Assessment of Paraspinal Muscle Hardness in Subjects With a Mild Single Scoliosis Curve: A Preliminary Myotonometer Study

Ángel Oliva-Pascual-Vaca, PhD,[a] Alberto Marcos Heredia-Rizo, PhD,[a] Alejandro Barbosa-Romero, BSc,[b] Jesús Oliva-Pascual-Vaca, PhD,[c] Cleofás Rodríguez-Blanco, PhD,[a] and Sergio Tejero-García, PhD[d]

Abstract

Objective: The purpose of this study was to evaluate the hardness of the paraspinal muscles in the convexity and concavity of patients with scoliosis curvatures and in the upper trapezius (UT) muscle in subjects with mild idiopathic scoliosis (IS) and to observe the correlation between the myotonometer (MYO) measurements and the value of body mass index (BMI) and the Cobb angle.

Methods: The sample included 13 patients with a single-curve mild IS (Risser sign ≤4) at thoracic, lumbar, or thoracolumbar level (mean Cobb angle of 11.53°). Seven females and 6 males were recruited, with a mean age of 12.84 ± 3.06 (9-18) years. A MYO was used to examine the differences in muscle hardness on both sides of the scoliosis curvature at several points: (*a*) apex of the curve, (*b*) upper and lower limits of the curve, and (*c*) the midpoint between the apex and the upper limit and between the apex and the lower limit. The UT was also explored.

Results: Although the MYO recorded lower values in all points on the concave side of the scoliosis, there were no significant differences in the comparison between sides ($P > .05$). No association was observed between BMI and MYO values, whereas the Cobb angle negatively correlated with muscle hardness only at 2 points on the convex side.

Conclusion: The preliminary findings show that, in subjects with a single-curve mild IS, muscular hardness in the UT and paraspinal muscles, as assessed using a MYO, was not found to differ between the concave and the convex sides at different reference levels. (J Manipulative Physiol Ther 2014;37:326-333)

Key Indexing Terms: *Adolescent; Muscle Tonus; Physical Examination; Scoliosis; Spine*

Scoliosis is a common health problem, defined as a 3-dimensional spine deformity.[1] Its origin is only verifiable in 15% to 20% of cases.[2] Therefore, idiopathic scoliosis (IS), which cannot be etiologically linked to any particular factor, is the most common diagnosis of spine curvature dysfunction in young subjects.[3] Prevalence rates vary from 0.35% to 13%, and it is most commonly seen in females.[4] The presence of a neuromuscular disorder has been suggested as a plausible cause for scoliosis,[5,6] along with hormonal and chemical dysfunctions.[7] A brain asymmetry has even been related to a head tilt and a consequent blocking of the atlantooccipital joint, which may influence the curve progression.[8]

A change in the spinal muscles fiber composition in the thoracic region has been observed in female scoliosis patients.[9] A decrease in the proportion of type I fibers and an increase in the percentage of types IIB and IIC fibers, in comparison with a control group, have been found on the concave side, whereas changes on the muscles of the convex side were of similar nature, but not so severe.[9] Whether these changes are a consequence or a causal factor of IS remains unknown.[10] Other studies also point to a difference in the spinal muscles volume between both sides of the curve[2] and to an increased electromyographic activity of the paravertebral muscles at the convex side,[11] especially at the apex vertebra.[2,12]

All of these translate as a possible spinal muscles tone imbalance and the presence of compensatory patterns as

[a] Assistant Professor, Department of Physical Therapy, Faculty of Nursing, Physiotherapy and Podiatry, University of Sevilla, Sevilla, Spain.

[b] Clinician, Physiotherapist, Dr. Banquer Clinic, Sevilla, Spain.

[c] Assistant Professor, Department of Physical Therapy, Universitary School of Osuna, Sevilla, Spain.

[d] Consultant, MD, Unit of Traumatology and Orthopaedics, Virgen del Rocío Hospital, Sevilla, Spain.

Submit requests for reprints to: Alberto-Marcos Heredia-Rizo, PT, PhD, Assistant Professor, Department of Physical Therapy, Faculty of Nursing, Physiotherapy, and Podiatry, University of Sevilla, C/Avicena s/n 41009 Sevilla, Spain.
(e-mail: *amheredia@us.es*).

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Fig 1. *Myotonometer.*

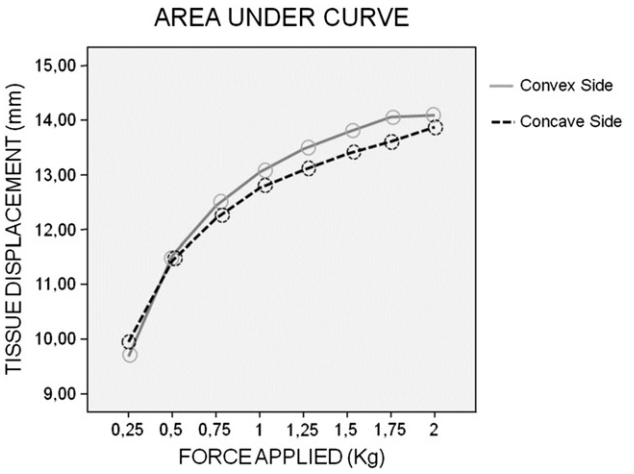

Fig 2. *Force-displacement curve displayed by the myotonometer in the lateral midpoint between the apex and the upper limit of the curve.*

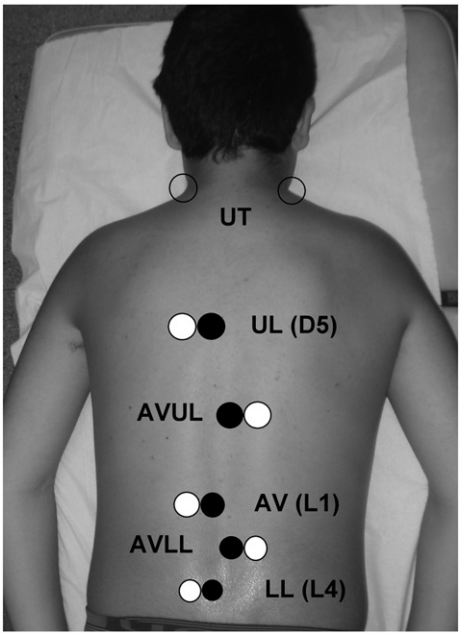

Fig 3. *Reference points for the examination of muscle tone by myotonometry. AV, apex vertebra of the curve; UL, upper limit of the curve; LL, lower limit of the curve; AVUL, midpoint between apex and upper limit; AVLL, midpoint between apex and lower. Black circles represent the medial points in each location, and white circles represent the lateral point. Note: Measurements were made in both sides.*

etiological factors for adolescent IS.[7] On the one hand, instability of the spine in IS has been correlated with muscle atrophy[13] and overstretching of the tissue on the convex side.[14] In regard to the metabolic processes involved in the pathogenesis of IS, there appears to be a disruption in the balance between muscle tone regulators (melatonin and calmodulin).[7] Higher levels of calmodulin have been found in paraspinal muscles at the convex side, which seem to increase muscle contractility at that side and to cause a neuromuscular imbalance.[15] On the other hand, several studies indicate an absence of changes in the erector spinae muscle functionality when comparing IS individuals with a control group.[16,17] Therefore, it is difficult to reach a definite conclusion about the possible differences between the sides of the scoliosis curve.[17]

Previous research in this area has primarily used surface electromyography (EMG) or magnetic resonance imaging as evaluative tools of muscle activity.[2,12,18] Muscle hardness (MH) is also a defining characteristic of muscle activity and can be measured using a myotonometer (MYO). Muscle hardness has been suggested to correlate with muscle pain sensitivity and exercise.[19] An increased MH seems to be associated with chronic musculoskeletal dysfunctions[19] and may be an indication of tissue edema, hypoxia and local acidosis,[20] or even altered mechanosensitivity in soft tissues.[21]

Truncal asymmetry has been linked with body mass index (BMI) in adolescent IS.[22] A lower BMI was found in IS and related to back shape asymmetry.[22] As suggested by Cheung et al,[23] increased paraspinal activity at different levels of the scoliotic curve may disturb the spinal balance and be related to the curve progression and, consequently, to the value of the Cobb angle. Therefore, an asymmetric paraspinal activity is associated with increased axial rotation, which in turn is linked with progressiveness of the scoliosis,[24] especially at the lower end vertebra of the curve.[6] However, no previous attempts have made been to correlate BMI or Cobb angle values with spinal MH. At present, there are no studies that use a MYO as an assessment tool for IS.