Finite Element Analysis of Extraforaminal Lumbar Interbody Fusion

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In lumbar interbody fusion, only sparse data is available analytically on stress distribution and end-plate bulging between spacer and fusion bone, and optimal position for spacer for the treatment of degenerative diseases of the lumbar spine. Recently, a minimally invasive, extraforaminal approach together with a newly designed implant, was developed for the lumbar interbody fusion. The aim of this study is to analyze the intrinsic parameters for the interbody fusion using finite element method.

METHODS & RESULTS

A parameteric study was done using an anatomically accurate and validated finite element model of L2/L3 motion segment by varying positions of the spacer (MicSpace, Aesculap, Germany) in anterior-posterior direction and size of the fusion bone accordingly for the extraforaminal approach. Three different configurations were studied by positioning at 5.5mm, 10.5mm and 15.5mm from the dorsal side of the spacer to rear edge of vertebral body. Figure 1 shows the finite element model used in this study.

With an axial displacement of 1mm applied onto the model, peak compressive stress on inferior end-plate is predicted to be 13.36MPa and 28.88MPa at the adjacent spacer and fusion bone, respectively, regardless of the spacer’s position and size of the fusion bone. Figure 2 shows the compressive stress profile of inferior end-plate along sagittal plane. The maximum end-plate bulging is predicted about 0.5 mm at around spacer’s position as shown in Figure 3.

CONCLUSION

The results show that the variation of the spacer’s position does not influence the stress distribution and end-plate bulging in inferior end-plate. This is important information as the small extraforaminal approach, although allowing for an easy introduction of the spacer, impedes exact placement of the spacer. Hence, this study concludes that the interbody fusion process is not affected by the position of the spacer.