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Pedicle subtraction osteotomy for postoperative flat back and sagittal imbalance

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Introduction

Treatment of fixed sagittal imbalance involves performing spinal osteotomies. One option is to perform multiple Smith-Petersen osteotomies (SPO). Another option is to perform a pedicle subtraction osteotomy (PSO), which usually achieves about 30° to 40° of lordosis. A variant of the latter procedure is to resect the disc space above (modified PSO). The first procedure (SPO) is indicated when the spine is flexible with partial reduction of the deformity through mobile segments (mobile intervertebral disc space); the second procedure (PSO) is performed when the spine is fused with no correction of the deformity in the recumbent position [1].

Case description

In this case a 72-year-old man, operated 3 years ago, with a posterior decompression and fusion from L2 to L5 is now complaining of sagittal imbalance and difficulties in walking.

Pelvic incidence is 52°, lumbar lordosis is 12°, pelvic tilt is 39°, sagittal vertical axis (SVA) is +9 cm and knee flexion is 26°.

As it is a fixed sagittal imbalance, a revision surgery with modified pedicle subtraction osteotomy at L4 was selected to increase lumbar lordosis with instrumentation from T10 to the pelvis.

Preoperative planning was made using the EOS 3D software. 3D modelling of the rigid spine with accurate measurement of the spinal and pelvic parameters enables us to define the amount of correction required at the osteotomy level, to obtain a balanced spine. It can also define, by geometrical measurements, accurate points above and below each pedicle corresponding to the level, where the osteotomes should be placed on the posterior wall to reach optimal correction [5, 6]. This distance between the upper and the lower point according to the centre of the pedicle is calculated in centimetres and can be defined preoperatively. In our case, this distance was defined as 2 cm on each side of the posterior wall. The goal of the osteotomy is to obtain a balanced spine with minimal hip compensation, normal or near normal pelvic tilt and extended knees.

Surgical procedure [2, 4]

The spine is exposed subperiosteally in a fashion similar to other posterior instrumented surgeries, going laterally to the transverse processes in the lumbar spine and to the costotransverse junction in the thoracic spine. A meningocele from the previous surgery at the L3/L4 level was noticed on the preoperative MRI and avoided during the approach, working around it progressively. Inferior facetectomy at all levels is performed bilaterally to provide maximum flexibility to the spine. The spinous processes

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are also resected, and the bone recovered prepared for use as a graft at the end of the procedure.

Pedicle screws are then placed across the deformity using the free-hand technique with two iliac screws for strong pelvic fixation and a claw construct made of two hooks (transverse process hook and pedicle hook) at the proximal part of the instrumentation. Both transverse processes of L4 are then cut at their bases using an osteotome to expose the lateral wall of the vertebra. Laminectomy of L4 is then usually performed, but in revision cases, opening of the canal is made progressively from lateral to medial keeping intact the posterior existing fibrosis. Two complete foraminotomies both cephalad and caudad to the pedicles on both sides are performed thus surrounding the pedicles. Both pedicles are then removed exposing the posterior wall of the vertebra. Two osteotomes are placed above and below each pedicle separated by the distance defined in preoperative planning. Cancellous bone is removed in a wedge fashion from posterior to anterior on both sides, as well as the disc above. The medial part of the posterior wall is finally removed. For the correction technique, firstly cantilevering of the spine with a pre-bent rod (6.32 titanium alloy) on one side is performed, and then closure of the osteotomy by compression at the PSO site is applied using a domino connector so that the rod is completely locked. A contralateral rod is placed and secured, two crosslinks are used to strengthen the construct, and the autologous graft is made for the postero-lateral fusion associated to bone morphogenic protein (BMP).

Postoperative information

The patient stands up at day 3 with X-ray control at day 6; a brace is needed for 3 months.

The postoperative X-ray shows an improvement in lumbar lordosis to 60°, pelvic tilt to 14° and SVA to +3 cm, knees are in extension.

Discussion and conclusion

The main problems of this procedure are: neurological deficit, which incite us to use routinely spinal cord monitoring, blood loss which should be controlled by haemostatic agents and packing, deep wound infection, pseudarthrosis and proximal junctional kyphosis [3]. The technique of modified PSO [4] permits single-stage correction from a posterior-only procedure and permits greater degrees of correction than that described for a standard pedicle subtraction osteotomy. It is highly effective in correcting fixed sagittal imbalance. It does not totally eliminate the need for anterior surgery especially in patients where it is performed through an area without prior fusion.

References

1. Bridwell KH (2006) Decision making regarding Smith-Petersen vs. pedicle subtraction osteotomy vs. vertebral column resection for spinal deformity. Spine 31(19 Suppl):S171–S178
2. Bridwell KH, Lewis SJ, Rinella A, Lenke LG, Baldus C, Blanke K (2004) Pedicle subtraction osteotomy for the treatment of fixed sagittal imbalance. Surgical technique. J Bone Joint Surg Am 86-A(Suppl 1):44–50
3. Bridwell KH, Lewis SJ, Edwards C, Lenke LG, Iffrig TM, Berra A, Baldus C, Blanke K (2003) Complications and outcomes of pedicle subtraction osteotomies for fixed sagittal imbalance. Spine 28(18):2093–2101
4. Boachie-Adjei O, Ferguson JA, Pigeon RG, Peskin MR (2006) Transpedicular lumbar wedge resection osteotomy for fixed sagittal imbalance: surgical technique and early results. Spine 31(4):485–492
5. Obeid I, Hauger O, Aunoble S, Bourghli A, Pellet N, Vital JM (2011) Global analysis of sagittal spinal alignment in major deformities: correlation between lack of lumbar lordosis and flexion of the knee. Eur Spine J 20(Suppl 5):681–685
6. Rose PS, Bridwell KH, Lenke LG, Cronen GA, Mulconrey DS, Buchowski JM, Kim YJ (2009) Role of pelvic incidence, thoracic kyphosis, and patient factors on sagittal plane correction following pedicle subtraction osteotomy. Spine 34(8):785–791