

## Surgical Treatment of Congenital High Standing of the Scapula in Children.

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**Abstract.** According to literature data, high scapula standing among orthopedic diseases of congenital genesis according to the frequency of occurrence is 0.2-1% and belongs to the number of primary congenital deformities. This pathology is quite relevant due to the fact that the available classifications do not specify some forms of scapular deformities, in which the use of well-known methods of surgical treatment does not provide elimination of these deformities, which in turn prompts specialists to further study the diagnosis and treatment of congenital high scapular stance. From 2005 to 2021, 88 children from 3 to 14 years of age with congenital high scapula were undergoing examination and treatment at the Department of Pediatric Orthopedics of the RSNPMCTO. There were 27 (30%) boys and 61 (70%) girls. All patients underwent clinical examination - digital radiography, EMG, and MSCT. In these patients 11 (13%) patients underwent Ternovsky operation, 77 (87%) patients underwent Pozdeev operation.

**Keywords:** scapula, clavicle, shoulder, spine, muscle.

### INTRODUCTION

High scapula height is a complex of developmental anomalies with the following main manifestations: spatial position disorder, growth disorder and deformity of the scapula, cranial displacement of the distal end of the clavicle, hypoplasia of the shoulder and trunk muscles, up to their complete aplasia, violation of functional status of the neuromuscular system, pathology of the main vessels and peripheral blood flow disorders. According to the literature, this pathology accounts for 0.2-1% of all congenital diseases of the musculoskeletal system in children.

Hypoplasia, aplasia of the trapezius, rhomboid, supraspinous, podalic, deltoid, dentate anterior and scapular muscles that accompany severe muscle and bone forms of pathology aggravates the course and complicates the prognosis (Abushkina V.G., 2001; Elena Traitsevskaia 2016; Cho T.G., 2000; Khairouni A., 2002; Ozsakhin M., Uslu M., Inanmaz E., Okur M. 2012; O'Brien S.J., Voos D.E., Nevassier A.S., Dracos M.S. 2009; Pozdeev A.A. 2006; Harvey E.J. 2012; Mihir M Tucker. 2014.). Analysis of the literature data shows that so far there is no unified view on the cause of Sprengel's disease development, the results of treatment are also controversial.

**The aim of the study** was to investigate the results of surgical treatment of children with congenital high scapula taking into account the shape and peculiarities of the pathology.

## **MATERIALS AND METHODS**

From 2005 to 2021, 88 children aged 3 to 14 years with congenital high scapula were inpatiently treated at the Department of Pediatric Orthopedics, RSNPMCTO. There were 26 (30%) boys and 62 (70%) girls. Left-sided pathology was observed in 42 (48%) children, right-sided - in 35 (39%) patients, bilateral - in 11 (13%) children.

To obtain objective information about the child's condition, a comprehensive assessment of changes, as well as the quality of surgical treatment, we used the following methods of investigation: paraclinical, clinical and instrumental, such as digital radiography, ENMG, and MSCT. These methods of investigation allowed us to make an accurate and timely diagnosis and provide specialized care to the patient depending on the age and severity of the lesion.

## **RESULTS OF THE STUDY AND THEIR DISCUSSION**

The study of the medical history and parental interviews revealed the following: 46 mothers of 88 sick children were pregnant against the background of toxicosis, of whom 38 mothers had toxicosis in the first half of pregnancy. In addition, 32 mothers had an acute respiratory disease during pregnancy, and 9 were married. Only one case was found to have a hereditary history of the disease when the family history was examined.

Radiological examination was performed at the patient's initial visit, on admission to the hospital, immediately after surgical treatment and 3-6 months after it.

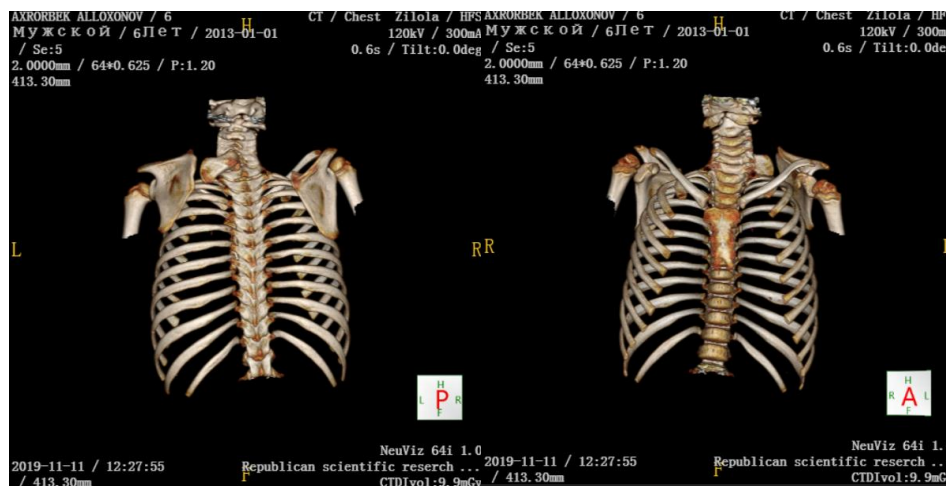
The following was observed on shoulder girdle radiographs made in anteroposterior projections:

- violation of the spatial position of the scapula, its cranial and medial displacement in 60 patients, pathological rotation in 10 patients.
- variants of its development disorders, i.e., changes in transverse and longitudinal dimensions in 78 patients.
- character of scapula fixation to the spine, absence of omovertebral bone in 71 patients and presence of omovertebral bone in 10 patients.
- shortening, thickening and change of the clavicle shape, determined by length measurement and violation of its spatial position in 7 patients (Sadofieva V.I. 1990).

The functional state of the neuromuscular apparatus, shoulder girdle and upper extremity, and upper extremity blood flow in children with congenital high scapular stance was investigated by electromyography of the trunk, shoulder girdle and shoulder muscles - trapezoidal, rhomboidal, plantar, front, dentate, deltoid (anterior, middle and posterior portions), large pectoral, biceps and triangles (Gecht B. M.1990 ).

Computed tomographic examination was performed on a multispiral X-ray computed tomograph using standard axial slices and various methods of three-dimensional image reconstruction (multiplanar image reconstruction (MPR), reconstruction with a shaded

external surface (SSD), volume rendering (VRT) (Cho T.J.200). The variants of scapula deformation in frontal and sagittal planes, its spatial relation to adjacent bone structures were studied. The size and shape of the clavicles were determined, as well as the value of displacement of their acromial end in the cranial direction (Fig. 1).



**Fig. 1.**MSCT of the patient A.A., 6 years old. The omovertebral bone is visible, which should not be there in the norm. Changes in the shape and size of the clavicle, as well as its displacement in the cranial direction.

If an omovertebral bone was present, its shape, variant, and level of its articulation with the scapula and spine were evaluated (Fig. 2).



**Fig. 2.**MSCT of the patient A.A., 6 years old. The MSCT of the patient clearly shows the omovertebral bone, which should not be present in the norm.

Analysis of computer tomograms provided objective data on the variants of the scapula deformity, its anatomico-topographic location, and the presence and severity of concomitant pathology (clavicles, spine, and thorax).

Children with muscle form of mild disease severity were subjected to conservative treatment. Conservative treatment in our patients included a complex of physical therapy aimed at maintaining the amplitude of movements in the shoulder joint, and massage of the collar zone, back and upper extremity to improve the trophicity and function of the shoulder girdle and trunk muscles. Physiotherapeutic treatment aimed at improving the functional state of the vascular and nervous systems (electrophoresis with aminophylline and pentoxifylline on the collar area) as well as electrical stimulation of the muscles involved in shoulder abduction was performed. Subsequently, swimming in a swimming pool and sanatorium-resort treatment were recommended.

The Ternovsky-Adrianov methods are widely used in the surgical treatment of children with congenital high scapula (Pozdeev A.P., 2003, 2004; Mironov S.P., Kotelnikov G.P. 2008). Taking into account the variant of severity and course of pathology, A.P. Pozdeev and A.A. Pozdeev (2006) developed a surgical intervention including mobilization of suprapubic neurovascular bundle, adaptation of scapula to thorax, plasty of underdeveloped muscles, shortening clavicle osteotomy, which allows completely or largely eliminate cosmetic defect, restore or improve upper limb function.

The indications for surgical treatment are medium and severe degree of the disease in children over 3 years old according to the classification of A.A. Pozdeev (2006).

Surgical intervention in children with bony and soft tissue forms of moderate and severe "A" degree of the disease. perform osteotomy of the cranial process (Mironov S.P., Kotelnikov G.P., 2008). By turning the acromial-clavicular joint the scapula is lowered. Transverse osteotomy of the internal and osteoclasia of the external cortical plates of the scapula is performed adapting the contacting surfaces of the scapula and thorax.

In the surgical treatment of children with soft tissue and bony forms of severe disease, an osteotomy of the beakoid process is performed. A pocket is formed between the thorax and the broadest muscle of the back. The scapula is lowered to the level of the healthy scapula and its lower level is fixed in the formed pocket with three U-shaped sutures to the broadest muscle, then they are replaced with paravertebral muscles.

The clavicle is shortened by resection of the part where the fragments are trapped behind each other. Retrograde osteosynthesis of the clavicle fragments is performed with a Kirschner wire.

Immobilization of the shoulder at clavicle osteotomy was performed with Smirnov-Weinstein plaster bandage for 6 weeks. To eliminate the cosmetic defect and restore the function of the upper extremity, depending on the variant of the disease, we used A.A. Pozdeev's method in full or separate techniques of the Ternovsky method. The treatment result in all forms was consolidated by the complex of rehabilitation therapies used in patients in the postoperative period (Mironov S.P., Kotelnikov G.P., 2008).

In the postoperative period, patients with congenital high scapulae showed restorative treatment including immobilization of the cervical spine with head tilt to the healthy side,

exercise therapy, physical therapy and medication aimed at restoring upper limb movements in the shoulder joint, improving muscle tone and function, resorption of scar tissue, improving regional blood flow and nervous system trophicity. Patients were followed up until the end of their growth.

The indications for surgical treatment were an average and severe degree of the disease in children over 3 years old. The basic principles of restoring the cosmetic defect of the scapula were considered to be:

1. Mobilization of the scapula, namely its medial edge, upper-medial and lower angle, anterior surface of the scapula;
2. Elimination of pathological rotation of the scapula;
3. Lowering of the scapula to the level of a healthy one;
4. Adaptation of the anterior surface of the scapula to the thorax;
5. Elimination of the scapula deformity.

Restoration of the upper extremity function was carried out using the following techniques:

1. Mobilization of the suprapubic neurovascular bundle. For this purpose, a semicircular osteotomy of the transverse notch of the scapula was performed. This technique made the suprapatellar neurovascular bundle motile and prevented disinervation of the supraspinous and plantar muscles when the scapula was lowered.
2. Elimination of a hook-shaped deformity of the upper part of the scapula and/or a rounded-concave deformity of the medial edge of the scapula and fixation with Kirschner spokes.
3. Physiological fixation of the scapula was performed by suturing its lower corner in the "pocket" between the thorax and the broadest muscle of the back according to A.A. Pozdeev.

Elimination of the cosmetic defect and restoration of the upper extremity function was carried out using the following operation.

Surgery technique. Narcosis was endotracheal. The patient was lying on his stomach with a roller under his shoulders. Skin incision was made, edging the upper and medial edges of the scapula up to the level of VII rib. Skin-subcutaneous-fascial flaps are mobilized: lateral - to the upper and external edges of the scapula and its lower angle; medial - to the spinous processes of the vertebrae. The trapezius and rhomboid muscles are cut off from the medial edge of the scapula and the fibrous cord is dissected. The muscle lifting the scapula is intersected at its attachment to the scapula. Along the medial edge of the scapula, along its anterior surface, the muscle fibers of the anterior dentate and scapular muscles are cut off. Soft tissue is separated from the anterior surface of the scapula up to the transverse notch, preserving the periosteum as much as possible. Subcutaneously, the transverse notch of the scapula is isolated, and the scapular bone is osteotomized with a grooved chisel at a distance

of 3-5 mm from the transverse notch of the scapula. Subcutaneously, osteotomy of the base of the beakoid process is isolated and performed, with the chisel pointing from bottom to top and from the middle to the outside. Rotation at the acromial-clavicular junction eliminates pathological rotation of the scapula and lowers it (the axes of the scapular bones are the reference point, and in bilateral lesions, the physiological norm, the lower edge of the second thoracic vertebra).

Congruence of the sliding surfaces of the thorax and scapula are assessed. In case of pronounced deformity of the latter, osteotomy of the internal cortical plate and osteoclasia of the external one at the top of the scapula deformity are performed.

A "pocket" is formed in the space between the rib cage and the broadest muscle of the back where the lower angle of the scapula is immersed. The scapula is fixed in its new position by suturing its lower angle in the formed "pocket" to the broadest muscle of the back with 3-4 U-shaped sutures. In the position of the achieved correction the trapezius and rhomboid muscles are fixed to the medial edge of the scapula with U-shaped sutures.

The wound is sutured in layers. Wound drainage is performed in the upper and lower sections with two rubber outlets. In the postoperative period the limb is immobilized with bandage dressing for 10 - 14 days.

In postoperative period patients with congenital high scapula is shown restorative treatment including immobilization of the cervical spine with head tilt to the healthy side, physical therapy, physiotherapeutic and medicamentous treatment aimed at restoration of upper limb movements in shoulder joint, tonus increase and muscle function restoration, resorption of scar tissue, improvement of regional blood flow and trophic of nervous system. Dispensary observation of the patients was carried out until the end of their growth.

In severe deformity, the shoulder joint together with the scapula was elevated and displaced anteriorly, and the scapula was reduced in size and located more than 5-10 cm above the healthy one. The muscles are severely hypotrophied, and the abduction of the shoulder does not exceed 90-120°.

The results of surgical treatment showed that the severe degree of the disease in 10 patients was combined with additive omovertebral bone, and in 6 patients it was combined with Klippel-Feil disease. In addition, various degrees of rib deformities and scoliosis were found in the remaining patients.

Surgical interventions were performed in 88 patients, 12 (13%) of them were operated on by the Ternovsky method, and 76 (87%) patients were operated on by the A.A. Pozdeev method. After surgery, the patients were placed in a thoracobrachial plaster cast for 4 weeks. In addition, we administered physical therapy to the fingers and UHF therapy to the brachial and popliteal region.

After the plaster cast was removed, the patients were prescribed massage, electrophoresis with potassium iodine in alternation with novocaine, and physical therapy, followed by active sports (swimming, basketball, and volleyball) in 3 months.

## CONCLUSION

In the follow-up period, of 88 (100%) patients, 75 (86%) had good and 13 (14%) - satisfactory results, in spite of the fact that these patients had a severe degree of the disease, and the disease was accompanied by neurological and endocrine disorders.

The efficacy of treatment was evaluated as follows:

The cosmetic result of treatment with preservation of normal anatomical relations between the scapula and spine in 75 pediatric patients was good, of which 9 patients had a mild degree of disease, 29 patients had a soft tissue medium degree of disease, 24 patients had a soft tissue severe degree and 13 patients had a bone medium degree of disease according to Pozdeev A.A. (2006) classification. Satisfactory cosmetic result was observed in 2 children with bone moderate degree and in 10 children with bone severe degree of the disease.

The functional result of treatment was assessed by the magnitude of abduction of the limb in the shoulder joint (Fig. 3). Complete restoration of function in the shoulder joint was considered a good result, which was observed in 9 children with mild degree and 23 children with soft-tissue medium degree disease, and limitation of abduction to 160°, which was observed in 7 children with soft-tissue medium degree, 19 children with soft-tissue severe degree, and 8 children with bone medium degree disease. A satisfactory result with a shoulder abduction amplitude of 120° to 160° was observed in 6 children with soft tissue severe, 5 children with bone moderate, and 7 children with bone severe disease. Unsatisfactory functional outcome with shoulder abduction not exceeding 120° was observed in 2 children with bone moderate degree and 3 children with bone severe degree.



**Fig. 3.**Functional and cosmetic result of the patient 1 year after surgery.

Thus, analysis of the obtained results correlates with the data of domestic and foreign literature and allows us to conclude that the operation according to A.A. Pozdeev's method is the method of choice in surgical treatment of congenital high scapula in children.

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