INTRODUCTION
Anterior lumbar surgery is technically challenging due to perioperative vascular complications. Many studies suggest approaches based on the anatomy of the abdominal vessel for safe vascular mobilization. However, the tension (strain) in the vascular structure is also important for adequate exposure of the target lesion. It has been established that the tension in the lumbar nerve at the root level can be changed by a straight leg raise test and that the structure of the vascular connection is similar to that of the neural connection. Consequently, a change in leg position could affect the tension of lumbosacral vessels. The purpose of this study was to evaluate the effect of leg position on the tension of lumbosacral vessels.

METHODS
We dissected 10 unembalmed cadavers using the method described by Gumbs et al., using the Synframe® system to expose the abdominal artery and vein [1,2]. The left iliac artery and the distal abdominal aorta were retracted to the right side at the L4-5 disc level by a measuring retractor to which a strain gauge was attached. The tension was checked at various angles of the hip joint and the motions of the abdominal arteries were monitored in four unembalmed cadavers using a C-arm fluoroscope (Figure 1).

RESULTS AND DISCUSSION
The arterial strain decreased significantly in all individual cadavers when the hip joint was flexed (p < 0.01). Although the amount of decrease differed with each cadaver, patterns with regard to the change in strain at each position showed similar tendencies in all cadavers. A typical change in arterial strain, which was monitored continuously when the hip joint was flexed between 0˚ and 45˚. This pattern of decrease in arterial strain indicates a close relationship between the position of the hip joint and arterial tension. The arteries including the common iliac artery, external iliac artery, internal iliac artery, and distal abdominal aorta, were displaced proximally during hip flexion. When the hip joint was flexed between 0˚ and 45˚, the mean parallel proximal displacement of the artery markers was 1.06 ± 0.45 mm (at the distal aorta), 1.51 ± 0.69 mm (at the origin of the common iliac artery), 1.62 ± 0.74 mm (in the middle of the common iliac artery), 1.86 ± 0.95 mm (at bifurcation of the common iliac artery), 3.61 ± 1.21 mm (at the proximal external iliac artery), 4.51 ± 1.59 mm (at the distal external iliac artery), 0.98 ± 0.51 mm (at the proximal internal iliac artery), and 1.08 ± 0.65 mm (at the distal iliac artery) (Figure 2A).

The vein measurements also showed a similar pattern (parallel cephalic displacement) to that in artery (parallel proximal displacement). When the hip joint was flexed between 0˚ and 45˚, the overall displacement of markers on veins was 1.38 ± 0.06 mm (at bifurcation of the vena cava), 1.59 ± 0.35 mm (in the middle of the common iliac vein), 1.90 ± 0.16 mm (at bifurcation of common iliac vein), and 2.64 ± 0.18 mm (at the external iliac vein) (Figure 2A).

Figure 1. The lead ball markers (Ø 2 mm) were attached to the artery (A). The motion was detected by C-arm fluoroscopy in the “hip flat” position and when the hip flexed 45˚. The pictures were then merged (B).
Figure 2. A schematic diagram showing the strains of the artery (A) and vein (B). The average strains (mm) are noted in colored circles.

CONCLUSIONS
The results of this study would be useful for not only spinal surgery but also other vascular surgeries, particularly, in cases where patients with conditions such as atherosclerosis or stenosis.

REFERENCES