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SURGICAL MANAGEMENT OF DEGENERATIVE LUMBER SCOLIOSIS

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Abstract

Background: Surgically treating degenerative lumber scoliosis (DLS) alleviates radiating pain and claudication and corrects deformity. In DLS, the key pathophysiological idea to understand is the unequal degradation of discs and facet joints, resulting in a gradual imbalance in the spine's sideways curvature under pressure. Additional complications in the pathophysiology of adult degenerative scoliosis encompass the thickening of the ligamentum flavum, loosening of the interspinous ligament, and the progression towards spinal instability. This work aimed to evaluate the surgical intervention outcomes in DLS.

Methods: A prospective cohort study was conducted on 30 individuals aged ≥ 51 years with DLS abnormalities identified using clinical examination, radiography, or magnetic resonance imaging. Patients were evaluated preoperatively and one month postoperatively using the Roland Morris Disability Questionnaire (RMDQ).

Results: The mean estimated blood loss was 475.2± 197.5 ml. Regarding complications, wound infection occurred in 1 (3.33%) patient; incidental durotomy occurred in 3 (10%) patients; postoperative hematoma occurred in 2 (6.67%) patients; and neurological deficit did not occur in any patient. The mean hospital stays were 3.9± 1.05 days. The mean estimated blood loss was 475.2± 197.5 ml. Cobb angle and RMDQ showed significant improvement after treatment.

Conclusions: Surgical management of DLS exhibited significant improvement with low complications and short hospital stays. In DLS the Cobb angle assumes a less prominent position compared to idiopathic curves, and factors such as lateral listhesis, spondylolisthesis, spinal stenosis, and sagittal imbalance carry equal, if not greater, role.

Keywords: Cobb angle, Degenerative lumber scoliosis, Management, Outcomes, RMDQ.

Introduction:

Degenerative scoliosis is caused by facet joints and intervertebral disks asymmetric degeneration , which results in malalignment or deformity of the spinal column. With advancing age, the incidence of degenerative scoliosis rises. With the advancement of life expectancy, the global population of individuals aged 60 and above is projected to triple by the year 2050 [1].

Degenerative scoliosis is primarily responding most effectively to surgical intervention. Conservative treatments should be seen largely as temporary relief for individuals who are not suitable for surgery due to considerable accompanying health issues [2].

Surgical intervention is widely regarded as an essential course of action for severe degenerative scoliosis despite the efficacy of non-surgical solutions in alleviating symptoms. Diverse surgical procedures with varying rates of complications and treatment efficacy have been developed [5, 6].
The primary objectives of scoliosis surgery are identified as follows: the realignment of the spine's sagittal profile, alleviation of symptoms from compressed neural elements, minimization of surgical complications, and overall enhancement of the patient's quality of life [3, 4].
Surgical objectives frequently alleviate the pain, reduce or stop deformity progression, and enhance the functional status [7]. However, utilization of long-segment fusion in corrective surgery offers the greatest potential for a favorable result [8]; the main surgical therapy for DLS often includes a complex fusion procedure. This approach has shown improvements in both radiographic and functional outcomes. Nevertheless, it is linked to a significant rise in postoperative problems, particularly in adult patients [7].
Multiple studies have documented a notable incidence of complications associated with surgical treatment of DLS [9, 10]. To extend our knowledge, this study aimed to evaluate the outcomes of the surgical intervention in DLS.

Patients and Methods:
This prospective cohort study was carried out on 30 patients, aged ≥ 51 years old, with abnormalities based on the clinical evaluation, radiographic, or magnetic resonance imaging findings.
The study was conducted from January 2019 to June 2021 at Al-Azhar University Hospitals, Egypt, and informed written consent was obtained from the patient.
Exclusion criteria were illnesses or symptoms that could have affected the amount of activity, and questionnaire results were excluded based on medical history and physical examinations.

All patients were subjected to complete history taking, clinical examination, laboratory investigations [Complete blood picture (CBC), prothrombin time and concentration (PT), partial thromboplastin time (PTT), the international normalized ratio (INR), liver profile Screening (HBsAg, anti-HCV and HIV-Ab/Ag), kidney function tests, C-reactive protein (CRP), random blood sugar (RBS), fasting blood sugar (FBS), 2-hour postprandial blood sugar test and the glycated haemoglobin (HbA1c).], radiological examinations [Chest X-ray (CXR), ECG, echocardiography, dorsolumbar, AP and lateral lumbosacral spine X-ray, computed tomographic (CT) and magnetic resonance imaging (MRI) lumbar spine].

Myelography enhances the capabilities of CT scans by providing the ability to examine both the skeletal and nervous systems simultaneously.

A goniometer employs the Cobb technique to assess the Cobb angle on the coronal curve, determining the angle formed by the most inclined end plates at the superior and inferior ends of the primary curve through intersecting perpendicular lines.
Patients were evaluated preoperatively and one month postoperatively using the Roland Morris Disability Questionnaire (RMDQ) [11].

RMDQ included statements describing various difficulties related to back pain, such as staying at home more often, changing positions frequently, walking slowly, avoiding certain tasks, using support to move, having trouble dressing or sleeping, and feeling irritable due to pain. Participants were instructed to mark each statement that accurately reflects their current situation, emphasizing the importance of only ticking statements that truly apply to them at the time of assessment.

Surgical correction involved alignment correction in both the coronal and sagittal planes, decompression of neural structures, and stabilization of the realigned and/or decompressed segments. This was achieved through the posterior approach, posterior decompression, fusion, and osteotomies using pedicle screws fixation by either the free-hand technique or the image-guidance method.

The safest osteotomy is the Ponte osteotomy, which involves resectioning the spinous processes, lamina, and facets at multiple levels. A more gradual correction can be achieved at approximately 3–5 degrees per level. This technique provided the superior three-column purchase of vertebrae, allowing for various potential deformity correction manoeuvres. Complications of transpedicular screw fixation were uncommon when screws were used in this manner.

Postoperative care: Vital signs (blood pressure, peripheral pulses, temperature, breathing rate, and pattern), clinical assessment, and care of wounds were recorded.

All patients were followed up either by clinical visits and/or by phone call during and/ or after the first month after surgical intervention by RMDQ.

Statistical analysis

Statistical analysis was done using SPSS v26 (IBM Inc., Chicago, IL, USA). Quantitative variables were presented as mean and standard deviation (SD) and compared between the measurements utilizing paired Student's t-test. Qualitative variables were presented as frequency and percentage (%). A two-tailed P value < 0.05 was considered statistically significant.

Results:

The mean value (± SD) of age was 51.2 (± 13.12) years. Gender was male in 13 (43.33%) patients and female in 17 (56.67%) patients. The mean value (± SD) of operative time was 139.8 (± 34.05) min. Table 1

Regarding types of curves, 30 (100%) patients were lumbar type. Regarding symptoms, 7 (23.33%) patients had back pain, 6 (20%) patients had leg pain and 17 (56.67%) patients had both back pain and leg pain. The mean value (± SD) of the duration of symptoms was 3.4 (± 1.04) months. The mean value (± SD) of estimated blood loss was 475.2 (± 197.5) ml. Table 2

Regarding sphincteric disturbances and lower limb weakness, sphincteric disturbances occurred in 2 (6.67%) patients, lower limb weakness occurred in 4 (13.33%) patients, and 5 (16.67%) patients had both. Regarding degenerative deformities, 30 (100%) patients had lumber scoliosis. Regarding complications, wound infection occurred in 1 (3.33%) patient; incidental durotomy occurred in 3 (10%) patients; postoperative hematoma occurred in 2 (6.67%) patients; and neurological deficit did not occur in any patient. The mean value (± SD) of hospital stays was 3.9 (± 1.05) days. Table 3
Cobb angle was significantly lower postoperative than preoperative (P value=0.02). RMDQ was significantly lower at one month than baseline (P <0.001). Table 4

Case presentation: A female patient, 54 years old, suffered from low back pain and sciatica on the left side with bilateral claudication pain. MRI of the lumbosacral spine and plain x-ray revealed DLS and lumbar canal stenosis at levels L2-3, L3-4, and L4-5. Patient submitted to laminectomy L2, L3, L4 and discectomy of L4-5 with posterior osteotomy and trans pedicular posterior fixation L2, L3, L4 and L5. RMDQ revealed an improvement in the health related quality of life as a a lower score 1 month postoperative compared to the higher preoperative one. Figure 1

Table 1: Demographic data and operative time of the studied patients

		(n=30)
Age (years)		41.5 ± 12.49
Sex	**Male**	13 (43.33%)
	Female	17 (56.67%)
Operative time (min)		139.8 ± 34.05

Data are presented as mean ± SD or frequency (%).

Table 2: Types of curves, symptoms, and duration of symptoms of the studied patients

		(n=30)
Types of curves	**Lumbar**	13 (43.33%)
Symptoms	**Back pain**	7 (23.33%)
	Leg pain	6 (20%)
	Both back pain and leg pain	17 (56.67%)
Duration of symptoms (months)		3.4 ± 1.04
Estimated blood loss (ml)		475.2 ± 197.5

Data are presented as mean ± SD or frequency (%).

Table 3: Sphincteric disturbances and Lower limb weakness, degenerative deformities, complications, and hospital stays of the studied patients

		(n=30)
Sphincteric disturbances and Lower limb weakness	**Sphincteric disturbances**	2 (6.67%)
	Lower limb weakness	4 (13.33%)
	Both	5 (16.67%)
Degenerative deformities	**Lumber scoliosis**	30 (100%)
Complications	**Wound infection**	1 (3.33%)
	Incidental durotomy	3 (10%)
	Postoperative hematoma	2 (6.67%)
	Neurological deficit	0 (0%)
Hospital stays (days)		3.9 ± 1.05

Data are presented as frequency (%).

Table 4: Cobb angle and RMDQ of the studied patients

	Preoperative	**Postoperative**	**P value**
Cobb angle	54 ± 26.53	38.8 ± 20.8	**0.02***
RMDQ	**Baseline**	**One month**	**P value**
	15.2 ± 3.03	6.7 ± 3.13	**<0.001***

*: significant as P value <0.05. Data are presented as mean ± SD. RMDQ: Roland Morris disability questionnaire.

Discussion

Adult spinal deformity (ASD) correction surgery utilizes several ways to correct scoliosis, kyphosis, or other abnormalities in order to align the spine more appropriately [12]. It is used in spinal deformities that are developmental or that occur because of a degenerative spine condition. ASD correction surgery is often performed with severe spinal deformities or when the condition leads to restrictions in daily life, pain, or loss of function [13].

Scoliosis in adults is identified by a coronal Cobb measurement of 10 degrees or more in a patient who has finished growing [29]. Generally, Cobb angles in ADS are less than 40 degrees, in contrast to the measurements of over 50 degrees that are frequently found in adult idiopathic scoliosis [30].

Surgical intervention in ASD is typically indicated for worsening neurological impairments, chronic axial back pain that does not improve with non-surgical treatments, debilitating pain and exhaustion linked to confirmed exacerbation of the spinal curve accompanied by imbalances in the sagittal and/or coronal planes, and aesthetic concerns in individuals who desire and are physically able to undergo corrective surgery [14, 15]. Correcting the deformity is necessary, but it is crucial to minimize the aggressiveness of the surgical procedure as much as possible [16].

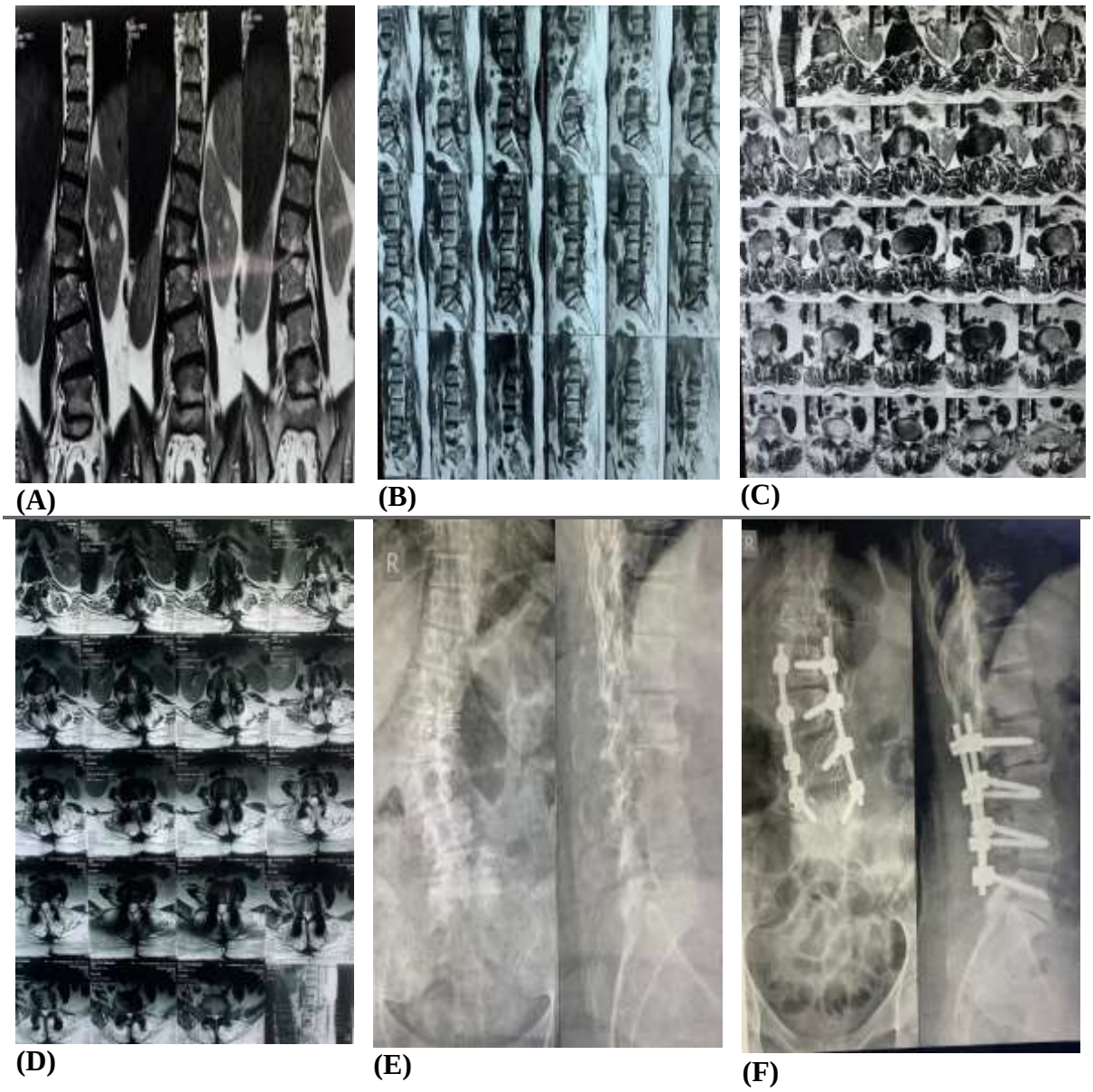

Figure 1:Preoperative magnetic resonance imaging LSS (A) coronal view T2w1, (B): saggital view T1 and T2 Wl, (C): axial view T2Wl, (D): Postoperative magnetic resonance imaging axial view T2Wl, (E): preoperative plain X-ray Ap and lateral, (F): post operative plain X-ray Ap and lateral

The majority of the population in our study were females, accounting for 56.67%. Lebel et al. [17] reported a female-to-male ratio of 1.5:1. Similarly, Liu et al. [18] reported that ASD was 2.4 times as prevalent in women than in males. Moreover, Di Silvestre et al. [19] reported that 87% of the population was female.

Females often possess vertebrae that are smaller and narrower than males. These structural variations may increase their susceptibility to degenerative alterations and spinal abnormalities [20]. Furthermore, variations in body composition and mechanics between men and females might also be a contributing factor. Females may have lower muscle mass and a different body fat distribution, which may impact spinal alignment and lead to degenerative changes [21].

In our study, the mean estimated blood loss was 475.2 (± 197.5) ml. There were 1(3.33%) case suffered from wound infection, 3(10%) cases of incidental durotomy, and 2(6.67%) cases of postoperative hematoma. The average hospital stay was 3.9 days, with a decrease in the Cobb angle postoperatively compared to preoperative measurements. The RMDQ scores were significantly lower in one month compared to the baseline.

Consistent with our findings, Di Silvestre et al. [22] demonstrated that dynamic stabilization without fusion and posterior instrumented fusion for treating DLS had similar functional clinical results at the final assessment, whereas fusion resulted in better scoliosis curve reduction and lumbar lordosis. The researchers determined that pedicle screw-based dynamic stabilization is a less invasive procedure with a shorter surgical time, less blood loss, and decreased risks of adverse events compared to instrumented posterior fusion.

In agreement with our results, Di Silvestre et al. [19] reported that the mean estimated blood loss was 650 ml. Overall complications were reported in 8 cases, which may be responsible for an elevated average hospital stay compared to ours (6.8 days vs 3.9 days). Also, a decrease in the Cobb angle was noted postoperatively compared to the last follow-up measurements (11.3 vs 17.2). RMDQ scores were significantly lower postoperative compared to final follow-up (12.4 vs 6.3).

Further studies by Di Silvestre et al. [23] exhibited that RMDQ scores revealed a statistically significant improvement after dynamic stabilization with pedicle screws for DLS treatment. The mean improvement was 58.2% for RMDQ scores. The average Cobb angle was improved postoperative compared to preoperative (11.1 vs 16.9).

Additionally, the study of Smith et al. [24] compared medicinal and surgical therapy for adult scoliosis and showed a significant improvement in back pain after surgical intervention.

Smith et al. [25] conducted a further study to compare patients with adult scoliosis who received medical and surgical treatment and reported that at a 2-year follow-up, there was a significant improvement in leg pain after surgical treatment. Moreover, Li et al. [26] found that there was a significant improvement in the surgically treated group than the medically treated group. Lastly, Bridwell et al. [27] noted an improvement in the quality of life in individuals who had surgery for symptomatic lumbar scoliosis.

The surgical management of degenerative spinal deformities can have a significant impact on both function and quality of life for affected individuals [28].

Limitations included the sample size, short follow-up, and absence of a control group. Further studies to compare our results with the results of medical treatment are recommended. Further studies are needed to compare the results of different surgical techniques.

Conclusions:

Surgical management of DLS exhibited significant improvement with low complications and short hospital stays. In DLS the Cobb angle assumes a less prominent position compared to idiopathic curves, and factors such as lateral listhesis, spondylolisthesis, spinal stenosis, and sagittal imbalance carry equal, if not greater, role.

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