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Low back pain, multifidus muscles, and lumbar stability - an anatomical approach

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Low back pain (LBP) is a major health problem with important financial implications for society, imposing a heavy economic burden as well. Chronic LBP is a multidimensional problem with patho-anatomical, neurophysiological, physical and psychosocial aspects. One of the causes of mechanical LBP is instability of the lumbar spine. Imbalance of mm. multifidi may play a role in spinal disorders and low back pain in the lumbar spine. Stability of the vertebral column in the frontal plane greatly depends on symmetrical activities of muscles, on both sides of the spine. To extend our data concerning the lines of application along which the forces produced by mm. multifidi in particular are acting, directions of these lines with respect to the vertebral column's longitudinal axis were determined in four otherwise normal anatomical whole body specimens (2 male, 2 female). Bony origins and insertions of the lumbar multifidus muscles in each anatomical specimen were marked by coloured pins, over a number of vertebral levels. Specimens were photographed in standard anatomical conditions, i.e. from dorsal views. On the photographs, following characteristics of the m. multifidus were measured: a) lengths of subsequent superficial muscle fibers of the multifidus muscle from their origins to their insertions and b) angles of these superficial multifidus muscle fibers with respect to the axis of each segment of the lumbar spine. Compared to female, male specimens showed significantly longer multifidi. After superimposing AP radiograms of the specimens on their photographs, moment arms of some multifidi respective to nuclei pulposi of lumbar intervertebral discs were measured. Although our data stretch farther caudally, results correspond with current biomechanical literature, especially concerning right-left differences (Oatis, 2009).

Our data also accord with scoliosis visible on AP radiograms. Biomechanically, the lumbar spine described as a multiarticular chain of rigid bodies tends to "buckle" or collapse - even when opposing muscle forces bilaterally that stabilise the articular chain in the frontal plane are of equal values - if the ratios of the joints' moment arms are unequal. In order to prevent buckling in the frontal plane, viz. scoliosis of the lumbar spine, the aforesaid biomechanical principle presumes equal values by opposing muscle forces, as well as equal ratios of moment arms of the joints of the multiarticular chain. Even if this last condition is fulfilled as it should normally be, bilaterally opposing muscle forces by lumbar multifidi may develop unequally e.g. after prolonged rhythmic muscle training during asymmetrical movements, as in the education of girl gymnasts.

In view of gender-related length differences of lumbar multifidus muscles, revealed by our in vitro study, some in vivo data regarding the incidence of postural defects and scoliosis were followed epidemiologically. Increased percentages of scoliosis during growth - being somewhat reduced over the years by adapted programs - were observed as vertebral column deformations in female gymnasts ages 5 - 17, in years of intense training, after asymmetrical muscle activities.

Reference:

Oatis C. A. (2009) Kinesiology: The Mechanics and Pathomechanics of Human Movement, 2nd Edition, Lippincott Williams & Wilkins, Baltimore, Philadelphia.