



SURGICAL CORRECTION OF IDIOPATHIC SCOLIOSIS USING TOTAL TRANSPEDICULAR FIXATION IN A PATIENT WITH INCOMPLETE GROWTH

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The paper presents a completed case of the surgical treatment of a 10-year-old female patient with progressive grade IV idiopathic scoliosis who underwent surgical correction using total transpedicular fixation. The paper demonstrates long-term results of treatment of idiopathic scoliosis in the actively growing patient without the use of epiphyseodesis and staged surgical interventions.

Key Words: progressive idiopathic scoliosis, incomplete growth, transpedicular fixation, adolescent idiopathic scoliosis, surgical treatment, long-term results, deformity of the spine.

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In November 2012, patient I. was admitted for a routine examination and making a decision on the tactics for further treatment of spinal deformity.

The girl grew and developed properly. At the age of 8, parents noticed the appearance of spinal deformities. Despite regular courses of conservative treatment (exercise therapy, massage, physiotherapy, swimming in the pool), a rapid rate of progression of scoliotic deformity was observed (the main thoracic curve increased by 10° over one year, and the lumbar counter-curvature increased by 7°).

According to X-ray data, at the time of the patient's admission to the clinic, the difference in the costotransverse angles, measured at the level of the apical vertebra on the convex and concave sides of the deformity, amounted to 8° (the first sign of Mehta), there was a visible projection of the head of rib on the convex side of the deformity to the upper angle of apical vertebra (phase II of the second sign of Mehta) [1], the score in the Risser apophysial test was 0. The patient had no menses. These indicators are prognostic signs of spinal deformity which is potentially subject to progression.

The following methods were used to assess the condition of the child: clinical,

radiological, MRI, computer optical topography (COT). Examination and materials were anonymized. An analysis of the results of the examination and medical documents was performed. The publication does not contradict the principles of the bioethical committee (Minutes of the meeting No. 003/14 of April 25, 2014).

Initial examination (2012). The patient complains of spinal deformity, moderate pain in the thoracic and lumbar spine departments during prolonged vertical load. Objectively, her state is satisfactory, the constitution is abnormal, the nutrition is satisfactory, there is no reduction in activity. Height 152 cm, weight 38 kg, at the time of examination no neurological deficit was detected. There is local asymmetry of the shoulder girdle, trigones of the waist, and the angles of the scapules. Right thoracic and left lumbar curves. Right rib hump.

Instrumental methods. X-rays in two projections with the patient in the standing position: grade IV scoliotic deformity (50° according to Cobb), equivalent right thoracic and left lumbar curves. The thoracic kyphosis is 29°, the lumbar lordosis is 57° (Fig. 1).

MRI of the thoracic and lumbar spine: No morphological changes were detected in the spinal cord and spinal canal.

Diagnosis: uncomplicated progressive compensated grade IV idiopathic scoliosis (50°) with the presence of equivalent right thoracic and left lumbar curves.

Taking into account the patient's age, continuing progression of the deformity and its severity, a surgical correction of spinal deformity was conducted using third generation segmental instrumentation with total transpedicular fixation, posterior spinal fusion with local autobone along the length of incision in prone position of the patient with abdominal wall unloading (surgeon A.S. Vasyura).

The course of the postoperative period was unremarkable. After the girl was verticalized, there was notable clinical and radiological improvement. She was discharged home without external immobilization.

At the time of publication, the follow-up period was 6 years.

Results of the control examination (September 2018) There were no complaints. Objectively, the condition is satisfactory. Height 163.5 cm, weight 48 kg. Somatic status within normal

limits. There was no clinically notable residual spinal deformity. No neurological deficit was detected.

Results of instrumental examination. X-rays in two projections with the patient in the standing position: correction of the spinal deformity is preserved; the instrumentation is intact and its supporting ability is maintained. Artifici-
al posterior bone block of the thoracic and lumbar spine is formed. T6–T11, 11°, T12–L1, 8°, T1–T5, 10° (Fig. 2–4).

Discussion

The choice of methods for surgical correction of idiopathic scoliosis in patients with incomplete growth remains a controversial issue and predicting the progression of idiopathic scoliosis is still one of the most difficult challenges in modern vertebralogy. These facts were the basis for this publication.

The issue of choosing the volume and staging of surgical treatment is very important in patients with incomplete growth (10–14 years). This is due to several reasons.

It is necessary to take into account the continuing growth as one of the determining causes of the progression of deformity, which, if untreated, would lead to the formation of gross spinal deformities in the long term. Vertebralogists around the world fear postoperative progression and, above all, the development of the crankshaft phenomenon, which is confirmed by foreign articles on this topic. According to some authors [2, 3], the method of staged spinal correction using Harrington instrumentation allowed achieving 41–47 % correction of spinal deformity in patients during active bone growth (5 to 7 distractions were performed). However, less than 40 % of surgical correction of spinal deformity remained five years after the start of surgical treatment. During this period, the growth of the spine in the instrumentation area averaged 3.5 cm. Significant disadvantages of the method are the need for repeated interventions, the absence of a derotation effect, frequent technical and infectious complications, instabil-

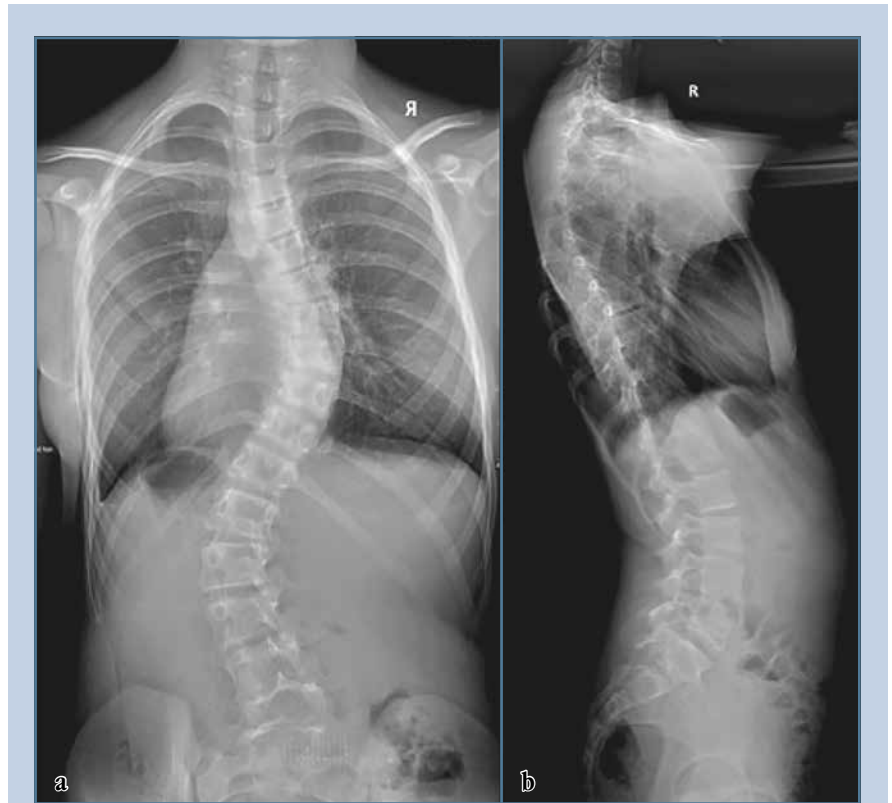


Fig. 1

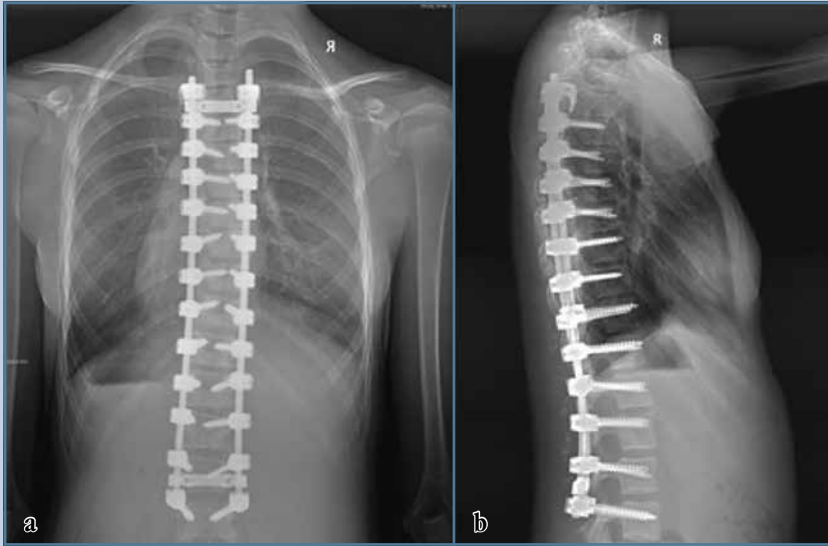
X-ray of the patient I. in the standing position prior to the surgery: **a** – grade IV scoliotic deformity (50° according to Cobb) with equivalent right-side thoracic and left-side lumbar curves; **b** – thoracic kyphosis – 29°, lumbar lordosis – 57°

ity of instrumentation, development of pseudarthrosis in the area of the bone block.

In 1997, Lee et al. [4] published an article with the results of surgical treatment using posterior instrumentation in 63 patients in the active growth phase (10–11 years) (Risser grade 0–1) with a postoperative follow-up from 5 to 16 years. Postoperative progression was observed in almost half of the patients.

Dubouset et al. [5] analyzed 39 cases of surgical correction of scoliotic spinal deformity in patients with Risser grade 1, which were performed in one stage using only the posterior instrumentation. In all cases, there was an increase in scoliotic curves in the long-term follow-up period. According to the authors, this circumstance is an inevitable consequence of the continued growth of the spine in the

conditions of the posterior instrumental spinal fusion without the formation of pseudoarthrosis of the bone block or disruption of the integrity of the instrumentation. The authors indicate that anterior spinal fusion in combination with posterior instrumental fixation is necessary to achieve stable correction in patients with incomplete bone growth. Tao et al. [6] presented the results of the correction of spinal deformity in 67 patients with idiopathic scoliosis in the period of incomplete bone growth. All patients were divided into three groups, based on the method of surgical treatment: hybrid instrumentation, total transpedicular fixation with an interval and sequential arrangement of screws. At the end of the postoperative follow-up period (36 months), the following results were obtained: there were 33% cases of post-

**Fig. 2**

X-ray of the patient I. in the standing position on day 7 after the surgery: **a** – magnitude of residual thoracic curve T6–T11 – 11°, lumbar curve T12–L1 – 8°, upper thoracic counter-curvature T1–T5 – 10°; **b** – thoracic kyphosis – 19°, lumbar lordosis – 45°

**Fig. 3**

X-ray of the patient I. in the standing position 6 years after the surgery: **a** – the formed articular posterior bone block in the thoracic and lumbar spine, the magnitude of residual thoracic curve T6–T11 – 11°, lumbar archcurve T12–L1 – 8°, upper thoracic counter-curvature T1–T5; **b** – thoracic kyphosis – 19°, lumbar lordosis – 45°

operative progression of scoliotic deformity in the 1st group, while there were no such cases in the 2nd and 3rd groups.

Lapinsky et al. [7] analyzed the results of surgical treatment of patients, dividing them into two groups. Group 1 consisted of 14 patients with incomplete growth and Risser grade 0–1 who underwent anterior spinal fusion in combination with posterior instrumental correction with hook instrumentation; Group 2 consisted of 12 patients who underwent only posterior hook instrumentation.

In Group 1, the magnitude of the correction of the main arch was 77 %, in Group 2, 63 %. In Group 1, the average age of patients was 10.7 years, the average postoperative follow-up was 37 months; in Group 2, the average age was 11.1 years, the average postoperative follow-up was 64 months. In Group 1, at the end of the follow-up period, postoperative progression did not exceed an average of 10°; in Group 2, the loss of correction significantly exceeded 10°. The authors concluded that the two-stage approach with the use of anterior fusion and posterior instrumental fixation is required to prevent the development of the crankshaft phenomenon.

It is necessary to consider the overall impact of surgery on the further course of the patient's life and the psychological characteristics of this age group. Patients who are only entering puberty are most sensitive to the opinions of others, to the perception of their appearance, which affects the quality of their life, so the question of surgical correction is vital for them. Moreover, the patients' psychological reactions influence the course of scoliotic disease and its outcome [8].

The third-generation posterior segmental instrumentation (CDI), introduced into clinical practice in 1983, revolutionized the field of spinal surgery [9–11]. Using CDI, surgeons from around the world have obtained good outcomes in correcting scoliotic deformities for idiopathic scoliosis in patients with incomplete growth. The third-generation instrumentation allowed to avoid multi-stage distractions. However, as mentioned above, many authors came to a consensus: to stabilize scoli-

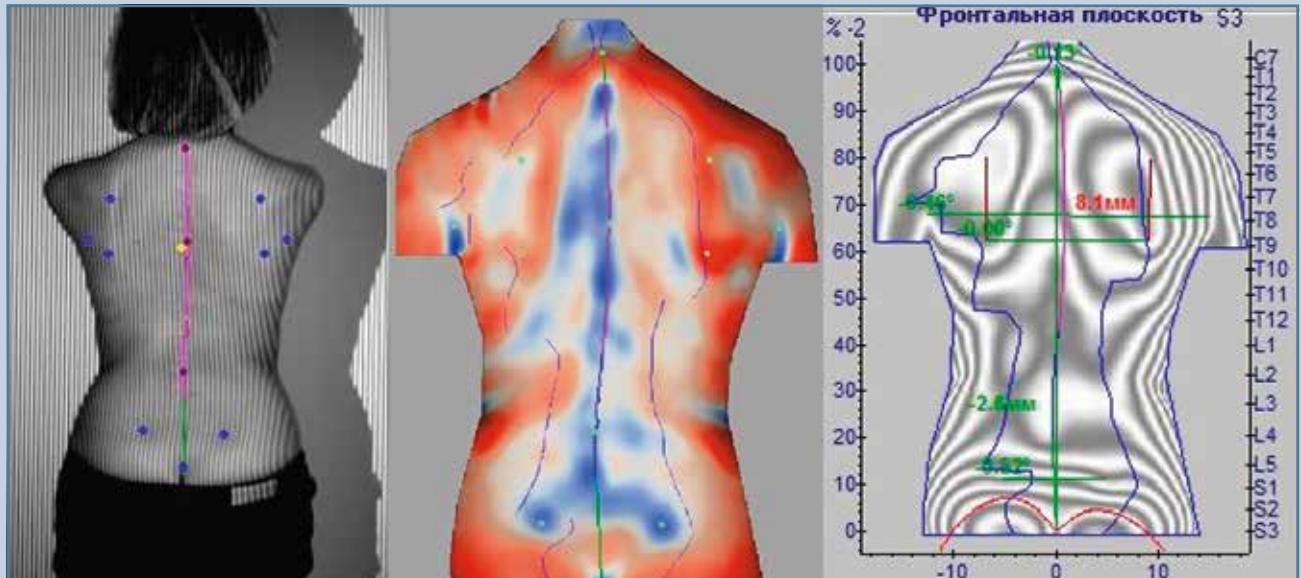


Fig. 4

Data of computer optical tomography of the patient I. 6 years after the surgery

otic curves and prevent postoperative progression, it is necessary to combine posterior fixation using CDI with epiphysiospondyloidesis.

The hook fixation was replaced by a hybrid and total transpedicular instrumentation that combines the advantages of CDI with the reliability of transpedicular fixation [12, 13]. Our colleagues from St. Petersburg [14] used transpedicular spinal system in the correction of the thoracolumbar, lumbar idiopathic scoliosis and achieved a correction of the thoracolumbar curves in 90.3 %, and the lumbar in 87.5 % of cases with the average residual deformities of 5.5° and 7.2°, respectively.

The presented clinical case of surgical correction of idiopathic scoliosis with the use of total transpedicular fixation without anterior intervention and staged corrections in a 10-year-old patient with

incomplete growth, high potential for progression, and high risk of crankshaft formation demonstrated good outcomes. It was possible to achieve a correction of the thoracic curve by 78 % of the initial value and lumbar counter-curvature by 84 % which was preserved in the late postoperative period and a significant improvement in the quality of life. The aforementioned outcomes achieved by Russian and foreign colleagues, our own experience and this particular clinical case prove the use of total transpedicular fixation allows achieving an excellent correction of scoliotic curves and ensure reliable fixation and maintenance of the achieved result in patients with progressive spinal deformity during the period of continuing bone growth even without anterior intervention and staged corrections. These conditions allow to prevent the development of the crank-

shaft phenomenon, and, consequently, there is no need for an anterior stage of epiphysiospondyloidesis.

Nevertheless, we should keep in mind that the method of total transpedicular fixation is the leading method at the present stage of development of scoliosis surgery. The need for anterior intervention is not determined by the prevention of possible postoperative progression, but by the magnitude of the spinal deformity, that is, the anterior intervention is performed in order to mobilize gross and rigid scoliotic deformity. Anterior release remains relevant and necessary stage of surgical treatment of severe and rigid spinal deformities in patients of any age.

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