Von Mises stress

Von Mises stress is a value used to determine if a given material will yield or fracture. It is mostly used for ductile materials, such as metals.

A study aimed to investigate the difference in physiological loading on the spine in three different motions (flexion-extension, lateral bending, and axial rotation) between osteoporotic and normal spines, using finite element modeling. A three-dimensional finite element (FE) model centered on the lumbar spine was constructed. Kang et al. applied two different material properties of osteoporotic and normal spines. For the FE analysis, three loading conditions (flexion-extension, lateral bending, and axial rotation) were applied. The von Mises stress was higher on the nucleus pulposus at all vertebral levels in all movements, in the osteoporosis group than in the normal group. On the annulus fibrosus, the von Mises stress increased at the level of L3-L4, L4-L5, and L5-S in the flexion-extension group and at L4-L5 and L5-S levels in the lateral bending group. The values of two motions, flexion-extension, and lateral bending, increased in the L4 and L5 cortical bones. In axial rotation, the von Mises stress increased at the level of L5 of cortical bone. Additionally, the von Mises stress increased in the lower endplate of L5-S and L4-L5 in all movements, especially lateral bending. Even in the group with no increase, there was a part that received increased von Mises stress locally for each element in the three-dimensional reconstructed view of the pressure distribution in color. The von Mises stress on the lumbar region in the three loading conditions (flexion-extension, lateral bending, and axial rotation) was greater in most components of osteoporotic vertebrae than in normal vertebrae and the value was highest in the nucleus pulposus. Considering the increase in the measured von Mises stress and the local increase in the pressure distribution, they believed that these results can contribute to explaining discogenic pain and disc degeneration [1].

1)
Kang S, Park CH, Jung H, Lee S, Min YS, Kim CH, Cho M, Jung GH, Kim DH, Kim KT, Hwang JM. Analysis of the physiological load on lumbar vertebrae in patients with osteoporosis: a finite-element study. Sci Rep. 2022 Jun 29;12(1):11001. doi: 10.1038/s41598-022-15241-3. PMID: 35768481.

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