TITLE: EFFECTS OF KINESIOTAPE® TAPING ON PLANTAR PRESSURE AND IMPACT ACCELERATION DURING WALKING

SUMMARY

Objectives: The aim of this study was to analyse the plantar pressure pattern, contact time, stride rate and impact acceleration in the shank during walking with and without Kinesio Tape (KT®) placed on two muscle groups: Peroneus and Triceps surae. **Methods:** 29 subjects (12 men, 17 women) participated in the study. KT® was placed on the triceps surae and peroneus and participants walked at two different speeds (V1: 0.73 m/s; V2:1.30 m/s) with and without KT®. The pedobarographic system Biofoot IBV® 6.0 was used to analyse plantar pressure (mean peak pressure [kPa]) in 5 foot areas and the kinematic variables of the study (contact time [s]; stride rate [steps/min]). One uni-axial accelerometer (Sportmetrics®) was placed on the shank for the impact loading analysis. **Results:** No significant difference was observed on plantar pressure ($p>0.05$), and kinematics variables ($p>0.05$) between the KT® and noKT® conditions. However, results revealed a relationship of dependence between speed and plantar pressure and kinematics parameters, especially under the rearfoot and the medial part of the foot ($p<0.005$). **Conclusion**: The results suggest that application of KT® on peroneus and triceps surae does not have a direct effect on the kinematic pattern of healthy individuals during walking.

Keywords

Kinesio Tape®, plantar pressure, acceleration, walking.

RÉSUMÉ

Objectifs: L'objectif de cette étude était d'analyser l'évolution de la pression plantaire, le temps de contact, la taux de foulée et l'impact de l'accélération lors de la marche avec et sans KinesioTape.**Méthodes:** 29 sujets (12 hommes, 17 femmes) ont participé à l'étude. KinesioTape a été mis sur le triceps sural et le péronier et les participants ont marché à deux vitesses différentes (V1: 0,73m/s; V2: 1,30m/s) avec et sans KT®. Le système pedobarographic Biofoot IBV® 6.0 a été utilisé pour analyser les pressions plantaires (pression maximale moyenne [kPa], le temps de contact [s]; taux de la foulée [des étapes/min]). Un accéléromètre uniaxial (Sportmetrics®) a été placé sur la tibia pour l'analyse des charges d'impact.**Résultats:** Aucune différence significative de la pression plantaire ($p>0,05$), et les variables cinématiques ($p>0,05$) n'a été observée entre les conditions avec et sans KinesioTape. Cependant, les résultats ont révélé une relation de dépendance entre la vitesse et la pression plantaire et les paramètres cinématiques et, en particulier, sous l'arrière-pied et la partie médiale du pied ($p<0,005$).**Conclusions:** Les résultats suggèrent que l'application de KinesioTape sur péronier latéral et les triceps n'a pas un effet direct sur le modèle cinématique des personnes saines pendant la marche.

Mots clés

Kinesio Tape ®, pression plantaire, accélération, marche.

INTRODUCTION

Kinesio Tape® (KT) is a novel thin and more elastic tape compared with the traditional rigid tape, which allows for elongation 120-140% of its original length and therefore leads to less mechanic constraints [1]. The fabric of KT® is air permeable and water resistant, allowing the individual to wear it for several days without interfering with the daily health care habits [2,3]. This type of taping is being widely used in different areas including sports performance and physical rehabilitation as a result of the numerous properties that have been associated with their use. It is believed that KT® positively influences proprioception and the muscular, lymphatic and articular systems through its action on propioceptors and exteroceptors [4-6]. In this sense, the application of KT® has been useful in sports such as football, basketball, tennis, badminton or baseball as well as in the rehabilitation of muscular injuries and proprioception [7-9]. However, KT® research is limited and the results are inconsistent, what requires further analysis in order to better comprehend how KT® can influence the human function [10,11].

Lower extremity and foot function during walking have been analysed from many perspectives [12]. In this sense, through the use of pressurometry techniques [13], plantar pressure has been analysed in different activities such as walking, running, gymnastics, tennis, soccer or nordic walking [14-19].

Taping is a practice commonly used by physiotherapists and podiatrists to treat or prevent lower extremity injuries [12,20,21]. However, due to the great amount of related benefits, the use of KT® has increased in recent years compared to the use of other traditional techniques lick the Low dye [1,22-25] or the High dye [26,27]. The Low dye is a less elastic tape, which restricts the range of motion and inhibits the muscle movement of the ankle [22,28] This type of tape has been previously used to treat lower extremity symptoms related to an altered or excessive pronation [20] Several studies showed how the use of Low dye in the lower extremities results in pain reduction in patients with fasciitis plantar [25] plantar pressure reduction under the forefoot and plantar pressure increase under the midfoot and rearfoot [22-24,26], and in restriction of the pronation movements of the foot [20,27,29].

Similar to the aforementioned purposes of the Low dye, the aim of the High dye taping (which embraces more surface than the Low dye) is to offer support to the ankle joint and to counteract the medial forces associated with excessive pronation [27,30]. The High dye elevates the longitudinal arch and therefore can be considered as an anti-pronation strategy both during standing and during dynamic locomotion such as walking and running [30].

Regarding the differences between the taping techniques, there is no agreement regarding to the procedure and many variations within the same technique have appeared [27,31]. However, literature and specialists universally agree that the Low dye is intrinsic to the foot, whereas the High dye spreads over the ankle until the lower part of the leg. In the case of KT®, literature that presents its possible effects on lower extremity dynamics and plantar pressure is scarce. As a consequence, the aims of the present study were: 1) to analyse the plantar pressure pattern, contact time and the stride rate during walking with and without KT® placed on two muscle groups: Peroneus and Triceps surae; and 2) to examine the effect of KT® placed on Peroneus and Triceps surae on the impact acceleration registered in the shank.

METHODS

Participants

Twenty-nine healthy participants: 12 men and 17 women (24.83 ± 3.51 years, 1.70 ± 0.09 m, 66.2 ± 14.0 kg) participated in the study. Inclusion criteria included no history of lower extremity injuries within the last 6 months, no history of foot and ankle surgery within the past 2 years. All subjects gave written informed consent before participation. The study procedures complied with the Declaration of Helsinki and were approved by the University ethics committee.

Test Conditions

Plantar loading variables were recorded in both feet at 265Hz during 5 seconds with Biofoot 2001® in-shoe pressure measurement system (IBV, Valencia, Spain). This system has been shown to be reliable [32] and comprises a pair of instrumented insoles each with 64 piezoelectric sensors connected to a logger attached to the waist. Figure 1 shows the five foot zones used for data analysis (rearfoot, midfoot, forefoot; and medial side of the foot, lateral side of the foot). Contact time (CT in seconds) and stride rate (SR in steps/minute) were measured as kinematic variables. Finally, a uni-axial accelerometer (Sportmetrics®) was attached to the shank in both legs in order to analyse the decceleration at the shank (m/s). Accelerometers registered at a sample frequency of 500Hz and were connected via Bluetooth radio-frequency to the SignalFrame Blt (Sportmetrics®) computer software for the analysis of the data. All participants used the same footwear (ROX Tennis Spandler WMNS) in order to avoid variability among conditions.

*** Figure 1. Foot zone distribution for plantar pressure analysis. ***

Taping

The model Kinesio® Tex Gold™ was used in the present study. It was placed on two muscle groups: a) Triceps surae (left leg); and b) Peroneus (right leg). KT® was used according to the recommendation of Kase [4,7]. For the left leg, as shown in figure 2, and "Y" shaped KT® was used. The proximal head of Y shaped KT® was applied on the surface of calcareous bone on the sole of the foot with the foot in maximum dorsiflexion. Then, two distal heads of Y shaped KT® were attached following the a) gastrocnemius and b) soleus muscles and ended on the surfaces of medial and lateral gastrocnemius muscles below the knee joint. In the right leg, KT® was placed from the lateral portion of the calcalneus and ended on the head of the fibula. All tapings were carried out by the same physiotherapist.

*** Figure 2. KT® on Triceps surae (a) and Peroneus (b). ***

Experimental Protocol

Participants warmed-up for 10 minutes at a self-selected walking speed (without reaching 0.73m/s) on a treadmill (BH Fitness Columbia Pro). Subsequently, participants walked for 5 minutes at two different speeds: a) V1: 0.73m/s; b) V2: 1.30m/s. All participants repeated this sequence twice, altering the speed (V1-V2) and the taping (with-without) conditions at random.

Data Analysis

Three steps for each leg were selected for the data analysis. The SPSS.15® statistical package was used for statistical analyses. After checking the normality of the variables (Kolmogorov-Smirnov), a descriptive analysis of the data was performed. Then, a Two-way Repeated-Measures MANOVA was carried out for each of the variables of the study: plantar pressure, contact time and stride rate (with KT®, speed and foot as independent variables); and deceleration (with KT® and speed as independent variables). Significance was set at α=.05.

RESULTS

In the present study, KT® did not significant modified mean peak pressure ($p>0.05$). However, the results showed that plantar pressure is significantly dependent on the walking speed of the individual (table 1), especially under the rear foot and the medial side of the foot.

*** Table 1. Values of mean peak pressure with and without KT® at different walking speeds***

Regarding the kinematic variables and the acceleration registered in the present study, no differences were observed with and without KT®, although similarly to what was observed in the plantar pressure analysis, the speed condition significantly influenced all three variables (figure 3).

*** Figure 3ab. KT® and Speed influence on the kinematic and acceleration variables. ***

DISCUSSION

In the present study it was analysed whether the application of Kinesio tape® placed on peroneus and triceps surae influence plantar pressure, impact loading and kinematics parameters such as contact time and stride rate during walking. Results showed that KT® did not modify any of the variables studied, although as it has been previously seen in other studies, both plantar pressure and acceleration were confirmed to be dependent on the speed of motion [19].

Previous studies have analysed the effect of KT® on the human body, indicating most of them little or no influence of this model of taping on the variables analysed. In this sense, it has been seen that KT® application on the lower part of the trunk led to higher flexion values, whereas extension and lateral flexion motion ranges were not modified [33]. Regarding the lower extremity, Fu et al. [1] and Vera-García et al. [34] observed that KT® application did not show any immediate effect on the reflex response of biceps femoris and grastocnemius lateralis.

Due to the dearth of studies that analyse the effect of KT® on plantar pressure and walking kinematics, most of the studies to date have focus on non-elastic tapes such as Low hye and High dye. The main different between these three models of taping is

that non-elastic tapes have been shown to affect the walking kinematic of the individual [22,24,26]. In this sense, the Low dye taping inhibits the movement of the plantar muscle groups, leading to a reduction in the range of movement of the subtalar joint [22,24-26], whereas the High dye taping decreases the maximum eversion values of the rearfoot compared to the Low dye [27]. During walking, the plantar pressure pattern in healthy people starts in the lateral rearfoot, describing a line that continues via the lateral midfoot to the central portion of the metatarsals head, only to end its path under the first and second toes when the push-off phase occurs and the heel rises over [35,36]. However, the application of KT® on the peroneus and triceps surae in the present study did not significantly modify the plantar pressure pattern. These results differ from those observed when using Low dye. In those studies, greater pressure under the lateral midfoot and lower pressure under the rearfoot and medial forefoot were observed [22,23]. Other authors [24,26] also found a reduction in pressure under the medial side of the foot and an increment of pressure under the lateral forefoot, midfoot and rearfoot; as well as a restriction of the pronation range of motion of the rearfoot [22,23,26,29]. Even though these studies analysed the influence of Low dye on the walking pattern, it is important to consider that this model of taping is applied directly on the ankle joint and, as a consequence, there was no intervention over the peroneus and triceps surae muscle groups, what may account for the differences among studies.

It is important to take into account that excessive plantar pressure is considered a risk factor for the development of ulcers, stress fractures, fasciitis plantar, metatarsalgia, sesamoiditis, and muscle-tendon pain in patients with rheumatoid arthritis [19,37-40]. For this reason, interventions such as taping that may reduce the plantar loading could become a relevant protective mechanism to take into account when addressing the prevention of injuries both in healthy and risk populations.

Finally, the KT® did not lead to any significant modifications in the acceleration registered in the shank, although this variable was strongly dependent on the walking speed. As a result, the faster the participants walked, the greater the impact observed in the shank, independently of the taping condition. Numerous authors have associated the acceleration impacts with the risk of injury [41-48]. In this sense, elevated acceleration values in the shank could lead to tibial stress fractures, spinal injuries and articular degeneration [44-46]. Moreover, regarding performance, elevated acceleration values have been related to a lower performance as a result of greater metabolic expenditure for a given activity [41-43]. These results highlight the essential role of the acceleration impacts both in the prevention of injury and the enhancement of performance in sports. The present study shows that the application of KT® did not

modify the acceleration values in the shank. As a consequence, the application of this model of taping not only may result in numerous benefits at different levels (therapeutic, proprioceptive), but it also does not provoke any elevated acceleration values which could be deleterious for the body. For this reason, it may be interesting to further analyse the effects of KT® on acceleration values and their role in a given activity when applied to the muscle groups relevant to that specific practice.

CONCLUSION

KinesioTape® applied on the peroneus and triceps surae does not seem to directly modify the individual's walking pattern. Moreover, this model of taping on the aforementioned muscle groups seems inappropriate in people who aim to reduce plantar pressure and impact loading during walking. However, it is important to take into account that these results are specific to these muscle groups during the activity of walking, what does not exclude that the application of KT® on other muscle groups or while performing a different activity may have significant effects on the parameters analysed in the present study.

Conflict of Interest: none.

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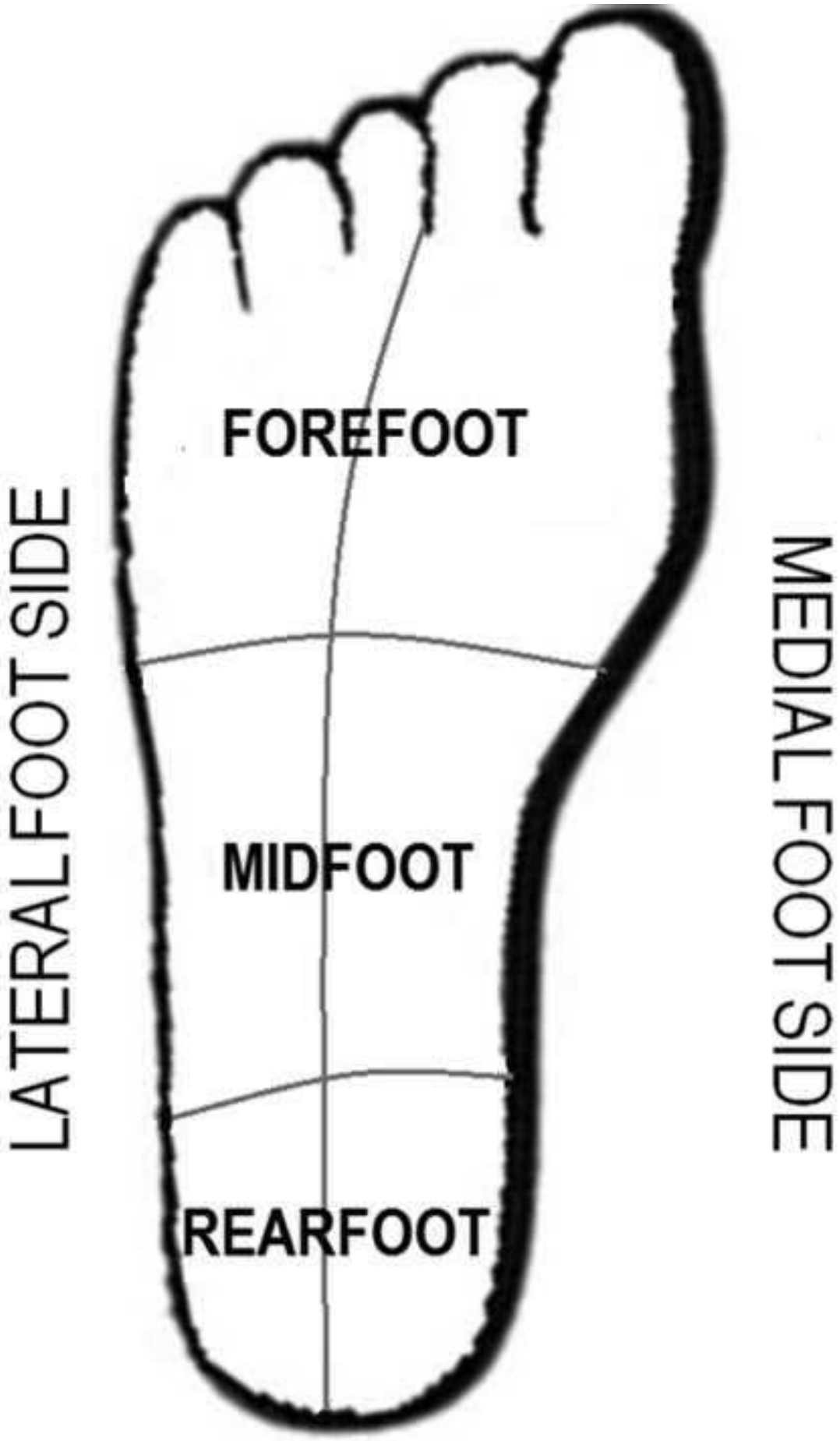

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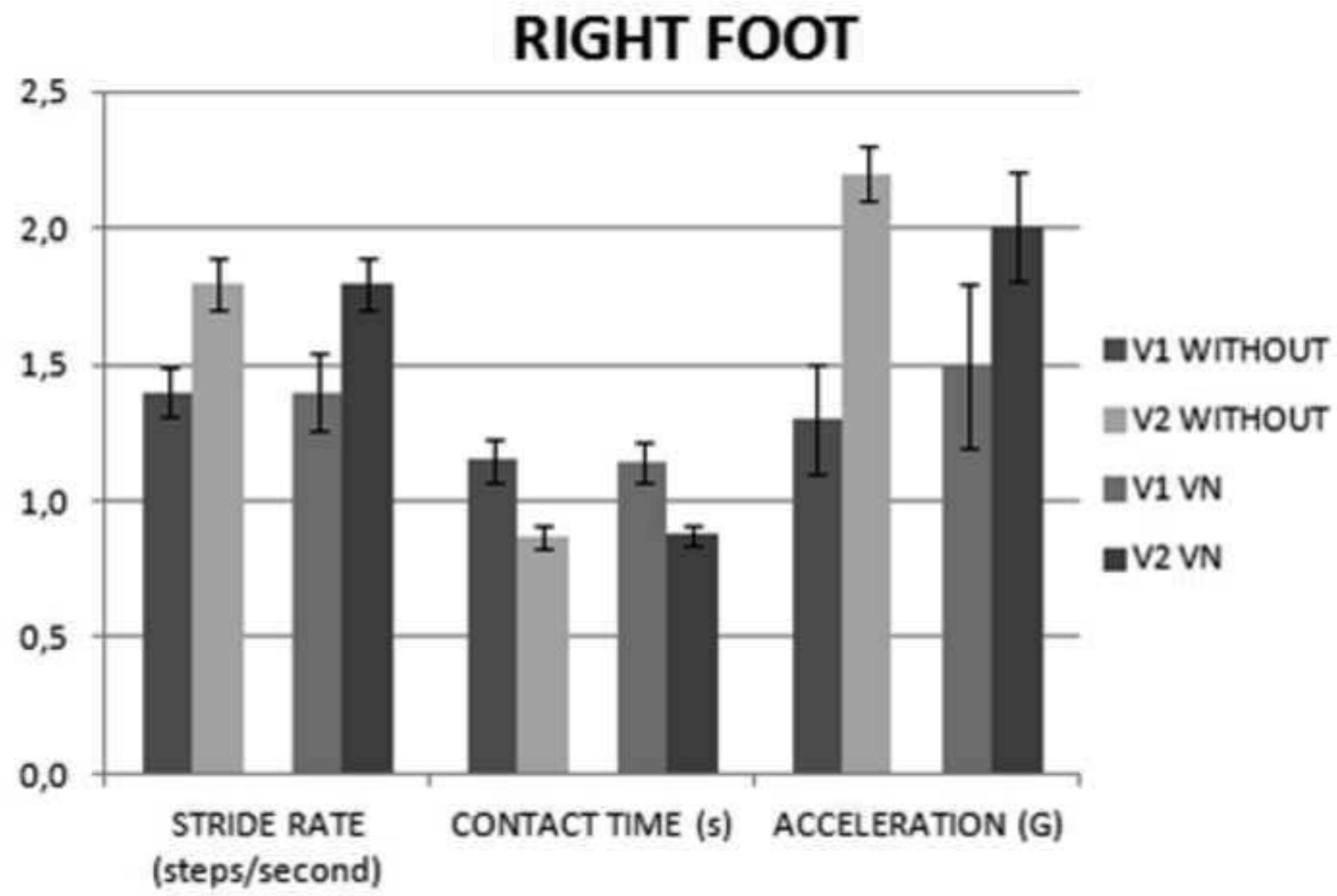

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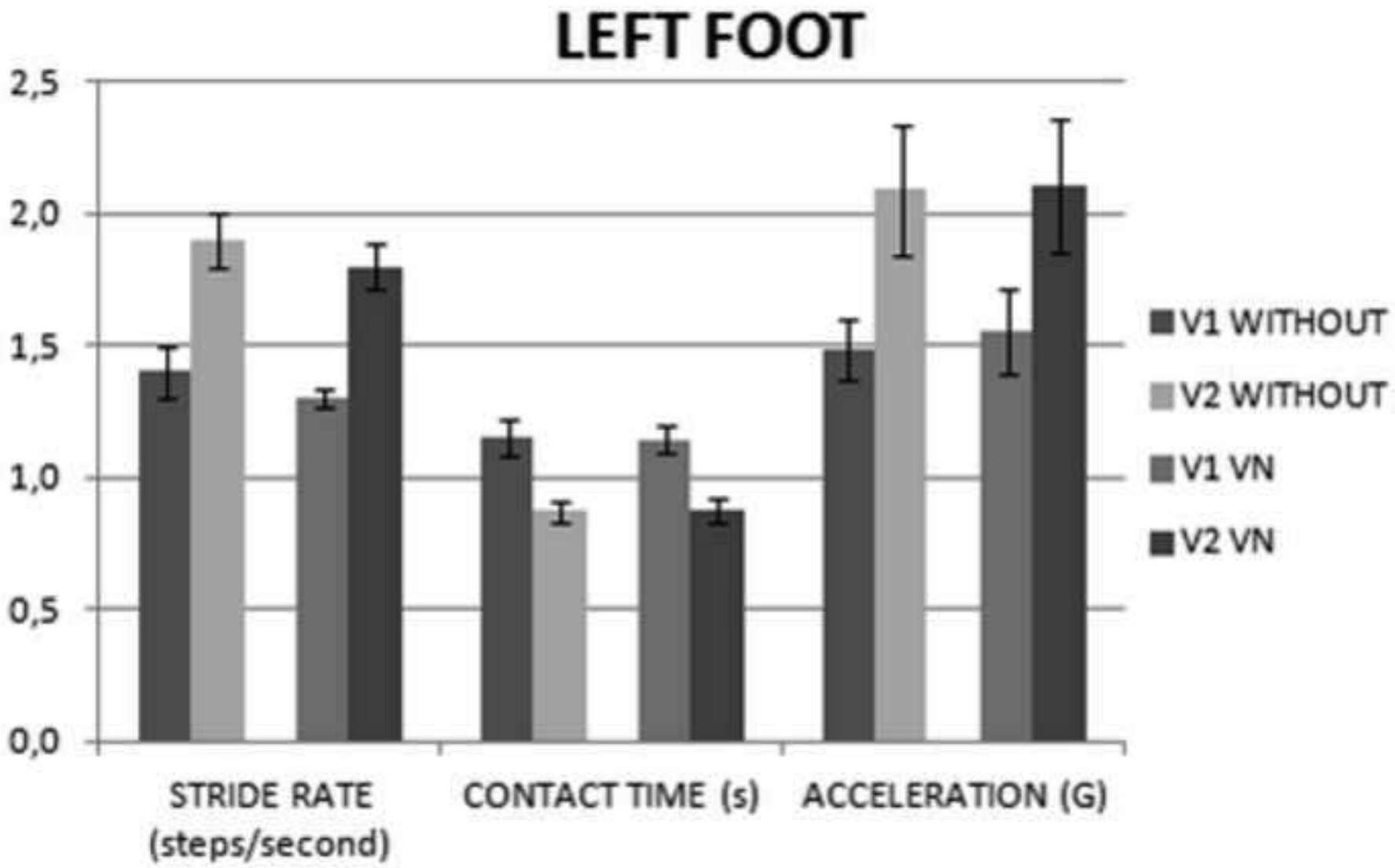

Table 1
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Table 1: Table 1. Values of mean peak pressure (kPa) with and without KT® at different walking speeds

RIGHT FOOT	Without KT®		KT®	
	V1 (0.73m/s)	V2 (1.30m/s)	V1 (0.73m/s)	V2 (1.30m/s)
Forefoot	65.5 ± 18.7*	75.3 ± 22.1	66.9 ± 14.3	73.3 ± 21.9
Midfoot	33.3 ± 20.6	38.5 ± 26.7	24.5 ± 12.3	26.8 ± 13.8
Rearfoot	103.9 ± 44.1*	136.8 ± 66.9	106.6 ± 29.3*	123.6 ± 50.9
Lateral side foot	53.4 ± 15.1	60.9 ± 20.5	52.5 ± 17.6	53.7 ± 19.9
Medial side foot	48.2 ± 16.6*	58.8 ± 22.6	46.7 ± 18.4*	59.5 ± 25.3

LEFT FOOT	Without KT®		KT®	
	V1 (0.73m/s)	V2 (1.30m/s)	V1 (0.73m/s)	V2 (1.30m/s)
Forefoot	74.5 ± 16.0	72.3 ± 13.9	70.8 ± 14.5	70.6 ± 16.9
Midfoot	27.9 ± 15.8	33.8 ± 21.7	25.9 ± 11.1	30.3 ± 16.1
Rearfoot	102.1 ± 45.5*	133.9 ± 54.6	98.0 ± 42.6*	122.4 ± 54.8
Lateral side foot	54.1 ± 14.5	52.8 ± 16.3	50.1 ± 12.0	50.3 ± 14.6
Medial side foot	50.8 ± 17.7	57.6 ± 14.1	52.6 ± 18.1	52.5 ± 11.5

Mean ± Standard Deviation. (*) p<.005.