LONG-TERM MONITORING OF THE FORCES ON A VERTEBRAL BODY REPLACEMENT

Antonius Rohlmann, Marcel Dreischarf, Thomas Zander, Hendrik Schmidt, Friedmar Graichen, Georg Bergmann

Charité – Universitätsmedizin Berlin, Julius Wolff Institute, Germany

Introduction

The temporal course of the loads on a vertebral body replacement (VBR) in the first postoperative years is still unknown. It is generally assumed that the implant forces will decrease with increasing postoperative time due to bony fusion of the adjacent vertebrae. In a long-term study, the temporal course of the forces on the VBR were measured to receive for the first time the *in vivo* acting forces during the healing phase.

Methods

Five patients with an A3 type fracture of a lumbar vertebral body (4x L1 and 1x L3) were first stabilized from posterior with an internal spinal fixation device. In a second surgery, parts of the fractured vertebral body and of the adjacent discs were removed. An instrumented VBR [Rohlmann et al, 2007] was integrated into the defect space and autologous bone material was added to enhance fusion between the adjacent vertebrae. The instrumented VBR allows a timely unlimited measurement of the six load components. From the three force components, the resultant force on the implant was calculated. The loads while standing and during walking were measured in overall nearly 100 measuring sessions over a period of up to 63 months postoperatively.

Results

In the period studied, the maximum resultant implant force for standing differed strongly for the five patients (315 N, 385 N, 210 N, 240 N, and 245 N). Moreover, also the intra-individual forces varied considerably during the course of time (Figure 1). For patient 1 the average implant force for standing decreased in the first 12 postoperative months by approximately 100 N. Then the force increased by 220 N. Contrary, for patient 2 the resultant implant force increased in the first 10 postoperative months up to 80 N and decreased subsequently by approximately 180 N. For patient 4 the implant force was nearly constant over a period of 45 months. For patients 3 and 5 the implant force decreased within the first two postoperative months by approximately 150 N and then stayed nearly constant. The short load increase in patient 3 about 11 months postoperatively was caused by re-instrumentation of the posterior implant due to pedicle screw loosening.

The temporal course of the implant force for standing and for walking was very similar.

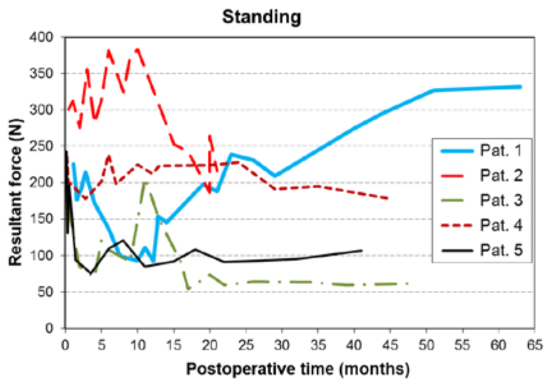

Figure 1: Temporal course of the resultant implant force for standing for the patients 1 to 5.

Discussion

The magnitude of the resultant implant forces varied strongly from patient to patient and in the temporal course. The assumption that the implant force will decrease in the postoperative time could not be corroborated. Other factors such as subsidence of the implant into the adjacent vertebral body and atrophy of the non-removed bone around the implant may also affect implant loads. Furthermore, changes in body weight and an increase of the thoracic kyphosis (all patients were older than 60 years at the time of surgery) can also have a slight effect on implant forces.

Existing radiological and rasterstereographic images allow the evaluation of the fusion state and the spinal curvature, respectively. These data will be correlated with those of the load measurements to verify the given explanations.

References

Rohlmann *et al*, J Biomed Eng & Phys, 29:580-585, 2007.