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Review Article

Physiotherapy Section

Low Dye Taping as a Conservative Intervention for Flat Foot: A Literature Review

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ABSTRACT

Flat foot, also known as pes planus is a very common foot deformity which presents itself through the collapse of the medial longitudinal arch. There is an increase in plantar pressure and biomechanical changes due to the collapse of the medial longitudinal arch. The navicular height is found to decrease due to the collapse of medial longitudinal height. Low Dye Taping (LDT) is used to decrease the plantar pressure and correct the biomechanical changes. The purpose of the review was to examine the effects of LDT in individuals with flat feet, which were assessed using a variety of outcome tools. A total of nine studies were found through extensive literature search related to treatment of flat foot with LDT. The search keywords were flat foot, pes planus, medial longitudinal arch, foot deformity and LDT. The study was completed using electronic databases including Google Scholar, Web of Science, PubMed, Scopus, and Cochrane Library. The result shows that LDT contributes to biomechanical changes in patients with flat feet, decreasing the dynamic baropodometric parameters. LDT thus increases and maintains the collapsed medial longitudinal arch.

Keywords: Flexible flat foot, Foot deformity, Kinematics, Navicular, Subtalar joint

INTRODUCTION

Pes planus, another name for flat foot, is a common foot deformity that can be brought on by poor biomechanics, obesity, or overuse injuries. This results in the collapse of the medial longitudinal arch. According to studies, over 26.5% of people worldwide have flat feet [1]. Both adults and children may have flat foot which can either be acquired or congenital. A flat foot is normal at birth due to improper development of the medial longitudinal arch. It is typically physiological and shows up as flexible flatfoot, which is not a medical condition. As a child grows older, the majority of flat foot symptoms usually improve. Flat foot in adults is a common condition due to abnormal foot bone structure or the relaxation of muscular ligaments resulting in the collapse of the medial longitudinal arch [2]. The arches of the foot begin to develop between the ages of two and six years, and typically reach structural maturity by the age of 12 to 13 years [3]. The medial longitudinal arch of the foot curves in flat feet, either touching the ground directly or almost touching it [4]. Flatfoot has been linked with foot pronation [5]. Flat foot is categorised into flexible and rigid types. When weight is supported, the arch of flexible flat feet decreases but the arch of rigid flat feet stays the same. The structure and function of the arch are determined by the foot's shape, the bones' structure, and the ligaments' stability. Race, age, gender, and footwear all have an impact on how the medial longitudinal arch forms [6]. The external foot muscles and ligaments, which are supported by bony alignment, are primarily responsible for maintaining the integrity of the arches. The plantar fascia, spring ligament, short and long plantar ligaments, ankle collateral ligament and subtalar joint interosseous ligament contribute to the soft-tissue support of the arches [7]. The posterior tibial tendon collapse is the cause of acquired flat foot deformity. The medial longitudinal arch collapses when the posterior tibial tendon malfunctions. The dynamic support for the medial longitudinal arch is provided by the posterior tibial tendon. It facilitates the midfoot's adduction, supination, and locking, making it a rigid lever that allows the foot to move to the stance phase. Synovitis of posterior tibial tendon results the tendon to stretch and weaken, which impairs dynamic stability and causes the medial longitudinal arch to collapse [8]. Flat foot also increases the plantar pressure of the mid foot and first, second and third metatarsal areas [9].

In order to alleviate plantar pressure and make biomechanical corrections, various taping techniques have been applied to treat flat foot. To correct the decreased medial longitudinal arch in flat foot, LDT is applied to the plantar area utilising many firm tape strips [10]. The LDT approach decreases the plantar pressures in the medial and lateral forefoot region [11]. In the weight-bearing position, LDT can effectively increase the range of motion of the first metatarsophalangeal joint, decrease calcaneal eversion, and raise the medial longitudinal arch height [12].

There is limited evidence in literature on the application of LDT among individuals with flat foot. The objective of the review was to evaluate the effect of LDT in individuals having flat foot measured through various outcome tools and its effect on navicular drop height and plantar pressure.

MATERIALS AND METHODS

To review the literature, a comprehensive literature search was carried out using a variety offprint and electronic resources. An extensive review was done from 2013 to 2024 searched from databases, including Google Scholar, Web of Science, PubMed, Scopus, and Cochrane Library. The various keywords that were used to search were pes planus, flat foot, LDT, navicular height, plantar pressure. This article is based on earlier research and does not include any new studies.

Inclusion criteria: The population included individuals with flat foot. Articles of original research, systematic review, meta-analysis, or literature review published only in English language were only selected. Research conducted between 2013 and 2024 is included in the analysis.

Exclusion criteria: Studies that focused on non- randomised trials and uncontrolled trials. Case studies, pilot studies, books, conference proceedings, editorial and opinion pieces studies were excluded to ensure similarity in methodology among the studies and these documents are secondary sources which are not sources of peer-reviewed data.

RESULTS

Following the previously mentioned inclusion and exclusion criteria, data extraction was carried out. Papers were then further screened

to improve the search results. The following table contains a list of the examined articles. Only nine full-text papers met the inclusion criteria after 16 were shortlisted from 61 that were assessed for eligibility. Studies found significant variation in the measures related to the taping technique for individuals with flat foot [Table/Fig-1] [11,13-20].

Impact of Modified and Low-Dye Taping (LDT) on Arch Support and Foot Posture

Across the reviewed literature, taping interventions consistently demonstrated a positive influence on foot posture in individuals with flat or over-pronated feet. It has been shown that LDT and its modifications enhance signs of medial longitudinal arch support, including improvements in resting calcaneal stance position and a reduction in navicular drop [13]. These effects show improved foot structural alignment in both static stance and dynamic activities [15]. While the amount of correction varied with taping type and time, elastic and non-elastic taping methods seemed to offer more postural control than modified or elastic techniques, especially over walking durations [11,15]. Since non-elastic tape helps to elevate the arch and reduce excessive pronation of the foot, it has been found to be more beneficial than elastic tape [19].

Impact on Ankle and Rearfoot Kinematics

The ability of taping to prevent excessive rearfoot pronation by limiting calcaneal eversion and encouraging inversion was a consistent

Author/year of study	Country	Study design	Title of the study	Aim of the study	Outcome measures	Study population	Key findings
Wang L, 2023 [13]	China	Randomised controlled trial	Acute effects of athletic taping techniques on calcaneus frontal motion in young female adults with flexible flatfoot.	To investigate how athletic low-dye tape techniques affect young female adults with flexible flatfoot's calcaneus motion while walking.	Static stance position in frontal motion	20	The frontal motion of the calcaneus was restricted by athletic taping in young female adults with flexible flat feet.
Ho IMK et al., 2022 [14]	Hong Kong	Repeated crossover study	LDT may enhance physical performance and muscle activation in basketball players with overpronated feet	To find out the effects of low-dye tape on plyometric performance and muscular activity in basketball players with overpronated feet.	Navicular drop, Countermovement jump, Flight time of drop jump, Contact time of drop jump, Reactive strength index	12	Overpronated feet can be effectively corrected with low dye tape by increasing the navicular drop height.
D'Silva C et al., 2017 [15]	India	Randomised controlled trial	Comparative effect of mobilisation, Low Dye Taping (LDT) and faradic foot bath in subjects with flat foot.	To evaluate and compare the effects of talo-navicular mobilisation, LDT and faradic foot bath in subjects with functional flat foot.	Navicular drop test, arch index	51	Talo-navicular mobilisation, LDT and faradic foot bath were equally effective in reducing the navicular drop height and the arch index in subjects with flat foot.
Bishop C et al., 2016 [16]	Australia	Randomised controlled trial	Effects of taping and orthoses on foot biomechanics in adults with flat-arched feet.	To find out the effect and changes in foot biomechanics with taping and foot orthosis in adults with flat foot.	Gait analysis	21	Taping is effective in supporting the midfoot and medial longitudinal arch.
Kim S and Chung JY 2016 [17]	Korea	Observatiional study	Immediate effects of LDT on the ankle motion and ground reaction forces in the pronated rear-foot during gait.	To find the immediate effects of low-dye tape on the pronated rear foot during movement in different ankle motions and ground reaction forces before and after its application.	Ankle motion, ground reaction force	24	Ankle inversion is improved when taping is applied to the pronated posterior foot.
Rogério FRPG et al, 2016 [18]	Brazil	Randomised controlled trial	Acute effect of LDT on dynamic plantar pressure in subjects with overpronation foot	To investigate the direct impact of LDT on dynamic plantar pressure in asymptomatic individuals with foot pronation.	Plantigraph	20	LDT changed the plantar pressure during gait and reduced dynamic baropodometry parameters of calcaneus and midfoot regions.
Lee SM et al., 2015 [19]	Korea	Randomised controlled trial	The effect of elastic and non-elastic tape on flat foot.	To investigate the effectiveness of elastic and non-elastic tape on flat foot.	Navicular height, medial border of foot print, lateral border of foot print	14	LDT is effective in subjects having flat foot.
Lim OB et al., 2015 [20]	Korea	Randomised controlled trial	Biomechanical effectiveness of the LDT on peak plantar pressure during treadmill walking exercise in subjects with flexible flatfoot.	To determine the effects of LDT on peak plantar pressure and to find out whether the it was maintained after removal of tape and also determine the shift of peak plantar pressure from medial to lateral side before and after its application.	Peak plantar pressure	20	LDT showed immediate effect in peak plantar pressure in lateral forefoot.
Newell T et al., 2015 [11]	USA	Randomised controlled trial	Arch-taping techniques for altering navicular height and plantar pressures during Activity	To determine whether LDT supports the arch during exercise.	Navicular height and plantar pressures.	25	LDT changed the plantar pressure of in lateral midfoot and was maintained till 15 minutes of exercise.

[Table/Fig-1]: Characteristics of included studies [11,13-20].

finding across studies [16]. Ankle inversion angles, peak calcaneal eversion and frontal plane motion control showed improvements, suggesting that taping improves rearfoot stability during gait [17]. Although a few studies reported only slight changes in the hindfoot's overall range of motion, the temporal and peak kinematic variables showed positive changes suggesting better mechanical efficiency rather than total motion restriction [16].

Variations Plantar Pressure Distribution

Plantar pressure patterns during walking and exercise were significantly influenced by taping techniques. Studies showed a redistribution of plantar loads, with reductions in peak and mean plantar pressures in the rearfoot and lateral forefoot regions and improved load sharing across the midfoot region [11]. These changes suggest that the taping method enhances more symmetric force distribution and efficient energy expenditure during gait [18]. Taping not only raises the arch height but it also works by altering the way forces are transmitted through the foot, which results in less stress on the areas that are most susceptible to it [20].

Neuromuscular and Functional Effects

Taping had been associated to functional improvements in addition to structural and biomechanical changes [14]. Increased muscle activation coincided with these biomechanical changes, especially in the tibialis anterior and other muscles that control the foot and ankle [14]. Improvements in performance and movement efficiency during functional tasks may be explained by such neuromuscular facilitation.

Durability of Tape and Time-Dependent Effects

Although taping showed immediate positive effects, several studies suggested that these benefits may diminish with prolonged activity [11]. Following periods of walking or exercise, reductions in arch support and postural correction were noted, indicating the temporary nature of taping interventions [13]. However, plantar pressure redistribution frequently continued even when structural changes like navicular height decreased over time indicating continued functional benefits despite decreased mechanical correction [11].

Research shows that LDT and its variations are useful short-term treatments for people with pronated or flat feet [13]. Improved foot posture is one of the primary benefits of taping interventions [16]. Optimal plantar pressure distribution is another significant benefit observed in individuals with pronated or flat feet [11]. It appears that taping modifies foot kinematics and force distribution during gait and functional activities rather than acting only through rigid arch elevation [16]. For long-lasting benefits, the effects are time-dependent and may require reapplication or additional interventions [13].

DISCUSSION

This review finding in [Table/Fig-1] suggests that athletic taping had very little impact on the calcaneus frontal motion in case of flexible flat foot. Augmented LDT resulted in higher resting calcaneus stance position during walking compared to Modified LDT. There is no significant immediate effect of the tape on calcaneus frontal motion. Augmented LDT shows increased frontal range of motion and peak calcaneus eversion after walking whereas modified LDT also showed increase after post taping [13]. Similar findings have been reported in previous studies that low-dye and anti-pronation taping techniques were found to provide initial rearfoot control, but this effect decreased after walking or dynamic activity. Previous studies have linked this decrease in mechanical efficacy to tape stretch, adhesive stiffness loss, and repetitive loading during gait, which increases calcaneal eversion and rearfoot motion [21]. Thus the changes are progressive rather than instantaneous after the taping techniques [13]. LDT is found to increase the navicular height and reduce the medial plantar pressure during walking [14,19]. It increases plantar pressures in the lateral midfoot region, resulting in a significant rise in load and decreasing the forefoot pressures [11]. During bilateral squats the activation of tibialis anterior muscle increases after application of LDT [14]. LDT controls the foot pronation, raising the medial arch and reducing strain on the plantar aponeurosis. The tape pulls the calcaneus anteriorly and medially to limit hindfoot eversion, the talar adduction and plantarflexion that go along with it. The arch is raised when subtalar motion is restricted, which lessens the strain on the plantar aponeurosis [15]. Similarly, the height of the medial arch rises as the tape pulls the lateral part of the foot medially [15]. Taping affects the kinematics of midfoot and medial longitudinal arch. It increases the peak dorsiflexion of the first metatarsophalangeal joint with taping unexpectedly showing a greater capacity to limit deformation of the medial arch [16]. LDT reduces inversion angles and eversion during stance and thus it aids in controlling load and pressure distribution. The applied tape is believed to limit the eversion phenomenon of the pronated rear-foot when holding up the body weight by supporting the arch structures of pronated rear-foot [17]. LDT reduces the dynamic baropodometric parameters in the metatarsus, midfoot, and hindfoot of young individuals with flat feet [18,22]. Peak plantar pressure, mean plantar pressure, and plantar pressure time integral are among the dynamic baropodometric parameters that are decreased by application of LDT [18]. These parameters have decreased as a result of the LDT forces' application direction, which aims to produce a supinator force vector in this segment linked to enhanced tibialis posterior muscle activity [18]. Taping showed an impact on size in the midfoot area, indicating a clinical improvement in the decrease of peak plantar pressure in this area that experiences significant loads during the gait cycle as a result of the medial longitudinal arch being reduced [18]. The peak plantar pressure decreased in the lateral forefoot immediately after taping [20]. No significant difference is seen in the midfoot and rearfoot regions concerning peak plantar pressure. It is found that LDT may not effectively support the medial longitudinal arch during dynamic walking [23]. After 20 minutes of walk the peak pressures reverts to pre-tape levels and increases the medial forefoot pressure indicated of potential adverse effects linked to excessive pronation [20]. LDT is effective in preventing weight-bearing bones during navicular descent [19].

The evidence shows that LDT can meaningfully influence foot mechanics by supporting the medial arch and adjusting how pressure is distributed across the foot [23]. While the tape does not cause major immediate changes in calcaneal frontal motion, it does lead to gradual improvements during movement such as raising the navicular height, lowering pressure on the medial side of the foot and shifting load away from overloaded areas [11,22,24]. These effects likely come from the tape's ability to gently guide the calcaneus inward and forward, reduce excessive hindfoot eversion and assist important stabilising muscles like the tibialis anterior [24,25]. Low dye–based taping can be a helpful short-term strategy for improving foot alignment, easing stress on the arch, and promoting healthier load distribution in people with flexible flat feet, especially during walking or other weight-bearing activities.

Limitation(s)

Studies on LDT have primarily focused on its immediate effects, with limited investigation into its long-term benefits or potential adverse effects. Variable data outputs, factors like walking speed and surface contact, small sample sizes, and non-randomised methods limit the statistical power and external validity of findings. There is a lack of standardised protocols for LDT application, making it difficult to compare results and draw definitive conclusions about its efficacy. Residual effects after tape removal and discomfort during taping can also affect compliance.

CONCLUSION(S)

The LDT increases peak eversion and frontal range of motion, which has a significant impact on biomechanical changes in people with flat feet. It limits hindfoot eversion and increases medial arch height by changing lower extremity muscle activity during bilateral squats and jumping while pulling the calcaneus anteriorly and medially. Additionally, this technique improves midtarsal joint control and lowers peak plantar pressure and dynamic baropodometric parameters. Although the tape has little immediate effect on calcaneal frontal motion, gradual changes occur during weight-bearing activities such as walking. The benefits diminish with prolonged use and pressure may shift unfavourably in certain regions. Despite these inconsistencies, the combined mechanical support suggests that LDT is a useful temporary intervention for individuals with flexible flat feet. Future studies should examine the comfort of taping methods for different levels of flatfoot severity, long-term effects, and injury prevention.

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