Rib Hook Fixation Device

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Technology description

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Inventors have developed a rib hook fixation device to control severe kyphosis (greater than 40° sagittal curve). The rib device is a combination of newly designed rib hooks that provide stress reduction with improved curvature and profile to better fit rib anatomy, and can be sized for children or adults.

Pedicle screws are currently used for as the standard in upper thoracic fixation for early onset scoliosis (EOS) patients instrumented with "growing rods". However, in EOS patients with severe kyphosis, pedicle screw pull-out failure in the upper thoracic region has been described by clinicians as a vexing and unsolved problem. Clinical studies have documented proximal fixation as the leading source of complications in growing rod surgeries to treat EOS. In addition, through our collaboration with adult spinal surgeons at MUSC, we have investigated similar pedicle screw limitations in adult patients with osteoporosis.

The rib device moves the spinal rod anchorage away from the vertebral body and onto the ribs. The rib device is placed bilaterally on ribs 2-5, with 2 down-going and 2 up-going rib hooks. The invention was developed through a study that investigated pull-out failure of pedicle screws compared to lamina hooks in similar orientation. Both biomechanical testing (see figure below) and a clinical follow-up study of over 50 patients using clinically available instrumentation have been conducted to validate the technique. Additionally, inventors have created a 3D printed prototype of the device.

Overview

Early onset Scoliosis (EOS) EOS has multiple etiologies and an incidence of roughly 1-2 per 2,000 births. If left untreated, the outcome of EOS is poor. The spinal curvature may progress, resulting in debilitating deformity, inhibited pulmonary development, respiratory failure, cardiac disease, and early mortality. The two widely used surgical techniques for the treatment of EOS include 1) growing rods, and 2) VEPTR. While these methods often provide significant curve correction, complication rates are high. In addition to EOS, this device could be translated to adult populations with osteoporotic fracture, spine fracture, spinal deformity and poor bone quality due to osteoporosis. One in three women older than 50 will have an osteoporotic fracture. Annual direct expenditure for care of patients with osteoporotic fractures in the United States exceeds $17 billion dollars (2001) and is predicted to double by 2025. Decreased bone mineral density due to osteoporosis is directly related to spinal fractures and deformities, with poor spinal fixation strength.

The rib fixation apparatus could provide clinicians with a proven method to treat patient populations considered untreatable by current available methods, including severe spinal deformities, severe osteoporosis, and vertebral fractures.

Key Words:Spine, scoliosis, kyphosis, osteoporosis, spine deformity, spinal fixation, pull-out failure, pedicle screw, lamina hook, rib hook

Application area

Spinal fixation, Spine deformity, Scoliosis, Kyphosis

The rib hook device can achieve dependable fixation strength and stability compared to pedicle screws in upper thoracic region. Moreover, the rib hook device offers significant advantages over existing spinal implants such as improved fixation strength to prevent pull-out failure, mitigating the risk of spinal cord injury by moving fixation away from the spine, and improving fixation strength in cases with osteoporosis.

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