

ARTICLE TYPE: REVIEW**A Podological Approach to Congenital Orthopedic Foot Deformities: A Literature Review
Konjenital Ortopedik Ayak Deformitelerine Podolojik Yaklaşım: Bir Literatür Derlemesi**Ayşegül Sarpkaya^{1*}, Fatmaz Zehra Küçük²¹Harran Üniversitesi, Sağlık Hizmetleri MYO, Podoloji Programı, aysegulsarpkaya@harran.edu.tr, 0000-0002-8479-0235²Harran Üniversitesi, Sağlık Hizmetleri MYO, Podoloji Programı, zehraklc2015@gmail.com, 0000-0002-0343-5291**ÖZET**

Konjenital ortopedik ayak deformiteleri, doğum öncesi veya doğum sırasında gelişen, kemik, yumuşak doku ve bağ yapılarındaki anormallikler nedeniyle ortaya çıkan önemli sağlık sorunlarıdır. Bu deformitelerin erken dönemde saptanarak uygun tedavi ve takip programlarına alınması, çocukların motor gelişimi ve genel yaşam kalitesi üzerinde belirleyici etkiye sahiptir. Podoloji, ayak sağlığının korunması, değerlendirilmesi ve tedavisinde uzmanlaşmış bir alan olarak konjenital deformitelerin yönetiminde çok yönlü yaklaşımlar sunmaktadır. Bu derlemede, konjenital ayak deformitelerinin tanı ve sınıflandırmasından tedavi protokollerine kadar uzanan süreç, podolojik bakış açısıyla ele alınmıştır. Literatürdeki güncel kanıtlara dayanarak, konservatif uygulamalar (ortez, tabanlılık, ayakkabı modifikasyonları), fiziksel rehabilitasyon yöntemleri ve cerrahi tedavileri içeren bütüncül yaklaşımlar tartışılmakta; ayrıca ekip çalışmasının ve aile eğitiminin önemine vurgu yapılmaktadır. Bu sayede, podolojik yaklaşımların konjenital ayak deformitelerinin tedavisinde nasıl tamamlayıcı ve destekleyici rol üstlenebileceği gösterilmektedir.

Anahtar Kelimeler: Konjenital ayak deformiteleri, Konservatif tedavi, Podolojik yaklaşım**ABSTRACT**

Congenital orthopedic foot deformities are significant health concerns that emerge due to abnormalities in the bones, soft tissues, and ligaments during prenatal development or at birth. Early detection of these deformities, followed by the implementation of appropriate treatment and follow-up programs, has a decisive influence on children's motor development and overall quality of life. Podology, as a specialized field dedicated to the preservation, evaluation, and treatment of foot health, provides multifaceted approaches to the management of such congenital deformities. In this review, the process encompassing the diagnosis and classification of congenital foot deformities, as well as various treatment protocols, is examined from a podologic perspective. Drawing on current evidence in the literature, it addresses comprehensive approaches that include conservative interventions (orthoses, insoles, and footwear modifications), physical rehabilitation methods, and surgical treatments, while underscoring the importance of interdisciplinary teamwork and family education. In doing so, it demonstrates how podologic approaches can function as complementary and supportive measures in the therapeutic management of congenital foot deformities.

Keywords: Congenital foot deformities, Conservative treatment, Podologic approaches**Sorumlu Yazar/Corresponding Author:** Ayşegül Sarpkaya, Harran Üniversitesi, Sağlık Hizmetleri Meslek Yüksekokulu, Podoloji Programı, Şanlıurfa, Türkiye, 0000-0002-8479-0235**Atf /Cite:** Sarpkaya A, Küçük FZ. A Podological Approach to Congenital Orthopedic Foot Deformities: A Literature Review. Mehes Journal. 2025;3(1):41-50.The journal is licensed under a [Attribution 4.0 International \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

Congenital orthopedic foot deformities have been an integral part of medical practice for centuries. These deformities, which arise during pregnancy or at birth due to persistent structural abnormalities in the skeletal and soft tissue components of the foot, may lead to functional limitations and pain that become more apparent once a child begins to walk (1). Particularly in the 19th century, as knowledge of foot anatomy advanced, various treatment protocols were introduced; moreover, thanks to developments in modern medicine, awareness regarding the genetic underpinnings and early treatment strategies for these issues has progressively increased. If not diagnosed and managed promptly, such deformities can persist into adulthood, resulting in biomechanical imbalances and postural disorders that significantly impair quality of life (2).

Among the most common congenital foot problems are pes equinovarus (clubfoot), pes planus (flatfoot), pes cavus (high-arched foot), and metatarsus adductus. In addition to hereditary influences, these deformities may also be related to intrauterine positioning, connective tissue disorders, or neuromuscular conditions. Recent studies indicate that family history (genetic predisposition), prenatal environmental factors, and epigenetic mechanisms may likewise contribute to their manifestation (1).

Podology, as a multidisciplinary field specializing in foot health maintenance, assessment, and treatment, offers multifaceted approaches in the management of congenital foot deformities. In particular, a comprehensive foot examination, risk assessment, and treatment plan conducted by a podologist are pivotal for timely intervention and the efficacy of non-surgical methods at later stages. Key podologic practices include thorough evaluation of the ankle and foot anatomy, pressure distribution analyses, provision of custom insoles and orthoses, and the design of individualized exercise programs (3-4).

Congenital Orthopedic Foot Disorders

Definition of pes equinovarus (clubfoot) and podologic approaches

Pes equinovarus (clubfoot) is a congenital deformity characterized by inward (varus) and downward positioning (plantar flexion) of the foot. Clinically, it typically presents with the heel in varus, forefoot adduction, and ankle plantar flexion. Occurring in approximately one to two cases per 1000 live births, clubfoot is relatively common among congenital foot pathologies. Multiple factors—such as genetic predisposition, abnormal intrauterine positioning, and connective tissue anomalies—may play a role in its etiology (5).

Conservative management: Conservative methods are often the first-line treatment for pes equinovarus, with the Ponseti method being the most widely accepted technique. This approach involves the gradual manipulation of the foot and serial casting, sometimes requiring a percutaneous Achilles tenotomy. Additionally, special orthoses or a brace may be recommended to reduce the likelihood of recurrence. The success of conservative management largely depends on initiating treatment at an early age and maintaining regular follow-up. In particular, manipulation and casting performed during infancy can often correct the deformity without the need for surgery (6-7).

Podologic approaches: Podology, a field dedicated to the preservation, assessment, and treatment of foot health, plays a significant supportive role in managing pes equinovarus. Podologists conduct regular evaluations and follow-up visits to detect any potential recurrence of the deformity during growth. These services include footwear modifications, insole or orthotic applications, and individualized exercise programs—collectively aiming to maintain the success of initial treatment. Furthermore, gait analysis and pedobarographic assessments performed by podologists are instrumental both in guiding the treatment process and in identifying an early risk of relapse (8). By minimizing the biomechanical imbalances caused by pes equinovarus, the ultimate objective is to facilitate healthier participation in daily living activities (9).

Definition of pes planus (flatfoot) and podologic approaches

Pes planus, commonly referred to as “flatfoot,” is a deformity characterized by an inadequate or absent arch, resulting in a flattened appearance of the sole. Clinical manifestations typically include a decreased medial longitudinal arch and various biomechanical problems that accompany this reduction. Flatfoot may be congenital or acquired; however, differentiating physiological flatfoot in childhood (often due to increased fat padding, especially before ages 3–4) from pathological flatfoot is a fundamental step in the diagnostic process (10-11).

Conservative management: The first step in treating pes planus involves evaluating the severity of the deformity and determining whether the patient experiences pain or functional limitations. In mild, asymptomatic cases, observation and simple exercises may suffice, as the arch can spontaneously develop during growth. In more advanced cases, orthopedic insoles (orthotic insoles), supportive footwear, and stretching or exercise programs are employed to relieve pain, reduce fatigue, and address postural imbalances. This approach aims to control pain, improve gait and posture, and maintain the foot arch (12).

Podologic approaches: Podologists conduct detailed assessments of foot structure and gait mechanics, utilizing tools such as pedobarographic (pressure-distribution) analysis and gait analysis. Based on these findings, they design custom orthotic insoles and footwear modifications tailored to the individual. In more severe presentations featuring pain, fatigue, or postural issues, orthotic insoles, supportive footwear, and stretching/exercise programs help alleviate symptoms, enhance gait and posture, and preserve the arch. During regular follow-up, the effectiveness of these interventions is reviewed; adjustments to insoles or footwear are made as needed, and exercise programs are revised. This comprehensive, multidisciplinary approach is crucial to limiting the progression of pes planus and improving the patient's overall quality of life (13).

Definition of pes cavus (high-arched foot) and podologic approaches

Pes cavus is a deformity characterized by an arch height exceeding the normal range in the foot. Pronounced elevation of the medial and/or lateral longitudinal arches can result in excessive pressure on the heel and metatarsal heads during weight-bearing. Individuals affected by this condition frequently experience diminished ankle stability, recurrent ankle sprains, and metatarsal pain. Etiologically, a significant portion of pes cavus cases arises from neurologic causes, such as Charcot-Marie-Tooth disease or other genetic or neuromuscular disorders; however, idiopathic presentations (of unknown origin) also occur (14-17).

Conservative management: In the treatment of pes cavus, conservative methods are typically prioritized based on the severity of the deformity and the patient's symptoms. Custom orthoses, orthopedic insoles, or supportive footwear are commonly employed to mitigate pain and address uneven weight distribution. Stretching and strengthening exercises can enhance the flexibility of tight muscles and ligaments, thereby reducing the risk of injury. The primary objectives include alleviating symptoms and maintaining functional capacity in daily activities (18).

Podologic approaches: Podology offers comprehensive evaluations and holistic treatment plans for pes cavus. Pedobarographic (pressure-distribution) assessments and gait analyses are particularly useful in identifying load imbalances associated with the high arch. Informed by these findings, podologists may design custom insoles, implement footwear modifications, and, if necessary, introduce heel lifts or other support elements. During regular follow-up sessions, both insole and footwear effectiveness are reassessed, and adjustments are made as needed. Additionally, podologists may prescribe stretching and strengthening exercises targeting the musculoskeletal system. When undertaken in collaboration with other foot-health professionals

(e.g., orthopedic surgeons, physical therapists), this multifaceted approach can help control the progression of pes cavus and significantly enhance patient comfort and quality of life (19).

Definition of metatarsus adductus and podologic approaches

Metatarsus adductus is a congenital foot deformity characterized by the medial deviation (adduction) of the metatarsals. Observed from birth, it can manifest in mild, moderate, or severe forms. While mild presentations may resolve spontaneously or respond to passive stretching exercises, more severe cases may necessitate active therapeutic interventions. The etiology involves genetic factors, intrauterine positioning, and soft tissue anomalies (20-21).

Conservative management: Conservative methods are the first choice in metatarsus adductus treatment. The initial step is to determine the degree of deformity and the child's functional requirements. Mild and moderate cases can be closely monitored through passive stretching exercises and parental education. Serial casting, specialized footwear, or braces (orthoses) are employed to progressively correct the foot alignment. Initiating these protocols early aims to reduce the risk of persistent gait abnormalities or biomechanical foot pain later in life. Success is strongly linked to consistent follow-up appointments and active participation from parents (22).

Podologic approaches: Podology provides significant benefits in managing metatarsus adductus through comprehensive evaluations and individualized treatment strategies. Gait analysis and pedobarographic assessments yield detailed insights into weight distribution and deformity severity. Drawing on these findings—particularly in more resistant cases—custom orthotic devices or footwear modifications may be introduced to decrease medial deviation of the foot, balance pressure distribution, and enhance walking comfort. Podologists also prioritize educating parents and designing home-based routines, which help sustain the consistency of passive stretching and mobility exercises, thereby inhibiting further progression of the deformity. Regular follow-up appointments allow adjustments to orthoses or footwear as the child grows, a holistic approach essential for correcting metatarsus adductus without surgery and fostering a healthy gait pattern as the child matures (23-24).

Definition of vertical talus (rocker-bottom foot) and podologic approaches

Vertical talus, also known in clinical literature as “rocker-bottom foot,” is a congenital deformity of the foot. Essentially, the talus bone assumes a vertical position, and the foot arch appears excessively flexible or collapsed; this condition involves distal displacement of the navicular bone from the talus, leading to a significant disruption of the arch. Such malposition of the ankle and tarsal joints adversely affects weight distribution and may cause difficulties in

gait and balance. Genetic, neurological, and musculoskeletal factors are thought to contribute to its etiology (25-26).

Conservative management: Conservative strategies generally represent the first choice in treating vertical talus. However, compared to other congenital foot issues, it may be more resistant to such measures, limiting the success of non-surgical interventions. Nonetheless, early intervention with splints, serial casting, or modified Ponseti-like techniques can partially correct the malalignment. In severe deformities, surgical intervention may become unavoidable; yet, conservative treatment can potentially reduce the extent of surgery and decrease the likelihood of complications (25, 27).

Podologic approaches: Podology employs various assessment methods to thoroughly evaluate foot mechanics and load distribution in cases of vertical talus. Through pedobarographic measurements and gait analysis, abnormalities in pressure distribution, restricted joint range of motion, and balance issues can be detected. Depending on the severity of the deformity and the patient's gait pattern, customized orthoses may be designed to support the ankle and foot. Shoe inserts, insoles, or heel supports can be used to achieve balanced weight distribution and maintain a more neutral foot position. As part of the conservative treatment, the podologists or orthopedic specialist closely monitors progress using serial casting. During this process, special emphasis is placed on parent education and home-based stretching exercises. Strengthening and flexibility exercises for the supporting muscles of the foot are prescribed, and simple daily activities are introduced to bolster muscle and soft tissue structures. The podologists also evaluates the suitability of footwear and orthoses in relation to the child's growth, making adjustments as needed. Regular follow-up visits assist in predicting potential surgical needs and optimizing the effectiveness of conservative measures. The primary goal of podologic interventions is to minimize the biomechanical imbalances caused by vertical talus and enhance the patient's walking comfort and functional capacity. Even if surgery is eventually required, podology-based evaluations and conservative treatments can provide perioperative support and, in some cases, reduce the scope of surgical intervention. Consequently, this approach fosters a favorable long-term prognosis and facilitates greater participation in daily activities (28).

Definition of polydactyly and syndactyly and podologic approaches

Polydactyly refers to a congenital anomaly characterized by the presence of more toes than normal (generally one or more additional digits). These extra digits may be fully developed or rudimentary in nature, potentially affecting both the functional and aesthetic integrity of the foot. Genetic factors play a significant role in the etiology of polydactyly; in addition to familial

inheritance, extra-digit formation is frequently observed in certain syndromes (e.g., Ellis-van Creveld syndrome) (29-30).

Conservative management: When polydactyly is accompanied by notable pain, gait abnormalities, or footwear difficulties, a treatment plan should be established. In mild cases, or when the extra digit does not significantly compromise function, surgical intervention may be postponed or deemed unnecessary. During this period, simple orthoses, toe caps, or padding can be utilized to minimize pressure areas and friction between the toes. Moreover, selecting footwear of appropriate size and width is crucial for preventing pain and skin lesions (31).

Podologic approaches: The primary objective of podologic interventions for syndactyly is to reduce friction and pressure points between the toes, thereby enhancing patient comfort and gait quality. Podologists address factors such as footwear and orthotic modifications, toe protection and separators, hygiene and skin care, exercise and mobility training, and perioperative assistance if surgery is required. For areas where toes are fused, custom insoles are designed to offset any additional pressure or friction. Additionally, widening the toe box of footwear can help prevent irritation and pressure ulcers. In cases of partial syndactyly, silicone or similar protective materials may be used to lower the risk of skin irritation or pressure-induced lesions between toes. Because syndactyly often creates a warm, moist environment that predisposes the skin to conditions like dermatitis or fungal infections, regular cleaning, thorough drying, and the use of suitable skin care products are essential, as advised by podologists. To maintain appropriate posture and gait mechanics, stretching and strengthening exercises are recommended to partially compensate for the restricted toe motion associated with syndactyly, thus preserving optimal ankle and foot muscle function. For more advanced forms of syndactyly requiring surgical correction, podologists collaborate closely with the surgical team to optimize postoperative protection and rehabilitation of the foot structure (31). This review discusses congenital orthopedic foot deformities—such as pes equinovarus, pes planus, pes cavus, metatarsus adductus, and vertical talus—that pose significant challenges to children’s motor development and daily activities. When accurately diagnosed in the early stages and referred for appropriate treatment, these deformities can yield favorable functional and aesthetic outcomes. According to the literature, conservative methods (e.g., serial casting, orthoses, insoles, footwear modifications, and exercise programs) effectively reduce the need for surgery when implemented during infancy and early childhood. In cases of digital anomalies like polydactyly and syndactyly, the choice of surgical intervention or conservative management depends on the severity of the deformity and any associated functional impairment.

Podology contributes a comprehensive perspective in the management of these deformities, using advanced evaluation tools such as gait analysis and pedobarographic imaging to elucidate the biomechanical characteristics of the foot. Customized insoles, footwear modifications, and tailored exercise programs developed by podologists aim to limit the progression of deformities and alleviate symptoms such as pain, fatigue, and postural imbalances. Additionally, the collaboration of podologists with orthopedic specialists, physical therapists, and other healthcare professionals fosters a multifaceted and effective treatment approach.

CONCLUSION

Early Diagnosis and Follow-Up: Because successful treatment of congenital foot deformities hinges on timely detection and prompt intervention, foot examinations should be emphasized during routine pediatric checkups. Regular monitoring throughout the child's developmental stages helps identify potential progression or recurrence of deformities.

Multidisciplinary Approach: Coordinated efforts among podologists, orthopedic specialists, physical therapists, and family physicians ensure a holistic strategy for managing deformities. This collaboration promotes more targeted, systematic, and effective treatment protocols.

Individualized Treatment Plans: Each deformity varies in degree and is influenced by the patient's age, overall health status, and daily requirements; hence, treatment must be tailored to the individual. Comprehensive assessments performed by podologists are essential for customizing orthoses and insoles to meet each patient's specific needs.

Family Education and Engagement: Families play a critical role in enhancing the effectiveness of conservative interventions (e.g., serial casting, splinting, home exercises). Providing detailed information on the deformity and its treatment process encourages active participation at home and leads to improved long-term outcomes.

Continuous Education and Research: Ongoing research into congenital foot deformities should be supported across relevant disciplines, especially podology and orthopedics. Treatment guidelines should be regularly updated in light of current evidence, ensuring the prioritization of evidence-based practices.

Implementing these recommendations can render the management of congenital foot deformities more effective and sustainable. Consequently, individuals affected by these conditions can progress through growth and development with minimal pain and functional impairment, thereby achieving a healthier quality of life.

Scientific Responsibility Statement

We hereby declare that we (the authors) bear full responsibility for the scientific content of this article, including the study design, data collection, analysis and interpretation, writing of the manuscript, the preparation of some or all of its main framework, the scientific review of its content, and the approval of the final version of the manuscript.

Ethics Approval and Consent

As this study did not involve human participants or experimental procedures, and/or utilized publicly available data, no additional approval by an ethics committee was required.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author Contributions

Ayşegül SARP KAYA: Conceived the idea, conducted the literature review, and prepared the entire draft of the manuscript, including final editing.

Fatmaz Zehra KÜÇÜK: Provided textual revisions, contributed to structural organization, and reviewed the final version of the manuscript for accuracy and clarity.

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