FUNCTIONAL CAPACITY EVALUATION

"ESSENTIALS IN SUCCESSFUL

REHABILITATION CENTER

MANAGEMENT"

97750 X 7 +/-
97530 X 2
97535
95831X2
95851X2

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"In the control of manual lifting hazards an alternative to redesign is pre-employment screening and selection. With a screening procedure, affecting a match between job demands and human work capacity can control lifting stresses. This is

predicated on the principle that jobs cannot be redesigned or changed to lower their demands. Accordingly, the hazard control strategy becomes one of selecting only those individuals with the capacity to perform the given job without excessive risk".

Journal of Occupational Medicine/Vol. 24, No. 10/Oct-82

FACTS ABOUT OCCUPATIONAL HEALTH

FACT: Every single day 500 workers are permanently disabled.

FACT: Every day there are 10,000 new cases of commensurable injuries.

FACT: Of all employee injuries, only back injuries are not on the decline. They are, in fact, increasing both in raw numbers and in severity.

FACT: Employee injuries cost the USA $10 billion every year, with 600,000 new victims each year - 30,000 of who are permanently disabled.

FACT: One back injury study shows that 10% of all workers receiving Workers' Compensation have been disabled for over six weeks - the cost is staggering.

FACT: Back pain affects more than half of all workers sometime in their careers.

FACT: Back pain doesn't discriminate - women are as prone as men.

WORK INJURIES AND DISABILITY

DEVELOPMENT: GENERAL INFORMATION

COST: There has been an increase of five fold from 1976- 1987. Compensation for low back injuries exceeds all other industrial injuries combined.

In 1992, 40 billion was spent on compensation, of which a high percentage of cost is concentrated in a relatively few cases.

Less than 25 percent of cases account for 90% of the costs.

Ten percent of Low Back Pain cases account for 75% of lost days, medical costs, and disability payments. Snook, Liberty Mutual Insurance, 1992

Abenhalm, 1992

DISABILITY DEVELOPMENT

It is reported that 60% of individuals report experiencing LBP that compromises their **FUNCTION** for one or more days per year, yet only 2.5 percent of industrial workers file injury claims. It is also noted that despite advances in imaging techniques, the specific cause of LBP is never identified in over 80% of cases. In developmental countries void of modern medicine, LBP disability is a non-entity. Difficulty in diagnosing the condition has resulted in a lack of studies to assess treatment methods.

In individuals 45 years old or younger, the number one cause of disability or loss of function is LBP.

The Quebec Spine Task Force demonstrated that most **Diagnostic Studies** and current treatment methods have no scientific validity.

Clinicians endless search for tissue pathology to explain continued subjective pain complaints places the individual at high risk for iatrogenic complications.

Haldeman: Failure of the Pathology Model to Predict Back Pain...Spine 13:345-350, 1988/Spine 15:1990

Scientific Approach to the Assessment and Management of Activity Related Spinal Disorders. Spine 12(Suppl):SE-S39, 1987.

MEDICAL DILEMMA AND MANAGEMENT

Patients suffering from pain expect doctors to find and explain the cause of their pain. The doctor attempts to "fit" the particular symptoms to any pathology found on x-rays or other imaging studies. Yet, it is recognized that factors causing back pain and related disability do not correspond to the pathology present on imaging studies. Eighty percent of acute spinal pain cannot be diagnosed based on the pathology found, in fact, 90% of patients disabled with chronic spinal pain have no evidence of pathology accounting for their pain.

The classic pathology and pain relationship does not apply in most spine pain. Bulging, protruded, herniated, degenerative discs, spinal stenosis, facet arthritis and nerve compression are identified in asymptomatic individuals to the same or greater degree than in individuals with back pain.

The decision by the M.D. to attempt treatment or restrict work **FUNCTION** activity is more often influenced by the intensity of pain reported and illness behavior present. If the factors causing the pain were not due to the pathology treated, work and

functional activity restrictions and unsuccessful treatments cause the pain to worsen.

PSYCHOSOCIAL FACTORS

These are the most significant factors related to a claim of industrial back injury; and most powerful predictions of injury and can be perceived by the following:

Psychosocial dysfunction: documented abnormal personality profile (MMPI Scale 3 Hy).

Job Satisfaction: Tested by simple questionnaire.

Current Occupation
Place of employment
Social situation
Poor employee appraisal ratings by supervisors

Bigos, et al; A Prospective Study of Work Perceptions and Psychosocial Factors affecting the Report of Back Injury...Spine 16: 1-6 1991/ Spine II, 1986; Back Injuries in Industry: A Retrospective Study

DEVELOPMENTAL FACTORS

Behavioral Dysfunction

Poor coping skills	Negative self-image
Neuroses	Unrewarding social
Motivation	relationships

Reesor, KA Medically Incongruent Chronic Back Pain...Pain 32: 1988

MEDICAL INTERVENTION

Individualized Exercise and Education

Designed for the 25% who do not respond to the treatment goals of Phase I. Also appropriate for individuals identified at high risk and those who have repeated complaints of recurring discomfort at work.

Goal: Objectively define and measure gradual improvement in **FUNCTION,** WELLNESS BEHAVIOR IS SHAPED AND REINFORCED.

Treatment offered on an out patient basis.

FUNCTIONAL TESTING is provided and evaluated for consistency of effort. Continued participation in exercise is contingent upon measured improvement in **STRENGTH,** and **MOBILITY**: re-test at 4-6 week intervals. Treatment program options: Clinical restoration of normal joint arthrokinetics and soft tissue distensability, (strength, flexibility, endurance).

Spine stabilization
Work Conditioning

Work hardening

Graves JE, Pollock, ML: Effects of training Frequency and Specificity...Spine: 15; 504-509, 1990. Mayer; Objective Assessment of Spine Function...Spine 10; 5/JAMA 258; 1763-1767, 1987

FUNCTIONAL CAPACITY TEST

Basically an objective test, for our purpose a functional capacity test, should give some very useful pieces of information. What can this person do, how does it compare to what they could do previously or how does it compare to a group of people whom are asymptomatic, but do the same job as the injured individual. Further, functional capacity testing can help to identify the area of involvement and the degree of disability.

Ideally, the treating physician will not only have the norms for people doing the same job, but for that specific individual as well. An example would be the Los Angeles Rams. Functional capacity may function as a means of pre-screening a potential employee, diagnosing an injured employee, or finally knowing when to release an employee to work. Objective testing, with the advent of Isokinetic lift tasks, etc. has increasingly made it easier and more efficient to both diagnose and treat the patient.

To be effective, functional capacity testing must not only be repeatable but also give pertinent information, in reference to the individual being tested as related to the general population and specific lifting task.

When discussing functional capacity we are talking about measurements of strength, and its relationship to functional movements and ability to perform work. The term strength denotes the capacity for active development of muscle tension and through the resulting muscle force, to generate joint torque. In the case of employment- related tests, the evaluation must **closely simulate critical job tasks.**

Reliability of Lumbar Isometric Torque in Patients with Chronic Low-Back Pain; Michael E. Robinson, Green AF, O'Conner P, Graves JE, and Mac Milan, Michael

Boundary Line Between the Strength and Endurance Regional Lifting; Methods of Back Strength Testing May result in Significant Errors: Clinical Biomechanics, 1987; 220-222

Experimental Models of Osteoarthritis: The Role of Immobilization; Videman, T., Clinical Biomechanics, 1987 2:

223-229.

PHYSICAL DEMANDS

Physical demands are those physical activities required of a worker in a particular job or lifting task. (Dictionary of Occupational Titles)

THE FACTORS

FACTOR I. These are the primary "STRENGTH" physical factors, and generally speaking, a person who engages in one of these activities can engage in all.

Lifting: Raising or lowering an object from one level to another (includes upward pulling).

Carrying: Transporting an object, usually holding it in the hands or arms or on the shoulder.

Pushing: Exerting force upon an object so that the object moves away from the force (includes slapping, striking, and kicking).

Pulling: Exerting force upon an object so that the object moves toward the force (including jerking).

DEGREES OF PHYSICAL DEMANDS IN FACTOR I

1.) Sedentary Work (S)

Lifting 10 lbs. maximum on an occasional basis (33%)

2.) Light Work (L)

Lifting 20 lbs. maximum on an occasional basis and frequently, objects up to 10 lbs. (33-66%)

3.) Medium Work (M)

Lifting 50 lbs. maximum on an occasional basis and frequently, objects up to 25 lbs.

4.) Heavy Work (H)

Lifting 100 lbs. maximum on an occasional basis and frequently, objects up to 50 lbs.

5.) Very Heavy Work (V)

Lifting 100 lbs. maximum on an occasional basis and frequently, objects above 50 lbs.

FACTOR II. Climbing and Balancing

Climbing: Ascending or descending object, or obstacles using Feet and legs and/ or hands and arms.

Balancing: Maintaining body equilibrium to prevent falling when performing any specific job task or gymnastic feat.

FACTOR III. Stooping, Kneeling, Crouching, Crawling

Stooping: Bending the body downward and forward at the waist.

Kneeling: Bending the legs at the knees to come to rest on one or both knees.

Crouching: Bending the body downward and forward by bending the legs and spine.

Crawling: Moving about on the hands and knees or hands and feet.

FACTOR IV. Reaching, Handling, Fingering, Feeling

Reaching: Extending the hands and arms in any direction.

Handling: Seizing, holding, grasping, turning or working with the hand or hands, without fingering.

Fingering: Picking, pinching or working with fingers primarily.

Feeling: Perceiving, primarily with fingertips.

FACTOR V. Talking and Hearing

FACTOR VI. Seeing

Acuity:

Far: Clarity at 20 feet or more.

Near: Clarity at 20 inches or less. Things to be aware of:

Depth Perception
Field of Vision
Accommodation
Color Vision

WORKING CONDITIONS

Working conditions are the physical surroundings of a worker in a specific job.

I. Inside, Outside/both

Spending approximately 75 percent or more inside/outside.

II. Extremes of Cold Plus Temp Changes

Temperature low enough to illicit bodily discomfort or reactions.

III. Extremes of Heat Plus Temp Changes

Same as II but related to heat.

IV. Wet and Humid

Contact with water or liquid and moisture content sufficient to elicit marked bodily discomfort.

V. Noise and Vibration

VI. Hazards

VII. Fumes, Odors, Toxic Conditions, Dust, Poor Ventilation

WORK CONDITIONING STANDARDS

DEFINITIONS:

REHABILITATION: The process of improving or restoring an individual's skill or level of activity of daily living, maintaining a maximum level of independent functional movements including self care and employment.

WORK HARDENING: Involves patients that have chronically dropped out of the work force, have complicated psychological problems, have been assigned as vocational rehab candidates, require interdisciplinary efforts, and use **real work activities for therapy.**

WORK CONDITIONING: Is applicable to patients soon after injury, with uncomplicated psychological profiles, prior to dropping out of the work force, does not require interdisciplinary efforts, and uses **simulated work activities for therapy.**

PROGRAM CANDIDATES: Appropriate for a wide variety of musculoskeletal cases and not limited to deconditioned and pain disabled patients.

APPROACH: Is to diminish functional disability in the cardiovascular, biomechanical and psychophysical domains.

GOALS: To communicate health, wellness and psychosocial appropriateness through specific vocational training, utilizing doctor patient interaction and exercise.

TESTING ISOMETRIC LITERATURE

A large amount of research has been conducted to increase the understanding of lifting capacity. The early research utilized static strength testing as the tool for lifting evaluations. The results of this research support the theory that lifting capacity is a function of isometric back strength, and that anthropometric measures are not good predictors of strength.

More research has shown that dynamic testing is a superior predictor of lifting capabilities. The ultimate action for properly assessing true weakness, disability and or functional impairment requires dynamic movements or "functional testing" including real life movements and standards efforts or "lifting tasks". The primary aim in healing and reducing disability is to insure proper motion and stability.

The National Institute for Occupational Safety and Health (NIOSH) in 1981 published an evaluation guideline entitled Work Practices Guide for Manual Lifting. Hopes are that further testing and studies be performed for standards utilizing real life movements and functional patterns.

Caldwell et al., 1974; Chaffin, 1975; Chaffin et al., 1978; Keyserling et al., 1978; Kisner, Carolyn, Colby 1985; Wandsworth, Carolyn, 1988.

ISOMETRIC STANDARD

One specific protocol has been published and is accepted as the standard procedure for static testing (Caldwell et al., '74; Chaffin, '75). This protocol consists of a five second exertion in which a constant maximal effort is gradually reached in the first two seconds and then maintained. The force produced during these lifting tasks is measured and the average force calculated. Since these tests are highly postural and proprioceptively oriented, results from similar body postures can be compared.

GUIDELINES (NIOSH)

Data from such tests are useful in reporting the percentile rankings of an individual relative to healthy industrial workers. In order to make lifting recommendations for an individual, the frequencies reported must be defined. In general, lifting frequency is divided into three categories: **Occasional, Frequent, and Continuous.** The most well received form of categorizing is in terms of time spent performing a task.

OCCASIONAL: ***UP TO 33% OF THE DAY***

FREQUENT: ***BETWEEN 34 AND 67% OF THE DAY***

CONTINUOUS: ***GREATER THAN 67% OF THE DAY***

To determine the lifting recommendations from isometric data alone is to make predictions of dynamic strength abilities from static strength measures. Static tests are safe, reliable and practical with coefficients of variation in test retest scores of less than 15% in non-injured patients, and less than 18% for the injured.

LIFTING RECOMMENDATIONS

Before making extrapolations from the isometric results to dynamic lifting, it is necessary to understand that an isometric test represents only one position of a dynamic activity.

It is for this reason that it be understood that the isometric position chosen approximates the maximum lifting requirement of the task, and this is usually the initial phase of a lift.

Chaffin et al., 1977

Within the above constraints, the lifting abilities of an individual can be determined by taking a percentage of the average force produced during the isometric test.

Most recent reports report percentages of:

50-80% of the average force for **Occasional**

40-50% of the occasional lifting recommendations for **Frequent**

20-33% of the occasional lifting recommendations for **Continuous**

Blankenship 1990; D.O.T., 1986, Physical Demand Ratings of the Department of Labor.

DYNAMIC LITERATURE

The research investigating dynamic lifting capabilities strongly shows that dynamic testing can better determine a person's ability to perform lifting tasks.

Aghaqadeh and Ayoub, 1985; Garg et al., 1980; Jiang et al., 1986; Kamon et al., 1982; Mirka, Mirras 1990; Mital et al., '86.

ISOKINETIC TESTING

Isokinetic testing, where the subject moves a load at a set speed can be used to test lifting abilities. The dynamic component and functional "real life" movement is better accounted for in isokinetic testing than in isometric testing, but isokinetic activities have, in the past had serious

limitations in simulating actual dynamic tasks

Stevenson et al., 1989; Mirka and Marras 1990

ISOINERTIAL TESTING

Isoinertial testing controls only the mass of the load and permits the subject to vary his speed, as the task requires. Jiang et al., 1986 recommended this as the most promising single screening test because it more closely simulates lifting tasks by involving both the static and dynamic components. This type of screening is limited due to safety factors and the inability to create 3d tasks.

NIOSH LIMITATION GUIDELINES

Once the maximum isometric lifting ability is measured for an individual, the next concern is to determine weather the load can be handled safely. It is noted that lifting activities are unsafe when excessive stress is placed on the trunk. The paraspinal musculature (PSM) of the lumbar area is unable to overcome the resultant compressive forces experienced by the spine during excessive loading. Combined with muscular overuse injury occurs.

In 1981, NIOSH published limits that provide assistance in determining whether a lift causes unacceptable compressive forces to be generated. These limits are based on the weight of the load, the initial position of the load relative to the person, the vertical travel distance between the origin and destination, and the frequency of the task.

MIXABLE PERMISSIBLE LIMIT (MPL)

Is the point at which most workers cannot tolerate the compressive forces at the L5/S1 disc. Only 25% of men, and less than 1% of women, have the capability of performing above the MPL.

ACTION LIMIT (AL)

The point at which most young, healthy workers can tolerate. Over 99% of men and 75% of women can lift loads defined by the AL.

MANUAL MATERIALS HANDLING

The research on dynamic lifting has investigated the types of tasks commonly performed in manual materials handling (MMH). Snook et al., 1970 divided MMH into six basic tasks:

LIFTING
LOWERING
PUSHING
PULLING
CARRYING
WALKING

He claims that almost every MMH task in industry consists of a combination of two or more of these tasks. Other studies support this claim. Mital et al., 1986.

The literature clearly points out the need to recreate job tasks closely during testing in order to improve predicting maximal lifting capabilities. Major studies suggest the importance of including the naturally occurring asymmetric and functional components of a lift into lifting assessment procedures. The enactment of the Americans with Disabilities Act in July of 1992 shows the significance of improving the job selection process. **The new law requires all screening tests to address only the essential tasks of the job.** This ultimately prevents discrimination toward the disabled.

Stevenson et al., 1989; Marras and Mirka 1989, 1990

ISOMETRIC AND DYNAMIC PROTOCOLS

ISOMETRIC PROTOCOL

The isometric protocol consists of seven different tests, at varying postures, including foot position, arm position and adheres to the NIOSH guide testing method.

ISOMETRIC PROTOCOL

TEST	POSTURE	ANKLE POSITION HORIZONTAL	HANDLE HEIGHT VERTICAL
1. Leg Lift	Knees hip and shoulders flexed as required by the	0 inches	15 inches

	horizontal and vertical distances, keeping the trunk as vertical as possible. Elbows are neutral.		
2. Torso Lift	Hips and shoulders flexed as required by the horizontal and vertical distances. Remaining posture is neutral.	15 inches	15 inches
3. Arm Lift	Elbows flexed 90 degrees. Forearm and Elbow Height Remaining posture is hands length		
4. High Near Lift	Shoulders and elbows flexed as required by the horizontal and vertical distances. Remaining posture is neutral	10 inches	60 inches
5. High Far Lift	Shoulders and elbows flexed as required by the horizontal and vertical distances. Remaining posture is neutral	20 inches	60 inches
6. Push	Posture not controlled; amount of trunk inclination suitable to subject. Feet staggered.	Determined by posture	Elbow Height
7. Pull	Posture not controlled; amount of trunk inclination suitable to subject. Feet staggered.	Determined by posture	Elbow Height

Frequent and Continuous lifting recommendations, as described within according to recent studies i.e.: Blankenship.

Two of the static tests involve pushing and pulling postures. NIOSH did not include these positions in the guidelines so percentile rankings are generally not reported.

ISOMETRIC & DYNAMIC TESTING

The isometric-dynamic protocol has two phases: isometric and dynamic.

The isometric phase consists of five of the seven tests from the isometric protocol:

Leg Lift
Arm Lift
Push
Pull
High Near

Once average forces of the above lifting tasks are measured, they will statistically provide a springboard for setting initial weights in the dynamic phase, according to a specific percentage of the static force.

Snook and Ciriello 1990 revised data; Keyserling et al., 1978.

DYNAMIC PHASE

The dynamic phase consists of one sagittal plane, or 2D lift, and two 3D lifts. The 2D lift is included to provide a dynamic test with a reduced number of variables by restricting the majority of the movement to the sagittal plane. The 3D lifts incorporate lifting, lowering, and carrying tasks including twisting components to represent the tasks typically occurring in industry. Drury et al., 1982; U.S. Department of Labor 1982.

Together the three tests measure the subjects lifting capabilities from the **floor to shoulder range.**

University of Michigan developed the Two Dimensional Static Strength Prediction Software which is a screening tool for those jobs which need further analysis and redesign.

"Those jobs which are not suited to 75% of the population will increase the risk for musculoskeletal injury, in fact, the injury rates will be at least 3 times greater and could be as much as 9 times greater.

In 1978, Liberty Mutual Insurance Company via Snook surveyed 191 compensable low back injury claims from a strength perspective and found that, "...approximately ¼ of jobs involve manual tasks that are less than 75% acceptable; however ½ of the low back injuries were associated with these jobs.

This indicates that a worker is 3 times mores susceptible if working a job that is acceptable to less than 75% of working population.

STRENGTH CAPABILITY - 8 HOUR DAY (40%)

Functional testing can also measure a person's maximal strength level, that is, what a person can handle safely during an eight hour day.

A workload taxing 30-40% of a person's maximal oxygen uptake or 1RM is a reasonable average upper limit for an 8-hour day. No more that 40% of maximal muscle strength should be applied in repetitious muscular work, otherwise a low back injury will occur.

Astrand P; Work Physiology

CUMULATIVE TRAUMA

For a patient sustaining at his 75th percentile for long periods of time, it is not uncommon to find him at a much lower level of percentile, i.e. greater than four hours at a time.

JOB STRENGTH RATING

If an employee or prospective employee does not possess adequate static strength, then those workers are **3-9 times** more likely to have a low back injury than those who have the appropriate strength.

$$\text{JSR} = \frac{\text{MAXIMUM JOB STRENGTH REQUIRED}}{\text{WORKER'S STRENGTH TESTED}}$$

RISK FACTORS FOR INJURIES

JSR > 1.0 = Very High Risk (3-9) times more likely to develop low back injuries.

JSR 0.5-1.0 = High Risk More likely to develop injury.

JSR < 0.5 = Low risk Not more likely to injure.

RISK FACTORS FOR NON-BACK INJURIES

$$\frac{\text{MAXIMUM JOB STRENGTH REQUIRED X REPETITIONS/WEEK}}{\text{WORKER'S STRENGTH TESTED}} =$$

Less than 100 = Low Risk

Greater than 100 = High Risk (Increased incidence and severity of injury.)

PHYSICAL CAPACITY LEVELS

ACCORDING TO 50% POPULATION

PHYSICAL CAPACITY LEVELS*

(50% population anthropometry)

TASK 75% Capability and Less Than BCDL

	MALE	(LBS)	FEMALE
JSR MAX			
1. Arm Lift	80	160-90	45
2. Back Lift	55	110-60	30
3. Leg Lift	115	230-160	30
4. High Far Lift	45	90-40	20
5. Floor Lift	45	90-130	65
6. High Near Lift	95	190-90	45
7. Push Down	60	120-60	30
8. Pull In	35	70-50	25
9. Pull Down	90	180-110	55
10.Push Out	55	110-60	30

TASK	WEAKEST JOINT	STRENGTH REQUIRED
1. Arm Lift	Elbow/Shoulder	Flexion
2. Back Lift	Ankle	Plantar flexion
3. Leg Lift	Knee	Extension
4. High Far Lift	Shoulder	Flexion
5. Floor Lift	Hip	Extension
6. High Near Lift	Shoulder	Flexion
7. Push Down	Elbow	Extension
8. Pull In	Ankle	Plantar flexion
9. Pull Down	L5/SI	Flexion
10. Push Out	Knee (Male	Extension
	Elbow (Female)	Extension

COEFFICIENT OF VARIANCE

One advantage of static strength testing is that the literature documents that a static strength pull will be relatively consistent when and individual is exerting a maximum effort or near maximum. This is shown as the (CV).

CV < 15% = Indicates that the patient has exerted a valid effort.

CV > 15% = Indicates need for determining why. This does not render the test invalid.

Reasons for a CV > 15%:

Learning effect
Symptom Magnification
Pain in one or two of the efforts
Poor standardization of the test
Misunderstanding

***Note: A CV up to 18% is acceptable for injured patients who are instructed to pull with a "force until discomfort" (FUD).**

REIMBURSEMENT AND BILLING: CODES/REPORTS (See 123Rehab Manual)

Once the doctor attains a baseline of functional capacity and physical performance by the appropriate testing then therapeutic exercise goals and rewards may be achieved.

FUNCTIONAL EXERCISES –

As in keeping with standard rehabilitation guidelines, Stage I of a prescribed program shall follow spinal stabilization goals as mentioned above. (Pre-Reactivation Home to In house to Stage I exercises)

Stage II of the rehabilitation process shall follow the intermediate goals of attaining appropriate strengths in the major (push-pull) relationships. (Stage II- Upper, Lower, Spinal)

All clients in keeping with standards as set by definitions noted above shall perform real life movements and exercises as depicted in Stage III of the rehab program.