

SUMMARY OF SCIENTIFIC/TECHNICAL PAPERS IN THIS ISSUE

Low Back Pain Assessment Training of Industry-based Physicians.

Kenneth J. Harwood, MA, PT; Margareta Nordin, MedDrSci; Rudi Heibert, BA; Sherri Weiser, PhD; Paul M. Brisson, MD; Mary Louise Skovron, DrPH; Stuart Lewis, MD. (p. 371)

Purpose of Work. This study was designed to measure physician compliance in completing a new low back pain (LBP) assessment procedure following an extensive training program. The low back assessment was based on the recommendations of the Clinical Practice Guidelines on Acute Low Back Pain Problems in Adults published by the Agency for Health Care Policy and Research, U.S. Department of Health and Human Services. **Subjects/Procedures.** Nineteen industry-based physicians were trained in an LBP assessment method in group and individual sessions. Compliance in completing the assessment form was measured through a computer-based surveillance system over a 16 month period of time. **Results.** The results showed a significant change ($p < 0.001$) in physician compliance in completing a standardized patient examination following an administrative mandate to change. Little change in clinical practice was recorded with an educational training program only. **Relevance to the Veteran Population.** LBP is common in all populations, including veterans. Effective assessment and treatment of persons with LBP requires a thorough knowledge of recent advances in the field. This study suggests methods that will assist clinicians in developing strategies to provide an effective training program and thereby decrease disability.

Kenneth J. Harwood, MA, PT

Decreasing Disability in Chronic Back Pain Through Aggressive Spine Rehabilitation.

James Rainville, MD; Jerry Sobel, MD; Carol Hartigan, MD; George Monlux, MD; Jonathan Bean, MD (p. 383)

Purpose of the Work. Disability caused by chronic back pain is a common problem among veterans. This paper describes an aggressive rehabilitation approach that has

been found to improve back function and decrease related disability. **Subjects/Procedures.** This approach systematically eliminates impairments in trunk flexibility, straight leg raising, back extensor strength, lifting ability, and endurance in persons with back pain. Behavioral techniques useful for reinforcing wellness behaviors are described. **Results.** Normal back function is acquired by a majority of persons treated with this approach, with a measurable improvement in functional abilities. **Relevance to Veteran Population.** These concepts developed in a nonveteran administration practice may be useful to those responsible for the development of treatment plans for veterans with chronic back pain.

James Rainville, MD

Use of Chiropractic Manipulation in Lumbar Rehabilitation.

John J. Triano, MA, DC; Marion McGregor, DC, MSc; Dennis R. Skogsbergh, DC. (p. 394)

Purpose of the Work. The purpose of this work is to review the scientific evidence and draw upon practical experience to consider the ways in which chiropractic manipulation can be useful in low back pain rehabilitation. **Subjects/Procedures.** This paper covers spinal pain patients with discopathy and radiculopathy, facet disorders, sacroiliac syndrome, and postsurgical rehabilitation. **Results.** The rationale for using chiropractic manipulation as a component of the rehabilitation treatment plan for appropriate cases is strongly supported when the therapeutic goals are compared with the evidence of clinical benefits. **Relevance to Veteran Population.** For the veteran or their health care practitioner, manipulation science and technical procedures are reviewed as a basis to help understand the utility of properly integrated chiropractic manipulation strategies into low back pain rehabilitation.

John J. Triano, MA, DC

Classification of Back Muscle Impairment Based on the Surface Electromyographic Signal

Serge H. Roy, ScD, PT; Carlo J. De Luca, PhD; Mark Emley, MS; Lars I.E. Oddsson, DrMedSc; Rudi J.C. Buijs, MS; Jo-Anne Levins, MS, PT; David S. Newcombe, MD; Joseph F. Jabre, MD.

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Purpose of the Work. The purpose of this work is to develop muscle-specific, objective techniques to identify and classify muscle impairments in persons with low back pain. **Subjects/Procedures.** The technique is embodied in a device referred to as a Back Analysis System. Numerous persons with subacute and chronic low back pain have been tested, some during back pain rehabilitation to monitor treatment progression. Normative studies are also described for comparison to a function of contraction duration and muscle site. The paper describes a series of studies that have been useful in developing an automated procedure for identifying back muscle impairment by comparing individual test results to a normative database. **Results.** To date, the research results have produced multivariate discriminant functions that have identified two muscle impairment categories associated with deconditioning and imbalances secondary to LBP. We have found that the functions can distinguish individuals with and without LBP with an accuracy of approximately 90%. Other studies are described in which the technique is applied to monitoring changes in muscle performance capability that occur following rehabilitation for LBP. **Relevance to Veteran Population.** LBP syndromes are among the most common musculoskeletal complaints treated both inside and outside the VA system and often affect veterans who are productive members of our workforce. The techniques described in this overview may improve the way their treatment is managed by providing objective and quantifiable measures of muscle impairment.

Serge H. Roy, ScD, PT

Development of New Protocols and Analysis Procedures for the Assessment of LBP by Surface EMG Techniques.

Lars I.E. Oddsson, DrMedSci; Johan E. Giphart, MSc;
Rudi J. C. Buijs, MS; Serge H. Roy, ScD, PT;
Howard P. Taylor, MD; Carlo J. De Luca, PhD.

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Purpose of the work. The aim of this paper is to investigate the force sensitivity of a set of EMG parameters acquired during a fatiguing contraction of the lumbar back muscles at 80% of maximal voluntary contraction (MVC), performed in a specially developed device called the Back Analysis System (BAS). In addition, some of our efforts to develop new surface EMG parameters that may be used in situations when the subject is unable or unwilling to develop a fatiguing contraction will be pre-

sented. Finally, the development of a model to predict MVC from anthropometrical measurements will be introduced. **Subjects/Procedures.** A group of 10 male controls were tested in the BAS at 20, 30, 40, 50, 60, 70 and 80% of MVC. EMG parameters were calculated and compared between the different force levels. The relationship between anthropometrical properties and muscle strength was investigated in a group of 17 nonimpaired male subjects. A post-hoc analysis of lumbar back muscle EMG signals was performed in a group of eight chronic LBP persons specifically selected for having pain at the left side of their back during the BAS test. **Results.** The results suggest that EMG imbalance parameters, reflecting aspects of load sharing between muscles of the lumbar back, display properties that make them suitable for classification purposes in previously non-testable populations of LBP persons. Our results also indicate that MVC can be predicted from anthropometrical measurements in a group of healthy males. **Relevance to Veteran Population.** The newly acquired knowledge from this project regarding characteristics of the surface EMG signal and its relationship to back muscle impairment will eventually be used in a clinical environment to benefit the individual person as improved and more cost-effective treatment methods.

Lars I.E. Oddsson, DrMedSci

The Use of Surface EMG Power Spectral Analysis in the Evaluation of Back Muscle Function.

Anne F. Mannion, PhD; Beth Connolly, MSc;
Kherrin Wood, MSc; Patricia Dolan, PhD.

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Purpose of the Work. The ease with which a muscle tires (i.e., its fatigability) is sometimes monitored by noting the maximal time that an individual can hold a given level of force. However, this measure is likely to be affected by psychological attributes, such as motivation and pain tolerance, as well as physiological characteristics of the muscle. This research was undertaken to evaluate the usefulness of surface electromyography (sEMG; the recording of electrical signals, generated by the muscle, on the surface of the skin) in making objective assessments of the fatigue characteristics of the back muscles. **Subjects/Procedures.** Evaluations were carried out both on persons with low back pain and on controls. Fatigability of the back muscles was examined during exercise tasks performed either with the back bent and the muscles lengthened, or with the back straight and the

muscles shortened. Surface EMG was recorded on the subjects while they held a given contraction of the back muscles for as long as possible. **Results.** In a motivated group of individuals, the surface EMG measures were predictive of the time that the contraction could be held. There was no difference in the fatigability of the back muscles on the right and left sides of the spine. Women were much less fatigable than men during the exercise tests. Preliminary findings suggested that highly fatigable back muscles were associated with both the existence of, and the risk of developing, low back pain. **Relevance to Veteran Population.** Highly fatigable back muscles seem to be an undesirable attribute associated with low back pain. Individuals should aim to develop and retain good fatigue resistance in the back extensors, through appropriate exercise training, for optimal functioning of this muscle group.

Anne F. Mannion, PhD

Endurance of Trunk Muscles on Persons with Chronic Low Back Pain: Assessment, Performance, Training

Mary T. Moffroid, PhD, PT. (p. 440)

Purpose of the Work. To demonstrate the importance of the endurance of the muscles of the abdomen and the back as related to chronic low back pain. This paper examines some methods to objectively test endurance of trunk flexor and extensor muscles in static and dynamic situations. **Subjects/Procedures.** Results of endurance testing in persons with chronic low back pain are compared to healthy cohorts. **Results.** Training has been shown to improve measured endurance characteristics of the trunk muscles, but diverse intervention programs over several months duration appear to be the most successful in improving physical performance. Return to work and other functional outcome measures depend not only on trunk muscle endurance and other physical attributes, but also on previous injury history and self esteem. **Relevance to Veteran Population.** Chronic lower back pain is a common complaint among veterans. This study emphasizes the importance of trunk endurance assessment and training in managing these persons.

Mary T. Moffroid, PhD, PT.

Distribution of Tissue Loads in the Low Back During a Variety of Daily and Rehabilitation Tasks.

Stuart M. McGill, PhD. (p. 448)

Purpose of the Work. Successful rehabilitation programs arise from the balance of wisdom obtained through scientific laboratory experiment, and the “art” developed from clinical experience. Specifically, choosing the best exercises is enhanced by knowledge of the resultant tissue loads to reduce the risk of injury exacerbation and to strengthen healthy supporting tissues. This report attempts to briefly describe a technique to obtain tissue load distribution, together with examples of tissue loads during the performance of some selected tasks. **Procedures.** Several data sets are used to provide examples and give context to the various issues. **Relevance for the Veteran Population.** Several principles of injury avoidance and optimal rehabilitation are provided. For example, it appears that those with shear injury to the joint (including facet neural arch damage or spondylolisthesis) or posterior ligament damage should avoid fully flexed postures given the resultant tissue loading. Specific data are provided to guide selection of various abdominal and low back exercises. Finally some hypotheses and opinions are offered for possible improvements in clinical success.

Stuart M. McGill, PhD

Modeling Of Functional Trunk Performance: Interfacing Ergonomics And Spine Rehabilitation In Response To The ADA.

Kinda A. Khalaf, MS; Mohamad Parnianpour, PhD; Patrick J. Sparto, MS; Sheldon R. Simon, MD. (p.459)

Purpose of the Work. The purpose of this study was to develop three-dimensional surface responses of trunk strength as a function of trunk angular position and velocity. **Subjects/Procedures.** The isometric and dynamic trunk strength of 20 male and female controls were tested in an asymmetric reference frame interfaced with a KIN-COM dynamometer. **Results.** Trunk strength was significantly influenced by dynamic parameters, such as trunk velocity; the interaction between trunk angular position and velocity was also highly significant. **Relevance to Veteran Population.** The strength capacity profiles developed can be combined with task demand parameters in order to provide appropriate task assignment based on an individual’s capabilities. Such data presentation could be of further use as functional constraints in the simulation of a wide spectrum of physical activities. This would be of value in predicting the consequences of task modifications and/or workstations

alterations without subjecting an injured or disabled veteran to unnecessary testing.

Kinda A. Khalaf, MS

Electrokinesiologic Measurement of Trunk Sagittal Mobility and Lumbar Erector Spinae Muscle Activity

Steven L. Wolf, PhD, FAPTA; Ana Bobinac-Georgievski, Physiatrist, MD, DSc; Vlado Braus, BSc; Marijan Montani, MD. (p. 470)

Purpose of the Work. Novel approaches to document movement in the trunk and lumbar spine during repetitive movements while concurrently monitoring paraspinal muscle activity may provide objective data to better document changes in function. The purpose of this study was to document the reliability of electrokinesiologic testing of trunk movement in the sagittal plane at two speeds of

motion over repeated sessions. **Subjects/Procedures.** The extent of trunk mobility and lumbar paraspinal EMG activity was recorded in 22 controls. Quantified data for the middle four repetitions were subjected to statistical analyses. **Results.** Maximal speed testing resulted in higher levels of EMG activity when compared to natural speed testing. Intratester reliability of measures was high at both speeds. Range of motion data correlated well between two trials for both natural and maximal speed movements, ranging from 0.81–0.97. Correlation of speed of movement measures ranged from 0.41–0.76. **Relevance to Veteran Population.** EMG activity and mobility signals can be obtained reliably using the techniques in this study. There is justification for exploring the applicability of this approach to veterans with low back pain so that more objective indices of improvement from clinical interventions can be gathered.

Steven L. Wolf, PhD, FAPTA