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FUNCTIONAL TRAINING HANDBOOK

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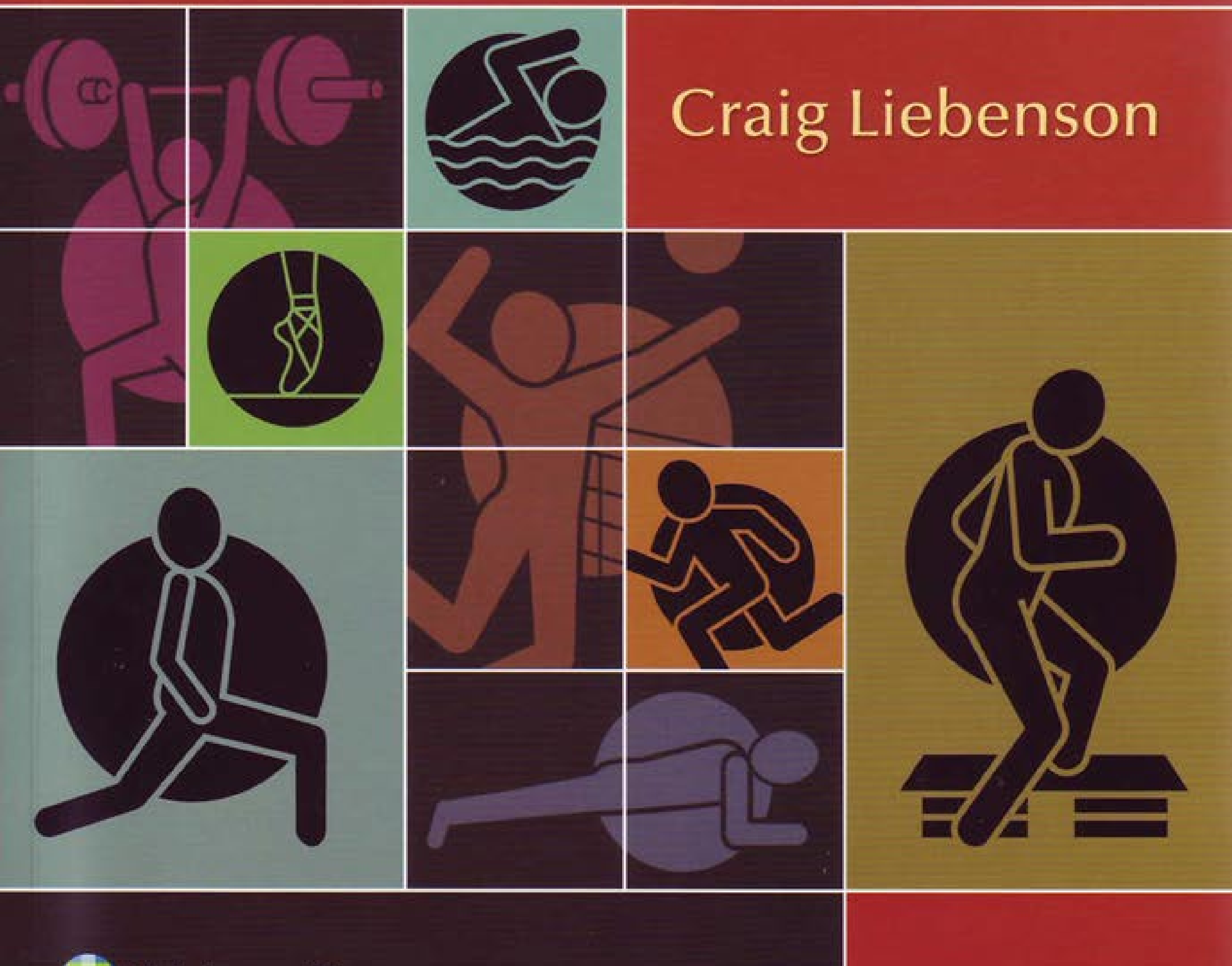

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CONTENTS

CHAPTER 4

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Dynamic Neuromuscular Stabilization: Exercises Based on Developmental Kinesiology Models

INTRODUCTION

The etiology of musculoskeletal pain, in particular back pain, is often evaluated from an anatomical and biomechanical standpoint and the influence of external forces (i.e., loading) acting on the spine. However, the evaluation of the forces induced by the patient's own musculature, is often missing. The stabilizing function of muscles plays a critical and decisive postural role and depends on the quality of central nervous system (CNS) control. Kolar's approach to dynamic neuromuscular stabilization (DNS) is a new and unique approach explaining the importance of neurophysiological principles of the movement system. The DNS encompasses principles of developmental kinesiology during the first year of the life; these principles define ideal posture, breathing patterns, and functional joint centration from a "neurodevelopmental" paradigm (1). DNS presents a critical set of functional tests assessing the quality of functional stability of the spinal and joint stabilizers and assisting in finding the "key link" of dysfunction. The treatment approach is based on ontogenetic global postural-locomotor patterns (2,3). The primary goal of treatment is to optimize distribution of internal forces of the muscles acting on each segment of the spine and/or any other joint. In the DNS treatment concept, patient education and participation are imperative to reinforce ideal coordination among all stabilizing muscles.

POSTURAL ONTOGENESIS AND MATURATION OF THE INTEGRATED STABILIZING SYSTEM OF THE SPINE, CHEST, AND PELVIS

Postural ontogenesis entails maturation of body posture and related human locomotion (1–3). Postural muscle function ensures all possible positions in the joints determined by their anatomical shapes and has a strong formative influence on bone and joint morphology. Postural muscle activity is genetically predetermined and occurs automatically during CNS maturation. During newborn stage (Figures 4.1 and 4.2), bones and joints are morphologically immature. For example, the shape of the plantar arch is not well defined (4,5), the chest is shaped like a barrel, the posterior angles of the lower ribs are situated anteriorly relative to the spine, the ribs appear to be more horizontal than in adulthood (6), and the spine is maintained in kyphosis as the spinal lordotic curves have not yet developed (7–9). As the CNS matures, purposeful muscle function increasingly occurs. Muscles controlled by the CNS subsequently act on growth plates influencing the shape of bones and joints. Every joint position depends on stabilizing muscle function and coordination of local and distant muscles to ensure "functional centration" of joints in all possible positions. The quality of this coordination is crucial for joint function and influences not only local but also regional and global anatomical and biomechanical parameters starting in the early postnatal stage.

Ontogenesis demonstrates a very close relationship between neurophysiological and biomechanical principles, which are important aspects in the diagnosis and treatment of locomotor system disorders. This relationship is very apparent in cases where there is a CNS lesion and muscle coordination is affected. The disturbed muscle coordination subsequently alters joint position, morphological development, and ultimately posture (Figure 4.3) (10,11). Postural function and motor patterns are not only the indicators of the stage of maturation, but can point to the fact if the CNS development is physiological or pathological (1–3,12,13). Posture is a term very closely related to early individual development. The quality of verticalization during the first year of life strongly influences the quality of body posture for the rest of a person's life. During early postural ontogenesis, lordotic and kyphotic spinal curves as well as chest and pelvic positions are established. This process corresponds to stabilization of the spine, pelvis, and chest in the sagittal plane at the age of 4.5 months (Figures 4.4 and 4.5). This is followed by the development of phasic locomotor

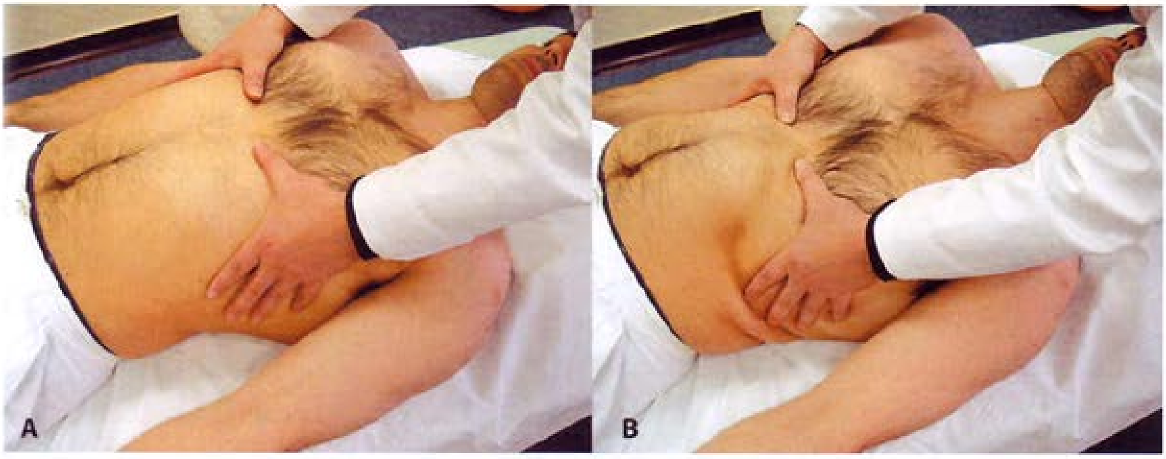

FIGURE 4-19. (A) "Inspiratory" position of the chest is often fixed and it is difficult to bring the chest to neutral position even passively. (B) Bring the chest to neutral position if possible (pull the chest caudally, do not press it against the table!) and spring the chest. The chest should be flexible and spring back symmetrically. Healthy individuals are able to keep the chest in this position at rest, while still breathing, and during the course of all postural activities.

Thoracolumbar (T/L) junction: This serves as a weight-bearing zone and should be in contact with the table (compare Figure 4.18A–C).

Prone

Place the patient in prone position that corresponds to that of a 4.5-month-old healthy infant (Figure 4.20). Ask the patient to lift the head slightly. Observe the following:

Head: In neutral position, it is elevated a few centimeters above the table.

Neck: When lifting the head, extension should start from the mid-thoracic (T3/4/5) segments. Head reclination (hyperextension of cervicocranial junction) and/or hyperextension of the mid- or lower cervical segments as the CT junction is often fixed or flexed is a sign of abnormal extension stereotype. This poor movement pattern is often related to insufficient coactivation of the deep neck flexors (see Figure 4.20C and Figure 4.23A). Compare the posture to that of a healthy 4.5-month-old infant (see Figure 4.20B); note the perfect and gradual lengthening of the entire spine including the cervical spine.

Arms: Medial epicondyles serve as weight-bearing zones. The shoulders should be relaxed, and the patient should not raise them.

Shoulder blades: These should be fixed in a "caudal" position due to balance between the upper and lower scapular stabilizers and between scapular adductors and abductors, with the scapula adhering to the rib cage (see Figure 4.20A,B). An elevated scapula suggests the dominance of the upper stabilizers (see Figure 4.20C). Another common abnormality is winging of the lower angle of the scapula. Proper scapular stabilization is dependent on proper support of the medial epicondyles.

Thoracic spine: Observe the lengthening of the spine. Palpate the mid-thoracic spine during head elevation (Figure 4.21). Normally, you should feel segmental movement between T3/4/5/6.

FIGURE 4-20. Prone test. (A) Physiological pattern in adult. (B) Ideal model in a 4-month-old healthy infant. (C) Pathological pattern in an adult: neck hyperextension, cervicothoracic junction kyphosis, scapular retraction and external rotation, support at the level of the umbilicus instead of the anterior superior iliac spine or symphysis, and pelvic anteversion.