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Correction of post-traumatic hyperkyphosis of the upper thoracic spine by multiple Chevron osteotomies

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Surgery · Thoracic spine · Kyphosis · Trauma · Spine fracture · Posterior spinal fusion · Instrumentation · Osteotomy

Introduction

Surgical correction of post-traumatic deformity of the upper thoracic spine should be considered in painful patients presenting with a local hyperkyphosis. Pain might be localized at the originally fractured areas due to residual instability, but it is more often associated with a global decompensation of the spine due to sagittal imbalance. Surgery is necessary in patients with a neurological deficit due to myelopathy, radiculopathy or a syrinx associated with the deformity. It might also be indicated because of cardiac or pulmonary dysfunction, sleep disturbance or loss of mobility.

Knowledge about the normal spinal and spino-pelvic alignment is crucial to plan the operation. According to the SRS (Scoliosis Research Society) a thoracic kyphosis of more than 50 degrees is defined as an abnormal sagittal alignment. A local excess of kyphosis in the fractured area superior to 20 degrees is also considered pathologic [1]. Thoracic hyperkyphosis might either be balanced due to a compensatory hyperlordosis of the lumbar spine (type I deformity) or it might be imbalanced (type II deformity). In the imbalanced patient the deformity might be compensated, if the plumb line is located behind the hip joints or it might be decompensated, if the plumb line is in front of the hip joints.

Chevron osteotomies in the thoracic spine are ideally suited for deformities limited to the sagittal plane. A prerequisite for the osteotomy is an adequate disc height with a residual flexibility within the intervertebral disc at the index level. The v-shaped osteotomy shortens the posterior column and slightly distracts the anterior column through the disc space. Together with instrumentation it provides immediate and significant biomechanical stability. If carefully planned and executed, approximately 5 degrees of sagittal plane correction can be achieved with every osteotomy. Hence, most often multiple osteotomies are necessary to achieve adequate correction.

Case description

The patient is a 46-year-old male complaining about intensive recurrent back pain in the upper thoracic and also in the thoraco-lumbar area. He was neurologically intact. He had a fall from 4 meters height 14 months ago with isolated spinal trauma. Initially, he was diagnosed with a stable compression fracture of Th3, Th4, Th5 and Th7 and had an intensive conservative treatment including even an inpatient rehabilitation program for 8 weeks. On the first presentation in our clinic he demonstrated on the full spine X-ray in standing position a decompensated imbalance of the sagittal alignment (type II deformity) with the plumb line located in front of the hip joints (+48 mm). His thoracic kyphosis was 64 degrees, while lumbar lordosis accounted for 54 degrees with a sacral slope of 34 degrees. There was no frontal plane deformity. In the CT scans there

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was evidence of spontaneous fusion only between Th5/6 suggesting residual flexibility within the adjacent intervertebral disc spaces. MRI confirmed adequate disc height at the index levels and demonstrated no signs of acute fracture or neurologic involvement.

Surgical procedure [2]

The complete surgical procedure was performed under neuromonitoring control (MEP). A standard posterior midline approach was used to expose the posterior aspects of the upper and middle thoracic spine (Th2 to Th8). Bilateral pedicle screw placement was performed in Th2, Th4, Th6 and Th8 using standard technique.

The Chevron osteotomy starts in the midline. Parts of the spinous process and the supra- and interspinous ligaments are excised. Then the ligament flavum is removed on both sides and the dura is exposed. The osteotomy is v-shaped in the coronal plane with the apex of the v distal and the arms extending at 30–45 degrees from a horizontal line running through the facet joints. The width of the osteotomy varies based on the spinal level and the desired degree of correction between 5–15 mm.

In this case 5 osteotomies were performed at the levels Th2/3, Th3/4, Th4/5, Th5/6 and Th6/7. Closure of the osteotomy was achieved by manual and instrumented compression. A bone-to-bone apposition is desirable. Dural compression due to inadequate laminar undercutting must be avoided. Two cross-connectors were added and fusion was applied by decortication of the facet joints, the lamina and the transverse processes adding autologous bone graft from the osteotomies.

Blood loss was 500 ml and operation time was 160 minutes. Neuromonitoring showed normal MEP′s during the operation.

Postoperative procedure

The patient was fully mobilized on the first day after surgery. No orthesis was applied. A standardized rehabilitation program was conducted. On the full spine X-ray in standing position 4 weeks after surgery he demonstrates a balanced sagittal alignment. The plumb line was located slightly in front of the posterior lateral aspect of S1 (+6 mm). His thoracic kyphosis was 44 degrees (overall 20 degrees correction, 4 degrees/osteotomy). Lumbar lordosis was 50 degrees with a sacral slope of 30 degrees. There was still no frontal plane deformity.

Discussion and conclusion

Corrective surgery of a post-traumatic deformity of the spine is a difficult procedure that should be performed by an experienced team. Many different types of osteotomies are available. Decision-making factors include the level of trauma, the severity of deformity, the amount of vertebral body destruction, a history of previous surgery in the area of the deformity, the bone quality and the age and type of fracture [1]. Multiple Chevron osteotomies are ideal to correct moderate sagittal plane deformities in the thoracic spine. However, a mobile anterior column is a prerequisite for the procedure, which often limits it to patients younger than 60 years. Complications of the procedure occur and lead to the need of re-intervention in up to 10% of patients. However, significant complications are seldom. The more severe is the deformity, the better are the chances to improve the patient [1].

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