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Diagnostics

# An Analysis of Chest Wall and Diaphragm Motions in Patients With Idiopathic Scoliosis Using Dynamic Breathing MRI

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### Abstract

**Study Design.** The motions of chest wall and diaphragm were measured in patients with scoliosis and healthy individuals using dynamic breathing magnetic resonance imaging.

**Objectives.** To investigate the motions of the chest wall and the diaphragm during deep breathing in patients with idiopathic scoliosis.

**Summary of Background Data.** Despite the central role of the respiratory motions in maintaining ventilation, it is difficult to measure and describe the motions because of the limited methods available. The kinematics of respiration in scoliosis have not yet been clarified.

**Methods.** Dynamic fast spoiled gradient-recalled echo sequences were used for 18 patients with idiopathic scoliosis and 9 healthy individuals. The chest wall and diaphragm motions were evaluated using a cineloop view and a fusion display of maximal inspiratory and expiratory images. The data were analyzed quantitatively by measuring displacements.

**Results.** Respiratory chest wall movements were significantly restricted in patients with scoliosis, although the diaphragm motion was normal. An analysis of the fusion magnetic resonance displays superimposed with the maximal inspiratory and expiratory images facilitated the understanding of the abnormal respiratory motion in patients with scoliosis. There was some correlation between the values of respiratory motions and pulmonary function tests.

**Conclusions.** The present technique is useful for assessing respiratory mechanisms dynamically and noninvasively. One of the distinguishing features of respiratory dysfunction in patients with scoliosis is their limited chest wall motion.

Several studies have shown the deleterious effect of idiopathic scoliosis on pulmonary function. 1-8 Thoracic deformity has long been considered to cause a reduction in lung volume and restrictive form of pulmonary dysfunction. 2,4,9,10 Although thoracic

deformity can also have a mechanical influence on the respiratory motions of the chest wall and diaphragm, the kinematics of the chest wall and diaphragm and the resulting influence on respiration have not yet been clarified.

There have been a few reports in which respiratory kinematics were studied during breathing in scoliotic individuals. Leong *et al*<sup>11</sup> reported the three-dimensional range of the movement of the chest wall. However, it is difficult to measure and describe chest wall and diaphragm motion simultaneously.

There have been some reports of dynamic analysis of chest wall and diaphragm motions using MRI based on a shortened image acquisition time. However, dynamic breathing MRI (BMRI) has led to a better understanding of respiratory function<sup>12-14</sup>; no direct dynamic BMRI of the chest wall and diaphragm has been reported for patients with scoliosis.

The purpose of this study was to investigate the motions of the chest wall and the diaphragm during deep breathing in patients with idiopathic scoliosis using dynamic BMRI.

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