Instrumented Spinal Fixation Devices

Unstable spines are often stabilized using an internal spinal fixation device. If, for example, a vertebra is fractured, screws are fixed posteriorly to the adjacent vertebrae left and right from the spinous process. On both sides a longitudinal rod is fixed to the screws. The spinal load is then partly shared by the paired implanted fixators. In a second operation a cage or an iliac crest bone graft is inserted into the fractured region from anterior. Usually, the bone graft will fuse with the adjacent vertebrae within a year and form a stable block.

Instrumented Spinal Fixator

Little was known about the loads acting on internal spinal fixators. In order to measure the loads a commercially available implant was modified. A measuring cartridge was integrated into the longitudinal rod containing six load sensors, an 8-channel telemetry transmitter, and the secondary coil for the inductive power supply.

Both Telemeterized fixators transmit their load values as a radio frequency pulse train outside the body. For the measurements a flat power coil, fixed to the patient's back, supplies the needed energy to both fixators. The power coil has an integrated antenna which delivers the signals to the external components of the telemetry system.

Measurements

A video camera records all movements of the patient and together with the received pulse trains the images are stored on a video tape. Simultaneously the signals are read into a PC, the forces and moments are calculated and displayed in real time on a monitor.

The first instrumented spinal fixators were implanted in 1994. Until now, ten patients received a pair of the instrumented fixators. The loads on the fixators have been measured for many positions and activities of daily life, including lying, sitting, standing, walking and physiotherapy.

Patients

Patients with instrumented Internal Spinal Fixators during load measurements

Publications

2003
ISSLS prize winner: A novel approach to determine trunk muscle forces during flexion and extension: a comparison of data from an in vitro experiment and in vivo measurements.

2002
Loads on an internal spinal fixation device during physical therapy.

Spinal load bearing during sitting in an office chair with a tilting back
2001
Is it possible to simulate physiologic loading conditions by applying pure moments? A comparison of in vivo and in vitro load components in an internal fixator.
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Loads on an internal spinal fixation device during sitting.
Show abstract

Comparison of intradiscal pressures and spinal fixator loads for different body positions and exercises.
Show abstract

2000
Changes in the loads on an internal spinal fixator after iliac-crest autograft.
Show abstract

Influence of load carrying on loads in internal spinal fixators.
Show abstract

2000 Volvo Award winner in biomechanical studies: Monitoring in vivo implant loads with a telemeterized internal spinal fixation device.
Show abstract

1999
Loads on internal spinal fixators measured in different body positions.
Show abstract

Braces do not reduce loads on internal spinal fixation devices.
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Loading on internal spinal fixation devices
Show abstract

1998
Placing a bone graft more posteriorly may reduce the risk of pedicle screw breakage: analysis of an unexpected case of pedicle screw breakage.
Show abstract

Influence of muscle forces on loads in internal spinal fixation devices.
Show abstract

1997
Loads on an internal spinal fixation device during walking.
Rohlmann A., Bergmann G., Graichen F.: J Biomech: 30(1) 41-7, 1997, 2.75 Impact Factor
Show abstract
Comparison of loads on internal spinal fixation devices measured in vitro and in vivo.
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1995
Telemeterized load measurement using instrumented spinal internal fixators in a patient with degenerative instability.
Show abstract

In vivo measurement of implant loads in a patient with a fractured vertebral body.
Show abstract

In-vitro measurement of loading using an instrumented vertebral internal fixator
Show abstract

1994
A spinal fixation device for in vivo load measurement.
Show abstract

1993
Stress measurements with an instrumented internal spinal fixator
Show abstract

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