SHIFT OF AXIAL POSITION FOR ROTATION AT THE INTERVERTEBRAL JOINT IN DOGS

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Received August 23, 2004

Abstract : To elucidate whether the position of axis for rotation at the intervertebral joint is related with the spinal curvature, the authors investigated the spinal columns of beagles. The spinal column of beagle was composed of 7 cervical, 13 thoracic, 7 lumbar, 3 sacral, and 19 coccygeal vertebrae. It was observed that the position of axis for rotation at the intervertebral joint was shifted on the superior and inferior views of the 2nd thoracic vertebra and was next shifted on the superior and inferior views of the 10th thoracic vertebra. It was suggested that in the case of beagle and Wistar rat with 13 thoracic vertebrae, the upper shift of axial position for rotation at the intervertebral joint occurred on the superior and inferior views of the 2nd thoracic vertebra and the lower shift of axial position for rotation at the intervertebral joint occurred on the superior and inferior views of the 10th thoracic vertebra.

Key words : Intervertebral joint, spine, vertebra, dog

INTRODUCTION

It is known that the position of axis for rotation at the intervertebral joint is shifted from dorsal to ventral direction and next from ventral to dorsal direction on the superior and inferior views of the thoracic vertebra. However, it is unclear why the two shifts of axial position for rotation at the intervertebral joint are necessary. Therefore, the authors previously investigated the cervical, thoracic, and lumbar spines of the human, baboon, Japanese monkey, and rat, and observed that the position of axis for rotation at the intervertebral joint is shifted on the superior and inferior views of the 1st or 2nd thoracic vertebra and is next shifted on the superior and inferior views of the 10th thoracic vertebra. The present paper describes the finding of the cervical, thoracic, and lumbar spine in beagles.

MATERIALS AND METHODS

Materials

The animal experiment was carried out in accordance with the US Guide for the care and

use of laboratory animals. The spinal columns were resected from beagles and the vertebrae were isolated from the spinal columns.

Photograph of Vertebrae

Vertebrae were photographed with a digital camera (FinePix S602; Fuji Film Co., Japan).

RESULTS

Structure of Vertebrae

Adult beagles were used in the present study. The spinal column consisted of 7 cervical, 13 thoracic, 7 lumbar, 3 sacral, and 19 coccygeal vertebrae.

Figure 1A shows the lower thoracic and lumbar vertebrae. The slender accessory process was present in the range between the 10th thoracic and 5th lumbar vertebrae. The

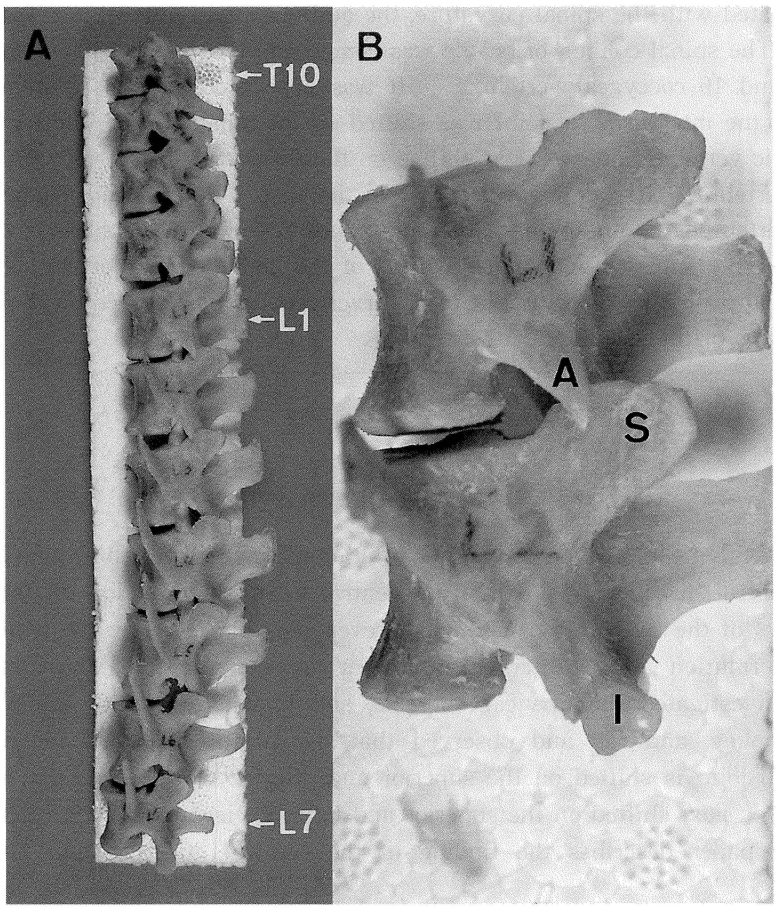

Fig. 1. Lateral views of the lower thoracic (T10-T13) and lumbar vertebrae (A) and the magnification of the 1st and 2nd lumbar vertebrae (B). T10, L1, and L7 indicate the 10th thoracic, 1st lumbar, and 7th lumbar vertebrae, respectively. A, I, and S in Fig. 1B denote the accessory, inferior articular, and superior articular processes, respectively.

slender accessory process was absent from the 6th and 7th lumbar vertebrae. The superior articular processes were tightly held between the accessory and inferior articular processes of the adjacent vertebra in the range between the 1st and 3rd lumbar vertebrae (Figs. 1A and 1B), but they were not tightly held between the accessory and inferior articular processes of the adjacent vertebra in the range between the 11th and 13th thoracic vertebrae. Therefore, the rotation movement of the spinal column was restricted in the range between the 1st and 3rd lumbar vertebrae.

Rotation Movement at the Intervertebral Joint

The position of axis for rotation at the intervertebral joint was examined in the cervical, thoracic, and lumbar vertebrae of three beagles. Figure 2 indicates that the position of axis for rotation at the intervertebral joint is shifted from dorsal to ventral direction on the

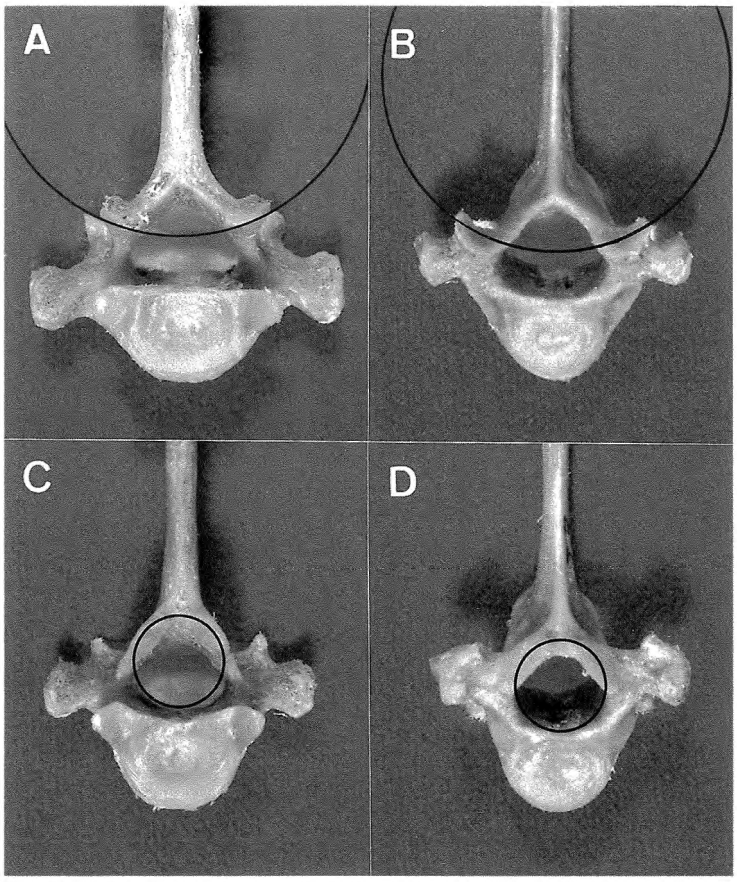

Fig. 2. The upper shift of axial position for rotation at the intervertebral joint on the superior and inferior views of the 2nd thoracic vertebra. A, inferior view of the 1st thoracic vertebra; B, superior view of the 2nd thoracic vertebra; C, inferior view of the 2nd thoracic vertebra; and D, superior view of the 3rd thoracic vertebra. The circles show rotation movement at the intervertebral joint.

superior and inferior views of the 2nd thoracic vertebra in the beagles. The position of axis for rotation at the intervertebral joint was dorsal in the 2nd–7th cervical and the 1st thoracic vertebrae, whereas it was ventral in the thoracic vertebrae caudal to the 3rd thoracic vertebra.

Figure 3 indicates that the position of axis for rotation at the intervertebral joint is shifted from ventral to dorsal direction on the superior and inferior views of the 10th thoracic vertebra in the beagles. The position of axis for rotation was ventral in the thoracic vertebrae cranial to the 10th thoracic vertebra, whereas it was dorsal in the

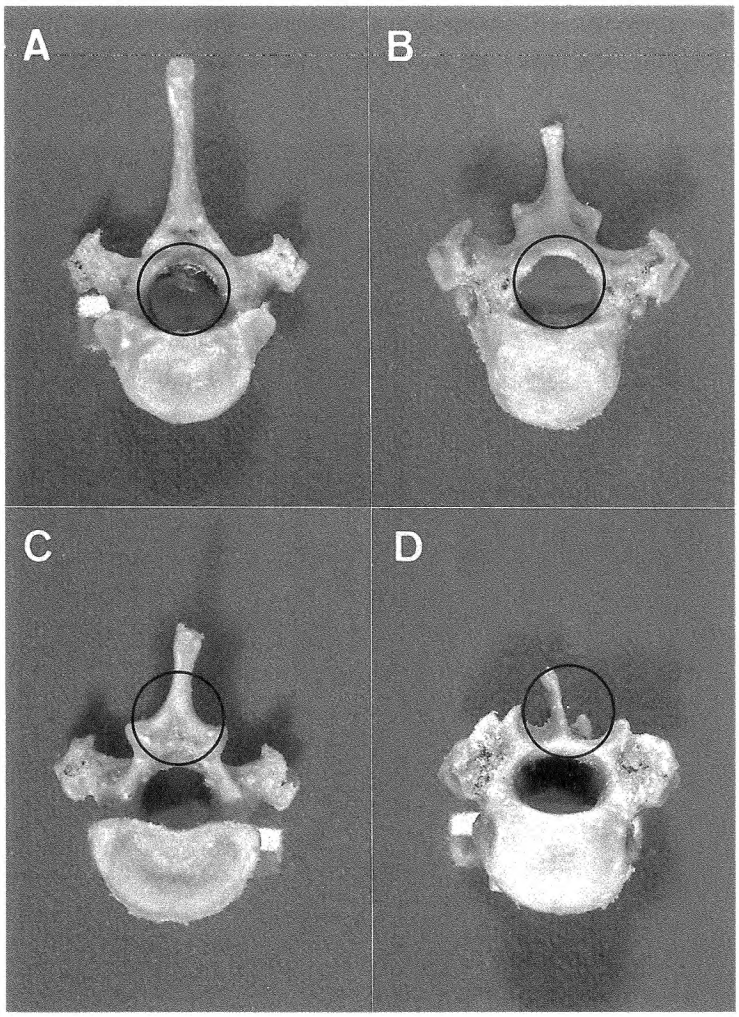

Fig. 3. The lower shift of axial position for rotation at the intervertebral joint on the superior and inferior views of the 10th thoracic vertebra. A, inferior view of the 9th thoracic vertebra; B, superior view of the 10th thoracic vertebra; C, inferior view of the 10th thoracic vertebra; and D, superior view of the 11th thoracic vertebra. The circles show rotation movement at the intervertebral joint.

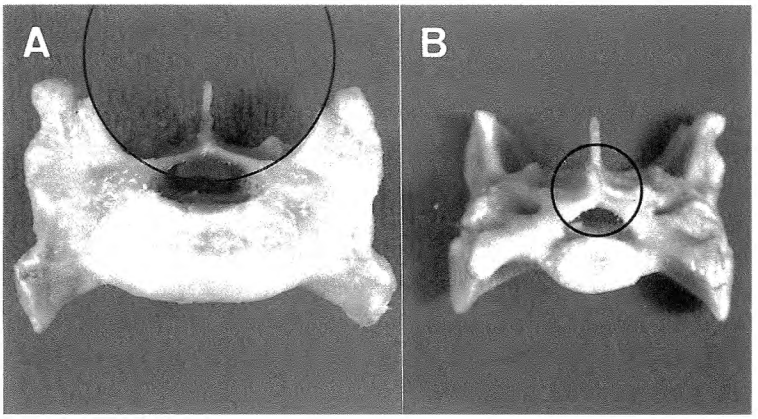

Fig. 4. The superior (A) and inferior (B) views of the sacrum. The circles show rotation movement at the intervertebral joint.

11th–13th thoracic vertebrae and all of the lumbar vertebrae.

The position of axis at the intervertebral joint was dorsal on the superior view of the sacrum and it was also dorsal on the inferior view of the sacrum (Fig. 4). Likewise, the position of axis for rotation at the intervertebral joint was dorsal on the superior view of the 1st coccygeal vertebra.

The shift of axial position for rotation at the intervertebral joint occurs suddenly on the superior and inferior views of both the 2nd and 10th thoracic vertebrae, but does not occur gradually.

DISCUSSION

The present study revealed that the position of axis for rotation at the intervertebral joint was shifted from dorsal to ventral direction on the superior and inferior views of the 2nd thoracic vertebra and was next shifted from ventral to dorsal direction on the superior and inferior views of the 10th thoracic vertebra in the beagles.

In the case of the baboon and Japanese monkey with 12 thoracic vertebrae, the position of axis for rotation at the intervertebral joint is shifted from dorsal to ventral direction on the superior and inferior views of the 1st thoracic vertebra and is next shifted from ventral to dorsal direction on the superior and inferior views of the 10th thoracic vertebrae, with some exceptions in the Japanese monkeys. In the Wistar rat with 13 thoracic vertebrae, the upper and lower shifts of axial position for rotation at the intervertebral joint occur on the superior and inferior views of the 2nd and 10th thoracic vertebrae, respectively.

In the case of the Wistar rat and beagle with 13 thoracic vertebrae, the upper shift of axial position for rotation at the intervertebral joint occurs on the superior and inferior views of the 2nd thoracic vertebra and the lower shift occurs on the superior and inferior views of the 10th thoracic vertebra, whereas in the case of the baboon, Japanese monkey and human with 12 thoracic vertebrae, the upper shift of axial position for rotation at the

intervertebral joint occurs on the superior and inferior views of the 1st thoracic vertebra and the lower shift occurs on the superior and inferior views of the 10th thoracic vertebra, except for the human. These results suggest that the upper shift of axial position for rotation at the intervertebral joint is related with number of the thoracic vertebrae.

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