A Survey of Clinical Applications and Outcome Assessment Procedures for Dynamic Lumbar Muscular Stabilization Exercise Training

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A SURVEY OF CLINICAL APPLICATIONS AND OUTCOME ASSESSMENT PROCEDURES FOR DYNAMIC LUMBAR MUSCULAR STABILIZATION EXERCISE TRAINING

By

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THESIS

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ABSTRACT

The San Francisco Spine Institute (SFSI) Dynamic Lumbar Muscular Stabilization (DLMS) Program is a comprehensive, non-operative treatment approach to lumbar spine dysfunction. This program is implemented in physical therapy clinics nationwide.

The purpose of this study was to compare DLMS treatment concepts and methods used by Michigan rehabilitation professionals with the SFSI protocol. Forty-nine clinicians were interviewed using a questionnaire developed by the investigators. The areas surveyed included: clinicians' rationale for use and implementation of DLMS training, and clinicians' assessment of patient functional outcomes.

The survey responses suggest that clinicians focus on orthopedic evaluation parameters and low back pain management during program progression rather than on the SFSI DLMS objective of improved patient function. The results also demonstrate that clinicians do not perform objective outcome assessment on a routine basis. Thus, clinicians must routinely measure functional outcomes to demonstrate DLMS program efficacy. Any variations to the SFSI DLMS protocol require further research to validate their effectiveness.
ACKNOWLEDGEMENTS

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Low Back Pain and Healthcare Costs

Low back pain (LBP) syndrome is the most common, costly, and disabling complex of musculoskeletal symptoms diagnosed and treated in the United States today. A large percentage of patients with this syndrome recover within sixty days of onset. Yet, an estimated 5.2 million individuals are affected by chronic or recurrent back disability (Andersson, Svenson, & Oden, 1983). Statistics indicate that fifty percent of the chronic group are classified as temporarily disabled while the remaining fifty percent are classified as permanently disabled (National Center for Health Statistics, [NCHS] 1981). The long term healthcare costs, disability payments, and lost wages related to LBP syndromes are estimated at 20-65 billion dollars annually (Mayer, 1990).

Patients with chronic back disabilities represent a major burden on the healthcare system in terms of treatment efforts and cost factors. Proposed national healthcare reform will demand managed rehabilitation costs and effective treatment outcomes. To meet these demands healthcare professionals must scrutinize the economics, efficacy, and efficiency of back treatment protocols.

Functional Restoration Programs

Functional restoration is one approach frequently utilized to address LBP syndromes and patient disability resulting from lumbar dysfunction. Functional restoration is defined as a combined education and exercise
training program designed to improve the physical deconditioning syndrome prevalent in patients with back dysfunction (Hazard et al., 1989; Mayer, 1991). Mayer (1991), describes five critical elements of a functional restoration program. These include: 1) quantification of the patient's physical function and pain complaints, 2) physical reconditioning of the injured functional unit, 3) work simulation and whole-body retraining activities, 4) a cognitive-behavioral multimodal disability management program, and, 5) ongoing patient outcome assessment reported with objective measures.

The reconditioning and work simulation aspects of the restoration program involve rehabilitation clinicians directing active, rather than passive treatment modalities. The quantification of the patient's physical status at initial evaluation and identification of vocational or avocational task demands is necessary in order to develop a progressive strength and conditioning program. Initial treatment is directed toward mobilizing and strengthening the "weak or injured link" in the biomechanical chain, while whole body activity addresses the physical deconditioning syndrome (Mayer, 1991). The primary goal of functional restoration is the elimination of disability. Once this has been accomplished, pain management and medical cost control can be anticipated as secondary phenomena (Mayer, 1990).

**Dynamic Lumbar Muscular Stabilization**

Lumbar muscular stabilization training is one treatment method that is frequently incorporated in functional restoration programs (Foster & Fulton, 1991; Matmiller, 1980; Moffet et al., 1986; Morgan, 1988; J. A.
Saal, 1990a; White et al., 1990). A formal exercise protocol, known as Dynamic Lumbar Muscular Stabilization (DLMS) was developed by clinicians at the San Francisco Spine Institute (SFSI). This training program is presently marketed to rehabilitation professionals and the SFSI has published research which demonstrates program efficacy (J. A. Saal, 1990a; J. A. Saal & J. S. Saal, 1989).

The protocol includes two distinct treatment phases. The DLMS program initially addresses the patient's pain complaints through management techniques such as: back first aid, trials of extension exercise or traction, basic stabilization exercise training, and medications. Back first aid includes the application of ice, instruction in comfortable resting postures and basic body mechanics to facilitate pain-free movement. Use of the above pain control methods is guided by the patient's level of function and his or her ability to comply with the exercise program (J.A. Saal & J.S. Saal, 1989).

The second phase of exercise training is divided into basic and advanced levels. Basic stabilization is performed in prone and supine positions. The patient is taught to control the position of the lumbar spine while performing stretching and strengthening exercises for the back, abdominal, and extremity musculature. This "functional position" is described as the optimally stable and pain free posture for the lumbar spine. The patient adjusts and maintains this position during activity. Once the patient correctly demonstrates basic stabilization exercises, an advanced stabilization program is initiated. The advanced program includes
progressively more challenging exercise positions and more demanding functional activities.

The objectives of the DLMS program are to improve low back muscular stability, dynamic strength, and coordination of extremity movements with the maintenance of stable trunk posture. Stabilization training promotes equalization and minimization of mechanical forces to the lumbar spine which helps to eliminate repetitive injury to intervertebral discs, facet joints, and paravertebral structures. The primary goal of DLMS is to train the patient to adjust and maintain their functional lumbar position while performing activities of daily living and occupational duties (J. A. Saal & J. S. Saal, 1989; J. A. Saal, J. S. Saal, & Herzog, 1990).

**Purpose of the Study**

The SFSI DLMS program is a commonly used protocol in physical and occupational therapy settings, back schools, and work hardening programs (Lindstrom et al., 1992; Moffett, Chase, Portek, & Ennis, 1986; White et al., 1990). Clinician education and training in the SFSI stabilization format varies and therefore clinical implementation and instructional presentation of the program can differ. These factors lead to questions regarding program utilization and efficacy. The purpose of this study is to identify DLMS treatment and assessment methods used by Michigan rehabilitation professionals, and compare these with the SFSI protocol. The study will: 1) evaluate clinicians' rationale for utilization of the stabilization training program, 2) evaluate the clinical applications of DLMS (including variations of the SFSI format), and 3) evaluate the use of outcome assessment procedures. The researchers hypothesize that
differences will exist in the surveyed clinicians' rationale, program implementation, and use of outcome assessment procedures when compared to the SFSI DLMS protocol. Further, the results of this study may be useful in future investigations which compare back treatment protocols using lumbar stabilization training techniques and specific treatment outcomes.
CHAPTER 2
LITERATURE REVIEW

A Conceptual Basis for the Dynamic Lumbar Muscular Stabilization Program

Mechanical spine dysfunction is a common cause of low back pain and radicular symptoms (J. A. Saal, 1990a, 1990b; J. A. Saal & J. S. Saal, 1989, 1991a). The efficacy of operative versus non-operative management of this condition has been investigated. Several studies indicate that aggressive, non-operative treatment can be successful in limiting injury effects and promoting healing (Morgan, 1988; J. A. Saal, 1988, 1990a, 1990b; J. A. Saal & J. S. Saal, 1989, 1991a).

Education, exercise, and postural retraining are used extensively in the treatment of low back disorders. These approaches are collectively referred to as back rehabilitation programs or "back schools." There is documented agreement as to which education and exercise formats should be taught in these program curricula. Exercise activities typically emphasize trunk and lower extremity strength, flexibility, and muscular endurance. Educational presentations stress an overview of anatomy, correct body mechanics, postural and activity modifications, and the importance of personal physical fitness (Foster & Fulton, 1991; Mattmiller, 1980; Moffet, et al., 1986; Morgan, 1988; J. A. Saal, 1990a; White et al., 1990). The San Francisco Spine Institute's (SFSI) Dynamic Lumbar Muscular Stabilization (DLMS) Program incorporates many of these commonly accepted approaches.
The DLMS Program recognizes that rehabilitation of patients with low back pain is a comprehensive process (J. A. Saal, 1990a, 1990b; J.A. Saal & J. S. Saal, 1991b). Accurate medical diagnosis and early intervention are crucial to the program's success. The primary goal of DLMS is to improve the patient's capacity for functional activities of daily living, employment, and recreation. That is, the focus of the rehabilitation program is to improve patient functional status rather than to exclusively treat pain symptoms. The program teaches patients to assume control of their lumbar dysfunction instead of allowing pain and related limitations to control their lives (J. A. Saal, 1990a, 1990b).

**The Dynamic Lumbar Muscular Stabilization Training Routine**

The DLMS Program is a multi-faceted, non-operative treatment approach to lumbar spine dysfunction. Patient inclusion criteria for participation in the program are self-reports of pain and a degree of functional disability (J. A. Saal, 1990a, 1990b; J.A. Saal & J. S. Saal, 1991b). Studies typically report inclusion of patients in DLMS training activities with non-surgical conditions such as: lumbar disc herniation, radiculopathy, and mechanical low back dysfunction (Hazard et al., 1989; Lindstrom et al., 1992; Moffet et al., 1986; J. A. Saal & J. S. Saal, 1989; J. A. Saal et al., 1990).

The rehabilitation program is divided into two phases: an acute pain-control phase and a training phase. The pain-control phase may include a variety of passive modalities such as: lumbar mobilization, traction, a medication regimen, or a trial of extension exercises (J. A. Saal, 1988, 1990b; J. A. Saal & J. S. Saal, 1991a). However, the key to the
rehabilitation program is the training phase, which emphasizes patient education, functional movement training, and specific dynamic lumbar muscular stabilization exercises.

**Dynamic Lumbar Muscular Stabilization Program Outline**

**I. Pain Control**
A. Back first aid
B. Trial of extension exercises
C. Trial of traction
D. Basic stabilization exercise training
E. Non-steroidal anti-inflammatory drugs
F. Non-narcotic analgesics
G. Corticosteroids
   1. Oral
   2. Epidural injection
   3. Selective nerve root injection
   4. Facet injection

**II. Exercise Training**
A. Soft tissue flexibility
   1. Hamstring musculotendinous unit
   2. Quadriceps musculotendinous unit
   3. Iliopsoas musculotendinous unit
   4. Gastrocsoleus musculotendinous unit
   5. External and internal hip rotators
B. Joint mobility
   1. Lumbar spine segmental mobility
   2. Hip range of motion
   3. Thoracic spine segmental mobility
C. Basic Stabilization program
   1. Finding neutral position (standing, sitting)
   2. Prone gluteal squeezes
   3. Supine pelvic bracing
4. Bridging progression  
a. Basic position  
b. One leg raised  
c. Stepping  
d. Balance on gym ball  
5. Quadruped (alternating arm and leg movements with ankle and wrist weights used during the progression)  
6. Kneeling stabilization  
a. Double knee  
b. Single knee  
c. Lunges (hand-held weights added during the progression)  
7. Wall slide quadriceps strengthening  
8. Position transition with postural control  
D. Advanced Stabilization program  
1. Abdominal program  
a. Curl-ups  
b. Dead bugs  
c. Diagonal curl-ups  
d. Diagonal curl-ups on incline board  
e. Straight leg lowering  
2. Gym program  
a. Latissimus pull-downs  
b. Angled leg press  
c. Lunges  
d. Hyperextension  
e. General upper body weight exercises  
f. Pulley exercises to stress postural control  
3. Aerobic program  
a. Progressive walking  
b. Swimming  
c. Stationary bicycling  
d. Cross-country ski machine
The training phase is closely supervised. The clinician uses a "hands-on" technique to facilitate optimal patient positioning during progressive exercise training (J. A. Saal, 1990b; J. A. Saal & J. S. Saal, 1989). The maintenance of proper posture during exercise performance is emphasized to the patient. Precise repetition of exercise movements is monitored by the clinician to ensure engram motor programming (J. A. Saal, 1990b; J. A. Saal & J. S. Saal, 1989).

The engram is a neurophysiologic phenomena that describes the motor information necessary to perform a complex movement. All the individual components of an exercise movement are stored together as a unit forming an engram. Research suggests that once engram programming has occurred, postures and exercise movements are patterned in the motor cortex and later used without conscious effort or control (Horn, 1991). This phenomena is associated with observed changes in patients' postural habits and a lesser need for clinicians to provide verbal and physical cues for trunk stabilization as DLMS training progresses.

Stabilization training exercises can be divided into basic and advanced levels (Morgan, 1988; J. A. Saal, 1988, 1990b; J. A. Saal & J. S. Saal, 1989, 1991a, 1991b). The basic program has been compared to the neurodevelopmental stages of postural control. It begins with exercises performed in externally supported supine or prone positions, progresses to...
exercises performed in a quadruped, kneeling, and standing stance, then on to movements of position transition. Each activity is designed to develop isolated and co-contraction muscle patterns to stabilize the lumbar spine in its functional position (J.A. Saal, 1988). The functional spine position is not necessarily zero degrees of lumbar lordosis, but rather a comfortable and mechanically correct posture controlled by the individual during movement. Postural transitions influence the patient's functional spine position and may necessitate alterations in the amount of lumbar lordosis required to maintain a comfortable position. An experienced clinician should instruct the training sequence since posture and technique must be reinforced continuously throughout exercise performance (J. A. Saal, 1990a). Patient understanding and participation in making necessary postural and activity adjustments is an integral part of the training program.

Once proper exercise form and technique are achieved and the patient can perform three sets of ten to fifteen repetitions of the basic exercise activities, the training can be advanced. The basic level of exercises are first taught with one-on-one instruction and can be later presented in group sessions if this is conducive to the patient's rehabilitation needs and the clinical setting. The rate of exercise progression for a patient participating in a group is determined by the individual's performance proficiency demonstrated during group activity (J.A. Saal, 1990a, 1990b).

Functional progress, rather than a decrease in the patient's pain level, is the criterion for determining advancement to more challenging exercise activities (Morgan, 1988; J. A. Saal, 1988, 1990b; J. A. Saal & J. S. Saal,
The advanced exercises should be tailored to meet an individual's ADL and sport-specific needs. Patient physical capacities for occupational tasks and recreational activities must be identified and used to structure the advanced program. The American College Of Sports Medicine's Guidelines For Exercise Training are used to determine appropriate training levels for the aerobic and weight conditioning exercise components. Aerobic and weight training activities are geared not only for truncal musculature, but for total fitness reconditioning. Exercise instruction must again demonstrate and emphasize functional spine position during activity performance (Morgan, 1988; J. A. Saal, 1988, 1990b; J. A. Saal & J. S. Saal, 1989, 1991a, 1991b).

**Biomechanic-Physiologic Rationale for Dynamic Lumbar Muscular Stabilization Training**

Muscle stabilization training facilitates a decrease in repetitive stresses and resultant microtrauma to the lumbar vertebral segments during trunk and extremity movement patterns. The concept of stabilization is based on "muscle fusion", a spinal bracing mechanism involving use of the truncal musculature and noncontractile soft tissues. The fusion mechanism protects the vertebral segments from excessive external loads, compressive stress, and torsional or shearing forces (Gracovetsky & Farfan, 1986; Gracovetsky, Kary, Pitchen, Levy, & Said, 1989; J. A. Saal, 1988, 1990b). The coupling of muscle activity and passive soft tissue tension acts to align the trunk posture and control the degree of lumbar lordosis. This control of lumbar lordosis in spinal flexion and extension is important due to changes in axial rotation which occur at individual segmental levels with the different degrees of lordosis. This is significant in that varying the
rotational angles about each segment may change the amount of compressive force directed to the intervertebral disc. It is predicted that for every angle of spinal flexion there is a unique degree of lumbar lordosis that will minimize and equalize the compressive stress to the spine (Gracovetsky & Farfan, 1986; Gracovetsky, et al., 1989).

The control of lumbar lordosis is accomplished by the co-contraction of the transverse abdominus, internal oblique, and psoas muscle groups combined with the passive longitudinal tension of the supraspinous and interspinous ligaments, capsular ligaments, ligamentum flavum, posterior longitudinal ligament, and lumbodorsal fascia (together referred to as the midline ligaments). The spinal bracing mechanism further involves the co-contraction of the rectus abdominus, external oblique, internal oblique, transverse abdominus, quadratus lumborum, and latissimus dorsi muscle groups to position the pelvis and increase lumbar segment support. The erector spinae and multifidi participate to reduce translational stress and balance shear forces to the intervertebral segments. The gluteus maximus and hamstring groups function to control the position of the spine during lifting activities. The bracing mechanism is enhanced by slight knee flexion and a broad base of support. Lower extremity positioning assists in controlling the body’s center of gravity during weight bearing activities and further reduces the compressive stress to the vertebral segments. The minimization of mechanical stress to the intervertebral joints decreases the progressive tearing and fatigue to the annular portion of the disc. Damage to the annulus is implicated in the onset and progression of disc

Adequate trunk and lower extremity strength and flexibility must first be attained to effectively utilize muscle fusion (J. A. Saal, 1988, 1990b). Sufficient spinal range of motion promotes extensibility of the annular fibers and spinal ligament structures, thus reducing the effects of repetitive fatigue stress to the intervertebral joint. Adequate flexibility of the hamstrings, gluteus maximus, quadriceps, iliopsoas, gastrocsoleus, hip rotators, and iliotibial band facilitates pelvic mobility and pelvic positioning, a key factor promoted with functional spine alignment during DLMS training (J. A. Saal, 1988, 1990b).

The functional spine position is highly emphasized during exercise and functional training (Morgan, 1988; J. A. Saal, 1988, 1990b). While the spine has a range of optimal positions in which it functions efficiently, these positions may vary in individuals secondary to complaints of LBP, spinal pathology, or specific functional activity. Patients adjust the functional spine position by altering the direction and/or degree of anterior/posterior pelvic tilt. This posture is maintained with use of the muscle fusion mechanism. The position is also identified by the patient as the most "comfortable" posture adopted during exercise and task performance. This position is associated with minimal erector spinae activation and a subsequent reduction in mechanical stress directed to the vertebral segments (Gracovetsky et al., 1989; Morgan, 1988).

Additionally, it is proposed that a neurophysiologic feedback mechanism monitors the mechanical stress directed to the intervertebral
joints. The feedback system is composed of a wide network of nerve fibers which connect receptor sites located in facet joint capsules, spinal ligaments, intervertebral discs, deep paraspinal muscles and the periosteum of spinal vertebrae (Hertling & Kessler, 1990). These receptors may transmit both pain information and kinesthetic feedback for joint position related to mechanical stress levels. The neural feedback mechanism can direct modification of muscle activity in a way that minimizes stress to the joint and reduces the risk of injury. Coordinated muscle activity and soft tissue tension also modify lumbar segment alignment and control the stress on spinal and pelvic ligaments (Gracovetsky & Farfan, 1986; J. A. Saal, 1988).
Outcome Assessment - Evaluating Treatment Efficacy

The DLMS program must meet reasonable time and treatment cost criteria. Early goal setting assists in fulfilling these criteria. Program goals are based on the patient's occupation, recreational activities, and functional level (J. A. Saal, 1990b; J. A. Saal & J. S. Saal 1991b). The objectives of DLMS training are improvement in patients' functional status with independence from medications, supervised physical therapy, and/or manipulative treatment. Therefore, the progression of active exercise training rather than the use of passive modalities and manual treatment is aggressively promoted.

The DLMS program's end point is determined by evaluation of the patient's functional status. When the individual's maximum functional capacity cannot be improved with additional exercise training or pain management techniques, discharge from the program is recommended. After program discontinuation, the patient's continued participation in independent exercise programming is recommended. Treatment of low back dysfunction with supervised DLMS is not indicated for longer than a twelve week duration (J. A. Saal & J. S. Saal, 1991b).

Outcome assessment is crucial in evaluating the patient's functional status. Assessment procedures may consist of repeated physical testing measures, patient self-reports of functional level or pain, and related criteria such as return to employment or the status of pending worker's compensation litigation (Mayer et al., 1986). J. A. Saal and J. S. Saal (1989) reported rates of return to employment and return to recreation after patient completion of the DLMS training and outcome assessment.
Mayer et al. (1986) utilized objective measures of functional capacity and patient self-reports of pain with return-to-work and litigation statistics to evaluate treatment approaches for low back dysfunction. Lindstrom et al. (1992) demonstrated significant correlation between physical gains in spinal rotation, abdominal muscle endurance times, and lifting capacity with the patient's rate of return to work.

Mayer et al. (1986) specifically recommend the following tests of physical function to evaluate functional capacity gains:

1) Spinal range of motion; gross lumbar range, true lumbar range, hip range and straight leg raise. Measurement of inclination at the T12-L1 interspace (gross range) less the inclination of the pelvis (hip range) yields a measure of T12-S1 motion (true range). The straight leg raise is an effort measure when compared to pelvic flexion.

2) Isometric and multi-speed isokinetic trunk strength testing. Measurement of the torque output of isolated trunk musculature in flexion and extension while in standing. Results are compared to normative data grouped according to subject's body weight.

3) Cardiovascular fitness/muscular endurance measures; bicycle ergometry and upper body ergometry. Standardized tests of lower and upper body ergometry under increasing workloads. End point is target heart rate at 85% maximum or fatigue.

4) Gait speed. Measurement of stride length and cadence over a measured course.
5) Obstacle course. A timed test simulating activities of daily living and work requiring subject to complete tasks in multiple positions.

6) Static lifting. Lifting dynamometer using static lifting test protocols.

7) Dynamic lifting. Measurement of repeated lifting through a full range of motion, floor to waist and waist to above shoulder.


Several studies also encourage long-term follow-up for a 6 to 24 month period after discharge from the supervised rehabilitation program.(Hazard et al., 1989; Mayer et al., 1986; Mayer, 1990; White et al., 1990). This strategy is thought to monitor changes in patient motivation, reassess functional capacities, and identify incidence of back reinjury.

Overall, outcome assessment based on functional capacity evaluation objectively demonstrates the therapeutic efficacy of DLMS and similar functional restoration programs.(Mayer et al., 1986). Patients obtain feedback regarding rate of improvement of functional status, rather than relying on change in pain perception as a gauge for progress. Additionally, patients become less fearful of reinjury through supervised simulation of exercise and occupational activities while physicians are provided with a quantifiable measure of patient function, improvement, and level of effort. Finally, ongoing outcome assessments guide the
rehabilitation program through structured levels where progression is based on objective changes in patient function and effort.

**Implications for the Study**

The recent literature on SFSI DLMS training program outlines specific stabilization exercise protocols and demonstrates efficacy attributed to the implementation of these specific techniques. The researchers hypothesize that differences will exist in the surveyed clinicians' rationale, program implementation, and use of outcome assessment procedures when compared to the SFSI protocol. Thus, this study attempts to identify clinician compliance with the SFSI published program and address the following questions:

1) Do clinicians demonstrate an accurate understanding of the rationale for DLMS training?
2) Do clinicians comply with SFSI protocol when instructing DLMS exercise?
3) Do clinicians routinely and objectively assess treatment outcomes?
CHAPTER 3
METHODS

Subjects
The study participants were physical and occupational therapists, physical and occupational therapy assistants, and certified athletic trainers at Michigan hospitals, physical therapy clinics, and rehabilitation facilities. Clinicians were selected as a sample of convenience determined by geographic accessibility. Prospective participants at facility sites located within a 75 mile travel radius (from the investigators) were identified. Clinician eligibility for survey participation was established using the following criteria: 1) the clinician must instruct an SFSI or similarly formatted DLMS program, 2) the clinician must have provided DLMS program instruction for a minimum of one year, and 3) the clinician must agree to voluntary participation in the study. Clinician eligibility was verified during preliminary telephone surveys (Appendix A).

Research Method
The investigators conducted a descriptive study using survey methodology. A questionnaire was developed based on the SFSI's published protocols and pertinent research articles (Appendix C). The survey tool consisted of 49 questions requiring either yes/no or short answer responses. The question categories addressed: 1) clinician demographics; 2) clinician rationale for the use and progression of DLMS training; 3) biomechanic concepts applied in DLMS training; 4) DLMS
training techniques with patients and; 5) assessment procedures used to evaluate patient response and program outcomes.

**Survey Procedure**

Participating clinicians were asked to review and sign participation consent forms prior to the interview process (Appendix B). The questionnaire was verbally administered to each clinician during a 30-40 minute interview session. Clinicians were provided with a non-keyed copy of the questionnaire for convenient reference during verbal questioning by the investigators (Appendix D). The investigators audiotaped interviews to expedite the sessions and facilitate accurate recording of clinician responses. The investigators strictly adhered to the outlined format of the survey tool to minimize interviewer bias and reporting inconsistencies. The investigators did not elaborate on questions or provide additional information (other than examples cited on the researcher's copy of the questionnaire - appendix C) when clinicians requested clarification of survey items. Finally, each questionnaire was assigned a numerical code to allow confidential treatment of survey data.
CHAPTER 4
RESULTS

Data Analysis

The researcher's copy of the DLMS questionnaire listed keyed terms and concepts after each survey question (Appendix C). These keyed terms and concepts were consistent with SFSI DLMS literature. Clinician responses obtained for each question were compared to the listed terms and concepts then marked as either "consistent with SFSI/DLMS protocol" or "other". Those responses categorized as "other" were entered separately after each short-answer question.

Clinician responses recorded on the keyed questionnaire were transferred to a coding sheet to assist with data analysis (Appendix E). For tabulation purposes, the responses in the "other" category were grouped together based on similarities in context. Every fifth questionnaire was recoded by an investigator other than the one who conducted the interview to check for bias in recording of responses. Questions 13, 15, and 27 were not analyzed secondary to inconsistent clinician interpretation of these survey items and concerns with question validity. Data analysis consisted of percentage calculations to determine the frequency of clinician responses for each question. Data calculation was completed using the Microsoft Works for Windows 3.1 Database program to generate a data summary sheet.
Clinician Demographics

Of the 49 survey participants, 41 were Licensed Physical Therapists (PT). Other respondents included: four Certified Athletic Trainers (ATC), one Physical Therapy Assistant (PTA), two Certified Occupational Therapy Assistants (COTA), and one Registered Occupational Therapist (OTR). Two PTs also had ATC credentials. The clinicians averaged 7.7 years in clinical practice with 2.3 years of DLMS training experience.

Forty-nine survey respondents (100%) reported using the SFSI or a similarly formatted DLMS training protocol. Seventeen clinicians also incorporated other stabilization training formats with the SFSI DLMS program. Examples of these formats included the Folsom Clinic (CA) Postural Stabilization Program For The Low Back Injured and the Bev Biondi Lumbar Stabilization Program. Sixteen respondents (32.7%) received training in DLMS during participation in a professional seminar, while 33 (67.3%) reported receiving informal orientation to DLMS during departmental inservice presentations or self-teaching efforts.

Clinician Rationale

Responses were categorized as either "consistent with SFSI DLMS training rationale" or "other". Concepts italicized in this text are those classified by the investigators as consistent with SFSI DLMS training rationale.

Thirty-eight clinicians (77.6%) reported use of inclusion criteria as a means to identify patients appropriate for participation in DLMS training. Twenty-three respondents considered patient report of pain or patient functional disability as inclusion criteria. Five clinicians recognized both
factors as primary inclusion criteria. "Other" responses totalled 42 and included: trunk weakness (17), postural dysfunction (10), and poor stabilization (10) (Figure 1).

Fifteen clinicians correctly identified two of the three primary DLMS treatment objectives. Twenty-four respondents identified one treatment objective. The majority of responses (39) included *increase in low-back strength* and *increase in low-back flexibility*. Nine clinicians considered *increase in movement coordination* a fundamental training objective. "Other" responses totalled 87 and included: patient report of decreased pain (19), increased postural awareness (18), and increased low back stability (11) (Figure 2).

Six respondents (12.2%) completely described the basic stabilization exercise program, while two clinicians (4.1%) accurately discussed advanced stabilization training activities. Individual DLMS exercise instruction was offered by 44 clinicians (89.8%) at their respective clinical sites. Five respondents (10.2%) instructed both group and individual patient programs.

Nineteen clinicians (38.8%) used the SFSI guideline of 2-3 sets of 10-15 repetitions (*maintaining functional spine position*) for progressing patient exercise programs. Forty-six clinicians (93.9%) recognized patient report of pain as a limiting condition to DLMS exercise progression. A significant number of respondents (61.2%) indicated that patient report of increased pain with exercise activity would limit the number of repetitions or patient progression to more challenging activities. Four clinicians
FIGURE 1: SFSI INCLUSION CRITERIA VERSUS REPORTED CRITERIA

SFSI DLMS Inclusion Criteria Key:
A = Patient’s report of pain
B = Functional disability

Other Non-SFSI Reported Criteria:
Trunk weakness (N=17)
Poor stabilization (N=10)
Postural dysfunction (N=10)
FIGURE 2: SFSI TREATMENT OBJECTIVES VERSUS REPORTED OBJECTIVES

SFSI DLMS Treatment Objectives Key:
A = Increase low back strength
B = Increase low back flexibility
C = Improve Coordination

Other Non-SFSI Reported Objectives:
Decrease pain (N=19)
Postural awareness (N=18)
Increase low back stability (N=11)
limited exercise if patients experienced pain during activities while maintaining functional spine position.

Clinicians were polled regarding patient use of gym and aerobic equipment during advanced DLMS training. Over eighty percent reported use of free weights, stationary bicycles, and treadmills as the most common DLMS training adjuncts. Aerobic conditioning programs were monitored and progressed based on patient's heart rate in 57.1% of the responses, by exercise intensity in 53.1% of the responses, and by duration of exercise sessions in 83.7% of the responses. It was noted that only six clinicians (12.2%) followed the American College Of Sports Medicine Guidelines For Exercise Training in progressing advanced DLMS conditioning activities.

Twenty-one respondents (42.9%) recognized maximal functional improvement as the primary criterion for patient discharge from the DLMS program. The average length of patient participation in stabilization training was 5.2 weeks with 57.1% of the clinicians limiting program duration to five weeks or less.

**Biomechanic-Physiologic Concepts**

Responses were categorized as either "consistent with SFSI DLMS biomechanic-physiologic concepts" or "other". Concepts italicized in this text are those classified by the investigators as consistent with SFSI DLMS biomechanic-physiologic concepts.

Clinicians were asked to list the primary muscle groups involved in the lumbar stabilization mechanism. One hundred percent of the respondents identified the abdominal muscle groups, 89.8% described the erector
spinae, and 77.6% included the gluteal muscle groups when describing muscle stabilization. Fewer clinicians correctly identified the hamstring muscles, latissimus dorsi, and multifidi (28.6%, 12.2%, and 9% respectively) as components of the stabilization mechanism.

Forty-two respondents (85.7%) correctly defined "functional" spine position as: patient position with controlled lumbar flexion / extension, patient position of comfort with controlled lumbar lordosis, or patient position which reduces stress to lumbar vertebral segments (Figure 3). One clinician was unable to define the term. Thirty-nine respondents (79.6%) acknowledged that "functional" or "neutral" spine position was altered by the patient during performance of DLMS exercise. Eighteen clinicians noted that modification of spinal alignment was necessary as functional positions and activity demands changed throughout the training sequence.

**Initial Treatment Techniques**

Responses were categorized as "consistent with SFSI DLMS treatment concepts" or "other". Concepts italicized in this text are those classified by the investigators as consistent with SFSI DLMS treatment concepts.

None of the surveyed clinicians reported use of a routine trial of pelvic traction prior to initiation of DLMS training. Thirty-six respondents (73.5%) considered use of pelvic traction if warranted by the patient's symptoms. None of the clinicians routinely used a trial of extension exercise prior to stabilization training. Thirty-three respondents (67.4%) instructed extension exercises if warranted by patients' symptoms. Forty clinicians (81.6%) reported use of manual techniques as an adjunct to
FIGURE 3: SFSI DESCRIPTION OF FUNCTIONAL SPINE VERSUS REPORTED DESCRIPTION

SFSI's Functional Spine Descriptions:
A = Position with controlled lordosis
B = Patient's position of comfort
C = Biomechanical position to reduce stress to lumbar spine

Other Non-SFSI Responses:
Posterior pelvic tilt (N=5)
Mid-range pelvic tilt (N=4)
exercise training. Myofascial release/muscle energy techniques and joint mobilizations were practiced by 85% and 77.5% of the respondents respectively.

**Assessment**

Responses were categorized as "consistent with SFSI DLMS assessment concepts" or "other". Concepts italicized in this text are those classified by the investigators as consistent with SFSI DLMS assessment concepts.

Forty-four clinicians (89.8%) reported use of pain assessment methods. Patient self-rating scores and patient pain diagram/grids were the methods frequently utilized (97.7% reported use). Twenty-five clinicians (51%) reported *routine assessment of patients' medications during DLMS training progression*.

Clinicians' *routine assessment of soft tissue flexibility, joint mobility and musculoskeletal strength* was also surveyed. Forty-two respondents reported evaluation of soft tissue flexibility, 36 assessed joint mobility, and 47 performed strength testing as part of the stabilization training protocol. Flexibility of hamstrings and hip flexors (85.7% and 57.1% reported evaluation), lumbar spine and hip joint mobility (83.3% and 50% reported evaluation) and manual muscle testing (95.7% reported evaluation) were the responses to questions which polled the clinicians' assessment techniques (Figure 4).

Three clinicians routinely performed functional capacity assessment (FCA). This assessment was performed at the time of patient discharge from DLMS training. Twenty-two respondents (44.9%) reported FCA is
FIGURE 4: REPORTED ROUTINE ASSESSMENT PROCEDURES

- Pain: 10.2% (yes), 89.8% (no)
- Medication: 51.0% (yes), 49.0% (no)
- Flexibility: 14.3% (yes), 85.7% (no)
- Joint Mobility: 73.5% (yes), 26.5% (no)
- Strength: 95.9% (yes), 4.1% (no)
performed based on individual patient need or physician referral. Twenty-four clinicians (49%) did not perform FCA's.

Two clinicians performed work capacity assessment (WCA) routinely as stabilization training progressed. Nineteen respondents reported WCA is performed based on individual patient need or physician referral. Twenty-eight respondents (57.1%) did not perform WCA's.

One clinician performed aerobic capacity assessment (ACA) at regular intervals during DLMS training. Five respondents completed ACA based on patient need or physician referral. Fifteen clinicians (30.6%) performed formal ADL assessment during patient initial evaluation and twenty-two respondents noted patient self-report of ADL's during assessment and stabilization training (Figure 5). Twelve clinicians did not evaluate ADLs or functional levels.

Forty-three respondents (87.8%) did not perform follow-up with patients after discharge from DLMS training. Of the six clinicians who did perform follow-up, two utilized phone surveys, three performed patient re-evaluation, and one combined use of phone surveys with mailed questionnaires.

**DLMS Program Limitations**

Thirty-six survey respondents (78.3%) commented on self-perceived limitations to the DLMS training program. Fourteen clinicians reported that the program was "difficult to learn", thirteen that it was "too time consuming "and ten that it was "not functional."
FIGURE 5: REPORTED ROUTINE OUTCOME ASSESSMENTS

Outcome Assessment Key:
FCA = Functional Capacity Assessment
WCA = Work Capacity Assessment
ACA = Aerobic Capacity Assessment
CHAPTER 5
DISCUSSION

An Overview of Survey Results

The purpose of this study is to identify clinicians' rationale for DLMS training, clinician application of DLMS techniques, and clinicians' use of outcome assessment methods and compare these with the SFSI DLMS protocol. The results of the clinician survey demonstrate differences in DLMS treatment rationale, applications, and outcome assessment procedures when compared to the SFSI protocol. The magnitude of these differences vary with topics of comparison. The most distinct variances relate to rationale for treatment objectives, training sequence, training progression, and the use of outcome assessment measures.

Discussion of Clinician Demographics

Physical therapists (PT) represent the majority of clinicians (83.7%) who met eligibility criteria for inclusion in the survey. This is attributed to the role PTs assume in interacting with the low-back patient population. Physical therapists typically evaluate patient posture and orthopedic parameters, then plan and implement therapeutic exercise (including DLMS). In comparison, allied rehabilitation clinicians report less familiarity with the DLMS protocol and infrequent use of stabilization techniques during functional training. This is explained by the "co-treater" relationship established with PTs in the clinical setting as well as differences in preparatory education and areas of treatment emphasis.
Sixteen clinicians received formal DLMS program orientation and training, while twenty-eight clinicians attended informal staff inservice presentations. The formal training was obtained through professional seminars, although these did not specifically instruct the SFSI stabilization protocol. Inservice programs were typically conducted by clinicians who had previously attended a professional DLMS training. This information suggests that SFSI training concepts and techniques are not directly introduced to clinicians during formal or informal orientation to stabilization protocols. Further, there are few local SFSI-sponsored seminars and professional education programs available to Michigan rehabilitation professionals. Other stabilization training formats presented to the surveyed clinicians included the Folsom Clinic (CA) Postural Stabilization Program For The Low-back Injured and the Bev Biondi Lumbar Stabilization Program. The concepts and training techniques for both formats parallel the SFSI protocol.

**Discussion of Clinician Rationale for DLMS Training**

The use of patient inclusion criteria and the choice of specific criteria do not differ among the clinicians as a factor of years in clinical practice or type of DLMS training (formal or informal) received. It is interesting to note, of the eleven respondents who consider functional disability as an inclusion criterion, only one routinely performed WCA and two routinely performed a formal ADL evaluation to demonstrate functional improvement. Of the 42 "other" responses offered by clinicians when asked to identify inclusion criteria, trunk weakness (17), postural dysfunction (10), and poor stabilization capacity (10) were discussed. This
information suggests a focus on improving patients' orthopedic status rather than functional abilities when planning therapeutic interventions. This is later discussed in the chapter summary of survey findings regarding use of outcome assessment procedures with DLMS training.

In considering the primary treatment objectives promoted by the SFSI DLMS protocol, it is interesting that only those clinicians who had participated in professional training and DLMS orientation could identify *increase in movement coordination* as a fundamental treatment objective (J.A. Saal & J.S. Saal, 1989; J.A. Saal, J.S. Saal & Herzog, 1990). Eighty-seven "other" treatment objectives were offered by clinicians including: decrease in patient report of LBP (19), increase in patient's postural awareness (18), and increase in low-back stability (11). "Low-back stability" was defined by clinicians as the combined physical capacity of patients to maintain low-back posture with proprioceptive awareness of trunk alignment. These responses demonstrate a tendency for clinicians to establish conceptual treatment goals, i.e., decrease patient report of LBP, rather than develop quantifiable, function-oriented (task-oriented) objectives.

Descriptions of the basic and advanced DLMS exercise sequences varied among surveyed clinicians. This is attributed to inconsistencies in program orientation and the lack of SFSI-specific professional training. Thus, it is common for clinicians to interpret and implement the illustrated SFSI exercise booklet based on patient presentation and individual need rather than on conceptual guidelines described in the SFSI DLMS protocol. Additionally, most clinicians were unable to identify their source of the
SFSI published material, elaborating only that the information was not obtained from professional training programs.

Survey respondents also differed in their means of progressing a patient through DLMS training activities. Twenty-five clinicians offered responses other than the SFSI guideline of 2-3 sets of 10-15 repetitions (J.A. Saal, 1990a, 1990b) The clinicians' alternate means of progression were based on patient report of exercise tolerance or patient report of fatigue (14) and duration of exercise sessions (6) measured in time increments rather than by numbers of exercise repetitions. Only five respondents reported use of the ACSM Guidelines For Exercise Training to progress patient endurance and aerobic conditioning programs. Seven clinicians stressed the importance of "functional spine" reinforcement to patients during advanced exercise activities. These results suggest inconsistent efforts by many clinicians to promote functional carry-over of stabilization concepts or base DLMS training progress on objective measures.

There is an obvious difference in surveyed clinicians' rationale for progression of stabilization training and the SFSI conceptual framework for DLMS. This is apparent in the focus on patient pain management and the importance of patient report of pain in limiting the training activities. Forty-six clinicians (93.9%) regarded patient report of pain as a limiting factor to DLMS exercise progression. Only four respondents stipulated that pain report would serve to limit exercise repetitions or level of difficulty, if pain persisted after the patient had adjusted and maintained the "functional spine" position. Three clinicians did not regard patient report
of pain as a limiting factor for DLMS program progression and all subsequently reported routine use of formal ADL assessment to quantify functional gains. Clinicians are encouraged by the SFSI protocol to limit passive pain management modalities and stress active and progressive reconditioning efforts with patients (J. A. Saal, 1990a, 1990b). These efforts promote improved physical capacities and enhanced awareness of posture and correct body mechanics. Collectively, these changes may improve patients' functional capacities and result in secondary gains in pain management (Mayer, 1990).

**Discussion of Biomechanic Concepts for DLMS Training**

A high percentage of clinician responses to survey question regarding DLMS biomechanic-physiologic concepts were consistent with the SFSI conceptual framework for stabilization training. Respondents consistently identified the abdominals, erector spinae, and gluteal muscle groups as primary components of the muscle stabilization mechanism. Fewer clinicians discussed the importance of the hamstrings, quadriceps, latissimus dorsi, multifidi, and iliopsoas muscle groups for low-back stabilization and performance of functional extremity movement patterns. Respondents also varied in the explanation for "functional spine" adjustment and modification during postural transitions and with changes in patient activity demands. Possible explanations for this response distribution are individual differences in clinician understanding and application of DLMS biomechanic concepts.
Discussion of Clinician Treatment Techniques

Clinician responses to survey questions regarding DLMS treatment techniques were consistent with the SFSI protocol. Although clinicians reported use of pelvic traction and extension exercise with patients whose symptoms warranted intervention, none routinely used these techniques prior to stabilization training. The SFSI DLMS program suggests routine use of pelvic traction and extension exercise during the acute pain control phase of training (J.A. Saal, 1990a).

Assessment Procedures

Clinician responses regarding use of patient pain evaluation methods and routine assessment of soft tissue flexibility, joint mobility, and musculoskeletal strength were consistent with SFSI assessment practices. Clinician use of assessment strategies including FCA, WCA, ACA and ADL evaluation differed in both type of assessments and consistency of application. A majority of respondents indicated that formal assessments were completed based on individual patient considerations (litigation status, participation in vocational rehabilitation) or as directed by the treating physician. Typically, FCAs and WCAs were performed at the time of patient discharge from therapy services. ADL evaluation was usually completed at the time of patient initial evaluation. Studies which demonstrate the efficacy of DLMS training implement routine objective evaluation procedures (Lindstromm et. al., 1992; Mayer et. al., 1986; J.A. Saal & J.S. Saal, 1989). Information from procedural reports guides patient participation and progress throughout the training protocol and defines measurable treatment outcomes. Functional outcome measures
identify patients' training needs, performance variables, and limitations encountered during DLMS program participation. Without routine assessment and patient follow-up, justification of DLMS interventions, resolution of problems related to impaired patient function, and prediction of final treatment outcomes cannot be addressed (Stewart & Abeln, 1993).

Clinicians' Perceptions of DLMS Program Limitations

Several clinicians (10) perceived lack of functional carryover for stabilization training as a limitation of the DLMS program. This is an indication of conceptual misunderstanding or lack of specific SFI protocol training and orientation for rehabilitation professionals. Thus, it is not surprising that these same clinicians did not perform functional measures and outcome assessment procedures during the course of DLMS training. While 13 clinicians commented that stabilization training was "too time consuming" or a "lengthy program." It was also found that DLMS was considered to be a treatment adjunct rather than a specific rehabilitation protocol. This is notable, since the purpose of the SFSI DLMS protocol is to provide a comprehensive, nonoperative treatment program (J.A. Saal & J.S. Saal, 1989).

Limitations of the Study

A number of limiting factors must be considered when interpreting the results of this study. First, the sample population was limited in size and geographic representation. The surveyed population was located within a 75 mile travel radius for the convenience of the investigators. Time constraints and method of interviewing prohibited sampling a larger geographic area. The sampling method contributed to bias in participant
selection, as some facilities may have recommended only those clinicians considered the most knowledgeable in DLMS for participation in the interview. Thus, the results of this study cannot be applied specifically to other populations.

The questionnaire design and survey method presented limitations to the study. Open-ended questions were used to construct the questionnaire. This was an effort to obtain a true representation of the clinician's knowledge of DLMS training and the methods used without suggestive inquiries. However, the use of open-ended questions created potential for error in clinician interpretation of the question and possible error in the investigator's interpretation when categorizing and analyzing responses. Additionally, the respondents may have reported what they felt were the most accurate answers rather than the program concepts or training techniques used in the clinical setting. Finally, because three investigators conducted the interviews, a potential for researcher bias was created.

Data analysis methods presented limitations to the study. The investigators coded and categorized the responses on the questionnaire and transferred the results to a simplified form for tabulation purposes. Individual investigator interpretation of responses may account for discrepancies in organization of response data.

Lastly, a pilot study was not conducted prior to initiation of the clinician survey. Thus, the questionnaire was not pre-tested for reliability. Questions 13, 15, and 27 were not analyzed secondary to clinician misinterpretation and concerns with item validity.
Implications for Future Research

The results of this study indicate that the SFSI DLMS training program is a commonly used treatment approach for low back pain dysfunction. However, the data suggest that variations exist in how DLMS is implemented by clinicians. The effects of these variations on program outcomes and effectiveness require further investigation. Suggestions for future research include: 1) comparison of treatment outcomes for the SFSI DLMS protocol and other non-operative musculoskeletal stabilization methods and; 2) evaluation of specific SFSI DLMS protocol components and their effect on treatment outcomes.

Summary

In this survey of forty-nine Michigan rehabilitation clinicians, all participants reported use of the SFSI or a similar DLMS program. Clinicians did not receive specific orientation to SFSI DLMS during professional staff training. Survey results suggest that clinicians using the DLMS program do vary from the SFSI protocol. Pronounced differences exist in the respondents' perception of DLMS training limitations resulting from patient pain report and also with inconsistent use of routine outcome assessment procedures.

These variances are attributed to clinicians' lack of familiarity with the SFSI protocol and their treatment emphasis on patients' orthopedic-physiologic status rather than functional status. The SFSI DLMS training protocol promotes progression of patients' functional abilities rather than passive treatment and pain management strategies. Without consistent use of objective outcome assessment procedures, program effectiveness cannot
be determined. Since the literature demonstrates efficacy based only on the SFSI DLMS protocol, the effectiveness of variations of the protocol is uncertain.

The demand for controlled healthcare costs requires use of efficient and efficacious treatment protocols. Thus, a review of DLMS training applications is warranted. Any variations to the SFSI DLMS protocol require further research to document efficacy and validate associated functional gains. In the interim, clinicians must consistently document DLMS training applications with patients and routinely measure functional outcomes. Finally, rehabilitation clinicians must educate referring medical providers regarding use of the DLMS program as a comprehensive therapeutic protocol.
REFERENCES


APPENDIX A

CLINICIAN TELEPHONE SURVEY

Date: ________________
Site name: ________________________________________________

Location/address: ____________________________________________

Phone number: ______________________________________________

Department director: _________________________________________

Contact person: ______________________________________________

Questions:

1. Do staff clinicians utilize the DLMS training program? (Y) (N)

2. If so, how long have clinicians used the DLMS training program? _______ years

3. Is the DLMS training program formatted similar to the SFSI protocol or another published program? (if not, how has your particular format been developed)? ___________________________

4. Explain objectives of research and determine interest in future contacts.

5. What is the procedure to obtain permission to evaluate your clinic program? ________________________________

6. Comments: ____________________________________________

__________________________________________________________

__________________________________________________________
CONSENT FOR PARTICIPATION IN CLINICIAN SURVEY OF CLINICAL APPLICATIONS AND OUTCOME ASSESSMENT PROCEDURES FOR DYNAMIC LUMBAR MUSCULAR STABILIZATION EXERCISE TRAINING

Department of Physical Therapy  
Grand Valley State University  
Allendale, Michigan

I understand that this is a study which compares rehabilitation clinicians' understanding, application, and assessment of the Dynamic Lumbar Muscular Stabilization (DLMS) exercise training program for treatment of patients with low back dysfunction. I further understand that information obtained from this project will assist rehabilitation professionals in identifying current DLMS treatment methods for lumbar dysfunction.

I also understand that:
1) participation in this study will require participation in a 20-30 minute personal interview session, including audiotaping of the interview,
2) the information I provide will be kept confidential and the data numerically coded to protect the identification of individual survey participants',
3) a summary of the results will be made available to me upon my request.

I acknowledge that:
1) all questions regarding this survey and interview have been answered to my satisfaction,
2) I have consented to participation in this study and that my participation is voluntary,
3) I authorize the investigators to release information obtained from the study to scientific literature.

Finally, I acknowledge that I have read and understood the above information and agree to participation in the clinician survey and interview procedures.

_________________________ ________________________________
Witness Participant Signature

____   ______
Date    Date

____ I am interested in receiving a summary of the survey results.
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APPENDIX C

QUESTIONNAIRE - RESEARCHER COPY

A SURVEY OF CLINICAL APPLICATIONS AND OUTCOME ASSESSMENT PROCEDURES FOR DLMS EXERCISE TRAINING

Client #____

CLINICIAN DEMOGRAPHICS

Introduction: In this group of questions I will ask for information about your experience in clinical practice and your training in DLMS.

1. Please specify type of clinical licensure you have.
   Type of licensure:
   PT _____
   OT _____
   ATC _____
   PTA _____
   COTA _____

2. Please identify the number of years you have been in practice:____
   (total years)

3. How long have you used the DLMS training program in your practice?____ (years)

4. Which DLMS exercise training format do you follow?
   A. SFSI
   O. Other______________________________

5. Which best describes your training in DLMS:
   A. Training at the San Francisco Spine Institute
   B. Professional Seminar___________________________
   O. Other________________________________________

RATIONALE FOR THE DLMS EXERCISE TRAINING PROGRAM

Introduction: In this series of questions I will ask you to explain your rationale for the use and progression of DLMS exercise training.

6. Do you use inclusion criteria to identify those patients who will participate in the DLMS exercise training? (Y) (N)
7. If yes to #6, identify two inclusion criteria you consider prior to directing patients in the DLMS training:
   A. Patient report of pain
   B. Functional disability (work, occupation, ADL’s, recreation)
   O. Other ________________________________

8. What are the primary treatment objectives promoted by DLMS training? (Identify 3):
   A. Increase LB strength
   B. Increase LB flexibility (ROM, joint mobility, soft tissue mobility)
   C. Improve coordination (extremity movement patterns combined with functional spine position)
   O. Other ________________________________

9. Generally describe the basic stabilization exercise sequence:
   A. Find functional spine position (FSP, neutral spine)
   B. FSP in neurodevelopmental positions (supine, prone, quadraped, kneeling, standing)
   C. FSP with extremity exercises (heel slides, alternating arms-legs, SLR, etc.)
   D. FSP with transitions (positional transitions)
   O. Other ________________________________

10. Generally describe the advanced stabilization exercise sequence:
    A. Abdominal exercise progression (curls, straight leg lowering, dead bugs)
    B. Gym/strengthening program (physioball, free weights, gym equip, isokinetics)
    O. Other ________________________________

11. Are individualized exercise sessions instructed?  (Y) (N)

12. Are group exercise programs offered at your clinical site?  (Y) (N)

13. Are there differences in the progression of DLMS exercises for individuals vs. groups?  (Y) (N)

14. How are exercises progressed for individual patients?
    A. 2-3 sets of 10-15 reps (maintaining functional spine)
    O. Other ________________________________
15. If yes to #13, how are exercises progressed for group patients?
   A. 2-3 sets of 10-15 reps (maintaining functional spine)
   O. Other

16. Does the patient's pain level limit exercise progression? (Y) (N)

17. If yes to #16, please explain:
   A. If pain increases with specific activity
   O. Other

18. Identify gym equipment/training systems which are introduced into the exercise progression:
   A. Eagle/Paramount
   B. Universal
   C. Free weights (theraband)
   D. Nautilus
   E. Cybex
   F. Biodex
   O. Other

19. Identify aerobic training activities which are incorporated into the training progression:
   A. Stationary bicycle
   B. Treadmill
   C. Aquatics
   D. Walking program
   O. Other

20. How are aerobic conditioning programs monitored?
   A. Heart rate
   B. Blood Pressure
   C. Duration of exercise session
   D. Distance performed
   E. Perceived exertion
   O. Other

21. How are aerobic conditioning programs progressed?
   A. Frequency
   B. Intensity
   C. Duration
   D. ACSM guidelines
   O. Other
22. How is the program end-point determined for individual exercise programs?
   A. Maximum functional improvement
   O. Other______________________________

23. How is the program end-point determined for group exercise programs?
   A. Maximum functional improvement
   O. Other______________________________

24. What is the average duration of patient participation in the DLMS training program? (total weeks)

   BIOMECHANIC CONCEPTS
   Introduction: In the following group of questions I will ask you to describe biomechanic concepts applied in DLMS training.

25. List the primary muscle groups involved in the spinal stabilization mechanism:
   A. Abdominals
   B. Erector Spinae
   C. Gluteals
   D. Latissimus
   E. Hamstrings
   O. Other______________________________

26. Briefly describe the functional spine position (or neutral spine position as cited in previous references):
   A. Controlled lordosis (control of spine flexion/extension)
   B. Position of comfort
   C. Biomechanic position which reduces stress to lumbar spine
   O. Other______________________________

27. Specifically describe the mechanism which allows the patient to adjust the functional spine position:
   A. Co-contraction of internal obliques, transverse abdominus, psoas, midline ligament
   O. Other______________________________

28. Does the patient alter their functional spine position during DLMS exercise activities?

   (Y)(N)
29. If yes to #28, why?
   A. In response to different mechanical loads to the spine with different tasks
   O. Other.................................................................

INITIAL TREATMENT CONSIDERATIONS
Introduction: In the following set of questions I will ask you to describe methods and techniques that you would use prior to beginning the basic stabilization exercises.

30. Do you utilize traction?
   A. Yes, routinely
   B. Yes, if symptoms warrant
   C. Do not use

31. Do you use manual techniques? (Y) (N)

32. If yes to #31, which techniques do you use?:
   A. Mobilization
   B. Muscle energy
   C. Myofascial release
   D. Craniosacral
   E. Manipulation
   O. Other.................................................................

33. Before starting DLMS do you use a trial of extension exercise?
   A. Yes, routinely
   B. Yes, if symptoms warrant
   C. Do not use

ASSESSMENT
Introduction: In this set of questions I will ask you to specify the assessment procedures you use to evaluate and monitor patient response and outcomes.

34. Do you objectively assess pain? (Y) (N)
35. If yes to question 34, which methods do you use?:
   A. McGill Questionnaire
   B. Oswestry LBP Disability Questionnaire
   C. Patient Self-Rating Score
   D. Patient Diagram/Pain Grid
   O. Other________________________________________________________

36. Do you routinely assess the patients use of medication throughout the rehabilitation program? (Y) (N)

37. Do you routinely assess for soft tissue flexibility (example - the quadriceps musculotendinous unit)? (Y) (N)

38. If yes to #37, please specify areas of assessment:
   A. Quadriceps
   B. Hamstrings
   C. Iliopsoas
   D. Gastrocnemius/Soleus
   E. Hip rotators
   O. Other________________________________________________________

39. Do you routinely assess for joint mobility (example - lumbar spine segmental mobility)? (Y) (N)

40. If yes to #39, please specify areas of assessment:
   A. Thoracic spine
   B. Lumbar spine
   C. Hips
   O. Other________________________________________________________

41. Do you routinely assess strength? (Y) (N)

42. If yes to #41, which methods do you use?
   A. MMT
   B. Isokinetic testing
   C. Graded isotonic testing
   O. Other________________________________________________________
Which of the following assessments do you conduct and when?

43. Functional capacity assessment:
   A. As part of initial evaluation
   B. During exercise progression
   C. At discharge
   D. Do not perform
   O. Pt dependent or if requested by health care professional

44. Work capacity assessment:
   A. As part of initial evaluation
   B. During exercise progression
   C. At discharge
   D. Do not perform
   O. Pt dependent or if requested by health care professional

45. Aerobic capacity:
   A. As part of initial evaluation
   B. During exercise progression
   C. At discharge
   D. Do not perform
   O. Pt dependent or if requested by health care professional

46. ADL Assessment:
   A. As part of initial evaluation
   B. During exercise progression
   C. At discharge
   D. Do not perform
   O. Per patient report

47. Do you perform long term follow-up (6-24 months) after discharge from DLMS training? (Y) (N)

48. If yes to # 47, what does follow-up entail?:
   A. Phone call
   B. Questionnaire
   C. Re-evaluation
   O. Other ____________________________

DLMS PROGRAM LIMITATIONS
49. What limitations do you feel that DLMS exercise training has?:
   ___________________________________________________________________________
1. Please specify type of clinical licensure you have.

2. Please identify the number of years you have been in practice (total years).

3. How long have you used the DLMS training program in your practice? (years)

4. Which DLMS training format do you follow?

5. Which best describes your training in DLMS:

6. Do you use inclusion criteria to identify those patients who will participate in the DLMS exercise training?

7. If yes to #6, identify two inclusion criteria you consider prior to directing patients in the DLMS training.

8. What are the primary treatment objectives promoted by DLMS training? (Identify 3)

9. Generally describe the basic stabilization exercise sequence.

10. Generally describe the advanced stabilization exercise sequence.

11. Are individualized exercise sessions instructed?

12. Are group exercise programs offered at your clinical site?

13. Are there differences in the progression of DLMS exercises for individuals vs. groups?

14. How are exercises progressed for individual patients?
15. If yes to #13, how are exercises progressed for group patients?

16. Does the patients pain level limit exercise progression?

17. If yes to #16, please explain.

18. Identify gym equipment/training systems which are introduced into the exercise progression.

19. Identify aerobic training activities which are incorporated into the training progression.

20. How are aerobic conditioning programs monitored?

21. How are aerobic conditioning programs progressed?

22. How is the program end-point determined for individual exercise programs?

23. How is the program end-point determined for group exercise programs?

24. What is the average duration of patient participation in a DLMS training program? (total weeks)

25. List the primary muscle groups involved in the spinal stabilization mechanism.

26. Briefly describe the functional spine position (or neutral spine position as cited in previous references).

27. Specifically describe the mechanism which allows the patient to adjust the functional spine position.

28. Does the patient alter their functional spine position during DLMS exercise activities?

29. If yes to #28, why?

30. Do you utilize traction?

31. Do you use manual techniques?
32. If yes to #31, which techniques do you use?

33. Before starting DLMS do you use a trial of extension exercise?

34. Do you objectively assess pain?

35. If yes to question #34, what methods do you use?

36. Do you routinely assess the patient’s use of medication throughout the rehabilitation program?

37. Do you routinely assess for soft tissue flexibility?

38. If yes to #37, please specify areas of assessment.

39. Do you routinely assess for joint mobility?

40. If yes to #39, please specify areas of assessment.

41. Do you routinely assess strength?

42. If yes to #41, which methods do you use?

43. Functional Capacity Assessment

44. Work capacity assessment

45. Aerobic capacity

46. ADL Assessment

47. Do you perform longterm follow-up (6-24 months) after discharge from DLMS training?

48. If yes to #47, what does the follow up entail?

49. What limitations do you feel that DLMS exercise training has?
Appendix E

Coding Sheet

CLINICIAN DEMOGRAPHICS

1. Licensure: PT OT ATC COTA PTA
2. Years Practice: ____ years
3. DLMS years: ____ years
4. Format:
   A. SFSI
   O. Other
5. Training:
   A. At SFSI
   B. Professional Seminar
   O. Other

RATIONALE
Key responses A-F represent concepts/terms consistent with SFSI DLMS protocol; "O" denotes other responses.

6. Inclusion Criteria: Y N
7. 2 criteria:
   A. Pts report of pain
   B. Functional disability (work, occupation, vocation, ADL's, recreation)
   O. Other

8. Treatment Objectives:
   A. Increase LB strength (MMT, Increase isokinetic testing)
   B. Increase LB flexibility (ROM, Jt mobility, soft tissue mobility)
   C. Increase movement coordination (extremity mvmt patterns combined w/ functional spine)
   O. Other

9. Basic:
   A. Functional spine (neutral)
   B. Neurodevelopmental Positions (in Functional spine)
   C. Extremity exercises (in FS; heel slides, alternating arms-legs, etc.)
   D. Transitions of position (in FS; Sit to supine or 4pt to prone)
   O. Other

10. Advanced:
    A. Abdominal exercise progression (curls, straight leg lowering, dead bugs)
    B. Gym/Strengthening Program (free wts, gym equip, isokinetic machines)
    O. Other
11. Individual Sessions: Y N
12. Group Sessions: Y N
13. Difference between: Y N
14. Individual progression:
   - A. 2-3 sets of 10-15 repititions (maintain functional spine)
   - O. Other

15. Group progression:
   - A. 2-3 sets of 10-15 reps
   - O. Other

16. Pain Limit: Y N
17. Explain how pain limits progression:
   - A. If pain increases w/ specific activity or exercise
   - O. Other

18. Gym Equipment:
   - A. Eagle/Paramount
   - B. Universal
   - C. Free-wts/Theraband
   - D. Nautilus
   - E. Cybex
   - F. Biodex
   - O. Other

19. Aerobic Activities:
   - A. Stationary Bike
   - B. Treadmill
   - C. Aquatics
   - D. Walking Program
   - O. Other

20. Aerobic monitor:
   - A. Heart rate
   - B. Blood Pressure
   - C. Duration of exercise session
   - D. Distance Performance
   - E. Perceived Exertion
   - O. Other

21. Aerobic Progress:
   - A. Frequency
   - B. Intensity
   - C. Duration
   - D. American College of Sports Medicine guidelines
   - O. Other

22. Individual Endpoint:
   - A. Maximal Functional Improvement
   - O. Other

23. Group Endpoint:
   - A. Maximal Functional Improvement
   - O. Other
24. Duration: ________ weeks

BIOMECHANIC CONCEPTS
25. Muscle Groups:
   _____ A. Abdominal  _____ D. Latisimus
   _____ B. Erector Spinea  _____ E. Hamstrings
   _____ C. Gluteals
   _____ O. Other

26. Functional Spine:
   _____ A. Controlled Lordosis (control of spinal flexion/extension)
   _____ B. Position of comfort (w/ controlled lordosis)
   _____ C. Biomechanical position which reduces stress to lumbar spine
   _____ O. Other

27. Adjustment Mechanism:
   _____ A. Co-contraction of internal oblique, transverse abdominis, psoas, and midline ligament
   _____ O. Other

28. Alter position: Y N

29. Why alter position:
   _____ A. To respond to change in mechanical load to spine w/ different positions
   _____ O. Other

INITIAL TREATMENT CONSIDERATIONS
30. Traction:
    A. Yes, routinely
    B. Yes, if symptoms warrant
    C. No

31. Manual: Y N

32. Manual Techniques:
   _____ A. Mobilization  _____ D. Craniosacral
   _____ B. Muscle Energy  _____ E. Manipulation
   _____ C. Myofacial Release  _____ O. Other

33. Extension:
    A. Yes, routinely
    B. Yes, if symptoms warrant
    C. No

34. Assess Pain: Y N

35. Assessment method:
   _____ A. McGill Questionnaire  _____ C. Pt Self-rating score
   _____ B. Oswestry LBP Disability  _____ D. Pt Diagram/ Pain Grid
   _____ O. Other
38. Areas of Flexibility:
   ____ A. Quadriceps
   ____ B. Hamstrings
   ____ C. Iliopsoas
   ____ D. Gastrosoleus
   ____ E. Hip Rotators
   ____ O. Other

39. Joint Mobility:  Y  N

40. Joint Areas of Assessment:
   ____ A. Thoracic Spine
   ____ B. Lumbar spine
   ____ C. Hips
   ____ O. Other

41. Assess Strength:  Y  N

42. Strength method:
   ____ A. Manual Muscle Test
   ____ B. Isokinetic
   ____ C. Graded Isotonic
   ____ O. Other

OUTCOME ASSESSMENTS

43. FCA:
   ____ A. Initial Evaluation
   ____ B. During Ex. progression
   ____ C. At Discharge
   ____ D. Do not perform
   ____ O. Patient dependent or if requested by health care professional

44. WCA
   ____ A. Initial Evaluation
   ____ B. During Ex. progression
   ____ C. At Discharge
   ____ D. Do not perform
   ____ O. Patient dependent or if requested by health care professional

45. Aerobic Capacity:
   ____ A. Initial Evaluation
   ____ B. During Ex. progression
   ____ C. At Discharge
   ____ D. Do not perform
   ____ O. Patient dependent or if requested by health care professional

46. ADL:
   ____ A. Initial Evaluation
   ____ B. During Ex. progression
   ____ C. At Discharge
   ____ D. Do not perform
   ____ O. Per patient report

47. Follow up:  Y  N

48. Describe follow-up
   ____ A. Phone call
   ____ B. Questionnaire
   ____ C. Re-eval
   ____ O. Other

49. Limitations: