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**Way of surgical correction of funneled deformation
of thorax in children with use of nickelid
titanium materials**

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Summary

Congenital chest distortions are the defects associated with changes in the chest shape. Funnel chest (FC) is the most common. [1, 3]. Besides cosmetic defect this malformation is accompanied by cardiovascular and bronchopulmonary functional disorders. According to Russian authors 0.06 - 2.3% of children have FC, 0.2 - 1.3% according to foreign authors [6, 10, 11].

Surgical treatment of congenital chest distortions in children is one of the most serious and urgent problems of childhood thoracic surgery. Currently, there are many methods of thoracoplasty in children with congenital deformities [5, 7, 9]. Improvement and widespread implementation of minimally invasive high-tech methods in surgical treatment of congenital chest distortions is a great stride in this direction [4, 8]. However, some vital questions associated with selection of the optimal method for treatment remain unresolved, i.e. methods of thoracoplasty and sternocostal complex fixation.

Work objective. To estimate the titanium nickelide use efficiency in the surgical treatment of funnel chest.

Materials and Methods

Research is based on the analysis of 78 FC thoracoplastic operations performed at orthopedic department of MLPMU Children's City Hospital No. 4.

72 male and 6 female patients aged 4-20 years were operated over the 1977 to 2009 period. Clinical material is divided into 3 study groups according to the method of surgical treatment.

The first group of 16 children aged 6-14 years was operated from 1977 to 1987 by the method of G.A. Bairov or N.I. Kondrashin [2, 7]. Marshev's splint was used for corrected chest fixation.

In the second group 20 patients underwent thoracoplasty (operated from 1986 to 1995). Round or flat wires were used for osteosynthesis, which were hypodermically implanted into the resected sections of ribs and sternum. Additionally we used a modified suspension splint with four movable supports. Traction threads were fixed by paired rings located on separate thread rods with a damper device. This provides even and graduated tension of traction threads throughout the mobilized sternocostal segment. The splint was easy and convenient to use, taking into account the patient's age.

The third group of 42 patients aged 4-20 years has been operated after 1996. Surgical treatment of this group can be divided into a few main stages.

Stage 1 - the deformed part was exposed by midline incision and mobilization of skin and muscle flaps as one unit.

Stage 2 - greater emphasis was made on mobilizing and correction of deformed ribs and sternum by their section or wedge resection.

Stage 3 - retrosternal commissures and ligaments were removed and parietal pleura layers were released after mobilization of the deformed part of the chest that provided visual control at the most difficult stage of the operation.

Stage 4 - transverse triangular wedge is harvested from the presternum (the upper edge of the funnel), which is subsequently used as an autograft, being fixed to the sternal split after its partial longitudinal section at the bottom of the funnel by Mylar thread.

Stage 5 - one, two or three titanium nickellide plates were used for rigid fixation of the eliminated chest distortion, depending on the appearance and depth of the funnel. They were placed on the front surface of the thorax in the transverse direction so that the curved ends leaned against unmodified parts of the ribs beyond the deformed region. Resected parts of ribs and sternum were fixed by interrupted sutures on the plates. Previously chilled titanium nickellide plates become blood-warm after implantation, thus creating additional corrective force due to thermodynamic properties and at the same time providing rigid correction of the deformation during 10-12 months till complete consolidation and alignment of the corrected segment. Retrosternal tube drainage was used for 3-5 days in the early postoperative period in most children, the wound was sutured by cosmetic stitch.

Results and Discussion

Analysis of the immediate results of FC surgical treatment by various methods of thoracoplasty and stabilization in 3 study groups showed different clinical peculiarities, frequency and form of intra- and postoperative complications, immediate and remote results of treatment.

In the first group (20 patients) 12 children had pleura injury with manifestation of unilateral or bilateral pneumothorax, 8 patients had marginal or extensive tissue necrosis of mobilized skin flap in the area of deformation; in 4 cases there was soft tissue necrosis and osteomyelitis of rib in one case. The use of external Marshhev's traction splint entailed bed rest for 2-3 months, then traction threads and the splint were removed. Length of hospital stay in the postoperative period ranged from 2 to 4 months. Loss of correction (recurrence of deformity) was observed during 1-2 years in majority of children from the first group - from mild to extremely severe.

In the second group (18 patients), pleural injury, pneumothorax and hemothorax was found in 8 children, soft tissue necrosis was observed in 7 cases, abscess - in 6 cases. Application of round and particularly flat wires reduced the frequency and intensity of the loss of correction. The splint was removed after 2 months, the wires were removed after 4-6 months. Good results were obtained in 6 patients, in 10 children - satisfactory, long-term follow-up showed recurrent deformation in 4 patients. Postoperative period in hospital is 2-3 months.

In the third study group (30 patients), clinical results were more successful. 6 children developed pneumothorax and hemothorax, abscess and tissue necrosis were not observed. After a 3-5-day stay in the ICU children were allowed to walk, and the sutures were taken out 10-12 days after the operation. The length of hospital stay in the post-operative period was reduced to 12-16 days. All children within a year after the operation every 1-2 months underwent test survey, and further examination was carried out 1-2 times a year. The plates were removed in 6-10-12 months outpatiently or with hospital admission for 1-3 days. In the follow-up period from 1 to 10 years 20 patients showed good cosmetic results after the chest correction, and 9 patients - satisfactory.

Resume

Thus, the thermodynamic force of titanium nickelide plates provided not only postoperative stabilization of the corrected deformity, but an additional correction in the postoperative period. Application of shape memory titanium nickelide plates for FC correction in children and adolescents is the method of choice and gives good clinical results.