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The effect of rectified kyphosis on the biomechanical behavior of the adolescent thoracic spine

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Introduction: Deformity in adolescent thoracic spine has high prevalence worldwide. The reduction of thoracic kyphosis with biplanar asymmetry has been associated with the phenomenon of adolescent idiopathic scoliosis. Objective: The objective of this work was to study the biomechanical behavior on the thoracic spines of adolescents under asymmetric ligament load in kyphosis and rectified kyphosis. Methods: Two finite element models of an adolescent thoracic segment, T5-T10, were generated with every bone component, intervertebral discs, the flavum, intertransverse and supraspinous ligaments. The 3-dimensional geometry of the T5-T10 was generated with Autodesk® Maya®, and HyperMesh® version 14.0 was used to generate the finite element models. Asymmetric ligament load of 10N was applied to the right in the T8-T9 segment, with and without axial load of 400 N in the T5 vertebra. Results: Rectified kyphosis showed the highest rotational displacement of the T8-T9 unit: 0.16° with axial load and asymmetric ligament load, and 0.22° with asymmetric ligament load alone. Kyphosis exhibited rotational displacement of 0.11° and 0.12°, respectively, for the same load conditions. The condition of rectified kyphosis showed a right lateral deviation of the T8-T9 segment, Cobb of 2.85°, and a rotational deviation of T9 in relation to T8, also to the right, reproducing the phenomenon of scoliosis. The same phenomenon was not observed in the condition of preserved kyphosis. Conclusions: Rectified kyphosis subjected to an asymmetric ligament force showed greater vulnerability to vertebral rotation, and greater in the absence of axial load condition, similar to the lying position. The results suggest the need for greater attention to the vertebral assessments in the sagittal plane, beginning from the growth spurt period, to adopt preventive therapeutic in vertebral deformities such as adolescent idiopathic scoliosis.

Keywords: Kyphosis, Scoliosis, Adolescent Medicine.