows the patient to assume an active role in planning treatment. The ability to achieve greater independence in ADL or to heighten awareness and improve the use of proper body mechanics might constitute a short-term goal. Achieving a functional capacity for lifting, pushing, and pulling to within normal limits might constitute a long-term goal. Normal limits can be defined by knowing the patient’s capabilities prior to injury. At this point in the evaluation procedure, referrals to other services such as vocational and psychological counseling may be discussed.

Regularly scheduled meetings with team members from each discipline are held to determine if old goals have been met and to establish new ones. This assures that the patient receives ongoing care.

Treatment

Occupational therapy treatment begins with patient education. Through discussion, demonstration, active participation, and visual aids, the therapist communicates the information patients need to fully understand their individual treatment program. Generally, patients are educated about pertinent subjects such as anatomy of the spine, body mechanics, and energy conservation. The patient also views a body mechanics videotape and reads an ADL body mechanics back booklet. Relaxation techniques and proper weight control are reviewed as appropriate. Relaxation techniques include meditation, progressive relaxation, increased body awareness, and control of breathing and muscle tension.

Following education, the patient begins activities that simulate the work environment. Staying within a patient’s limitation, selected activities are employed to obtain or maintain short-term goals. Work simulation activity is gradually increased to a level that approaches the patient’s average pre-morbid work schedule. This allows the therapist and patient to discover the patient’s work tolerance levels and to decide together whether a return to regular employment is a realistic goal.

Patients monitor their activity level by maintaining an activity log. This log encourages them to assume increased responsibility for their own rehabilitation. The types of activities performed and the increase of activity levels in relation to the patterns of pain are discussed with the therapist at the end of each week.

Modalities

Various modalities, such as the following, are used to reach the goals established after the initial evaluation:

**Balance Monitor.** The balance monitor (see Figure 1) is a graded
lower extremity weight-bearing apparatus used during stationary standing activities. The machine indicates the percentage of weight that the patient bears on an extremity and provides feedback on symmetrical and asymmetrical posture.

**Multiwork Station.** A work-simulation modality, the multiwork station (see Figure 2) has many repetitive operations that are found in various construction occupations. It is designed so that most tasks can be performed in optimum working positions, using small materials and tools. As the patient progresses, the variables (i.e., repetition, time, increases in loads) may increase in difficulty.

The station is a 2.44 m (8 ft) square, 3.35 m (11 ft) high wooden-frame structure with four sides. Three sides are designed to simulate construction work in carpentry, plumbing, and electrical wiring.

The carpentry side has a height-adjustable wooden beam that can be used for manual nailing, drilling, and sawing. There are also plywood sheets of various sizes that can be used to side the work station.

The plumbing side of the work station is equipped with 3.17 cm (1/4 in.) pipe flanges that are attached to vertical studs at increments of 60.96 cm (2 ft). A variety of pipes, fittings, and wrenches are supplied to help the patient fabricate simple and complex plumbing arrangements at work levels from the floor to the second level. A wall-mounted pipe vise and pipe rest is also outfitted on the plumbing side so that different pipe sizes can be cut and threaded.

The electrical side of the work station is equipped with boxes connected by conduits. Patients may practice snaking and pulling wires to simulate the installation of an electrical system. There is also a metal sheet to which screws may be applied at different levels.

The truck simulator was designed and constructed at Liberty Mutual Research Center, Boston.

The fourth side of the work station has a vertical ladder and a step-ladder, as well as staging that provides access to the upper level. Patients may practice climbing and stabilizing themselves on the ladders during work activity. They may also use the ladder or pulley arrangement, or both, to transport materials between the two levels. For example, boxes of floor tiles are available to be transported to the upper level through an opening in the work station.

The work station can also be used by the group to practice cooperative skills; group members disassemble, then reassemble, the separate sections. A group format allows patients to share feelings and experiences with others in a supportive atmosphere.

**Truck Simulator.** This modality (see Figure 3) is specifically designed for truck drivers and consists of a 3.05 m (10 ft) high, quarter-truck cab equipped with a steering wheel and foot pedals that have graded resistance. A computerized video road screen simulates the driving process.
0.9144 cm (2 ft × 3 ft) platform, operated pneumatically on a time-sequenced basis, is used to simulate the lifting process (see Figure 4). The amount of time that the pneumatic lift remains at a certain level may be programmed into the attached control box to set the activity.

**Upper Extremity Work Simulator.** The primary components of this simulator (see Figure 5) are the adjustable shaft, which accommodates a number of tools that can be adjusted to different heights and angles, and the computerized console, which displays the amount of resistance the therapist programs for each tool. After each activity is completed, the console supplies a printout displaying data, such as force exerted on the tool and the amount of time spent on the activity. A large steering wheel and an attachment that simulates shoveling are two tools often used when treating the patient with low back pain. These bilateral tools encourage the controlled use of the musculature of the torso and upper extremities.

**The Back School**

Sometime during their treatment program at the center, patients with low back pain may be referred to the center-sponsored Back School. This is a week-long patient education program that is offered once a month. The goals of the Back School are to encourage participants to gradually increase their level of function, to prevent further back-related problems, to reduce the risk of further surgery to the back, and to promote a return-to-work attitude. The school emphasizes topic areas such as epidemiology, anatomy, physiology, stress management, drug use and abuse, exercise, and body mechanics. The professionals responsible for the different topic sessions include occupational therapists, physicians, physical therapists, psychologists, vocational counselors, and ergonomists.

In the Back School, occupational therapists are specifically responsible for instructing patients in proper body mechanics for carry-over use in the home and workplace (see Figure 6). This is achieved by lecture, demonstration, and, most effectively, by asking the patient to complete an "obstacle course." This course consists of a number of standardized physical tasks designed to simulate everyday activities such as bending, lifting, sitting, and reaching. The patient's untutored performance of these tasks is videotaped. The videotape is used as objective visual feedback by the patient who, together with the occupational therapist, reviews and criticizes his or her performance. Suggestions for modifying or correcting the performance of these tasks are made, with improvement in proper body mechanics usually resulting by the end of the week.

**Discharge**

Discharge from the center is indicated when patients have reached their short- and long-term goals or when they have reached a plateau in the treatment process. Discharge is determined within the interdisciplinary meeting. As patients approach discharge, the therapist's documentation of functional capacity is particularly important. Information on a patient's abilities, limitations, and potential for change is necessary for determining his or her future work status.

Prior to discharge, the therapist may provide the patient with a home therapy program. Such a program might include the application of treatment goals to the patient's home and work environments. Examples of goals are to maintain strength, endurance, and mobility, and to continue to use proper body mechanics. As a patient nears discharge, vocational interests are discussed, and recommendations are made as necessary.

Patients are discharged to their regular jobs or to adjusted or light-duty work at their place of employment. They can also continue vocational counseling at the center to explore new job opportunities or related fields of interest.

**A Case Study**

KJ is a 38-year-old male who was referred for rehabilitation 3½ months after an L5 disectomy. KJ, a mechanic of construction equipment, had sustained a ruptured disc while repairing a crane. He reported numbness and tim-
The upper extremity work simulator was designed and constructed at Liberty Mutual Medical Service Center, Boston.

Figure 5
Upper extremity work simulator

Figure 6
Occupational therapists instructing patient in proper body mechanics

Glimp in his left lower leg and pain in the left buttock and across the low back. These symptoms increased with activity.

Upon examination, KJ stood symmetrically without evidence of scoliosis, abnormal kyphosis, lordosis, or pelvic obliquity. However, he demonstrated increased weight bearing on the lower left extremity during a standing activity. He walked quickly and with a symmetrical arm swing, but with a slight deviation in gait. Although no limp was present, the left leg externally rotated to a greater degree than did the right leg. He could stand for one hour, but only if he was able to place alternately one leg and then the other on a low footstool. He could squat and perform an activity for a maximum of two to three minutes. He climbed a vertical ladder using a smooth reciprocal pattern.

A functional evaluation yielded a few limitations in ADL, for example, he was unable to drive for more than 30 minutes, vacuum, mow the lawn, or repair his car.

Prior to implementing treatment, a job description was secured. KJ's work as a mechanic of large equipment required that he be able to assume a variety of postures and perform several motions for varied periods of time. These included standing, pushing and pulling very resistive levers, lifting 22.5 kg to 45 kg (50 lb to 100 lb) objects, squatting, kneeling, climbing stairs and ladders, and maneuvering in and out of awkward or confined spaces.

Using this information, the therapist and patient jointly devised a treatment program that would simulate the motions and postures his job requires. Treatment activities included crafts performed in a standing position, pulling and pushing a short lever on the upper extremity work simulator, lifting a weighted box, laying tile while squatting and kneeling, climbing ladders, and "wriggling through" the exposed framework of the multiwork station. He was also given both upper and lower extremity exercises, which included using the bicycle saw, the bucket hoist, and inclined sander. KJ was also instructed in proper body mechanics, he was evaluated and then assigned necessary adaptive equipment (e.g., shower seat, long-handled sponge, long-handled shoehorn, and back support for driving).

Upon admission, KJ had a phy-
physician’s orders for occupational therapy, physical therapy, and general fitness. He initially attended occupational therapy twice a day, for approximately 1 to 1½ hours each session. A graded approach to treatment was used. The time spent on the activities was gradually increased and heavier weights were lifted. Treatment activities were also made more strenuous; they included more difficult climbing and activities performed in a squatting position. Monitoring and instruction of body mechanics took place throughout the treatment. In the meantime, KJ was encouraged to engage in increasingly strenuous activities at home. He participated in outpatient rehabilitation for one month, at the end of which he and the medical staff determined that he was ready to return to work.

Discharge was determined by a decrease in subjective complaints, improvements in objective performance, and the results of a work tolerance capacity assessment by the occupational therapist, which evaluates the patient’s ability to stand, sit, squat, kneel, lift, bend, carry, and crawl.

Discussion

Vocational activity has re-emerged as a focal point in occupational therapy discussions during recent years. Recently, work evaluation, work capacity, and work tolerance were a focus of a special issue of The American Journal of Occupational Therapy (Volume 39, Number 5, May 1985). Occupational therapists are concerned with these aspects of patient care. A patient’s working capacity is considered important by Tunturi, Kataja, Keski, and others (20) because it is an objective measure. The objective reporting of work tolerance thus is a legitimate form of patient evaluation.

A difficult obstacle for rehabilitated patients is their fear of changing their life-style from that of a dependent, passive patient to an independent, active member of a business or community. Many patients who have lost their ability to function as a healthy family member and as a worker consider themselves failures. Persons on workers’ compensation may feel they are receiving a financial “reward” for their disability (9). If they are also receiving sympathy from family and friends, they may fall into a “habit of disability” (9, 11, 13, 20, 21).

The occupational therapy protocol for treating patients with low back pain described in this paper encourages patients to become active as soon as possible to optimize their physical abilities and prevent learned pain behavior.

The occupational therapy clinic provides a supportive atmosphere in which the patients can test their increasing work, home, and vocational skills. The clinic’s goals are to help the patient control pain and reduce the risk of reinjury by strengthening the structural spinal support, using the principles of proper movement, and to lessen his or her fear of activity. The clinic provides the environment for functional return to normal life at work and home.

REFERENCES