CAE FOR BIOMEDICAL APPLICATIONS: SPINE SURGERY

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Abstract

Computer-aided Engineering is applied in a variety field of biomedical applications such as surgical simulations and prosthesis design. In this presentation a state of the art application of CAE for the evaluation of spine surgery is proposed. Since the advent of the pedicle screw fixation system, posterior lumbar fusion has become a very popular procedure, because pedicle screws can provide robust initial stability and lead to higher lumbar fusion rates when compared to those of uninstrumented lumbar fusions. However, even though many previous studies have reported excellent surgical results with instrumented lumbar fusion for degenerative lumbar disease, the robust stiffness of pedicle screws and rods might lead to an increase in the stress concentration at the adjacent segment after fusion, which could be a candidate risk factor for adjacent segment degeneration. Even though fusion affects the motion and disc stress of the adjacent segment, there are significant questions that remain. To investigate the increment of the stresses at adjacent segments due to each risk factor and their interactions between the risk factors the disc stress, the range of motion, and facet joint contact force are investigated at adjacent segments after fusion, using a finite element model of the lumbar spine. Four important risk factors were chosen. They were the pedicle screw fixation, the ablation of proximal posterior ligament complex (PLC), the position of the inserted pedicle screw and the unilateral pedicle screw fixation. It is found from the computer simulations that these risk factors are significantly related to the surgical short and long-term prognosis in orthopaedic surgery.