LONG-TERM EFFICACY OF DYNAMIC NEUROMUSCULAR STABILIZATION IN TREATMENT OF CHRONIC MUSCULOSKELETAL PAIN

Bokarius AV. University of California, Los Angeles, USA, andrew@bokarius.com
Bokarius V. Department of Psychiatry, Cedars-Sinai Medical Center, Los Angeles, CA USA, bokariusv@cshs.org

Aim of the Study

Chronic pain in musculoskeletal disorders is treated with a variety of methods including pharmacotherapy (PMT), manual therapy and acupuncture (AP). Dynamic Neuromuscular Stabilization (DNS) is a novel approach in physical medicine that is performed by manually stimulating reflex locomotion zones to elicit efferent signaling from movement control centers in the Central Nervous System (CNS) in order to achieve functional correction of the musculoskeletal system. After the incorporation of DNS at our clinics, we noticed that the number of our chronic pain patients coming back with relapsed pain decreased. We were thus interested to see the significance of our observations. The aim of this study was to determine long-term effect of DNS as an adjunct to the aforementioned treatment methods in patients with chronic pain.

Background

DNS is an innovative approach in physical medicine developed by Professor Pavel Kolar, Director of the Rehabilitation Department at University Hospital Motol, School of Medicine, Charles University of Prague, Czech Republic. Dr. Kolar's method incorporates late works of a Pediatric Neurologist, Professor V. Vojta, whose revolutionary findings encouraged the development of the new physical therapy method – DNS.

Vojta worked in physical rehabilitation medicine with infants using developmental diagnosis on the basis of ontogenesis of locomotion. He found out that applying specific peripheral stimulation to infants in precise body positions results in consistent patterns of motor reactions. Vojta termed this "reflex locomotion" (RL) and defined it as the reflex response obtained by specific peripheral stimulation that elicits efferent signaling from movement control centers in the Central Nervous System (CNS) and produces generic movement patterns associated with locomotion. (Vojta V. 1970, 1968) Furthermore, the reflex exhibited more general, dynamic patterns of human ontogenesis of motor activity – these were termed "global patterns"(GP). (Müller H and Vojta V. 1974) As described by Wickstrom RL (Wickstrom RL 1975), healthy (free of developmental disorders) newborns exhibit precise developmental movements (such as grabbing, turning, crawling and eventually walking) without specifically learning the tasks. (Forslund M and Bjerre I 1985) Vojta recognized that majority of the evoked global musculoskeletal responses are common to all human locomotion forms throughout development. (Vojta V. 1972) Evidently, the neuronal circuitry that guides these complex developmental behaviors may be activated by stimulating peripheral areas, or zones. These zones are generally derived from balance and stabilizing points during an infant's development. Two main GPs are reflex turning – an ipsilateral pattern of turning from supine to prone position, and reflex creeping – a contralateral pattern of locomotion more commonly known as crawling. Vojta was able to implement RL therapy to treat motor disturbances in infants. His work was primarily focused on children with Cerebral Palsy. By enhancing the functionality of CNS movement centers Vojta achieved improved neuronal regulation of movement. (Vojta V. 1972b)

As Vojta's student, Pavel Kolar further expanded the theory and methodology of RL. While continuing to work in pediatric rehabilitation, Kolar applied RL to developing methods of treatment for adult patients. He postulated that while children's neurodevelopmental circuitry is highly active in the first years of ontogenesis, it becomes dormant later in life as locomotor patterns become more automatic. (Kolar et al., 2007) Through clinical practice and continuous application of RL to adults, Kolar was able to elicit GPs in adults that were similar to GPs seen in normal children. Moreover, he noticed that predicted movement patterns were sometimes compromised not only in patients with musculoskeletal pathologies, but also in healthy volunteers. This may have indicated that the guiding role of CNS in motor development ceases its control later in life, after the motor patterns become fully learned and automatic.

In infants, RL activates CNS-efferent pathways that induce specific patterns of muscle contraction, carefully dosing recruitment of agonists and antagonists to eventually produce a coordinated, highly controlled movement. GPs of reflex creeping and turning rely on correct motor ontogenesis to produce these synergistic muscle actions. As an effect of DNS, Kolar explains GPs as accomplished by activating particular muscle chains. (Kolar et al., 2007) It is therefore possible to isolate a specific component of a GP and stimulate the CNS to activate a correct pattern of muscle fiber contractions. Thus, through proper RL therapy and DNS exercises, a "wrong" pattern (hypothetically causing musculoskeletal dysfunction in an adult) may be corrected to the "right" pattern, and a proper neuro-musculoskeletal function can be re-established.

Working with adults, Kolar established another fundamental principle of DNS, called "centration". Centration is defined as the position of a joint, in which there is highest stability and approximation of the articulating surfaces, and is a result of normal motor development. (Kolar et al., 2007) Kolar states, that for pathological conditions, it is imperative to place the joint of interest in the "centrated" position prior to RL stimulation, in order to increase afferent proprioceptive stimulation that will address the CNS motor control centers. Following appropriate RL therapy, a predicted isolated movement of a GP around a joint may be manually inhibited from propagating in case a "wrong" pattern is observed; in the arrested state, the joint may be re-centrated to achieve ideal muscle activation. (Kolar et al., 2007) Proper co-activation of muscles work together with CNS directed patterns to recall dormant locomotion reflexes and thus obtain proper activation.

Kolar devised methods and exercises that, if properly performed, may activate correct neural patterns to re-stabilize pathological deep stabilizing system of the spine (DSSS). A primary principle of DNS is that any segmental movement of a GP has repercussions in the whole posture; therefore for correct movement to occur, high postural stabilization must be achieved. (Kolar et al., 2007) Kolar proposes the intra-abdominal pressure stabilization theory (IAPS). (Figure 1)

Following appropriate training in establishing proper respiratory dynamics, and pathology-specific RL therapy, isolated phasic movements (for instance reaching, adapted from reflex creeping) from GPs are prescribed as exercises. During the exercise, the patient must stabilize the intra-abdominal pressure correctly and perform the locomotive movement voluntarily, thereby activating neural systems of DSSS and CNS movement control centers and further reinforcing RL therapy in "learning" the proper activation. By introducing new concepts of centration to RL therapy and IAPS to DSSS, Kolar's physical therapy method is refereed to as Dynamic Neuromuscular Stabilization (DNS).

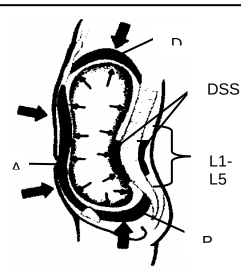

Figure 1. Intra-abdominal pressure stabilization theory.
A schematic representation of the abdominal cavity biomechanics; lateral view. Large arrows indicate force generated from major muscle groups surrounding the abdominal cavity; small arrows indicate force generated in the opposite direction to the surrounding muscles by the intra-abdominal pressure. The system is in static equilibrium, where D is the diaphragm, A is abdominal muscles, P is pelvic floor musculature, DSSM is deep stabilizing spine muscles, and L1-L5 demonstrates the location of lumbar vertebrae. Adapted from Kolar P 2007[9].

Methods:

This retrospective cohort study analyzes 6 years of data that included 2824 patients with chronic musculoskeletal pain who received an initial course of 4 to 12 treatments: Group A [N=2004] was treated with PMT, adapted manual therapy (AMT) and AP in various combinations; Group B [N=820] received DNS in addition to various combinations of PMT, AMT and AP. AMT included techniques such as myofascial release, muscle energy technique, positional release technique and ischemic pressure. 2 sample T-tests were performed on data of disease relapse. A total of 715 patients were excluded from statistical analysis because they did not return to clinic after initial course of treatment.

Results:

The demographic data of patients included in the study is presented in Table 1.

Age	**%**
18-25	3
26-35	9
36-45	20
46-55	28
55-65	24
>65	16
Gender	
Male	42
Female	58
Ethnicity	
Caucasian	31
African American	2
Asian	4
Hispanic	63

Data were pooled from four clinics in Los Angeles. Locations of our two main clinics in Montebello, and East Los Angeles resulted in higher representation of the Hispanic population. Our clinic in West Hollywood provided data on mostly Caucasian patients. The fourth clinic in Beverly Hills slightly expanded the ethnic variation to African American and Asian patients. Prevalence of the older population is attributed to the age related increase in frequency of musculoskeletal disorders.

The primary pain diagnoses are presented in Table 2:

Diagnosis	**%**
Lumbosacral Spinal Pain of Unknown or Uncertain Origin	20.4
Muscle Tension including tension headaches and cervical dystonia	14
Miofascial Pain Syndrome	13.2
Lumbosacral Vertebrogenic Pain	11.7
Arthritic Pain with or without enthesopathy	8.1
Lumbar Spinal or Radicular Pain after Failed Spinal Surgery	7.3
Cervical Spinal Pain of Unknown or Uncertain Origin	5.8
Cervical Vertebrogenic Pain	5.5
Fibromyalgia	4.9
Tunnel Syndromes of upper extremities	4.1
Tendinitis and epicondylitis of upper extremities	3.1
Chronic Pelvic Pain Without Obvious Pathology	0.9
Thoracic Spinal Pain of Unknown or Uncertain Origin	0.6
Thoracic Vertebrogenic Pain	0.2
Coccygeal Pain of Unknown or Uncertain Origin	0.2

The numbers represent a normal distribution of the population with chronic pain. 92% of patients within the age group 18-25 never returned to the clinic after initial course of treatment; they were therefore excluded from statistical analysis. Average return periods for Groups A and B were 156 and 227 days respectively. Two-sample T-tests revealed significant evidence ($P<0.05$) that patients in Group B returned for treatment in a significantly longer period of time than patients in Group A among all age groups and genders.

Conclusions:

1. Supplementing AP, AMT and PMT with DNS resulted in significant decrease in frequency of patient return to clinic with chronic pain, thus decreasing medical costs and improving patients' overall wellbeing.
2. The results of DNS in decreasing pain relapse rate are independent of age and gender.
3. We plan to conduct more research involving randomized controlled clinical trials and studying neurophysiological mechanisms of DNS.
4. We speculate the group of the 18-25 age group never returned to clinic following one course of treatment due to less severe pathology and faster healing time and better response to treatment.

We understand our study has limitations. For example, we did not analyze the clinical efficacy of DNS either in its application to all disorders, or in specific disorders. We also did not break down significance of relapse rate based on ethnicity. This is primarily due to the predominance of clients from the Hispanic population in our study. We also did not look at the possible effect of co morbid disorders and concurrent medication use. In addition, we did not factor in the length chronic pain prior to treatment.

Acknowledgements

We would like to acknowledge the medical training in DNS of Professor Pavel Kolar and his team from the Rehabilitation Department, University Hospital Motol, School of Medicine, Charles University, Prague, Czech Republic, and Dr. Craig Morris, Clinical Director of F.I.R.S.T. Health, who organized the training in USA.

References:

1. Forslund M, Bjerre I. Growth and development in preterm infants during the first 18 months. *Early Human Development*. 1985 Jan 10;(3-4):201-16
2. Kolar P, Kobesova A, Safarova M. Lepsikova M "Dynamic neuromuscular stabilization according to Kolar: a developmental kinesiology approach" A course manual from Locomotion Enhancement Specialists. Functional Action, Inc. 2007
3. Müller H, Vojta V. [Early diagnosis and therapy of cerebral disturbances of motility in infancy] *Zeitschrift fur Orthopadie und ihre Grenzgebiete*. 1974 Apr;112(2):361-5
4. Vojta V. [Early diagnosis and therapy of cerebral motor disorders in childhood. A. Postural reflexes in developmental kinesiology. I. Normal developmental stages] *Zeitschrift fur Orthopadie und ihre Grenzgebiete*. 1972b Aug;110(4):450-7
5. Vojta V. [Early diagnosis and therapy of cerebral motor disorders in childhood. A. Postural reflexes in developmental kinesiology. 2. Pathologic reactions] *Zeitschrift fur Orthopadie und ihre Grenzgebiete*. 1972a Aug;110(4):458-66
6. Vojta V. [Reflex creeping as an early rehabilitation programme] *Zeitschrift fur Kinderheilkd*. 1968;104(4):319-30
7. Vojta V. [Reflex rotation as a pathway to human locomotion] *Zeitschrift fur Orthopadie und ihre Grenzgebiete*. 1970 Nov;108(3):446-52
8. Wickstrom RL. Developmental kinesiology: maturation of basic motor patterns. *Exercise and Sport Science Reviews*. 1975 3:163-92