The effects of fifth lumbar posterior element on vertebral body and intervertebral disc

1Ji Hyung Park, 1,2Dae Gon Woo, 1Dae Woon Lee, 1Chi Hoon Kim, 3Beob Yi Lee and 4Han Sung Kim
1 Department of Biomedical Engineering and Institute of Medical Engineering, Yonsei University, Wonju, Korea
2 Medical devices Research Division, National Institute of Food and Drug Safety Evaluation, Korea Food & Drug Administration, Seoul, Korea
3 Department of Anatomy, School of Medicine, Konkuk University, Seoul, Korea; email: arnia.park@gmail.com

SUMMARY
The aim of this study is to investigate the microbiomechanical changes both morphological characteristics of vertebral body and intervertebral disc under removal of rat spinal posterior element. We found that posterior element of lumbar disperses the load of vertebral body and has a role of stability. Therefore we could consider that posterior elements have a stable biomechanical effect both vertebral body and intervertebral disc.

INTRODUCTION
In many advanced countries, treatment of low back pain (LBP) is important problem to the clinician [1]. It is asked for lots of billion dollars in the United States to treat the LBP [2]. Degeneration of the posterior elements has been found to be a reason of LBP by lots of research [3, 4]. Facet joint accords the stability to lumbar due to roles of resistance about anterior shear displacement accompany flexion, extension rotation [5]. Therefore, posterior elements are highly important factors for LBP moreover research of spine. In this study, we would like to observe effects of lumbar fifth posterior elements both vertebral body and intervertebral disc.

METHODS
6 Sprague-Dawley (12 weeks old) rats were divided into removal group (removed posterior element of fifth-lumbar) and normal group. Specimens were acquired in lumbar 3-5 (L3-5) two motion segments and scanned at 0 week (before culturing) and at 1 week after culturing in the Biomechanical Lumbar Culture System (BLCS) inside of CO2 incubator (Sanyo, Japan) (Figure 1) by using high resolution in-vivo micro-computed tomography. The culture media was consist of Dulbeco’s Modified Eagle’s Medium (DMEM, Lonza, BioWhittaker, USA), Fetal Bovine serum (FBS, Gibco, BioWhittaker, USA), L-ascorbate (Sigma Aldrich, USA), Gentamycin (BioWhittaker, USA), Fungizone (BioWhittaker, USA), HEPES (BioWhittaker, USA). The loading condition was applied rats body weight 3N loading vertically to two motion segments during 12 hours and 12 hours rest time [6]. To estimate morphological characteristic of trabecular bone of vertebral body structural parameters were acquired and analyzed by CT-AN (Skyscan, Belgium). To observe histological changes in intervertebral disc, we implemented H&E and Safranin-O staining.

RESULTS AND DISCUSSION
In morphological analysis, trabecular bone of removal group was tended to worsen slightly. BV/TV and Tb.N were decreased and Tb.Sp was increased in L3, L4, L5. SMI was not changed in L3, L4, L5, but L5 of Tb.Th was decreased. In the normal group, L3 and L4 of all structural parameters were not changed relatively. However, there was a statistical difference between normal and removal group in those of L5. L5 trabecular bone was increased in BV/TV, Tb.Th, Tb.N and decreased in Tb.Sp, SMI.

In the histological analysis, after stimulation, nucleus pulposus and annulus fibrosus of removal group were lost their morphologic construction. However, in the normal group we could find morphologic construction of nucleus pulposus and annulus fibrosus. In addition, we confirmed that nucleus pulposus and annulus fibrosus of removal group were lost proteoglycan due to red color was almost disappeared from safranin-O stain.

If posterior elements were not existence, trabecular bone of vertebral body was tended to worsen and intervertebral disc was degenerated. We thought that posterior elements were maintained load condition as degree of smoothly metabolism activity by disperses the load of vertebral body. Therefore, posterior elements were very important effects on lumbar.
CONCLUSIONS
In this study, we found that posterior elements of lumbar disperses the load of vertebral body and has a role of stability. Therefore we could consider that posterior elements have a stable biomechanical effect both vertebral body and intervertebral disc. Moreover, posterior elements must be considered when experiment on spine both in-vivo and in-vitro.

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