Self-applicable taping for plantar pressure redistribution in individuals with neutral and flatfeet: a quasi-experimental study

Vendaje autoaplicable para la redistribución de la presión plantar en pies neutros y planos: Un estudio cuasi-experimental

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Abstract

Introduction: Flatfeet is a prevalent condition that alters foot biomechanics. The Low-Dye taping technique can modulate plantar loading, but its multi-strip procedure is technically demanding and is usually applied by a clinician.
Objective: To assess the immediate effects of a self-applicable taping technique on plantar pressure distribution and footprint in adults with flat or neutral feet, under static and dynamic conditions.
Methodology: In a single-session, pre–post design, twenty-seven participants (18-25 years) were assigned to a flatfoot (n=9) or neutral-feet (n=18) group using the Chippaux-Smirak Index. Each participant applied the tape to their own foot under the supervision of a trained examiner, and plantar pressures were recorded with a baropodometric platform.
Results: In the flatfeet group, taping was associated with a lateral shift in rearfoot pressure under both static ($p=0.0077$) and dynamic ($p=0.0209$) conditions. In the neutral-feet group, a lateral rearfoot shift ($p=0.0311$) and a medial forefoot shift ($p=0.0057$) were observed only under static conditions. No significant changes occurred in footprint. These rearfoot effects remained significant after Benjamini-Hochberg correction for multiple comparisons.
Discussion: The findings regarding the lateralization of rearfoot pressure are consistent with the literature on traditional Low-Dye taping. However, this study suggests that comparable rearfoot effects may be obtained with a simplified, self-applied technique.
Conclusions: A single application of this self-applicable taping was associated with an immediate, region-specific redistribution of plantar pressure in young adults with neutral or flat feet. However, controlled studies with sham conditions, clinical endpoints, and longer follow-up are needed before clinical recommendations can be made.

Keywords

Flatfoot; Low-Dye; plantar pressures; pronation; taping.

Resumen

Introducción: El pie plano es una condición prevalente que altera la biomecánica del pie. El vendaje Low-Dye puede modular la carga plantar, pero su procedimiento de múltiples tiras es técnicamente exigente y habitualmente lo aplica un clínico.
Objetivo: Evaluar los efectos inmediatos de una técnica de vendaje autoaplicable en la distribución de la presión y la huella plantar en adultos con pie plano o neutro, en condiciones estáticas y dinámicas.
Metodología: En un diseño pre-post de sesión única se evaluó a veintisiete participantes (18-25 años) divididos en grupo de pie plano (n=9) y pie neutro (n=18) mediante el Índice de Chippaux-Smirak. Cada sujeto se aplicó el vendaje bajo la supervisión de un evaluador entrenado, registrando sus presiones plantares con una plataforma baropodométrica.
Resultados: En el grupo de pie plano, el vendaje se asoció con un desplazamiento lateral de la presión del retropié tanto en condición estática ($p=0.0077$) como en dinámica ($p=0.0209$). En el grupo de pie neutro, se observó un desplazamiento lateral en el retropié ($p=0.0311$) y medial en el antepié ($p=0.0057$) solo estáticamente.
Discusión: La lateralización de la presión en el retropié es consistente con la literatura sobre el vendaje Low-Dye tradicional. Sin embargo, este estudio sugiere que podrían obtenerse efectos comparables con una técnica simplificada y autoaplicada.
Conclusiones: Una única aplicación de este vendaje se asoció con una redistribución inmediata y región-específica de la presión plantar en adultos con pie neutro o plano. Sin embargo, se requieren estudios controlados con condición placebo y seguimiento prolongado antes de formular recomendaciones clínicas.

Palabras clave

Low-Dye; pie plano; presiones plantares; pronación; vendaje.

Introduction

Flatfeet, clinically referred to as pes planus, is a highly prevalent and multifactorial musculoskeletal condition. It is anatomically characterized by a diminished or absent medial longitudinal arch, which is frequently associated with hindfoot valgus and forefoot abduction (Aenumulapalli, 2017; Flores et al., 2019; Khorshidi et al., 2025; Pita-Fernández, 2017; Praewpipat et al., 2024; Singh et al., 2022; Smyth et al., 2017). While clinical classifications distinguish between flexible and rigid forms, the flexible flatfoot, constitutes the vast majority of presentations in the adult population. The prevalence of this condition is estimated to range from 3% to 37% among adults, with this wide range largely reflecting differences in diagnostic criteria, measurement methods, and population characteristics such as ethnicity, sex, and age, thereby underscoring its significant clinical relevance within rehabilitation and biomechanical contexts (Aenumulapalli, 2017; Pita-Fernández, 2017; Smyth et al., 2017).

The etiological factors contributing to the development of flatfeet are diverse and include abnormal posterior tibialis muscle function and structural misalignments of the lower extremity. These underlying issues often lead to compensatory movement strategies, including antalgic gait patterns and significant postural adaptations. Consequently, an accurate assessment of foot posture is essential, given the well-documented association between flatfeet, chronic foot pain, and functional gait impairments (Bruening et al., 2023; Flores et al., 2019; Shin et al., 2019). Furthermore, significant biomechanical differences in plantar characteristics have been consistently reported between individuals with flatfeet and those with neutral feet. These differences manifest as altered footprint morphologies, increased overall plantar forces, and most notably, an elevated medial pressure distribution combined with a greater total contact area, increasing the likelihood of lower extremity injuries (Filardi, 2018; Khan et al., 2023; Khorshidi et al., 2025; Praewpipat et al., 2024; Zhai et al., 2017). Such foot-type differences are commonly quantified using footprint indices, which have also been applied to screen for flatfoot in young, physically active populations (Gómez Ríos et al., 2023).

A broad spectrum of treatment strategies exists for managing flatfeet, ranging from invasive surgical procedures like midfoot locking or soft tissue repair, to more conservative interventions (Praewpipat et al., 2024; Tao et al., 2019). Among the conservative approaches, therapeutic taping, particularly the Low-Dye technique, has been repeatedly shown to be effective for improving foot alignment, modulating muscle activation patterns, and optimizing joint forces (Bruening et al., 2023; Castro-Méndez et al., 2022; Franettovich et al., 2012; Lange et al., 2004; Newell et al., 2015; Russo & Chipchase, 2001). However, despite its demonstrated efficacy, the clinical utility of the conventional Low-Dye technique is often constrained by its procedural complexity, which typically requires application by a trained practitioner and limits its potential for routine, independent use. Other widely used taping approaches, such as Kinesio tape and dynamic tape, likewise rely on skilled application, leaving a gap for techniques that users could apply themselves. Such accessible, self-administered options could be particularly relevant for adherence in chronic conditions and in settings where access to specialized care is limited. As a first step toward this goal, and framed as a preliminary, proof-of-concept investigation rather than as a confirmatory trial or a finished clinical tool, the present study proposes and evaluates a simplified, self-applicable variant of the Low-Dye taping method, which uses only five strips of tape while aiming to retain the core biomechanical principles of the original design.

Accordingly, the primary aim of this study was to assess the immediate effects of this novel, self-applicable taping technique on plantar pressure distribution and footprint characteristics. This was investigated in a cohort of young adults, aged 18 to 25 years, with either flatfeet or neutral feet, under both static and dynamic conditions. It was hypothesized that, immediately after application, the technique would shift plantar loading laterally at the rearfoot, with this effect being most evident under static loading conditions. Because the study was exploratory in nature, no specific effect-size threshold was pre-specified. Consistent with this framing, the present work is best understood as a preliminary, hypothesis-generating proof of concept, based on a single-session, single-group design and intended to inform the design of future confirmatory trials rather than to establish clinical efficacy.

Method

Study Design and Participants

A quasi-experimental pre-test post-test research design was employed. The recruitment process began with an initial cohort of 45 potential participants who were engaged through interviews and subjected to a comprehensive screening process to determine their eligibility. The inclusion criteria considered that participants must be aged between 18 and 25 years, possess a body mass index within the range of 18.5 to 29.9 kg/m2, and present with either a flatfoot or neutral foot type, as determined by the Chippaux-Smirak Index (CSI). Conversely, the exclusion criteria included any acute lower extremity injuries within the preceding six months, a history of lower extremity surgery within the last two years, pregnancy, current or recent use of foot orthoses, or the presence of any notable structural deformities of the lower limbs.

This single-group, pre–post design was a deliberate methodological choice appropriate for a first-stage, proof-of-concept investigation whose purpose was to establish feasibility and to obtain preliminary estimates of the immediate biomechanical effects of the technique, rather than to provide confirmatory evidence of efficacy. Uncontrolled, within-subject designs of this kind are recognized as a reasonable first step in feasibility and preliminary-efficacy research, prior to investing in larger controlled trials (Thabane et al., 2010). A sham-controlled design was not considered feasible at this stage because a credible sham for a rigid, visible taping configuration is difficult to implement without unblinding participants, and no validated sham taping exists for this specific five-strip technique. Accordingly, the present design can characterize the direction and approximate magnitude of the immediate, within-participant changes that accompany taping and can inform the design of future trials, but it cannot, on its own, isolate the causal contribution of the tape from placebo effects or familiarization.

From the initial pool, 30 individuals met all eligibility requirements and were invited to participate. A final sample of 27 participants (13 females, 14 males) successfully completed all phases of the study protocol. Based on their CSI scores, nine participants were classified into the flatfeet group (4 females, 5 males), while the remaining eighteen were assigned to the neutral feet group (9 females, 9 males). Prior to any measurement procedures, every participant was fully informed about the study and provided written informed consent. The complete study protocol received formal approval from the local institutional ethics committee (reference number K5004, CEC UAndes).

Procedure

Data Collection and Plantar Pressure Assessment

The data collection process began with participants standing barefoot on a FootWork® baropodometric platform (Amcube IST, France), which was utilized to confirm foot type. Subsequently, essential anthropometric data, including height, weight, and body mass index were measured and recorded for each individual using a digital stadiometer (Tanita WB3007301, Japan).

Plantar pressure data were subsequently acquired under two distinct conditions: static and dynamic. The static assessment required participants to maintain a stable, upright bipedal stance on the platform for a continuous ten-second period to capture a comprehensive static pressure profile. For the dynamic assessment, participants walked along a designated walkway, with the protocol designed to ensure their fourth step landed naturally on the platform. This sequence included three preparatory steps and two follow-through steps to promote a natural gait cycle. To ensure data reliability, each foot underwent four separate attempts in an alternating sequence, as dictated by the FootWork® software protocol. A familiarization period with practice trials was provided to all participants to minimize any gait alterations resulting from awareness of the measurement platform.

All plantar pressure measurements were systematically performed twice: first, to establish a baseline before the taping intervention, and then repeated immediately following the application of the tape. Furthermore, to uphold the statistical independence of observations and prevent the risk of pseudo-replication, which can arise from the high correlation between bilateral foot data, only the right foot of each participant was selected for the final analysis (Broom et al., 2019).

Taping Procedure and Self-Application Protocol

For the taping procedure, participants were positioned comfortably in a supine posture on a standard treatment table. To ensure optimal tape adhesion by removing natural skin oils and debris, the plantar surface of the right foot was thoroughly cleansed with an alcohol wipe. A lead researcher, proficient in the technique, provided a detailed, step-by-step demonstration of the entire taping method. Following this demonstration, each participant was given the opportunity to practice the self-application procedure under guidance, with up to three practice attempts permitted to ensure they could replicate the technique accurately and confidently. Once proficiency was achieved, each participant carried out the definitive application on their own right foot. Because this test application was performed by the participant but under continuous supervision and standardized verbal and tactile guidance from the examiner, the procedure is most accurately described as a supervised self-application rather than a fully independent one.

The specific taping protocol employed consisted of a total of five strips of rigid athletic tape (Leukotape Classic, Germany), which included three functionally "active" strips and two "passive" anchoring strips. The entire application process was closely supervised by a qualified professional who provided continuous, real-time verbal and tactile feedback on critical aspects such as appropriate tape tension and correct foot posture at each stage of the application. The procedure commenced with the first passive strip (anchor), which was applied horizontally across the anterior aspect of the ankle, approximately three finger-widths superior to the malleoli. The first active strip originated from the lateral aspect of this anchor, traversed obliquely anterior to the lateral malleolus, crossed the midfoot, and wrapped around the plantar surface, concluding its path one finger-width inferior to its starting point. The second active strip followed a similar trajectory but was specifically routed to pass directly inferior to the navicular bone to provide arch support. The third active strip ran posterior to the lateral malleolus and directly inferior to the calcaneus. To conclude the procedure, the second passive strip was applied horizontally at the same level as the initial anchor, effectively securing the distal ends of the three active strips and preventing their displacement during movement. A visual representation of this complete taping protocol is provided in Figure 1.

Figure 1. A step-by-step visual guide to the self-applicable taping protocol, a modification of the Low-Dye technique. (A) the placement of the initial anchor and the first active strip from a medial perspective; (B) the same initial steps shown from a lateral view; (C) the completed taping with all active strips in place, as seen from the medial side; (D) the lateral view of the three active strips before being secured by the final passive anchor strip.

Source: Own elaboration.

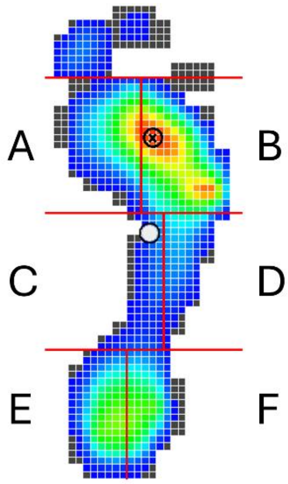
Signal Processing and Data Extraction

Following data acquisition, the raw plantar pressure data from both static and dynamic trials were initially captured using the FootWork Pro software (version 3.7. Amcube IST, France). Subsequently, these data were exported to IgorPro (version 6.3.7.2. WaveMetrics, Portland, USA) for detailed analysis.

The extraction of mean pressure values for specific foot regions was accomplished through the application of a custom-written macro within the IgorPro environment.

For regional foot analysis, six distinct anatomical masks were algorithmically defined and applied to the plantar footprint: lateral and medial forefoot, lateral and medial midfoot, and lateral and medial rearfoot, which were then further subdivided sagittally into lateral and medial halves, as illustrated in Figure 2.

Figure 2. Anatomical segmentation of a plantar footprint for regional pressure analysis. The image displays a representative footprint obtained from baropodometry, divided into six distinct anatomical masks used for data extraction: (A) medial forefoot; (B) lateral forefoot; (C) medial midfoot; (D) lateral midfoot; (E) medial rearfoot; and (F) lateral rearfoot.



Source: FootWork 3.7.8.0 software (Amcube, France); modified by the authors.

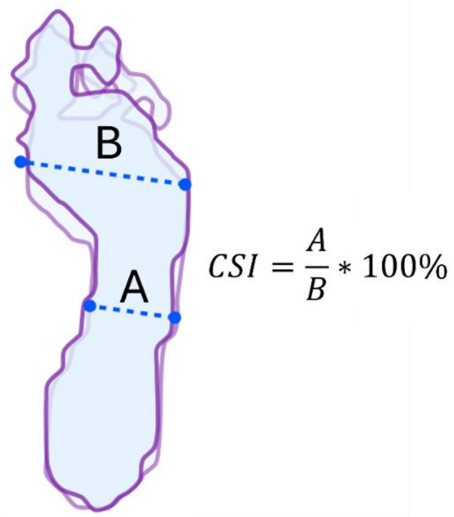
To enhance the reliability of the dynamic data and minimize trial-to-trial variability, the pressure data from three successful dynamic trials were averaged for each participant. To quantify the mediolateral balance of plantar loading, a pressure distribution ratio was calculated for each foot region by dividing the mean medial pressure by the mean lateral pressure. A resulting ratio greater than 1 indicated a medially dominant pressure distribution, a ratio equal to 1 signified balanced pressures, and a ratio less than 1 indicated a laterally dominant pressure distribution.

Footprint Assessment

Concurrently with the static pressure measurements, the Chippaux-Smirak Index (CSI) values were calculated for each static sample. This analysis was performed using the SOLEIT software (version 2.1.1, SOLEIT app, Chile), providing a quantitative measure of the medial longitudinal arch for each footprint, as depicted in Figure 3. This process yielded a dataset for each participant's right foot, comprising a total of eight distinct samples: one static sample without tape, three dynamic samples without tape, one static sample with tape, and three dynamic samples with tape.

The CSI was selected pragmatically as the classification instrument because it is derived directly from the same baropodometric footprint used for pressure analysis, allowing foot type to be determined from the available data without additional equipment. It should nonetheless be acknowledged that footprint-based indices such as the CSI capture only the contact geometry of the plantar surface and provide an indirect estimate of arch morphology. However, despite this, the CSI has proven to be an acceptable index for determining flat foot type, with very high intra-rater reliability (Paecharoen et al., 2023).

Figure 3. Visual representation of the method used for calculating the Chippaux-Smirak Index (CSI) from a baropodometric footprint. The figure illustrated how the index is derived by establishing the ratio between the narrowest width of the midfoot isthmus (arch) and the widest width of the forefoot.



Source: Own elaboration.

Data analysis

All statistical analyses were conducted using Stata/MP 18 software (StataCorp LLC, College Station, TX, USA). Descriptive statistics were generated to summarize the data; qualitative variables were presented as absolute frequencies, while quantitative variables were first assessed for normality. The Shapiro-Wilk test was utilized for this purpose, and as several key variables deviated from a normal distribution, non-parametric statistical tests were employed for all subsequent inferential analyses, with results reported as medians and interquartile ranges (IQR).

To compare the baseline demographic characteristics between the flatfoot and neutral-foot subgroups, the Mann-Whitney U test was utilized. To evaluate the primary effect of the taping intervention, Wilcoxon matched-pairs signed-rank tests were performed to compare the taped versus untaped conditions within each subgroup, as well as for the overall sample. To determine the magnitude of the observed effects, effect sizes were computed using Cohen's d for paired samples, with the results interpreted according to established conventions as small ($d > 0.2$), medium ($d > 0.5$), or large ($d > 0.8$). The statistical significance was established at $p < 0.05$ for all statistical tests. Because multiple within-group comparisons were performed, p-values were adjusted for the false discovery rate using the Benjamini-Hochberg procedure, applied separately within each family of comparisons (defined as the set of variables tested within a given group and loading condition). Adjusted p-values (q-values) are reported alongside the unadjusted values, and statistical significance for the taping comparisons was based on $q < 0.05$. Given the modest sample size, particularly in the flatfeet subgroup, all analyses were regarded as exploratory. As the sample size was not determined a priori, the post-hoc statistical power for the primary outcome (the rearfoot mediolateral pressure ratio) was additionally computed for each subgroup and loading condition from the obtained effect sizes, assuming a two-sided α of 0.05. These post-hoc values are reported with the well-known caution that observed power is a direct function of the obtained p value and should not be over-interpreted.

Results

Participant Characteristics

The final study cohort consisted of 27 individuals (13 females and 14 males) who successfully completed the entire experimental protocol. Based on the classification criteria of the Chippaux-Smirak Index (CSI), nine of these participants were assigned to the flatfeet group (4 females and 5 males), and the remaining eighteen were assigned to the neutral feet group (9 females and 9 males). A comparative analysis of baseline demographic variables revealed no statistically significant differences in age, height, weight, or body mass index between the two groups (p > 0.6578). This confirmed the homogeneity of the groups prior to the intervention, as detailed in Table 1.

Table 1. Comparison of demographic characteristics between the neutral feet and flatfeet groups. Data are presented as median [interquartile range].

Variables	Total sample (n=27)	Neutral feet (n=18)	Flatfeet (n=9)	*p*-value[a]
Age [years]	22 [21 – 23]	22 [21 – 23]	22 [20 - 23]	0.9905
Height [m]	1.70 [1.60 – 1.79]	1.70 [1.63 – 1.79]	1.70 [1.59 – 1.78]	0.9096
Weight [kg]	73 [58 – 78]	71 [58 - 75]	75 [56 - 80]	0.6578
Body mass index [kg/m2]	23.3 [22.3 – 25.1]	23.4 [22.7 – 24.4]	23.1 [22.3 – 25.5]	1.0000

[a]*p*-value derived from the Mann-Whitney U test for the comparison between groups.

Effects of Taping Under Static Conditions

Under static bipedal stance, the application of the taping technique was associated with changes in plantar pressure distribution (Table 2). Analysis of the entire sample using Wilcoxon matched-pairs tests revealed a distinct pattern of pressure redistribution: forefoot pressures decreased with medium to large effect sizes (p ≤ 0.0014, d ≥ 0.74), while pressures in the midfoot and rearfoot regions concurrently increased with small to large effect sizes (p ≤ 0.0071, d ≥ 0.47); all of these comparisons remained significant after FDR correction (q < 0.05). This general pattern was largely consistent across both subgroups, with two exceptions in the flatfeet group: the medial rearfoot showed no significant change (p = 0.3743), and the reduction in medial forefoot pressure did not remain significant after FDR correction (p = 0.0382, q = 0.0636).

When examining the mediolateral pressure distribution ratios, which indicate a directional shift in loading, differences emerged between the groups. The neutral-foot group showed a lateral shift in rearfoot pressure (p = 0.0311, q = 0.0389, d = 0.58) and, simultaneously, a medial shift in forefoot pressure (p = 0.0057, q = 0.0142, d = 0.88). The flatfoot group exhibited a lateral pressure shift that was confined to the rearfoot and associated with a very large effect size (p = 0.0077, q = 0.0256, d = 1.77); all three of these ratio effects remained significant after FDR correction. Because the flatfoot subgroup was small (n = 9), these effect-size estimates, most notably the very large rearfoot-ratio value (d = 1.77), are likely subject to substantial bias and should be interpreted as preliminary. For the rearfoot ratio under static loading, the corresponding post-hoc power was 0.64 in the neutral-foot group and exceeded 0.99 in the flatfoot group. By contrast, the taping intervention did not produce any significant change in the Chippaux-Smirak Index (CSI) for either group (p ≥ 0.6626, trivial effect sizes), indicating that the static footprint geometry of the arch was unchanged.

Table 2. Effects of Taping on Plantar Pressures and Chippaux-Smirak Index Under Static Condition. Data are presented as median [interquartile range]. Effect sizes were calculated as paired Cohen's d. p-values are unadjusted Wilcoxon signed-rank values; significance was determined after false discovery rate (Benjamini-Hochberg) correction applied within each group (q < 0.05).

Variables	Pre-taping	Post-taping	p-value	q-value	Effect size
All sample (n=27)					
Chippaux-Smirak [%]	34 [30 – 41]	35 [32 - 41]	0.6820	0.6820	0.08
Medial forefoot [KPa]	31.29 [21.81 - 38.87]	19.88 [15.60 – 27.82]	0.0014[a]	0.0023	0.74
Lateral forefoot [KPa]	36.03 [30.08 - 48.39]	21.62 [18.19 – 25.40]	<0.0001[a]	0.0002	1.10
Medial midfoot [KPa]	9.52 [7.42 - 11.75]	13.41 [8.42 – 19.75]	0.0002[a]	0.0005	0.86
Lateral midfoot [KPa]	13.60 [10.25 - 18.45]	23.76 [14.61 – 39.67]	0.0001[a]	0.0003	0.98
Medial rearfoot [KPa]	41.89 [30.04 - 56.89]	55.72 [40.83 – 62.36]	0.0071[a]	0.0102	0.47
Lateral rearfoot [KPa]	42.36 [28.84 - 63.83]	72.42 [48.26 – 78.68]	0.0001[a]	0.0004	1.05
Ratio forefoot[b]	0.73 [0.59 – 1.02]	0.95 [0.70 – 1.29]	0.0152[a]	0.0191	0.50
Ratio midfoot[b]	0.75 [0.58 – 0.81]	0.62 [0.44 – 0.76]	0.0288[a]	0.0320	0.44
Ratio rearfoot[b]	0.97 [0.92 – 1.09]	0.85 [0.70 – 0.96]	0.0003[a]	0.0006	0.85
Neutral foot (n=18)					
Chippaux-Smirak [%]	32 [27 - 34]	33 [28 - 37]	0.6626	0.6626	0.09
Medial forefoot [KPa]	30.26 [21.81 – 36.28]	19.91 [17.34 – 29.20]	0.0139[a]	0.0198	0.69
Lateral forefoot [KPa]	44.33 [33.86 – 50.71]	22.81 [19.61 – 33.63]	0.0005[a]	0.0053	1.09
Medial midfoot [KPa]	8.18 [6.35 – 9.75]	11.82 [7.82 – 18.69]	0.0074[a]	0.0148	0.72
Lateral midfoot [KPa]	11.74 [8.55 – 13.88]	19.99 [11.78 – 31.08]	0.0018[a]	0.0061	0.75
Medial rearfoot [KPa]	40.54 [29.49 – 56.89]	57.89 [49.53 – 65.51]	0.0108[a]	0.0181	0.58
Lateral rearfoot [KPa]	41.82 [26.73 – 65.18]	72.31 [52.81 – 77.42]	0.0016[a]	0.0061	1.01
Ratio forefoot[b]	0.64 [0.58 – 0.84]	1.00 [0.72 – 1.21]	0.0057[a]	0.0142	0.88

Ratio midfoot[b]	0.75 [0.56 – 0.80]	0.62 [0.44 – 0.76]	0.1024	0.1138	0.40
Ratio rearfoot[b]	0.96 [0.89 – 1.01]	0.90 [0.70 – 0.98]	0.0311[a]	0.0389	0.58
Flatfoot (n=9)					
Chippaux-Smirak [%]	41 [39 - 50]	43 [38 - 50]	0.8510	0.9455	0.06
Medial forefoot [KPa]	33.00 [24.36 – 38.90]	18.44 [15.60 – 21.35]	0.0382	0.0636	0.83
Lateral forefoot [KPa]	30.08 [26.80 – 34.32]	19.44 [16.32 – 21.62]	0.0152[a]	0.0379	1.48
Medial midfoot [KPa]	12.78 [11.19 – 13.03]	19.71 [13.41 – 25.69]	0.0077[a]	0.0256	1.15
Lateral midfoot [KPa]	16.36 [14.51 – 18.84]	37.64 [24.20 – 40.77]	0.0077[a]	0.0256	1.81
Medial rearfoot [KPa]	41.89 [34.40 – 52.97]	51.53 [40.71 – 56.66]	0.3743	0.4678	0.21
Lateral rearfoot [KPa]	46.52 [30.02 – 53.92]	73.39 [48.26 – 78.88]	0.0209[a]	0.0418	1.08
Ratio forefoot[b]	1.13 [0.63 – 1.38]	0.92 [0.70 – 1.29]	0.9528	0.9528	0.16
Ratio midfoot[b]	0.72 [0.68 – 0.84]	0.64 [0.47 – 0.66]	0.2604	0.3720	0.50
Ratio rearfoot[b]	1.05 [1.00 – 1.21]	0.75 [0.68 – 0.90]	0.0077[a]	0.0256	1.77

[a] Indicates a statistically significant difference ($p < 0.05$) between the untaped and taped conditions, as determined by the Wilcoxon matched-pairs signed-rank test after false discovery rate correction applied within each group ($q < 0.05$).
[b] The pressure ratio was calculated by dividing the mean pressure in the medial region by the mean pressure in the corresponding lateral region.

Effects of Taping Under Dynamic Conditions

During the dynamic condition of walking, the taping intervention produced pressure modifications that were directionally similar to those observed under static conditions; however, these changes were generally characterized by fewer statistically significant differences and, in some areas, smaller effect sizes (Table 3). For the total sample, lateral forefoot pressure decreased ($p = 0.0012$, $q = 0.0027$, $d = 0.74$), while pressure in the lateral midfoot and rearfoot increased markedly (both $p \leq 0.0001$, $q \leq 0.0002$, $d \geq 1.03$). In the flatfeet subgroup, the corresponding decrease in lateral forefoot pressure did not remain significant after FDR correction ($p = 0.0382$, $q = 0.0687$).

An analysis of the mediolateral ratios for the entire cohort indicated a lateralization of pressure in both the midfoot and rearfoot, with a medium effect size ($p \leq 0.0077$, $q \leq 0.0115$, $d \geq 0.57$). When analyzed by subgroup, these effects were less consistent: in the neutral feet group the reduction in the midfoot ratio did not remain significant after FDR correction ($p = 0.0311$, $q = 0.0560$, $d = 0.58$), and, importantly, the lateral shift in the rearfoot ratio itself did not reach significance after correction in this group ($p = 0.0854$, $q = 0.1097$, $d = 0.50$; post-hoc power = 0.52), whereas the flatfeet group showed a reduction that was confined to the rearfoot and remained significant after correction ($p = 0.0209$, $q = 0.0470$, $d = 0.68$, post-hoc power = 0.43). Overall, a substantial proportion of the comparisons examined, particularly under dynamic conditions and at the forefoot in the subgroups, did not reach significance, and the most robust and reproducible effect across analyses was the lateral shift of rearfoot loading. Because lateralization of rearfoot loading during gait is the most biomechanically meaningful outcome, the absence of a statistically significant rearfoot-ratio effect in the neutral group under dynamic loading should be interpreted considering this limited statistical power and the generally smaller, less consistent dynamic effects, rather than as evidence that no effect exists.

Table 3. Effects of Taping on Plantar Pressures Under Dynamic Condition. Data are presented as median [interquartile range]. Effect sizes were calculated as paired Cohen's d. p-values are unadjusted Wilcoxon signed-rank values; significance was determined after false discovery rate (Benjamini-Hochberg) correction applied within each group ($q < 0.05$).

Variables	Pre-taping	Post-taping	p-value	q-value	Effect size
All sample (n=27)					
Medial forefoot [KPa]	49.60 [40.95 – 58.10]	49.80 [41.66 – 61.36]	0.5322	0.5322	0.04
Lateral forefoot [KPa]	61.65 [51.12 – 80.14]	57.75 [43.53 – 68.87]	0.0012[a]	0.0027	0.74
Medial midfoot [KPa]	8.66 [5.77 – 11.02]	11.88 [9.45 – 16.04]	<0.0001[a]	0.0001	1.35
Lateral midfoot [KPa]	13.15 [9.16 – 16.47]	19.80 [15.86 – 29.53]	<0.0001[a]	0.0001	1.26
Medial rearfoot [KPa]	44.40 [37.95 – 58.15]	50.19 [41.56 – 61.31]	0.0388[a]	0.0499	0.45
Lateral rearfoot [KPa]	41.11 [35.00 – 47.54]	45.21 [40.67 – 52.77]	0.0001[a]	0.0002	1.03
Ratio forefoot[b]	0.84 [0.61 – 1.08]	0.88 [0.71 – 1.17]	0.0794	0.0894	0.41
Ratio midfoot[b]	0.67 [0.60 – 0.79]	0.60 [0.51 – 0.71]	0.0066[a]	0.0115	0.61
Ratio rearfoot[b]	1.14 [1.06 – 1.26]	1.11 [0.97 – 1.18]	0.0077[a]	0.0115	0.57
Neutral foot (n=18)					
Medial forefoot [KPa]	45.84 [39.93 – 58.06]	49.48 [41.66 – 61.36]	0.9826	0.9826	0.05
Lateral forefoot [KPa]	68.58 [58.64 – 80.36]	61.03 [54.86 – 71.11]	0.0108[a]	0.0244	0.70
Medial midfoot [KPa]	7.36 [5.77 – 10.22]	11.61 [8.94 – 12.58]	0.0006[a]	0.0035	1.12
Lateral midfoot [KPa]	10.76 [7.95 – 15.04]	16.32 [14.68 – 20.89]	0.0010[a]	0.0035	1.09
Medial rearfoot [KPa]	43.19 [37.95 – 57.02]	45.86 [41.74 – 61.31]	0.0707	0.1060	0.47
Lateral rearfoot [KPa]	41.65 [35.00 – 47.54]	44.55 [40.67 – 52.28]	0.0012[a]	0.0035	1.04
Ratio forefoot[b]	0.72 [0.50 – 0.98]	0.87 [0.65 – 1.07]	0.1569	0.1765	0.43
Ratio midfoot[b]	0.71 [0.67 – 0.81]	0.64 [0.59 – 0.71]	0.0311	0.0560	0.58

Ratio rearfoot[b]	1.10 [1.04 – 1.21]	1.13 [0.97 – 1.18]	0.0854	0.1097	0.50
Flatfoot (n=9)					
Medial forefoot [KPa]	50.58 [48.41 – 58.10]	49.80 [44.05 – 56.22]	0.1731	0.2225	0.59
Lateral forefoot [KPa]	56.67 [43.36 – 61.65]	46.79 [41.14 – 55.90]	0.0382	0.0687	0.86
Medial midfoot [KPa]	10.99 [7.92 – 14.72]	17.89 [11.82 – 19.39]	0.0077[a]	0.0231	2.09
Lateral midfoot [KPa]	16.86 [13.15 – 24.54]	33.84 [25.18 – 38.21]	0.0077[a]	0.0231	2.06
Medial rearfoot [KPa]	45.83 [41.48 – 58.20]	51.66 [41.45 – 58.09]	0.3139	0.3139	0.38
Lateral rearfoot [KPa]	40.20 [35.70 – 45.82]	51.90 [42.71 – 52.77]	0.0077[a]	0.0077	0.99
Ratio forefoot[b]	1.03 [0.88 – 1.17]	0.99 [0.82 – 1.29]	0.3139	0.3139	0.35
Ratio midfoot[b]	0.60 [0.49 – 0.65]	0.51 [0.47 – 0.56]	0.1097	0.1097	0.63
Ratio rearfoot[b]	1.21 [1.14 – 1.26]	1.10 [1.01 – 1.12]	0.0209[a]	0.0209	0.68

[a] Indicates a statistically significant difference ($p < 0.05$) between the untaped and taped conditions, as determined by the Wilcoxon matched-pairs signed-rank after false discovery rate correction applied within each group ($q < 0.05$).
[b] The pressure ratio was calculated by dividing the mean pressure in the medial region by the mean pressure in the corresponding lateral region.

Discussion

The primary aim of this investigation was to assess the immediate effects of a novel, self-applicable taping technique on plantar pressure distribution and footprint characteristics in individuals with flatfeet and neutral feet. Our findings successfully demonstrated that this technique effectively modifies plantar pressure distribution in both groups, thereby corroborating our initial hypothesis. The principal finding was that the application of the tape induced a significant increase in mean pressure within the lateral rearfoot and midfoot regions under both static and dynamic conditions. This was evidenced by decreased mediolateral pressure ratios, suggesting a reduction in the biomechanical markers of excessive foot pronation. However, the magnitude and specific location of these pressure shifts varied between the flat-footed and neutral-footed participants.

A consistent finding across both groups was a posterior redistribution of plantar loading, characterized by decreased forefoot pressures and a concurrent increase in midfoot and rearfoot pressures. The magnitude of this reduction was substantial, with post-taping forefoot pressures decreasing to approximately 50% of the static normative values reported for adults (Pomarino & Pomarino, 2014). This anteroposterior shift is consistent with findings from previous research on the traditional Low-Dye taping technique (Lange et al., 2004; Newell et al., 2015; Russo & Chipchase, 2001; Tang et al., 2024). Mechanistically, the taping configuration could act through a dorsiflexion-like force vector that offloads the forefoot. This mechanism was not measured in the present study and remains speculative. Such offloading might be beneficial for forefoot pathologies such as metatarsalgia (Verdu Roman et al., 2021), but could also reduce forefoot loading and thereby diminish propulsion during the terminal stance phase of gait (Melai et al., 2013), although the evidence on whether this technique meaningfully alters locomotor force vectors during gait is inconsistent (Koh et al., 2020).

During dynamic conditions, the anteroposterior redistribution of pressure was generally less pronounced. A key observation was the consistent and significant pressure increase in the midfoot across both static and dynamic assessments. As suggested by some authors, tape coverage can induce sensory changes that elevate plantar pressures in the covered regions (Russo & Chipchase, 2001). Given that our protocol provided the most substantial coverage to the midfoot, this neurosensory mechanism could explain the sustained pressure increase. This finding, however, warrants careful consideration for individuals with flatfeet, who often present with elevated midfoot forces due to the collapse of the medial longitudinal arch (Buldt et al., 2018; Chuckpaiwong et al., 2008). Further studies are needed to clarify whether this localized increase in midfoot pressure carries any long-term negative consequences for this population.

Notably, our results partially diverge from previous reports. For instance, some studies observed that traditional Low-Dye taping lowered peak pressure in the medial midfoot while raising it laterally (Khorshidi et al., 2025; Newell et al., 2015; Russo & Chipchase, 2001). While our data also indicated a lateralization of pressure, we did not observe a concomitant decrease in medial midfoot pressure. This discrepancy suggests that our simplified, five-strip method, may not fully replicate all the biomechanical effects of the more complex traditional technique. More specifically, the present technique appears to lateralize loading without the medial-midfoot offloading reported for traditional Low-Dye taping, indicating a partially different pressure-redistribution profile. Clinically, this suggests that the simplified five-strip variant may be better suited to redistributing rearfoot and lateral loading than to directly offloading the medial arch, so its use should be matched to the intended therapeutic goal. However, some authors have demonstrated that simpler taping strategies can offer superior comfort, which may enhance user adherence (Newell et al., 2015). Since our study did not evaluate patient-reported outcomes, future research incorporating validated instruments like the Manchester-Oxford Foot Questionnaire (Morley et al., 2013) is warranted to explore this potential trade-off between biomechanical fidelity and user experience.

The differential responses between the groups under static conditions were particularly informative. While both groups experienced rearfoot lateralization, only the neutral-footed participants exhibited a coupled compensatory pronation in the forefoot (medialization). This phenomenon may be elucidated by the load-adaptation mechanism (Neumann, 2017), where rearfoot supination is physiologically linked with forefoot pronation to maintain full plantar contact. Individuals with neutral feet may retain this natural intersegmental adaptability, whereas those with flatfeet, who often present with increased ligamentous laxity, may be less capable of executing such fine-tuned compensatory movements (Flores et al., 2019; Singh et al., 2022).

During gait, both subgroups demonstrated a clear trend toward the lateralization of plantar pressures. This aligns with previous studies which, although using different metrics, also noted a greater pressure increase in the lateral foot regions following Low-Dye taping (Khorshidi et al., 2025; Newell et al., 2015; Russo & Chipchase, 2001). This suggests that our self-applicable method can produce comparable dynamic effects to traditional taping. The mechanism is likely multifactorial, stemming from both the mechanical restriction of subtalar joint pronation and alterations in foot proprioception (Lange et al., 2004). The observed variability between groups may reflect differences in these mechanisms. For instance, elevating a lowered arch could trigger more pronounced proprioceptive input in flat-footed individuals, potentially influencing neuromuscular activation patterns to a greater degree (Ghai et al., 2024; Ho et al., 2022; Martínez-Sebastián et al., 2023). However, future investigations should include motion capture analysis and electromyography measurements to confirm this hypothesis.

Another finding was the absence of significant changes in the Chippaux-Smirak Index, despite the clear modifications in plantar pressure. While some research has suggested that taping can influence static foot morphology (Castro-Méndez et al., 2022), our results indicate that the observed effects were primarily functional rather than structural. The absence of any change in the CSI shows that the technique did not modify the static geometry of the arch. This could mean either that the intervention redistributes loading functionally without correcting structure, or that the simplified method does not provide sufficient corrective force to alter the footprint and may therefore be ineffective for structural correction. In either case, the technique should not be presented as a structural correction for flatfoot. This pattern is consistent with other studies on modified taping techniques (Tang et al., 2021).

Beyond the biomechanical outcomes, this study contributes to the clinical applicability of the proposed taping technique. The fact that participants successfully applied the tape under supervision highlights its potential to expand access to care. Whether this translates into patient empowerment, better adherence, or improved clinical outcomes cannot be determined from the present data and was not assessed. Establishing these potential benefits would require specific next steps, including a feasibility study of unsupervised self-application, an adequately powered sham-controlled trial to confirm the mechanical effect, and direct measurement of adherence, comfort, and patient-reported outcomes over time. Caution is also warranted when generalizing these results beyond the young adult demographic studied here.

The findings of this study should be interpreted in the context of several limitations. First and most importantly, the study used a single-group, pre-post design without a control or sham-taping condition. Consequently, placebo effects or familiarization with the platform cannot be excluded as contributors to the observed changes, and these changes cannot be causally attributed to the taping itself. Second, there is a possibility of gait adaptation due to platform awareness during evaluations. Third, the analysis was restricted to the acute effects of a single application, so longer-term efficacy remains unknown and may be relevant (Nolan & Kennedy, 2009). Fourth, no a priori power calculation was performed and the sample was small, particularly in the flatfoot group (n=9). The analyses were therefore treated as exploratory, and the subgroup effect sizes could be biased and unstable. Fifth, although every application was performed by the participant, it was supervised and guided in real time by a trained examiner with standardized verbal and, where necessary, tactile cueing. Full independence of self-application was therefore not established. Sixth, gait adaptation due to platform awareness during the dynamic evaluation cannot be ruled out. Finally, the results were obtained in healthy young adults and may not generalize to other age groups or clinical populations. Taken together, these limitations mean that the present results should be regarded as preliminary and hypothesis-generating, and adequately powered, randomized studies that include a sham-taping control, an a priori power analysis, and objective measures of application quality and patient-reported outcomes are needed to confirm them.

Conclusions

Under the constraints of a single-group, pre-post design, a single application of the proposed self-applicable taping was associated with an immediate, region-specific change in plantar pressure in young adults with neutral or flat feet, but these changes cannot be causally attributed to the taping itself due to the absence of a control or sham condition. The most consistent and statistically robust effect was a lateral shift of rearfoot loading. Effects at other regions were smaller and less consistent, and the static footprint (CSI) was unchanged. Rather than a validated clinical tool, this simplified five-strip technique is best described as a proof of concept that may offer an accessible, self-applied alternative worth investigating further. Before any clinical recommendation can be made, these preliminary findings must be confirmed in adequately powered, randomized studies that include a sham-taping control, assess the quality and feasibility of self-application, and evaluate longer-term efficacy, comfort, and patient-reported outcomes across different populations and functional activities.

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