SURGICAL TREATMENT OF CONGENITAL SPINAL STENOSIS ASSOCIATED WITH FAILURE OF THORACIC VERTEBRAE SEGMENTATION*

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A case report of surgical treatment of a patient with congenital spinal stenosis associated with spinal malformation, failure of segmentation of the T4—T7 vertebrae, and of the spinal cord is presented. The original surgical technique was applied to decompress the spinal canal and simultaneously form posterior spinal fusion.
Key Words: spinal stenosis, spine and spinal cord malformation.

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Congenital abnormalities of the spine associated with failure of segmentation of thoracic vertebrae belong to disorders causing rough (and usually rapidly progressive) deformities that require orthopedic treatment. Abnormalities of spinal development are often accompanied by severe malformations of the internal organs, limbs, and the spinal cord [2].

Clinical manifestations of spinal cord abnormalities come to the fore in these cases, making the correction of spinal deformity without interventions on the spinal cord impossible [1].

Choice of a method and extent of surgery treatment in patients with a combination of spine and spinal cord abnormalities is associated with certain problems [2–4].

We present a case of surgical treatment of a patient with maldevelopment of the spine associated with spinal canal stenosis and spinal cord abnormality.

A 13-year old female patient N. was admitted to the neurosurgery department with complaints of gait disturbance, progressive deformity and pain in the thoracic spine, and decreased exercise tolerance. It is known from the past medical history that the gait disturbance and deviation of the spinal axis appeared in the age of 4 years. The patient was examined at the place of residence: abnormal development of thoracic vertebrae was revealed. Symptomatic and sanatorium-resort treatment was provided.

The patient's general condition at admission was assessed as serious. Skin and visible mucous membranes were of normal color and clean. Pharynx was normal. Nasal breathing was unconstrained. Peripheral lymph nodes were not enlarged. Heart sounds were clear and rhythmic, without organic murmurs. Breathing was vesicular, performed in all areas, no rales. The abdomen was soft, painless, available for examination in all sections, no symptoms of peritoneal irritation were determined.

Orthopedic status. Normostenic body type; satisfactory nutrition. The patient was capable of walking independently without assistance and had an abnormal gait with knee flexion and spreading of both feet towards the external parts. Shoulder girdles were asymmetrical, with the right one being 0.5 cm higher, the angle of the right scapula was 1.0 cm higher then that of the left scapula. Waist triangles were asymmetrical, with the left one being deepened. The spine axis in the thoracic spine deviated rightwards. Flattening of the thoracic kyphosis and lumbar lordosis were observed in the sagittal plane. Forward inclination of the body was confined. The feet had transversal arch flattening.

Neurological status. Consciousness was clear, catastasis was active; orientation in space was undisturbed; the patient was cooperative. Pupils D = S, photoreaction was active, consensual. The eyes had movements in the full range. Palpebral fissures D = S, nasolabial folds were symmetrical. Swallowing and phonetics were not impaired. The tongue was in the midline. Coordination in the Romberg position was stable. The patient could perform a full range of active movements of the upper limbs. The upper limb tone was not changed. The tendon and periosteal reflexes of the upper limbs were of moderate activity, S = D. Movements of the lower limbs were in the full range. Reflexes from the legs were D = S and active. No pathological reflexes were determined. The lower extremity muscle tone was reduced. Strength of extensor muscles was reduced to 2 points, that of the extensors of the knees – to 2 points; dorsal flexion of the feet was reduced to 2 points. Pain hypoesthesia of the conductor type from the T5 segment level was detected. Kinesthesia was unimpaired. Disorder of the pelvic organs (urinary incontinence) was observed.

Electrophysiological study. Electrogenesis of the lower limb muscles was dramatically reduced, the pathological process localized at the spinal or supraspinal level. Analysis of temperature and pain sensitivity in the C2–S2 dermatomes showed that the normal thresholds of this kind of sensitivity were detected only in the dermatomes C4 and C5 left, C7 right, T1 left , T2 left, T3, T4 left , T5, T7 right. Various disor-

ders were found in other studied dermatomes: an increase in the threshold of temperature and pain sensitivity by 2–5° in dermatomes C2, C3 right, C8 left, T1 right, L1; a lack of thermal sensitivity and a significant increase in pain sensitivity thresholds (by 2–6°) in dermatomes C3 left, C5 right, C6 left, T8, T10, T11, L1, L3, L4, L5, S1, S2, S3; no thermal sensitivity in the presence of normal pain sensitivity thresholds in dermatomes C6 right, C7, T2 right, T4 right , T6, T7 left, T9, T12.

Neurologist's opinion: flail legs, impaired function of the pelvic organs.

No functional disorders of the respiratory, cardiac, digestive, and excretory systems were found.

Radiological examination of the spinal column. Computed tomography (CT) scanning in the frontal plane revealed the deviation of the spinal axis from T3 to T10 with the curve magnitude of 7°. In the sagittal plane, the local lordosis from T6 to T9 with the magnitude of 10° was detected. Concrescence of the T6–T9 vertebrae and reduction of the anteroposterior and cranial sizes of the T6–T9 vertebral bodies by 1/3 of body dimensions were observed. Spinal canal stenosis at the T6–T8 level up to 0.8 cm and an acute narrowing of the intervertebral foramina on both sides in the T6–T9 segments were also detected. Bilateral approximation of ribs 5 through 9 was observed (Fig. 1).

Spinal cord compression at the T6–T9 level, hydromyelia and atrophy of the spinal cord at the T3–T5 level, and spindle-shaped arachnoid cyst of the spinal cord at the T3–T5 level were observed according to the MRI data (Fig. 2).

With allowance for the neurological status of the patient, the changes in spinal cord, spinal canal stenosis, and progressive deformity of the spinal column, we performed expansive laminoplasty that was based on the original technique allowing for one surgical session to cut short all pathological processes, to eliminate the spinal canal stenosis, to normalize cerebrospinal fluid circulation, to create conditions for the formation of the posterior compensative bone block with overlapping areas of one segment above and below the pathological lordosis.

With the patient in the prone position, we made an incision along the spinous processes at the T5–T10 level. We performed skeletization of the posterior support structures and osteoplastic laminotomy at the T5–T10 level with partial resection of the yellow ligament. Adhesion in the spinal canal was observed, so we transected the commissures in a sharp/blunt manner. The dural sac was lying freely in the spinal canal and pulsating.

Using an individual right-sided approach to rib 8, we harvested autografts from the posterior regions of ribs 8 and 9 subperiosteally within 7 cm.

The autografts of 1 cm in width were placed in laminectomic intervals on both sides and the osseous structures of the posterior supporting complex were placed on top of them. The vertebral arches and grafts were fixed with the Matrix Rib plates (Fig. 3).

Fig. 1
CT scans of the thoracic spine of the 13-year old patient N. before the treatment: **a** – failure of segmentation of the T4–T7 vertebrae; **b** – narrowing of the radicular foramina in the T4–T7 vertebrae; **c** – spinal stenosis

Fig. 2
MRI scans of the 13-year old patient N. before the treatment: **a** – compression of the spinal canal from T4 to T7 with dural sac compression; **b** – spindle-shaped arachnoid cyst of the spinal cord at the T3–T5 level

Fig. 3
X-ray images of the thoracic spine of the 13-year old patient N. on the 9th day after the surgical treatment.

No neurologic impairment of the lower limbs was observed after the surgical treatment. The patient was put on her legs, using spinal support, on the 3rd day after the surgery and was discharged for outpatient treatment on the 21st day.

CT scans of the thoracic spine after the surgery (Fig. 4) showed that the spinal axis in the coronal plane of the thoracic spine deviated rightwards up to 3°, no deviation was observed in the lumbar spine in the sagittal plane at the T6–T9 level; formation of the bone block in the thoracic spine within the zone fixed with the autografts was observed, the spinal cord at the T5–T10 level had no signs of compression.

Neurophysiological study after the surgery showed positive dynamics with an increase in the electrogenesis amplitude of the back muscles up to 10 %. An analysis of the temperature-pain sensitivity state after the surgical treatment showed a significant improvement in the dermatomic areas C2 left, C3, C5 right , C6, C7, C8 left, T1 right, T2 right, T4 right, T8, T10, T11, L1, L2, L3, L4, L5, S1, S2. Positive changes (Fig. 5) were revealed in the form of the temperature-pain sensitivity normalization (in the dermatomes C2 left, C3, C5 right , C6 , C7 , C8 left, T2 right, T4 right, T8), in reduction of pain sensitivity thresholds by 2-6° (in the dermatomes T1 right, T10, T11, L1, L2, L3, L4, L5, S1, S2).

Neurologist's opinion after the surgery: muscle strength of the lower limbs was increased up to 3 points, joint and muscular sense was retained, light flail legs associated with dysfunction of the pelvic organs persisted.

Thus, the spinal stenosis was eliminated, the cerebrospinal fluid circulation was normalized, and conditions for the formation of balancing spinal fusion for pathologically low-lying vertebral bodies were created in the course of the surgical treatment.

A significant improvement of the neurological state of the lower limbs has been observed. The neurosurgical and orthopedic problems have been solved in the course of the operations performed. Based on the original technique, expansive laminoplasty with simultaneous decompression and formation of posterior bone block was performed in order to cut short neurological impairments, to eliminate spinal stenosis and liquor-dynamic disturbances, as well as to stabilize progressive pathological lordosis.

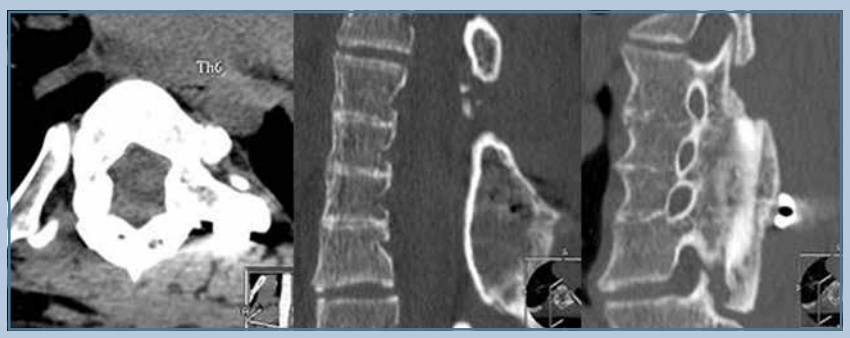

Fig. 4
CT scans of the thoracic spine of the 13-year old patient N. six months after the surgical treatment: expansion of the stenotic spinal canal through the area of developmental abnormality of vertebrae

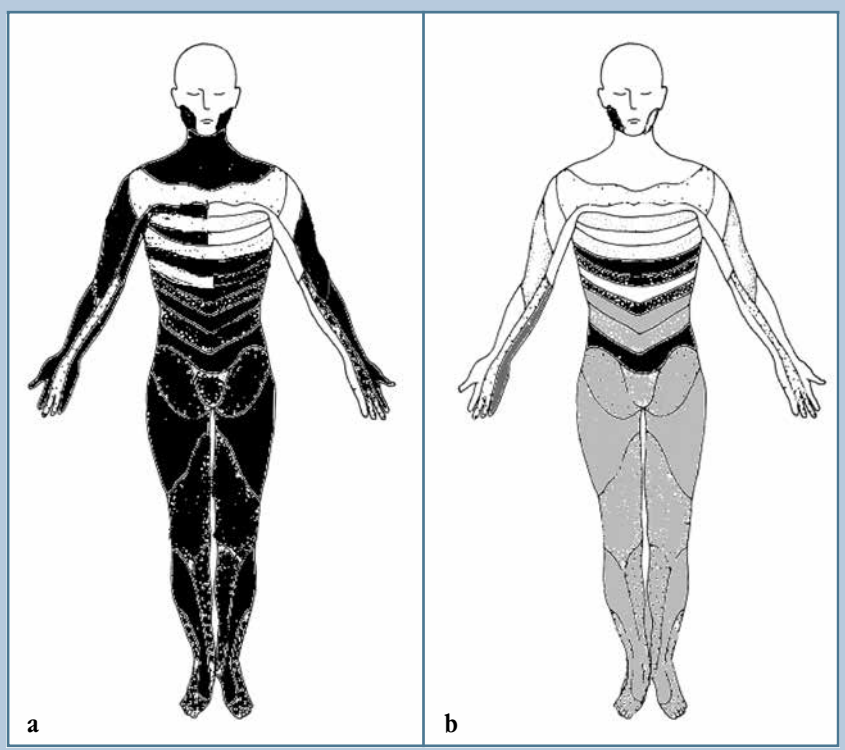

Fig. 5
Scheme of the distribution of temperature-pain sensitivity disturbances in the 13-year old patient N.: **a** – before; **b** – after the treatment. The area of temperature-pain sensitivity disturbance is depicted in dark, the area of the normal parameters is depicted in light, the area of the improvement (reduction in the pain sensitivity thresholds) due to the treatment is depicted in grey

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