RECOVERY THROUGH UTILIZATION: 1985 VOLVO AWARD IN CLINICAL SCIENCES OBJECTIVE ASSESSMENT OF SPINE FUNCTION FOLLOWING INDUSTRIAL INJURY A PROSPECTIVE STUDY WITH COMPARISON GROUP AND ONE-YEAR FOLLOW-UP

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Objective functional capacity measurement techniques were used to guide a treatment program for a group of 66 chronic back pain patients. These patients were compared with a group of 38 chronic patients who were not administered the treatment program. Outcome data were collected by telephone survey at an average 1 year follow-up. In addition, functional capacity measures were collected for treatment group patients on admission and follow-up evaluations. Results demonstrated that the functional capacity measures collected for the treatment group improved in approximately 80% of the patients. These changes were also accompanied by positive changes in psychologic measures. In addition, at 1 year follow-up, the treatment group had approximately twice the rate of patients who returned to work, relative to the comparison group. Additional surgery rates were comparable for both groups (6% in the treatment and 7% in the comparison group), but the frequency of additional health-care professional visits was substantially higher in the comparison group. The findings suggest that quantitative functional capacity measures can give objective evidence of patient physical abilities and degree of effort and can significantly guide the clinician in administering an effective treatment program [Key words: chronic back pain, functional capacity measures, prospective study, spine function]

While 90-95% of acute low-back patients will resolve their disability within 3 months of injury,[1,14] in some, chronic or recurrent back disability may persist for years. The fact that the mere passage of time plays such an important role in the spontaneous resolution of acute spinal problems also makes randomized, controlled treatment evaluation studies of these problems difficult to perform. In fact, the literature does not contain any such comprehensive studies.[6] To evaluate the impact of objective assessment techniques on low-back dysfunction, the chronic patient appears to provide the best subject population. The present study employed a chronic patient sample in evaluating the utility of new functional capacity technology in guiding a spine rehabilitation treatment program.

As is well known, chronic low-back pain is a major socioeconomic problem. It rates as the number one cause of disability below the age of 45, and as the third major cause over the age of 45 (following arthritis and heart disease).[10] There is an accompanying high cost related not only to medical and surgical care, but also to litigation, workers compensation, long-term disability insurance and social security payments, as well as lost work time. Because of the important socioeconomic issues of financial cost to society and loss of productivity, the present study was designed to address these issues by collecting treatment outcome criteria measures such as return-to-work, insurance litigation, and additional health-care costs.

The chronically injured back pain patient may go on to multiple surgeries and repeated use of the medical care system, in addition to the costly litigation and considerable morbidity affecting work productivity and family relationships. For these chronic patients, however, multiple surgeries appear to be of little benefit, so that alternate methods of care become necessary. As an alternative, medical care for chronic low-back pain has evolved into a "hodge-podge" of techniques aimed at altering the patient's self-report of pain. More than 1,000 "pain clinics" have been developed during the past 15 years in the United States, most of which employ primarily passive physical modalities such as spinal manipulation, acupuncture, electrical stimulation, and repeated spinal injections, as well as biofeedback and various behavior modification regimes, which often increase the patient's dependence on the medical care system.

There have, however, been major problems associated with these alternative approaches. The effectiveness of pain clinics in modifying back pain disability has recently been strongly questioned.[17] Unfortunately, the multifaceted nature of medical, legal, psychological, and socioeconomic problems inherent in this disability problem make it a difficult and complex phenomenon to evaluate. As a result, very few studies have been conducted documenting efficacy, or even agreeing on basic concepts such as methods of treatment, appropriate outcome criteria, and objective diagnostic measures and categories. Furthermore, the socioeconomic status of the patients creates great difficulty in retrieving long-term follow-up information.[2]

The absence of objective functional capacity measurement is a likely cause for much of the present confusion in spine care. In the extremities, musculoskeletal physicians rely on visual observation of joint motion and stability, extremity circumference, right/left comparisons, as well as ergometry and muscle strength measurement, to help guide treatment programs after injury or surgery and to determine disability and feed information back to patients about their progress. In the spine, small well-camouflaged joints and deep muscles with complex multiplanor movements and interconnections make visual feedback impossible, thus leading to a near-total reliance on subjective pain complaints and radiographic imaging to guide treatment. The potential value of objective measurement of spine function leading to the same understanding of the spine as is currently utilized in guiding sports medicine treatment of the extremities has been recognized for some time, although practical and clinically useful technology has not been generally available.[3,7,8,10,15,18] Self-report of pain and medical history, structural measure (e.g., radiographic imaging), and functional capacity measurements are the three critical components necessary for diagnosis and surgical decisionmaking in the extremities. However, only the first two of these components are currently utilized in spine treatment and decisionmaking. The addition of this latter component to spine assessment is essential, and it is the purpose of the present study to demonstrate how effective the treatment program guided by functional assessment can be.

Because of the vexing problems of lack of correlation between structural diagnoses and symptoms, as well as lack of adequate patient follow-up, nonsurgical treatment has usually been nonspecific, and treatment effectiveness poorly validated. What is currently needed, and fortunately not available, is a quantitative technique for objectively documenting spine function as opposed to imaging techniques that merely assess the spine degenerative process, which is after all progressive and universal, and correlates poorly with clinical symptomatology in the vast majority of patients. The increasing understanding of disuse and the "deconditioning syndrome" as a factor in long-term disability, and the recent, novel developments in the quantification of true spine range of motion,[13] trunk muscle,[5,11,16,18] endurance, and lifting capacity[12] bring a new dimension to low-back assessment. In addition, use of realistic outcome criteria[7,13] in which success is gauged by improvement in disability and function, and not solely by the patient's subjective pain self-report, which is frequently modified by psychological, legal, and financial factors, is another feature of the current investigation.

The present treatment program was designed to utilize objective assessment approaches to low-back pain. Fitness has been recognized as an important factor in decreasing the incidence of low-back injuries,[4] and a direct relationship between specific functional measures and subsequent back injury has been demonstrated.[3] In fact, a key assumption of the present investigation is that a major physical deficit in this chronic patients is the disuse-induced "deconditioning syndrome" caused by prolonged and excessive self-protection of spinal joints and muscles, and often iatrogenically abetted. In primitive societies, disuse of the low back is not compatible with survival, and may help to account for the near-absence of this disability in these cultures. The present program involved the repeated noninvasive testing of back function to steer the treatment process toward attaining physical goals, rather than simply pursuing changes in self-report of pain complaints. The guided philosophy of this "functional restoration" program was the restoration of joint motility, muscular strength, endurance, and conditioning, as well as cardiovascular fitness leading to restoration of the ability to perform specific functional tasks such as lifting, bending, twisting, and tolerance of prolonged static positioning (i.e., sitting and standing).

Integrated with this "functional restoration" emphasis was a multimodal pain management program (MPMP) that employed a comprehensive cognitive-behavioral treatment orientation to help patients better cope with, and manage, their pain, temporarily increased while undergoing the sports medicine physical approach to correct functional deficits. The treatment program depended on an extension of the physical quantification of function approach to the psychologic realm. In evaluating this novel approach, the changes in physical functioning and how they related to self-reported measures of pain, as well as to outcome criteria measures, such as return-to-work, resolution of litigation, and subsequent medical care, were all examined.

Results

Although 66 patients completed the present program study, all were not totally quantified because of intermittent scheduling difficulties, unavailability of measurement devices, etc. The number of patients included in the various analyses will be noted. Of the 74 patients in the comparison group, only 50 (68%) could be contacted. The whereabouts of the remaining 24 (32%) could not be ascertained. For this comparison group, only the return-to-work and additional medical care data was collected.

Return-to-work outcome

Over the average 5 month follow-up period, the overwhelming majority of the 66 patients completing the present study returned to gainful employment in full-time jobs (82%), and an additional 6% to a full-time training program supported by the Texas Rehabilitation Commission, with the goal of patients learning a new employable job skill. Three of the 4 patient involved in training were taking vocational courses lasting no more than 6 months and geared to specific employment goals. Of the 8 failures, five were unemployed for reasons other than the back pain (two head injuries, one mental retardation, one hospitalized with gunshot wound, and one bypass surgery, post MI). As can be seen, their return-to-work figures are much smaller. Only 12 of the 50 (24%) were actually working, while an additional 32% were more active (hobbies at home or participating in training programs). There were 22 failures (44%) remaining disabled and unproductive (including 14% reoperated).

Functional Capacity Testing

Table I presents the means and standard deviations of the various functional capacity measures evaluated in the present study at the initial admission assessment and the 3-month follow-up assessment. As can be seen, there was a substantial increase in these functional capacity measures at follow-up, for both strength measures (e.g., Cybex performance) as well as range-of-motion measures (e.g., spine flexion/extension). This was true for both males and females. Analyses of these changes (paired t-tests) statistically documented the significant improvement (P values of these tests are included in table 1).

Admission data for the lifting tests could only be obtained on a total of 18 patients and, therefore, the change from admission to follow-up could only be computed for this small number (see table 1). However, as follow-up, a larger number of patients were tested. The mean lifting capacity for males (n=26) at follow-up for frequent lifts from floor to waist was 55.5 lbs., and from waist to above shoulder was 49.6 lbs.; for females (n=19), floor to waist frequent lifting was 35.2 lbs., and waist to above shoulder was 32.3 lbs. Occasional lifting capacity was also tested at this 3-month follow-up, utilizing a standard state lifting dynamometer under NIOSH guidelines. Mean leg lift (of bent knee, straight back lift) capacity for males (n=24) was 238.3 lbs., and for females (n=14) was 112.5 lbs. Mean torso lift (a straigh knee, bent back lift) capacity for males was 162.9 lbs. and for females was 82.5 lbs. There were frequent repeated lifting tasks as part of work simulation and testing during the 3-week program, and these lifting figures attest to the impressive capacity of patients in these areas at time of follow-up.

Psychological Testing

Figure 1 presents the means and standard deviations of the psychological measures evaluated in the present study at the initial admission assessment and the 3-month follow-up assessment. As is evident, there was a substantial improvement in self-reported pain and dysfunction. There was a significant decrease in self-reported pain on the Million Analog Scale (a decrease of 27% from a mean of 106-77), as well as a decrease on the quantified pain drawing (extremity scores dropped 50%, and trunk scores decreased 22%). Self-reported depression also decreased 33%. Analyses of these figures (paired t-tests) statistically documented the significance of these changes. These significant changes were evident in both males and females.

Table 1. Tests of Physical Function Used in the Present Study

Tests	Description
Spinal range of motion Gross lumbar range True lumbar range Straight leg raising	A quantitative noninvasive measur of trunk range of motion in the sagittal plan involving measurement of inclination at the T12-L1 interspace (gross motion) minus the inclination of the pelvis (hip motion), giving an actual measure of the T12-S1 motion segments (true lumbar) in flexion and extension. A straight leg raising is an effort measure when compared to pelvic flexion.
Isometric and multispeed isokineti dynamic trunk strength utilizing Cybex (Lumex Corp., Ronkonkoma, NY) flexion/extension trunk strength tester	Measures torque output in standing (functional position isolating trunk musculature in flexion and extension. Results compared to normal database normalized to subject body weight.
Cardiovascular Fitness/ Muscular Endurance Measures Bicycle ergometry Upper body ergometry	Standardized tests of lower and upper body ergometry under increasing work loads. End point is target heart rate at 85% maximum or fatigue.
Gait speed	Measurement of stride length and cadence over measured course.
Dynamic obstacle	Timed test simulating activities of daily living and work requiring subject to complete tasks in multiple positions.
Static lifting	Lifting dynamometer using standard static lifting test protocol. (NIOSH)
Lifting under workload	Dynamic lifting done freqeuntly through full range of motion, floor to waist and waist to above shoulder.
Global effort rating	Rating of effort by therapists involved in quantitative testing based on nonorganic signs and consistency measures obtained from all of the above.

Assessing Effort

Patient effort has always been difficult to assess. Some low back pain patients (with secondary gain enticing them to "beat the system" and document their disability) may intentionally try to "look bad." Others, because of dependency, anxiety, depression, or lack of responsibility for their own health, are unwilling to comply with a program that requires their active participation to improve. Fear of reinjury of fear of pain, often combined with low intelligence or oppositional personalities, may cause patients to do poorly on the "effort factors" in each of the quantitative tests. These same persons may overuse the medical care system by "doctor shoppling" with half-hearted participation in repeated series of ineffective treatments. In the functional restoration approach we describe here, all patients with deficits can make progress in functional capacity measures if they try. Quantification removes the subjectivity in assessing effort.

Each test has an effort factor to help make the assessment objective, similar to use of straight leg raising to confirm rang-of-motion testing. Variability of curve shape and inconsistencies help to evaluate strength and lifting tests; it is extremely difficult to produce consistent curves with submaximal effort. Effort on cardiovascular fitness testing can be measured by the percentage of the target heart rate that the patient is willing or able to reach. These quantitative effort factors are objective.

The best predictor for patients' cooperation and motivation is their rate of progress in a functional restoration program that also provides education and psychological support to help them deal with their personal barriers to good health. If a ptient dhooses not to get well after being given the opportunity, it is unlikely that other forms of treatment will be effective.

On the other hand, if a patient shows good effort and reaches high levels of physical function once again, but continues to be symptomatic, it is reasonable to reassess that patient from a structural point of view to decide whether surgical intervention might be appropriate. In my experience, patients found to have borderline indications for surgery and who remain symptomatic after functional restoration usually do very well with appropriate surgery.

Information on motivation and effort can also greatly benefit the patient's attorney and insurance carrier, neither of whom wish to expend time and effort on the patient who is unwilling to get well.

It has been our experience that when patients who are progressing slowly must acknowledge that their level of effort can be determined by health professionals, they either increase their efforts and cooperation in the rehabilitation process or they become evasive, angry, and oppositional - and often find an excuse for withdrawing from the program. In either case, they have made a personal decision to accept or reject their chance.

The treatment program utilized in the present study was based on the use of these objective physical measures. Results of the program demonstrated significant functional recovery in a group of 66 patients, which was paralleled by positive outcome on a number of realistic criteria such as return-to-work, resolution of litigation, decrease of medical care, and decreased self-report of pain and disability. New potential predictors of return-to-work outcome - range-of-motion and strength measures - were also suggested by the data. Future studies employing this new technology should make a major impact in areas such as industrial selection, disability determination, methods of spine care, and attitudes toward individuals with low-back pain.

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