Effect of reduced Mechanical Stress on Development of the Femoral Head

Kohei Arakawa¹, Takanori Kokubun¹,²

¹Graduate School of Health, Medicine, and Welfare, Saitama Prefectural University, Saitama, Japan
²Department of Physical Therapy, School of Health and Social Services, Saitama Prefectural University, Saitama, Japan

Email of Presenting Author: 2391001y@spu.ac.jp

DISCUSSION

This study examined the effects of decreased mechanical stress on development on skeletal development. In developmental stages, bone modeling occurs, in which epiphysis cartilage is replaced by bone. Previous studies in adults have shown that hindlimb suspension decreases BV/TV. This study evaluated the osteogenic process of the femoral head of the hip, which is most subjected to mechanical stress due to weight bearing. As a result, we found that the BV/TV of the femoral head decreased. To further reveal this mechanism, we evaluated the hypertrophy of chondrocytes by immunohistochemical staining of Col 2 and Col X, and osteoclast activity by TRAP staining. The results showed that the staining intensity of Col2 was higher, and the positive cell rate of Col X, a marker of hypertrophic chondrocytes, was lower in the STHU and LTHU groups that underwent hindlimb suspension. These results suggest that decreased mechanical stress suppresses endochondral ossification due to hypertrophy of chondrocytes. In addition, there was no change in osteoclast activity. Previous reports have suggested that osteoclast activation is responsible for the decrease in BV/TV in adults. In addition, these results suggest that decreased mechanical stress during development may prolong the duration of bone maturation, and could be influenced by external factors such as lifestyle. Furthermore, there were no significant differences between the STHU and LTHU groups in all analyses. This indicates that the reduction of mechanical stress during development may have short-term but also long-term effects.

SIGNIFICANCE/CLINICAL RELEVANCE

This study found that a decrease in mechanical stress during development inhibits chondrocyte hypertrophy and delays endochondral ossification. Furthermore, the results suggest that the effects of delayed endochondral ossification during development may continue for a long time.