SURGICAL TREATMENT OF SEVERE CONGENITAL KYPHOSIS IN AN ADULT PATIENT: RARE CLINICAL OBSERVATION AND A BRIEF LITERATURE REVIEW

V.V. Novikov, A.Yu. Sergunin, V.V. Belozerov, M.N. Lebedeva, A.S. Vasyura, M.V. Mikhaylovskiy
Novosibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan, Novosibirsk, Russia

The paper presents a clinical case of surgical treatment of an adult patient with severe rigid congenital kyphosis developed due to multiple anomalies in the thoracolumbar spine. Surgical intervention included vertebral column resection (VCR) and the deformity correction using segmental third-generation instrumentation with transpedicular fixation. The VCR made it possible to correct the relationship between vertebrae in the anomaly zone, to improve the shape of the spinal canal and increase its volume, and to achieve apparent mobility of the spine at the apex of the kyphosis. Preservation of the anterosuperior portion of the body of the resected vertebra allowed avoiding anterior mesh cage use to support and reconstruct the anterior supporting column of the resected segment. This enabled performing necessary correction of severe kyphotic deformity, reduced the risk of neurological complications, and favored the formation of solid bone block in the long-term period after surgery.

Key Words: congenital kyphosis, surgical treatment, VCR, spinal instrumentation.

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A 32-year-old female patient S. was admitted to the Clinic of Children and Adolescent Spine Surgery (Novosibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan) in September 2014 with uncomplicated congenital thoracolumbar 156° kyphosis with left-sided scoliotic component of 65° due to multiple vertebral anomalies. The patient was followed by a doctor until the age of 5 at the place of residence, as listed in the past medical chart. She suffered from lumbar spine pain from early childhood; the deformity became visually apparent at the age of 10 and then gradually progressed until the age of 14–15. Conservative treatment was received on irregular basis. Parents were extremely negative about the possibility of surgical treatment for their daughter due to the fear of neurological complications. The patient made an independent decision to undergo spinal deformity correction in adulthood due to increasing pain and a pronounced cosmetic defect. X-ray obtained in an upright position showed that the Cobb angle of the left-sided scoliotic component was 65°, the Cobb angle of the kyphotic curve was 156°. Spine abnormalities were identified: posterior wedge vertebrae T10 and L1, posterior wedge T11 hemivertebra. Clinically apparent acute angular kyphosis with a left-sided scoliotic component was formed as a result of spinal deformity progression with fully formed posterior parts of the anomalous vertebrae by the age of 32. A total of 11 thoracic and 4 lumbar vertebrae were observed. MRI and MSCT of the thoracolumbar spine showed pronounced kyphotic deformity with stenosis of the spinal canal with anteroposterior diameter of 5 mm at the apex (Fig. 1). The patient was neurologically intact during examination. Traction test with total body weight was conducted, which showed no neurological symptoms. Vertical traction revealed a lack of mobility at the apex of the spinal deformity and of body elongation.

The patient underwent sequential surgery (surgeon, V.V. Novikov) including skeletal cranio-tibial traction, partial resection of the T10 vertebra, resection of the T11 vertebra via posterior median approach to the spine, correction of spinal deformity using "NITEK" instrumentation (transpedicular fixation) and posterior fusion with local autologous bone throughout the length of instrumentation (T7–L3). The intervention was performed under multicomponent TIVA and ALV. Due to anatomical features at the apex of the kyphosis, the T11 vertebra was completely resected, T10 vertebra was partially resected with preservation of the anterosuperior portion of its body due to the uneven shape of the cranial surface and reduced support ability of the underlying body of the L1 vertebra. During resection of the abnormal T10 and T11 vertebrae, the corresponding nerve roots were dissected. The preserved anterosuperior portion of the T10 vertebra was used as anterior support for the corrective action during kyphotic deformity correction using instrumentation. This allowed us to avoid using additional ventral implants such as titanium

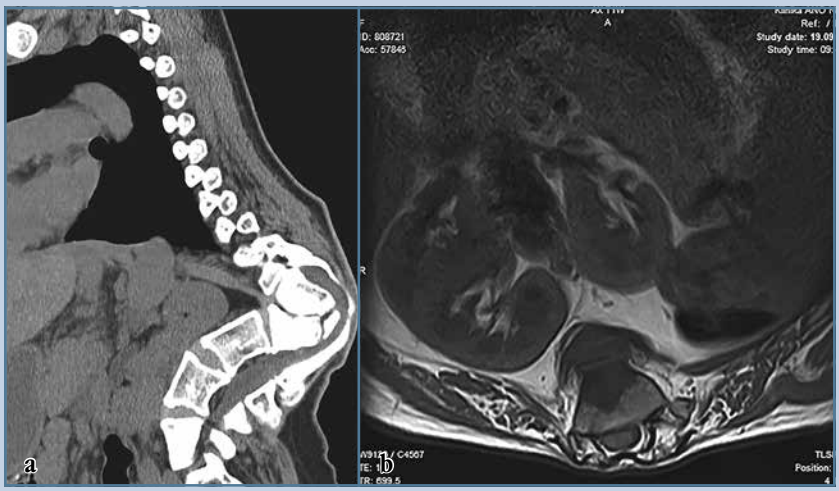

Fig. 1
MSCT **(a)** and MRI **(b)** data on the patient S., aged 32, prior to surgery: spinal kyphotic deformity due to abnormal development of T10–L1 vertebrae with anteroposterior stenosis of the spinal canal to 5-mm in diameter

Fig. 2
Lateral view of the patient S., aged 32, immediately before and immediately after surgery

mesh cage to support and reconstruct the anterior supporting column. The wound at the apex of the kyphosis was sutured without tension and deficit of soft tissues. Overall duration of the surgical intervention was 390 minutes, intraoperative blood loss volume constituted 900 mL, postoperative blood loss volume was 300 mL. Intraoperative and postoperative periods were uncomplicated. The patient was transferred from intensive care unit to the specialized department on the next day after surgery due to stable condition.

T10–L1 radiculopathy on both sides (corresponding to the level of the dissected nerve roots) and an apparent clinical and cosmetic effect were observed after surgery (Fig. 2). The patient was allowed to walk one week after surgery and discharged for outpatient follow-up without external immobilization. X-ray examination demonstrated 65° to 16° and 156° to 52° reduction in the scoliotic and kyphotic components of spinal deformity, respectively.

However, 6 months after surgery, progression of kyphosis by 13° superior to the instrumentation area at the level of T6–T7 (PJK) with an increase in total kyphosis angle to 65° was revealed in the absence of patient's complaints. No progression of total kyphosis and proximal junction kyphosis was noted afterwards (in the period of 4 years). Sagittal and frontal balances were completely recovered. Instrumentation is stable and fixed to the bone structures. Artificial bone blocks were formed throughout the whole length of instrumentation, no spinal stenosis was detected (Fig. 3, 4). Additional surgery was not required. There is a significant improvement in the patient's appearance with preservation of the body balance (Fig. 5).

Discussion

Kyphosogenic malformations are found at any level of the spine, with thoracolumbar anomalies being mostly detected. X-ray-based anatomical and clinical differences require differentiated approach for choosing the terms and method of surgical treatment of each

Fig. 3
Radiographs of the spine of the patient S., aged 32, lateral view (upright position), at different stages of the treatment: **a** – 156° kyphosis prior to surgery; **b** – 52° kyphosis after surgery, change in the body sagittal balance; **c** – 65° kyphosis 6 months after surgery, PJK is formed superior to the level of spinal fixation, restoration of the sagittal balance of the body; **d** – 65° kyphosis 2 years after surgery, no progression, artificial bone blocks are formed

type of kyphotic deformity [1]. Smith-Petersen-type osteotomies can be used for mobilization and correction of small or extended kyphotic spinal deformities [2]. However, one of the few solutions in case of severe and rigid spinal deformities with severe trunk decompensation is vertebral column resection (VCR) [2, 3], which was first performed by MacLennan [4] as early as in 1922 to treat severe scoliosis via the posterior approach to the spine. Since then, it has been used to treat congenital kyphosis and scoliosis, including hemivertebra resection [5–7]. In 1983, Luque [8] presented several cases of vertebrectomy in patients with spinal deformities of more than 90° through a combined anterior and posterior approaches to the spine. A modification of the Luque's surgery for the treatment of fixed multilevel deformities of the spine was described by Bradford et al. in 1987 [9], who performed it through a combined anterior and posterior approaches. In 2002, Suk et al. [10] developed a posterior approach for performing VCR (pVCR) in order to reduce surgery duration and the number of complications typical for durable combined anteroposterior surgery. Indications for these interventions have been determined: local non-extended and angular severe and rigid spinal deformities, when the spinal segment can be resected at one or two levels without significant increase in the risk of spinal cord tension or bending at the site of resection [11]. At the same time, titanium mesh cage implantation is recommended for support and reconstruction of the anterior spinal column of the resected segment in case of its deficit of more than 5 mm to reduce the risk of body shortening [12], which requires rigid fixation of the titanium mesh cage in adjacent vertebrae that serve as the anterior support for the corrected spinal deformity.

Having analyzed our own observation, we point out the following features:

1) to date, such interventions for congenital deformities are performed mainly in pediatric and adolescent patients, but, when our patient was a child, pVCR-type surgeries were only at the stage of development;

2) the surgery did not require the use of ventral implants (mesh cage) and transplants; instead, anterosuperior portion of the resected vertebral body was used, which served both to reconstruct the anterior spinal column and to provide a support during correction using posterior spinal instrumentation;

3) a significant decrease in the kyphosis and the volume of the posterior spinal column at its apex allowed us to adequately suture soft tissues at the apex of the deformity without their deficit;

4) development of PJK is associated with formation of the upper points of instrumentation anchoring at the T7 level, which led to a negative sagittal imbalance due to insufficiently high cranial fixation area; PJK development was not accompanied by clinical complaints and did not require additional surgical correction.

The presented observation demonstrates the possibility of one-stage correction of severe and rigid congenital kyphosis in adult patients using VCR at several levels without using additional ventral corrective or fixing metal structures while reducing the risk of fatal neurological complications. The use of transpedicular instrumentation in com-

Fig. 4
Radiographs of the spine of the patient S., aged 32, frontal view (upright position), at different stages of the treatment: **a** – 65° scoliosis before surgery; **b** – 16° scoliosis after surgery, improved frontal balance of the body; **c** – 16° scoliosis in 6 months and 2 years after surgery, frontal balance of the body is restored

bination with correction of all deformity components improves the shape of the spinal canal bringing it closer to the physiological shape. However, it is not only the length of the spinal deformity that should be taken into account during the placement of instrumentation, but also the spinal balance for its restoration or maintenance in the long-term postoperative period. In case of nonadherence to these principles, deterioration of the corrective effect and deformity progression beyond the instrumentation area might happen in the postoperative period.

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Fig. 5
Rear and lateral views of the patient S., aged 32, 4 years after surgery

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Address correspondence to:
Novikov Vyacheslav Viktorovich
Novosibirsk Research Institute of Traumatology
and Orthopaedics n.a. Ya.L. Tsivyan
Frunze str., 17, Novosibirsk 630091, Russia,
niito@niito.ru

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Vyacheslav Viktorovich Novikov, DMSc, senior researcher, head of Research Department of Children and Adolescent Spine Surgery, Novosibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan, Frunze str., 17, Novosibirsk, 630091, Russia, niito@niito.ru;
Aleksandr Yuryevich Sergunin, junior researcher of Research Department of Children and Adolescent Spine Surgery, Novosibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan, Frunze str., 17, Novosibirsk, 630091, Russia, niito@niito.ru;
Vadim Vasilyevich Belozerov, junior researcher of Research Department of Children and Adolescent Spine Surgery, Novosibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan, Frunze str., 17, Novosibirsk, 630091, Russia, niito@niito.ru;
Maya Nikolayevna Lebedeva, DMSc, head of Research Department of Anesthesiology and reanimatology, Novisibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan, Frunze str., 17, Novosibirsk, 630091, Russia, niito@niito.ru;
Aleksandr Sergeyevich Vasyura, MD, PhD, senior researcher of Department of Children and Adolescent Spine Surgery, Novosibirsk Research Institute of Traumatology and Orthopaedics n.a. Ya.L. Tsivyan, Frunze str., 17, Novosibirsk, 630091, Russia, niito@niito.ru;
Mikhail Vitalyevich Mikhaylovskiy, DMSc, Prof., chief researcher of Department of Children and Adolescent Spine Surgery, Novosibirsk Research Institute of Traumatology and Orthopaeducs n.a. Ya.L. Tsivyan, Frunze str., 17, Novosibirsk, 630091, Russia, niito@niito.ru.