Volume 3, Issue 2, February - 2025 **ISSN (E):** 2938-3811

A COMPREHENSIVE APPROACH TO THE DIAGNOSIS AND TREATMENT OF FLAT FEET IN CHILDREN

Zokirkhojaev M. A.
Resident Physician in the Traumatology Department,
Clinic of the Tashkent Pediatric Medical Institute

Abstract

Relevance: Flatfoot is a common orthopedic pathology in children (30–60%), leading to biomechanical disorders, pain syndrome, and postural changes. Traditional treatment methods are not always effective, and the biochemical mechanisms of pathogenesis remain insufficiently studied.

Objective: To develop and substantiate a comprehensive diagnostic and treatment method for flatfoot in children, considering biochemical changes in connective tissue.

Method's of research: A total of 88 children (aged 1–14 years) with varying degrees of flatfoot were examined. Clinical, radiological, and podometric assessments were performed, along with the analysis of glycosaminoglycan and oxyproline levels. Traditional and experimental treatment methods were compared.

Results' of research: Flatfoot of grade II was identified in 52.3% of children, grade I in 26.1%, and grade III in 22.7%. Elevated glycosaminoglycan and oxyproline levels were observed, which decreased by 39.2–72.9% after treatment. Clinical and functional improvements were noted in 66% of patients, which is 30% higher compared to traditional treatment.

Conclusion: A comprehensive therapy approach, including biochemical correction, physiotherapy, and orthopedic support, significantly enhances treatment efficacy and reduces the risk of recurrence.

Keywords: Flatfoot, biochemical markers, connective tissue, orthopedic correction, physiotherapy, children.

Introduction

Flatfoot is one of the most common orthopedic pathologies in childhood, significantly affecting the quality of life and the development of the musculoskeletal system. According to various epidemiological studies, the prevalence of this condition among children ranges from 30% to 60%, depending on age, region of residence, and diagnostic methods. Congenital forms occur in 3–10% of cases, whereas acquired flatfoot is diagnosed much more frequently, affecting 45–55% of school-age children [1,5,8].

The problem of flatfoot extends beyond an isolated orthopedic disorder, as it triggers a cascade of secondary changes that impact not only the foot but also the entire biomechanics of the musculoskeletal system. Impairment of the foot's shock-absorbing function leads to increased stress on the ankle, knee, and hip joints, as well as the spine. In 70–80% of cases, flatfoot is accompanied by pain syndrome, rapid fatigue, postural disorders, and an increased risk of

Web of Scientists and Scholars: Journal of Multidisciplinary Research

Licensed under a Creative Commons Attribution 4.0 International License.

scoliosis. According to statistical data, 65% of adolescents diagnosed with flatfoot exhibit spinal changes, including hyperlordosis, kyphosis, and scoliotic posture [2,3,6].

Despite the variety of treatment methods, issues regarding the effectiveness and comprehensive approach to therapy remain unresolved. Traditional methods, such as orthopedic insoles, therapeutic exercise, and massage, focus on the mechanical correction of foot shape but do not address the underlying causes of the disease. In 30–40% of cases, relapses and progression of flatfoot continue to be observed after standard conservative treatment, particularly in older children [4,7,9].

In recent years, scientific research has increasingly focused on the biochemical aspects of flatfoot development. Studies indicate that disturbances in glycosaminoglycan metabolism, alterations in collagen fiber structure, and imbalances in mineral metabolism are key factors contributing to the weakness of the foot's ligamentous-muscular apparatus. According to recent data, 60–70% of children with flatfoot exhibit elevated levels of glycosaminoglycan and oxyproline excretion in urine, indicating disruptions in connective tissue formation [7,10].

Thus, the necessity of studying biochemical changes in flatfoot and developing comprehensive treatment methods that take these factors into account is a crucial scientific and practical task. Integrating biochemical, physiological, and orthopedic approaches will not only enhance treatment effectiveness but also prevent further disease progression, ultimately improving patient prognosis and quality of life.

Research Objective

To develop and substantiate a comprehensive diagnostic and treatment method for flatfoot in children, considering biochemical changes in connective tissue, to improve therapy effectiveness and prevent complications.

Materials and Methods

The study was conducted between 2014 and 2024 in medical and educational institutions, including the clinic of the Tashkent Pediatric Medical Institute. A total of 88 children aged 1–14 years with flatfoot were included and divided into three groups. The first group consists of children aged 1–3 years (12 children, 13.6%), the second group includes children aged 4–7 years (59 children, 67.0%), and the third group comprises children aged 8–14 years (17 children, 19.3%).

Diagnosis included clinical, radiographic, plantographic, and podometric assessments, analyzing foot angular parameters and load distribution. Biochemical tests measured urinary levels of glycosaminoglycans and oxyproline. Functional tests, including electromyography, assessed foot muscle tone.

The treatment involved traditional methods (massage, therapeutic exercise, orthopedic insoles) and experimental approaches (biochemical correction, staged casting, pharmacological support). Treatment effectiveness was evaluated based on the dynamics of clinical, biochemical, and instrumental indicators. Statistical analysis was performed using variation analysis and correlation statistics methods.

Licensed under a Creative Commons Attribution 4.0 International License.

Results of Research

The study conducted a comprehensive analysis of clinical, radiographic, biochemical, and functional parameters in children with varying degrees of flatfoot, allowing for an objective evaluation of the effectiveness of the proposed comprehensive treatment method. The distribution analysis of patients by severity of flatfoot showed that the most common form was Grade II, identified in 46 children (52.3%), while Grade I was diagnosed in 23 patients (26.1%), and Grade III in 20 children (22.7%). Gender distribution confirmed a predominance of boys (57.9%), which may be associated with greater physical activity and increased foot load during childhood. Age-related characteristics revealed that flatfoot was most frequently diagnosed between the ages of 4–7 years (67.0% of cases), coinciding with the active phase of foot formation. The condition was less common in the 1–3-year-old group (13.6%) and occurred in 19.3% of cases in children aged 8–14 years, which correlates with the completion of ossification processes and reduced ligamentous plasticity.

The study of biochemical markers of connective tissue revealed a significant increase in urinary glycosaminoglycans (GAG) and oxyproline levels in children with flatfoot, indicating an imbalance in metabolic processes within the collagen-elastin system. Before treatment, the average urinary GAG concentration was 5.1±0.9 mg/day in boys and 5.9±0.8 mg/day in girls. These values exceeded the norm and indicated accelerated degradation of the connective tissue matrix, confirming the pathogenic role of biochemical changes in the development of flatfoot. After comprehensive treatment, GAG levels decreased by an average of 39.2–72.9%, indicating normalization of connective tissue metabolism. Oxyproline, a key marker of collagen degradation, also showed significant changes. In patients with Grade III flatfoot, its level exceeded the normative values by 24.45% in boys and 24.73% in girls, indicating enhanced collagen catabolism. Following the treatment course, oxyproline levels decreased by 36.3% in boys and 31.18% in girls, signifying stabilization of connective tissue remodeling processes.

Radiographic analysis of the longitudinal and transverse arches of the foot demonstrated positive dynamics in most patients. After treatment, there was a reduction in the talus inclination angle, an increase in the height of the longitudinal arch, and normalization of bone structure alignment. Specifically, the average longitudinal arch angle in patients with Grade II flatfoot changed from 140° to 120°, bringing it closer to physiological norms. Podometric studies showed an improvement in foot load distribution. Before treatment, 78.4% of children exhibited excessive weight redistribution onto the medial foot, contributing to pathological flattening. After therapy, 65.2% of patients achieved even weight distribution between the longitudinal and transverse arches.

Physiological tests, including electromyography, confirmed improved muscle tone in the foot. Before treatment, 82.1% of patients exhibited hypotonia of the flexor digitorum longus and posterior tibial muscles, which play a crucial role in maintaining the longitudinal arch. After therapy, physiological muscle activity was restored in 69.5% of children, indicating improved foot stability under load. Comparative analysis of traditional and comprehensive treatment methods demonstrated a significant advantage of the proposed approach. In the group receiving

Licensed under a Creative Commons Attribution 4.0 International License.

standard therapy (orthopedic insoles, therapeutic exercise, massage), improvement was observed in 36.2% of children, but disease progression continued in 26.6% of cases. In the comprehensive treatment group, which included biochemical correction, staged casting, and physiotherapy, 66% of children either fully recovered from flatfoot or showed significant improvement. Specifically, 27.3% of children with Grade I flatfoot achieved full recovery. Among children with Grade II flatfoot, 31.8% experienced significant improvement, transitioning to a mild form. Additionally, 7.0% of patients with Grade III flatfoot fully recovered.

The remaining patients either transitioned to a milder form (17.0% of cases) or experienced symptom reduction (6.8%), demonstrating the high efficacy of the comprehensive approach. Thus, incorporating methods aimed at correcting connective tissue metabolism not only mechanically corrected foot deformities but also eliminated their biochemical causes, ensuring a lasting therapeutic effect and reducing the risk of recurrence. The obtained data confirm the necessity of a personalized approach to flatfoot therapy, considering the age-related, functional, and biochemical characteristics of the condition.

Conclusion

The results of this study confirmed the significant role of biochemical changes in connective tissue in the pathogenesis of flatfoot in children, opening new prospects for optimizing treatment approaches. The analysis of clinical, radiographic, and biochemical parameters demonstrated that traditional treatment methods, primarily focused on the mechanical correction of foot arches, do not always provide a lasting effect, particularly in patients with severe forms of the disease.

For the first time, it was revealed that increased levels of glycosaminoglycans and oxyproline in the urine of children with flatfoot indicate an imbalance in the synthesis and degradation of connective tissue, contributing to the instability of the foot's ligamentous apparatus. It has been proven that correcting these abnormalities in combination with traditional orthopedic methods significantly enhances treatment effectiveness. Comprehensive therapy, including biochemical support of connective tissue, staged casting, physiotherapy, and therapeutic exercise, resulted in full recovery or significant improvement in 66% of patients, which is 30% higher than the results of standard treatment.

Based on the obtained data, practical recommendations have been developed for managing children with flatfoot, including early diagnosis of biochemical markers, individualized treatment selection based on the degree of deformity and metabolic characteristics of connective tissue. It has been demonstrated that a multidisciplinary approach not only eliminates the clinical manifestations of the disease but also reduces the risk of recurrence, ensuring stable structural and functional restoration of the foot.

Thus, the proposed treatment concept for flatfoot in children represents a significant step toward personalized medicine, allowing therapy to be adapted to the individual characteristics of patients and significantly improving its effectiveness. Further research in this direction may

Licensed under a Creative Commons Attribution 4.0 International License.

contribute to the development of new methods for predicting and preventing flatfoot, which is particularly relevant in pediatric orthopedics.

Key Findings

Flatfoot in children is associated with significant biochemical changes in connective tissue, including elevated levels of glycosaminoglycans and oxyproline, indicating impaired collagen metabolism and instability of the foot's ligamentous apparatus.

A comprehensive treatment approach, incorporating biochemical correction, orthopedic methods, staged casting, and physiotherapy, has demonstrated high effectiveness, leading to significant improvement or complete recovery in 66% of patients, which is 30% higher than standard treatment outcomes.

The inclusion of biochemical correction methods in flatfoot therapy has normalized connective tissue metabolism, contributing to the restoration of foot arches, improved functional parameters, and reduced risk of recurrence, confirming the rationale for a pathogenetic approach to the treatment of this condition.

References

1. Barry K, Pille C. Foot Orthoses for Treating Flat Feet in Children. Am Fam Physician. 2023 Mar;107(3):232-233.
2. Carr JB 2nd, Yang S, Lather LA. Pediatric Pes Planus: A State-of-the-Art Review. Pediatrics. 2016 Mar;137(3):e20151230. doi: 10.1542/peds.2015-1230.
3. Evans AM, Rome K, Carroll M, Hawke F. Foot orthoses for treating paediatric flat feet. Cochrane Database Syst Rev. 2022 Jan 26;1(1):CD006311. doi: 10.1002/14651858.CD006311.pub4.
4. Evans AM, Rome K, Carroll M, Hawke F. Foot orthoses for treating paediatric flat feet. Cochrane Database Syst Rev. 2022 Jan 14;1(1):CD006311. doi: 10.1002/14651858.CD006311.pub3.
5. Jafarnezhadgero A, Madadi-Shad M, Alavi-Mehr SM, Granacher U. The long-term use of foot orthoses affects walking kinematics and kinetics of children with flexible flat feet: A randomized controlled trial. PLoS One. 2018 Oct 9;13(10):e0205187. doi: 10.1371/journal.pone.0205187.
6. Malden S, Gillespie J, Hughes A, Gibson AM, Farooq A, Martin A, Summerbell C, Reilly JJ. Obesity in young children and its relationship with diagnosis of asthma, vitamin D deficiency, iron deficiency, specific allergies and flat-footedness: A systematic review and meta-analysis. Obes Rev. 2021 Mar;22(3):e13129. doi: 10.1111/obr.13129.
7. Rerucha CM, Dickison C, Baird DC. Lower Extremity Abnormalities in Children. Am Fam Physician. 2017 Aug 15;96(4):226-233.
8. Turner C, Gardiner MD, Midgley A, Stefanis A. A guide to the management of paediatric pes planus. Aust J Gen Pract. 2020 May;49(5):245-249. doi: 10.31128/AJGP-09-19-5089.

Web of Scientists and Scholars: Journal of Multidisciplinary Research

Licensed under a Creative Commons Attribution 4.0 International License.

9. Ueki Y, Sakuma E, Wada I. Pathology and management of flexible flat foot in children. J Orthop Sci. 2019 Jan;24(1):9-13. doi: 10.1016/j.jos.2018.09.018.
10. Xu L, Gu H, Zhang Y, Sun T, Yu J. Risk Factors of Flatfoot in Children: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2022 Jul 6;19(14):8247. doi: 10.3390/ijerph19148247.

Licensed under a Creative Commons Attribution 4.0 International License.

Web of Scientists and Scholars: Journal of Multidisciplinary Research