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Original research article

Three-dimensional correction for idiopathic scoliosis with posterior spinal fusion and the risk of neurological complications

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ABSTRACT

Introduction: The correction of adolescent idiopathic scoliosis (AIS) using the posterior approach is the most common and well-documented technique in medical literature. As with any invasive procedure, it carries the risk of potential neurological complications (NCs). **Aim:** Evaluation of NCs after surgical treatment of AIS and patient satisfaction after surgery. **Material and methods:** A retrospective evaluation of 195 patients operated in 2007–2013 with posterior approach and direct vertebral derotation. We evaluated the age of the patients during the surgery, the angle of the main curvature, the thoracic kyphosis, sex, BMI, the average length of stay in the hospital after surgery, the average percent curve correction, postoperative NCs, and SRS-22 at the final follow-up (FFU).

Results: The operated patients were 71% female. The average age was 16.5 years. The mean duration of surgery was 330 min. The average amount of blood loss was 820 mL. The average length of stay was 5.5 days. NCs were recorded as follows: numbness of the lateral femoral cutaneous nerve (6), muscle weakness of the lower limbs (5), paraesthesia of the foot (5), lower limb paraesthesia (5), radiculopathy (4), paraparesis (2), and neurogenic bladder (2). All NCs were eliminated in the postoperative period and at FFU, and there were no neurological deficits. SRS-22 scores at FFU were good.

Conclusions: (1) The rate of NCs is insignificant and left no lasting musculoskeletal dysfunction. (2) Number of complications was higher when we did not use neuromonitoring. (3) Total satisfaction after surgery at FFU was good.

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1. Introduction

Spinal deformities are a group of diseases of varying etiology and pathogenesis whose essential common feature is a significant, visible, and noticeable deviation of construction, which together involve varying conditions in the biomechanics of the spine.^{1–3} Adolescent idiopathic scoliosis (AIS) is a three-dimensional deformation that appears during development, applies to patients with no apparent cause for its formation, and measures at least 10° (Cobb angle) in the AP-standing X-ray.^{4–6} AIS is found in 0.3%–15.3% of spinal deformities, and is found in 13.8% of the total population.⁷ During most of the twentieth century, the main goal of the treatment of AIS was to stop the progressive curvature, which, in its advanced form, could affect the functioning of internal organs, which in turn is associated with the functioning of the whole body, leading to irreversible dysfunction, and even death.^{5,6} Today, due to the rapid advancement of medical knowledge, a new generation of implants and operating techniques as well as devices to improve the safety of operations have been established. The goals of treatment have evolved regarding the correction of deformity, such as providing cosmetic effects.^{3,8–12} The primary goal of treatment remains the welfare and safety of the patient, which should always be remembered.

The correction of AIS using the posterior approach is the most common and well-documented technique in medical literature. As with any invasive procedure, it carries the risk of potential complications. In spinal surgery, where the use of various implants and instruments for correction of deformation is the norm, complications may be related to the procedure itself, or the equipment and implants.^{5,6,9–11,13–18} Though complications in spinal surgery among adults are well known, and have been repeatedly described in medical literature, reports of complications among children and adolescents are scarce.

2. Aim

In our work, we have decided to evaluate the neurological complications (NCs) that can occur after the surgical treatment of AIS performed by the posterior approach technique, using transpedicular screws, driven by a 'free-hand' technique, as well as assess the satisfaction of patients after the surgical treatment using the rating scale SRS-22.

3. Material and methods

We carried out a retrospective evaluation of 195 patients operated on due to AIS in our department during 2007–2013. The following inclusion criteria were adopted: (1) bone maturity above stage 2 using Risser's classification; (2) scoliosis classified as Lenke 1, 2, 3, 4, 5, 6; (3) angle of the main curvature greater than 45°; (4) correction technique (posterior approach technique) and correction system based on Cotrel–Dubousset; and, (5) period of postoperative final follow-up (FFU) of a minimum of 2 years.

In all patients included in the study, the surgical technique used the posterior approach, transpedicular screws, and the

system based on Cotrel–Dubousset. Correction techniques used were direct vertebral rotation or bilateral apical vertebral derotation. Patients were examined preoperatively and the study included only those without neurological deficits and without prior surgical procedures in their medical history. Summary demographics of our study group are presented in Table 1. A complication was defined as an unexpected event that required medical or surgical intervention to improve the resulting outcome. In addition, NCs were divided as follows: perioperative (intraoperative, and those in the first 7 days postsurgery), early postoperative (8–30 days after the surgery) and late postoperative (more than 30 days postoperatively). All complications were included in the study. We did not divide them into minor or major. All adverse events were counted. A single patient could manifest several complications, and in such cases, each complication was noted individually.

Statistical analysis used 10.0 Statistica (StatSoft, Inc., 2011). The study used the Shapiro–Wilk test, Student's *t*-test, and nonparametric methods. The significance level was assumed at level $\alpha = 0.05$. The results were considered statistically significant when the calculated probability *P* met the test inequality $P < 0.05$. We have analyzed the collected material and confronted it with the available literature.

4. Results

The patient outcomes are included in Table 2. Most patients were female (71%). Regarding the distribution of Lenke curve types, we recorded most as type I ($n = 75$), and fewest as types IV ($n = 9$) and VI ($n = 6$). The average age was 16.5 years. The mean duration of surgery was 330 min. The average amount of blood loss was 820 mL. The average length of stay in the hospital after surgery was 5.5 days.

Out of 195 operative patients, there were 380 perioperative complications. NCs accounted for 7% of all adverse events. The remaining 93% were not neurological and were not analyzed here. All NCs were recorded and summarized in Table 3, and all were classified as perioperative.

Table 1 – Summary demographics of patients with AIS.

Demographics	Number and percentage
Male	56 (29%)
Female	139 (71%)
Lenke classification	
I	75
II	56
III	18
IV	9
V	31
VI	6
Age, years	16.5 ± 1.5
BMI	21.5 ± 3.5
Risser's classification	3.5 ± 1.0
Preoperative major Cobb angle,°	65 ± 9
Preoperative thoracic kyphosis T5–T12,°	42 ± 8

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