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RESULTS OF FOOT PLANOVALGUS DEFORMITY SURGICAL TREATMENT IN CHILDREN WITH CEREBRAL PARALYSIS

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Issues of treatment feet planovalgus deformity in children with cerebral palsy remain unresolved due to various structural, functional and biomechanical changes in the foot, as well as the complex pathogenesis of the disease formation. The purpose of the study was to present the results of retrospective analysis of surgical treatment of feet planovalgus deformity in children with cerebral palsy. Retrospective analysis was performed on case histories of 39 feet planovalgus deformity patients, with spastic type of cerebral palsy, who underwent surgical treatment in the period from 2002 to 2019. In Group 1, combined soft tissue interventions were used to correct feet planovalgus deformity, and in Group 2, in addition to the surgeries, interventions were performed aimed at correcting alignment in the joints of the hindfoot and midfoot. In Group 3, all children underwent combined surgery. Surgical treatment of feet planovalgus deformity in children with cerebral palsy aged 7-11 years, using techniques that are singularly aimed to correct contractures and tendon-muscle balance, is accompanied by a significant recurrence rate (66.7%). An algorithm for differentiated choice of methods for feet planovalgus deformity surgical treatment in children with cerebral palsy has been developed.

Key words: cerebral palsy, planovalgus deformity of feet, algorithm.

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ХАРАКТЕРИСТИКА РЕЗУЛЬТАТІВ ХІРУРГІЧНОГО ЛІКУВАННЯ ПЛОСКОВАЛЬГУСНОЇ ДЕФОРМАЦІЇ СТОП У ДІТЕЙ ХВОРИХ НА ДЦП

Проблеми лікування плосковальгусної деформації стоп у дітей з дитячим церебральним паралічем залишаються не вирішеними через різноманітні структурно-функціональні і біомеханічні зміни в стопі, а також складного патогенезу формування. Мета роботи: представити результати ретроспективного аналізу результатів хірургічного лікування плосковальгусної деформації стоп у дітей, хворих на дитячий церебральний параліч. Матеріал: Ретроспективний аналіз історій хвороб 39 пацієнтів із плосковальгусною деформацією стоп, зі спастичним типом дитячого церебрального параліча, яким виконано хірургічне лікування у період із 2002 по 2019 рр. В Групі 1 для корекції плосковальгусної деформації стоп використані комбіновані втручання на м'яких тканинах, а в Групі 2 разом із хірургічними втручаннями, виконувалися втручання, спрямовані на корекцію взаємовідносин у суглобах заднього та середнього відділів стопи. В Групі 3 усім дітям проведено комбіноване хірургічне втручання. Хірургічне лікування плосковальгусної деформації стоп, у дітей, хворих на дитячий церебральний параліч, у віці 7-11 років, із використанням методик, що ізольовано спрямовані на корекцію контрактур та сухожилково-м'язового балансу, супроводжується значним відсотком рецидивів (66,7 %). Розроблено алгоритм диференційованого вибору методики хірургічного лікування плосковальгусної деформації стоп у дітей, хворих на дитячий церебральний параліч.

Ключові слова: дитячий церебральний параліч, плосковальгусна деформація стоп, алгоритм.

The work is a fragment of the research project: "Program of social and hygienic monitoring of health and prevention of foot pathology in youth", state registration No. 0116U003021.

One of the significant deviations in the musculoskeletal system of children with cerebral palsy is development of feet planovalgus deformity (FPVD), which accounts for 16 to 35% of all orthopedic pathology in this group of patients. The feature of foot development in children with cerebral palsy is that their feet have a normal shape from birth, and only later, during the child's growth against the background of soft tissue imbalance, there occurs deformation of the foot shape and function, especially during active growth. [4, 5, 8, 12]. Additionally, over time, plantar callosity is formed on the plantar-medial surface of the foot, pain syndrome and difficulties in choosing shoes occur.

Formation of FPVD in a child with cerebral palsy differs from the idiopathic form of FPVD in children without neurological pathology, therefore, the developed standard treatments can not be used in children with cerebral palsy [1, 6, 10].

In the treatment of FPVD in children with cerebral palsy, the following techniques are used: physical rehabilitation (exercise therapy and other techniques), orthotics, botulinum toxin treatment, soft tissue foot structures surgery, bones and joints, and their combination surgery [2, 11].

It should be emphasized that a number of studies have shown the absence or low efficacy of conservative FPVD treatment in children with cerebral palsy [3, 7, 9].

The proposed methods of FPVD surgical treatment in children with cerebral palsy, differ in the fact that they affect either the tendon-muscle complex of the leg and (various tendon transpositions or lengthening of shortened muscles (Strayer's operation, Z-plasty of the Achilles tendon, etc.) are performed, or interventions are carried out on the foot bones and joints (osteotomies, arthrodesis) [13].

We must state the lack of clear indications for a particular method of FPVD treatment in children with cerebral palsy according to the literature, including the age and severity of FPVD.

The purpose of the work was to present the results of a retrospective analysis of surgical planovalgus deformity treatment of the feet in children with cerebral palsy.

Materials and methods. A retrospective analysis of case histories of 39 patients with FPVD, with spastic type of cerebral palsy, who underwent surgical treatment on the basis of the pediatric orthopedics clinic of the State Institution "Sytenko Institute of Spine and Joint Pathology NAMS of Ukraine" (SI SISJP NAMSU) in the period from 2002 to 2019. Differentiated choice of methods for FPVD surgical treatment in children with cerebral palsy was made depending on the age of the child, the level of major motor functions and clinical characteristics of FPVD (mobile-immobile, mild, moderate and severe degree of deformation, present secondary and tertiary deformations of the foot).

Patients were divided into 3 groups:

- Group 1 included 15 patients (29 feet) in whom surgical treatment of FPVD was performed on soft tissues (Z-achilloplasty or Strayer's operation, calcaneonavicular ligament plasty and posterior tibial tendon augmentation). Additionally, 5 patients in this group (9 feet) underwent surgery of the subtalar joint (1 patient - Grice arthrodesis and 4 of the subtalar – arthroeresis (STAE) with a conical implant);

- Group 2 included 19 patients (27 feet) who underwent corrective FPVD lateral augmentation calcaneus osteotomy (Evans osteotomy);

- Group 3 included 5 patients (10 feet) who underwent surgical FPVD treatment by STAE using a hollow adapted anatomic implant (patent of Ukraine No. 113131) in combination with soft tissue interventions, which were similar to Group 1.

The mean age of patients in Group 1 was 7 ± 2.5 years, in Group 2 – 12 ± 2.5 , and in Group 3 – 8 ± 1 year.

Clinical assessment of FPVD in children was performed taking into account the criteria proposed by V. Mosca [10] and met the standards for orthopedic patients' examination developed by V.O. Marx [9]. For a comprehensive assessment of shape impairment and function disorders of the foot in the study group of patients, the standard scale of the American Orthopaedic Foot and Ankle Society (AOFAS hindfoot scale) was chosen. The Modified Ashworth Scale was used to assess muscle tone [13]. Assessment of the support and kinematic functional level of patients was performed according to the latest modification of the scale of gross motor skills (GMFCS E&R – English Gross Motor Function Classification System Extended and Revised), taking into account the child's age [13]. The shape of the feet, their changes in the vertical position and the functional capacity of the child were recorded using digital photography and video.

We proposed a working clinical and radiological classification of this deformity, which is based on the gradation of standard parameters characterizing the medial longitudinal arch and valgus deviation of the hindfoot bones and are based on certain criteria: distinguishing clinical severity of FPVD; characteristics of radiological parameters (determination of the lateral talar-1-metatarsal angle (Meary angle), mild level of deformation from 5 to 14 degrees, moderate – from 15 to 30 degrees; severe level with more than 30 degrees and the angle of the calcaneus inclination (calcaneal pitch): mild level of deformation – 15 – 20 degrees, moderate – 10 – 14 degrees, and severe level – less than 10 degrees, as well as the level of mobility in the subtalar joint, secondary supination deformity of forefoot: absent – with the mild level, deformity is absent; with the moderate level, mobile deformity is observed; with the severe level, a rigid deformity is observed.

Results of the study and their discussion. A retrospective analysis of the FPVD treatment results in the studied groups of 1–3 children with cerebral palsy showed that surgical treatment in these groups was performed by different methods: the nature and number of surgical interventions in patients of all groups are presented in table. 1.

In Group 1, combined soft tissue interventions were used to correct FPVD, and in Group 2, together with the above-mentioned surgical interventions, there were interventions aimed at correcting the interaction in the joints of the hind and midfoot (STAE, corrective lateral augmenting osteotomy of calcaneus was performed).

Table 1

Nature and number of surgical interventions for FPVD in patients of all groups

Type of surgical intervention	Group 1 29 feet	Group 2 27 feet	Group 3 10 feet	Total

	Number of feet (%)			
Soft tissue surgical interventions				
1. Intervention on the triceps muscle	27 (93.1)	20 (74.1)	4 (80.0)	51
- Strayer procedure		7 (25.9)	1 (20.0)	8
- Z-achilloplasty	6 (20.6)	25(92.5)		31
2. Intervention on m.peroneus brevis				
STAE	8 (27.6)	-	10 (100)	18
Grice arthrodesis	2 (6.9)	-		2
Corrective lateral augmenting osteotomy of calcaneus with autoplasty of the iliac bone	-	25 (92.5)	-	25
Corrective closing-wedge osteotomy of medial sphenoid bone	-	25 (92.5)	-	25
Corrective calcaneocuboid foot arthrodesis with bone autoplasty of the iliac wing	-	1(3.7)	-	1
Corrective three-joint arthrodesis	-	1(3.7)	-	1
Other manipulations	2 (10.5)		2 (40.0)	4
Botox administering into m.gastrocnemius with ultrasound control				

Results of FPVD surgical treatment in patients of Group 1: the performed surgery permitted to normalize the supporting ability of the operated foot in 13 (86.7%) patients (25 feet (86.2%)) of Group 1.

Indices of the hind and forefoot deviation angle after surgery are given below: the mean angle of the hind foot deviation before treatment was 16 degrees at Me ($p < 0.05$ compared to the "Before treatment" indices) 10% – 14 and 90% – 26,

after 6 months - the mean measurement angle was 10 degrees at Me 10% – 7 and 90% – 16, after 12 months - the mean measurement angle was 15 degrees at Me 10% – 10 and 90% – 23, after 24 months - the mean measurement angle was 17 degrees at Me 10% – 10 and 90% – 28.

It is noteworthy that 6 months after surgery there was a significant improvement in the angles of deviation of the hindfoot and abduction of the forefoot, but 12 and 24 months after the intervention there is a regression of the above indices to the baseline values, indicating recurrence of FPVD in children of Group 1. The dynamics of changes in the complex assessment by the AOFAS hindfoot scale in patients of Group 1 are shown in table 2.

Table 2

Integral assessment of feet in patients of Group 1 by the AOFAS hindfoot scale in the dynamics after 6, 12, 24 months

Scale points	Before treatment	6 months	12 months	24 months
Pain syndrome (max– 40 points)	28±4.2	31±3	30±3	30±4
Function (max– 50 points)	17.5±5.2	21±7	20±4	19±6
Foot shape and position (max – 10 points)	4.3±2.0	7±1.5	5.5±1.5	5±1
Total assessment (max – 100 points)	49.8±9	59±8	55.5±6	54±6

Analysis of the comprehensive assessment by the AOFAS scale in patients of Group 1 revealed a gradual decrease in the AOFAS scale and its overall assessment, indicating a gradual deterioration of the structural and functional state of the foot in patients of Group 1 in the dynamics after surgery.

In 4 patients (8 feet) of Group 1, chronic pain syndrome of low and medium intensity (3–4 points according to Visual Analog scale – VAS scale) was noted in the projection of the sinus tarsi - which lasted for 6–18 months after the installation of a standard conical implant.

The data obtained indicate a temporary effect of improving the shape and function of the foot after surgical treatment of FPVD in patients of Group 1 and the development of FPVD recurrence.

The results of FPVD surgical treatment in patients of Group 2: the performed interventions allowed to normalize the supporting ability of the operated foot in 18 patients (34 feet) of Group 2, which makes 94.7%. Dynamics of the obtained data in patients of Group 2 is as follows.

Indices of the angle of deviation of the hindfoot and forefoot after surgery are given below: the mean angle of deviation of the hindfoot before treatment was 18 degrees at Me ($p < 0.05$ compared to the "Before treatment" indices) 10% – 10 and 90% – 23, after 6 months – the mean measurement angle was 8 degrees at Me 10% – 5 and 90% – 16, after 12 months – the mean measurement angle was 9 degrees at Me 10% – 7 and 90% – 16, after 24 months – the mean measurement angle was 11 degrees at Me 10% – 8 and 90% – 16. And the score by the AOFAS hindfoot scale in the dynamics is presented in table 3. The data obtained indicate a significant and sustained improvement in the foot shape of Group 2 patients. Significant improvement was observed 12 and 24 months after the surgery.

Table 3

**Integral assessment of the foot in patients of Group 2 by the AOFAS hindfoot scale
in the dynamics after 6, 12 and 24 months**

Scale points	Before treatment	6 months	12 months	24 months
Pain syndrome (max – 40 points)	20±3	30±3*	34±3*	29±4*
Function (max – 50 points)	13±7	12±5	19±6	26±6*
Foot shape and position (max – 10 points)	3±1.5	8±1*	7.5±1*	8±1*
Total assessment (max – 100 points)	46±8	50±3	60.5±8*	63±8*

* p<0.05 compared to the “Before treatment” index

In 5 patients (5 feet) of Group 2 a slow consolidation of the calcaneal bone osteotomy area was found, in 1 patient (1 foot) there was a loss of postoperative correction at the level of corrective medial cuneiform bone osteotomy – these complications were treated conservatively and did not affect the late positive outcome.

In Group 2 patients, 6 months after the intervention, there was an improvement in radiological and plantographic parameters that characterize the shape of the foot, and after 12 months there was a significant improvement in the overall AOFAS score, indicating an overall positive effect of surgical FPVD treatment in children. This clinical and radiological effect of surgical intervention persisted for 12 and 24 months after surgery.

Results of FPVD surgical treatment in Group 3 patients: all children underwent combined surgery – Strayer's operation and minimally invasive STAE with the developed hollow two-stage cone implant. The treatment permitted to correct the foot shape in all 5 children (10 feet) of the study group.

Indices of the hindfoot and forefoot angle of deviation after surgery are given below: the mean angle of deviation of the hindfoot before treatment was 17 degrees at Me (p <0.05 compared to the “Before treatment” indices) 10% – 12 and 90% – 26, after 6 months – the mean measurement angle was 10 degrees at Me 10% – 7 and 90% – 15, after 12 months – the mean measurement angle was 10 degrees at Me 10% – 7 and 90% – 15, after 24 months - the mean measurement angle was 10 degrees at Me 10% – 7 and 90% – 15. Note that the achieved correction remains without significant changes in the dynamics.

The dynamics of changes in the comprehensive assessment by the AOFAS scale for the hindfoot in patients of Group 3 is shown in table 4. The performed surgical treatment had a positive effect on the indices of the AOFAS foot integrated assessment, which was performed 6 and 12 months after surgery, indicating normalization of foot shape and function. No foot pain or other complications were observed during the observation period.

Table 4

**Integral assessment of the foot by the AOFAS hindfoot scale in FPVD patients before and after 6, 12 months after
surgical treatment of FPVD by STAE method with a hollow two-stage cone implant**

Scale points	Before treatment	6 months	12 months
Pain syndrome (max – 40 points)	22±7	30±3	30±3
Function (max – 50 points)	17.5±5.2	21±7	23±9
Foot shape and position (max – 10 points)	4.3±2.0	7±1.5	7.5±1
Total assessment (max – 100 points)	44±9.2	58±8	60.5±8

A retrospective study of the treatment results in three groups of patients and analysis of literature data allowed us to develop and implement an algorithm for differential selection of surgical FPVD treatment in children with cerebral palsy, taking into account the patient's age, level of major motor functions and clinical characteristics of FPVD (fig. 1).

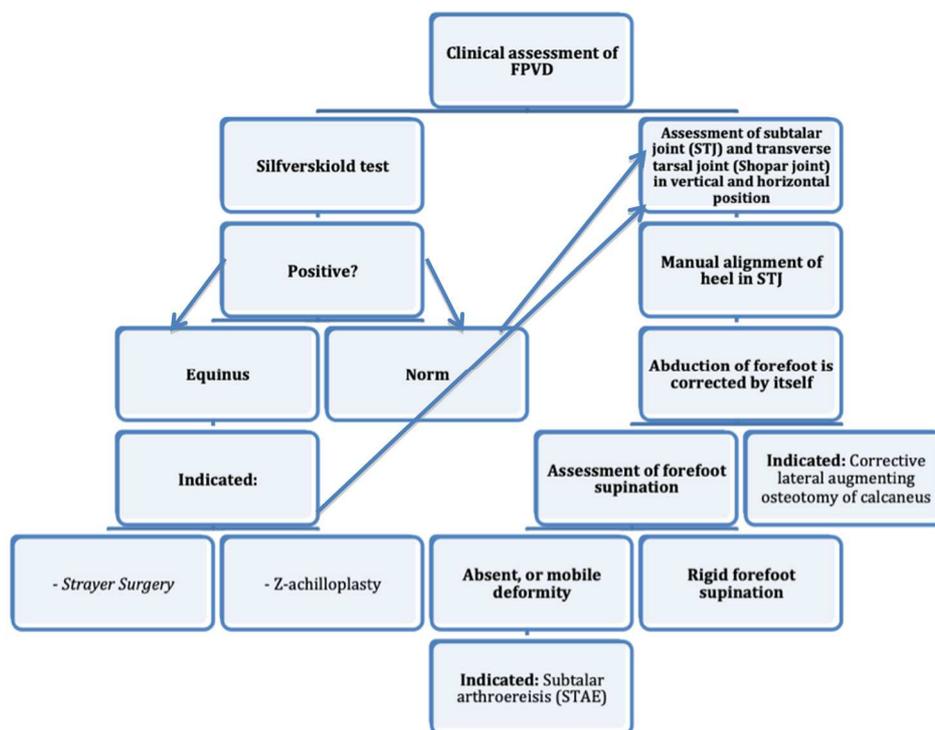


Fig. 1. Algorithm of differential selection of surgical method for FPVD treatment in children with cerebral palsy (GMFCS levels I, II, III)

In general, our results are consistent with the data of other researchers [5 – 7, 10, 11]. Kadhim [5, 6], Miller [8, 9] and Mosca [10] dealt with this problem, but their work was partially done, they did not study the problems of the pathology recurrence [4], the age features with different types of mobile planovalgus deformity surgical treatment were not fully studied [7], and algorithms for the treatment of mobile planovalgus deformity have not been developed [12]. We have studied the presence of a high recurrence rate in the treatment of feet mobile planovalgus deformity with conical implants by means of subtalar arthroereisis surgery method (STAE). We have confirmed the efficacy of moderate and severe FPVD treatment in children over 8 years of age. We have also developed a step-by-step algorithm for FPVD treatment in children with cerebral palsy, depending on age, level of major motor functions and FPVD clinical characteristics.

Conclusions

1. Surgical treatment of FPVD in children with cerebral palsy aged 7–11 years, using techniques that are singularly aimed to correct contractures and tendon-muscle balance, is accompanied by a significant recurrence rate (66.7%). Additional use of minimally invasive surgical technique of the subtalar joint arthroereisis can improve the results of FPVD correction, but in 80% it is accompanied by the development of chronic pain syndrome.

2. In patients aged over 8 years, with moderate and severe FPVD in children with cerebral palsy, the efficacy of surgical treatment using corrective lateral augmenting calcaneus osteotomy and corrective osteotomy of the medial sphenoid bone has been confirmed.

3. The developed algorithm for differentiated choice of surgical FPVD treatment methods in children with cerebral palsy, which depending on age, level of large motor functions and clinical FPVD characteristics permits to choose between minimally invasive techniques (STAE, soft tissue interventions) and surgery on the foot bones and joints (corrective lateral calcaneus osteotomy, arthrodeses of large joints in the hindfoot and midfoot).

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PROSTHODONTIC CARE FOR ENLISTMENT AGE MEN OF THE WESTERN REGION OF UKRAINE: MORBIDITY, ANATOMICAL AND TOPOGRAPHIC STRUCTURE, STATE OF PROVISION AND PROGNOSIS

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Dental examinations involved 294 men of enlistment age (185 of urban and 109 of rural population) under the age of 20 years old. The prevalence and intensity of the development of prosthodontic morbidity has been determined. The anatomical and topographic description has been provided for the extracted teeth and teeth for prosthodontic rehabilitation and their ratio was provided. Extremely unsatisfactory state of prosthodontic care provision for enlistment age men of urban and rural population has been found, the satisfaction of which was only 6.2% and 3.3%, respectively, for single crowns, with almost no manufacturing of bridge dentures and implant-supported dentures. The negative prognosis for the development of prosthodontic morbidity and increase in the scope of prosthodontic care has been proved. Ways to reform the system of organization and planning of the medical care for conscripts in the Armed Forces of Ukraine have been proposed.

Keywords: dental morbidity, enlistment age, prosthodontic care, single crowns, bridge dentures.

С.В. Рачинський, С.А. Шнайдер, О.В. Лабунець, Т.В. Дієва, В.А. Лабунець, Р.М. Ступницький ЗАХВОРЮВАНІСТЬ, АНАТОМО-ТОПОГРАФІЧНА СТРУКТУРА, СТАН НАДАННЯ ТА ПРОГНОЗ РОЗВИТКУ СТОМАТОЛОГІЧНОЇ ОРТОПЕДИЧНОЇ ДОПОМОГИ ЧОЛОВІКАМ ПРИЗОВНОГО ВІКУ ЗАХІДНОГО РЕГІОНУ УКРАЇНИ

Проведено стоматологічні огляди 294 осіб чоловічої статі призовного віку до 20 років у Західному регіоні України, з яких 185 серед міського і 109 – сільського населення. Визначена розповсюдженість та інтенсивність ортопедичної захворюваності. Надана анатомо-топографічна характеристика видалених зубів, зубів які потребують протезування та їх відсоткове співвідношення. Встановлено, що задоволеність наданням ортопедичної допомоги чоловікам призовного віку складає всього 6,2% і 3,3% відповідно за одиночними коронками при практично повній відсутності виготовлення мостоподібних протезів і штифтових конструкцій. Доведено негативний прогноз розвитку ортопедичної захворюваності та збільшення об'єму ортопедичної допомоги. Запропоновані шляхи реформування системи організації і планування даної медичної допомоги призовникам до Збройних Сил України.

Ключові слова: стоматологічна захворюваність, призовний вік, протезування, одиночні коронки, мостоподібні протези.

The work is a fragment of the research project "Development of clinical methodological basics for comprehensive dental assistance using dental implants", state registration No. 0119U002246.

Currently, national researchers are concerned about the study of dental morbidity among young people, both pre-conscription trainees [1, 5, 7, 8, 10-12] and enlisted men of the Armed Forces of Ukraine [2-4].

Based on the analysis of the above publications, the wide-spread prevalence of the diseases and the intensity of their development in this category of the national population is proved and proposals for improving a range of dental treatment and prevention activities (approaches, tools, medications, rinses, etc.).

However, the issues on the state of prosthodontic morbidity in young men of enlistment age among urban and, especially, rural population, their comparative characteristics, determining the degree of