effectively use Taiji in physical rehabilitation and health and wellness programming.

ARE INPATIENT UPPER EXTREMITY MOVEMENT PRECAUTIONS FOLLOWING MEDIAN STERNOTOMY JUSTIFIED? M Perez, D Shaw. Physical Therapy Department, Southwest Texas State University, San Marcos, TX.

Physical therapists often strictly limit inpatients' upper extremity movement (UEM) following median sternotomy (MS). Typical sternal precautions usually limit shoulder flexion (= 90°), scapular adduction, weight-bearing through the upper extremity and lifting more than ten pounds. However, such practice is suspect since early mobilization is typically indicated following other surgical procedures wherein bony segments are re-approximated. With an estimated 400,000 MS procedures performed annually, we felt the rationale for MS precautions warranted further investigation. The purpose of this literature review is to: 1) examine the scope of published research specific to UEM and MS and, 2) determine if published research supports UEM limitation. The authors reviewed 94 articles searching by various combinations of "median sternotomy", "exercise", "sternal dehiscence", "wound healing", and related descriptors. No inpatient studies and only one outpatient abstract specific to UEM and MS were found. The remaining published research addressed cardiothoracic procedures using MS (57), sternal dehiscence (9), brachial plexus injury (9), rib trauma (5), musculoskeletal and post-operative non-surgical complications (13). The single study addressing both UEM and MS was retrospective and involved 77 patients following participation in outpatient cardiac rehabilitation. A variety of upper extremity modalities were employed including arm ergometers and rowing machines. Pain status and tolerance to range of motion (ROM) challenge governed progression. No sternal non-unions secondary to UEM were reported. Given the present review, it appears the rationale for limiting UEM immediately following MS is not on based objective evidence. Further, although sternal precautions are prudent, we hypothesize that strict UEM limitations may produce negative sequelae (eg. frozen shoulder). Such sequelae might be ameliorated via progressive restoration of normal UEM starting at the inpatient level.

A THEORETICAL PERSPECTIVE OF ADAPTIVE ENERGY AND ITS CLINICAL RELEVANCE. S Collins. Dept. of Physical Therapy, University of Massachusetts-Lowell, Lowell, MA.

In 1955, after two decades of research on the General Adaptation Syndrome, Selye proposed a description of Adaptive Energy as the adaptability that is gradually consumed during exposure. Selye was never able to provide a more complete description of such energy. This presentation proposes a theory of Adaptive Energy in an attempt to provide measurement opportunities for further research. Measurement would allow quantification of the impact of multiple modes of stress on human function. Stress is broadly conceptualized to represent any perturbing force to physiological processes. For patients receiving physical therapy, stressors include not only the pathologies, impairments, functional limitations and disabilities, but also the environmental exposures as part of their lives, and physical therapy interventions. The Adaptive Energy theory propounds that the number of possible states within the human system needs to be greater than the number of possible disturbances in order to minimize the deviation of that system from its state of stability. Adaptive Energy is the number of states available to the human system across spatial and temporal scales. Adaptive Energy is manifest as the presence of variation within fundamental components of the physiological control system. Supporting research will be presented from diverse scientific areas which have utilized heart rate variability, approximate entropy, correlation dimensions, and more recently the author's own work in the area of cardiac vagal regulation utilizing Poincare plot analyses, where healthy subjects reporting exhaustion had the lowest levels of short term variation in vagal cardiac control. An abundance of evidence demonstrates associations between reduced system level variations with adaptive energy based outcomes such as exhaustion, overtraining syndrome, congestive heart failure and myocardial infarction. Mechanisms of testing the theory (including those underway) in both animal and human models will be discussed. Implications for clinical practice include: 1. current possibilities for heart rate variability outcomes in heart disease patients; 2. the use of an aggregate system variability measure to provide a clinical assessment of available adaptive energy either for short term (within a treatment) or long term (through the course of treatment) adaptation.

THE ROLE OF THE INTERNAL INTERCOSTALS AND THE EXTERNAL INTERCOSTALS DURING BREATHING: A KINESIOLOGICAL MODEL. J Roush[1], D Madras[2]. [1]Physical Therapy Program, Arizona School of Health Sciences, Mesa AZ, [2]Physical Therapy Program, College Misericordia, Dallas, PA.

The diaphragm muscle is the principal muscle of inspiration, contributing between 66% and 75% of the tidal volume depending on the position of the individual. However, the intercostal muscles also make a significant contribution to inspiration. It has been generally assumed that the external intercostals contribute to inspiration while the internal intercostals contribute to forced expiration. The external intercostals were assumed to be inspiratory muscles as they acted on the ribs by elevating them. The internal intercostals were assumed to be expiratory muscles as they acted on the ribs by depressing them. DiMarco et al (1990) found that both the internal intercostals and the external intercostals are active during inspiration and the external intercostals are active during forced expiration. Since publication of this study, there has not been an adequate explanation of the role of the internal intercostals and the external intercostals during breathing. The purpose of this presentation is to provide a possible explanation of the role these muscles play during inspiration and expiration. In addition, two other possible theories will be presented how the intercostals function for patients with pathologies. These explanations, based on recent reviews of the literature and basic biomechanical principles, and may provide a better understanding of the kinesiology of the intercostals during breathing.