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THE ERECTOR SPINAE MUSCLE, A DETERMINING FACTOR IN THE PATHOLOGICAL BIOMECHANICS OF THE SPINE

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ABSTRACT. Pathological biomechanics of adolescent idiopathic scoliosis is dominated by unilateral erector spinae stiffness. This leads to morpho pathological vertebral changes that aggravate the condition. Manual therapies can be used to correct the asymmetry of the stretch reflexes, and massage techniques can be used to improve the range of motion. Pain is an aggravating factor for biomechanical disorders and can be combated by myofascial techniques. To prevent scoliosis in adults, it is possible to tone the erector spinae muscles (deadlifts and their variations, exercises with free weights, arm and leg ergometer exercises, some aquatic exercises, Pilates isometric exercises performed on a stable surface).

Keywords: *spinal erector muscles, scoliosis prophylaxis*

REZUMAT. ***Mușchiul erector spinal, factor determinat în biomecanica patologică a coloanei vertebrale.*** Biomecanica patologică a scoliozei idiopatice a adolescentului este dominată de rigiditatea unilaterală a erectorului spinal. Aceasta duce la modificări morfopatologice vertebrale ce agravează afecțiunea. Pentru a corecta asimetria reflexelor de întindere pot fi folosite terapiile manuale, iar pentru îmbunătățirea amplitudinii de mișcare, tehnicile de masaj. Durerea este un factor agravant pentru tulburările biomecanice și poate fi combătută prin tehnici miofasciale. Pentru profilaxia scoliozei adultului se poate face tonifierea mușchilor erectori spinali (deadlift și variantele lor, exerciții cu greutăți libere, exerciții la ergometrul de brațe și la cel de picioare, unele exerciții acvatice, exerciții izometrice Pillates executate pe o suprafață stabilă).

Cuvinte-cheie: *mușchi erectori spinali, profilaxie scolioză*

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INTRODUCTION

In the biomechanical asymmetries present in adolescent idiopathic scoliosis, the main role is played by the erector spinae muscles, as shown by the following studies:

a) Patients with scoliosis show pathological changes in walking speed, step length, and peak EMG activation for the erector spinae, biceps femoris, semimembranosus, rectus femoris, gastrocnemius, and tibialis anterior (Garg et al., 2021).

b) In adolescents with idiopathic scoliosis, the gait analysis showed that the frontal pelvic motion and stance phase are significantly reduced, and the duration of the electrical activity of quadratus lumborum, erector spinae and gluteus medius was significantly increased in the group with idiopathic scoliosis of the adolescent compared to the subjects healthy (these muscles have a prolonged activation time) (Kim et al., 2020).

From a biomechanical point of view, the spine with degenerative scoliosis tends to be more rigid and has a lower range of motion in flexion-extension (Rustenburg et al., 2020). In this case, it should be considered that the spinal erectors intervene in the flexion-extension movements of the trunk (Othman et al., 2007). Rigidity of the spine and biomechanics disorders due to anatomic-functional changes in the spinal erectors lead to vertebral pathologies that make the movements of the spine difficult, thus creating a vicious circle. Thus, on an experimental model of scoliosis that used Sprague-Dawley rats, it was demonstrated that asymmetric tensions contribute to asymmetries regarding the expression of proteins and implicitly of the quality of the bone material of the vertebral epiphyseal plates, and such anatomical asymmetries aggravate asymmetric muscle tensions, and thus it creates a vicious circle (Li et al., 2017). Another study revealed that the range of motion of the lumbar vertebrae is limited in the case of changes in their physiological shape (Zhang et al., 2021). Even postoperatively, for scoliosis, biomechanical loading of the sacrum endplate is related to postural balance and newly established spino-pelvic alignment (Pasha et al., 2015). Evidence that the spinal erectors are the main muscles involved in the biomechanical and anatomo-functional disturbances in scoliosis is provided by the literature, in which a case is described in which after 6 months of orthotic treatment, the main thoracolumbar/lumbar structural curve partially corrected, and the amplitude frontal movements of the pelvis and hip increased, thereby improving muscle biomechanics during walking, and the duration of EMG activity of the erector spinae muscles was decreased at the end of treatment, but this was not true for the lumbopelvic muscles (Mahaudens et al., 2014). The applications are in therapy, because in the

thoracic region of the spine, on the convex side of the scoliosis, the shortened and tense erector spinae muscles must be stretched, while in the lumbar region the same maneuver must be performed on the concave side of the scoliosis (Wilczyński, 2021). Moreover, in a patient with spinal myeloid osteosarcoma, myolysis of the erector spinae was found to produce low back pain, protective contracture, and scoliosis (Kawahara et al., 2002). As a result, the present article proposes a review of the possibilities of toning and pain therapy at the erector spinae level, as measures to prevent and treat scoliosis. This is because scoliosis can also occur in adulthood (Ishihara et al., 2020).

Pain therapy

Myofascial techniques can be successfully used to reduce spinal erector stiffness, also having analgesic effects (Devantéry et al., 2023). Devices capable of quantifying the stiffness of the spinal erectors in patients with chronic low back pain have been invented, the pain of this muscle being more pronounced in the sitting position (Li et al., 2022). When designing an exercise program for the spinal erector muscles, it should be considered that they are activated more strongly during forward propulsion in individuals with chronic low back pain than in healthy people (Taylor et al., 2023). However, it should be specified that if inspiratory muscle training is done for patients with low back pain associated with respiratory dysfunction, the activated muscles are multifidus and transverse abdominis (Ahmadnezhad, Yalfani, & Gholami Borujeni, 2020).

Exercises for the erector spinae muscles

In the specialized literature, there are articles that analyze the activation of spinal erectors during physical exercises. Their toning would allow the prevention of scoliosis or the maintenance of the results of therapies to correct the condition. The erector spinae muscles and the quadriceps femoris are activated more strongly than the gluteus maximus and the biceps femoris during the Deadlift and its variants, but still during the Romanian Deadlifts the demand on the spinal erectors is lower (Martín-Fuentes, Oliva-Lozano & Muyor, 2020), which matters for the selection of exercises according to the goal pursued. The greatest activation of the spinal erectors, however, occurs during exercises with free weights (Oliva-Lozano & Muyor, 2020). Both arm and leg ergometers can be training tools for the erector spinae muscle (Shima et al., 2022). In subjects with non-specific low back pain, the squat and bird-dog exercises are the most effective for stimulating the lumbar spinal erectors (Calatayud et al., 2019). Other exercises that also activate the spinal erectors

are leg curl, "good morning", glute-ham raise (McAllister et al., 2014). Aquatic exercises (squat exercises) can also be of real use for toning the spinal erectors, in which case the multifidus, another extensor of the back, also comes into action (Psycharakis et al., 2022). Another method to tone the spinal erectors are isometric Pilates exercises, more effective being those performed on a stable surface than those on the Swiss Ball, and among these those with back extension together with elbow extension (Paz et al., 2014). The T7 and L3 spinal erectors can be selectively activated by back extension exercises (Yoo, 2015).

CONCLUSIONS

1. The central element of the physio pathological chain that characterizes adolescent idiopathic scoliosis is the unilateral stiffness of the erector spinae, and this can lead to anatomical and functional changes in the vertebrae that aggravate the disease.

2. Therapeutically, some manual therapies can be used to correct the asymmetry of the stretch reflexes, myofascial techniques can be used for pain therapy, and massage techniques can be used to increase the range of motion.

3. In order to prevent scoliosis occurring in adulthood, various exercises can be done to tone the erector spinae muscles.

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