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# Therapeutic update of pediatric flatfoot: a systematic review with meta-analysis

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**Abstract:** Objectives: The aim of this systematic review is to evaluate the effectiveness of the use of orthoses in the treatment of pediatric flatfoot.

Methodology: A systematic review was carried out in the online databases Cochrane Library, EMBASE, CINAHL, Medline and PubMed, using the following terms: flatfoot AND pediatric AND Orthotic

Devices. There were no limitations on gender, date or language. All results up to

February 1, 2024 were included.

Results: 213 patients under the age of 18 were included in this study. The use of medial arch support insoles proved to be effective in the treatment of flat feet in

children, with an improvement in ankle internal rotation angles and knee internal and external rotation.

Conclusion: The use of orthoses has shown good results and is a reproducible and reliable approach, especially in pre- school patients who have been using them for more than 12 months, with improvements in gait, alignment and coordination of the lower limbs.

**Keywords:** Flatfoot; Pediatrics; Orthopedic procedures.

**Introduction:** Flat feet result from loss of the medial longitudinal arch, abduction of the forefoot and excessive subtalar subtalar eversion, divided into rigid or flexible. The pathology itself is marked by the rigid form with etiologies such as genetic, neurological, inflammatory, rheumatological, traumatic and/or bone abnormalities.1,2 As it is mostly asymptomatic, flexible flatfoot is classified as idiopathic, with no apparent cause. It is one of the most common diseases affecting pediatric health, as of 2006 the high prevalence of flexible flatfoot in children aged three to six was 44%, but the prevalence of pathological flatfoot was less than 1%. It is a frequently reported disease. 1,2

The discussion of treatment and monitoring of asymptomatic and symptomatic flat feet remains heated in the orthopedic population, however the main goals of treatment of flat feet are the relief of pain or disability and the prevention of future disabilities. Therapeutic options are diverse and include rest, physical therapy, orthoses and the use of anti-inflammatory drugs. 1,3–5 Surgical intervention is uncommon, however, in the event of failure of conservative treatment, the approach is indicated. 3–5 Surgical options and techniques include: soft tissue procedures, realignment osteotomies and limiting motion techniques without joint fusion. It is worth noting that the latter is not recommended in the pediatric population. 1,2,5

It is known that the progressive increase in the number of obese children in the population is a relevant epidemiological fact. Faced with mechanical overload, these children report greater complaints of musculoskeletal pain than eutrophic children, therefore, obese children have a higher prevalence of flat feet. The association between body weight and flat feet in children shows a variation in the prevalence of flat feet between 14% and 67%. Almost all studies have indicated an increase in flat feet in children with increasing weight.

Due to the different methodologies, the lack of consensus regarding the definition of flat feet, the scarcity of research on pain/complications and the few existing studies, more research is needed to determine a relationship between children's body weight, flat feet and the associated effects on pain and function. The aim of this systematic review is to evaluate the effectiveness of the use of orthoses in the treatment of pediatric flatfoot.

## METHODOLOGY

### Method

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines.6

### Search strategy

The online databases Cochrane Library, EMBASE, CINAHL, Medline and PubMed were searched using the following terms: flatfoot AND pediatric AND Orthotic Devices. The search was repeated using several alternative spellings for flatfoot. No limitations were imposed on gender or language.

All results up to 1 February 2024 were included. The SPICE strategy was used to identify the most relevant studies.

- Setting: Patients under 18 years of age diagnosed with flatfoot.

- Perspective: Individuals undergoing a non-surgical approach using orthoses for the treatment of flatfoot in children.

- Intervention: Non-surgical treatment.

- Comparison: patients undergoing flatfoot treatment using orthoses compared to the placebo group.

- Evaluation: effectiveness of non-surgical treatment.

### Inclusion and exclusion criteria

The following were included: (1) studies with patients under 18 years of age (2) studies with an approach to patients diagnosed with flatfoot treated with the use of orthoses (3) studies published between 2009-2024 (5) original studies, preferably randomized studies.

Exclusion: (1) studies that evaluated surgical techniques for the treatment of flatfoot (2) studies published more than 15 years ago (3) non-original studies.

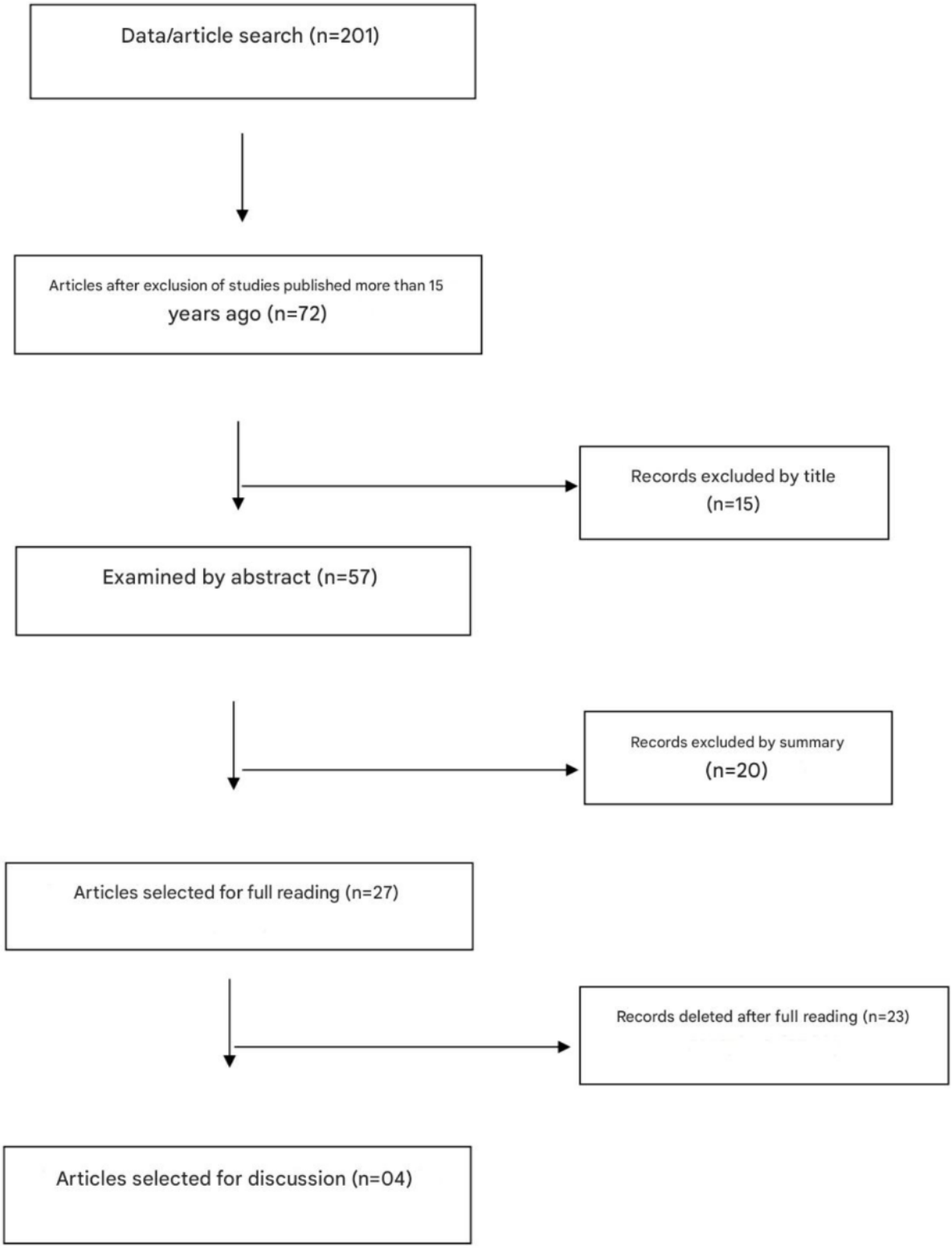
This systematic review has the registry code of the successful ID CRD42024519348.

## RESULTS

Initially, 201 articles were selected, 72 of which were excluded because they had been published more than 15 years ago, leaving 15 articles. After evaluating the titles and abstracts, 35 were excluded, leaving 27 for full reading. These articles were analyzed and only 04 were

randomized clinical trials related to the treatment of flexible flatfoot (Figure 1).

**Figure 1 - Studies selected according to PRISMA parameters.**




Source: Own authorship (2024).

The 04 selected articles presented children diagnosed with flatfoot who underwent treatment with orthoses. An analysis of the functional evaluation, correction of the deformity and associated pain was performed in those studies that involved these variables. In total, 213 patients under 18 years of age were included in this study.

Table 1 presents the selected studies and their outcomes. 7,8,9,10

**Table 1. Results obtained by the selected studies.**

| Study | Approach | Results |
|---|---|---|
| Liebau e col | Support insole Placebo sensorimotor insole | Foot and ankle disability index (FADI); Valgus index; Pain assessment. |
| Jarfanezhadgero e col | Supportive insole | Kinematics and kinetics of walking. |
| Sinha et al | Supportive insole | American Orthopaedic Foot and Ankle Society (AOFAS); Angular variation of the foot. |
| Hsieh e col | Supportive insole | Functional assessment. |

Table 2 contains the analysis of treatments for correction of flat feet in children. 7,8,9,10

**Table 2- Analysis of the studies selected to evaluate the efficacy of treating flexible flat feet in children.**

| Study | Type of study | Sample | Age | Type of orthosis X control group | Conclusion |
|---|---|---|---|---|---|
| Liebau e col | Randomized clinical trial | 52 patients | 8.2 years | Medial arch support insole Sensorimotor insole | Support and sensorimotor insoles present satisfactory results in muscle activities and longitudinal arch in flexible flat feet compared to placebo. |
| Jarfanezhadgero and col | Randomized clinical trial | 30 patients | 10 years | Medial arch support insole | The use of a support insole provides better results in the angles of internal rotation of the ankle, internal and external rotation of the knee, being effective in walking kinematics. |
| Sinha et al | Randomized clinical trial | 81 patients | 8.3 years | Medial arch support insole | All angles of flat feet showed good results with the use of the support insole. In the control group, only the metatarsal angle showed improvement. |
| Hsieh e col | Randomized clinical trial | 52 patients | 6,2 | Medial arch support insole | The parameters evaluated demonstrated better results in the group using support insoles compared to placebo. |

The randomized clinical trial by Liebau et al evaluated the efficacy of support and sensorimotor insoles in relation to a control group. An evaluation of the muscular activity of the tibialis anterior and peroneus

longus muscles was performed as a parameter in the treatment of flat feet. The comparison, in relation to the mean, of the activity of the tibialis anterior muscle with the support insoles (p: 0.757), sensorimotor insoles (p: 0.971) and placebo (p: 0.046). While the muscular activity of the peroneus longus for the support insoles (p: 0.180), sensorimotor insoles (p: 0.057) and placebo (p: 0.600). The valgus index, which assesses rearfoot alignment, varied from 31.7 to 34.1 in the placebo group, 32.2 to 33.7 in the sensorimotor insole group, and 32.5 to 32.0 in the support insole. The foot and ankle disability index (FADI) changed from 95.8 versus 98.9 in the placebo group, 90.7 versus 96.3 in the sensorimotor group, and 94.8 versus 94.0 in the support insole. There were no significant variations in pain between groups.7

Jafarnezhadgero et al presented a randomized clinical trial that compared the use of support insoles with placebo insoles. The mean time of use of support insoles was 6.8±3.8 hours and 7.0±3.7 hours per day for placebo. The use of support insoles was related to significant improvement in walking kinematics with evolution of the results of internal rotation angles of the ankle (5.2° +- 0.8 versus 3.3° +- 1.2) and internal rotation (8° +- 2.5 versus 4.8° +- 0.6) and external rotation (-12.7° +- 0.9 versus -10.7 +- 0.7) of the knee. There was no association between an improvement in walking speed and leg length adjustment; the support insole group presented pre-treatment values of

2.43±0.37 m/m/s and post-treatment values of 2.42±0.35 m/m/s, while the placebo group was associated with 2.44±0.38 m/m/s and post-test values of 2.43±0.34 m/m/s.8

Sinha et al, through a randomized clinical trial, analyzed the effectiveness of using a medial arch support insole in relation to placebo. The orthosis group had a shorter follow-up time than the control group, median of 9 vs. 19 p=0.003. The use of the support insole was related to a significant improvement in the AOFAS scores of the forefoot, midfoot and hindfoot, values before and after treatment: 56+- 15 versus 68+- 12; 63 +- 10 versus 66 +- 12 and 66 +- 10 versus 77 +- 13, respectively. For the control group, only the forefoot and hindfoot scores showed improvement: 54 + -10 versus 58 + -10 and 63 + -10 versus 67 + -11, respectively. When comparing the changes in foot angles in the two groups, there were significant differences in the lateral angle of the first metatarsal of the left foot (p = 0.004), lateral angle of the talocalcaneal of both feet (p < 0.001), and inclination angle of the calcaneus of the left foot (p = 0.016).9

The randomized clinical trial by Hsieh et al also evaluated the use of medial arch support insoles in the treatment of flexible flatfoot. The parameters evaluated demonstrated better results in the group using support insoles compared to placebo: physical health (10.3% vs −38.9%, P = 0.035 PedsQL and P < 0.001 by ANCOVA); pain (30.4% vs −7.7%, P = 0.048 and P < .008 by ANCOVA), mobility (65.9% vs 20.7%, P = 0.042 and P < 0.005 by ANCOVA) and physical function (21.6% vs −33.3%, P = 0.016 and P < 0.001 by ANCOVA).10

## DISCUSSION

The muscle activity of the lower leg, assessed in the study by Liebau et al, was greatly influenced by the use of support and sensory motor insoles, with no significant functional differences between the two. The use of medial arch support insoles proved to be effective in treating flat feet in children, improving ankle internal rotation angles, internal and external knee rotation, providing functional results in walking kinematics, as well as improving pain, limb mobility and physical function.7,8,9,10

There is a wide range of treatments for flexible flatfoot, although it is still a much debated and controversial subject, which involves issues ranging from differentiating between physiological and pathological, how to make the diagnosis, when to start treatment, what is the best therapeutic option and when to advise surgical intervention or whether not to approach it and allow the physiological evolution to continue11,12,13..

For this reason, the choice of the therapeutic approach often depends on the individual doctor14. However, the factors that are taken into account when establishing an intervention are age, flexibility, the symptoms presented, the equinus position, the severity of the deformity and suitable footwear15.

The most commonly used conservative treatments are foot orthoses (FOs), physiotherapy with joint manipulation, the Mulligan method, corrective footwear and

physical exercise. 14,16-23 The surgical approach includes procedures such as subtalar arthrolysis 24, indicated for feet with severe deformity, rigid flat feet or without clinical improvement and persistence of symptoms even with the conservative approach. 25

The earlier effective treatment is started, the less damage will occur to other parts of the body. Furthermore, they added that conservative treatment should be carried out rather than invasive treatment19,26. Therefore, since untreated flexible flatfoot can trigger problems in the foot itself or in other structures, it is necessary to demonstrate the effectiveness of OP as a conservative therapy to reduce clinical symptoms and improve the quality of life of

patients8,25,27-3

A recent study showed that OP has a positive impact on pain, gait, posture and foot function.1 Although there is no agreement on the ideal type of orthosis, they all have a high degree of longitudinal support of the medial arch and are made of different materials, but always rigid or semi-rigid25. The use of factory-made orthoses has been proven to be better than prefabricated orthoses, as they promote better foot adaptation and pressure distribution32. There is also a relationship between the hardness of the OP and the effectiveness of the treatment, but this increase is related to soft tissue damage33.

As for the time of use, studies specify that it should be used every day, for a period of between 3 months and 6 years8,34,35,36. However, there is no agreement on this time, however three months are considered an insufficient period for therapy37,38. Its use can have an immediate effect and modify the children's feet, but it is after 12 months that more changes and improvements are observed, such as in gait kinematics, alignment and coordination of lower limbs8,34,39.

Regarding age, some argue that the best results and evolution of treatment is before the age of six and others after the age of six40,41. The study published by

Lee et al.42 found that FO should be offered to children under the age of six, given that in their study of children aged between 1 and 12, the best results were in preschoolers, and that children over the age of 7 showed minimal correction.However, it should also be pointed out that the natural development of the foot occurs before the age of 6-743,44,45. Furthermore, it is not known whether gender influences the prevalence of flat feet, although it does show a higher incidence in male children46,47,48.

As for the negative effects of this therapy, they report skin irritation, increased pain, intolerance or discomfort after using the orthosis and problems with the fit of the shoe49. Some scholars state that the use of footwear is part of the treatment to ensure the effectiveness of the OP39. However, only one group of scholars have advised patients on a specific type of footwear8,34.

## CONCLUSION

It can be concluded that this pediatric pathology needs to be further discussed and studied, since there is no agreement as to its definition, diagnosis, therapeutic management and onset. The use of orthoses has shown good results, being a reproducible and reliable approach, especially in pre-school patients who use them for more than 12 months, with improvements in gait, alignment and coordination of the lower limbs.

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