



## LASER SURGERY FOR THE DECOMPRESSION OF SPINAL CANAL STENOSIS

### Task

Every year 55,000 surgeries are performed in Germany to decompress lumbar spinal stenosis. These are bony growths that narrow the spinal canal of the lumbar spine and, through mechanical pressure on the neuronal structures, cause severe pain and imitations in the mobility of affected patients. In advanced stenoses, surgeons use a procedure in which they gain access through the affected vertebral body with a high-speed drill and remove the bony growths in the spinal canal. In one out of 200 patients, the spinal cord or the nerve root are injured, which results in significant physical disabilities for the patient.

### Method

For this reason, Fraunhofer ILT, in cooperation with the neurosurgical clinic of the Freiburg University Hospital, has developed a surgical procedure with which the vertebral body can be opened with the help of short-pulse laser radiation of high power. The laser radiation is coupled via a beam guiding system into a handpiece. In addition to the laser cutting function, the handpiece has an observation unit and an interferometric cutting depth measurement, both of which monitor and control the process inline. As a result of this, the

surgeon can terminate the laser process free of inertia after the vertebral body has been opened, without causing injuries to the underlying neuronal structures.

### Results

In the laboratory, the project partners have developed a laser cutting process with ps laser radiation that can be used to treat hemorrhages under water rinsing. Furthermore, they have developed a handpiece that distributes the laser pulses on the tissue surface via an integrated mini-scanner so that tissue can be removed both efficiently and with no thermal influence. The handpiece includes not only a depth measurement with optical coherence tomography (OCT) but also a rinsing and suction function. In the laboratory, removal rates of  $\Delta V/\Delta t = 1 \text{ mm}^3/\text{s}$  were achieved with an average laser power of  $P = 55 \text{ W}$  and pulse durations of  $\tau = 2 \text{ ps}$ .

### Applications

The laser surgery system is designed for use in neurosurgery and can be used in particular for spinal surgery and craniotomies.

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1 Laser cut in bone.

2 Handpiece for spine surgery  
with ps laser radiation.