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ABSTRACTS

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ORAL COMMUNICATION

1

IDENTIFICATION AND MANAGEMENT OF INTRAOPERATIVE NEUROPHYSIOLOGICAL ADVERSE EVENTS IN PAEDIATRIC VERTEBRAL COLUMN RESECTION SURGERY WITH COMPLEX PATHOLOGIES. ARE THE RECOMMENDATIONS PROVIDED BY SOCIETIES USEFUL? PROSPECTIVE COHORT STUDY

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Three-column osteotomy spinal surgery serves to correct severe deformities, as revision surgery and for the resection of congenital anomalies. This intervention is associated with high-risk of developing neurological lesion. The goal of this work is to assess three-column osteotomy surgeries, describe the neurophysiological adverse events, their management following the recommendations of the Spanish Spine Society (*GEER*), and the final clinical impact. We aim to determine differences between revisions versus primary surgeries.
Materials and methods: Prospective cohort study that included 27 patients who underwent complex spinal surgery during 2017 and 2018 in a single centre and by the same surgeon. We analysed the types of deformities, performed interventions (primary or revision surgery), existence or not of neurophysiological events, and final clinical outcome.
Results: Patient mean age was 10.6 years (51.9% female). Most common pathologies were congenital at thoracolumbar level, followed by thoracic and congenital kyphosis, comprising 70.3% of all the pathologies that required intervention. Neurophysiological events occurred in five cases and the recommendations protocol provided by the *GEER* was followed. From these five events, clinical consequences were observed a posteriori in two cases, from which one completely recovered and the other underwent progressive partial recovery. In one case, the neurophysiological control was completely normal but in the postoperative period, the patient develops foot dorsiflexion, probably related with an epidural hematoma that required reoperation.
Conclusions: Surgery of complex spinal deformity associates with high-risk of morbidity. To follow an action protocol in case of a neurophysiological event helps prevent or reduce possible clinical compromise a posteriori. It is important these techniques to be performed by expert hands with a learning curve to minimize the risk of neurological lesion, which has relevant consequences on this population.
In our series, intraoperative events were more frequent in revision surgeries; however, both postoperative deficits were documented in primary surgery.
GEER recommendations were useful for the intraoperative management of these alerts.

	n	%
Deformity		
Congenital kyphosis	6	22.2
Hemivertebra T	6	22.2
Hemivertebra TL	7	25.9
Multiple surgery EOS	4	14.8
Congenital CT	2	7.4
Hemivertebra T and L	1	3.7
Marfan syndrome	1	3.7
Type of surgery		
Osteotomy and long fixation	13	48.1
Hemivertebrectomy and short fixation	14	51.9
Neurophysiological event		
None	22	81.5
Altered	5	18.5

EOS early-onset scoliosis

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TWO-STAGE INSERTION OF MAGNETICALLY CONTROLLED GROWING RODS FOR THE MANAGEMENT OF SEVERE EARLY-ONSET SCOLIOSIS

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Introduction: The management of early-onset scoliosis (EOS) is a challenge. Despite the development over the last years of magnetic growing rods (MCGR), the rate of reoperation due to instrumentation failure remains to be high. Aiming to reduce these errors, we have designed new strategies such as a two-stage insertion of MCGR combined with a period of halo traction. The goal in this work is to report our results and establish the indications to be followed for this technique.
Methods: Seventeen patients with severe EOS who underwent two-stage insertion of MCGR with a minimum two-year follow-up were included in this study. In the first stage, anchors and halo were implanted followed by a period of halo traction. In a second stage, the MCGR were inserted. X-ray Images, complications, and indications were retrospectively collected.
Results: Indications for this procedure were as follows: short trunk (T1T12 shorter than 150 mm) in six patients, five patients with low bone density, three patients with past anchoring failures and three patients presenting rigid curves. Mean hospitalization length of stay was 87.5 (120–59) days. Mean Cobb angle correction was 49.2% (13.2–60.2). Thoracic kyphosis was corrected 18.1° (− 15° to 74°), the T1–T12 height increased 22.6 mm (0–61), the T1–S1 height increased 45.4 mm (12–109). There were 11.7% of complications, including a broken rod in a patient with Proteus syndrome and the loosening of a cephalic anchor that required revision. No infections were observed nor neurological complications related to the traction.
Conclusions: Although MCGR are well known for treating EOS, new strategies have been developed aiming to reduce associated complications. Here, we present a new strategy to help reduce the risks in patients with short trunk, low bone density, rigid curves, hyperkyphosis, and past instrumentation failures. According to our results, two-stage MCGR combined with halo traction provides good outcomes with improvement of the Cobb angle and of the T1T12 and T1S1 height with low rate of complications. To date, this is the first work in which indications and results of this technique are reported.

3

PRELIMINARY RESULTS AND COMPLICATIONS OF NINE CONSECUTIVE PATIENTS TREATED WITH MAGNETIC RODS AND BILATERAL PEDICLE INSTRUMENTATION

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Introduction: Early-onset scoliosis (EOS) is difficult to treat. When left untreated it causes serious anomalies and complications. Guided growth systems are the surgical treatment of choice for most patients with this condition. Constructions using magnetic bars are the current alternative with the advantage of avoiding the complications associated to multiple interventions.
Objectives: To present the results and complications of a series of patients who underwent treatment with a guided growth system using magnetic bars and fixation with pedicle screws.
Materials and methods: We retrospectively assessed the results and complications of the surgical treatment of a consecutive series of patients diagnosed with EOS. All patients underwent treatment with guided growth systems and one magnetic bar was used. Proximal and distal fixation was performed with bilateral pedicle screws at two or three levels depending on bone quality. All the patients were treated by the same surgical team.
Results: We assessed nine patients (seven girls and two boys). Mean age: 7.6 years. Etiology, three SMA, two ECNE, two myopathies, two syndromic. Mean follow-up: 1.5 years (4 months–3 years). Preoperative angular value: 74.8° (62–89°), 32° (22–43°) in the immediate postoperative period and 34° at the end of follow-up. Average distraction interval: 4.8 months. Average number of distractions: 2.8 (1 to 11).
Complications: One beakage of a 4.5 mm bar at 1.6 years of follow-up. One intraoperative failure of the manual distractor. In four occasions, the remote distractor indicated failure before termination of the elongation. No elongation of the system was observed with two bars. In none of the patients, the achieved distraction was the expected one.
Conclusions: There were no complications related with the fixing using bilateral pedicle screws. The use of one bar helps minimize problems of skin coverage and reduces costs. We advise against the use of 4.5 mm bars. Mechanical failures associated with the system are rather frequent. The use of one bar reduces to half the chance of the system to work incorrectly.

4

THE EFFICACY OF PREOPERATIVE HALO TRACTION IN SURGICAL TREATMENTS OF ANOMALIES

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Introduction and objectives: The treatment of severe anomalies is a difficult task frequently requiring aggressive techniques such as vertebral column resection and osteotomies, with high prevalence of comorbidities.
Progressive correction using cranial halo traction with weight is a gradual procedure that improves the deformity of the spinal column and may facilitate the subsequent isolated corrective surgery.
The aim of this work is to assess and quantify the efficacy of preoperative halo traction with constant gravity and the safety of this procedure.

Materials and methods: Retrospective cohort clinical study of a series of consecutive clinical cases on 37 patients with severe spinal anomalies to whom traction was applied before surgery. Minimum follow-up of 2 years. The following variables were collected and analysed: demographic, clinical, regarding the halo (duration of preoperative traction and applied traction), radiological (coronal Cobb angle, sagittal Cobb angle), and complications. Radiological variables were measured before and after placing the halo, and at the end of the halo traction period, after the surgery and at the end of follow-up.
Results: The most frequent aetiologies were syndromic (13 patients), neuromuscular (10 patients), idiopathic (seven patients) and congenital (seven patients). In 17 cases before primary surgery and in 20 cases before revision surgery. 57% ASA III and 43% ASA II. Mean preoperative Cobb angle was 88° (range, 12–135); after the halo a 34% mean correction of the deformity was achieved ($p < 0.05$). After the surgery, this correction improved, although at 2 years of follow-up there was a 20% loss of the correction ($p < 0.05$). There were three complications (8.1%): two infections of the pins and a cervical subluxation.
Conclusions: Halo traction of severe rigid anomalies is useful as it allows correcting 34% of the deformity preoperatively, making the surgery easier. In this series, the majority had severe kyphoscoliosis, most of which had underwent previous surgery. During follow-up, there was a 20% loss of correction particularly in patients with kyphosis.

Measured parameter	Preoperative (mean ± standard deviation)	Postoperative (mean ± standard deviation)	Postoperative in last measurement (mean ± standard deviation)
Cobb angle (°)	34.95 ± 9.44	7.32 ± 6.04	10.47 ± 8.13
Sacral slanting (°)	7.58 ± 5.99	3.32 ± 3.67	4.16 ± 4.45
Low back pain lordosis (°)	41.56 ± 11.35	38.00 ± 11.28	42.05 ± 9.08
Thoracic kyphosis (°)	35.32 ± 14.23	33.74 ± 9.53	31.58 ± 11.17

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IS HEMIVERTEBRA RESECTION FOR CONGENITAL SCOLIOSIS THE DEFINITIVE TREATMENT?

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Introduction and objectives: Hemivertebra is a common cause of congenital scoliosis. One of the most widely used therapeutic strategies for treating this type of scoliosis is early hemivertebra resection and short instrumented fusion to help prevent the progression of the deformity. Thoracolumbar cases are more problematic due to their location and stress forces.
Here, we aim to determine the long-term development, curve progression, and other possible complications in patients who undergo hemivertebra resection due to congenital scoliosis.
Materials and methods: Retrospective study with prospective data collection and analysis (2010 to 2018). Nineteen patients with mean age of 5.4 years underwent posterior approach thoracolumbar hemivertebra resection and selective instrumentation with a minimum follow-up of 1 year.
Results: Mean follow-up was 48.1 months. Mean preoperative Cobb angle was 34.95°, 7.32° postoperative and 10.47° in the last follow-up. The correction In the last follow-up was 69.61%. Mean correction of sacral slanting was 4.26°. At the sagittal plane, mean preoperative thoracic kyphosis was 35.32°, postoperative of 33.74° and 31.58° at the last control, as well as a preoperative mean low back pain lordosis of 41.56°, 38.00° immediately after the intervention and 42.05° at the last control.
Conclusions: Posterior approach thoracolumbar hemivertebra resection with selective instrumentation provides a satisfactory correction at sagittal and coronal planes. However, in three cases there was an increase of the primary curve at the coronal plane, as well as two instrumentation failures. These complications occurred in the eldest patients of our series and no relationship was determined with lower correction of the sacral slanting. These results suggest that the follow-up of patients with congenital scoliosis who undergo posterior approach hemivertebra resection should continue until final growth.

6

EFFECT OF MONONUCLEAR CELL THERAPY ON RABBIT DISC DEGENERATION

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Objectives and introduction: Disc degeneration is part of the aging process and involves loss of structural, biological, and biochemical properties. Several biological treatment models have been proposed as new technological options. In this work, we aim to assess the effect injections of autologous bone marrow-derived mononuclear cells have on the fibrous ring of the intervertebral disc at histological level after causing an experimental lesion.
Methods: Thirty-two New Zealand rabbits underwent intervertebral disc punching, followed by an injection of iliac crest mononuclear cells or saline solution as follows: 2 months after the lesion, 2 weeks immediately after the lesion, and without inducing degeneration. Two months after the cell therapy, the animals were euthanized and collagen changes of the intervertebral discs were assessed histologically.
Results: We observed significant differences in the external layer of the fibrous ring between the group of animals who received mononuclear cells injections versus saline solution at 2 weeks ($p = 0.018$). This difference was due to an increase of type I collagen for the mononuclear cells group (56.7%) in comparison to the group who was given saline solution (13.28%).
Conclusions: Treatment with mononuclear mesenchymal stem cells reduces changes in the distribution of types I and II collagens in the rabbits 2 weeks after inducing the degeneration.

7

UPDATE ON CUSTOM-MADE 3D PRINTED TITANIUM IMPLANTS FOR ANTERIOR COLUMN RECONSTRUCTION FOLLOWING *EN BLOC* RESECTION OF SPINAL TUMOURS

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Introduction: Reconstruction of a segmental defect after *en bloc* resection of spinal tumours requires immediate stability and subsequent solid fusion. In this work, we aim to update the results of the ongoing studies on 3D printed custom-made implants for anterior column reconstruction.
Materials and methods: Anterior column reconstruction was performed using 3D printed custom-made implants on 18 patients submitted to *en bloc* resection due to spinal tumour between November 2015 and December 2018 in a single institution. Resection was planned following the Enneking and Weinstein-Boriani-Biagini staging system. Implants were designed according to the preoperative planning of the resection on a CT-scan.
Results: The average follow-up was 22 months (range 2–35). One major mechanical complication occurred and one implant had to be replaced due to recurrence of the disease. Mechanical complications consisted in a massive subsidence into the adjacent vertebral body with development of progressive distal junctional kyphosis. Critical analysis of the construct revealed insufficient posterior instrumentation, although the custom-made implants *per se* did not show postoperative mechanical complications (implant breakage or migration). However, the surgical revision of the construct was considered a major mechanical complication. The removed implant was processed and sectioned for histological examination revealing new bone formation within the implant.
Conclusions: Custom-made 3D printed titanium implants seem to be a viable option for restoring the anterior column after *en bloc* resection of a spinal tumour. Longer follow-ups are needed to obtain fusion rates and long-term complication rates.

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RELATIONSHIP BETWEEN INTERVERTEBRAL DISC DEGENERATION AND OBESITY: ROLE OF LOW-GRADE CHRONIC INFLAMMATION

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Introduction: Intervertebral disc degeneration (IVDD) is a multifactorial disorder characterized by metabolic and structural alteration of all their components. Despite its high prevalence, IVDD is an orphan disease regarding efficient therapeutic options. Obesity and associated low-grade chronic inflammation are risk factors for IVDD; however, the mechanisms are still not fully understood. In this study, we aim to assess the differential expression of pro-inflammatory mediators in primary cells of intervertebral discs from healthy humans [nucleus pulposus (NP) and annulus fibrosus (AF) cells] against the primary cells of a degenerated disc and IL-1β stimulated immortalized human nucleus pulposus cells [HNPSV-1].
Materials and methods: Primary disc cells were obtained from degenerated human intervertebral discs during circumferential fusion (Pfirrmann degeneration grades 6, 7 and 8) or healthy intervertebral discs from the corpse of a donor, who had previously given informed consent. The HNPSV-1 nucleus pulposus cell line was obtained from the laboratory of Dr Daisuke Sakai (Tokai University, Japan) with whom we have a collaboration. mRNA expression of diverse inflammatory factors, specifically NOS2, COX2, IL-6, IL-8, TNF-α, VCAM-1 and MMP13, was determined by RT-qPCR using the comparative ddCt method.
Results: IL-8, VCAM-1 and MMP13 expressions increased in the HNPSV-1 nucleus pulposus cell line when stimulated by IL-1β. Similar results were obtained in human cells from degenerated human intervertebral discs, with increasing expression of NOS2, COX-2, IL-8 and VCAM-1 after IL-1β treatments. Furthermore, human degenerated intervertebral disc cells showed higher levels of NOS2 and TNF-α expression in comparison to cells in the nucleus pulposus or the annulus fibrosus from healthy discs.
Conclusions: This study clearly shows that intervertebral disc degeneration associates to the increase in the expression of inflammatory and catabolic factors. Moreover, the results obtained in immortalized human nucleus pulposus cells suggest that the associated inflammation may have an important role in intervertebral disc degeneration.

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MEASURING THE WIDTH OF VERTEBRAL PEDICLES OF THORACIC AND LOW BACK PAIN USING MULTI-SLICE COMPUTED TOMOGRAPHY. STUDY OF THREE HUNDRED AND FORTY VERTEBRAE

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Objectives: To quantify the width of thoracic and low back pain pedicles in normal spines and establish a preoperative protocol using multi-slice computed tomography.
Introduction: Transpedicular instrumentation is a widely used method in spinal surgery. Biomechanical studies show that pedicles are very strong anatomical structures. It is known that their width varies between vertebrae. The morphometric characteristics of the pedicles determine the size of the screws. Determine pedicle width in preoperative planning is essential to make the instrumentation less complex and prevent transoperative complications or reoperation to relocate the implant.

Materials and methods: Three hundred and forty vertebrae were examined in twenty male and female patients without spinal disorders aged between 21 a 60 years. Images were obtained using computed tomography with 16 detectors and multiplanar reconstruction; in the bony window, before identifying the main axis of the pedicle, in the pedicle isthmus a thin measurement line passes between the external corticals; the measurement is expressed in millimetres with one decimal place. A radiologist performed the measurements and the data were confirmed with another radiologist. A spine surgeon validated the data. Descriptive statistics was done with the mean test.
Results: In males T4 to T5, females T3 to T9 the width of the pedicle were under 5 mm. The average height in male was 1.67 meters and in female 1.56 meters. We determined a positive significant correlation between pedicle width and height.
Conclusions: Male pedicles are 30% wider than female ones (significant difference). When instrumenting segments between T3 and T9, plan the surgery with the aid of tomography.

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TEACHING HOW TO PLACE PEDICLE SCREWS BASED ON SURGICAL SIMULATION: PILOT STUDY

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Objectives: Simulation is an effective strategy for teaching skills to residents and fellows. The placement of a pedicle screw is difficult to teach during a residency. Most of the learning is generated in the "real world" with the patients. The objectives of this study are:
To examine the learning curve of different techniques for placing pedicle screws.

To compare the effectivity and safety of these techniques.

To improve the safety and effectivity of pedicle screw placing during the teaching period of physicians who are in their learning period.
Methods: All fellow spinal specialists from our institution participated in the study. Each placed 10 pedicles (T3 to T7) using a motor drill with a navigation system (SNPD), 10 with alw navigation (SNPP), 10 freehand with alw (FHPP) and 10 freehand with a drill (FHPD) on four scoliotic spines (true trainer). Each model was identified with a code for each fellow. The experiments were timed and registered. A spine surgeon performed a laminectomy to check the placement of the screws. A post-surgery Computerized Axial Tomography assessed malposition of screws.
Results: Five fellows participated in the study placing 10 screws (T3 to T7) using the four techniques. The time for placing the screws with the different techniques was registered: FHPP 17.57 min, FHPD 11.93 min, SNPP 19.87 min, and SNPD 13.31 min. Thirty nine screws (11 screws (25.6%) on the left side and 29 (74.3%) on the right side) were wrongly placed: 15 FHPP screws (38.5%), 14 FHPD (35.9%), six SNPP (15.4%) and seven SNPP (17.9%) SNPD. The fellows completed questionnaires for scoring their previous experience, satisfaction with the training and safety perception.
Conclusions: This pilot study may imply the development of a novel training based on simulation for teaching pedicle screw placement within a safe environment. Should the results be positive, the model may be introduced in the teaching of residents and orthopaedic and neurosurgical surgery fellows at national and international level to improve surgical effectivity and safety within teaching hospitals.

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LUMBAR DECOMPRESSION IN PATIENTS WITH PARKINSON'S DISEASE: SERIES OF CASES TREATED WITH MINIMALLY INVASIVE DECOMPRESSION

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Introduction: Parkinson's disease is a neurodegenerative disorder mainly affecting individuals over 65 years of age. The generated neuromuscular alterations cause changes in the quality of the spinal bone, as well as progressive unbalance at the sagittal and coronal planes. The variations in the axis usually worsen when these patients require surgical treatment of the axial skeleton, leading to controversy regarding a patient with degenerative changes that alter their quality of life. The aim of this work is to assess minimally invasive decompression in patients with Parkinson's disease and lumbar spinal stenosis secondary symptoms.
Materials and methods: We assessed patients with confirmed Parkinson's disease who had been surgically treated. The indication for performing the procedure was the presence of symptoms associated to a degenerative narrowness of the lumbar spine canal. All patients underwent decompression of the lumbar spine through a minimally invasive technique.
Results: Six patients with Parkinson's disease and narrow lumbar spine underwent surgery between January 2015 and December 2018. The approach used was tubular separation with microscope assistance. Decompression surgery was performed on 12 levels; patients remained hospitalized less than 24 h with no need of transfusion nor associated complications; the average duration of the surgery was 120 min. The mean follow-up period was 12 months without reappearance of the symptoms.
Conclusions: The high rate of complications described in interventions on patients with severe stenosis of the lumbar spinal stenosis and Parkinson's disease, and the decrease of these complications as shown in this study allows us to suggest that minimally invasive lumbar spine surgery may be a surgical alternative to be considered in advanced age subject.

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COMPARATIVE STUDY OF THE LUMBAR PLEXUS RIGHT AND LEFT PATHWAY THROUGH THE PSOAS MUSCLE TO DEFINE A SAFE AREA FOR MINIMALLY INVASIVE LATERAL TRANSPSOAS APPROACH

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Objectives and introduction: To date lateral transpsoas approach is used for managing spinal degenerative diseases; however, there is high incidence of neurological lesions due to L4 radicular involvement. Thus, it is necessary to establish parameters to prevent this complication. Here, we aim to find a practical and safe anatomical reference to help prevent this neurological lumbar spine lesion during minimally invasive lateral transpsoas approach and validate potential anatomical differences between right and left sides.
Materials and methods: We collected four measurements (cm) from 38 corpses: distance from the lumbar plexus and transverse apophysis (L4–L5) and distance from the lumbar plexus and middle line of the lumbar spine, from both the right and left sides. The corresponding statistical analyses were performed.
Results: The average distance from the lumbar plexus to the L4–L5 transverse apophysis was 1.03 cm and the distance to the middle line was 3.99 cm on the right side. The mean values for the left side were 1.13 cm and 3.88 cm, respectively. The non-parametric Wilcoxon test showed statistical differences between sides ($p < 0.05$).
Conclusions: We suggest as the anatomical reference the area located at two centimetres from the transverse apophysis to define the entry way through the psoas muscle as it prevents L4 neurological lesions. Level IV of evidence; the study was performed on corpses.

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EXTREME LATERAL LUMBAR INTERBODY FUSION (XLIF): CLINICAL AND RADIOLOGICAL RESULTS AFTER A YEAR OF FOLLOW-UP

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Objectives and introduction: Assess clinical and analytical results of extreme lateral lumbar interbody fusion (XLIF) in the management of degenerative spondylopathy, particularly its effect on the restoration of coronal and sagittal balance. Minimally invasive techniques have begun to popularize as an alternative to help minimize surgical trauma, blood loss, and reduce time of hospital stay. XLIF allows the lateral placement of a hyperlordotic interbody that may help optimize the sagittal balance and determine better clinical results.
Materials and methods: Fourteen patients, who underwent surgery with the XLIF technique with or without supplementary instrumentation between 2014 and 2018, were prospectively assessed. Among the indications, there were six adjacent segment syndromes, four degenerative scoliosis, two degenerative disc pathologies, and two neuromuscular scoliosis. Data collection included details of the surgical procedure, duration of the surgery, neuromonitoring, estimated blood loss, hospital stay, surgical/post-surgical complications and clinical/radiological follow-up of 1 year. Pre- and post-operative lumbar X-rays were obtained, regional and segmental Cobb's angles were measured, disc height, pelvic incidence (PI), pelvic extension (PT), sacral slope (SS), lumbar lordosis (LL) and PI-LL unbalance. For the analysis of the clinical results preoperative VAS and ODI scales were used, as well as in the most recent follow-up.
Results: Regional Cobb angle improved from 17.4° to 6.19° ($p < 0.001$) and segmental Cob angles from 5.6° to 1.63° ($p < 0.001$). Disc height was significantly restored ($p < 0.001$). A trend for improvement was observed for PT, SS and LL, but without reaching statistical significance. Significant reduction of the PI-LL unbalance was determined ($p < 0.05$). VAS and ODI scores decreased four points ($p < 0.001$) and 26.3%, respectively ($p < 0.001$). Furthermore, there was occurrence of a cage subsidence, a lesion of the crural nerve undetected during intraoperative neuromonitoring and an instrumentation failure due to screw pull-outs.
Conclusions: Good restoration of disc height and coronal balance was achieved with the XLIF, although it did not significantly restore sagittal balance. Despite all, clinical improvement is worthy of consideration and seems a promising alternative for the management of degenerative lumbar pathology.

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FULL-ENDOSCOPIC INTERLAMINAR APPROACH AT L5–S1. TEN YEARS OF EXPERIENCE

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Introduction: Spine endoscopic surgery is an option for managing foraminal disc herniation. Transforaminal approach is the most commonly used route; however, it is limited for central extruded and migrated herniated discs. Full-endoscopic interlaminar approach has allowed a symptomatic management of central extruded and migrated disc herniation at L5–S1 intervertebral disc level; furthermore, it is a new alternative to solve some technical difficulties associated to the posterolateral approach at this level. Here, we report the results achieved with the interlaminar endoscopy approach for the treatment of central extruded and migrated disc herniation in our first decade of experience.
Materials and methods: A retrospective, descriptive, observational study was performed with the aid of patient's medical reports who presented radicular symptoms secondary to central disc hernia at the L5–S1 level and who underwent full-endoscopic interlaminar fragmentectomy. We assessed three measures: pre and post-operatively visual analogue scale (VAS) and Oswestry Disability Index (ODI), and postoperatively MacNab criteria.
Results: Between 2008 and 2018, one hundred and sixty-five procedures were carried out on the same number of patients. All subjects underwent a standard surgical technique under local anaesthesia and sedation during the first 7 years, after which regional blockade was used. A six-point reduction of the VAS scoring was obtained. The ODI decreased in 46%. Ninety percent of the patients was very satisfied with the treatment under MacNab criteria.
Discussion: The results obtained in our series allows to consider full-endoscopic interlaminar fragmentectomy under local–regional anaesthesia and sedation as a safe and effective procedure to relieve lumbar and radicular pain secondary to central extruded and migrated disc herniation at the L5–S1 level

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MINIMALLY INVASIVE PERCUTANEOUS AND ENDOSCOPIC SPINE SURGERY IN PATIENTS AGED OVER 80 YEARS

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Objectives and introduction: Lumbar pain is the primary cause for visiting the doctor by older people. The most common pathology in these types of patients is osteoarthrosis and lumbar stenosis. Prevalence of lumbar pain in people over 75 years is between 24 and 36%. Lumbar pain intensity -as well as- its incapacitating effects is more severe in older patients. The comorbidities in aged individuals limit the surgical management. Minimally invasive techniques allow treating lumbar pain with lower risk of complications and less tissue lesions compared with conventional procedures. The aim of this work is to present the results of the minimally invasive treatment in patients aged over 80 years obtained in our clinical centre.
Materials and methods: Retrospective, descriptive, observational study in which we assessed the medical reports of patients aged over 80 years afflicted with lumbar pain who underwent treatment with percutaneous non-endoscopic and endoscopic minimally invasive lumbar procedures. We assessed three measures: pre and post-operatively visual analogue scale (VAS) and Oswestry Disability Index (ODI), and postoperatively MacNab criteria.
Results: Between 1998 and 2018, fifty-five procedures were carried out on 40 patients. 92% of patients were treated in more than one level. Mean age was 85.2 years (range 80–99 years). Eighty percent of patients besides suffering from lumbar pain had some other type of pathology. The most common comorbidity was: high blood pressure with 72%. The clinical outcomes obtained were: VAS reduced in five points, ODI decreased 35% and ninety percent of patients were very satisfied with the treatment. Two cases had to undergo reoperation (5%). In one case, the surgery had to be interrupted due to important changes in the patient's hemodynamic balance (2.5%).
Conclusions: Minimally invasive techniques are a safe and effective alternative for the treatment of lower back pain in older Individuals. The type of anaesthesia and less tissue damage may be determinant factors for the safety of the technique.

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COMPARATIVE RESULTS BETWEEN OPEN FUSION SURGERY AND MINIMALLY INVASIVE IN DISC DEGENERATIVE DISEASE

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Introduction and objectives: Spinal fusion is indicated in patients with degenerative disc disease who are stubborn regarding conservative treatments. The aim of this study is to compare peri- and post-operative results of conventional open surgery against minimally invasive surgery (MIS) through 350 degree instrumented posterior lumbar fusion.
Materials and methods: We examined 25 patients who underwent MIS and 40 open surgeries between 2015 and 2017. We compared perioperative variables and progression of lumbar radicular pain with a Visual Analogue Scale (VAS) and the Oswestry Disability Index (ODI) until 12 moths post-surgery.
Results: The MIS group showed lees blood loss (140 vs. 345 ml; $p = 0.001$), shorter duration of hospital stay (1.1 vs. 2.2 days; $p = 0.001$), longer time in surgery (113 vs. 94 min; $p = 0.001$) and exposure to X-rays (80 vs. 6 s; $p = 0.001$) in comparison to the group who underwent open surgery. The MIS group showed better results in the ODI and lumbar VAS. No differences were observed in radicular VAS.
Conclusions: MIS surgery has several advantages over the open technique, although the learning curve should be optimized to try to reduce the length of the Intervention.

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CERVICAL LAMINOPLASTY IN THE TREATMENT OF MYELOPATHY. FIVE-YEAR EXPERIENCE

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Introduction: Cervical myelopathy particularly affects golden agers due to a degenerative process in which static and dynamic factors are involved leading to the compression of the spinal cord and nerves (1)(2)(3)(4)(5). Within the range of surgical possibilities, there are multiple described techniques for anterior and posterior decompression. In this study, we aim assess O'Brien's laminoplasty (16).
Objectives: To report the results obtained in patients with cervical myelopathy treated with O'Brien's cervical laminoplasty technique during 2010–2014 and review the causes, symptoms and classifications of cervical myelopathy.
Methods: Retrospective, descriptive, observational study to review preoperative and postoperative evolution of patients with cervical myelopathy treated with O'Bien's technique for a five-year period. The information on clinical evolution was extracted from the institution's medical record. Radiographic and MR studies were examined. We applied the scale from the Japanese Orthopaedic Association (JOA) to measure the functional level of the patients (15). Furthermore, in diagnostic images, the canal diameter, the Chiba line, Pavlov's index and instability signs were obtained from the X-rays; MR was used to describe canal amplitude and signs of myelopathy.
Results: The JOA scale revealed functional improvement (10–14; functional class II to I). Radiological and MR indexes indicated significant extension of the cervical canal postoperatively (preoperative Pavlov 76% to 96% POP; 33% of extension in the diameter of the canal in MR). We assessed seven patients with a mean age of 74 years. Pain improved in all patients (VAS from 7 to 3). The radiology indexes and MR provided significant cervical canal enlargement data in the postoperative period (pre-surgery Pavlov 76% to 96% POP; 33% of diameter enlargement of the canal diameter in MR).
Conclusions: When managing cervical myelopathy, the appropriate documentation on the pathology at clinical level and imaging has to be performed to determine the level of treatment needed by the patient. Our results confirm that O'Brien's laminoplasty technique is an effective alternative for the management of patients with this pathology.
Keywords: cervical myelopathy, laminoplasty.

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ARE QUALITY QUESTIONNAIRES IN LINE WITH THE REALITY OF CERVICAL MYELOPATHY SURGERY OUTCOMES?

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Introduction and objective: Overall frequency of cervical pain is around 34%. In this study, we aim to assess the progression of

Table 1 Baselines characteristics of the cohort of patients included in this study

Variable	Values	Percentage
Gender	14 women	37.8
	23 men	62.2
Number of instrumented levels	11 with 1 level	29.7
	20 with 2 levels	54.1
	6 with 3 levels	16.2
Superior instrumented vertebra	5 patients in C3	13.5
	8 patients in C4	21.6
	23 patients in C5	62.2
	1 patients in C6	2.7
Inferior instrumented vertebra	2 patients in C4	5.4
	8 patients in C6	43.2
	19 patients in C7	51.4
Smoking habits	13 patients No	35.1
	15 patients Yes	40.5
	7 patients were former smokers	18.9
ASA	I 11 patients	34.4
	II 20 patients	62.5
	III 1 patient	3.1

Table 2 Analysis of the Neck Disability Index questionnaire in the cohort of study patients

Question	Progression	Values	*p* value
1. Intensity of the pain in the neck	Pre-IQ	2.65 ± 1.19	
	6 weeks	1.78 ± 1.12	0.008
	6 months	1.85 ± 1.45	0.007
	1 year	2.17 ± 1.52	0.111
2. Personal hygiene (wash, dress…)	Pre-IQ	1.52 ± 1.20	
	6 weeks	0.83 ± 1.19	0.003
	6 months	1.37 ± 1.20	0.076
	1 year	1.33 ± 1.23	0.087
3. Lift weight	Pre-IQ	2.57 ± 1.46	
	6 weeks	3.19 ± 1.40	0.073
	6 months	2.41 ± 1.58	0.560
	1 year	2.75 ± 1.48	0.358
4. Read	Pre-IQ	2.96 ± 1.32	
	6 weeks	2.32 ± 132	0.019
	6 months	2,00 ± 124	0.014
	1 year	2,66 ± 1.43	0.191
5. Headache	Pre-IQ	2.91 ± 1.37	
	6 weeks	1.36 ± 1.67	0.002
	6 months	1.44 ± 1.59	0.001
	1 year	1.75 ± 1.48	0.002
6. Concentration	Pre-IQ	2.23 ± 1.30	
	6 weeks	1.27 ± 1.42	0.001
	6 months	1.78 ± 1.54	0.143
	1 year	1.00 ± 0.95	0.000
7. Work	Pre-IQ	2.73 ± 1.06	
	6 weeks	3.05 ± 1.39	0.229
	6 months	2.83 ± 1.24	0.775
	1 year	2.67 ± 1.31	0.551
8. Driving	Pre-IQ	3.31 ± 1.08	
	6 weeks	2,75 ± 1.94	0.208
	6 months	2.12 ± 1.65	0.039
	1 year	2.30 ± 1.63	0.054
9. Sleep	Pre-IQ	2.82 ± 1.50	
	6 weeks	1.82 ± 1.62	0.003
	6 months	2.26 ± 1.652	0.350
	1 year	2.36 ± 1.91	0.019
10. Leisure time	Pre-IQ	3.23 ± 1.44	
	6 weeks	2.68 ± 1.76	0.097
	6 months	2.75 ± 1.75	0.307
	1 year	2.17 ± 1.69	0.024

Values are shown as means and standard deviations. *P* values were calculated using Student's t-test Student's t-test for related samples

disability in patients who underwent surgery due to degenerative cervical myelopathy (DCM).

Materials and methods: Prospective analysis of a cohort of patients who had undergone surgery since 2015 due to cervical myelopathy. We collected demographic data and their health-related quality of life was assessed using the specific Neck Disability index. Student's *t* test was used for statistical analyses.

Results: 37 patients were included in the study, median age was of 54.96 years (± 10.98), bleeding of 405.83 (± 220) cc, an average BMI of 27.52 (± 3.99), 135.15 (± 36.65) min of average surgical time. A total of 30 patients completed all the questionnaires at 2 years of follow-up, with a minimum follow-up of 1 year, the patients were found to have an average disability of 49,72 (± 8,13) and the next the values were: 6 weeks 40,58 (± 21,63), 6 months 39,62 (± 20,78), 1 year 47,14 (± 20,61). We did not find statistically significant differences between the pre-surgery with year, but yes at 6 weeks ($p = 0.008$) and at 6 months ($p = 0.000$). Table 1 shows the complete analysis of the questionnaire throughout the follow-up.

Conclusions: The initial disability of the patients improves over the first 6 month post-intervention (Table 2). However, after 1 year, they are in the same situation as before the surgery, although improvement is observed particularly regarding headache and concentration ($p = 0.000$). Considering these results, is it possible that cervical myelopathy surgery instead of improving the progression values in comparison with the preoperative status, no clinical progression occurs—as observed in this study-, and consequently no clinical worsening?

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REOPERATIONS IN PATIENTS WHO UNDERWENT SURGERY FOR CERVICAL MYELOPATHY. DISEASE PROGRESSION

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Objectives and introduction: Retrospective descriptive study to analyse reoperations in patients who had undergone surgery for cervical myelopathy (CM). There is little information in the literature regarding this type of surgery.
Our goal is to assess the causes, time elapsed objectives and surgical techniques in patients who require surgery due to progression of CM.
Materials and methods: We reviewed 297 patients who underwent surgery due to cervical pathology in our centre (excluding fractures and tumours) between January 1, 2010 and December 1, 2017, choosing patients who had previously undergone surgery for CM. Causes and time of the reoperation were assessed. We assessed epidemiological data, time and cause of reoperation, used surgical technique, and clinical and neurophysiological outcome in patients who had to undergo intervention again due to progression of myeloradiculopathy.
Results: Fifty-seven patients (64 interventions) who had previously undergone surgery due to CM. The causes for reoperation were seven due to infection or hematoma (reoperation in < 6 weeks); 10 linked to the initial surgery (reoperation between 4 months and 2.5 years after the first surgery); one due to dysphagia 11 years later; 46 due to progression of the disease (reoperation between 9 months and 23 years after the initial surgery). Regarding the 45 patients who underwent surgery again due to progression of the disease (46 surgeries), mean age was 63.93 (SD 9.08) years, 69.8% male, mean time before reoperation was 9.8 years (SD 5.78). All these patients had to undergo surgery again due to medullary or radicular clinical worsening. Anterior surgical approach was initially used in 32 patients (72.6%), while reoperation was performed using a posterior approach. Anterior surgical approach was initially used in eight patients (18.2%) and the intervention was performed using the anterior approach. Extension of fusion in 65.2% of the cases was due to progression in the upper segments, 6.5% in the lower segments, and a combination in 28.3%. Clinical improvement was observed in 65.2% of the patients, stability in 30.4%, and worsening in 4.3%. Pre- and post-operative neurophysiological control reports were available only for 26 patients. Among this sub-population of patients, 23.1% showed improvement, 69.2% stability and 7.7% worsened.

Conclusions: Reoperation in myelopathy is uncommon but not exceptional, usually due to disease progression and occurring at medium-long term, for which reason patients require long-term follow-up. The reoperation is decided following the same criteria used for primary myelopathy. The clinical outcome is in general good, without the rate of clinical improvement reported for primary surgeries.

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CERVICAL SPONDYLOTIC MYELOPATHY. POST-LAMINOPLASTY CLINICAL OUTCOMES

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Introduction: The aim of this work is to assess the clinical outcomes in patients with cervical spondylotic myelopathy who underwent open door laminoplasty in our service.
Materials and methods: We carried out a retrospective analysis of patients who underwent a laminoplasty due to cervical spondylotic myelopathy between 2010 and 2017. From the 102 operated patients, 18 did not have the required follow-up. Of the remaining 84 cases, 58 were male and 26 female. Mean age was de 63 years. The following aspects were assessed in this work: the relationship of the narrow channel in the lumbar pole, time elapsed from the beginning of symptoms to surgery, cervical morphology, myelomalacia and clinical evaluation using the Nurick scale and the modified Japanese Orthopaedic Association (JOA) scale.
Results: The most frequent area of laminoplasty was C3–C6 (83%). Preoperative scoring of the JOA scale was 12.1 and postoperative at 6 months 14.8. The recovery rate was 81% (Hirabayashi method). Mean preoperative score with the Nurick scale was 2 and at 6 months 1.1. Forty-two patients (50%) presented T2 medullary hyperintense signal in magnetic resonance imaging. The recovery rate observed with the JOA and Nurick scales was significantly higher in patients who were operated within the following 12 months after the beginning of symptoms. We observed high incidence of bipolar suffering (48%). There were no major complications; two patients had temporary C5, one patient developed a seroma that required superficial drainage, and four subjects had mild axial pain not present before the surgery.
Conclusions: According to our experience, open door laminoplasty provides very good clinical outcomes and low incidence of complications for the treatment of cervical spondylotic myelopathy. There is a significant relationship between the JOA recovery rate and the period between occurrence of symptoms and surgery. Furthermore, there is no significant association between the clinical outcome and the number of releases spaces or changes of the medullary signal.

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PEDICLE SUBTRACTION OSTEOTOMY IN SAGITTAL IMBALANCE. IN WHAT MEASURE THIS PROCEDURE MODIFIES SPINOPELVIC PARAMETERS AND SAGITTAL BALANCE?

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Objectives and introduction: In case of sagittal imbalance, pedicle subtraction osteotomy (PSO) may achieve 30° to 40° of correction at the treated level, being one of the most used methods for managing a severe imbalance. There are discrepancies in the literature regarding if PSO by itself is sufficient to restore normal parameters. The aim of this study is to determine the achieved degree of correction after PSO. Our hypothesis is that SPO restores sagittal balance to normal values.
Materials and methods: We retrospectively assessed 37 patients with sagittal imbalance who underwent SPO between 2005 and 2017 from two centres. We analysed pre- and post-operative radiological parameters: sagittal vertical axis (SVA), lumbar lordosis (LL), pelvic incidence (PI), pelvic tilt (PT) and sacral slope (SL). We also

examined potential differences in the degree of correction as per the level of osteotomy, etiology and sacroiliac fixation.

Results: Thirty-seven patients were included in the study (nine male; 28 female) with a mean age of 62 years. Nine, 23 and five subjects had L2, L3 and L4 osteotomy, respectively. Nine arthrodesis were performed with sacroiliac fixation in 20 patients. In average, the SVA Improved from 117.57° to 61.88° (47.35% of correction), $p < 0.0001$. Mean LL and spinopelvic parameters also reached normal values after the intervention; LL from 20.16° to 43.89° ($p < 0.0001$); PT from 34.69° to 26.49° ($p < 0.0001$), SS 21.88° increased to 29.77° ($p < 0.001$). PI remained with no significant differences (56.13° pre- to 55.69° post-surgery; $p > 0.769$). No differences were detected between the different levels of osteotomy, etiology or sacroiliac fixation.

Conclusions: PSO achieved 47.35% of SVA correction and 117.7%. correction of LL. Considering the values of normality (40°–60°), this study confirms that this technique is efficient for restoring lumbar lordosis. Furthermore, it also improves spinopelvic parameters, which is essential for a correct alignment. In conclusion, we show that PSO is an efficient technique to correct sagittal imbalance and spinopelvic parameters in the period immediately after the intervention.

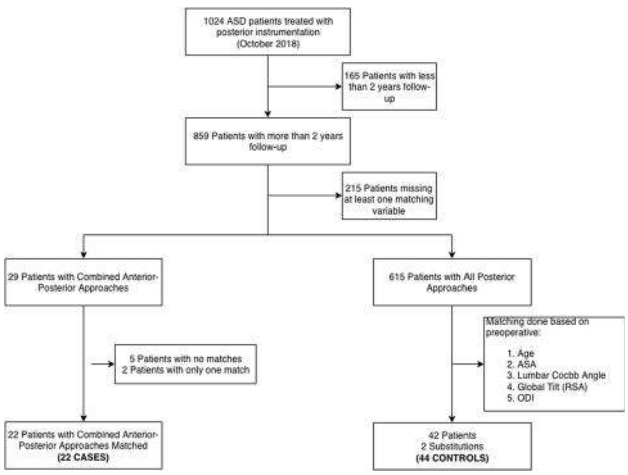
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COMBINED ANTERIOR–POSTERIOR VERSUS ALL-POSTERIOR APPROACHES FOR ADULT SPINAL DEFORMITY CORRECTION: A MATCHED CONTROL STUDY

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Objectives and introduction: Anterior approaches are gaining popularity for Adult Spinal Deformity (ASD) surgeries especially with the introduction of hyperlordotic cages and improvements in minimally invasive techniques. Combined Approaches (CA) provide powerful segmental sagittal correction potential and increase the surface area available for fusion in ASD surgery, both of which would improve overall outcome when compared to all posterior approaches. This is the first study directly comparing surgical outcomes between Combined Anterior–Posterior (CA) approaches and All Posterior (PO) approach in a matched ASD population.



	Preoperative variables				
	Cases		Controls		*P* value
	Mean/%	SD	Mean/%	SD	
Demographical variables					
Gender (female)	72.73%		81.82%		0.524
*Age	58.57	13.01	57.78	15.77	0.841
*ASA classification	18.18%		18.18%		1.000
	68.18%		68.18%		
	13.64%		13.64%		
BMI	25.56	3.69	25.30	3.74	0.791
Diabetes	9.09%		2.27%		0.256
Liver disease	0.00%		0.00%		1.000
Nervous system disorder	13.64%		11.36%		0.538
Osteoporosis/osteopenia	9.09%		18.18%		0.476
Renal disease	4.55%		6.82%		0.593
Smoker	13.60%		22.70%		0.339
Prior spine surgery	54.55%		59.09%		0.795
Radiological—preoperative					
*Lumbar cobb	12.02	14.67	11.09	12.50	0.790
Major cobb	38.88	26.33	38.95	23.66	0.992
Coronal balance	6.14	56.66	− 12.52	36.50	0.113
Sagittal balance	69.05	81.82	66.57	58.41	0.888
Lumbar lordosis	− 34.21	22.60	− 36.25	20.60	0.716
PI	56.22	12.69	55.84	12.69	0.909
PT	26.81	10.96	26.17	11.90	0.834
SS	29.41	12.30	30.29	8.93	0.743
*Global tilt	35.89	17.35	33.50	19.07	0.623
PI-LL	22.01	22.85	19.60	24.52	0.701
HRQoL—preoperative					
Back pain VAS	7.36	2.65	7.48	2.30	0.858
Leg pain VAS	5.18	3.57	4.68	3.75	0.605
COMI back—score	7.49	1.82	7.52	1.74	0.958
*ODI—score (%)	47.00	18.57	45.45	17.23	0.739
SRS22—function	2.80	0.62	2.79	0.65	0.928
SRS22—pain	2.14	1.02	2.20	0.82	0.814
SRS22 -SI	2.18	0.76	2.14	0.62	0.831
SRS22—MH	3.11	0.92	3.07	0.79	0.874
SRS22—satisfaction	3.09	1.20	3.20	1.04	0.796
SRS22—SRS subtotal	2.57	0.57	2.56	0.55	0.913
SRS22—SRS total score	2.60	0.57	2.58	0.55	0.888
SF36—PCS	33.04	7.86	33.09	7.24	0.982

Materials and methods: Retrospective Matched-Control cohort analysis with substitution using a multicenter prospectively collected ASD data of patients with > 2-year FU. Matching criteria include: Age, American Society of Anesthesiologists Score, Lumbar Cobb angle, Sagittal deformity (Global Tilt) and ODI. Patients with missing data were excluded (Flowchart)

Results: 1022 ASD patient were available for analysis. Out of the 29 CA patients who met inclusion criteria only 22 could be matched to 2 controls each (1:2 Ratio). Preoperative non-matched demographical, clinical, surgical and radiological parameters were comparable between both groups, validating matching criteria. CA

group had longer surgeries (548 mns vs. 283; $p < 0.001$) with more blood loss (2850 ml vs. 1471; $p < 0.001$) and needed longer ICU stays (74 h vs. 27; $p < 0.001$). Despite the added morbidity, they had comparable complication rates but with significantly less readmissions (9.1% vs. 38.1%) and reoperations (18.2% vs. 43.2%). CA group achieved a more individualised and harmonious deformity correction as measured by Global Tilt and GAP score parameters. Both groups however achieved similar final radiological corrections and functional results were comparable up to 2 years after surgery. At the 2-year control, CA patients reported better outcomes as measured by COMI and SRS scores. This trend was maintained in the CA group reaching 3-year.

Conclusions: Despite an increased initial surgical aggression, combined approaches seem to achieve a more harmonious correction with superior sagittal deformity control, they need less revisions and have improved long-term functional outcomes starting 2 years after index surgery when compared to all-posterior approaches for ASD deformity correction.

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INFLUENCE OF THE LEVEL OF LUMBAR PEDICLE SUBTRACTION OSTEOTOMY ON THE DISTRIBUTION OF LORDOSIS AND EFFECT ON POSTOPERATIVE MECHANICAL

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Table 1 Characteristics of the different transpedicular osteotomies (126)

PSO	T12–L1–L2	L3	L4	L5–S1	ANOVA Bonferroni
Variables					
MaxKyphosis Diff (°)	− 12.1 ± 15	+ 7.9 ± 25.7	+ 6.3 ± 13.5	+ 5.7 ± 10.4	0.001*
L1–S1 Diff (°)	− 16 ± 16.7	− 26 ± 18.2	− 28.8 ± 18.6	− 23.8 ± 13.3	0.080
L4–S1 Diff (°)	+ 12.8 ± 18.4	+ 2.6 ± 17.9	− 15.3 ± 12	− 28.7 ± 17.4	0.000*
LDI Diff (%)	− 23.5 ± 20.4	− 34.6 ± 23	+ 2 ± 27.5	+ 27.7 ± 36.6	0.000*
GT Diff (°)	− 14 ± 11.9	− 14.7 ± 16.9	− 20.8 ± 13.7	− 15.4 ± 7	0.107
PI–LL mism Diff (°)	− 17.4 ± 13.2	− 26.9 ± 19.2	− 30.5 ± 18	− 21.4 ± 9.5	0.038*
PI Diff (°)	− 1.4 ± 7.9	− 0.9 ± 4.8	− 1.7 ± 6.4	+ 2.4 ± 4.7	0.265
PT Diff (°)	− 8 ± 7.7	− 7.1 ± 8.9	− 10 ± 9.6	− 8.1 ± 7.4	0.522
SS Diff (°)	+ 6.4 ± 10.2	+ 6 ± 8.8	+ 8 ± 9.2	+ 10.6 ± 9	0.557
NLL Diff	+ 2.3 ± 1.4	+ 2.3 ± 1.5	+ 1.2 ± 2.2	+ 0.1 ± 2.2	0.007*

Location	T12/L1 (68.8%)	L1 (47.8%)	L2 (30%)	T12/L1 (80%)	Chi2
Postoperative inflection point					
Higher than the preoperative	93.8%	91.3%	68.8%	40%	0.006*
Same as the preoperative	6.2%	8.7%	11.7%	10%	
Lower than the preoperative	0%	0%	19.5%	50%	

Location	Variable L3–L4 (37.5%)	L3–L4/L3 (65.2%)	L3–L4/L4 (80.5%)	L4–L5/L4/L3–L4 (80%)	Chi2
Postoperative lumbar apex					
Higher than the preoperative	75%	87%	50.6%	20%	0.002*
Same as the preoperative	12.5%	8.7%	16.9%	10%	
Lower than the preoperative	12.5%	4.3%	32.5%	70%	
Type of ideal Roussouly (indicated by the PI)					
Type 1 Roussouly	12.5%	0%	3.9%	10%	0.634
Type 2 Roussouly	31.3%	26.1%	18.2%	10%	
Type 3 Roussouly	31.3%	47.8%	51.9%	50%	
Type 4 Roussouly	25%	26.1%	26%	30%	
Postoperative imbalance of Roussouly type versus the ideal situation					
Adjusted (%)	62.5%	78.3%	50.6%	80%	0.053
Not adjusted (%)	37.5%	21.7%	49.4%	20%	

PSO: transpedicular osteotomy; MaxKyphosis: Maximum kyphosis; Diff: Difference between postoperative and preoperative; L1–S1: lumbar lordosis; L4–S1: lordosis between L4–S1; LDI: lordosis distribution index = L4–S1 lordosis/L1–S1 lordosis; GT: Global Tilt; PI–LL mism: mismatch between pelvic incidence and lumbar lordosis; PI: Pelvic incidence; PT: pelvic retroversion; SS: sacral slope; NLL: number of vertebrae in the lordosis

*Statistical significance

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Objectives and introduction: To assess what effect the level of lumbar pedicle subtraction osteotomy (PSO) has on the distribution of postoperative lordosis and on mechanical complications.
Materials and methods: We examined all (126 patients) lumbar PSO from a prospective multicentre adult deformity database. We analysed pre- and postoperative X-rays, focusing on the sagittal profile, level of the osteotomy, position of the inflection point (InflecPoint) (change from kyphosis to lordosis) and position of the lumbar apex (LApex), as well as the spinopelvic parameters, lordosis L1–S1, lordosis distribution (LDI) and number of levels in the lordosis (NLL). We performed a univariate analysis of mechanical complication risk with a minimum follow-up of 2 years.
Results: L4–PSOs achieved the maximum desired effect (mean gain L1–S1 = 28.8° ± 18.6, mean gain of the imbalance PI-LL = − 30.5° ± 18.7); the lowest effect was observed in high PSOs (T12–L1–L2). Low PSOs (L4–L5) increased the inferior arch of the lordosis (particularly L5–PSO = 27.7 ± 36.6) and added one vertebra to the lordosis (NLL). The PSOs above L3 increased the superior arch of the lordosis and added two NLL. The PSOs above L4 increased the LApex (mean = 1.12 levels) and the InflecPoint (mean = 2.4 levels) to values above the ones before the surgery. L5 PSOs decreased the LApex (mean = − 1.1 levels) and the InflecPoint (mean = − 1.6 levels). Table 1 includes the location of the LApex and the InflecPoint based on the level of the PSO. No PSO level in particular shaped any specific Roussouly profile and neither adjusted better than any other the ideal profile as per the PI ($P > 0.005$). Forty point nine per cent of the patients suffered postoperative mechanical complications. A larger number of complications were seen in subjects who were poorly adjusted postoperatively in comparison to the ideal profile. LApex was the factor that affected mechanical complications the most; the greater the distance of the levels from the ideal situation (particularly when inferior), the greater the risk of complication ($P = 0.033$).
Conclusions: The data presented in this study may help choose the level of lumbar PSO that better adjusts to the ideal sagittal profile to be restored and foresee the impact on the distribution restoration of the lordosis (lumbar apex, inflection point and distribution of the lordosis between both arches).

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IMPLANT-RELATED COMPLICATIONS IN THE MANAGEMENT OF VERTEBRAL COLUMN PATHOLOGIES IN OLDER ADULTS

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Introduction: The management of anomalies in people of advanced age is associated to more comorbidities and risk of complications. Implant-related complications are one of the challenges in surgical treatments of these patients. The aim of this study is to classify and determine the rate and type of implant-associated complications.
Materials and methods: We assessed 53 patients who underwent surgery consecutively between 2013 and 2017, using fenestrated cemented screws as the fixation system. To be included in the study patients had to meet the following criteria: ≥ 5 fusion levels and be ≥ 55 years. We examined the demographic data, level of proximal and distal instrumented vertebra (PIV and DIV, respectively), type of proximal fixation (PF) and conventional radiological measurements (Cobb angles, pelvic parameters, proximal junctional kyphosis (PJK), proximal junctional failure (PJF) and sagittal alignment) preoperatively, postoperatively and at the end of follow-up. The complications were classified as early or late (base if they occurred < or > 3 months). The Chi-squared and Mann–Whitney U tests and Pearson's correlation coefficient were used in the statistical analyses.

Table 1 .

Mean and SD	Preop	Postop	Follow-up	*P* value
Pelvic incidence (PI)	51.43 ± 24.23	58.23 ± 13.7	55.79 ± 15.96	0.476
Pelvic tilt (PT)	25.74 ± 16.69	27.67 ± 9.74	27.15 ± 10.73	0.750
Sacral tilt (ST)	26.40 ± 13.87	30.62 ± 8.25	29.62 ± 11.11	0.151
Lumbar lordosis (LL)	36.19 ± 20.1	44.45 ± 13.36	47.12 ± 15.75	0.101
Thoracic kyphosis (TK)	35.97 ± 17.39	39.78 ± 15.72	48.84 ± 20.48	0.004
Proximal junctional kyphosis (PJK)	6.22 ± 10.11	12.69 ± 12.43	16.38 ± 16.7	0.009
SVA	8.93 ± 6.6	9.64 ± 7.08	11.23 ± 6.65	0.143

Table 2 .

		N
Early complications		
Compression fractures	Adjacent vertebra	1
	PIV with cemented screw	13
Pull-out or failure of distal implant		2
Local cement leakage	Venous or paravertebral plexus	11
	Intradiscal	2
	Epidural	4 (7.5%) (1 symptomatic)
Distant leakage of cement	Pulmonary embolism	1 (1.9%)
(asymptomatic)		
Late complications		
Implant loosening	Proximal screws	2
	Distal screws	5
Hardware failure	Broken rod	1

Results: Mean age was 68.31 ± 9.22, BMI 21.74 ± 4.13, n° fused vertebrae 7.5 ± 2. PIV: (T3 (1), T4 (3), T5 (1), T8 (2), T9 (5), T10 (10), T11 (8), T12 (6), L1 (8), L2 (9). DIV: (S1 (17), sacroiliac (20), L3 (2), L4 (2), L5 (12). PF: hooks (20), screws (30), screws and bands (3). Early complications: compression fractures (14): one adjacent vertebra, 13 PIV with PF (cemented screws); failure in distal implant (2); local cement leakage: venous or paravertebral plexus (11), intradiscal (2), epidural (4) 7.5%; asymptomatic pulmonary embolism (1). Late complications: implant loosening: proximal screws (2), distal screws (5); bar breakage (1). Thoracic kyphosis and PJK significantly increased at the end of the follow-up (48.84 ± 20.48, p 0.004) and (16.38 ± 16.7, p 0.009), respectively (Rho 0.517, p 0.014). Patients with inadequate sagittal alignment (LL + PI + CT > 45) developed proximal junctional failure (PJF) p 0.002.
Conclusions: The use of fenestrated cemented screws improves the loss of correction; reduces the rate of pseudarthrosis. In our series, we determined low-risk of pulmonary embolism and cement leakage into the epidural space. Seventy-five per cent of the patients had some implant-related complication. Sixty-four per cent of the complications occurred within the following three months following the procedure and 30% (cement leakage) were asymptomatic. Twenty-eight per cent of symptomatic patients (45%) required revision surgery; 21% was associated to PJF (Tables 1, 2).

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SURGICAL SITE INFECTION FOLLOWING SCOLIOSIS SURGERY: COHORT STUDY OF 361 CASES

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Introduction and objectives: Surgical site infection is a disastrous complication in scoliosis correction surgery that determines the worsening of clinical and functional outcomes. This study aims to (1) determine the overall incidence of surgical site infection following scoliosis surgery; (2) assess potential risk factors or identifiable protective factors.
Materials and methods: Retrospective cohort study of patients who underwent consecutive scoliosis surgery patients between 2014 and 2017. Subjects with incomplete clinical and/or radiological records were excluded from the study. We assessed demographic, clinical, and surgical variables, including the ASA, type of scoliosis, Cobb degrees, surgery motive, type of implant, number of segments included in the setting.

Results: We detected 21 surgical site infections (5.8%). No significant relationship was found with gender, ASA level, type of surgery, preoperative Cobb, number of segments included in the surgery or number of implanted segments. A statistically significant association with the type of scoliosis was determined, ranging between an infection rate of 2.3% in idiopathic scoliosis to 9.3% in neuromuscular scoliosis (Table 1). A powerful relationship was found with the existence of a previous surgery (primary 4.3%, revisions 21.9%).
Conclusions: Overall infection rates in our series are similar to those in the literature. To date, there are no studies comparing primary surgeries with revision surgeries. In our work, it strongly associates to the presence of infection, as well as the etiology of the scoliosis, with the highest rates seen in neuromuscular and syndromic.

Table 1 General characteristics of study participants

	Infection		
	No (n = 340) % (n)	Yes (n = 21) % (n)	*p* value
Gender			
Male	93.9 (107)	6.1 (7)	0.515 (NS)
Female	94.3 (223)	5.7 (14)	
Type of scoliosis		0.001	
Congenital	93.5 (29)	6.5 (2)	
Idiopathic	97.7 (171)	2.3 (4)	
Neuromuscular	90.7 (78)	9.3 (8)	
Syndromic	91.2 (57)	8.8 (6)	
Cause for surgery		0.001	
Primaria	95.7 (315)	4.3 (14)	
Revision	78.1 (25)	21.9 (7)	
ASA scale			0.29 (NS)
I	95.2 (40)	4.8 (2)	
II	96.4 (159)	3.6 (6)	
III	91.4 (139)	8.6 (13)	
Type of surgery		0.37 (NS)	
Growth bars	89.7 (35)	10.3 (4)	
VEPTR	95.9 (47)	4.1 (2)	
Fusion	94.5 (258)	5.5 (15)	
Preoperative Cobb			
Mean	69.7 ± 18.7	67.8 ± 25.5	0.18 (NS)
Instrumented segments			
Mean	12.2 ± 3.1	13.1 ± 2.3	0.13 (NS)
Number of screws			
Mean	14.2 ± 7.7	12.2 ± 7.6	0.94 (NS)

% percentage, n: number de patients, ASA: American Society of Anesthesiologists, VEPTR: vertical expandable prosthetic titanium rib

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SIMULTANEOUS PEDICLE SCREW INSERTION ON CONCAVE AND CONVEX SIDES SIGNIFICANTLY REDUCES SURGERY DURATION IN ADOLESCENT IDIOPATHIC SCOLIOSIS

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Introduction and objectives: Surgery duration relates to the increase of intraoperative bleeding, higher need for blood transfusion, and an associated rise of postoperative infection. The goal of this study is to compare the perioperative outcome of a cohort A of adolescent idiopathic scoliosis (AIS) with Lenke 1A curves by dissection and placement of pedicle screws simultaneously on concave and convex sides against a cohort B of patients with similar characteristics and sequential pedicle screw placement.
Materials and methods: Retrospective study of non-consecutive AIS Lenke 1A cases who underwent "all screw" posterior surgery with a minimum follow-up of 1 year. In cohort A (n = 43) two experienced surgeons performed the dissection, pedicle screw insertion and simultaneous closing on the concave and convex sides. In cohort B (n = 25) the dissection and screw insertion were not done simultaneously. We describe demographic and anthropometric parameters, the Risser degree, curve type and magnitude, number instrumented vertebras, degree of correction, days of stay in the hospital and perioperative complications. We assessed total duration of surgery (TDS) from the incision to the closing of the wound. The SPSS was used for data analysis.
Results: No significant A/B differences were found regarding age (13 y/13 y), preoperative Cobb (56°/58°), or postoperative Cobb (4°/8°). Percentage of postoperative correction (88%/93%), instrumented vertebras (11/12) and mean hospital stay (7/7). Mean TDS was 170 ± 20 min/231 ± 35 min ($p < 0.05$). No neurological perioperative complications; one case of infection with surgical washing out in cohort A.
Conclusions: In Lenke 1A AIS surgery simultaneous pedicle screw placing on the concave and convex sides significantly reduces the duration of the surgery without increasing the number of perioperative complications.

Table 1 General characteristics of study participants

	Readmission and reoperation			
	No (n = 498) % (n)	Yes (n = 115) % (n)	Total % (n)	*P* value
Gender				0.385
Male	33.1 (165)	37.4 (43)	33.9 (208)	
Female	66.9 (333)	62.6 (72)	66.1 (405)	
Age (years)				< 0.001
Mean	13.9 ± 3.8	11.6 ± 4.3	13.4 ± 4.0	
Type of scoliosis			< 0.001	
Congenital	7.2 (36)	10.4 (12)	7.8 (48)	
Idiopathic	54.8 (273)	20.9 (24)	48.5 (297)	
Neuromuscular	25.3 (126)	39.1 (45)	27.9 (171)	
Syndromic	12.7 (63)	29.6 (34)	15.8 (97)	
Cause for surgery			0.215	
Primary	92.0 (264)	87.5 (70)	91.0 (334)	
Revision	8.0 (23)	12.5 (10)	9.0 (33)	
ASA class				< 0.001
I	13.8 (67)	5.3 (6)	12.2 (73)	
II	48.8 (238)	31.6 (36)	45.6 (274)	
III	36.8 (179)	63.2 (72)	41.8 (251)	
IV	0.6 (3)	0	0.5 (3)	
Type of surgery				< 0.001
Growth bars	9.6 (48)	20 (23)	11.6 (71)	
VEPTR	8.0 (40)	19.1 (22)	10.1 (62)	
Fusion	81.7 (407)	60.9 (70)	77.8 (477)	
Other	0.6 (3)	0	0.5 (3)	
Time before readmission				< 0.001
No	100.0 (498)	0 (0)	81.2 (498)	
< 30 days	0	22.6 (26)	4.2 (26)	
30 to < 90 days	0	10.4 (12)	2.0 (12)	
> 90 days	0	67.0 (77)	12.6 (77)	
Preoperative Cobb				0.001
Mean	68.6 ± 18.4	74.8 ± 20.2	69.8 ± 18.9	
Postoperative Cobb				< 0.001
Mean	28.3 ± 14.5	38.1 ± 19.4	30.2 ± 16.0	
Need of surgery at readmission				< 0.001
No	100.0 (498)	20.9 (24)	85.2 (522)	
Yes	0 (0)	79.1 (91)	14.8 (91)	
Follow-up (months)				< 0.001
Mean	23.3 ± 20.8	42.6 ± 26.9	27.5 ± 23.6	

n: number of patients, ASA: American Society of Anesthesiologists, VEPTR: vertical expandable prosthetic titanium rib

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READMISSION AND UNPLANNED SURGERY AFTER SCOLIOSIS SURGERY IN CHILDREN. COHORT MULTIVARIATE STUDY IN 613 CASES

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Objectives and introduction: Scoliosis surgery in children is a demanding complex technique accompanied by complications. The aim of this study is to establish failure determinants of this type of surgery leading to readmission and surgery.

Table 2 Logistic regression OR (CI of 95%) risk factors associated to readmission and reoperation

	Bivariate		Multivariate	
	OR (CI of 95%)	*P* value	OR (CI of 95%)	*P* value
Age	0.88 (0.84–0.92)	< 0.001	0.92 (0.86–0.99)	0.024
Gender				
Male	1		1	
Female	0.83 (0.54–1.26)	0.385	1.30 (0.82–2.06)	0.263
Type of scoliosis				
Idiopathic	1		1	
Congenital	3.79 (1.75–8.23)	0.001	2.22 (0.89–5.53)	0.088
Neuromuscular	4.06 (2.37–6.96)	< 0.001	3.76 (2.13–6.61)	< 0.001
Syndromic	6.14 (3.40–11.07)	< 0.001	4.35 (2.27–8.33)	< 0.001
Type of surgery				
Fusion	1		1	
Growth bars	2.79 (1.59–4.87)	< 0.001	1.41 (0.72–2.78)	0.315
VEPTR	3.20 (1.79–5.70)	< 0.001	1.15 (0.54–2.46)	0.712
Other	1		1	
Preoperative Cobb				
Mean	1.02 (1.01–1.03)	0.002		
Postoperative Cobb				
Mean	1.04 (1.02–1.05)	< 0.001		
Cause for surgery				
Primary	1			
Revision	1.64 (0.75–3.61)	0.219		
ASA class				
I	1			
II	1.69 (0.68–4.18)	0.257		
III	4.49 (1.87–10.81)	0.001		
IV	1			

CI: confidence interval; ASA: American Society of Anesthesiologists, VEPTR: vertical expandable prosthetic titanium rib

Materials and methods: Cohort study that consecutively included patients under 18 years of age who underwent scoliosis surgery between 2009 and 2017. The relevant outcome was readmission and unplanned reoperation after discharge. The primary surgery was the initial procedure with a minimum follow-up of 12 months. The causes of readmission were classified as follows: (1) local of the surgery area, (2) material-related complications, and (3) medical or systemic. We carried out a descriptive and risk-adjusted multivariate logistic regression (MLR) statistical analyses using Stata® 13.
Results: Six-hundred and thirteen patients met the inclusion criteria. Mean age was de 13.4 years (SD 4.0), 66.1% female. The most frequent diagnosis were idiopathic scoliosis (297 patients; 54.8%) and neuromuscular (171; 25.3%). Four hundred and seventy-seven instrumented fusions, 71 growth bars, 62 VEPTR and three other procedures were carried out. Overall readmission rate was 18.8% (115/613). Classified by readmission period: < 30 days: 4.2% (26 patients), 30–90 days: 2.0% (12 patients) and 12.6% (77 patients) after the first 90 days (Table 1). The primary cause for readmission was material-related complications (44.3%). 79.1% of the readmitted patients required surgery. The risk-adjusted MLR analysis showed that comorbidities was the determinant factor with the highest odds ratios (OR). Syndromic scoliosis (OR 4.35, CI of 95%: 2.27–8.33) and neuromuscular scoliosis (OR 3.76, CI of 95%: 2.13–6.61) in comparison to baseline idiopathic. Age was also a significant factor (Table 2).
Conclusions: Syndromic and neurological scoliosis patients with curves similar to those of idiopathic patients have greater risk of complications and failure of surgery, adjusted by the remaining confusion factors. Eighty per cent of readmitted patients required reoperation. Material-related complications are the main cause for readmission.

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CHANGES IN THE CORONAL PLANE OF THE THORACOLUMBAR SPINE FOLLOWING SURGICAL TREATMENT OF LENKE 1A SCOLIOSIS

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Objectives and introduction: Examine the changes on the antero-posterior plane after adolescent idiopathic scoliosis (AIS) Lenke type 1A correction in the instrumented and non-instrumented curve.
Materials and methods: Retrospective study on 30 girls with Lenke 1A AIS with uniform characteristics: straights, curve apex T8–T9, moderate severity (< 70°), kyphosis (20–35°), fusion levels (T2–3 and L1–2), posterior approach, all screws and maximum correction. We assessed horizontal inclination against T1, limiting proximal (LPV) and distal (LDV) vertebra, apex, proximal (PIV) and distal (DIV) instrumented vertebra (preoperative, immediate postoperative and 2 years after the surgery). The concave and convex length of T1–S1, LPV-LDV, LPV–apex, apex-LDV, PIV-DIV, T1–PIV and DIV-S11 were measured.

Concavity/convexity lengths	Preoperative concavity	Postoperative concavity	Concavity at 2 years	Preoperative Convexity	Postoperative convexity	Convexity at 2 years
T1–S1	390	416	424	389	416	424
LPV–LDV	173.4	194.2	199.3	197.8	199.8	204.5
LPV–Apex	79.4	84.3	88	92	93.1	96.7
Apex–LDV	105.1	119.1	122	116.2	116.4	120.3
PIV–DIV	265	297.5	303.7	281.1	298.8	306.1
T1–PIV	33.1	31.5	31.7	28.7	29	29.9
DIV–S1	98.8	99	101	89.4	98.3	100.1

Mean vertebral inclination with respect to the horizontal plane	Preoperative	Postoperative	Two years post-surgery
T1	1.2	5.6	5
LPV	27.7	10	10
PIV	− 8.4	2	2.5
Apex	5.5	4.4	4.4
DIV	3.7	1.2	1.5
LDV	24.6	0.9	0.7

Results: The LDV and the PIV horizontalize almost completely in the postoperative period, the position of the apex changes slightly and the LPV and PIV were partially corrected. Statistically significant differences were detected between proximal and distal levels (PIV vs. DIV, LPV vs. LDV) with the apex being the less corrected area ($p < 0.001$). No significant differences were seen in global pre- and postoperative T1–S1 concave and convex distance (mean increase 26 mm). In the postoperative period, scoliosis correction occurred due to the lengthening of the concavity of the instrumented spine with minor changes in convexity (56%, $p < 0.001$). This increase was greater in the distal hemicurve (LPV-Apex vs. Apex-LDV, $p < 0.001$). The increase of concavity length was balanced by the proximal non-instrumented vertebras (T1–UIV) and primarily by the distant ones (LIV-S1) were an increase in convexity occurred, not balanced by the increased concavity ($p < 0.05$).
Conclusions: Correction of the vertebral inclination in the postoperative period was maximum in the distal instrumented levels and incomplete in the proximal ones. Concavity lengthening in the instrumented spine primarily occurs in the distal hemicurve. The postoperative vertebral balance is maintained at the expense of the non-fused lumbar spine. We confirm an asymmetric rigidity in the thoracic spine, maximum at proximity with progressive decrease towards the distal end.

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FACTORS ASSOCIATED TO ASSEMBLY FAILURE IN DEFORMITY SURGERY. COHORT STUDY IN 365 SCOLIOSIS

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Objectives and introduction: Implant failure (loosening and/or breakage) is a potential complication following scoliosis surgery that can lead to loss of the correction achieved with the procedure and potential need of reoperation. In this study, we aim to (1) determine the current incidence of implant failure in patients who underwent surgery due to scoliosis and (2) assess the risk and the protective factors associated to material-related complications.

Table 1 General characteristics of study participants

	Implant failure			
	No (n = 323) % (n)	Yes (n = 42) % (n)	TOTAL % (n)	*P* value
Gender				0.505
Male	30.7 (99)	35.7 (15)	31.2 (114)	
Female	69.4 (224)	64.3 (27)	68.8 (251)	
Age (years)				< 0.001
Mean	13.6 ± 4.1	9.6 ± 4.4	13.1 ± 4.3	
Type of scoliosis			< 0.001	
Congenital	8.3 (27)	9.5 (4)	8.5 (31)	
Idiopathic	52.6 (170)	14.3 (6)	48.2 (176)	
Neuromuscular	21.4 (69)	40.5 (17)	23.6 (86)	
Syndromic	17.7 (57)	35.7 (15)	19.7 (72)	
Cause for surgery			0.024	
Primary	92.3 (298)	81.0 (34)	91.0 (332)	
Revision	7.7 (25)	19.1 (8)	9.0 (33)	
ASA grade				< 0.001
I	12.8 (41)	2.4 (1)	11.6 (42)	
II	48.2 (155)	26.2 (11)	45.7 (166)	
III	39.0 (125)	71.4 (30)	42.7 (155)	
Type of surgery			< 0.001	
Growth bars	9.0 (29)	31.0 (13)	11.5 (42)	
VEPTR	11.1 (36)	33.3 (14)	13.7 (50)	
Fusion	79.6 (257)	35.7 (15)	74.5 (272)	
Other	0.3 (1)	0	0.3 (1)	
Iliac fixation				0.007
No	81.9 (263)	64.3 (27)	79.9 (290)	
Yes	18.1 (58)	35.7 (15)	20.1 (73)	
Preoperative Cobb			0.038	
Mean	69.1 ± 18.7	75.7 ± 21.7	69.8 ± 19.2	
Postoperative Cobb			< 0.001	
Mean	28.3 ± 16	42.7 ± 22.7	29.9 ± 17.4	
Magnitude of the correction			0.010	
Mean	40.7 ± 17.6	32.9 ± 22.1	39.8 ± 18.3	
Instrumented segments			0.004	
Mean	12.2 ± 3.1	13.6 ± 2.0	12.3 ± 3.0	
Material density				< 0.001
Mean	1.3 ± 0.6	0.8 ± 0.2	1.3 ± 0.6	
Follow-up (months)				
Mean	25.02 ± 21.4	47.09 ± 29.73	27.55 ± 23.55	

n: number de patients, ASA: American Society of Anesthesiologists, VEPTR: vertical expandable prosthetic titanium rib

Table 2 Logistic regression; OR (CI of 95%) risk factors associated with implant failure

	Bivariate	
	OR (CI of 95%)	*P* value
Age	0.84 (0.79–0.90)	< 0.001
Type of scoliosis		
Idiopathic	1	
Congenital	4.20 (1.11–15.85)	0.034
Neuromuscular	6.98 (2.64–18.45)	< 0.001
Syndromic	7.46 (2.76–20.13)	< 0.001
Type of surgery		
Fusion	1	
VEPTR	7.68 (3.33–17.72)	< 0.001
Growth bars	6.66 (2.97–14.94)	< 0.001
Other	1	
Material density	0.22 (0.13–0.39)	< 0.001
Instrumented segments	1.20 (1.06–1.37)	0.004
Cause for surgery		
Primary	1	
Revision	2.80 (1.17–6.71)	0.020
Preoperative Cobb	1.02 (1.001–1.03)	0.009
Postoperative Cobb	1.04 (1.02–1.06)	< 0.001
Magnitude of the correction	0.98 (0.96–0.99)	0.010
Iliac fixation		
No	1	
Yes	2.52 (1.26–5.03)	0.009
Intra-hospital complications		
No	1	
Yes	1.19 (0.54–2.61)	0.671

CI: confidence interval, VEPTR: vertical expandable prosthetic titanium rib

Materials and methods: Retrospective cohort study of patients with scoliosis who consecutively underwent surgery between 2015 and 2018. Subjects with incomplete clinical and/or radiological records were excluded from the study (15 patients). We collected and analysed demographic, clinical, and surgical variables, including type of scoliosis, Cobb degrees, cause for performing the surgery, type of surgery, type of implant, number of segments included in the setting implant density, and Iliac fixation

Results: Three hundred and sixty-five patients were included in the analysis. Female 68.8%. Mean age 13.1 (SD 4.3) years (Table 1). The global rate of material-related failure was 11.5%. Among these failures, loosening was the most frequent (71.4%). Material-related risk factors were: neuromuscular (Odds ratio (OR) 6.98; CI of 95%: 2.64–18.45) and syndromic (OR 7.46; CI of 95%: 2.76–20.13) scoliosis, a larger number of segments in the assembly (OR 1.20; CI of 95%: 1.06–1.37), reoperation with change of the system (OR 2.80; CI of 95%: 1.17–6.71), iliac fixation (OR 2.52; CI of 95%: 1.26–5.03), and the use of growth bars and VEPTR. Lower rate of failure was determined in older age (OR 0.93; CI of 95%: 0.83–1.04) and greater Implant density (OR 0.22; CI of 95%: 0.13–0.39), revealing as protective factors (Table 2).

Conclusions: In this study, we observe a low rate of implant failure, the most frequent being hook loosening (71.4%). Protective factors were the age of the patient and density of the used material, while the risk factors were reoperation, a larger number of segments in the assembly, and type of implant.

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HOW TO INNOVATE USING CLASSICAL TECHNIQUES? COMBINING TRACTION, DRILLING AND NAVIGATION IN AIS

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Introduction: Posterior fusion is a common and expensive surgical procedure for the management of adolescent idiopathic scoliosis (AIS). Since 2010, our unit has improved the efficiency of AIS treatment by systematically using two classical surgical strategies that were modified introducing current technology: intraoperative transskeletal traction (IOSFT) and navigated sequential drilling (NSD). In this study, we describe the impact on quality, safety, and cost by using IOSFT and NSD in our environment.

Methods: We reviewed the data from 125 AIS patients who consecutively underwent posterior fusion between 2008 and 2015 in our centre. Three cohorts were identified based on the different surgical techniques used for managing AIS. Traditional technique (n = 28), with IOSFT (n = 45), and IOSFT + NSD (n = 52). The following parameters were registered: surgery duration, percentage of cases who required additional time for the surgery, percentage of patients who required transfusion, hospital stay, and total cost per case. Additionally some secondary parameters were also measured: implant density, percentage of correction of the deformity, perioperative complications.

Results: All the parameters showed significant improvement in the IOSFT + NSD cohort ($p < 0.001$). Surgery duration decreased in 59%; need of additional time for the surgery decreased from 89% to 0%; transfusion rate from 64 to 1.9%; hospital stay was reduced from 5 to 4 days and total cost per case in 24%

Conclusions: IOSFT + NSD combination improves the quality, safety and cost of our surgeries without increasing the risk of perioperative complications and with 24% cost saving per case. The data we present in this work may have significant implications for the management of health resources in AIS. Prospective studies with a higher number of patients are needed to generalize these results.

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EFFECT ON RELIABILITY AND VALIDITY OF THE TAPS BY ADDING A DRAWING THAT ALLOWS ASSESSING THE SAGITTAL PLANE

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Objectives: To assess the effect on reliability and validity of adding a drawing depicting the deformity in the sagittal plane to the Trunk Appearance Perception Scale (TAPS).
Material: We included 170 untreated patients (mean age 16.9 years; 77.4% women) distributed in three groups. Control group (no deformity): 22 cases; kyphosis group (sagittal deformity): 49 cases; scoliosis group (coronal deformity): 99 cases (mean Cobb 42.4°).
Methods: We designed a new drawing (TAPS4) depicting the deformity in the sagittal plane that includes five possible answering options. Clinical (SRS-22 and 4-item TAPS) and radiological (T4–T12 kyphosis) data were collected from all patients. We determined the reliability of the 3-item TAPS versus 4-item TAPS for each group, as well as the discriminant validity (correlation with the magnitude of the kyphosis) and the convergent validity (correlation with the image subscale of SRS-22).
Results: The three study groups differed in the magnitude of the kyphosis, quality of life and perception of body image (Table). Statistically significant differences in the scoring of the new TAPS4 drawing were determined between the three groups, as well as in the summation of 3-item TAPS and 4-item TAPS. The addition of the TAPS4 figure did not cause a significant change of the internal consistency of the scales (Cronbach's alpha) (0.85 for 3-item TAPS vs. 0.82 for 4-item TAPS). The magnitude of the kyphosis showed no correlation with the summations of the 3-item TAPS and the 4-item TAPS; however, in the kyphosis group, a significant negative correlation was seen between the kyphosis and the TAPS4 figure (Rho = $-$ 0.43, $p = 0.0001$). A significant correlation was found in all groups between the summation of the 3-item TAPS and the 4-item TAPS and the SRS-22 image; the relationship between TAPS4 figure and SRS-22 image was 0.35 for the scoliosis group and 0.67 for the kyphosis group.
Conclusions: The 4-item TAPS does not provide advantages in the assessment of trunk deformity over the 3-item scale. However, in patients with kyphosis, the TAPS4 drawing by itself may be a valid tool for monitoring the perception of the deformity.

	CONTROL	KYPHOSIS	SCOLIOSIS	*P* value
KYPHOSIS	35.9	58.2	37.9	0.000*
SRS- 22 SUBTOTAL	4.2	3.8	3.9	0.05*
SRS-22 IMAGE	3.9	3.3	3.4	0.004*
TAPS 3 ITEMS	4.1	4	3.4	0.000*
TAPS 4 ITEMS	4.1	3.8	3.7	0.01*
ITEM 4	4.1	3.1	3.5	0.002*

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REOPERATIONS IN NON-INSTRUMENTED SURGERY OF THE LUMBAR SPINE

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Objectives: To observe the complications and survival following non-instrumented lumbar surgery in our centre.

Materials and methods: Retrospective, descriptive study of 477 patients affected by lumbar spine pathologies (disc herniation, spinal stenosis or juxtafacet cyst) who underwent surgery without instrumentation (laminectomy with or without discectomy) between 2011 and 2017. In each case, we examined the affected segment, follow-up time, and any complication that required reoperation, taking into account if instrumentation was necessary.
Results: Four hundred and seventy-seven patients were included in this study. Mean follow-up was 4 years (1–8). Seventy per cent of the cases had disc herniation and 30% spinal stenosis and/or juxtafacet cyst. Reoperation was required in 23.9% of the subjects, from which 2.7% came from other centres; 14.3% cases were relapses to whom decompression was increased; 7.1% required a new surgery with instrumentation material and the remaining cases were acute complications such as hematomas, infection or LCR fistula. The causes for reoperation were in 25% of the cases due to spinal stenosis, from which 13.5% were acute surgeries and 17.1% long-term (71% due to relapse (increasing decompression) and 10% due to instrumentation); 23.4% were disc herniations, 3.1% acute and 23.6% long-term (7.5% relapse and 16.1% instrumentation); 16% were juxtafacet cysts, 4% acute and 12% long-term (4% relapse; 8% instrumentation).
Conclusions: In this study, patients who underwent surgery for lumbar spinal stenosis had 90% of survival in surgery without instrumentation. Thus, if patients are selected correctly, satisfactory outcomes may be obtained through individualized decompression, as well as avoid additional risks and instrumentation costs.

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FACTORS ASSOCIATED WITH PERIOPERATIVE COMPLICATIONS IN LUMBAR SPINE SURGERY IN PATIENTS OVER 65 YEARS

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Introduction: Perioperative complications may affect the clinical outcomes in older subjects. This population is at risk of presenting adverse events such as infection, delirium and significant blood loss. We aim to assess perioperative complications in older patients ($>$ 65 years) who underwent lumbar spine surgery in our institution and determine potential associated risk factors.
Materials and methods: We identified patients aged $>$ 65 years who underwent lumbar spine decompression and/or fusion surgery between January 2015 and June 2018. Retrospective review of demographic data, intra- and postoperative (up to 30 days) complications. Descriptive analysis together with a logistic model to determine the risk of having a perioperative complication were performed.
Results: Seventy-three patients met the inclusion criteria (mean age of 72.3 $\pm$ 5.5 years). The median of Charlson's comorbidity index score was 3 (2–11) and the most frequent comorbidities were high blood pressure (60.3%), cancer (19.2%), diabetes (16.4%) and osteoporosis (5.5%). The median of surgical invasiveness index was 6 points (2–22); open surgery was performed in the majority of the patients. Average decompressed and fused levels were 1.23 and 1.34, respectively. We found 52 perioperative complications in 26 patients (10 intraoperative complications in eight patients and 42 postoperative complications in 24 patients. The most frequent intraoperative complication was a dural tear (six cases), while wound complications were the most recurrent postoperative complications (13 cases). We detected the following risks factors with the multivariate analysis for developing any type of perioperative complication: having an

intraoperative complication (OR 8.81, $p = 0.012$), Charlson's comorbidity index (OR 1.54, $p = 0.018$), spine surgical invasiveness index (OR 1.26, $p = 0.014$), number of decompressed levels (OR 2.82, $p = 0.02$), number instrumented levels (OR 1.65, $p = 0.047$) and length of hospital stay (OR 1.59, $p = 0.006$).
Conclusions: In this study, we identified demographic and surgical factors that are significantly associated with the occurrence of complications in older patients who undergo lumbar spine surgery, particularly an eight-fold increase of this risk after presenting an intraoperative complication.

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POSTOPERATIVE INFECTION IN THE LUMBAR SPINE. CAN IT BE PREVENTED?

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Table 1 Bivariate analysis of categorical variables

Variable	Total	Development of infection	*P* value
Gender			0.731
Male	76	4 (5.2)	
Female	124	8 (6.4)	
Age			0.035
≤ 65	92	2 (2.1)	
> 65	108	10 (9.2)	
BMI			0.849
< 25	32	1 (3.1)	
25–30	55	3 (5.4)	
> 30	70	4 (5.7)	
Previous UTI			0.009
No	163	6 (3.6)	
Yes	33	5 (15.1)	
Diabetes			0.030
No	174	8 (4.6)	
Yes	26	4 (15.3)	

Values in absolute cases and percentages between brackets
P values calculated with the Chi-squared test

Table 2 Bivariate analysis for continuous variables

Variable	No infection	Development of infection	*P* value
Age	67 (56–75)	74 (68–80)	0.061
BMI	29.4 (25.9–32.7)	29.5 (26.5–35.3)	0.487
Levels	2 (1–3)	4 (2–11)	0.005
IO time	180 (135–255)	330 (300–525)	< 0.001
Bleeding	600 (300–1200)	2050 (1400–3000)	0.019

Values expressed as medians and interquartile range
P values calculated with the Mann–Whitney U test

Introduction and objectives: Surgical site infection following adult spinal surgery is one of the most relevant complications in the early postoperative period with an incidence of around 0.7–12%, which implies an increase in morbidity, mortality and healthcare costs. Thus, identifying the risk factors is essential for the development of preventive strategies.
Materials and methods: Retrospective longitudinal study with follow-up of a cohort of patients who underwent spine surgery between 2016 and 2018. We determined the potential factors associated with the development of postoperative infection. The comparison of patients with infections against those who did not develop any was carried out using the Chi-squared test for categorical variables and the Mann–Whitney U test for continuous variables (Tables 1 and 2).
Results: Two hundred patients were included in the study with a mean age of 68 years from which 62% were female; mean BMI was 29.4 and a mean of two instrumented levels. Twelve patients (6%) developed postoperative infection; eight were female, 10 had more than 65 years of age, and eight were diabetic. Five subjects had urinary tract infection before undergoing surgery ($p = 0.009$). In all the patients for whom postoperative infection was shown, a statistically significant association with the length of the surgery (over 300 min ($p < 0.001$), number of instrumented levels (mean of four levels (2–11) p 0.005) and intraoperative bleeding (mean of 2050 ml (1400–3000) p 0.019) was observed.
Conclusions: In patients who undergo lumbar spine degenerative pathology surgery, prolonged interventions, intraoperative bleeding, instrumentation levels and diabetes significantly associates with greater risk of postoperative infection. Presence of previous infection in the urinary tract indicates a greater association with postoperative infection risk. In such cases, treatment should be assessed before spine surgery. An additional work increasing sample size is recommended to reaffirm the results of this study (Tables 1, 2).

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MANAGEMENT OF HERNIATED DISCS IN THE LOWER BACK. IS THERE ANY ADVANTAGE OF FUSION OR INTERSPINOUS STABILIZATION WITH RESPECT TO MICRODISCECTOMY? PROSPECTIVE COMPARATIVE STUDY

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Objectives and introduction: To assess if the addition of an interspinous spacer or interbody fusion provides clinical, safety or cost advantages in comparison to microdiscectomy only, in the management of lumbar herniated disk.
Materials and methods: Patients with a herniated disc in the lower back who were going to have surgery were chosen to participate in this study. Subjects in this cohort study were separated in three groups; microdiscectomy only (MD), microdiscectomy and interspinous spacer (IS), and posterior lower back interbody fusion (PLIF). The primary outcome measure was the clinical effectiveness (Oswestry disability index (ODI)). We also assessed other result parameters such as the visual analogue scale (VAS) for back and leg pain, length of hospital stay, hospital costs, 90-day complication rate and reoperation rate after 1 year.

Results: One hundred and three subjects with mean age 39.1 (± 8.5) years were included in the study. Significant improvements of initial back and leg pain scores were detected in the three groups with the ODI and the VAS. ODI scores changed from 62.66, 62.93 and 59.62 to 13.77, 13.50, and 17.62 in the MD, IS and PLIF groups, respectively ($p < 0.001$). After 1 year, no significant differences between the three groups were detected in back and leg pain with the ODI and VAS. Hospital costs increased 169% in the IS group and 287% in the PLIF group, in comparison to the MD group ($p < 0.001$). The length of hospital stay was 86% higher for the IS group and 384% higher for the PLIF group in comparison to MD ($p < 0.001$). Reoperation rates at 1 year were 5.6%, 10% and 16.2% ($p = 0.33$) for the MD, IS and PLIF groups, respectively.
Conclusions: Clinical improvement seems to be linked to microdiscectomy, without the implant (interspinous or fusion) adding any benefit. The inclusion of an interspinous spacer or fusion did not provide protection against reoperation and increased the length of hospital stay and the surgical costs.

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PROSPECTIVE RANDOMIZED CLINICAL TRIAL TO ASSESS THE EFFECTIVENESS AND SAFETY OF THE TREATMENT WITH EX VIVO-EXPANDED AUTOLOGOUS MESENCHYMAL CELLS IMMOBILIZED ON AN ALLOGENEIC-DERIVED BONE MATRIX (XCEL-MTOSTEO-ALPHA) IN COMPARISON TO AUTOLOGOUS ILIAC CREST BONE GRAFT IN LUMBAR SPINAL FUSION. PART I: RADIOLOGICAL RESULTS

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Objectives: The primary goal of this clinical trial is to assess the viability, safety and effectiveness of inserting ex vivo-expanded autologous bone marrow mesenchymal cells combined through the colonization of matrices of heterologous human cancellous bone (XCEL-MT-OSTEOALPHA) and compare the condition of the estimated intervertebral fusion with radiological techniques (Rx, TAC) against the obtained with autologous iliac crest bone graft.
Materials and methods: Phase II multicentre, randomized, prospective, open-label, parallel-group, single dose study (N° EudraCT: 2010-023999-12; NCT01552707). Sixty-five patients (mean age 61.05; 65.6% female) with degenerative spondylolisthesis (79.4%) and/or L4–L5 disc disease were included in the study. Subjects underwent an instrumented circumferential L4–L5 fusion to: transforaminal lumbar interbody fusion (TLIF) with interbody cage filled with autologous crest graft; intertransverse fusion: a local graft was placed on the TLIF side while XCEL-MTOSTEO-ALPHA (Group A, treatment) or autologous iliac crest bone graft (B, control) were placed randomly on the contralateral. One-year follow-up by registering adverse events. X-ray control at three, six, and 12 months; and CT scan control a six and 12 months. The condition of bone fusion was determined by a radiologist without knowledge regarding the used technique and based on previously established qualitative criteria.
Results: Thirty-one cases in treatment group (A) and 34 in the control group (B) were includeed in this study. No significant differences were determined in preoperative variables. No significant adverse reactions linked to the product were detected. The radiological results are shown in Tables 1 and 2. Intertransverse fusion rates (X-ray results) in the treatment group were significantly superior at three (85.7% vs. 56.3%), six (81.5% vs. 48.3%) and 12 months (96.3 vs. 51.7%). CT scan results showed a significantly higher rate of intertransverse fusion at 6 months (96.3% vs. 54.8%). Fusion rate after 1 year was higher in the treatment group, although not in a statistically significant way (86.2% vs. 66.7%).
Conclusions: XCEL-MTOSTEO-ALPHA is a viable and safe product in spinal fusion of the lower back surgery. Radiological fusion rates in the area at which the treatment was applied are significantly higher in comparison to those in which autologous crest graft was used (Tables 1, 2).

Table 1 Fusions (X-ray)

	Total	Group A (treatment)	Group B (control)
Anterior fusion 3 months (%) (n = 58; A = 31; B = 33)	15.8	11.1	20
Posterior fusion 3 months (%)	70	85.7*	56.3
Anterior fusion 6 months (%) (n = 56; A = 27; B = 29)	21.4	29.6	13.8
Posterior fusion 6 months (%)	64.3	81.5*	48.3
Anterior fusion 1 year (%) (n = 55; A = 27; B = 28)	32.7	44.4	21.4
Posterior fusion 1 year (%)	73.2	96.3*	51.7

*Intergroup significant difference ($p < 0.05$)

Table 2 Fusions (CT scans)

	Total	Group A (treatment)	Group B
Intertransverse fusion 6 months (%) (n = 59; A = 28; B = 31)	75	96.3*	54.8
Anterior fusion 6 months (%)	80	85.7	74.2
Intertransverse fusion 1 year (%) (n = 61; A = 28; A = 33)	75.8	86.2	66.7
Anterior fusion 1 year (%)	82.3	92.9	75.8

*Intergroup significant difference ($p < 0.05$)

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BONE MORPHOGENETIC PROTEIN 2 VERSUS AUTOLOGOUS ILIAC CREST BONE GRAFT IN LUMBAR LUMBAR FUSION: META-ANALYSIS

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Table 1 Table of risk differences in the consolidation rates of the included randomized clinical trials: a. at 6 months, b. at 12 months, c. at 24 months and d. CT scan

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Events	Total	Events	Total		CI of 95%
a. at 6 months						
Cho et al. 2017	41	41	46	51	1.6	9.82 [0.53–182.96]
Dawson et al. 2009	18	22	12	20	7.2	3.00 [0.74–12.23]
Dimar et al.2009	155	196	115	176	79.9	2.01 [1.26–3.19]
Glassman et al. 2005	26	37	6	32	6.0	10.24 [3.30–31.82]
Hulbert et al. 2013	89	93	38	88	5.3	29.28 [9.87–86.81]
Total (CI of 95%)		389		367	100.0	4.14 [2.91–5.89]
b. at 12 months						
Boden et al. 2002	11	11	2	5	0.5	32.20 [1.23–841.82]
Dawson et al. 2009	17	21	13	20	9.9	2.29 [0.55–9.52]
Dimar et al.2009	182	208	151	183	78.2	1.48 [0.85–2.60]
Glassman et al. 2005	30	37	15	35	11.4	5.71 [1.98–16.50]
Total (CI of 95%)		277		243	100.0	2.21 [1.41–3.46]
c. at 24 months						
Boden et al. 2002	11	11	3	5	1.2	16.43 [0.63–429.50]
Dawson et al. 2009	18	19	14	20	4.5	7.71 [0.83–71.69]
Dimar et al. 2006	48	53	33	45	21.0	3.49 [1.12–10.84]
Dimar et al.2009	186	194	151	169	41.4	2.77 [1.17–6.55]
Glassman et al. 2008	42	49	37	52	31.9	2.43 [0.89–6.61]
Total (CI of 95%)		326		291	100.0	3.20 [1.88–5.46]
d. CT scan						
Cho et al. 2017	4.56	42	3.98	51	60.0	0.58 [0.22–094]
Glassman et al. 2008	4.3	50	3.8	52	40.0	0.50 [0.06–0.94]
Total (CI of 95%)		92		103	100.0	0.55 [0.27–0.82]

Table 2 Table of risk differences of the included randomized clinical trials assessing: a. duration of the surgery, b. loss of blood and c. length of hospital stay

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Mean	Total	Mean	Total		CI of 95%
a. Duration of the surgery						
Boden et al. (2002)	222.0	11	186.0	5	4.6	36.00 [12.43, 59.57]
Dawson et al. (2009)	144.0	25	156.0	21	3.7	− 12.00 [− 38.32, 14.32]
Dimar et al. (2006)	144.0	53	174.0	45	17.9	− 30.00 [− 41.92, − 18.08]
Dimar et al. (2009)	150.0	239	174.0	224	41.0	− 24.00 [− 31.89, − 16.11]
Glassman et al. (2005)	168.0	38	210.0	36	20.3	− 42.00 [− 53.21, − 30.79]
Glassman et al. (2008)	248.0	50	270.0	52	7.2	− 22.00 [− 40.78, − 3.22]
Hulbert et al. (2013)	150.0	98	162.0	99	5.3	− 12.00 [− 33.84, 9.84]
Total (CI of 95%)		514		482	100.0	− 24.75 [− 29.80, − 19.70]
b. Blood loss						
Boden et al. (2002)	577.0	5	430.0	11	13.5	147.00 [36.73, 257.27]
Dawson et al. (2009)	329.0	25	452.0	21	11.0	− 123.00 [− 245.36, − 0.64]
Dimar et al. (2009)	343.0	239	449.0	224	61.0	− 106.00 [− 157.89, − 54.11]
Glassman et al. (2008)	670.0	50	674.0	52	4.9	− 4.00 [− 187.26, 179.26]
Hulbert et al. (2013)	615.0	98	643.0	99	9.6	− 28.00 [− 158.80, 102.80]

Table 2 continued

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Mean	Total	Mean	Total		CI of 95%
Total (CI of 95%)		417		407	100.0	− 61.19 [− 101.73, − 20.66]
c. Length of hospital stay						
Boden et al. (2002)	3.3	11	4.4	5	31.4	− 1.10 [− 1.54, − 0.66]
Carreon et al. (2009)	5.0	50	6.0	52	10.4	− 1.00 [− 1.77, − 0.23]
Dawson et al. (2009)	4.0	25	4.1	21	11.8	− 0.10 [− 0.82, 0.62]
Dimar et al. (2009)	4.1	239	4.0	224	41.8	0.10 [− 0.28, 0.48]
Hulbert et al. (2013)	6.0	98	7.0	99	4.6	− 1.00 [− 2.15, 0.15]
Total (CI of 95%)		423		401	100.0	− 0.47 [− 0.71, − 0.22]

Table 3 Table of risk differences of the included randomized clinical trials assessing the possibility of unscheduled surgery

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Events	Total	Events	Total		CI of 95%
a. Unscheduled surgery						
Dawson et al. (2009)	2	25	2	21	3.8	0.83 [0.11, 6.43]
Dimar et al. (2006)	0	53	3	45	7.1	0.11 [0.01, 2.26]
Dimar et al. (2009)	20	239	36	224	64.9	0.48 [0.27, 0.85]
Glassman et al. (2008)	5	50	11	52	18.5	0.41 [0.13, 1.29]
Hulbert et al. (2013)	2	95	3	93	5.7	0.65 [0.11, 3.95]
Total (CI of 95%)		462		435	100.0	0.46 [0.29, 0.74]

Table 4 Table of risk differences in clinical variables of the included randomized clinical trials: a. Low back pain Oswestry disability index (ODI), b. the 36-item health survey (SF-36) and c. Low back pain rating scale

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Mean	Total	Mean	Total		CI of 95%
a. Low back pain Oswestry disability index (ODI)						
Cho et al. (2017)	39.1	42	38.3	51	11.4	0.80 [− 17.23, 18.83]
Glassman et al. (2008)	15.8	50	13.0	52	88.6	2.80 [− 3.67, 9.27]
Total (CI of 95%)		92		103	100.0	2.57 [− 3.51, 8.66]
b. 36-Item health survey (SF-36)						
Cho et al. (2017)	60.3	42	60.0	51	1.1	0.30 [− 32.57, 33.17]
Glassman et al. (2008)	6.6	50	7.5	52	98.9	− 0.90 [− 4.34, 2.54]
Total (CI of 95%)		92		103	100.0	− 0.89 [− 4.31, 2.54]
c. Low back pain rating scale						
Boden et al. (2002)	5.1	11	6.2	5	15.2	− 1.10 [− 3.32, 1.12]
Dimar et al. (2009)	8.55	239	7.95	224	41.9	0.60 [− 0.74, 1.94]
Glassman et al. (2008)	3.5	50	3.4	52	42.9	0.10 [− 1.22, 1.42]
Total (CI of 95%)		300		281	100.0	0.13 [− 0.74, 0.99]

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Objectives and introduction: Different types of bone grafts are used in lumbar fusion. Bone morphogenetic proteins (BMP) seem to be a good option to substitute autologous iliac crest bone graft. However, there is still scarce evidence on the use of BMP. The aim of this metanalyses is to compare the effectiveness and safety of BMP-2 against autologous iliac crest bone graft.

Materials and methods: We carried out a systematic search in PubMed, EMBASE, Scopus and the Cochrane Collaboration Library from were nine randomized clinical trials were selected. A comparison of effectiveness, morbidity, quality of life and safety was done between the experimental group (BMP-2) and the control group (autologous iliac crest bone graft). Review Manager ver. 5.3 was used for the statistical analysis and to grade the quality of the evidence of the included trials.

Table 5 Table of risk differences of the included randomized clinical trials assessing no consolidation

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Events	Total	Events	Total		CI of 95%
a. No consolidation						
Carreon et al. (2009)	3	50	7	52	21.6	0.41 [0.10, 1.69]
Dawson et al. (2009)	0	25	2	21	8.9	0.15 [0.01, 3.37]
Dimar et al. (2006)	0	53	2	45	8.9	0.16 [0.01, 3.48]
Dimar et al. (2009)	6	239	18	224	60.6	0.29 [0.11, 0.76]
Total (CI of 95%)		367		342	100.0	0.30 [0.14, 0.61]

Table 6 Table of risk differences in adverse events of the included randomized clinical trials: a. Cardiovascular, b. Respiratory, c. Malignization, d. Surgical infection and e. Neurological

Study or subgroup	BMP-2		Autograft		Percentage	Odds ratio
	Events	Total	Events	Total		CI of 95%
a. Cardiovascular						
Carreon et al. (2009)	1	50	7	52	12.1	0.13 [0.02, 1.11]
Dimar et al. (2006)	9	53	6	45	9.7	1.33 [0.43, 4.07]
Dimar et al. (2009)	52	239	54	224	78.3	0.88 [0.57, 1.35]
Total (CI of 95%)		342		321	100.0	0.83 [0.56, 1.22]
b. Respiratory						
Cho et al. (2017)	0	42	1	51	9.2	0.40 [0.02, 9.98]
Dimar et al. (2006)	0	53	1	45	11.0	0.28 [0.01, 6.98]
Dimar et al. (2009)	15	239	12	224	79.8	1.18 [0.54, 2.59]
Total (CI of 95%)		334		320	100.0	1.01 [0.49, 2.09]
c. Malignization						
Dimar et al. (2009)	8	239	2	224	50.2	3.84 [0.81, 18.30]
Hulbert et al. (2013)	2	95	2	93	49.8	0.98 [0.13, 7.10]
Total (CI of 95%)		334		317	100.0	2.42 [0.75, 7.80]
d. Surgical infection						
Carreon et al. (2009)	1	50	4	52	7.7	0.24 [0.03, 2.27]
Dawson et al. (2009)	1	25	1	21	2.1	0.83 [0.05, 14.19]
Dimar et al. (2006)	0	53	1	45	3.2	0.28 [0.01, 6.98]
Dimar et al. (2009)	39	239	45	224	78.0	0.78 [0.48, 1.25]
Hulbert et al. (2013)	11	95	5	93	9.0	2.30 [0.77, 6.91]
Total (CI of 95%)		462		435	100.0	0.86 [0.57, 1.29]
e. Neurological						
Carreon et al. (2009)	0	50	1	52	3.2	0.34 [0.01, 8.54]
Dimar et al. (2009)	70	239	60	224	96.8	1.13 [0.75, 1.70]
Total (CI of 95%)	70	289	61	276	100.0	1.11 [0.74, 1.65]

Results: Nine hundred and eighty-two patients were included in the study. At 9 months, the fusion was confirmed in 94% of the subjects in the BMP-2 group and 82% in the control group (OR 3.20; CI of 95%: 1.88–5.46). At 6 and 12 months, the fusion was also superior in the BMP-2 group (85% vs. 59% and 87% vs. 74%, respectively). Surgery duration, intraoperative blood loss and length of hospital stay also showed significant differences in favour of the experimental group ($p < 0.00001$, 0.003 and 0.0002, respectively). No differences were detected between the two groups for the Oswestry disability index, the SF-36 health survey and the Low Back Pain Rating scale. There were no significant differences in terms of safety, except in no consolidation. The highest percentage of no consolidation was observed with autologous iliac crest bone graft ($p = 0.006$).
Conclusions: With the use of BMP-2 in lumbar fusion there is less surgical morbidity and more beneficial effects on the consolidation rate at short- and long-term. The quality of life and the safety are the same for both groups according to the clinical scoring (Tables 1, 2, 3, 4, 5, 6).

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VERTEBROPLASTY OUTCOMES IN KÜMMEL DISEASE

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Introduction and objectives: Avascular necrosis following an osteoporotic vertebral fracture (Kümmel disease) is a distinguishable entity among necrosis-free fractures. Some publications indicate that vertebral cementation is effective after the procedure, although it may cause medium-term complications. Here, we present clinical and radiological results achieved after percutaneous vertebroplasty (PVP) in Kümmel disease (KD).
Materials and methods: Retrospective analysis of a prospective cohort that includes 32 osteoporotic vertebral fractures in patients affected by the KD who underwent vertebroplasty in our centre. Intraoperative data on technique and complications were collected. We carried out a clinical-radiological follow-up. The following parameters were assessed: the pattern of PMMA distribution, morphological changes in the cemented vertebral body, new adjacent fractures, and pain improvement (VAS).
Results: Study patients were 59.4% female with median age of 82 years and 3.28 mean number of comorbidities. Sixty-five per cent were D11–L1 fractures. Mean follow-up was 13 months post-PVP. Mean injected PMMA was 4.39 cc: 37.5% solid pattern (SP) and 62.5% interdigital pattern (IP). Radiological changes were observed in 13 cases: six heterotopic ossifications, five fusions with the supra-adjacent vertebra, one fragmentation of the cement, and one radiolucency around the PMMA. Pre-PVP, immediate postoperative and at the end of follow-up values were as follows: percentage of crushing: 52%, 44% and 45%. Kyphosis: 15°, 14° and 16°. Pain-VAS: 7.9, 3.2 and 3.6 points. There was one postoperative re-collapse of the cemented vertebra, one total degeneration of the adjacent disc and seven adjacent fractures, all occurring within the first month following PVP, with higher frequency in the SP group (41% of the cases; $p < 0.05$). No cases of cement leakage into the canal nor secondary stenosis that required surgical decompression.
Conclusions: Although vertebroplasty performed in patients suffering Kümmel disease does not achieve total stabilization, there is significant improvement of pain, maintenance of vertebral height and kyphosis, without neurological deterioration. Thus, we hold that it is a safe alternative for fragile patients. Rigorous follow-up is required in these patients, particularly those with non-interdigital cement distribution within the vertebral body, as they have higher risk of suffering complications.

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VERTEBRAL FRACTURES IN DIFFUSE IDIOPATHIC SKELETAL HYPEROSTOSIS AND ANKYLOSING SPONDYLITIS: REVIEW OF OUR SERIES

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Introduction and objectives: Diffuse idiopathic skeletal hyperostosis (DISH) and ankylosing spondylitis (AS) determine a rigidity of the column that leads to high incidence of unstable fractures. The goal of this study is to determine the management and complications of this type of fractures from the arrival of the patient to the emergency department until the follow-up at year 1.
Materials and methods: Retrospective review of patients with AS and DISH who came to the emergency department in our centre between 2008 and 2018 and were diagnosed with vertebral fracture. We determined: Diagnostic delay between the arrival of the patient until the classification of the fracture as unstable. Neurological deficit. Performed surgical procedure. Intra- and postoperative complications. Mortality at 1 year.
Results: Seventeen patients (9 AS, 8 DISH) were included. Mean age 75.23 years; 88% male. Diagnostic delay was seen in 58.81% of patients, being up to 70% doctor's failures. Neurological deficit was established in 53.3% of cases (2 cases Frankel A, 5 cases Frankel C-D). The thoracolumbar spine was the most affected (58.9%), and chance fracture was the most commonly found (70.5%). In the nine cases of dorsal spine fracture, posterior fusion of two levels above, two levels below, and instrumentation of the affected vertebra was performed with no material failure 1 year after the surgery. In cervical spine, anterior fusion was performed in 3 cases, and posterior fusion in 4 cases. Half of the patients who suffered neurological deficit recovered from their lesion, at least partially, by year 1 post-intervention. There were three postoperative wound infections that required debridement once or twice, one material failure in a anterior cervical procedure and four medical complications (three pneumonias and one gastroparesis). Mortality by year 1 was 29.4%.
Conclusions: In a high percentage of cases, the unstable nature of vertebral fractures in patients with AS and DISH remains unnoticed in the emergency department. Half of the patients have neurological deficit. In our series, fusion of two levels above and two levels below and instrumentation of the fractured vertebra was enough in subjects with dorsal spine fractures.

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SURGICAL URGENCIES AND EMERGENCIES IN THE SPINE

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Introduction: The relevance of determining the initial management, based on the type of lesion in acute spine pathologies with medullary Involvement, radicular or fractures, with or without neurological changes, requiring surgical treatment as per the established protocols, allows Identifying the surgery as urgent or emergent.
Objectives: To determine the urgent or emergent surgical treatment based on the time elapsed in performing the surgery.
Materials and methods: Prospective, interventional, comparative study. Pre- and postoperative assessment of patients who underwent surgery within 6 and 24 h, and after 48 h; follow-up of 1 year and 6 months using the ASIA classification and the SF36 survey. The results were analysed using the non-parametric Wilcoxon signed-rank and the Kruskal–Wallis tests. Significance p 0.05.
Results: Seventy-five patients. Group I underwent surgery within 6 hours (10); Group II within 24 h (22); Group III were operated after

48 h (43). The ASIA and SF36 tests showed statistically significant improvement in the first groups; $p = 0.005$ and $p = 0.006$, respectively. Subjects who underwent surgery after 48 h with incomplete medullary lesion showed non-significant improvement. No improvement was seen in subjects who underwent surgery after 48 h with complete medullary lesion. Patients treated between 4 and 24 h with complete or incomplete medullary lesion showed statistically significant improvement. Acute spinal cord lesions requiring surgical treatment is treated based on the type, level and stability, at cervical, dorsal and lumbar level without neurological changes preferably before 48 h. Complete medullary lesion is a surgical urgency. Medium or high cervical medullary lesion and incomplete dorsal are emergencies due to the risk of an increase of neurological changes or death.
Conclusions: In cases of complete medullary lesion, there are scarce possibilities of neurological recovery regardless of the time to surgical treatment. In cases of incomplete medullary lesion, there are higher possibilities of improvement with early surgery and it should be considered a surgical emergency.

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COMPLICATED SPINAL FRACTURES WITHOUT NEUROLOGICAL CHANGES

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Introduction: Complex vertebral column fractures or fractures/dislocations show similar biomechanical changes between them when. In this context, we refer to complicated fractures without neurological changes as those pathologies with high risk of neurological changes and serious structural damage depending on the affected spinal region.
Objectives: To classify complicated fractures with no spinal neurological changes to determine the duration of the surgical treatment.
Materials and methods: Prospective, interventional, comparative study. We assessed and classified pre- and postoperatively complicated fractures without neurological changes for 1 year and 6 months of follow-up using the ASIA classification and the SF36 survey. The results were analysed using the non-parametric Wilcoxon signed-rank and the Kruskal–Wallis tests. Significance p 0.05.
Results: Twenty-nine patients. Group I: type A lumbar fractures. Subtype A1 multiple levels; subtype A2 fracture and dislocation (7); Group II: type B dorsal fractures. Subtype B1 high dorsal; subtype B2 dorsal; B3 dorsolumbar junction (11); Group III: type C cervical fractures. Subtype C1 cervical; subtype C2 cervicothoracic; subtype C3 occipito-cervico junction (11). Assessed with ASIA and SF36 with high and medium risk of presenting medullary lesion with statistical significance $p = 0.006$. Types B2, B3 and C3 had statistically significant high risk of presenting neurological lesion at 24 and 48 h following the trauma in comparison to those who underwent surgery within the first 6 h. Types A1, A2, B1, C1, C2 had statistically significant medium risk of presenting neurological lesion at 48 h following the trauma in comparison to those who underwent surgery within 24 h.
Conclusions: Serious spinal fractures without neurological changes need to be diagnosed and treated promptly considering the type of complication and level of the fracture. This way it is possible to determine any required special care, type and duration of surgery. The classification of complicated spinal fractures without neurological changes determines that types B2, B3 and C3 fractures have to be treated as surgical emergencies and be operated within the following 6 h after the occurrence of the trauma, while type A1, A2, B1, C1, C2 fractures are classified as surgical urgencies to be resolved within 24 h.

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VERTEBROPLASTY IN PATIENTS WITH OSTEOPOROTIC VERTEBRAL FRACTURE: IS SAGITTAL IMBALANCE PROGNOSTIC FACTOR OF THE FINAL CLINICAL OUTCOME?

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Introduction: To our knowledge, little research has been carried out on the correlation between values defining sagittal and postoperative outcome following vertebroplasty (VP) due to osteoporotic vertebral fracture (OVF). We designed a prospective observational study and included 51 patients with OVF who underwent VP for a period of 2 years and 12-moth follow-up. We assessed the clinical outcomes (pain, disability and quality of life) of patients who underwent VP due to OVF based on their sagittal balance.
Materials and methods: Sixty-seven subjects were initially included in the study, although 16 did not end the follow-up. The clinical evaluations at 1, 3 and 12 months determined the spinal axial pain with the aid of the visual analogue scale (VAS), disability using the Oswestry disability index (ODI) and la quality of life with the SF-36. The radiological assessment included sagittal balance parameters (SVA, LL, TK, PI, SS, PT).
Results: Overall, the 51 patients had 113 OVF. No significant differences were found in the VAS and the ODI between the SVA > 50 mm group and the SVA < 50 mm ($p > 0.05$). On the contrary, pre-VP of SF-36 scores showed worse results in the SVA > 50 mm group in the physical function domain ($p < 0.05$) and in the physical component ($p < 0.05$). These differences were observed up to 6 month of follow-up ($p < 0.05$).
Conclusions: Patients with SVA > 50 mm show a slower recovery of their quality of life after undergoing surgery (no significant differences), with regard to pain or disability, in comparison to patients with SVA < 50 mm. These findings have allowed identifying a new potential prognostic factor—sagittal imbalance- and consequently to identify a subgroup of patients for whom we can anticipate a slower recovery after undergoing a VP due to OVF and provide this subpopulation with more realistic expectations regarding their clinical outcome following VP.

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HAS THE CURRENT SCIENTIFIC EVIDENCE ON THE ADVANTAGES OF EARLY SURGERY FOR URGENT TREATMENT OF TRAUMATIC SPINAL CORD LESION CHANGED THE WAY SPINAL SURGEONS PROCEED?

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Table 1 .

	Group				*P* value
	10–13		14–17		
	N	% of N	N	% of N	
Gender					
Male	261	80.1	224	71.8	0.015
Female	65	19.9	88	28.2	
Total	326	100.0	312	100.0	
Age range					
< 25	55	16.8	58	18.6	< 0.001
26–35	77	23.6	45	14.4	
36–45	60	18.4	50	16.0	
46–55	42	12.9	39	12.5	
56–65	34	10.4	53	17.0	
66–75	34	10.4	41	13.1	
> 75	24	7.4	26	8.3	
ASIA at admission					
A	171	52.5	147	47.1	0.464
B	54	16.6	51	16.3	
C	56	17.2	65	20.8	
D	45	13.8	49	15.7	
ASIA at discharge					
A	159	48.8	133	42.6	0.161
B	39	12.0	30	9.6	
C	49	15.0	48	15.4	
D	77	23.6	96	30.8	
E	2	.6	5	1.6	
NASCIS					
NO	191	58.6	234	75.0	< 0.001
SI	135	41.4	78	25.0	

	< 24 h		< 48 h		< 72 h		4–7 days		> 7 days	
	N	%	N	%	N	%	N	%	N	%
Group A	70	21.5	67	20.6	26	8.0	58	17.8	105	32.2
Group B	102	32.7	40	12.8	37	11.9	59	18.9	58	18.6

Objectives and introduction: Assess if the publication over recent years of clinical guidelines and recommendations on the advantages of early surgery (< 24 h) has changed the way of acting of spine surgeons towards the treatment of acute traumatic spinal cord injury (TSCI).
Materials and methods: Analytical, observational, retrospective, longitudinal cohort study. Temporal comparison of two cohorts of patients with TSCI. Group A: 326 TSCI patients (2010–2013); Group B: 312 TSCI patients (2014–2017). We assessed the time between the occurrence of the lesion and surgery, ASIA scale at admission and discharge at our hospital, demographic variables, implementation of the NASCIS III protocol in the hospitals of origin. Inclusion criteria: TSCI patient, admitted in our hospital within 90 days after the lesion, had undergone surgery in the hospital of origin, assessment of the ASIA scale at admission and discharge by the same physician. Statistical analyses: Chi-squared test for comparing proportions and the Kruskal–Wallis test for comparing continuous variables between subgroups.
Results: The most relevant data are shown in Table 1. In group A, 21.5% of the subjects underwent surgery within the first 24 h in comparison to 32.7% in group B ($p = 0.001$). Twenty-six point seven per cent of the patients with incomplete lesions from group A underwent surgery < 24 h in comparison to 31.2% from group B ($p = 0.36$). In group A, 20.1% per cent of the subjects with cervical lesions were operated < 24 h in comparison to 25.7% de from group B ($p = 0.23$). The NASCIS III protocol was implemented in the hospitals of origin on 41.4% of the patients from group A and 25% from group B ($p < 0.001$).
Conclusions: Over the last years, there has been an increase of TSCI patients operated during the first 24 h after the lesion, although to date it is only done in one third of the lesions and not more in incomplete or cervical cases. The implementation of the NASCIS III protocol in hospitals is decreasing. Still, high doses of corticoids are administered in 25% of the patients despite the recommendation of not doing so.

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DEVELOPMENT OF PATIENT-TAILORED GUIDE IN HIGH CERVICAL SPINE FIXATION

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Objectives and introduction: High cervical spine fixation may represent a challenge for spine surgeons due to the complex anatomy and the risks of vascular and medullary lesions. The recent advances in 3D printing technology have opened a new range of options. In this study, we aim to assess the accuracy of C1 lateral mass fixation using a patient-tailored printed guide through a 3D cervical model.
Methods: We developed a guide for the adjustment of C1 lateral mass screws with the help of 3D printing. Eight real-size models of the high cervical spine and the corresponding guides based on CT scans were created. The guiding threads were introduced with the help of the guides and the models analysed using a CT scan.
Results: All the assessed guiding threads in this study showed a safe path in the models, respecting superior and inferior articular surfaces, the vertebral canal and the vertebral artery.
Conclusions: In this study, we show the effectiveness of the guide. It is a reliable tool to assist in the adjustment of guiding threads in C1 lateral masses screws.

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CROWNED DENS: COMMON FINDING IN OLDER PEOPLE, RADIOLOGICAL DEGENERATIVE SIGN OR CLINICAL SYNDROME?

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Objectives and introduction: It is unknown if the ossification around the dens is a common or pathological finding. The aim of this study is to determine the differences in ossification around the odontoid

apophysis to distinguish between a common finding in aged individuals, early degeneration and the crowned dens syndrome.
Materials and methods: Retrospective study on 843 upper spine CT scans studies carried out between January and June 2018. For each patient the following variables were considered: age, gender, nape pain and fever, as well as the presence of linear or clot-like calcifications in the CT scan and signs of degeneration in the disc spaces or in the zygapophyseal joints.
Results: Twenty-seven of the 843 CT scan studies (3.2%) reveal some type of calcification around the odontoid apophysis. Mean age of the patients was 80.4 (range, between 57 and 98) years; 59% male and 41% female. The most frequent indication for performing the study was neurological pathology. One case indicated nape pain; no fever in any of the cases. Among the patients with calcification around the odontoid, two (2/27) had chondrocalcinosis in other sites.
Conclusions: Calcification around the odontoid apophysis is frequent in aged patients. There is no correlation between the presence of calcification and nape pain and should be assessed as an involutional change inherent to age, although it should be associated with crowned dens in middle age (30 to 50) patient with nape pain.

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IS IT NECESSARY TO SAVE BLOOD PREOPERATIVELY IN CERVICAL SPINE SURGERY? MULTIVARIATE ANALYSIS

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Objectives and introduction: Preoperative blood saving is a prophylactic measure aiming to solve any urgent need of intraoperative or immediate postoperative blood transfusion. However, is this necessary in transfusion rates below 5%? Our primary objective is to determine the current rate of transfusion in cervical spine surgery, establishing the hypothesis that it is not necessary to save blood for all patients who undergo this surgery. The secondary objective is to assess the risk factors in patients who required blood transfusion.
Materials and methods: Cohort of patients who underwent cervical spine surgery in two centres between 2012 and 2017 (655 patients). Patients whose clinical record was unavailable were excluded (149 patients). The following variables were collected and analysed: demographic, clinical and surgical including preoperative and postoperative haemoglobin (Hb), preoperative INR, need of transfusion, cause for surgery, surgical approach, corpectomy, surgeon's experience and centre at which the surgery was carried out.
Results: We analysed 503 patients (302 men and 204 women). Mean age 56.2 (SD 15.2) years; 73.7% of the patients underwent surgery due to degenerative disease. Concentration of preoperative Hb was 14.2 gr/dl (SD 1.7) (Table 1). Eighteen patients required transfusion (3.6%). The need of intraoperative transfusion was 0.7% (4 patients). In our final multivariate model having preoperative anaemia (OR 49.48; CI of 95%: 11.65–210.18), INR > 1.2 (OR 33.25; CI of 95%:

Table 1 General characteristics of study participants

	Surgical approach			*P* value
	Anterior (n = 176) % (n)	Posterior (n = 330) % (n)	TOTAL % (n)	
Gender				0.993
Male	59.7 (197)	59.7 (105)	59.7 (302)	
Female	40.3 (133)	40.3 (71)	40.3 (204)	
Age (years)				< 0.001
Mean	54.0 ± 14.3	60.1 ± 16.1	56.2 ± 15.2	
Surgery				0.050
Primary	94.5 (309)	89.8 (158)	92.8 (467)	
Revision	5.5 (18)	10.2 (18)	7.2 (36)	
Blood transfusion				0.078
No	97.6 (319)	94.3 (166)	96.4 (485)	
Yes	2.4 (8)	5.7 (10)	3.6 (18)	
ASA	classification			
0.001				
I	10.1 (29)	7.6 (11)	9.3 (40)	
II	61.5 (176)	46.9 (68)	56.6 (244)	
III	27 (77)	38.6 (56)	30.9 (133)	
IV	1.4 (4)	6.9 (10)	3.3 (14)	
Corpectomy				< 0.001
Si	3.41 (6)	86.9 (284)	9.7 (49)	
No	96.6 (170)	13.2 (43)	90.3 (454)	
Preoperative Hb (gr/dl)			0.002	
Mean	14.2 ± 1.5	13.7 ± 1.8	14.0 ± 1.7	
Postoperative Hb (gr/dl)				< 0.001
Mean	12.4 ± 1.8	11.5 ± 1.9	12.1 ± 1.8	
Type of pathology				0.006
Degenerative	78.8 (260)	64.2 (113)	73.7 (373)	
Fracture	16.4 (54)	25.6 (45)	19.6 (99)	
Tumoral	2.7 (9)	7.4 (13)	4.4 (22)	
Other	2.1 (7)	2.8 (5)	2.3 (12)	
INR				0.115
Mean	1.0 ± 0.15	1.0 ± 0.19	1.0 ± 0.16	
Surgery duration (min)				< 0.001
Mean	145.8 ± 51.53	172.6 ± 62.41	155.1 ± 56.95	

ASA: American Society of Anesthesiologists, Hb: Haemoglobin, INR: International normalized ratio, gr: grams, dl: decilitres

Table 2 Logistic regression OR (CI of 95%) risk factors associated with blood transfusion in cervical spine surgery

	Bivariate		Multivariate	
	OR (CI of 95%)	*P* value	OR (CI of 95%)	*P* value
Age	0.99 (0.97–1.03)	0.776		
Corpectomy				
No	1		1	
Yes	5.14 (1.84–14.38)	0.002	7.92 (1.54–40.71)	0.013
Preoperative Hb (gr/dl)				
> 12 gr/dl	1		1	
≤ 12 gr/dl	49.48 (11.65–210.18)	< 0.001	49.48 (11.65–210.18)	< 0.001
Postoperative Hb (gr/dl)	0.26 (0.16–0.43)	< 0.001		
Differential Hb (gr/dl) (postoperative Hb- preoperative Hb)	0.92 (0.62–1.37)	0.681		
Type of pathology				
Degenerative	1			
Fracture	4.69 (1.66–13.27)	0.004		
Tumoral	5.21 (1.02–26.74)	0.048		
Other	4.74 (0.54–41.91)	0.162		
INR	8.28 (1.69–40.46)	0.009	33.25 (2.47–447.95)	0.008
Surgery duration (min)	1.02 (1.01–1.03)	< 0.001	1.01 (1.001–1.03)	0.028
Surgeon's experience (years)				
+ 20 years	1		1	
10–20 years	5.29 (1.48–18.92)	0.010	8.23 (1.31–51.80)	0.025
5–10 years	0.73 (0.12–4.39)	0.725	9.39 (0.74–119.74)	0.085
Surgical approach				
Posterior	1		1	
Anterior	2.40 (0.93–6.20)	0.070	2.31 (0.59–9.11)	0.232

OD: Odds ratio, CI: Confidence interval, Hb: Haemoglobin, INR: International normalized ratio, gr: grams, dl: decilitres

2.47–447.95), corpectomy (OR 7.92; CI of 95%: 1.54–40.71) and surgeon's experience (OR 8.23; CI of 95%: 1.31–51.80) were significant risk factors for transfusion need (Table 2).

Conclusions: Considering the low current need of intraoperative and postoperative blood transfusion, we hold that it is not necessary to ask for blood saving for all patients who undergo cervical surgery, which would lead to saving In the health. Blood saving should be considered only in high risk patients, e.g., patients with preoperative anaemia, increased INR and those who will undergo a corpectomy.

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COMPARATIVE STUDY BETWEEN X-RAY AND RESONANCE FOR MEASURING CERVICAL SAGITTAL PARAMETERS IN THE SPINE

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Introduction: Over the last years, assessment of the cervical spine profile and sagittal balance has been gaining interest, considered essential for preoperative planning and associated to the outcome. The traditional gold standard for these measurements—profile X-ray-frequently makes it difficult to correctly assess them due to the unfavourable exposure of the structures of interest, particularly the C7 or T1 bodies or the complication to assess cranial parameters, which may determine its reliability.

Objectives: To analyse if cervical measurements performed with X-rays and CT scans are comparable and assess if CT scans may be a valid test image for determining cervical sagittal parameters.

Materials and methods: Retrospective study of a series of cases from patients who underwent cervical spondylotic myelopathy surgery between 2010 and 2014. Inclusion criteria: patients older than 18 years with preoperative, immediate postoperative and follow-up X-rays and CT scans. Reoperated patients were excluded. The following parameters were measured: C0–C2 Cobb angle, C2–C7 Cobb angle, C7 Slope, C2–C7 SVA. Data are presented as means and SD. The comparative study of means between X-rays and CT scans was performed using Student's t-test and the degree of agreement was assessed with Pearson's correlation. SPSS version 20.0 (IBM Corp, NY).

Results: We analysed 41 patients (70.7% male) with a mean age of 57.76 years (37–81). No significant differences were determined in the analysis of means between X-rays and CT scans. We found an intermediate-high correlation in all the compared measurements, except for preoperative C2–C7 SVA (r = 0.3; $p < 0.107$). Preoperative C0–C2 angle (r = 0.738; $p < 0.037$). Preoperative C2–C7 angle (r = 0.484; $p < 0.006$). Postoperative C2–C7 angle (r = 0.65; $p < 0.003$). Follow-up C2–C7 angle (r = 0.533; $p < 0.016$). Preoperative C7 slope (r = 0.733; $p < 0.001$). Postoperative C7 slope (r = 0.463; $p < 0.046$).). FU C7 slope (r = 0.557; $p < 0.016$). Postoperative C2–C7 SVA (r = 0.519; $p < 0.019$).). C2–C7 SVA FU (r = 0.47; $p < 0.018$).

Conclusions: There is good correlation between X-rays and CT scans of cervical sagittal parameters. CT scans may be an alternative to X-rays and a reliable test for measuring cervical parameters.

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CARDIAC AND GENITOURINARY ANOMALIES ASSOCIATED CONGENITAL ANOMALIES OF THE SPINE. RETROSPECTIVE STUDY ON 223 PATIENTS

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Objectives and introduction: The cardiovascular/genitourinary systems and the spine share a mesodermal origin that explains the common presence of cardiac and genitourinary anomalies in cases of spine anomalies. For this reason, it is important to suspect and detect these cases. The objectives of this study are to (1) determine the incidence of cardiac and genitourinary anomalies in our patients affected of congenital spine anomalies; (2) determine the type of associated cardiac and genitourinary anomalies; (3) determine the most frequent types of spine anomalies in patients with cardiac and genitourinary anomalies.
Materials and methods: Retrospective study on 223 patients with congenital scoliosis between 2013 and 2017. Patients for whom clinical and radiological records were unavailable were excluded (20 patients). The following data were collected and analysed for subjects with anomalies: demographic (age, gender) and clinical (type of associated cardiac, genitourinary and/or vertebral anomalies).
Results: We found 9% of cardiac anomalies and 20% genitourinary anomalies in our patients with congenital scoliosis. The most frequent cardiac anomalies were interventricular communication (27%) and interauricular communication (14%). Thirty patients had genitourinary malformations. The most frequent genitourinary malformations were renal agenesis (congenital solitary kidney) (12%) and horseshoe kidney (17%). In these patients, the most frequent vertebral alteration was the mixed type, segmentation and formation defects (45%), based on the classification by McMaster. Forty-five per cent of the vertebral anomalies were found in the thoracic region. The most frequent associated syndromes were the Goldenhar syndrome (26%) and the Jarcho-Levin syndrome (17%).
Conclusions: Our study shows 9% and 20% incidence of cardiac and genitourinary anomalies, respectively, in patients with spine congenital anomalies. The most frequent vertebral changes in these patients were of the mixed type in the thoracic region.

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MEDULLARY ANOMALIES IN CONGENITAL SCOLIOSIS: ANALYSIS OF INCIDENCE AND PROGRESSION CURVES

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Objectives and introduction: There is close anatomical and embryological association between the spine and the spinal cord. It is common to find intramedullary anomalies linked to congenital scoliosis. Studies carried out in other countries have reported a prevalence of 15–47% of intramedullary anomalies associated with congenital scoliosis. To the best of our knowledge, this type of study has not been published in Spain. The aim of this study is to (1) determine the incidence, in our patients, of intramedullary anomalies related to congenital scoliosis and analyse the type of intramedullary and associated anomalies; (2) assess curve progression in congenital scoliosis based on the associated intramedullary anomaly and the McMaster classification.
Materials and methods: Retrospective study on 223 patients with congenital scoliosis between 2013 and 2017. Patients without CT scan images at the final analysis were excluded from the study. We determined the incidence of intramedullary anomalies assessing demographic, clinical and radiological data in these patients. A comparison against 26 random controls (patients with congenital scoliosis without associated anomalies) was done to assess the role of intramedullary anomalies in curve progression. Moreover, we compared the progression based on the McMaster classification.
Results: We found 14.8% incidence of intramedullary anomalies in patients affected by congenital scoliosis. The most frequent anomaly was siringomielia and most frequent curve was the thoracic one. Eight patients had associated thoracic anomalies. Curve progression during follow-up was significantly higher in patients with intramedullary anomalies associated to thoracic anomalies (p value = 0.019). In our

Table 1 Demographic and clinical data of study patients

Total	19 cases-mean (SD)
Age at the end of follow-up (years)	7.3 (5.3)
Age at diagnosis of congenital scoliosis (years)	3.8 (3.6)
Follow-up (months)	5.4 (2.9)
Female (%)	57.9%
Thoracic anomalies (%)	42.1%
Cardiac anomalies (%)	5.2%
Genitourinary anomalies (%)	15.7%

SD: standard deviation, %: percentage

Table 2 Characteristics and curve progression in patients with congenital scoliosis in our study depending on their association with or without intramedullary anomalies

	Group 1 Medullary anomaly (n = 11)	Group 2 Medullary + thoracic (n = 8)	Group 3 Controls (n = 26)	*P* value
Age (years): Mean (CI)	8.3 (4.4–12.2)	9.9 (5.2–14.6)	11.5 (9–14)	0.326
Age at diagnosis (years): mean (CI)	2.8 (0.4–5.2)	5.1 (1.8–8.5)	4.9 (3.1–6.7)	0.351
Follow-up (months): mean (CI)	6.4 (3.5–9.3)	5.6 (3.8–7.3)	7.4 (5.8–9)	0.457
Preoperative Cobb (degrees): Mean (CI)	25 (15.1–34.7)	38.6 (9.2–68)	26 (21.7–31)	0.194
Postoperative Cobb (degrees): Mean (CI)	36 (19.8–52.4)	58.6 (31–86.2)	33.5 (27.2–39.8)	0.019

CI: Confidence interval

Table 3 Characteristics and curve progression in patients with congenital scoliosis in our study as per the type of McMaster classification

	McMaster classification			*P* value
	Group 1* (n = 26)	Group 2 + (n = 3)	Group 3[a] (n = 16)	
Preoperative Cobb (degrees): Mean (SD)	29.8(16.7)	28 (30.4)	25.1(15.4)	0.708
Postoperative Cobb (degrees): Mean (SD)	36.7(17.2)	45.3 (37.8)	39.2(26.1)	0.797

*Segmentation anomalies, [+] Formation anomalies, [a] Mixed anomalies, SD: Standard deviation

study, there was no correlation between the McMaster classification and greater progression (p value = 0.797).

Conclusions: Here we observe a lower percentage of intramedullary anomalies in comparison to other published series. Patients with congenital scoliosis and intramedullary and thoracic anomalies show a significant increase in curve progression. Contrary to other studies, in this study there is no correlation between the different categories of the McMaster classification and greater progression of scoliosis (Tables 1, 2, 3).

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EFFICACY OF THE MANAGEMENT WITH GROWTH BARS OF EARLY-ONSET SCOLIOSIS IN CHILDREN YOUNGER THAN FIVE YEARS OF AGE

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Objectives and introduction: The usefulness of growth bars in the management of early-onset scoliosis is known, although it is unknown what happens if they are introduced too early and lose their effectiveness before the skeleton is fully developed. The purpose of this work is to investigate if the treatment "wears out" before the beginning of the pubertal peak.

Materials and methods: Retrospective descriptive study of a cohort in one centre between 2004 and 2018. Patients with growth bars introduced before the age of five and follow-up until the pubertal peak were included. We analysed serial X-rays during distraction visits and collected the following parameters: length of the thorax (T1–T12), spine height (T1–S1) and magnitude of the major curve (Cobb), in all pre- and postoperative retightening.

Post-retightening measurements

Post-retightening measurement moment	Cobb (°)	T1–T12 (mm)	T1–S1 (mm)
Before the surgery	85.3	140.3	223.1
Initial surgery	46	153.15	260.13
First retightening	48	168.3	274.6
Second retightening	44.4	170.8	275.5
Third retightening	47	176	283.6
Fourth retightening	46	181	292
Fifth retightening	46	190.6	309
Sixth retightening	44	196.2	314.3
Seventh retightening	47	192.75	323.50
Adjustment	51	178	316

Measures before each retightening

Pre-retightening measurement moment	Cobb (°)	T1–T12 (mm)	T1–S1 (mm)
Before the surgery	85.3	140.3	223.1
First retightening	53.8	164.3	253.55
Second retightening	53.69	168.92	270.42
Third retightening	54.67	162.45	270
Fourth retightening	52	163.36	272.54
Fifth retightening	51.54	178.3	276.63
Sixth retightening	55.75	179.14	297. 75
Seventh retightening	52.71	175.14	305

Results: We analysed 16 patients with a mean age of 4.50 (1.03) years at the beginning of the treatment. Thirteen girls (81%) and three boys (18%). There were two cases of neuromuscular etiology, three

congenital, four idiopathic and seven syndromic. Mean time between retightening was 9.9 months. Mean Cobb angle at the beginning of the study was 85.33° (14.08). After the initial surgery, there was 56% improvement, with no further advance subsequently. There was a 10° decline before every retightening, which was corrected in each intervention. Mean final Cobb angle was 51.25° (a decline of 10° since the initial surgery). Mean initial T1–T12 length was 140.3 mm. The greatest increase was achieved with the initial surgery (13 mm). With each retightening, there was a mean gain of 10.4 mm, lost between retightenings. Growth of T1–T12 was observed until the fourth retightenings and from then on, this distance was maintained in each retightening. Total T1–T12 growth was 20 mm. Initial T1–S1 height was 223.1 mm. The index surgery lengthened 37 mm. There was a 3-cm improvement until the fourth retightening. Although there was a loss of 7.4 mm between each retightening, the gain was higher. Mean growth at the end of the study was 65 mm.
Conclusions: No T1–T12 length growth occurs after the fourth retightening. Subsequent retightenings allow maintaining the initial gain. With each retightening, there is growth of the T1–S1 height. Initially there is 56% improvement of the magnitude of the curve and the program allows maintaining this gain.

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VENOUS THROMBOEMBOLISM PROPHYLAXIS. IS IT NECESSARY IN SCOLIOSIS SURGERY FOR THE PAEDIATRIC AGE?

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Introduction: Venous thromboembolism (VTE) includes deep vein thrombosis (DVT) and thrombus-pulmonary embolism (TPE), rarely occurring in paediatric patients. Few studies report its incidence following scoliosis surgery, consequently making the use of prophylaxis to avoid them a controversial issue and complicating the creation of protocols for its administration.
Objectives: To review the complications of VTE in our centre after scoliosis surgery and the current prophylaxis protocol to help prevent VTE complications. We also aim to present a recommendation guide for chemoprophylaxis in scoliosis surgery for children.
Materials and methods: We performed a retrospective review of VTE incidence based on the database in our centre between 1997 and 2017 with the parameters spine surgery with DVT and TPE. During the first years, the protocol did not include heparin prophylaxis; from 2015 on, a general protocol was created by the Haematology Service (not exclusive for scoliosis) that includes chemoprophylaxis treatment based on patient's risk factors (VTE history, age, obesity, tobacco use, medication, associated conditions, immobilization). General measures (hydration, wandering and early removal of the central venous catheter). Mechanical measures (elastic stockings, pneumatic boots). A review of this protocol was performed considering the results.
Results: One thousand eight hundred and eighty-two surgeries were done with no associated diagnosis of DVT or TPE. Two TPE cases were reported (one hip surgery, one tenotomy) and eight DVT cases linked to OST independent processes. Use of chemoprophylaxis, mechanical measure are reported in $< 0.5\%$, early removal of the central venous catheter, early mobilization was done in 98%. Considering the negative VTE results, our recommendations Include mobilization, early removal of the central venous catheter and no heparin administration in children 12 to14 years, except in cases with VTE history. In children aged over 14 years, we suggest the use of heparin In cases of obesity, existence of one or more hereditary thrombophilia factors, or prothrombotic risk factors.
Conclusions: Thromboprophylaxis in children is not universally recommended; prophylactic measures should consider the risk factors of thrombosis and haemorrhage in every patient.

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USE OF POWDERED VANCOMYCIN OVER THE GRAFT. DOES IT AFFECT SPINAL FUSION IN RABBITS?

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Introduction: *In vitro* studies suggest that vancomycin is highly cytotoxic for the osteoblasts. However, various in vivo clinical studies have provided no evidence or determined this effect on osteogenesis.
Objectives: To investigate the effect of topic vancomycin in a lumbar fusion model on New Zealand white rabbits.
Methods: Experimental, randomized, double blind study. Posterolateral spinal fusion was performed on 30 rabbits divided in two groups: A: graft/placebo B: graft/vancomycin. After the animals were sacrificed, bone calluses were assessed with the aid of CT scans, and were classified in three groups: no fusion (0), partial/incomplete fusion (1) and fusion (2). Histological analyses of the samples were also done. We assessed the association between presence of fusion (complete/incomplete) and the studied group with Poisson's log-linear model with two covariables. Adherences to the histological results were examined using contingency tables and the Chi-squared test. Level of significance 0.05.
Results: We determined 30% less chance of complete fusion with vancomycin treatment (0.30. CI of 95%: 0.12–0.94) in comparison to the group. In other words, the vancomycin group had 2.3 times (CI of 95%: 1.02–4.91) more chance of incomplete fusion in comparison to placebo group.
Conclusions: The use of powdered vancomycin on grafts reduces fusion rates in 30%, at doses five times higher than those routinely used by our team in fusions.

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PROGNOSTIC ABILITY OF THE TOKUHASHI SCORE IN A SERIES OF 305 PATIENTS

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Objectives: To analyse the prognostic ability (percentage of patients whose survival was the indicated) of the Tokuhashi score in a series of 305 patients with spinal metastasis in our hospital.
Materials and methods: Retrospective study of spinal metastasis diagnosed in our centre between 2006 and 2016. The following variables were studied: mean age, gender, Tokuhashi score, pathological fracture, metastasis into internal organs and medullary lesion. Cases with incomplete data or loss of follow-up were excluded from the study.

Results: We analysed 305 cases. Mean age of 63.7 years; 56.7% male subjects. Tokuhashi group I, II, and III were made up by 181, 87 and 37 patients, respectively. Patients with e lesion: group I 26%, group II 11.5% and Group III 16.2%. Pathological fractures: group I 17.1%, group II 12.6% and group III 21.6%. Metastasis into internal organs: group I 69%, group II 37.9% and group III 14%. Consistent prognosis: group I 71.3%, group II 33.3% and group III 78.4%. Consistent prognosis was significantly different between groups I and II ($p < 0.001$) and between II and III ($p < 0.001$). The last 33 patients of the series were assessed by a multidisciplinary tumour commission (traumatology, radiotherapy, oncology, radiology, etc.), and no statistical improvement was detected in the variable consistent prognosis Metastasis into internal organs were significantly more frequent in group I in comparison to groups II and III ($p < 0.001$ and $0 < 0.007$, respectively). Medullary lesions were significantly more frequent in group I with respect to group II ($p < 0.006$). No 'significant differences were found between groups regarding pathological fractures.
Conclusions: 1. In 59.3% of the cases, patients with spinal metastasis arrive to the spine unit in an advance stage of the condition. 2. Tokuhashi score shows high prognosis consistency for groups I (71.3%) and III (78.4%), and low for group II (33.3%). In this latter group, crucial decisions have to be taken on the type of treatment, conservative or surgical (radical or palliative surgery). 3. Due to the inexistence of a more powerful scoring method, decisions must be supported by several tools: the modified Tokuhashi score, SINS, Karnofsky and some specific tools depending on the type of tumour (Her2 markers in breast cancer, hormone receptors in prostate cancer, etc.).

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DOES ACHIEVING APPROPRIATE RADIOLOGICAL CORRECTION IN ADULTS WHO UNDERGO DEFORMITY SURGERY PREVENT AGAINST THE APPEARANCE OF IMPLANT-RELATED COMPLICATIONS?

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In adult deformity surgery, certain radiological reference parameters have been established that mark the goal of the correction to achieve the estimated improvement of the disability and quality of life. However, no studies have been performed to assess if achieving these radiological goals also prevents from the occurrence of implant-related complications.
Objectives: To assess if achieving the correction of the deformity considering the reference radiological parameters reduces the occurrence of implant-related complications.
Methods: Retrospective study on patients who underwent adult deformity surgery with a follow-up of at least 2 years. Study subjects were divided in two cohorts depending if the correction after the surgery adjusted to the reference values (Correction group: SVA $\leq$ 5 mm; PT $\leq$ 20°; PI-LL $\leq$ 10°; no correction group: SVA > 5 mm; PT > 20°; PI-LL > 10°). We identified patients who had suffered complications associated with the implants (breakage, loosening, adjacent disc syndrome, pull-out, etc.) and compared if the percentage of patients with complications differed between both groups using the Chi-squared test.
Results: One hundred and nine patients were included in the study with a mean age of 69 years, 28% male and BMI 28.1. Mean follow-up was 36 months (minimum 27–maximum 51). The variables age, gender, BMI and number de instrumented levels were similar in both groups. Considering the reference values, in 28 (25.7%) patients correction of SVA was achieved, en 18 (16.6%) pelvic extension (PT) and in 27 (27.3%) the PI-LL. Implant-related complications were identified in 43 cases (39.1%). In the group of patients for whom the appropriate correction was not achieved, only those who did not achieve adequate PT had significantly higher number of implant-related complications (Table 1).
Conclusions: Achieve radiological reference values of correction in adult patients with spinal deformities requires adequate planning to prevent insufficient corrections. The correction of the PT, one of the primary compensation mechanisms in sagittal imbalance, not only is relevant to improve the quality of life, but it should also be considered to help prevent implant-related complications.

Table 1 Occurrence or not of complications depending on the correction group

Measure	Achievement of correction	Implant failure	*P* value
SVA	No (n = 81)	32 (38.1)	0.584
	Yes (n = 28)	12 (44.1)	
PT	No (n = 91)	41 (44.3)	0.008
	Yes (n = 18)	2 (10)	
PI-LL	No (n = 82)	28 (34.1)	0.851
	Yes (n = 27)	10 (38.4)	

Values are presented as absolute number of cases and percentage between brackets

P values calculated using the Chi-squared test

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RESTORING THE IDEAL ROUSSOULY SAGITTAL PROFILE IN ADULT SCOLIOSIS SURGERY HELPS REDUCE THE RISK OF MECHANICAL COMPLICATIONS

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Objectives and introduction: The optimization of the global sagittal alignment in adult deformity improves patient's quality of life and

reduces the risk of postoperative complications. However, no studies have been carried out examining if restoring the sagittal profile according to Roussouly classification provides additional benefits in adult scoliosis (AS). Here, we aim to examine this effect on a cohort of patients who underwent AS with and without postoperative mechanical complications.

Materials and methods: Retrospective study of a cohort of patients who underwent AS surgery. Data were collected from a prospective multicentre database. We distinguished the sagittal types considering Roussouly's 4-type classification using pre- and postoperative (at 6 weeks) lateral X-rays. We analysed sagittal plane mismatch in each patient based on the pelvic incidence (ideal plane), pre- and postoperatively. Univariate and multivariate analysis was performed to determine the potential risk factors for the occurrence of postoperative mechanical complications after a minimum follow-up of 2 years.

Results: Ninety-six patients were included. We compared 57 patients without mechanical complications against 39 patients with mechanical complications (18 proximal junctional kyphosis, 11 ROD breakages/pseudarthrosis, 10 screw pull-outs). Seventy-two per cent of the patients postoperatively mismatched from the ideal plane developed mechanical complications in comparison with 15% of matched subjects ($p < 0.001$). The univariate analysis showed that the risk of suffering a mechanical complication was higher in the following populations: aged patients 64.9 ± 13 versus 40.7 ± 15.6 years ($p < 0.001$), preoperative Roussouly's profile type 1–2 ($p = 0.025$), upper vertebra instrumented at thoracolumbar level versus high thoracic level (T2–T5) (62% vs. 21%) ($p < 0.001$), instrumented to the iliac versus above S1 (76% vs. 6%) ($p < 0.001$), and postoperative mismatched from ideal Roussouly type (72% vs. 15%) ($p < 0.001$). The multivariate analysis selected as the most relevant: distal iliac instrumentation, age and postoperative mismatched from ideal Roussouly type.

Conclusions: Adult scoliosis surgery aims to restore the ideal sagittal profile determined by pelvic incidence to reduce the risk of mechanical complications, particularly in patients older than 65 years with instrumentation to the iliac.

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ANALYSIS OF CORONAL AND SAGITTAL FACTORS THAT INFLUENCE BODY IMAGE PERCEPTION IN PATIENTS WITH ADULT DEFORMITY

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Introduction: Body image (BI) can be assessed with self-image (SRS-22. Image) and trunk deformity (TAPS) perception. The literature on adult deformity (AD) suggests that BI is linked to the outcome in surgical patients. To date it is unknown which radiological factor affect BI in AD.

Table 1 Pearson's and Spearman's correlation analyses

	TAPS	SRS-22 Image
Continuous radiographic variables		
LMC	− 0.48** ($p = 0.00$)	− 0.10 ($p = 0.09$)
Coronal balance	− 0.16** ($p = 0.00$)	− 0.20** ($p = 0.00$)
GT	− 0.25** ($p = 0.00$)	− 0.28* ($p = 0.00$)
SVA	− 0.26** ($p = 0.00$)	− 0.33** ($p = 0.00$)
T2–T12 kyphosis	0.00 ($p = 0.93$)	− 0.07 ($p = 0.19$)
T10–L2 kyphosis	− 0.20** ($p = 0.00$)	− 0.04 ($p = 0.43$)
L1–S1 lordosis	0.09 ($p = 0.13$)	0.22** ($p = 0.00$)
PI	− 0.08 ($p = 0.19$)	0.02 ($p = 0.75$)
PT	− 0.14* ($p = 0.02$)	− 0.18** ($p = 0.00$)
SS	0.06 ($p = 0.30$)	0.23** ($p = 0.00$)
SRS-Schwab classification groups		
Coronal curve types	− 0.13* ($p = 0.02$)	0.09 ($p = 0.09$)
Pelvic Tilt modifier	− 0.15* ($p = 0.00$)	− 0.20* ($p = 0.00$)
Global alignment modifier	− 0.28** ($p = 0.00$)	− 0.37** ($p = 0.00$)
PI minus LL modifier	− 0.13* ($p = 0.03$)	− 0.23 ($p = 0.00$)

LMC (large major Cobb); GT (global tilt); SVA (Sagittal vertical axis); PI (pelvic incidence); PT (pelvic tilt); SS (sacral slope)

Objectives: To determine which factors affect BI in non-operated patients with AD.

Methods: Retrospective analysis of data collected prospectively from a multicentre database of AD patients. We identified patients who had not undergone surgery diagnosed with idiopathic or degenerative scoliosis and complete baseline data of SRS-22 and TAPS. We assessed baseline scoliograms: Cobb angle of the major curve (Max Cobb) and measurements of the sagittal profile (Table 1). Patients were classified in different groups based on: the Max Cobb ($\leq 25°$; 26°–45°; 46°–60° and $> 60°$) and sagittal deformity (SRS-Schwab classification). An analysis of variance (ANOVA) was performed to determine BI differences in each of the radiological groups. For the correlation analysis between the various variables a level of significance (p) of ≤ 0.05 was applied.

Results: Three hundred and twenty patients (85% female; mean age 49.3 years; mean Max Cobb 48.4°). The ANOVA identified significant Inter-group differences in the TAPS and SRS-22.Image scores. The post hoc analysis showed differences of the TAPS scores in all coronal deformity (CD) groups. Patients with greater CD had worse perception of trunk deformity. Regarding sagittal modifiers, we found differences between the groups of patients without deformity (PI-LL $< 10°$; PT $< 20°$ and SVA < 4 mm) and patients with severe deformity (PI-LL $> 20°$; PT $> 30°$ and SVA > 9.5 mm) in TAPS in SRS-22.Imagen ($p = 0.00$). We observed a mild-moderate correlation between the questionnaires and the radiological parameters (Table 1).

Conclusions: In AD, although patients with greater radiological deformity have worse BI, the correlation of the radiological parameters *per se* and the SRS-22.Imagen and TAPS scores correlate poorly. Global sagittal alignment parameters and the Max Cobb seem to be the main parameters related with adult BI.

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DOES THE USE OF CLINICAL PHOTOGRAPHS IMPROVE THE SATISFACTION AND SELF-IMAGE OF PATIENTS WHO UNDERGO ADULT DEFORMITY SURGERY?

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Objectives and introduction: Previous studies have shown that pre- and postoperative use of spinal photographs in adolescents who undergo scoliosis and kyphosis surgery improves the satisfaction of the patients with the treatment. In this work, we aim to assess if the satisfaction and self-image of patients who undergo adult deformity (AD) surgery change after seeing pre- and post-operative photographs.
Materials and methods: Non-concurrent prospective study. Inclusion criteria: older than 25 years at the time of surgery, availability of pre-and postoperative follow-up (after 2 years) photographs of the whole body, and had undergone fusion of five or more levels for some of the following reasons: idiopathic or degenerative scoliosis greater than 40°, sagittal and/or coronal imbalance > 5 cm, T3–T12 kyphosis > 80°, thoracolumbar greater than 20°. Subjects with congenital, neuromuscular, tumoral or traumatic anomalies were excluded. After the approval of the ethics committee, study patients attend two medical appointments. First visit: The patient completes the SRS 22 questionnaire. New anteroposterior, posteroanterior, and lateral clinical photographs are taken. All the photographs were made by the same professional photographer under the same technical conditions. Second visit (1 week later): The patient sees the preoperative and updated photographs and answers again questions 4, 6, 10, 14, 19 (self-image) 21 and 22 (satisfaction) of the SRS 22.
Results: Thirty patients (28 female) were included in this work. Causes for surgery: scoliosis (20), imbalance (8) and hyperkyphosis (2). Twenty-one posterior approaches, nine double approaches. Arthrodesis of 11 levels (5; 17). Mean age 59 (28; 81) years. Median follow-up duration of 60 months (24; 120). SRS 22 in the first visit: activity 2.79 ± 0.75; self-image 2.71 ± 0.82; pain 2.53 ± 1.10; mental health 3.08 ± 0.77; satisfaction $3.4\ 6 \pm 1.20$; Global 2.74 ± 0.2. SRS22 in the second visit: self-image 2.9 ± 0.75; satisfaction 4.02 ± 0.97. After seeing the preoperative and the updated photographs there was a significant improvement of the SRS self-image ($p = 0.000$) and SRS satisfaction ($p = 0.011$).
Conclusions: In patients who undergo AD surgery, showing whole body clinical photographs improves their satisfaction and self-image.

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IS THE CLINICAL CONDITION OF ADULT PATIENTS WHO UNDERGO SPINE DEFORMITY SURGERY COMPARABLE TO THAT OF THE GENERAL POPULATION? COMPARATIVE STUDY WITH A FOLLOW-UP GREATER THAN TWO YEARS

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Surgical treatment of adult patients with spine deformity has shown to be more efficient than conservative treatment regarding the improvement of the disability and quality of life. However, it is not clear if the clinical situation of these patients after the surgery is comparable to that of the general population.
Objectives: To analyse the clinical outcome in adult patients who undergo spine deformity surgery adjusted by age and determine how much it differs from the clinical situation described for the general population.
Methods: Retrospective study with a follow-up greater than 2 years of a cohort of adult patients who underwent spine deformity surgery. Two groups were established based on patient's age (≤ 60 vs. > 60 years) and the achieved improvements following the surgery were examined using Student's t-test and the Mann–Whitney U test for paired samples. The result was then compared against quality of live values described in the literature for the healthy general population with the Student's t-test t.
Results: Eighty-two patients were included. Mean age 68 years (85–75), 78% female, BMI 28.1 (24.5–31.6) and eight mean instrumented levels (6–13). At the end of the follow-up period, patients

Table 1 Pre-/postoperative clinical differences

TEST	Preoperative	Postoperative	*P* value
ODI	57.1 (18.4)	36.5 (22.2)	< 0.001
SRS22 PAIN*	1.80 (1.4–2.2)	3.25 (2.4–4.2)	< 0.001
SRS22 FUNCTION*	2.40 (2.0–2.6)	3.00 (2.4–3.6)	< 0.001
SRS22 SELF-IMAGE*	2.00 (1.6–2.3)	3.40 (2.8–3.8)	< 0.001
SRS22 MENTAL HEALTH	2.34 (0.77)	3.52 (0.97)	< 0.001
SRS22 TOTAL	2.18 (0.4)	3.34 (0.8)	< 0.001

Values presented as absolute number of cases and percentage between brackets

P values calculated using Student's t-test for paired samples

*Not normal variables in the groups. Data presented as medians and interquartile ranges between brackets, *P* value calculated using the Mann–Whitney U test for paired samples

Table 2 Differences between the healthy population and the study group

TEST	Healthy population	N = 82	Worse %	*P* value
ODI	8.75	36.5	310	< 0.001
SRS22 PAIN	4.36	3.29	24.5	< 0.001
SRS22 FUNCTION	4.27	3.12	26.9	< 0.001
SRS22 SELF-IMAGE	4.22	3.33	21.1	< 0.001
SRS22 MENTAL HEALTH	4.19	3.52	16.0	< 0.001
SRS22 TOTAL	4.25	3.34	21.2	< 0.001

Values presented as means. *P* values were calculated using Student's t-test

Table 3 Results as per gender

Gender	Group age	Healthy population	N = 82	Worse %	*P* value
ODI					
Male	≤ 60	9.52	43.12	348.7	< 0.001
	> 60	10.60	30.94	210.3	0.005
Female	≤ 60	8.58	17.50	123.2	0.070
	> 60	12.55	40.44	221.5	0.010
SRS22 PAIN					
Male	≤ 60	4.40	3.10	25.0	< 0.001
	> 60	4.40	3.40	22.7	0.006
Female	*≤ 60*	*4.33*	*4.06*	*6.2*	*0.478*
	> 60	4.23	3.13	26.0	0.031
SRS22 FUNCTION					
Male	≤ 60	4.29	3.02	29.6	< 0.001
	> 60	4.18	3.26	22.0	0.003
Women	≤ 60	4.30	3.71	17.3	0.044
	> 60	4.11	2.50	39.1	0.003
SRS22 SELF-IMAGE					
Male	≤ 60	4.25	3.30	22.3	< 0.001
	> 60	4.27	3.34	21.7	0.001
Women	≤ 60	4.16	3.60	13.4	0.011
	> 60	4.16	3.17	23.7	0.009
SRS22 MENTAL HEALTH					
Male	≤ 60	4.22	3.45	18.2	< 0.001
	> 60	4.28	3.38	21.0	0.003
Women	*≤ 60*	*4.08*	*4.12*	*− 1.1*	*0.884*
	> 60	4.09	3.45	15.6	0.127
Total SRS22					
Male	≤ 60	4.27	3.23	24.3	< 0.001
	> 60	4.28	3.38	21.0	0.001
Female	*≤ 60*	*4.19*	*3.88*	*7.3*	*0.235*
	> 60	4.14	3.17	23.4	0.014

Values presented as means. *P* values calculated using Student's t-test

showed significant improvement of their disability and total scoring in all SRS-22 subdomains (Table 1) in comparison to their preoperative situation. However, the clinical improvement achieved after surgery was significantly different from the values described for the general population, particularly regarding disability (Table 2). The comparison between groups as per age revealed that only women under 60 years of age had results similar to those of the healthy general population regarding pain, mental health and total SRS-22 score (Table 3).

Conclusions: Although surgical treatment significantly improved the disability and quality of life of adult patients who underwent spinal surgery, this improvement differs from the clinical situation described for the general population. Further research on which factors contribute to this difference may help improve the clinical outcome in these patients.

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GLOBAL ALIGNMENT PARAMETERS (GSA, CSVAH). IS THERE A BETTER CORRELATION WITH QUALITY OF LIFE THAN WITH SPINOPELVIC ALIGNMENT PARAMETERS IN PATIENTS WHO UNDERGO ADULT SPINAL SURGERY?

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Correction goals in adult deformity (AD) surgery are based on spinopelvic alignment (SVA, PT, PI-LL) parameters. However, the convergence of lower extremity compensatory mechanisms poses the need to assess recently described global alignment parameters (GSA, CSVAH).

Objectives: To compare global alignment parameters with spinopelvic alignment parameters and assess their relationship with quality of life. Considering the global alignment parameters described to date (GSA, CSVAH), analyse which of them correlates better with quality of life tests.

Materials and methods: We performed a retrospective study on a cohort of patients who underwent AD surgery with a minimum follow-up of 24 months was performed. Spinopelvic alignment and global alignment parameters were studied and next the correlation between these parameters and quality of life tests was examined using Spearman's correlation. We also verified if the correlations were significantly different from zero.

Results: Twenty-five patients for whom the necessary radiological studies were available for measuring the angles of interest, as well as quality of life clinical data after 2 years of follow-up were included. Eighty per cent of the subjects were women, mean age was 68 years and BMI 29.2. Mean follow-up was 26 months (minimum 24–maximum 36). A powerful correlation between both global alignment parameters and between them and the SVA (Table 1) was found. In the analysis of the association with quality of life, we determined that CSVAH correlated better with the function subdomain of SRS22 than of GSA or the spinopelvic parameters. However, parameters such as pelvic extension (PT) or spinopelvic harmony (PI-LL) correlated better with the pain ad self-image subdomains of SRS22, respectively (Table 2).

Conclusions: In this work, we show a strong correlation between global alignment parameters and spinopelvic parameters, which assess sagittal imbalance (SVA) as previously described in the

Table 1 Correlation with spinopelvic parameters

Measurement	CSVAH	GSA
PT	0.906***	0.060
PI-LL	0.329	0.448
SVA	0.563**	0.927***

*$0.05 < p < 0.1$; **$0.01 < p < 0.05$; ***$p < 0.001$

Table 2 Correlation with quality of life

Quality of life test	GSA	CSVAH	SVA	PT	PI-LL
VAS	0.240	0.223	0.115	0.174	0.296
ODI	0.165	0.136	0.054	0.080	0.213
SRS22	− 0.135	− 0.105	0.012	0.081	− 0.267
SRS22 function	− 0.314	− 0.344*	− 0.211	− 0.205	− 0.314
SRS22 pain	− 0.118	− 0.031	0.074	− 0.354*	− 0.287
SRS22 self-image	− 0.251	− 0.240	− 0.158	− 0.194	− 0.388*
SRS22 mental health	0.159	0.163	0.235	− 0.084	0.067

* $0.05 < p < 0.1$; ** $0.01 < p < 0.05$; *** $p < 0.001$

literature. However, in this study global alignment parameters do not clearly show a better correlation with the quality of life tests in comparison with the previously described spinopelvic parameters.

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HEALTH RELATED QUALITY OF LIFE PREOPERATIVE PREDICTION ASSOCIATED TO ADULT SPINAL DEFORMITY SURGERY: ONE STEP FORWARD TO PERSONALIZED MEDICINE

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Objectives and introduction: Health Related Quality of life (HRQoL) results have been shown to be heterogeneous following Adult Spinal Deformity (ASD) surgery. Predictive analytics may accurately model HRQoL improvements after ASD surgery. Predictive modeling may be useful in shared-decision making and surgical planning may help stratify patients according to the risk–benefit associated with each surgical option. The objective of this study was to model health-related quality of life (HRQOL) overall improvement, including the likelihood of achieving clinically important improvement, at 2 years postoperatively. The aim of this study is to model HRQoL overall improvement, including the likelihooin minimal clinically important differences (MCID) at 2 years after the surgery.

Materials and methods: Two prospective observational cohorts were retrospectively queried for ASD patients with SRS-22/ODI/SF-36v2 data at baseline, 1 year and 2 years after surgery. 75 variables were used in the training of the models including demographic data, enrollment HRQOL, and modifiable surgical data. 8 different prediction algorithms were trained with 3-time horizons: baseline to 1-year, baseline to 2-year and 1-year to 2-year. The validation was accomplished via an 80/20 data split for training and testing each model, respectively. 5-Fold cross validation within the training sample was performed. Accuracy was measured as the mean average error (MAE; smaller is better) and R^2 values.

Results: Five hundred and seventy patients were included in the analysis. Models with the lowest MAE for each of the 5-time points were selected; ultimately the model had 82.4% predictive power. Patients with lower enrolment HRQoL were likely to appreciate the greatest improvements in HRQOL at 2-year followup. SRS22r questions linked to back pain (p1), level of activity (p5), housekeeping (p12) or self-image (p19) were the ones that predicted with greater accuracy. The models were less sensitive to questions about financial difficulties (q15), depression (q16) and days of sick leave (q17). The surgeon and site increased the predictive power 1.8%. Site and surgeon fixed-effects had a crucial role when explaining outcome variance.

Conclusions: We present an accurate and consistent way of predicting outcome scores for ASD surgery in the largest-to-date prospective operative multicenter cohort with 2-year follow-up. This study has significant clinical implications for shared-decision making, surgical planning and postoperative counseling. Surgeon and site were important components of the model, explaining variance in predicted 2-year HRQOL. Here we present an accurate and consistent way of predicting outcome scores for ASDsurgery at 2 years after surgery. These models may be of help during decision-making, surgical planning, and preoperative counseling in the personalized medicine era.

Predictive results simulating the surgery five and 10 years later

	QoL instruments	Preoperative score	Improvement probability (%)	10% higher preoperative score (%)	5-year wait with 10% reduction of preoperative QoL (%)	10-year wait with 20% reduction of preoperative QoL (%)	Number of levels between 10 and 15 (%)	Variation range between options (%)
Global improvement	ODI	68	54.4	43.5	67.6	72.6	54.4	29.1
Improvement above MCID	ODI	68	38.4	28.4	52.0	57.7	38.4	29.3
Global improvement	SRS22 Function	3.2	65.0	51.4	76.4	83.5	65.0	32.1
Improvement above MCID	SRS22 Function	3.2	35.4	23.4	48.3	58.4	35.4	35.0
Global improvement	SRS22 Mental health	2.4	80.6	82.0	86.0	90.3	78.6	11.7
Improvement above MCID	SRS22 Mental health	2.4	64.7	66.6	72.4	79.2	62.0	17.2
Global improvement	SRS22 Pain	2	61.4	67.1	76.2	82.6	62.2	21.2
Improvement above MCID	SRS22 Pain	2	46.2	52.3	62.9	71.0	47.0	24.8
Global improvement	SRS22 Self-image	2.4	81.5	83.7	84.3	86.9	81.5	5.4
Improvement above MCID	SRS22 Self-image	2.4	34.6	37.8	38.8	43.3	34.6	8.7
Global improvement	SRS22 subtotal	2.38	69.8	74.7	84.8	91.7	70.7	21.9
Improvement above MCID	SRS22 subtotal	2.38	45.8	51.7	65.6	77.7	46.8	31.9
Global improvement	SF32v2 MCS	22.18	95.6	95.6	97.0	98.0	95.6	2.4
Improvement above MCID	SF32v2 MCS	22.18	81.5	81.5	85.9	89.5	81.5	8.0
Global improvement	SF32v2 PCS	39.66	44.3	34.6	60.4	63.4	43.5	28.8
Improvement above MCID	SF32v2 PCS	39.66	17.4	11.6	29.7	32.4	16.9	20.8

Patient: 60 years ol female with previous surgery, loss of balance, without comorbidities, employed, no gait problems, height 167.6 cm, weight 63.9 kg, sagittal disruption of 71.68 cm, major coronal Cobb of 11.8°, pelvic tilt of 30.59°. Surgery: pelvic fixation, seven fused vertebrae, posterior instrumentation, one PSO, 0 SPO, no interbody fusion, 10 levels between the first and the last Instrumented level

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UTILIZATION OF ARTIFICIAL INTELLIGENCE BASED HIERARCHICAL CLUSTER ANALYSIS OF PATIENT BASELINE CHARACTERISTICS AND SURGICAL INVASIVENESS PROVIDES NOVEL INSIGHTS ON 2-YEAR OUTCOMES AND COMPLICATIONS THROUGH PATTERN RECOGNITION

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Objectives and introduction: Adult Spinal Deformity (ASD) is a heterogeneous condition with a broad range of surgical options. Unsupervised machine-based pattern clustering of patient types based on radiographic parameters and quality of life measures alongside combinations of surgical options may simplify ASD patient types, procedures and outcomes. Artificial intelligence (AI) based pattern recognition may augment preoperative decision making for surgeons in real time by identifying similarity patterns in ASD patient types when combined with procedure groups.

Materials and methods: Two prospective cohorts were retrospectively queried for surgical ASD patients with SRS-22/ODI/SF-36 data at baseline, 1 year and 2 years. Artificial intelligence based hierarchical cluster analysis was utilized to identify 12 empirically-driven groups for adult spinal deformity (ASD) surgery. Classification built upon delineation of 3 patient types and 4 surgery types facilitates statistical prediction of quality of life improvements and major complications (MC) rates. Two dendrograms on the same observations were fitted, one with surgical features and one with patient characteristics. Both were built with Ward distances and optimized with the Gap method. For each of the possible "n" patient clusters by "m" surgeries, normalized average improvement at 2 years and adjusted MC rates were computed.

Results: Three optimal patient types were identified based on 570 patients: Young with Coronal plane deformity (YC) (n = 195), Older with prior spine surgeries (ORev) (n = 194) and Older without prior spine surgery (OPrim)(n = 218). Osteotomy type, instrumentation and interbody fusion were combined to define 4 optimal average surgical options. 2-year normalized average improvement ranged from − 0.074% for SF36 MCS score in cluster (1.3) to 100.2% for SRS self-image score in cluster (2.1). MC rates at 2 years ranged from 0 to 51.8%.

Average 2 Year Normalized HRQL Improvement and Major Complication Rates Across Clusters

Patient Class	Surgery Class	ODI	SF36v2 PCS	SF36v2 MCS	SRS subtotal	SRS SI	SRS MH	SRS function	SRS pain	Major Complication Rate	n
YC (1)	1	16.0%	25.3%	0.6%	15.7%	36.9%	2.5%	14.4%	22.9%	40.7%	27
1	2	11.0%	9.6%	8.8%	16.0%	39.6%	8.7%	8.1%	16.2%	26.9%	52
1	3	23.4%	26.5%	-0.1%	19.3%	31.2%	3.7%	13.9%	36.4%	30.4%	46
1	4	15.8%	22.1%	4.7%	21.6%	51.6%	7.3%	13.4%	26.4%	18.6%	70
ORev (2)	1	48.7%	23.5%	33.7%	48.2%	100.2%	32.5%	30.2%	76.0%	51.8%	56
2	2	48.5%	29.7%	17.2%	36.4%	60.1%	20.4%	24.5%	58.5%	0.0%	7
2	3	52.3%	24.7%	41.8%	46.5%	67.5%	40.2%	30.6%	79.4%	51.8%	56
2	4	55.4%	35.6%	45.7%	59.9%	92.8%	45.3%	45.0%	93.1%	44.7%	38
OPrim (3)	1	31.1%	36.2%	7.2%	27.1%	57.9%	14.1%	19.7%	38.4%	35.6%	59
3	2	41.5%	22.4%	11.2%	31.2%	35.7%	27.8%	31.8%	49.7%	38.5%	13
3	3	41.1%	41.7%	13.8%	31.8%	48.2%	14.0%	31.4%	54.1%	38.0%	92
3	4	41.1%	34.1%	13.3%	33.3%	68.0%	11.7%	23.4%	58.9%	35.2%	54

Patient Class	Sample Size	Prior spine surgeries	Age	Sagittal Balance (mm)	Coronal Balance °	Major Curve Cobb °	Inverse ODI score	SRS22 subtotal score	SF36v2 MCS score	SF36v2 PCS score	
1	N=195	0.08 (0.31)	47.6 (18.1)	17.3 (47.4)	27.7 (23.7)	50.4 (20.8)	74.7 (13.8)	3.44 (0.40)	53.0 (9.62)	40.8 (9.76)	Baseline
2	N=157	0.48 (1.28)	62.3 (11.7)	88.1 (73.4)	28.1 (24.4)	32.7 (18.8)	41.6 (13.3)	2.05 (0.36)	31.0 (9.37)	28.9 (6.43)	
3	N=218	0.07 (0.29)	61.0 (13.8)	66.8 (67.8)	36.8 (40.1)	36.6 (19.2)	53.7 (13.2)	2.78 (0.37)	46.8 (10.4)	30.0 (8.00)	
P-value overall		<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	

Surgery Class	Sample Size	Osteotomy	Number of levels	Pelvic Fixation	IBF	TLIF	ALIF	SPOs	PSOs	3CO	
1	N=142	0.85 (0.36)	11.4 (4.81)	0.66 (0.47)	0.60 (0.49)	0.25 (0.44)	0.15 (0.36)	1.01 (2.24)	0.65 (0.49)	0.84 (0.44)	Surgical Param.
2	N=72	0.00 (0.00)	10.0 (3.36)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	
3	N=194	0.47 (0.50)	9.48 (4.34)	0.72 (0.45)	0.89 (0.31)	0.69 (0.47)	0.10 (0.30)	1.99 (2.61)	0.00 (0.00)	0.00 (0.00)	
4	N=162	0.98 (0.14)	11.8 (3.34)	0.65 (0.48)	0.32 (0.47)	0.01 (0.11)	0.32 (0.47)	4.98 (2.54)	0.00 (0.00)	0.00 (0.00)	
P-value overall		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	

Conclusions: Unsupervised AI hierarchical clustering can identify subtle patterns and classification clusters that may augment preoperative decision making through construction of a 2 year risk benefit grid. In addition to enhancing outcome and complication prediction, pattern identification may facilitate treatment optimization by educating surgeons on which treatment patterns yield optimal benefit with lowest risk.

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INTERSPINOUS DEVICE FOR PREVENTING ADJACENT SEGMENT DEGENERATION IN LUMBAR SPINE SUPRA-FUSION LEVEL

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Introduction: One of the uses of lumbar interspinous devices is to protect the supra-adjacent level from degenerating following lumbar fusion by limiting the mobility without fusing the segment. The aim of this study is to compare the incidence of degeneration of the adjacent segment between patients with lumbar fusion without interspinous device (Cohort A) and patients with lumbar fusion and interspinous device in the supra-adjacent level (Cohort B).

Materials and methods: Retrospective study. We compared the appearance of radiological disc degeneration between patients with lumbar fusion with/without interspinous device (ISD) in the supra-adjacent level who underwent surgery in our centre between 2008 and 2018, with a radiological follow-up of at least 1 year. In the radiological study, we determined the disc ratio (relationship between disc height and the anteroposterior distance of the vertebral body) and the angulation between the vertebras superior and inferior to the disc, pre- and post-operatively. To establish the pre- and postoperative differences of each cohort we used Wilcoxon's test and for intergroup differences the Mann–Whitney U test.

Results: We examined 20 patients with mean age of 54.4 years in cohort A and 55.8 years in cohort B and mean follow-up 46.8 and 56.7 months, respectively. Pre- and postoperative disc ratio differences were − 0.03 (interquartile range, − 0.08 to − 0.01) (P = 0.009) for cohort A and − 0.02 (interquartile range, − 0.054 to 0.082) (P = 0.016) for cohort B. The difference between the two

groups at the end of the follow-up was − 0.02 (interquartile range, − 0.06 to − 0.01) ($P = 0.364$). Pre- and postoperative angulation differences were 0.3 (interquartile range, − 1.66 to 3.61) ($P = 0.507$) for cohort A and 0.48 (interquartile range, 0.13–0.68) ($P = 0.332$) for cohort B. Intergroup difference at the end of the follow-up was 0.47 degrees (interquartile range, − 1.27 to 1.2) ($P = 0.879$).
Conclusions: In this study, we show that the use of an interspinous device does not seem to influence the degeneration of the supra-fusion level in patients with lumbar fusion.

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RADIOGRAPHIC MEASUREMENTS OF THE TRANSITION DISC AND THE DISC ADJACENT TO THE LUMBAR FUSION, COMPARISON BETWEEN HYBRID INSTRUMENTATION, INTERSPINOUS SPACER AT TRANSITIONAL LEVEL AND RIGID FUSION

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Type of study: Retrospective, observational, longitudinal study.
Abstract: Different methods help prevent degeneration of the level adjacent to a rigid lumbar fusion. However, the radiographic effects of these methods have not been studied in depth.
Objectives: To radiographically examine the adjacent and transition segment in a lumbar fusion of up to three segments and compare the effects of hybrid fixation (dynamic bar at transitional level), the use of interspinous spacer at transition level, and rigid fusion.
Materials and methods: Three groups of 20 patients each who underwent the following procedures: instrumented lumbar fusion, instrumented fusion plus interspinous spacer, and hybrid construction (instrumented fusion with dynamic bar at the transitional level). We analysed the measurements of the adjacent disc and one level above (disc height, disc angle, angle of the sheet, lumbar lordosis). Three registered times in the three variations of the surgical treatments, with a 2 year follow-up period. The data was studied analyzed using Multivariate analysis of variance
Results: No significant differences were found in none of the three surgical treatments ($p > 0.05$), as corroborated by the Tukey post hoc test.
Conclusions: In this study, no radiographic differences in the measurements of adjacent and transition discs (disc height, disc angle, angle of the sheet, lumbar lordosis) were detected with hybrid instrumentation and the use of interspinous spacers as preventive measure against the degeneration of the adjacent segment, when compared between them and against rigid fusion alone.
Keywords
Adjacent segment, hybrid instrumentation, interspinous spacer, transition disc, dynamic stabilization

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RISK FACTORS INVOLVED IN INTERBODY CAGE MIGRATION IN LUMBAR FUSIONS (TLIF)

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Objectives and introduction: The objective of this study is to examine and analyse the different factors involved in the displacement of interbody implants used in transforaminal lumbar interbody fusion (TLIF).
Materials and methods: Longitudinal observational study in which 138 patients were included from 233 who underwent TLIF due to lumbar degenerative disease between January 1, 2014 and October 1, 2017. The following clinical variables were included: body mass index (BMI), gender, age, smoking, alcohol use, and endocrine disorders. The clinical results were assessed using the visual analogue scale (VAS) and the Oswestry disability index (ODI). Imaging studies: preoperative CT scan and pre- and postoperative simple X-rays. The following was determined: lumbar fusion levels, segmental angulation and their sagittal translation; cage number, size and position. Height of disc spaces before the surgery, shape of the disc space (common, pear-shaped or pear-shaped with increased disc angulation) and implant displacement. The follow-up was done 1 month, 6 months and 1 year after the fusion.
Results: There were 11 migrations (8.03%), five (45.5%) at the L4–L5 level and the remaining six at the L5–S1 level (54.5%). Eight cases were symptomatic and the device was removed. We observed a statistically significant relationship between disc shape and displacement (greater likelihood of displacement in pear-shaped discs), increased disc angulation, and preoperative disc height $\geq$ 10 mm. In cases with more than one fused level and high BMI (63.6% of the subjects with displacement had overweight) there a was a trend towards a directly proportional relationship with migration. No statistically significant relationship was detected with other parameters, e.g., size of the interbody implants.
Conclusions: There are multiple factors associated with the increase of cage migration in TLIF, including factors inherent to the patient and characteristics of the cages and of the intervention. Considering the results obtained in this study, the potential risk factors for cage migration are the existence of more than one fused level and Increased BMI.

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PEDICLE SCREW LUMBOSACRAL FUSION DUE TO DEGENERATIVE DISC DISEASE. CLINICAL RESULTS AT 16 YEARS. PROSPECTIVE STUDY

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Objectives and introduction: To assess long-term clinical results of lumbosacral fusion due to degenerative disc disease in one or two levels.
Materials and methods: We reviewed 61 patients (aged under 55 years) who underwent surgery due to degenerative disc disease in 2001 and 2002. At admission, all patients completed the NASS Low Back Pain Outcome Instrument protocol, lumbar/sciatica VAT, the Sf-36 (physical) and Goldberg's test (anxiety and depression scale). From the 61 patients those who were reoperated were discarded (11: 18%): one due to infection, four pseudarthrosis and six adjacent level surgeries; not localized/do not want/do not answer (nine) and fallecidos (two). The study was carried out with the remaining 39 subjects. Between March and June 2018, these patients completed the same tests they did preoperatively. Characteristics of the patients: female (64.1%), married (89.7%), primary education (76.9%), sick leave (69.2%) and smokers (41.7%). Statistical analyses were carried out with SPSS.
Results: Clinical results after 16 years according to the patients were good/very good (71.8%), regular (12.8%) or bad/very bad (15.4%). These results had a significant relationship with the following preoperative variables: lower back pain and sciatica, neurological problems (numbness and "weakness"), lumbar and sciatica VAT, Oswestry (ODI) and Goldberg's test. We found no relationship with age, gender, progression time, education, sick leave, smoking or SF-36. Sixty-four point one per cent of the patients would undergo surgery again, 15.4% had doubts and 20.5% would not. Direct relationship with the clinical result ($p = 0.0001$).
Conclusions: Discarding the patients who were reoperated (18%), long-term pedicle screw lumbosacral fusion clinical results are good in 72% of degenerative disc disease cases. Bad results had a direct relationship with a depressive personality and poor preoperative clinical situation ($p < 0.001$).

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SURGICAL TREATMENT OF JUXTAFACET CYSTS IN THE LUMBAR SPINE; IS SEGMENTAL FUSION NECESSARY? ANALYSIS OF SURGICAL RESULTS IN 29 PATIENTS

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Introduction and objectives: Lumbar juxtafacet synovial cysts (LJSC) are a rare cause of radiculopathy, lower back pain and neurogenic claudication. The fusion or not of the affected segment in the surgical treatment of LJSC is a matter of controversy. The objective of this study is to analyse the patients who underwent LJSC surgery in our unit over the last 6 months and assess the results of the surgical treatment.
Materials and methods: Retrospective study on 29 patients who underwent LJSC surgery. We analysed age, gender, affected lumbar level, previous treatments, association with spondylolisthesis, pathological anatomy, associated surgical procedures, and clinical assessment using preoperative and postoperative visual analogue scale (VAS) and postoperative Oswestry Disability Index (ODI).
Results: We analysed 29 patients (15 women and 14 men) with a mean age of 61.5 years. Mean follow-up was 3 years (2–6). The L4–L5 level was affected in 21 cases (75%), L3–L4 in three cases and L5–S1 in five cases. Fourteen patients (48.3%) had Meyerding spondylolisthesis I and one patient (3.4%). Meyerding spondylolisthesis II. Before undergoing surgery, 28 of the 29 patients followed a conservative treatment and its failure was indicative for surgery. In 25 cases (86.2%) LJSC extirpation and nerve release was done and in only four cases (13.7%) a fusion was associated in the operated level. Lumbar and radicular VAS significantly improved after the surgery and mean postoperative ODI was nine. Comparison of postoperative VAS and ODI did not reveal statistically significant differences in age, gender, operated level, previous surgeries, presence of spondylolisthesis and reoperations. There is high incidence in the coexistence of degenerative spondylolisthesis and LJSC. Improvement of radicular and lumbar pain can be achieved in most cases with complete LJSC resection by hemilaminectomy and partial facetectomy. This solution provides excellent short- and long-term clinical results.

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DOES THE OPERATED LEVEL INFLUENCE ON MEDIUM-TERM CLINICAL RESULTS IN SINGLE-LEVEL FUSIONS? L4–L5 VERSUS L5–S1

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Objectives and introduction: The goal of this study is to determine if there are differences in the clinical results at medium-term (minimum follow-up of 5 years) in single-level fusions based on the fused level (L4–L5 vs. L5–S1) using health questionnaires.
Materials and methods: Non-concurrent prospective study. Inclusion criteria: patients older than 18 years who underwent a single-level fusion (L4–L5 in group A and L5–S1 In group B) due to degenerative disease in the lumbar spine, without previous instrumented surgery, and minimum postsurgical follow-up of 5 years. All subjects completed the SF36 and ODI questionnaires for this study.
Results: One hundred and eighty patients (76 men, 104 women) were included. L4–L5 (group A) fusion was performed on 44 patients and L5–S1 (group B) on 136. Mean age 46 (18–80).
Group A and B were homogeneous regarding the type of fusion (circumferential vs. posterolateral), gender, smoking habits, pre-/postoperative haemoglobin concentration and preoperative comorbidities.

No significant differences were found in complications (7 vs. 19), surgery duration (145 vs. 150 min), and length of hospital stay (7 vs. 7).

No significant intergroup differences were detected in any of the preoperative SF36 domains, except for worse physical function in patients who were operated on L4–L5; 15 (0; 45) versus 30 (0;80) ($p = 0.002$).

SF36 al final del follow-up:

Group A: physical function (PF) 60 (20–100); physical role (PR) 75 (0–100); pain 70 (0–100); overall health (OH) 60 (10–100); vitality 55 (10–100); emotional role (ER) 66.6 (0–100); mental health (MH) 64 (16–100).

Group B: PF 60 (0–100); PR 25 (0–100); pain 47 (5–100); OH 50 (0–100); vitality 62.5 (0–100); ER 66.6 (0–100); MH 64 (0–100).

Patients who underwent surgery on the L4–L5 level showed significantly better results for SF36 pain ($p = 0.02$) and SF36 OH ($p = 0.018$) in comparison with patient who operated on L5–S1.

ODI at the end of the follow-up: 16 for Group A 16 (0–66) versus 24 for Group B (0–90) (non-significant difference).

Conclusions: In this study, patients who underwent L5–S1 fusion show clinically worse results at medium-term (minimum follow-up of 5 years) in pain and physical role In comparison with patients operated on L4–L5.

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REVISION SURGERY IN PAN-LUMBAR ARTHRODESIS FOR ADULT SPINAL DEFORMITY: INCIDENCE, RISK FACTORS AND IMPACT

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Objectives and introduction: Pan Lumbar Arthrodesis (PLA) is often required for correction of adult spinal deformity (ASD). Very few papers have investigated complications and outcomes in the subset of patients with less compensatory capacity associating pelvic fixation and PLA. Revision surgery (RS) in PLA in ASD are common and have negative impact on clinical outcome. The aim of this study was to assess RS rate after PLA for ASD, its risk factors and impact on clinical outcomes.

Materials and methods: Retrospective multicenter review of prospectively collected ASD data from two prospective databases in 7 hospitals covering Europe and Japan. ASD patients from having a posterior instrumented fusion spanning the whole lumbar region (UIV $\geq$ T12; LIV $\leq$ S1) with more than 2 years of follow-up were reviewed. Demographic, surgical, deformity and Health Related Quality of Life (HRQoL) parameters were included in the analysis. Univariate and multivariate regression models analyzed risk factors for RS.

Results: Out of the 1359 ASD patients included in the database 589 (43%) had a PLA. Of these 357 reached the 2-years follow-up and were analyzed. Average age was 67 and 82% were females. 100 Patients (28.1%) needed a RS and 80% were due to mechanical failures. 16 patients needed more than 1 RS. Infection rate was 2.8%. Revised patients were more likely to have nerve system disorder comorbidity, higher BMI and worst immediate postoperative alignment (Global Tilt and Relative Pelvic Version). Deformity and HRQoL parameters were comparable at baseline and non-revised patients had significantly better clinical outcomes at 2 years (SRS 22 scores, ODI, Back pain). Multivariate analysis could identify nerve

N		No-revision		Revision		P value
		257	(%, SD)	100	(%, SD)	
Demographical variables						
Age		67.3	69.06	65.69	11.09	0.146
Gender (%)	F	214	83.3	80	80	0.536
	M	43	16.7	20	20	
ASA classification		1.98	0.46	2.2	0.53	0.444
BMI		24.23	4.31	25.97	4.82	0.001
Diabetes		29	11.3	10	10	0.851
Liver disease		8	3.1	4	4	0.745
Neurological disorder (Parkinson, etc.)		8	3.1	13	13	0.001
Osteoporosis		73	28.4	32	32	0.519
Renal disease		15	5.8	4	4	0.606
Tobacco consumption		30	11.7	19	19	0.086
Surgical variables						
Total blood loss		1816.88	1212.05	2017.4	1266.2	0.167
Total surgical time		143.89	220.74	190.57	199.31	0.067
Number of fusion segment		9.79	2.82	9.6	3.12	0.691
Combined anterior/posterior approaches		42	16.3	11	11	0.247
3-Columns osteotomy		82	31.9	31	31	0.9
First standing X-ray parameters						
Cobb angle		12.81	11.67	13.44	15.58	0.686
Global tilt		20.41	10.59	23.48	11.59	0.02
PI-LL		5.49	13.47	8.19	13.56	0.099
PT		20.89	9.27	21.69	8.82	0.471
SVA		35.98	44.43	40.62	47.4	0.407
Relative lumber lordosis		− 13.91	11.51	− 15.79	13.13	0.194

continued

N	No-revision		Revision		P value
	257	(%, SD)	100	(%, SD)	
Relative pelvic version	− 7.92	7.52	− 9.83	7.97	0.04
Lumber Distribution Index	64.97	18.66	67.78	19.39	0.348
Relative spinopelvic alignment	10.76	8.77	13.46	10.53	0.072
2 Years HRQoL parameters					
Back pain VAS	3.69	2.8	4.45	3.15	0.031
Leg pain VAS	3.49	2.89	3.62	3.04	0.708
ODI score	31.09	19	40.7	21.16	< 0.001
SRS-22 function	3.2	0.79	2.91	0.85	0.003
SRS-22 mental	3.34	0.78	3.07	0.85	0.005
SRS-22 pain	3.67	0.96	3.26	1	< 0.001
SRS-22 satisfaction	3.8	0.98	3.59	1	0.075
SRS-22 self image	3.37	0.85	3.05	0.89	0.002
SRS-22 total score	3.43	0.7	3.12	0.74	< 0.001
ΔODI	16.18	18.72	9.7	− 17.86	0.003

system disorder comorbidity (OR 4.8; $p = 0.001$) and BMI (OR 1.1; $p = 0.004$) as independent risk factor for RS.
Conclusions: Revision surgery due to mechanical failures is relatively common after Pan Lumbar Arthrodesis leading to worse clinical outcomes. Prevention strategies should focus on individualized restoration of sagittal alignment and better weight control to decrease stress on these rigid construct in non-compliant spines. Nerve system disorder comorbidities also increase RS risk in PLA.

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PEDICLE SCREW STIMULATION AS A METHOD TO DETERMINE THE SUITABILITY OF THEIR POSITIONING: ANALYSIS OF 817 SCREWS

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Stimulation of transpedicular screws (STS) is part of the techniques used during intraoperative neurophysiological monitoring (IONM) in patients who undergo spinal surgery. The technique consists of the stimulation of the head of the screw using a monopolar stimulator through which continuous current is applied to measure the impedance between the screw and the adjacent neural structures, obtaining a motor action potential (CMAP) that allows establishing an intensity threshold that allows estimating if the screw is placed close to nervous structures.
Objectives: Observational study of the findings observed with STS between January 2017 and November 2018 in a series of patients who underwent complex spinal deformity surgery.
Materials and methods: We collected intraoperative and postoperative data from 61 patients (mean age 35.75 years, 81% female).
Results: We performed 817 screw stimulations; from these, 793 screws were considered to be correctly placed in accordance to the threshold of the stimulus. There were warnings of possible misplacement of 24 screws (2.9%): 17 due to low threshold at stimulus, four due to a lower threshold limit and three due to clear asymmetry (> 10 mA). The screws and trajectory were checked in all cases. In 12 cases (50%) the intracanal trajectory or an opening in the medial wall were examined and the screws were redirected and stimulated again to confirm their position. None of these patients presented postoperative medullary or radicular clinical symptoms. Statistical analyses showed that STS has a sensitivity of 54.5%, a specificity of 98.5% and a negative predictive value of 98.7%.
Conclusions: IONM STS is a reliable accurate method for establishing neurological risk in pedicle screws.

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EXAMINING FRAILTY AS A PREDICTIVE FACTOR OF CLINICAL OUTCOME IN PATIENTS WHO UNDERGO ADULT DEFORMITY SURGERY

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Introduction: Frailty can be defined as a state of increased vulnerability because of the scarce correction of patient's balance under stress situations. Applied to surgery, previous frailty state entails greater risk of occurrence of complications and poor prognosis in the clinical outcome.
Objectives: To assess the state of frailty in patients who undergo spinal deformity surgery and the influence it has on the clinical outcome after the end of the follow-up.
Materials and methods: Retrospective assessment of a cohort of patients who underwent spinal deformity surgery for whom disability and quality of life clinical data were available and with a follow-up of more than 2 years. The frailty index (mFI) before the surgery based on the NSQIP scale was determined and the sample was categorized

Table 1 Differences in quality of life

TEST	Fragile (N = 9)	Not fragile (N = 29)	*P* value
ODI	28.7 (17.6)	34.5 (21.6)	0.470
VAS*	5.5 (2.2–6.0)	4.0 (2.0–5.5)	0.633
SRS22 PAIN	3.5 (1.2)	3.5 (0.0)	0.996
SRS22 FUNCTION	3.4 (0.6)	3.3 (0.9)	0.786
SRS22 SELF-IMAGE	3.6 (0.4)	3.5 (0.8)	0.762
SRS22 MENTAL HEALTH*	4.2 (3.0–5.0)	3.2 (2.6–3.8)	0.301
TOTAL SRS22	3.6 (0.8)	3.4 (0.7)	0.647

Values expressed as means and standard deviation between brackets

P values were calculated using Student's t-test for paired samples

*not normal variables within the groups: Values expressed as medians and interquartile ranges between brackets. *P* value calculated using the Mann–Whitney U test for paired samples

in two groups: fragile (those with a mFI greater than 0.09) or not fragile (mFI equal or below 0.09). Next, we determined if there were statistically significant intergroup differences in quality of live scores (ODI, VAS, SRS22) using Student's t-test or the Mann–Whitney U test for paired samples according to the nature of the variables.

Results: Thirty-eight patients were included. Mean age 68.5 years (61.2–74.5), 78% female. BMI of the sample was 29.5 (25.4–31.8) and mean follow-up 29.5 months (25.4–31.8). The group of fragile patients had more pain at the end of the follow-up (VAS), lower disability, and better mental health in comparison with the group of not fragile patients, although the differences were not significant (Table 1). No significant differences were neither determined for total SRS22 or for the remaining studied subdomains.

Conclusions: In this study, the preoperative frailty state of adult spine deformity patients does not seem to be a determinant factor for the clinical results obtained in quality of life tests. However, a larger sample is necessary to confirm these preliminary conclusions.

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HOW TO DISTINGUISH ADULT DE NOVO DEGNERATIVE SCOLIOSIS FROM ADOLESCENT IDIOPATHIC SCOLIOSIS IN THE ADULT? PROPOSAL OF OBJECTIVE RADIOLOGICAL PARAMETERS, BASED ON PATHOGENESIS

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Adult scoliosis is classified as *de novo* degenerative and progressive adolescent idiopathic into adulthood (Aebi, 2005). Its differentiation in a single X-ray has little intraobserver variability, but only medium interobserver variability (Guler, 2016).

There are no objective reproducible parameters to differentiate them besides patient's radiological follow-up since adolescence. Based on pathogenesis of *de novo* degenerative scoliosis it might be possible to define some such discriminatory parameters. In *de novo* there are 2–3 burnt-out degenerated discs (usu L3–L4, L4–L5) with rotatory dislocation while in progressive there is a junctional disc (between curve and "healthy" spine) usu between L3 and L5 which means a coronal break in overall spine, without rotation.

Hypothesis: L3–L5 is the key segment for differentiation. L3–L4 and/or L4–L5 discs should be away from the midline and horizontal in *de novo* degenerative and centered and slanted in progressive. Furthermore, the distinct pathogenesis may affect differently the forma sagittal balance.

Series of 64 patients who underwent adult scoliosis surgery by the same surgeon.

Variables: age, gender, height, weight, T, L and LS curves, T1 and L1 coronal and sagittal balance, spinopelvic parameters (IP, IS and EP) and: a) CSL distance to L3L4 and L4L5 (DL3L4; DL4L5) disc centre; b) plate tilt of these discs.

Three independent observers carried out the measurements. Statistical analysis was done with SPSS 22.0

DL3L4 bimodal distribution. Correlation with IP ($p = 0.025$); EP ($p = 0.009$) and lumbar Cobb ($p < 0.001$). Stratified study (DL3L4 < 15 mm vs. > 15 mm): EP 22° versus 30° ($p = 0.024$); IP 55° versus 62° (NS); lumbar Cobb 23° versus 39° ($p < 0.001$; no effect on the apex nor lower end vertebra.

Conclusions: The distance to the central sacral line in the AP plane can help distinguish the pathogenesis. Furthermore, there is a correlation with the pelvic extension. Cut-off point: 15 mm.

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SPINAL SURGERY INFECTIONS, IDENTIFYING THE PATIENT AT RISK

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Objectives and introduction: Surgical site infection (SSI) in spinal surgery increases morbidity and mortality among the operated patients. The objective in this study is to assess the incidence, risk factors, and associated complications and determine a profile of the patient with high risk of infection.

Materials and methods: Retrospective cohort study that reviewed patients who underwent surgery in the university hospital between January 2013 and April 2017. Exclusion criteria: presence or suspicion of previous infection, percutaneous procedures, cervical surgery, infection 90 days after the surgical intervention. Postoperative infection was defined following the criteria of the Centre for Disease Control and Prevention. For the statistical analyses, the SPSS version 20 was used. Significant ALPHA $P < 0.05$ value for a 95% confidence interval.

Results: We examined 1030, from which 850 met the inclusion criteria and identified 34 infection cases (2.9%). Seventy-three per cent SSI occurred with instrumented surgery, *Staphylococcus aureus* being

the most commonly isolated bacteria. The most determining patient-dependent factors were presence of DM ($P = 0.075$) and osteoporosis ($P = 0.052$). Amongst surgery-dependent factors the most relevant was the presence of instrumentation ($P = 0.05$). Patients who developed infection suffered 36% of serious complications in comparison to 7% and mean days of hospital stay was 7.1 in non-infected patients in comparison to 77.5 for subjects with SSI.
Conclusions: The rate of infection is within the values accepted on a statewide level. The profile of a "patient at risk" associates the presence of DM II, osteoporosis and complex surgery in a potentially susceptible patient. The presence of infection significantly increases the length of hospital stay and the rate of serious complications. The joint approach of infectious disease and internal medicine units is key to help control preoperative modifiable risk factors.

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INTEGRAL APPROACH AGAINST INFECTION

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Objectives and introduction: Surgical site infection in spinal instrumented surgeries is a worldwide phenomenon with an incidence ranging between 0.7% to over 12% that causes numerous complications to the patient and the medical team. The aim of this work is to present an integral approach protocol for treating infectious complications in instrumented spinal surgery.
Materials and methods: Multicentre case study in which 2227 patients who underwent surgery between January 2012 and June 2018 were retrospectively assessed. Patients were stratified using the "Postoperative Infection Risk Table" by which a particular score was assigned to each risk factor observed in the patient: Score under six: low risk of developing postoperative infection. Score equal or greater than six: high risk of developing postoperative infection.
Results: The developed tables may be used to arrange and remember the preoperative risk factors for the patient, helping to correct modifiable factors, or in the case of high-risk patients plan the surgery using minimally invasive approaches, the lowest possible number of instrumentation or implants capable of resisting infection and the development of a biofilm on their surface, such as implants with a coat of silver nanoparticles.
Conclusions: This integral management system is an original, integrating and simple approach for a complication that accompanies surgery since its beginning and continues to prevail with the possibility of worsening due to progressive antibiotic resistance. We consider that the best way to systematize this management procedure should begin by standardizing the course of action categorizing and stratifying the patients, the working tools, and precisely determine the

Preoperative infection risk

Surname and name						
ID						
Medical coverage						
Date						
Surgery-dependent risk factors						
Factors	Score	Yes–no	Factors	Pts	Yes–no	Total score
Posterior approach to spine	1		High intraoperative blood loss	2		0
Use of instrumentation	1		Surgical site environment	2		
Extended surgery time	1		Revision surgery	2		
Extended preoperative hospitalization (+ 4 days)						
Partial score		0	Partial score		0	
Patient-dependent risk factors						
Factors	Score	Yes–no	Factors	Score	Yes–no	Total score
Spine fracture	1		Spine fracture/Polytrauma/Neurological lesion	2		0
Age (+ 65 years)	1		Poorly controlled diabetes	2		
Another infection site in the patient	1		Obesity	2		
Smoking	1		Malnutrition	2		
Alcoholism	1		Medullary lesion	2		
Rheumatoid arthritis	1		Metastatic spine	2		
Chronic corticoid use	1		Previous infection of the surgical site	2		
Preoperative epidural corticoid injection	1		Previous radiotherapy in surgical site	2		
Anaemia	1		Immunodepressed	2		
Cardiovascular disease	1		Presence of eschars	2		
Myelomeningocele	1		Gunshot wound (contaminated surgical site)	2		
Diabetes	1					
Chronic kidney insufficiency	1					
Liver disease (cirrhosis and hepatitis C)	1					
Osteoporosis	1					
EPOC	1					
Partial score		0	Partial score		0	
Total score						0

moment and for which patient should each be used. This will help achieve similar outcomes in different places and provide us in the future with comparable data for an objective analysis with clear numbers for the validation of results.

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DEEP SURGICAL INFECTION FOLLOWING INSTRUMENTED THORACOLUMBAR SURGERY. THE EXPERIENCE OF A QUARTER OF A CENTURY

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Introduction: Deep surgical infection following instrumented thoracolumbar surgery (DSIITS) is a major complication in spine surgery and its impact on long term morbidity and mortality is yet to be determined.
Objectives: To evaluate the characteristics and evolution of DSIITS in a large series with a long follow-up.
Materials and methods: We included all consecutive patients who underwent spinal surgery in our institution between January 1992 and December 2016 and who developed DSIITS. General health status, epidemiological and surgical data, gamma scan, infection characteristics, and major complications linked to infection were evaluated.
Results: An overall of 174 patients (106 women) developed DSIITS during the study period. Median follow-up after infection diagnosis was 40 months (56 patients over 5 years follow-up). Median age at primary surgery was 54.5 years old. Diabetics 16.1%. Smokers 20.1%. BMI 27.8. Frailty Index over 0.18 in 27% of the cases. Frailty Index was significantly higher in early infections. Most frequent etiologies were adolescent idiopathic scoliosis, degenerative lumbar stenosis and adult scoliosis. Surgical approach was posterior in 88.5% and double in 11.5%. Average number of fused levels was 7. Average surgical time 5.5 h. In 32 patients a preoperative Gamma Scan was performed with a sensibility of 43.7%. Infection presentation was early in 59.2% cases, delayed in 11.5% cases and late in 29.3% cases. Serous/purulent exudate was present in 49.5% cases, fistula in 25.3%, abscess in 4.6%, sepsis in 2.9%, and other types of presentation in 17.7%. More than one surgical debridement was required in 20.7% of the patients. Implant removal was necessary in 46.6% of the cases. Earlier debridement was associated with a greater probability of implant retention. Most frequently isolated microorganisms were Staphylococcus coagulase negative (30.1%), E. coli (20.4%), Proteus spp. (20.4%), Enterococcus spp. (18.4%) and Staphylococcus aureus (17.4%) in early infection; Staphylococcus coagulase negative (40%) and Propionibacterium acnes (30%) in delayed infection and Propionibacterium acnes (37.2%) and Staphylococcus coagulase negative (33.3%) in late infection. One third of the infections, were polymicrobial. Mayor complications appeared in 25 patients. The most frequent was pseudarthrosis with loss of correction. Over 80% of those patients required major surgery during follow-up.
Conclusions: In a large series and after a long follow-up, late DSIITS are more frequent than previously reported. Implant removal is necessary in 46% of the cases. Early surgical debridement helps implant retention. We found a remarkably high incidence of Gram negatives in early DSIITS. Skin microorganisms predominate in delayed and late DSIITS. Mayor complications in 14% of the DSIITS patients.

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PARALLEL BAR GUIDANCE PLUS PEDICLE SUBTRACTION OSTEOTOMY IN SPINAL TUMOURS OF THE CERVICOTHORACIC JUNCTION

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Introduction: Diseases that affect the lower cervical spine and upper thoracic spine, which require posterior and anterolateral cervical approach, expose the cervicothoracic junction from C7 to T3. In this work, we report our experience with posterior single cervico-dorsal approach with parallel bar guidance plus pedicle subtraction osteotomy.
Objectives: Describe a sample of patients with primary and metastatic tumours and analyse the variables related with functional prognosis.
Materials and methods: Six patients between 2017 and 2018 with decompression and stabilization of bone tumours and 6 months of follow-up using the ASIA and SF36 scales. Results were analysed with the non-parametric Wilcoxon's signed-rank test and the Kruskal–Wallis test. Significance p 0.05.
Results: Four tumours due to multiple myeloma, two due to metastasis, in four two vertebrae were involved, in two one vertebra; intrusion of the medullary canal in over 30% of the cases, and neurological lesion; complete two patients, incomplete four ASIA C patients. Decompression and vertebral shortening was done in all patients as follows: pedicle subtraction osteotomy, posterior fixation and tutoring with parallel bars. ASIA A progressed to ASIA C, from

ASIA C to ASIA D and E with statistically significant improvements ($p = 0.005$). Technically, the decompression and stabilization of cervico-thoracic tumours is very difficult due to the importance of the vascular and nervous structures present in the area and the complicated anterolateral approach access. We carried out pedicle subtraction osteotomy, posterior fixation and tutoring with parallel bars, without anterolateral decompression and stabilization and determined this technique is ideal for this region. It allows appropriate decompression and stabilization and suitable control of vascular and nervous structures with a favourable postoperative neurological recovery.

Conclusions: Parallel bar guidance plus pedicle subtraction osteotomy is ideal for this anatomic region. It allows adequately decompressing and stabilizing the spine with a single surgical approach.

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EN BLOC RESECTION OF MALIGNANT TUMOURS OF THE CERVICAL SPINE WITH COMPROMISE OF THE VERTEBRAL ARTERY. PROSPECTIVE FOLLOW-UP OF THE SAME SURGICAL TECHNIQUE IN TWO REFERENCE SURGICAL TEAMS

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Malignant tumours of the spine are infrequent entities and their management is a challenge on which the survival of the patient depends.

In the literature, we can only find series of isolated patients who have undergone different vertebral resection techniques.

The aim of this work is to describe the experience and results of two work teams using the same surgical resection technique described in 2010 (although it has been used since 2006) with medium-term patient follow-up.

To our knowledge, this is the largest series of this type of surgery.

Materials and methods: Prospective study with patients who underwent *en bloc* resection of cervical malignant tumours using the resection technique described and documented in 2010 (Cervical Spine Research Society). Inclusion criteria: malignant primary tumours or solitary metastasis with en bloc criteria affecting the vertebral body. Patients with tumours in posterior elements without compromise of the vertebral artery were excluded.

Results: Eight patients were included in the study (Table). Single approach surgical technique was performed on three patients and the remaining subjects underwent double approach due to the involvement of posterior elements or of more than one level. Before the blockage of the vertebral artery, a test was performed in all cases and its sacrifice was necessary in five subjects (with no functional consequences). In all cases, the margins remained free from the disease, and in two local relapse was reported requiring reoperation with good outcome. The Table below describes the diagnosis, complications and follow-up.

Conclusions: Malignant cervical tumours are infrequent and require an expert surgical management for a good outcome.

Good medium-term results are obtained with this surgical technique as well as low percentage complications.

Tumour	Age	Surgery	Complications	Follow-up (years)
3C chordoma	55 years old male	Anterior approach en bloc resection. No vascular sacrifice. Margins free from disease	Recurrence. Dysphagia	11
Chondrosarcoma	32 years old male	Double approach. Left vascular artery involved. Margins free from disease	Local recurrence. Reoperation	11
Solitary metastasis breast cancer	50 years old female	Anterior en bloc resection. Margins free from disease	No	10
C6 desmoid tumour	52 years old female	Anterior en bloc resection. No vascular sacrifice Margins free from disease	Temporal C6 radiculopathy	10
C3–C5 Ewing	72 years	Double approach. Left vascular artery involved. C2–3–4–5 roots sacrificed. Free	Temporal hemiparesis	9
C7 chordoma	65 years old female	Double approach. Free	No complications	6
C4–5–6 chordoma	64 years old female	Double approach. Free	Bleeding of vascular artery. New surgery. Previous tracheostomy	4
C6 osteosarcoma	44 years old female	Double approach. Free	Posterior surgical site infection	4

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ANALYSIS OF INTRAOPERATIVE AND POSTOPERATIVE COMPLICATIONS IN PATIENTS WHO UNDERGO *EN BLOC* SACRECTOMY

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Objectives and introduction: Few studies have examined long- and short-term complications of *en bloc* sacrectomy. The goal of this study is to analyse the complications, review surgeries and length of hospital stay or in the ICU/semi-critical of subjects who undergo *en bloc* sacrectomy.

Materials and methods: Series of cases. Thirty patients who underwent en bloc sacrectomy. We collected the following variables: demographic, Fourney's classification, ASA indexes, Karnofsky and Charlson, intraoperative and postoperative complications (at 1 month, 6 months, 1 year and 2 years) (without considering those derived from intentional root amputation), reoperations, intraoperative blood loss and length of hospital stay and semi-critical/ICU.

Results: The most frequent intraoperative complication was incidental durotomy (10%). One hundred per cent of the patients had some kind of complication during their follow-up. The most frequent complications during the first 6 months after the surgery were wound-related (90.8%) and from then on wound-related and failure of the osteosynthesis material complications (40% respectively). The most frequent minor complication was urine infection throughout the whole follow-up: 42.2% during the first 6 months and 56.66% from 6 months to 2 years of follow-up. Most reoperations occurred during the first 6 months post-intervention (95.1%) prevailing in the first month (85.51%) and mainly caused by problems in the wound. The reoperations after 6 months were due to spinopelvic instrumentation failures (60%). Median length of hospital stay was 40 days (RIC: 18.5–62.5). The number of complications during the first month and intraoperative bleeding $\geq$ 2900 cc were associated to longer lengths of hospital stay.

Conclusions: *En bloc* sacrectomy was associated to a high rate of postoperative complications. The most frequent major complications during the first 6 months were those related to the surgical wound and later to those related to spinopelvic instrumentation. The most frequent minor complication was urine Infection. The number surgery reviews decreased after the first 6 months post-surgery. During the

	First month post-surgery	1 month–6 months post-surgery	6 months–1 year post-surgery	1 year–2 years post-surgery
Minor complications (n, %)	Urine infection (23, 76.7%) Depression (18, 60%) Irritative dermatitis (4, 13.3%) Allergic reaction to a drug (3, 10%) Hypertensive crisis (3, 10%) Peripheral facial paralysis (1, 3.3%) Ulcer due to trochanter pressure (1, 3.3%) Rectocutaneous fistula (1, 3.3%)	Urine infection (30, 100%) Depression (18, 60%) Arrhythmia (3, 10%) Necrosis wound edges (2, 6.7%) Seroma (2, 6.7%) Hematoma (1, 3.3%) Acute kidney failure (1, 3.3%) Sacral fracture after radiotherapy (1, 3.3%) Phlebitis (4, 13.3%)	Urine infection (10, 70%) Depression (16, 53.3%)	Urine infection (10, 70%) Depression (6, 20%) Iliac crest ulcer due to support on the screw (1, 3.3%)
Major complications (n, %)	Acute confusional syndrome (2, 6.7%) Wound dehiscence (24, 80%) Deep wound infection (21, 70%) Superficial wound infection (20, 66.7%) Cerebrospinal fluid fistula (1, 3.3%) Flap failure (1, 3.3%)	Deep wound infection (10, 33.3%) Wound dehiscence (4, 13.3%) Septic shock urinary focus (2, 6.7%) Flap failure (2, 6.7%) Spinopelvic instrumentation failure (1, 3.3%)	Deep wound infection (2, 6.7%) Spinopelvic instrumentation failure (2, 6.7%) Flap failure (1, 3.3%)	Spinopelvic instrumentation failure (2, 6.7%)
Number of reoperations	61	36	4	1

first 6 months they were required due to surgical site wound problems and later due to the failure of the spinopelvic reconstruction system

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FROM CONTEMPLATION TO IMPLEMENTATION. INTRODUCING PREOPERATIVE PSYCHIATRIC ASSESSMENT IN SPINAL SURGERY

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Introduction: Psychic factors have an important role in surgical success. Screening tools have been adapted in our environment, allowing to detect patients with a high risk of surgical failure due to psychosocial factors.
Objectives: To develop an integrated process of psychiatric evaluation in spinal surgery. Assessment of outcome.
Materials and methods: We designed a three-step complementary process. All patients for whom surgery was considered completed the Distress and Risk Assessment Method (DRAM). Patients who showed an altered DRAM, attended a clinical session with the members of the Spine Unit and Liaison Psychiatry. Patients in which there was still doubt regarding psychiatric risk were called in for a complete psychiatric evaluation. The results of the evaluations were registered directly in the clinical record of the Spine Unit.
Results: One hundred and ninety patients completed the DRAM scoring in 6 months, from which 13 (6.8%) did not complete the screening adequately, 124 (65.3%) showed a normal DRAM and 53 (27.9%) and altered one, 21 depressives and 32 somatomorphic. After the clinical session, 28 patients were sent to psychiatric consultation, from which no psychopathology was detected in eight individuals to justify the problem, four had reactive depression with no contraindication for surgery and 16 had psychopathology which contraindicated surgery (nine somatomorphic, two factitious disorders, two TAG, one TEPT, one simulator and 1 opiate-dependent patient) and initiated psychiatric treatment.
Conclusions: Systematized multidisciplinary approach helps prevent surgeries doomed to fail and offers personalized therapeutic alternatives for each case.

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"SPINAL ARACHNOID WEB", A RARELY KNOWN CONDITION THAT MAY LEAD TO POOR NEUROLOGICAL OUTCOME AFTER SPINE SURGERY FOR DEFORMITY OR TRAUMA

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Objectives and introduction: The term "arachnoid web" describes the abnormal formation of an arachnoid membrane in the medullary subarachnoid space. It blocks cerebrospinal flow, progressively leading to compression of the spinal cord. The scalpel sign is characteristic, typically appearing in the dorsal region, although difficult to diagnose by imaging studies. Very few cases have been described in the literature and in most, considered idiopathic, the mechanism of formation remains unclear.
Materials and methods: We reviewed four cases who were treated in a single centre with different etiologies. In one of the cases, the entity appeared following adult deformity surgery (kyphoscoliosis), one post-traumatic case, and two idiopathic. All subjects presented myelopathy clinical features and underwent intradural approach and resection of the arachnoid membranes. We carried out a literature review for a description of the physiopathology and therapeutic management.
Results: From the four treated cases, the best development was observed in idiopathic patients with good clinical and radiological results. In the case that was diagnosed after deformity surgery, despite the disappearance of the compressive effect in the imaging studies, the myelopathy persisted with no initial clinical improvement, which finally occurred after undergoing more than one surgery. In the post-traumatic case, we observed clinical improvement through imaging and later the appearance on an anterior cyst in another site; we continued with the follow-up. In the cases with trauma history or postoperative occurrence, intraoperative findings are in agreement with multiple membranes with higher medullary adherence and anchoring. An inflammatory component may be seen secondary to the traction or medullary trauma injury that contribute to arachnoid membranes formation.
Conclusions: "Arachnoid web" is a rare entity of difficult diagnosis, to be taken into account not only in patients with myelopathy without a history, but also in cases that arise late after spinal trauma or deformity corrective surgery. Diagnostic suspicion in patients with poor clínical evolution and magnetic resonance imaging of cysts are essential for the adequate management.

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OSTEOPLASTIC LAMINOPLASTY VERSUS SIMPLE LAMINECTOMY IN THE TREATMENT OF SPINAL INTRADURAL LESION

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Objectives: Laminectomy (LE) is the standard technique used for the approach of spinal intradural lesion, although this procedure may be associated with the development of postoperative instability and kyphosis. Osteoplastic laminoplasty (OL) is a surgical variant developed to overcome the problems derived from classical laminectomy. The goal in this study is to assess the impact OL use has on adult spinal intradural lesion in comparison to LE regarding the incidence of postoperative kyphosis and postoperative complications.
Methods: We retrospectively analysed the data of 64 adult patients who underwent spinal intradural lesion surgery in our centre (spinal AV tumours and fistulas) between 2015 and May 2018. The following data were collected: demographic (age and gender), clinical (modified McCormick Scale), radiological (spinal segment and intra- or

extramedullary location), type of procedure (LE or OL with ultrasonic saw) and number treated levels (≤ 2 vs. > 2). We documented the following: postoperative complications (infection, LCR fistula, hematoma), number of days of hospital stay, degree of axial pain (VAS scale at Month 1) and presence of radiological changes follow-up (development of focal kyphosis focal using the Cob angle or progression or degenerative disc disease or facet).
Results: From the 64 cases who consecutively underwent surgery in our centre, 25 se underwent a OL and 39 a LE. Intergroup demographic and radiological data were similar. The percentage of complications was 10.25% for the LE groups and 8% for the OL group. No significant differences were detected in length of hospital stay. Postoperative mean VAS at Month 1 was 2.8 versus 4.7 (OL vs. LE). No radiological changes were seen in the OL group with a minimum follow-up of 6 months, while seven patients (17.94%) from the LE group developed focal kyphosis.
Conclusions: In our series, osteoplastic laminoplasty offers advantages in comparison to classic laminectomy, with decreased postoperative pain and incidence of postoperative kyphosis.

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ACUTE NORMOVOLEMIC HEMODILUTION IN SPINAL DEFORMITY SURGERIES

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Objectives and introduction: One of the most important complications in spinal deformity correction surgery is bleeding, for which reason strategies to minimized blood loss and its clinical effects are being tested. The aim of this work is to prospectively compare the clinical and laboratory parameters of patients who undergo acute normovolemic hemodilution associated to tranexamic acid against a control group in which the subjects only received tranexamic acid, during spinal deformity correction surgery. To assess the influence of this hemodilution technique on postoperative bleeding and the need of autologous blood transfusion.
Methods: Prospective comparative study that included subjects between 12 and 62 years de age who underwent a surgery for correcting spinal deformities with acute normovolemic hemodilution technique associated to tranexamic acid versus a control group whose members only received tranexamic acid (15 mg/kg). Laboratory studies were performed at three different moments.
Results: Thirty patients were included in the work, 17 in the hemodilution group and 13 in the control group. Mean surgery time was greater for the hemodilution group. The number of operated levels varied from seven to 16 against four to 13 in the control group. Osteotomies were done on 20 patients, mainly posterior. Intraoperative mean bleeding was higher in the control group. The clinical parameters remained stable throughout all the procedures. Only six patients required autologous blood transfusion, most of which were from control group ($p > 0.05$).
Conclusions: There was no intraoperative differences regarding the need of transfusion and bleeding volume between both study groups. The seriousness of the deformity was the main determinant factor for transfusion.

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BIOMECHANICAL ASSESSMENT OF LUMBOSACRAL STABILIZATION EN HIGH-GRADE SPONDYLOLISTHESIS. COMPARISON BETWEEN CONVENTIONAL POSTERIOR FUSION AND TRANSDISC FIXATION

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Objectives and introduction: Surgical stabilization in high-grade spondylolisthesis remains a controversial issue as none of the techniques has clearly shown to be superior. The aim of this study is to compare the biomechanical response in patients who undergo posterior conventional fusion versus transdisc fusion in high-grade L5–L1 spondylolisthesis performing daily routine activities with moderate low back effort.
Materials and methods: Prospective, non-randomized, comparative, gender-matched study. We assessed patients who underwent surgery between 2013 a 2015 and met the inclusion/exclusion criteria. We performed a computerized biomechanical functional study analysing two daily activities requiring lumbar effort: standing up from a chair without support and lifting a weight from the floor. A comparative study of the patients versus a database normalized by age and gender, and a logistic regression analysis by comparing the mean value against the database was carried out.
Results: No significant differences regarding mean age and BMI between both samples were determined (Table 1). Functional values were statistically similar. Although sample size was small, they were comparable.
Standing up from a chair

Most parameters in both groups were within normal ranges ($> 90\%$), except lumbar mobility (below normal in the two groups). Statistically significant differences were seen for maximum vertical strength, asymmetry between limbs, lumbar mobility and thoracic inclination (Table 2).

Lifting weight

Table 1 .

	Pedicle	Transdisc	*p*
n	10	10	0.267
Gender (M/H)	5/5	5/5	
Age	44.4 (22–51)	45.3 (22–59)	
BMI	22.5 (17–26)	23.6 (21–24)	0.121
Post lumbar VAS	2.3 (2–3)	2.0 (1–3)	0.742
Post ODI	13.5 (6–24)	13.2 (4–24)	0.849
Post COMI	12.2 (9–14)	10.8 (8–13)	0.089

Table 2 Biomechanical functional results of standing up from a chair

	Pedicle		Transdisc		*p*
	Value	%Normal*	Value	%Normal*	
Execution time (s)	2.6 ± 0.2	94.3	2.4 ± 0.1	96.4	0.096
Maximum angular velocity (°/s)	70.5 ± 7	94.8	75.83 ± 5	98.2	0.228
Maximum angular acceleration (°/s2)	176.4 ± 22	90.4	184.4 ± 26	97.6	0.619
Maximum vertical strength (%N)*	112.7 ± 5	96.3	119.0 ± 2	98.6	0.036
Asymmetry between limbs (%)	9.0 ± 3	89.2	5.1 ± 2	93.6	0.041
Lumbar mobility (°)	18.4 ± 5	72.8	24.6 ± 3	81.2	0.044
Thoracic inclination (°)	33.6 ± 5	98.9	21.8 ± 2	93.4	0.003
Global normality index**		91.6		97.6	

Data are presented as means ± standad deviation. *p* value is between absolute values

*Percentage with respect to normality weighted for age, gender and weight. **A value is considered between ranges of normality if greater than 90%

Table 3 Biomechanical functional results of lifting weight

	Pedicle		Transdisc		*p*
	Value	%Normal*	Value	%Normal*	
Execution time (s)	2.16	83.8	1.91	91.6	0.175
Maximum angular velocity (°/s)	109.9 ± 17	80.2	125.3 ± 13	89.3	0.148
Maximum angular acceleration (°/s2)	209.6 ± 27	85.2	248.1 ± 24	90.6	0.044
Maximum vertical strength (%N)*	118.9 ± 3	81.2	125.5 ± 5	89.6	0.035
Asymmetry between limbs (%)	9.9 ± 5	80.7	3.6 ± 3	91.6	0.040
Lumbar mobility (°)	29.7 ± 4	80.6	35.9 ± 3	88.2	0.024
Thoracic inclination (°)	58.5 ± 10	82.6	40.0 ± 12	87.2	0.035
Trunk flexion (hip) (°)	102.65	83.8	111.97	89.6	0.090
Knee flexion (°)	95.7 ± 18	88.6	95.5 ± 15	88.6	0.982
Global normality index		83.8		94.2	

Data are presented as means. *p* value is between absolute values

*Percentage with respect to normality weighted for age, gender and weight. **A value is considered between ranges of normality if below 90%

This activity is more demanding and many parameters were under the range of normality in both groups, with statistically significant differences in maximum angular acceleration, maximum vertical strength, asymmetry between limbs, lumbar mobility and thoracic inclination (Table 3).

Our findings suggest that the biomechanical behaviour of the lumbar spine is better in patients who are subjected to a transdisc technique in comparison to those subjected to a conventions fusion technique.

Conclusions: Considering the small sample size limitation, patients from the transdisc group show greater lumbar mobility, perform the exercises with greater strength and push, higher support symmetry, and lower number of strategies to reduce the effort. Our results support the clinical advantages of transdisc construction in comparison to conventional posterior fusion.

83

INFLUENCE OF TOTAL HIP ARTHROPLASTY ON LUMBOPELVIC SAGITTAL BALANCE: ASSESSMENT OF RADIOGRAPHIC PARAMETERS

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Objectives and introduction: Bo-sacral": Lumbosacral sagittal balance affects lower back pain, which can change with total hip arthroplasty. The aim of this work is to prospectively analyse pre- and

postoperative radiographic lumbosacral sagittal variables in patients who undergo total hip arthroplasty.
Methods: Prospective, observational, comparative study. We assessed pre- and postoperative radiographic parameters in 71 patients who underwent 72 total hip arthroplasties over a period of 3 years (2014–2017) due to primary coxarthrosis, from which 28 had late postoperative follow-up (6 months) through the Surgimap Spine program. Statistical analysis: was carried out using Student's t-test, the analysis covariance model (ANCOVA) and the Kolmogorov–Smirnov test. Data analysis was performed using the IBM SPSS Statistics v. 20.0 software. p value < 0.05 indicated statistical significance.
Results: Seventy-two cases. Mean age of 57.9 years; 60.6% female; 71.8% older than 50 years. An overall decrease of lumbar lordosis values was determined in the immediate postoperative period, without major global changes at the end of evolution. We found that patients with pelvic incidence equal or greater than or 60° usually showed other sagittal balance parameters elevated.
Conclusions: There were no significant differences between lumbopelvic sagittal balance radiographic variables in the assessed periods. Lumbar lordosis and la pelvic incidence were the primary alteration factors. Lower back pain improvement after total hip arthroplasty without changes in lumbovelvic balance parameters suggests different pathological mechanism that are still to be clarified.

E-POSTER PRESENTATION

1

ANATOMICAL VARIATIONS IN THE POSITION OF THE AORTA BASED ON THE POSTURE OF PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS. PROSPECTIVE, COMPARATIVE STUDY IN PRONE AND LATERAL SUPINE DECUBITUS POSITION

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The position of the aorta with respect to the vertebral body has been studied and defined by analysing how it changes based on patient's posture. To the best of our knowledge, no studies have been published comparing the behaviour of the aorta with respect to the vertebral body with the patient in prone and lateral supine decubitus position. The latter will possibly provide much information as is how the patient is placed when performing an anterior procedure for spinal deformity correction.

The aim of this work is to assess the relation of the aorta with the vertebral body and how it modifies when the patient is in prone or lateral supine decubitus posture.
Materials and methods: We prospectively included all adolescent idiopathic scoliosis (AIS) patients who were going to be operated in the same centre. We obtained informed consent from the patients and/or family members. This study was approved by the hospital's Ethical Committee. We analysed 21 patients. Magnetic resonance images were obtained in prone or lateral supine decubitus position.
Results: Mean age 15.2 years, 71.4% female. We identified the position of the aorta in relation to the vertebral body and developed a coordinate system to identify a safe zone for placing the implants in the vertebral body via anterior approach and the areas to consider in prone posture: one to the right of the aorta, safe zone right (SZR) and the other to the left safe zone left (SZL). The means for SZR and SZL at each level is shown in the table below. Statistically significant differences were determined for all levels when comparing the location of the aorta at each position.
Conclusions: The position of the patient during spinal surgery significantly changes the location of the aorta with respect to the vertebral body. To avoid potential vascular lesions it is important to consider these variations when a magnetic resonance in supine is done and the patient is going to be operated in a different position.

SUPINE	SZR	SZL
T4	0–87.3	148.8–180
T5	0–130.1	167.7–180
T6	0–137	172.9–180
T7	0–139.5	173.8–180
T8	0–139.4	172–180
T9	0–135.1	167–180
T10	0–120.1	153.2–180
T11	0–111.4	139.7–180
T12	0–98.2	126.1–180
L1	0–85.8	111.5–180
L2	0–81.3	102.9–180
L3	0–81.3	102.2–180
L4	0–79.4	108.4–180
PRONE	SZR	SZL
T4	0–85.9	138.8–180
T5	0–118.7	156.1–180
T6	0–123	159.1–180
T7	0–127.9	161.8–180
T8	0–129.7	161.2–180
T9	0–128.5	159.4–180
T10	0–121.3	151.5–180
T11	0–114.5	142.5–180
T12	0–99.7	127.9–180
L1	0–87.6	114.4–180
L2	0–85.3	107.5–180
L3	0–83.4	103.3–180
L4	0–80.6	107–180
LATERAL DECUBITUS	SZR	SZL
T4	0–86.6	142.3–180
T5	0–120	157.4–180
T6	0–128.3	163.7–180
T7	0–131.3	164.2–180
T8	0–130.6	161.8–180
T9	0–129.1	159.5–180
T10	0–120.6	150.1–180

continued

LATERAL DECUBITUS	SZR	SZL
T11	0–110.5	137.7–180
T12	0–100.1	124.8–180
L1	0–87.9	114–180
L2	0–82.2	104.5–180
L3	0–80.3	101.7–180
L4	0–82.3	109.5

2

"THE CONVENT OF THE BENDED NUNS". ANTIPSYCHOTIC-INDUCED PISA SYNDROME (CAMPTOCORMIA)

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Camptocormia is characterized by an abnormal posture of the trunk with thoracolumbar spinal flexion greater than 45° while standing and gait that corrects completely in the dorsal decubitus position. It has been associated to Parkinson's disease and to other neurodegenerative diseases. The pathophysiology of the Pisa syndrome remains unclear.

In this work, we present three cases of camptocormia related to antipsychotic treatment.

Three women aged 51, 56 and 62 years. Nuns in strict enclosure and residents of the same convent. They visited the consultation at different times afflicted by low back pain and progressive deviation of the trunk that prevented them from standing straight up and walk. The first two nuns had a diagnosis of bipolar disorder and were under treatment with lithium, venlafaxine, lamotrigine, olanzapine, and mianserin. The third nun had a diagnosis of depression and was under treatment with the same drugs, except for lithium.

The 51-year old nun—the first we treated-, had lumbar spine degenerative scoliosis with a Cobb angle of 34° and low back acute anterior and lateral trunk inclination. She underwent surgery—T4-sacrum fusion—with good results.

We began to suspect when at the six-months check-up of the first nun, the Mother Superior came with two other sisters who were also bending. We collected information on their dietary habits (they do not eat meat), positions while in prayer, penances and personal history, confirming that all the sister were being treated with a combination of multiple antipsychotics, antiepileptics and antidepressants, all prescribed by the same psychiatrist. The nuns were referred to neurology where Pisa syndrome or camptocormia was confirmed, possibly related to the use of antipsychotics. The treatment was modified and postural control improved. With a correct diagnosis, the surgery of the first nun most possibly could have been avoided.

Conclusions: Presumed adult scoliosis associated to camptocormia should be referred to neurology to discard a neurodegenerative disease. The use of atypical antipsychotics such as risperidone or olanzapine may be related to the appearance of camptocormia and can be reverted by interrupting their use or with the use of anticholinergics in 40% of the cases.

3

EXPERIENCE IN THE SURGICAL TREATMENT OF SCOLIOSIS SECONDARY TO TUMOURS SURROUNDING THE SPINAL CORD. RETROSPECTIVE STUDY OF A SERIES OF CASES

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Introduction: Tumours surrounding the spinal cord are an infrequent cause of secondary scoliosis. This association tends to cause adverse outcomes, as confirmed by the high rate of reinterventions and hospital readmissions of these type of patients.
Objectives: 1. To identify the most common tumours causing scoliosis. 2. To determine adverse outcomes associated to surgical correction in patients with tumoral scoliosis.
Materials and methods: Retrospective study of a series of consecutive patients who underwent tumoral scoliosis between 2014 and 2017 (12 patients). Patients with incomplete clinical and radiological records were excluded (1 patient). We collected and analysed the following variables: demographic, clinical and surgical, including diagnosis, indications for the surgery, type of implant, days of hospital stay, unplanned readmission.
Results: Seven women and five men. Mean age at first intervention was 12.3 years (SD ± 4.6). The most common tumours were Ewing's sarcoma (n = 3), astrocytoma (n = 3) and neuroblastoma (n = 3). An osteoblastoma, a medulloblastoma and a non-identified tumour were also identified. The most frequent primary surgery was the placement of rib distractors (n = 5), followed by vertebral arthrodesis (n = 3), four cases of other procedures, and one case of growth bar placement. Mean duration of intrahospital stay in the first surgery due to scoliosis was 22.7 days (SD ± 35.9). Three patients developed complications in their first hospital admission; the main cause was infection of the surgical wound site. Seven patients (58%) underwent unplanned readmission at least once (mean unplanned readmissions per patients 0.83). Three patients required more than three reoperations. All readmissions were due to material failure (material loosening or rupture) and one case also developed infection at the surgical site and required debridement.
Conclusions: Surgical correction of tumoral scoliosis is a complex procedure with high risk of complications. During follow-up, in most some material failure occurs requiring hospital readmission and a new surgery (Table 1).

Table 1 General characteristics of study patients

	Total number (%)
Gender	
Male	5 (41.7)
Female	7 (58.3)
Age (years) (mean)	12.3 (4.6)
Tumour	
Ewing's sarcoma	3 (25)
Astrocytoma	3 (25)
Neuroblastoma	3 (25)
Osteoblastoma	1 (8.3)
Medulloblastoma	1 (8.3)
Unidentified tumour	1 (8.3)
Intrahospital stay in the first surgery (days) (mean)	22.7 (35.9)
Unplanned readmissions	7 (58.3)

4

ANALYSIS OF 100 VERTEBRAL FRACTURES TREATED AS PER THE TLICS SCALE: ADVANTAGES AND INCONVENIENCES

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Objectives and introduction: Vacaro's Thoracolumbar Injury Classification and Severity score (TLICS) combines type of fracture, posterior ligamentous complex involvement and neurological involvement. Shen questions the usefulness of this classification in three-point cases for which the recommendation is to previously consider the degree of pain with the visual analogue scale (VAS) and the measurement of the interpedicular distance. The goal of this study is to review 100 patients with acute thoracolumbar vertebral fractures, present the outcomes according to the type of treatments received by the patients and based on the above-mentioned classification.
Materials and methods: Retrospective, observational, descriptive study on 100 patients with acute thoracolumbar fractures with a mean age of 46 years. Eighty-six per cent of the patients were male and 14% female. Conservative treatment was performed in 77 cases, surgery in 18 and five subjects were excluded because they ended their follow-up elsewhere. We analysed the baseline and post-treatment kyphotic index of the fractures, as well as t VAS at the acute moment and at the end of treatment. The classification was carried out according to Denis, AO and TLICS. In all the involvement of the posterior wall, posterior ligamentous complex and spinal canal invasion were collected.
Results: In the group that underwent conservative treatment, 92% of the subjects scored under four points in the TLICS; 71% reached discharge status and returned to their usual workplace and a final VAS of 3.8 points. In the group that underwent surgery, 52.9% scored four points in the TLICS scale and the remaining 41.2% over four points. From this group, 11% returned to work with a mean VAS score of five points.
Conclusions: There is no unanimous agreement on the type of classification that should be used in cases of spinal fracture. The contribution of the TLICS classification is the posterior ligamentous complex, although it does not assess disease progression. In this study, there is angular improvement in operated patients with four-point TLICS in comparison to those who were not operated, which does not imply clinical improvement. Further prospective studies are needed on the subject.

5

EN BLOC RESECTION OF EWING'S SARCOMA WITH L1–L2 VERTEBRECTOMY. CASE REPORT

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Introduction: Ewing's sarcoma is a rare malignant bone tumour usually affecting the thighbone and the pelvis, with a peak incidence at ages between 10 and 20 years. A primary location in the spine is exceptional and has an aggressive behaviour, particularly when there is involvement of the sacrum. The treatment of this disease is complex, usually requiring neoadjuvant chemotherapy to facilitate radical surgical resection.
Objectives: To present a clinical case of a male patient aged 24 years, with lower back pain lasting 1 year and of progressive intensity not associated to other symptoms. On examination a paravertebral, painless mass is found. No neurological deficit. Lumbar spine magnetic resonance imaging (MRI) reveals a $76 \times 65 \times 75$ mm lesion at L1–L2 level affecting posterior left elements; it occupies the spinal canal through the foramen infiltrating part of the vertebral body, besides the psoas and the ipsilateral paravertebral muscles.
Methods: A percutaneous biopsy is done resulting in Ewing's sarcoma. Following the VACA/IE protocol, neoadjuvant chemotherapy is initiated, which greatly reduced the volume of the tumour. Surgical resection was next performed through double combined left posterior and anterolateral approach with en bloc resection of the lesion with L1–L2 vertebrectomy plus T10 to L4 fixation using transpedicular screws and L1–L2 interbody cage with double pseudo-pedicle.
Results: Complete surgical resection. Postsurgical MRI control with no evidence of tumoral tissue. Expected neurological deficit with weakness in left hip bending and knee extension. Autonomous gait. Adjuvant chemotherapy. Free from disease 8 months after the intervention.
Conclusions: It is necessary to consider previous biopsy in all vertebral tumours case. A tailored approach should be carried out by studying the case and multidisciplinary management. Here, we chose neoadjuvant chemotherapy, which notably reduced the volume of the tumour, and next performed a radical resection of the lesion, followed by chemotherapy. En bloc vertebrectomy is a complex spinal surgery that may achieve good control of tumoral lesions in selected cases.