Influence Of Back Extensor Strength On The Natural History Of Kyphosis Without Fresh Vertebral Fractures

Michio Hongo, Naohisa Miyakoshi, Yuji Kasukawa, Yoshinori Ishikawa, Daisuke Kudo, Yoichi Shimada. Akita University Graduate School of Medicine, Akita, Japan.

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Introduction: Spinal kyphosis progresses with age. The risk factors for progression included vertebral fractures, degenerative disc disease, muscle weakness, and decreased mobility. Previous cross-sectional study demonstrated that spinal kyphosis was significantly associated with back extensor strength. In this study, we have focused on the influence of muscle strength on spinal kyphosis. However, the Influence of trunk muscle strength on the natural history of spinal kyphosis is still unclear. Namely, whether kyphosis induced reduction of back strength or decreased back strength cause kyphosis is still unclear. The purposes of this study were to evaluate the natural history of spinal kyphosis in the patients without evident vertebral fractures and to analyze the association of back extensor strength and progression of kyphosis with longitudinal follow up.

Methods: Postmenopausal women with records of radiographs and muscle strength for more than two years were included in this study. We excluded the patients with severe kyphosis with 2 or more vertebral fractures recent fracture within the last 6 months and who underwent back exercise. Finally 30 women with mean age of 66 years were selected for this retrospective analysis. Follow-up period was 2.8 years. Spino-pelvic parameters were evaluated with standing lateral radiographs including thoracic kyphosis, lumbar lordosis, sacral slope, pelvic tilt, pelvic incidence, and sagittal vertical axis (SVA). We also evaluated scores for quality of life with the Japanese Osteoporosis Quality of Life Questionnaire, back pain with Roland Morris Questionnaire. Isometric back extensor muscle strength was evaluated with a custom-made dynamometer and grip strength was measured with a hand dynamometer.

Results: Both average back extensor strength and grip strength did not change at the follow up. Spino-pelvic parameter demonstrated that Thoracolumbar kyphosis (7.5° to 9.8°, p=0.02) and Sagittal vertical axis (13.9mm to 24.8mm, p=0.008) increased at the follow up, but there were no change in thoracic kyphosis, lumbar lordosis, pelvic incidence, pelvic tilt and sacral slope. SVA increased from 13.9mm to 24.9mm at the final follow up. Only four cases showed more than 50 mm, which has been shown to cause imbalance. Then, the correlation of the change in SVA with baseline data using simple regression analysis was performed, and age (r=-0.521, p=0.003), RDQ (r=0.492, p=0.015), grip strength (r=-0.474, p=0.008), back extensor strength (r=-0.487, p=0.006), and sacral slope (r=-0.37, p=0.044) was significantly correlated with the change in the SVA. Initial SVA was not correlated with the increase in SVA. Figure 1 showed an association between the change in SVA and back extensor strength. Back extensor strength under 15 kg showed increase in SVA. However, multiple logistic regression analysis did not reveal significant factors affecting the increase in SVA.

Discussion: According to the results of our study, possible causes for the progression of kyphosis were older age, low back pain, lower grip and back extensor strength, and lower sacral slope. Especially back extensor strength and grip strength showed higher correlation. Therefore, general muscle weakness
may be an important factor for progression of kyphosis. However, multiple logistic regression analysis did not detect any significant factors. So further study will be needed with large number of subjects and longer follow-up. The influence of spino-pelvic alignment might be contributing factors on the development of spinal kyphosis. Hence, we have expected that larger initial SVA or larger initial kyphosis might be associated with increase in SVA. However these measurements were not associated with SVA increase. Whereas, back extensor strength less than 15kg was significantly associated with increase in SVA. Therefore, back exercise to improve or maintain spinal kyphosis can be recommended for those patients with reduced back strength.

**Significance:** Increase in sagittal vertical axis was associated with back extensor strength and grip strength, irrespective of spino-pelvic alignment.

![Graph showing association between change in SVA and back extensor strength](image)

**Figure 1.** Association between the change in SVA and back extensor strength

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