Implantierbare Mikrosensoren fuer die Visualisierung von Wirbelkoerperbewegungen in der spinalen Chirurgie
Implantable microsensors for visualization of vertebral body motion in spinal surgery

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Objective

Degenerative diseases of the spine may not only cause neurological deficits due to direct compression of the spinal cord or the spinal nerves, but also alter its biomechanical function and statics. In such cases, the aim of surgery is double: to decompress neural structures and to provide the highest possible stability and the best possible preservation of function. Regardless of the surgical technique used, intraoperative prediction of the functional (neurological and biomechanical) results of surgery, might represent a major progress.

Materials & Methods

Navigationsystems have been used in spinal surgery for specific surgical planning, optimization of anatomical orientation and improvement of surgical accuracy. In the present research project (sponsored by the Deutsche Arthrose Hilfe e.V.), reference sensors of an electromagnetic navigation system (ACCISS II, Schaerer Mayfield Technologies) have been miniaturized for direct implantation into one or more vertebral bodies with the aim of providing precise additional spatial online information on the location of the vertebral bodies and their orientation in space. In laboratory tests, up to three microsensors were implanted into several cervical vertebrae of cadaver specimens.

Results

Different surgical techniques (e.g. ventral fusion, dorsal fixateur implantation, ventrolateral plate osteosynthesis, foraminotomy, cage implantation) were performed in a total of ten cervical spine models using different segments (C1-3, C5/6, C6-T1). The isolated vertebral body movements were registered and visualized online on the navigation screen.

Conclusion

The implanted reference sensors allow computer-animated, real-time visualization of isolated movements of individual vertebral bodies or of entire motion segments. This means that motion can be visualized immediately during surgery without the need for additional intraoperative imaging procedures such as fluoroscopy or computed tomography. These results indicate that reliable information on the expected postoperative biomechanical outcome can be obtained by continuous intraoperative three-dimensional animation.