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Treatment of severe planovalgus foot deformity in a child

© Olga D. Bagdulina, Yurii V. Lartsev, Andrei V. Shmelkov, Aleksandr S. Pankratov, Nikita E. Likholatov, Denis A. Ogurtsov

Samara State Medical University (Samara, Russia)

Abstract

Planovalgus foot deformity is one of the most common orthopedic conditions detected in childhood. According to the literature, it is present in 70% of children under 11 years with various degree of severity. Without timely correction, the common complications of this deformity are: arthrosis of the talonavicular joint, valgus deformity of the knee joints, impaired posture and functional scoliosis, pain syndrome, impaired function of the lower extremities, which is an indication for surgical treatment of this pathology.

The article presents a clinical case report of surgical treatment of a patient with severe planovalgus foot deformity. The main stages of surgical correction were tendon-muscle plasty, subtalar arthroeresis and Cotton osteotomy (wedging osteotomy of the medial sphenoid bone). Relying on the results of surgical treatment of the patient, we conclude that the use of the combination of methods is valid for the treatment of patients with severe planovalgus foot deformity.

Keywords: planovalgus foot deformity, children, secondary deformities, foot surgery, clinical case.

Conflict of interest: nothing to disclose.

Citation

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Information about authors

Olga D. Bagdulina – post-graduate student of the Department of Traumatology, orthopaedics and emergency surgery n.a. academician of RAS A.F. Krasnov.
ORCID: 0000-0003-1111-900X
E-mail: o.d.bagdulina@samsmu.ru

Yurii V. Lartsev – PhD, Professor, Department of Traumatology, orthopaedics and emergency surgery n.a. academician of RAS A.F. Krasnov.
ORCID: 0000-0003-4450-2486
E-mail: yu.v.lartsev@samsmu.ru

Andrei V. Shmelkov – PhD, assistant of the Department of Traumatology, orthopaedics and emergency surgery n.a. academician of RAS A.F. Krasnov.
ORCID: 0000-0001-6900-0824
E-mail: a.v.shmelkov@samsmu.ru

Aleksandr S. Pankratov– PhD, Associate professor of the Department of Traumatology, orthopaedics and emergency surgery n.a. academician of RAS A.F. Krasnov.
ORCID: 0000-0002-6031-4824
E-mail: a.s.pankratov@samsmu.ru

Nikita E. Likholatov – post-graduate student of the Department of Traumatology, orthopaedics and emergency surgery n.a. academician of RAS A.F. Krasnov.
ORCID: 0000-0002-6677-5277
E-mail: n.e.liholatov1@samsmu.ru

Denis A. Ogurtsov – PhD, Associate professor of the Department of Traumatology, orthopaedics and emergency surgery n.a. academician of RAS A.F. Krasnov.
ORCID: 0000-0003-3830-2998
E-mail: d.a.ogurcov@samsmu.ru

Corresponding Author

Olga D. Bagdulina
Address: Samara State Medical University, 89 Chapaevskaya st., Samara, Russia, 443099.
E-mail: o.d.bagdulina@samsmu.ru

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Лечение плосковальгусной деформации стоп тяжелой степени у ребенка

© О.Д. Багдулина, Ю.В. Ларцев, А.В. Шмельков, А.С. Панкратов, Н.Э. Лихолатов, Д.А. Огурцов

ФГБОУ ВО «Самарский государственный медицинский университет» Минздрава России (Самара, Россия)

Аннотация

Плосковальгусная деформация стоп является одним из наиболее распространенных ортопедических заболеваний опорно-двигательной системы, выявляемых в детском возрасте. По данным литературы, у 70% детей до 11 лет выявляется плосковальгусная деформация стоп различной степени тяжести. Распространенными осложнениями данной деформации без своевременной коррекции являются артроз таранно-ладьевидного сустава, вальгусная деформация коленных суставов, нарушение осанки и функциональный сколиоз, болевой синдром, вплоть до нарушения функции нижних конечностей, что является показанием для хирургического лечения данной патологии.

В статье приведен клинический случай оперативного лечения пациента с плосковальгусной деформацией стоп тяжелой степени. Основными этапами хирургической коррекции являлись сухожильно-мышечная пластика, подтаранный артроэрез и остеотомия Коттона (расклинивающая остеотомия медиальной клиновидной кости). На основании полученных результатов хирургического лечения сделан вывод о клинической обоснованности применения комбинации способов для лечения пациентов с плосковальгусной деформацией стоп тяжелой степени.

Ключевые слова: плосковальгусная деформация стоп, дети, вторичные деформации, оперативное лечение стоп, клинический пример.

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Сведения об авторах

Багдулина О.Д. – аспирант кафедры травматологии, ортопедии и экстремальной хирургии имени академика РАН А.Ф. Краснова.
ORCID: 0000-0003-1111-900X
E-mail: o.d.bagdulina@samsmu.ru

Ларцев Ю.В. – д-р мед. наук, профессор кафедры травматологии, ортопедии и экстремальной хирургии имени академика РАН А.Ф. Краснова.
ORCID: 0000-0003-4450-2486
E-mail: yu.v.lartsev@samsmu.ru
Шмельков А.В. – канд. мед. наук, ассистент кафедры травматологии, ортопедии и экстремальной хирургии имени академика РАН А.Ф. Краснова.
ORCID: 0000-0001-6900-0824
E-mail: a.v.shmelkov@samsmu.ru
Панкратов А.С. – канд. мед. наук, доцент кафедры травматологии, ортопедии и экстремальной хирургии имени академика РАН А.Ф. Краснова. ORCID: 0000-0002-6031-4824
E-mail: a.s.pankratov@samsmu.ru
Лихолатов Н.Э. – аспирант кафедры травматологии, ортопедии и экстремальной хирургии имени академика РАН А.Ф. Краснова.
ORCID: 0000-0002-6677-5277
E-mail: n.e.liholatov1@samsmu.ru

Огурцов Д.А. – канд. мед. наук, доцент кафедры травматологии, ортопедии и экстремальной хирургии имени академика РАН А.Ф. Краснова.
ORCID: 0000-0003-3830-2998
E-mail: d.a.ogurcov@samsmu.ru

Автор для переписки
Багдулина Ольга Дмитриевна
Адрес: Самарский государственный медицинский университет, ул. Чапаевская, 89, г. Самара, Россия, 443099.
E-mail: o.d.bagdulina@samsmu.ru

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BACKGROUND

Planovalgus foot deformity is one of the most common diseases of the lower extremities and is often detected in childhood [1–6]. Despite the process prevalence and scientific works and publications, the principles and types of surgical treatment have not been sufficiently investigated.

In younger children, this pathology is caused by anatomical factors in the lower extremities, feet, and ankle joints. Typically, a healthy child begins to walk independently by the end of the first year of life. At this age, a characteristic aspect of the anatomical structure of the distal segments of the lower extremities is the flattening of the arch, which is associated with an increased subcutaneous fat layer in this area and physiological hypermobility of the joints, manifested in the valgus position of the hindfoot. With the growth and development of the musculoskeletal system in children, most patients with this deformity undergo self-correction associated with natural strengthening of the ligamentous apparatus and restoration of muscle balance. As a rule, physiological planovalgus deformity of the foot does not cause any discomfort to the patient and does not require treatment. Follow-up of patients is performed by an orthopedist to monitor and predict the course of the process and, simultaneously, adjust the patient's management approach to avoid severe forms of deformities in future. [7]. Despite the natural age-related regression of the deformity, this pathology is registered in many older children and up to 15% of the adult population.

Planovalgus deformity of the foot is multicomponent and involves all parts in the pathological process. Various methods of surgical treatment are available for this pathology. The treatment approach is determined based on the severity of the deformity, patient's age, and secondary deformities. The two main types of correction include extra-articular and intra-articular techniques. Extra-articular techniques are minimally invasive and include various tendon–muscle plastic surgeries on the feet, subtalar arthroereisis [8], and variations of extra-articular arthrodesis [9]. They are easier to tolerate by patients and often enable them to avoid prolonged rehabilitation.

Historically, Chambers used minimally invasive correction in 1946, who proposed the use of a bone graft to correct calcaneal valgus. Grice also used an autograft taken from the bones of the patient's lower leg for arthrodesis of the talocalcanean joint when correcting paralytic valgus deformities of the calcaneus. In the 1970s, in the USA, Subotnick described the installation of a cone-shaped silicone implant in the sinus tarsi. In 1976, Smith published work on the introduction of a polyethylene block into the subtalar sinus; his follower, Lundeen, proposed modifying the shape of the block. At present, an analog of these interventions is the installation of implants made of various materials (subject to removal or not) into the subtalar sinus.

The main intra-articular interventions include three-joint arthrodesis of the foot [10, 11], which includes approximation with subsequent fusion and immobilization of the three joints (talocalcaneal, talonavicular, and calcaneocuboid). Despite the high efficiency of this technique, it is invasive and irreversible, requires a long rehabilitation period, and is characterized by severe postoperative pain. Delayed results do not always satisfy the doctor and patient.

Based on the results of the analysis of literature data and clinical cases, we advised the use of a combination of several methods to improve the treatment results for this deformity.

CLINICAL CASE

Patient K., born in 2008, sought a consultation at the Clinics of Samara State Medical University in May 2021, with complaints of foot pain when walking and moderate physical activity, foot deformity (cosmetic defect), and rapid wear of shoes.

Clinical examination revealed a marked decrease in the subarch space, valgus deviation of the calcaneus, and contouring of the scaphoid bones.

Complaints. The patient complained of pain in the feet and ankle joints when walking a distance of >300 m and during physical education, rapid wear of shoes on the inner surfaces, and cosmetic foot defects.

Medical history. According to the patient and his mother, the foot deformity was noted from the first grade of school, and the patient was treated conservatively, on an outpatient basis, without any visible clinical result. Approximately three years before the visit, he began to experience foot and

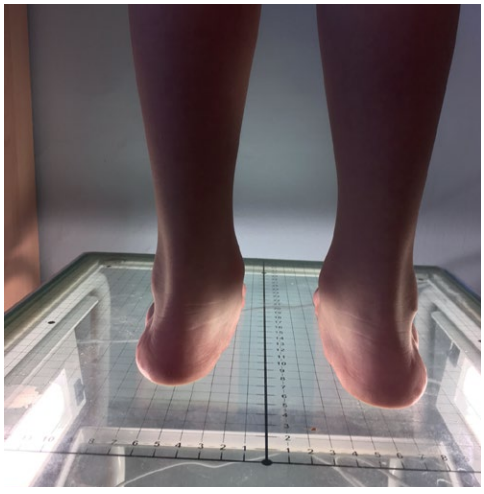

Figure 1. *Appearance of feet before surgery.*
Рисунок 1. *Внешний вид стоп до операции.*

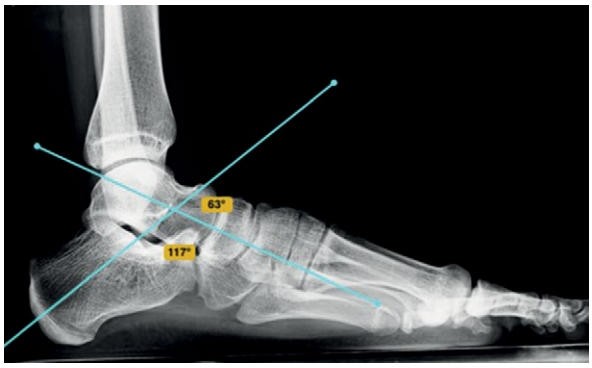

Figure 2. *X-ray of the right foot in the lateral projection under load.*
Рисунок 2. *Рентгенограмма правой стопы в боковой проекции под нагрузкой.*

ankle joint pain, which became more chronic and pronounced over time.

Clinical tests. Manual tests were performed to identify the rigidity of the deformity, as well as the Hubscher–Jack test, a test to assess the range of motion in the subtalar joint, the "scaphoid bone elevation" test, etc.

X-ray imaging of the feet under load evaluated indicators such as the angle of the longitudinal arch of the foot, which is formed by the intersection of two tangents, namely, one to the plantar surface of the calcaneal bone and the other to the plantar surface of the first metatarsal bone (normally, the angle of the longitudinal arch of the foot is 125°–130°, height arch is >35 mm); Kite's angle, formed by the intersection of the longitudinal axes of the talus and calcaneal bones (normal 25°–55°); and Meary angle between the first metatarsal and talus bones (normally should not exceed 4° (**Figs. 1 and 2**).

On the basis of the examination results, surgical treatment was decided.

In June 2021, the patient was electively hospitalized in the pediatric traumatology and orthopedic department of Samara State Medical University Clinics. Surgical intervention was performed on the right foot.

The surgical procedure was performed with the patient in the supine position; a pneumatic tourniquet was applied to the middle third of the thigh. The surgical field was treated with sterile positioning. Stage 1 was a partial Bayer achillotomy, followed by manual recovery of the ankle joint. Then, tendon–muscle plastic surgery was performed, in the form of the transposition and tenodesis of the tibialis anterior tendon into a cleft of the scaphoid bone with transosseous fixation with nonabsorbable sutures. Therefore, the transv n lead to earlyerse arch was "formed," correcting the midfoot deformity (**Fig. 3**).

Moreover, a 2-cm incision was made along the lateral surface in the projection of the subtalar sinus. The sinus area was freed from soft tissues and subcutaneous fat, and the sinus size was assessed using a specialized set of tools and manual tests, followed by the installation of a subtalar implant under image intensifier control. This manipulation was performed to eliminate the valgus component of the deformity and correct the hindfoot.

The next step consisted of making a linear incision of up to 5 cm in the lower third of the leg in the fibular projection. Subperiosteally, with minimal trauma to the soft tissue, a part of the fibula (one cortical segment) was taken and prepared for further implantation and impaction into the osteotomy zone of the first cuneiform bone (**Fig. 4**).

By using a saw, a wedge-shaped cleaving descending osteotomy of the medial sphenoid bone was performed with the installation of a previously prepared autograft,

Figure 3. *Arch of the foot formation.*
Рисунок 3. *Формирование свода стопы.*

Figure 4. *Fibular graft harvesting.*
Рисунок 4. *Забор трансплантата из малоберцовой кости.*

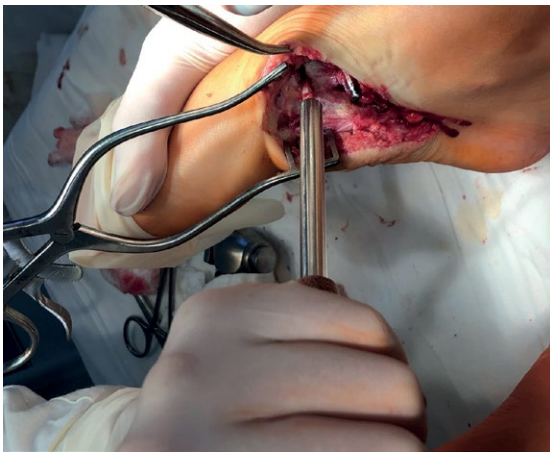

Figure 5. *Impression of the graft into the zone of osteotomy of the medial sphenoid bone.*
Рисунок 5. *Импакция трансплантата в зону остеотомии медиальной клиновидной кости.*

thereby lowering one ray of the foot and eliminating excessive pronation. This procedure corrected the deformity of the anterior section (**Fig. 5**).

Further, layer-by-layer suturing of the tissues was performed with the application of an aseptic dressing. External immobilization in the corrected position lasted for six weeks.

In the early postoperative period, anti-inflammatory, analgesic, and antibiotic therapy was administered according to the schedule. The patient was trained in the orthopedic regimen, and he was allowed to walk with crutches without loading the operated limb and perform static gymnastics until the external immobilization was removed (six weeks).

After six weeks, bandage was removed, and on follow-up examination, the patient had no active complaints. Rehabilitation was carried out as scheduled, and a date was set for surgery to correct the left foot.

In November 2021, Patient K. was hospitalized again in the pediatric traumatology and orthopedic department of Samara State Medical University Clinics for planned surgical treatment. After preoperative preparation, a manipulation was performed on the left foot similar to that performed on the right foot six months ago. The management protocol for this patient remained unchanged.

In mid-December 2021, according to the treatment plan, the immobilizing polyurethane bandage was removed from the left lower limb. The patient had no active complaints.

In January 2022, the patient was followed up again after completing a full course of rehabilitation treatment.

During the follow-up examination, positive dynamics were noted, manifested in the complete absence of pain on the right foot and a decrease in the severity of pain on the left foot. X-ray and photoplantographic parameters were within the reference values for his age group. Scores on the manual and functional tests also improved (**Figs. 6 and 7**).

DISCUSSION

The relevance of this topic is beyond doubt. This is evidentby the prevalence of the disease and the multitude of proposed treatment methods.

The foot performs a shock-absorbing function, adapting to the topography of the surface being walked, thereby protecting the joints from constant injury. Planovalgus foot deformity is not an isolated problem, and the lack of appropriate treatment can lead to the early development of secondary deformities.

Patients consisted of school-age children. Therefore, a pediatric orthopedist must primarily reduce the rehabilitation time and decrease the probability of repeated interventions. This is implemented by individualizing the choice of treatment based on age-related anatomical and physiological characteristics. The combined methods of surgical treatment are preferred.

During the initial visit, most patients with planovalgus foot deformity complain of rapid fatigue and foot and ankle joint pain, which is caused by the impaired distribution of the load on the lower extremities. The quality of life of such patients is significantly reduced; the child does not want to engage in sports activities or develop socially. This prompts parents to consider surgical treatment, particularly if conservative measures have already been used several times before the examination.

In the present clinical case, following surgical correction, the patient experienced a decrease in pain that eventually led to its complete disappearance during regular activities. Additionally, as specialists, we observed an improvement in anatomical

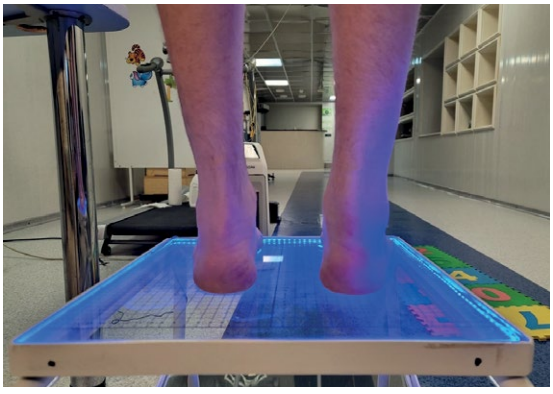

Figure 6. *The appearance of the feet after surgery.*
Рисунок 6. *Внешний вид стоп после оперативного лечения.*

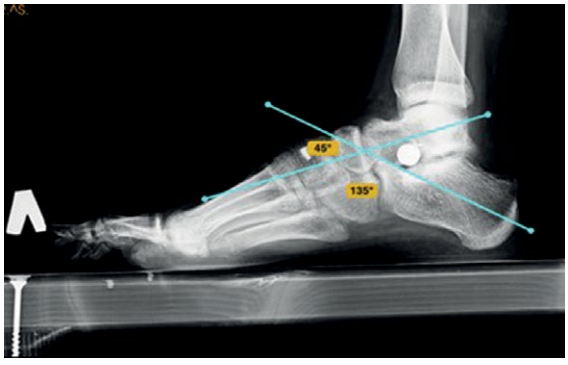

Figure 7. *X-ray of the left foot under load after surgical treatment.*
Рисунок 7. *Рентгенограмма левой стопы под нагрузкой после оперативного лечения.*

relationships, supported by the results of further clinical and instrumental studies.

CONCLUSIONS

The present clinical case, alongwith the data and results obtained, revealed the effectiveness of the combined method of surgical treatment of children with severe planovalgus deformity. By restoring the anatomical congruence of the articular surfaces, the relationship between foot sections, effect on the three sections, and work with the bone and soft tissue components, the foot acquires a physiologically correct shape. This type of surgical correction provides a good clinical effect; the rehabilitation period is reduced, and the limb function is restored.

Conflict of interest. *The authors declare no conflict of interest.*

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