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Disc distraction shows evidence of regenerative potential in degenerated intervertebral discs as evaluated by protein expression, magnetic resonance imaging, and messenger ribonucleic acid expression analysis

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ABSTRACT

Objectives

Effects of temporary dynamic distraction on intervertebral discs were studied on the lumbar spine rabbit model to characterize the changes associated with disc distraction and to evaluate feasibility of temporary disc distraction to previously compressed discs in order to stimulate disc regeneration.

Methods

New Zealand white rabbits (n = 32) were used for this study. The rabbits were randomly assigned to one of five groups. In 12 animals, the discs were first loaded for 28 days using a custom-made external loading device to stimulate disc degeneration. After 28 days loading time, the discs in six animals were distracted for 7 days and in six animals for 28 days using the same external device, however, modified as dynamic distraction device. In six animals, the discs were distracted for 28 days without previous loading; and in six animals, the discs were loaded for 28 days and afterwards the loading device removed for 28 days for recovery without distraction. Six animals were sham operated. The external device was situated; however, the discs remained undistracted and they also served as controls.

Summary of Background Data

Studies have shown that accelerated degeneration of the intervertebral disc results from altered mechanical loading conditions. The development of methods for the prevention of disc degeneration and the restoration of disc tissue that has already degenerated are needed.

Results

After 28 days of loading, the discs demonstrated a significant decrease in disc space. Histologically, disorganization of the architecture of the anulus occurred. The number of dead cells increased significantly in the anulus and cartilage endplate. These changes were reversible after 28 days of distraction. The disc thickness increased significantly as compared with the specimens from the 28 days loading group without distraction. Histologically, the discs showed signs of tissue regeneration after 28 days of distraction. The number of dead cells decreased significantly in comparison with the loaded discs without distraction. The flexibility of compressed discs was higher than of compressed/distracted discs.

Conclusions

The results of this study suggest that disc regeneration can be induced by axial dynamic distraction in the rabbit intervertebral disc. The decompressed rabbit intervertebral discs showed signs of tissue recovery on a biologic, cellular, and a biomechanical level after 28 days of distraction