Basic Degenerative Lumbar Scoliosis

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13.1 Introduction

Degenerative lumbar scoliosis (DLS) or "de novo scoliosis" represents a pathological condition associated with rotational subluxation and anteroposterior or lateral olisthesis leading to coronal deformity [22]. DLS is defined as a coronal Cobb angle of more than 10° but rarely exceeding 50° [1, 12]. The etiological progress is multifactorial and still unclear but starting with intervertebral disc degeneration, facet joint degeneration and changes in canal as well as pedicle morphology [15, 25]. The scoliotic curve typically develops in the fifth decade of life and is not based on idiopathic adolescent scoliosis (AIS). Life time prevalence is between 8–13% increasing with age, so that the prevalence in the sixth decade of life rises up to 60% with women being more frequently affected than men [3, 5, 7, 8, 26, 27]. In contrast to patients with AIS, the clinical symptomatology in DLS patients is usually characterized by low back pain, neurogenic claudication associated with neurological deficits in the lower extremities and rarely cauda equina syndrome. The spinal deformity shows a mean annual curvature progression in the coronal plain of 3–4°, although the progression does not translate linearly, so that the prognosis which curve is progressing cannot be reliably predicted [16]. Nevertheless, the literature provides evidence, that increased intervertebral disc degeneration, lateral translation >6 mm and an intercrest line through the L5 vertebra may be considered as progression factors of these coronal deformities [6]. The majority of DLS show an accompanied segmental kyphosis resulting in moderate or severe sagittal imbalance [5, 8, 26]. As a result, a classification system of degenerative disc disease based on the distribution of the diseased segments and the balance status of the spine has been generated to guide the treatment of DLS [2]. Therefore, the treatment of DLS patients is characterized by a wide variability of surgical options ranging from simple lumbar nerve root decompression to complex thoracolumbar fusions with sagittal deformity corrections. The surgical treatment is even more complex due to the accompanied comorbidities associated with the increased age in DLS patients.

This chapter will capture the essentials of degenerative lumbar scoliosis, the clinical presentation, the indications and the surgical approach.

13.2 Case Description

A 67 year-old female patient presented with severe back pain for years and she complained about new right-sided radicular pain in the lower

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extremities for about 4 months (NRS, Numeric rating scale 7/10). The patient suffered from neurogenic claudication with a walking distance of less than 300 metres. Conservative treatment including pain therapy, physical therapy as well as behavioural therapy was undertaken with only minimal and short-lasting improvement. Preoperative long-standing lateral and anteroposterior as well as conventional lumbar x-ray images revealed a degenerative left convex lumbar scoliosis with the apex at the L3/L4 motion segment (Fig. 13.1). The end vertebrae were identified at the levels L2 and L5 (Fig. 13.1). The coronal profile showed a Cobb angle of approximately 27° with an apical and segmental Cobb angle of the motion segment L3/L4 of approximately 17° accompanied with a rotatory subluxation (Fig. 13.1). A compensatory right thoracic curve was observed without any pain or discomfort at this region (Fig. 13.1). The sagittal profile was appropriately aligned with a lumbar lordosis (LL) of approximately 37°, a pelvic incidence (PI) of 45° with a corresponding pelvic tilt (PT) of 20° and a sagittal vertical axis (SVA) of <30 mm. According to the proposed classification systems to evaluate the sagittal profile, PI and LL did not differ much. Nevertheless, for patients with low PI the authors recommend a LL in the range of PI plus 10° (PI of 45°, type B or type 2 according to the classification system of LeHuec and Roussouly, respectively) [10, 17, 20]. The motion segment of the level L3/L4 showed a collapsed neuroforamen on the right side with L3 and L4 radicular pain without motor deficits caused by the right concave degenerative lumbar curve (Fig. 13.2). Magnetic resonance imaging (MRI) revealed central canal stenosis at the level L2/L3 and predominantly lateral recess stenosis at the level L3/L4 (Fig. 13.3). Adequate decompression followed by dorsal pedicle screw

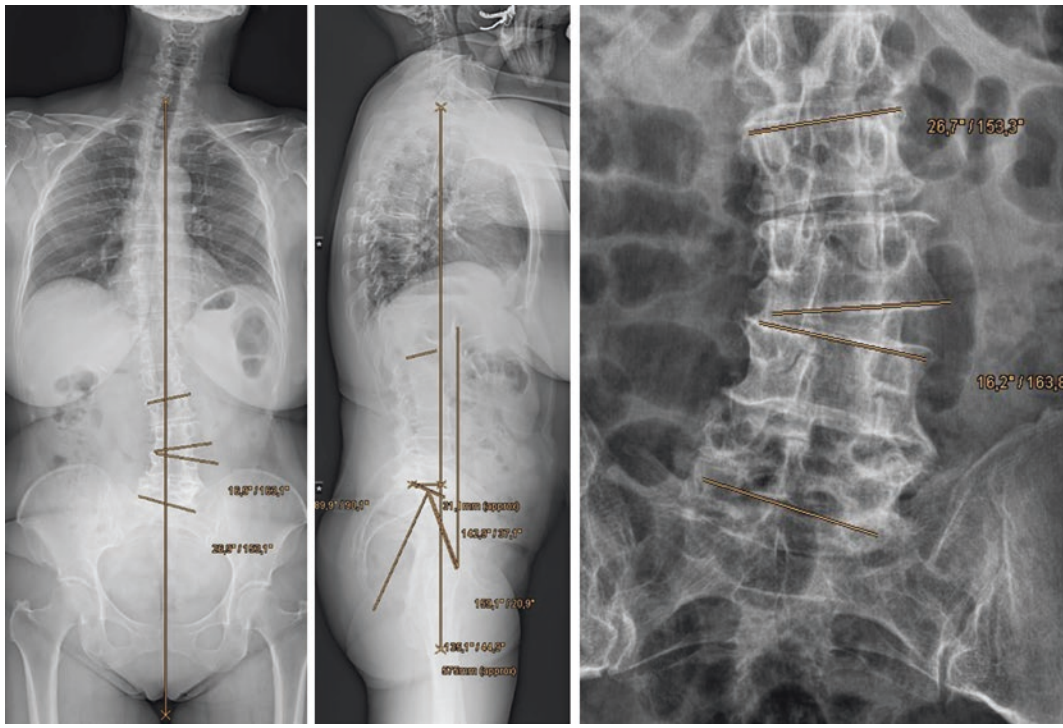

Fig. 13.1 Preoperative long-standing lateral and anteroposterior plus conventional x-rays. Preoperative coronal and sagittal x-ray with degenerative coronal malalignment. The coronal Cobb angle demonstrated a degenerative lumbar scoliosis of 27° with a corresponding apical and segmental Cobb angle of 17° (L3/L4). Sagittal balance analysis revealed an aligned profile identified as a LL of 37°, a PI of 45° with a corresponding PT of 20° and a SVA of <30 mm

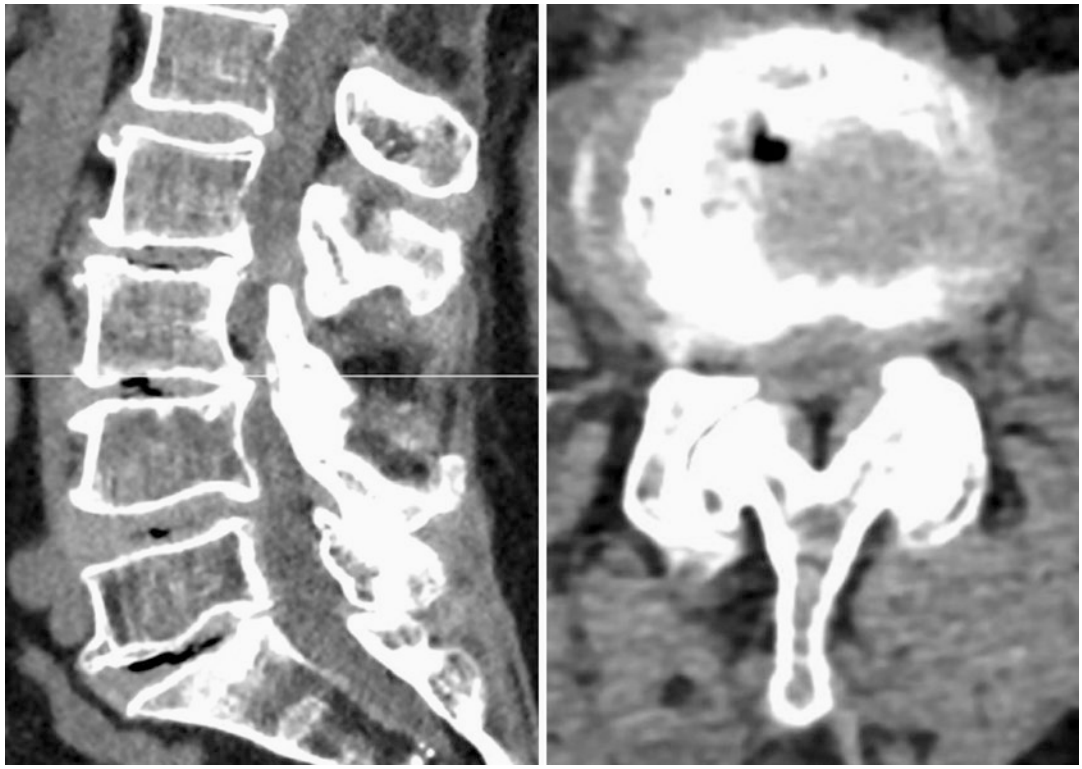

Fig. 13.2 Preoperative CT. A collapsed right-sided neuroforamen was seen at L3/L4 with a central and right-sided lateral recess stenosis aggravating the L3 and L4 radicular pain of the patient. The apex of the scoliotic curve was located at the segment L3/L4 with the end vertebrae L2 and L5 cranially and caudally

instrumentation L2–L5 with TLIF cage implantation at L2/L3, L3/L4 and L4/5 was performed. Smith-Peterson osteotomies were additionally carried out at L3/L4 and L4/L5 with derotation manoeuvres to realign the coronal profile (Fig. 13.4). Surgery was uneventful and the patient was discharged after 7 days.

During the postoperative inpatient stay, no additional brace was used and the patient was sent to physiotherapy daily. NRS improved to 5 after surgery and to 3 and 1 after 3 and 12 months, respectively. The walking distance improved to approximately 3000 metres and 6000 metres after 3 and 12 months. Routine postoperative radiological follow-up did not reveal any signs of implant-related complications, adjacent segment disease or proximal junctional kyphosis (Fig. 13.4). The LL improved to approximately 45° and the coronal Cobb angle to 8°.

13.3 Discussion of the Case

DLS is predominantly affecting the aging population and results in asymmetric degeneration succeeding in rotatory subluxation of functional spinal units of the lumbar spine [1]. Asymmetric degenerative lumbar changes caused by intervertebral disc and facet joint degeneration leads to a coronal plane deformity with lateral slippage. These degenerative changes often occur as a focal deformity including one motion segment at the mid portion of the lumbar spine (L3/L4 and L4/L5) with progressive degenerative changes adjacently. At first, the patients experience low back pain. Due to the coronal deformity, the convex curve opens the contralateral neural foramen and causes radiculopathy at the concave exiting nerve root [11]. In some cases, however, the degenerative changes affect multiple motion

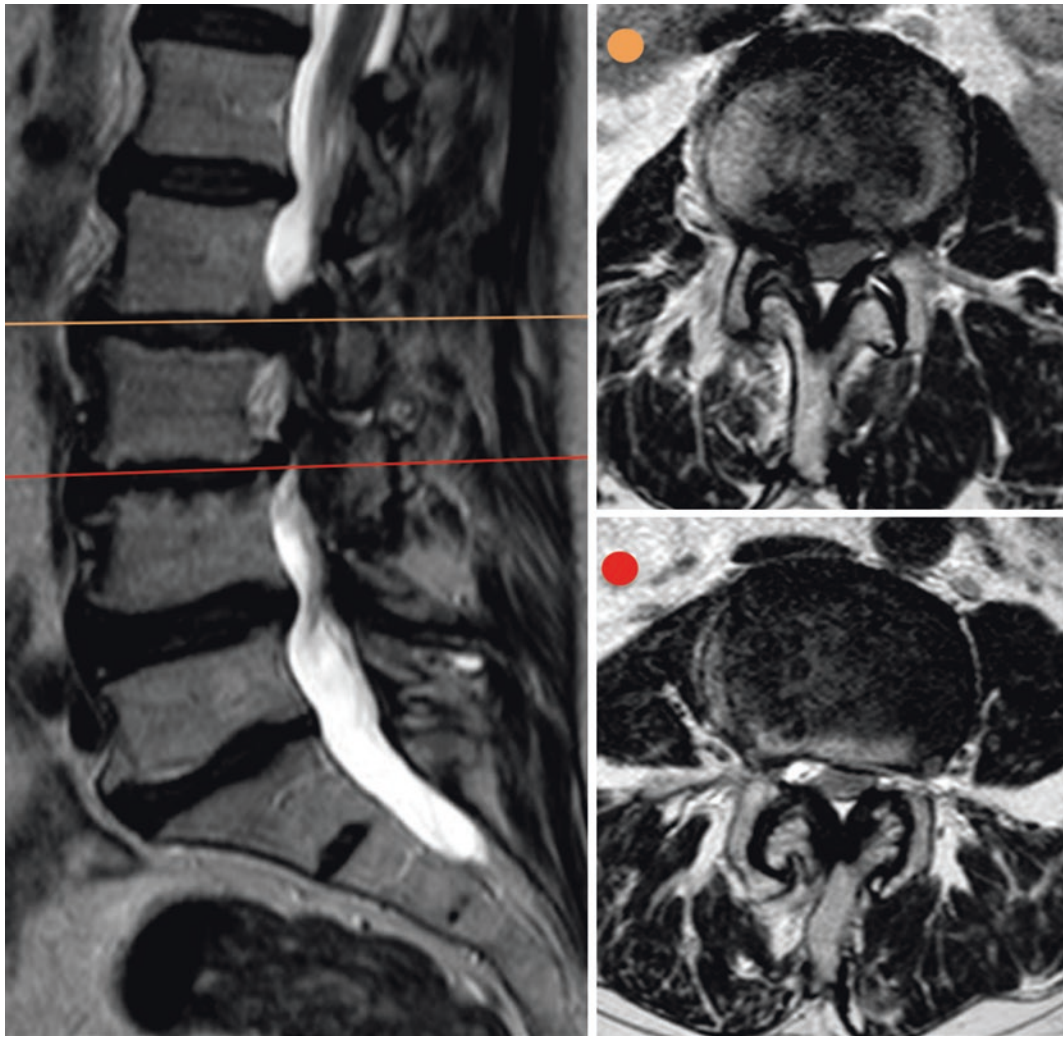

Fig. 13.3 Preoperative MRI. MRI confirmed a central and lateral canal stenosis at the levels L2/3 and L3/4, respectively. Additionally, the facet joints at these levels demonstrated effusion and pronounced hypertrophy

segments, so that extended lumbar curves with both sagittal and coronal deformities are present. DLS leads than to a significant reduction of quality of life with a high "burden of disease" level. Nevertheless, the first treatment steps for symptomatic adult degenerative lumbar scoliosis are non-operative involving pain medication, injection therapies and physical therapy. In case of refractory symptoms, a bundle of different surgical options is available. The surgical options largely depend on the clinical presentation of DLS, so that simple and potentially minimally invasive decompression procedures may be feasible in patients with predominantly claudicative symptoms.

In patients with multisegmental sagittally and/or coronally decompensated curves, the procedures might be expanded to long instrumented fusions including correction manoeuvres in both planes [2, 4, 23, 24]. Osteotomies, anterolateral approaches or combined procedures allow the surgeon to increase the degree of correction, however, the complication rate is simultaneously rising with this complex surgical armamentarium. The overall complication rate of DLS patients treated surgically has been

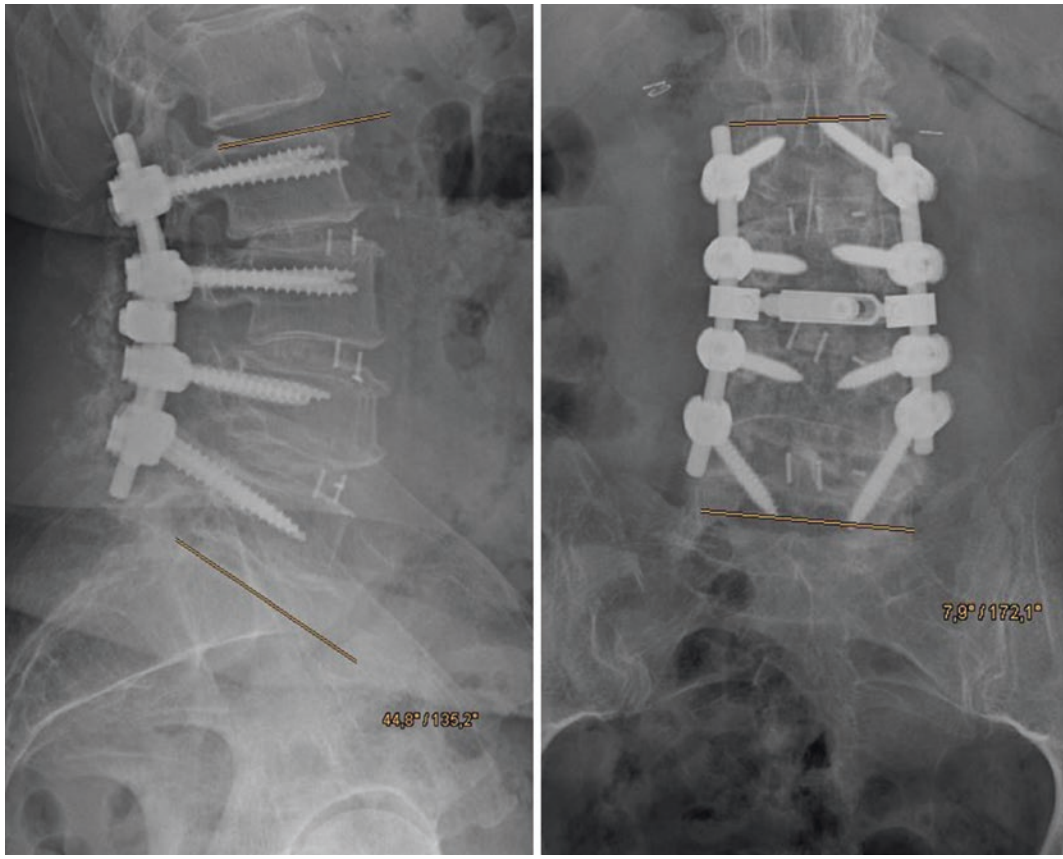

Fig. 13.4 Postoperative lateral and anteroposterior x-ray. Postoperative sagittal and coronal scans showed an improvement of LL to 45° and the coronal alignment improved to a Cobb angle of 8°. No signs of implant-related complications, adjacent segment disease or proximal junctional kyphosis were observed on follow-up, but there was some retrolisthesis at L2/L3

estimated at approximately 40%, and more than half of these patients required revision surgery for both mechanical as well as neurological complications [4]. In patients requiring osteotomies these rates are even higher. The number of instrumented vertebrae, extended fusions to the sacrum, osteotomies and a preoperative pelvic tilt over 26° have been determined as risk factors [4]. Due to the associated complication rate, however, short fusion techniques may be favoured over long constructs, especially in older patients with cardiovascular comorbidities, obesity or osteoporosis [9, 14]. All this complicates the treatment of DLS patients and questions whether surgical therapy should be performed at all and, if so, what surgical option should be used to improve the coronal and sagittal profile. To help choosing the appropriate surgical strategy, a bundle of classification systems is available. Berjano and Lamartina published a classification system based on the distribution of the symptomatic segments and the spinal alignment [2]. The authors describe the apical area of the patients' degenerative scoliotic curve as the apex of the main curve, a vertebra or a disc level (in the case presented L3). The end area is defined as the non-apical area adjacent to the end vertebra of the main lumbar degenerative curve. As a result, four types can be distinguished and the invasiveness of the surgical procedure increases from type 1 to type 4.

Other classification systems differentiate the etiological characteristics of the spinal deformity or morphological aspects based on the

surgical outcome. The background of Aebi's classification system describes the cause of the deformity and Schwab's classification deals with the severity of the curve. The information to identify candidates for selective fusion based on the distribution of the symptomatic segments and the spinal alignment is still lacking [2, 13, 18, 19, 21].

13.3.1 Accordance with Literature Guidelines

The management of DLS patients remains an individual patient to patient decision. New surgically based classification systems have been published to aid in selecting the extent of the required procedure.

Level of Evidence: B to C
The level of evidence available is poor to moderate.

13.4 Conclusion and Take Home Message

The decision-making progress in the management of DLS patients is based on several factors including the clinical presentation, the age of the patient, the associated comorbidities and the spinopelvic sagittal and coronal alignment. Current classification systems may help surgeons to determine the invasiveness of the procedure based on the distribution of the symptomatic segments and the spinal alignment. Nevertheless, in view of the overall high complication and reoperation rates of adult deformity surgery, the invasiveness of the surgical procedure (simple decompression, instrumented fusion or osteotomies) should be determined critically. Overall, however, outcome is surprisingly good and patient satisfaction high, if patients are selected carefully.

Pearls

- Evaluate associated comorbidities to anticipate a potentially high complication rate especially in older patients
- Identify the affected and symptomatic segment(s)
- Reserve surgery after failed conservative treatment
- Always take the spinopelvic alignment into account
- Use classification systems to identify the cause and the severity of the deformity and use them to determine the invasiveness of the surgical procedure.
- Prefer simple decompression procedures to (multisegmental) instrumented fusion in case of predominant neurogenic claudication
- Long-term outcome seems to favour surgery over non-operative care

Editorial Comment
Lumbar degenerative scoliosis is a topic which is dominated by firm beliefs and strong opinions of experts, but almost no sound evidence at all. Therefore the decision making puts one everytime "between a rock and hard place". This chapter illustrates very well all the difficulties in that respect and the solution for this case worked well, for the time being one may add. Everything surrounding this difficult field is further elaborated in chapters 54–58 and 78 of the advanced modules. For the time being the message is, that whatever you do has disadvantages, like the high likelyhood of early adjacent segment degeneration and reoperation with this solution.

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