

## Operative therapy of spine deformities in Parkinsons disease

Werner Lack\*, Marc Lorenz\*\*, Josef Krugluger\*, Andreas Zeitelberger\*, Michael Nicolakis\*\*, Ronald.J.Sabitzer\*\*\*

### Abstract

**BACKGROUND CONTEXT:** Parkinson disease (PD) can cause several spine problems: Camptocormia („Bent Spine-Syndrome“), probably by paresis of back muscles, scoliosis (“Pisa-Syndrome”) and osteoporosis. According to literature 7% of Parkinson-patients develop a spinal deformity, especially in severe form and following spine-surgery.

**PURPOSE:** This paper regards the results of the operative treatment of spinal deformities in patients with Parkinson disease.

**STUDY DESIGN:** Retrospective observational study

**PATIENT SAMPLE:** 15 patients with deformities according to Parkinson-disease, 8 of them with previous operation; 10 female, 5 male patients, age 73 years (63-81), with a FU of 24 (12-66) months were retrospectively investigated; OP-indications were 5 kyphosis, 5 kyphoscoliosis, 4 kyphosis after vertebral body fracture and 1 scoliosis above a double-level instrumentation. All patients had a by neurologists approved diagnosis of Parkinsons disease.

### OUTCOME MEASURES:

Treatment consisted of 8 pedicle-subtraction-osteotomies L3 or L4 (PSO), in 4 cases combined with long posterior fusion of 9 (6-14) segments, 4 long-distance fusions and 3 anterior vertebral body resections with stabilization by cages and posterior instrumentation. Investigations were done using preop. Cobb-angle of kyphosis and scoliosis and VAS; OP-time; postoperative improvement of kyphosis and scoliosis, postop. VAS, postop. personal grade of satisfaction, complications and reoperations.

**RESULTS:** OP-time was 245 (160-380) minutes; correction of kyphosis in Camptocormia was 46° (15-84°), in vertebral fractures 22° (12-40°), correction of scoliosis was 15°(8-23°).

The subjective clinical results show 5 patients excellent, 5 good, 3 fair, 1 poor and 1 patient „lost in follow-up“; VAS preoperatively 8,4, at FU 3.

Complications were 1 complete painfree patient with motoric caudalesion in very slow regression with normal sensibility and bladder/bowel-function after PSO because of a fracture above instrumentation, 2 reversible weakness L4 and L5, 1 rod-loosening L5/S1, 1 vertebral fracture above, 3 fractures below, 1 implant-fracture, 1 psychosyndrome.

The following reoperations in 8/15 patients were necessary: 3 superior and 4 inferior elongations of fusion, 1 decompression, 1 change of loosened pedicle screw with anterior support by AxialLIF L3-S1, 1 change of implantation.

**CONCLUSIONS:** Operative treatment of Camptocormia by PSO and/or long-distance-compression-spondylodesis demonstrates in spite of a high complication- and reoperation rate satisfying results, as the preoperative state concerning pain, posture, neurologic problems and mobility of patients is very bad. In mobile curves progressing during the day the posterior long distance fusion is indicated; in rigid kyphosis PSO is the therapy of choice, eventually in combination with long distance posterior fusion. Short kyphotic deformity by

vertebral fracture demands anterior resection/decompression and cage-implantation in combination with posterior lordosation/instrumentation/fusion, optimally with cemented screws. To avoid problems of the L5/S1-segment additional anterior fusion (ALIF, PLIF or AxiaLIF) is recommended.

## Introduction

PD is the most common cause of disability in the elderly. Besides the well-known neurologic symptoms the disability can be caused by progressive spine deformity.

Camptocormia is defined as an abnormal, severe and involuntary forward flexion of the thoracolumbar spine, which becomes manifest during standing and walking and subsides in the recumbent position (1) in a prevalence of 6,9% (2), caused by weakness of abdominal and/or paravertebral muscles based on myopathy and not as a direct spine disease (1,3,). Besides kyphosis a scoliosis can be evident (3) with the side of the deviation correlating with the side of major symptoms. As a third factor for a possible development of deformity by fractures of the spine the prevalence of osteoporosis is high in PD (5). The significantly reduced trunk strength correlates with reduced bone mineral density in Parkinson patients (6).

In combination with the gait-disturbances and other neurologic problems these deformities can reduce the quality of life severely. They can cause severe back-pain, radicular pain, radicular motoric deficits and can make walking impossible. Conservative treatment is nearly without effect on the development of the deformity and cannot improve quality of life really; there is no specific pharmacologic treatment for primary axial myopathy (7). Deep brain stimulation is discussed controversially (8,9). Exercise treatment is recommended (10), but cannot really stop the progression of deformity.

Therefore in severe symptoms caused by Parkinson deformity surgical correction, decompression (if necessary) and fusion is the only treatment for regaining life quality.

## Patients and method

This is a retrospective study on 15 patients operated because of deformities according to PD between 2008-2014; gender-distribution is 10 female and 5 male; the average age at operation was 73 years (6-81), with a FU of 24 (12-66) months;

OP-indications were 5 patients with kyphosis, 5 with kyphoscoliosis (combination of Camptocormia and Pisa-sndrome), patient with scoliosis after a 2-level lumbar instrumentation and 3 patients with kyphosis after vertebral body fracture (L1-2, L4 and Th12-L2), the latter with the impossibility of sitting or standing because of pain and cauda paresis in these positions.

Previous operations in 8 patients were: 4 vertebroplasties, 3 decompressions, 2 dynamic instrumentations and 2 single-level-fusions. 7 patients had no previous operation.

Treatment consisted of 8 pedicle-subtraction-osteotomies (PSO), in 5 cases combined with long posterior fusion of 9 (6-15) segments, 4 long-distance fusions of av. 9 (5-15) segments and 3 anterior vertebral body resections with stabilization by cages and posterior instrumentation, 1 over 3 segments with anterior decompression. The posterior instrumentations after vertebral resection and cage implantation were performed with cemented pedicle screws. In 1 case of vertebral resection a posterior release had been performed.

All operations were performed using Neurovision neuromonitoring system.

In severe foraminal stenosis, degenerative spondylolisthesis and rotational instability an additional anterior fusion as PLIF or TLIF was performed.

Investigation was done looking at OP-duration, subjective clinical result ( excellent-excellent postural correction, very good improvement of pain, good-good postural correction, good improvement of pain, fair- long-during complication with either good postural correction or good pain improvement, poor-no improvement), VAS, correction of kyphosis correction of scoliosis in degrees according to Cobb, complications and reoperations.

## Results

Av. OP time was 245 (160-380) minutes.

Correction of kyphosis in camptocormia was 46° (15-84°!), correction of scoliosis 15° (8-23°).

Correction of kyphosis in case of osteoporotic fracture was 22° (12-40°).

Subjective results of the patients were: 5 excellent

5 good

3 fair

1 poor

1 lost in FU

VAS in case of higher-graded pain was preoperative 8,4, postoperative 3.

Complications (9) were:

- 1 very slowly recovering pain-free motor cauda lesion without sensoric deficit or loss of bladder/ bowel- function (caused by vertebral fracture at the cranial end of instrumentation)
- 2 reversible pareses L4, L5
- 1 rod-loosening at L5/S1
- 1 rod-luxation
- 1 cranial vertebral fracture
- 2 caudal vertebral fractures
- 1 postoperative psycho-syndrome

Reoperations (8/15 patients) were

- 2 cranial fusion elongations (1 with decompression)
- 4 caudal fusion elongation
- 1 decompression
- 2 screw-change with AxiaLIF L3-S1
- 1 screw-change
- 2 new instrumentations after rod luxation and rod fracture

## Discussion

Camptocormia in PD is based on neurologic and/or myogenic changes, but not with primarily changes in the spine itself like Bechterews disease. The EMG-pattern is similar to changes in myositis (10,11). Camptocormia occurs in severe PD with axial predominance, motor fluctuations and dysautonomic symptoms, often associated with spondylarthrotic changes and pain (12). This paper also confirms the hypothesis, that rigidity may induce spinal problems leading to a neurogenic syndrome via the compression of spinal nerves. Nallegowda et al (13) see the quantitative reduction of muscle strength in the spine, muscle and ankle, along with impaired proprioception, visual sense and smaller base of support as the main causes of postural instability in PD.

Interestingly Magnetic imaging demonstrates the result, that Parkinson with camptocormia may represent a selective form of this disease in which a specific neuronal dysfunction possibly occurs within the brainstem (14).

Besides hyperkyphosis lateral flexion (Pisa-syndrome) is relatively common in PD, divided in chronic and subchronic type (15).

Patients develop neuromuscular symptoms 2,7+/- years after onset of Parkinson's disease (16). Muscle biopsies in this study were all abnormal, demonstrating either necrotizing myositis, inflammatory myopathy or myopathy with mitochondrial abnormalities.

In addition kyphotic posture leads to further problems: the investigations of You et al. 2002 (17) indicates, that elderly forward bent walkers with limited spinal mobility and weakness of the trunk and hip muscles may have to rely on other non-contractile structures such as ligaments and joint capsules. Biomechanical data demonstrate a higher risk of vertebral compression fractures in pre-existing kyphosis due to biomechanical stress (18); Kamanli et al. find an increased risk for osteoporosis in elderly female patients with PD, which seems to be one of the main problems of this disease(19).

Conservative treatment of Camptocormia is difficult, as this deformity is not responsive to dopaminergic medication and the results of deep brain stimulation are reported generally as poor (20). A brace treatment for progressive deformity causes a rather severe decrease in life quality and cannot stop further deterioration. Some better results in combination with physiotherapy are reported by de Seeze et al. (21), but one should keep in mind, that even physiotherapy is difficult in a disease with pathologic patterns of the muscles.

The only valid therapy for Parkinson-deformities and vertebral fractures with kyphosis, severe pain and/or neurologic problems by cord or cauda compression due to osteoporosis in Parkinson remains the surgical decompression, correction and fusion, although spinal surgery in PD has a very high reoperation rate associated with technical complications (22, 23, 24). One of the problems in poor results of fusion in PD besides osteoporosis may be the fact, that in short constructions the underlying muscle pathology can lead to further deformity and problems of the nonfused areas. Therefore it should be considered to perform early long-distance fusions.

Nakashima et al. report 2009 on 3 cases of thoracolumbar vertebral body fractures in PD with osteoporosis; they treated by anterior decompression, anterior insertion of a titanium cage and posterior reconstruction using laminar hooks and pedicle screws with instrumentation from 2 vertebrae above and 1 vertebra below fracture; they had altogether sufficient results of all three patients, despite hard postoperative body cast; 2/3 cages demonstrated sinking of the cage (25). We have a similar approach to spinal compression fractures with or without PD and to other causes of anterior destabilisation and cord compression. In our opinion anterior decompression is the best technique for cord or cauda equina problems in kyphosis, both theoretically (compression takes place from anterior) and practically, as we had no single case of neurologic deterioration in all indications (fractures, infectious diseases or tumours). Recovery of neurologic deficits took place much faster in cases of anterior compression treated by anterior decompression than in the majority of other cases of decompression (laminectomy, laminotomy, foraminotomy...) in spinal surgery.

On the other hand the results of Nakashima et al. confirm us to perform a posterior fixation 3 levels above and 2 levels below using cemented screws in cases of severe osteoporosis in fractures with anterior decompression/resection/cage (26). We did not use a postoperative brace fixation, which especially in this group of patients causes often severe walking

problems, nevertheless we had no sinking of cages postoperatively. In generally there is no real disadvantage of fusing three levels above in the thoracic spine; if the fractures concern levels below L1, fixation of 2 levels below can cause problems in the future; in such cases we

would nevertheless prefer fixation 2 levels below, but fusion only 1 level, removing implants at the second level 6-9 months later. In no case we would recommend fusion down to L5 without fixation of the sacrum.

In mobile kyphotic deformities increasing during the course of the day with the possibility of passive correction a long distance posterior fusion can restore position of spine and reduce thoracolumbar pain. In the majority of cases fusion down to the sacrum is necessary to avoid caudal adjacent disc disease. Bourghli et al. report very satisfying results with posterior T2-sacrum-fusions in these cases (26). In long-distance fusions of the spine there exists a high danger of pseudarthrosis in the lumbosacral motion segment, especially in patients older than 55 years and with thoracolumbar kyphosis (27); this can be avoided either by the technically rather difficult Galveston-technique incorporating the rods into the pelvis, by special screw-constructs at the sacrum or by additional anterior (intervertebral) fusion, either by ALIF, PLIF or TLIF; the most stabile intercorporeal fixation and fusion is AxiaLIF (28, 29).

In patients with fixed deformity an operative correction of kyphosis is necessary, in most cases by pedicle subtraction osteotomy. PSO is a rather invasive operation with a relatively high complication rate (30), but has no real alternative in rigid severe kyphotic deformity; in severely increased rigid kyphosis and Pisa-syndrome a combination of PSO combined with long distance posterior spondylodesis is necessary. A PSO should regain correct lumbar lordosis, we have never seen an overcorrection in all our cases.

Alltogether we recommend an early operation avoiding fixed deformities, as this can reduce complication rate of osteotomies significantly; it is also technically less demanding to achieve a correct spino-pelvic balance with lumbar lordosis and global sagittal alignment, which are necessary for a satisfying result(31).

Possible neurologic complications by pedicle screws, during pedicle removal and especially during lordosation can be avoided using a neuromonitoring system, which we do for five years in very lumbar operation with pedicle screws (32).

## Conclusion

Operative treatment of Camptocormia by PSO and/or long-distance-compression-spondylodesis demonstrates in spite of a high complication- and reoperation rate satisfying results, as the preoperative state concerning pain, posture, neurologic problems and mobility of patients is very bad. In mobile curves progressing during the day the posterior long distance fusion is indicated, in most cases down to the sacrum in different techniques of intercorporeal fusion or Galveston technique; in rigid kyphosis PSO is the therapy of choice, eventually in combination with long distance posterior fusion. Short kyphotic deformity by vertebral fracture demands anterior resection/decompression and cage-implantation in combination with posterior lordosation/instrumentation/fusion, optimally using cemented screws, with posterior instrumentation 3 levels above and two levels below. To avoid problems of the L5/S1-segment additional anterior fusion (ALIF, PLIF or AxiaLIF) is recommended.

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