Analysis of relationship between standing posture and riding form using spinal curvature index

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1. Introduction:

In competitive cycling, trainers always measure the cyclist's riding posture and optimize the bicycle fitting for comfort and efficiency (bikefitting.com, Sittard, Netherlands; RETÜL, Boulder, Colo., USA). Well-trained cyclists tend to extend their thoracic spine and flex their lumbar spine when riding [1]. However, these angles may depend on the pattern of spinal curves when standing on the floor, or depend on mobility of the spine. There probably is a form considered "ideal," but it depends on the specifics of the rider's body. Thus, coaches, trainers, and bike fitters should consider and provide the cyclist with proper standing posture form.
The aim of this study was to measure the inclination angles to the vertical axis of the thoracic spine and the lumbar spine and to find the relationship between the alignment of the spine curvature and riding form.

2. Methods

Participants 18 Japanese amateur cyclists (average age: 31.8 ± 11.8 y, average years of experience: 5.6 ± 3.7, average body height: 172.8 ± 5.6 cm, average body weight: 62.4 ± 7.4k g).

Measurement methods We placed a triaxial acceleration sensor (X-IMU, x-io Technologies Ltd., Bristol, UK) on the skin of the spinal process of Th5 and L5, and calculated the inclination angle on the basis of gravitation towards the vertical axis of the thoracic region and the lumbar region.
After the measurement of standing and anteflexion in standing, the participants rode their own bicycles on a flexed roller (GT-ROLLER Flex 3.5, GLOWTAC, Tokyo, Japan) with bracket bar position and drop bar position, and pedaled for 15 s under 60% intensity of maximum effort. The angles of the thoracic region and lumbar region were then measured. We used average data of 15 s for the subsequent analysis.

Analysis methods

1) We calculated an equation of the inclination angle towards the vertical axis of the thoracic spine and the lumbar spine, and defined it as the spinal curvature index (SCIndex; Fig. 1).

2) The amount of change in the inclination of the thoracic vertebrae or lumbar vertebrae (angle) when the riding posture is taken from the standing position was defined as the amount of change in the inclination angle (thoracic or lumbar spine). The forward inclination angle change amount was calculated in both the bracket position and the drop position.

3) The difference in the inclination of the lumbar region (angle) between the static standing position and the forward bending position was calculated as the standing posture forward bending angle. This was used as an index of hip flexibility. The correlation coefficients of these values were calculated.

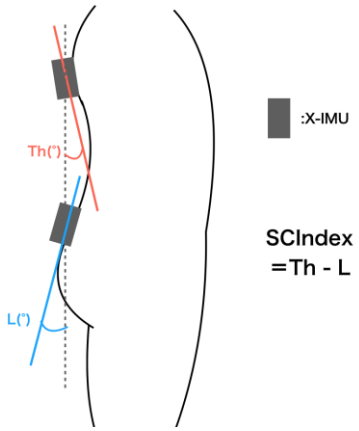
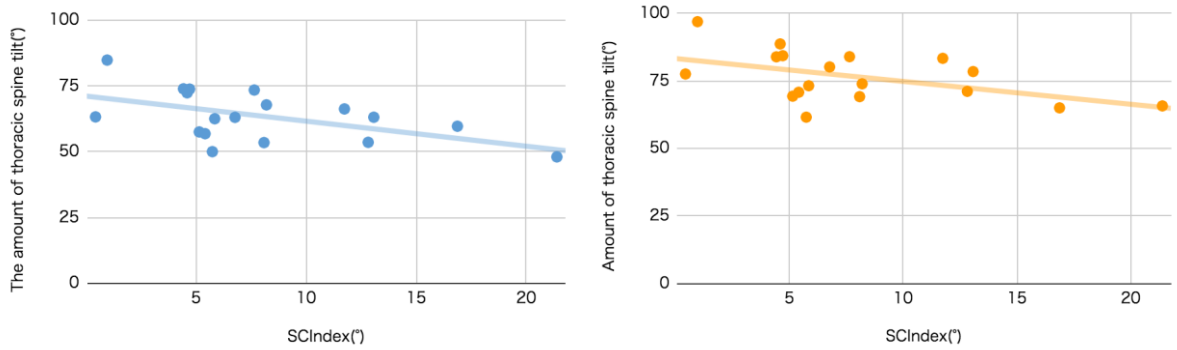


Fig. 1 SCIndex definition

3. Results

(1) The spinal curvature index was significantly correlated with the amount of change in the inclination angle of the bracket bar position (r = −0.52) and was also significantly correlated with the amount of change in the inclination angle of the drop bar position with r = −0.49 (Fig. 2). There was no correlation with the amount of change in the anterior inclination angle of the lumbar spine.

(2) A correlation of 0.39 in the bracket position and 0.34 in the drop-handle position was observed in the forward bending angle of the lumbar spine during riding.



(a) *Bracket bar position* (b) *Drop bar position*

Fig. 2 Relationship between SCIndex and the amount of the change of anterior tilt of the thoracic spine

4. Discussion: The relationship between SCIndex and riding form

The spinal curvature index is defined as the difference in the inclination of the thoracic and lumbar vertebrae with respect to their vertical axes and is a simple measure of the degree of lordosis of the spinal column. A higher SCIndex value corresponds with greater lordosis and higher dorsal muscle tone. According to the correlation between the spinal curvature index and the spinal column during riding, the level of muscle tension on the back may inhibit forward tilting of the trunk, especially the chest, during riding.

In addition, the possibility of inhibiting the forward inclination of the lumbar region during riding was also indicated, when the flexibility of the lumbar region is low. Muyor et al. [2] reported that professional cyclists maintain their lumbar spine flexed more when riding than when standing. Considering cycling performance, the mobility of the hip and the lumbar region is an important point, because cyclists maintain the lumbar region and hip joint flexed deeply during riding. Therefore, it may be effective to use interventions aimed at controlling back muscle tone as physical conditioning to reduce air resistance and lower form. This method could improve the rider's standing posture in daily life and approach from a place outside the context of riding.

5. Conclusions

It was shown that the alignment of the lumbar region and thorax in the standing posture was related to the forward tilt angle change of the riding form. These results suggest that conditioning of the spine, not only during riding but also based on the assessment of standing posture, may lead to further improvement of riding form.

References

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