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ORIGINAL

The positive role of kinesio taping in adjunctive therapy of static plano-valgus feet in children between the ages of 5 and 7

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background Kinesio taping (KT) might be of substantial value as far as adjunctive therapy of flat foot correction in children is concerned. The study's prime aim is to evaluate the role of KT in terms of static plano-valgus foot therapy in children.

Material/Methods The study involved 120 children aged 5 to 7. Parameter calculations determining the shape of foot were performed on the electronic podoscope before and after the therapy, and after the subsequent 4 months in order to evaluate the permanence of the therapy result.

Results Statistical analysis revealed that the study period considerably influenced the change of parameters which determine the shape of foot within particular groups. During the consecutive study periods, a significant discrepancy in parameters determining the shape of foot was also identified.

Conclusions Application of kinesio taping, together with kinesiotherapy as well as separately, constitutes a successful treating method in the case of static plano-valgus foot in children and it also demonstrates a lasting outcome after the therapy is completed.

Key words kinesio taping, static plano-valgus foot, children

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INTRODUCTION

The fundamental objectives of the study are to define the impact of kinesio taping (KT) on a number of parameters describing the shape of foot, i.e. the Clark angle, γ angle (Fig. 1), Sztriter-Godunow index (Ky), Wejsflog index (W) (Fig. 2), as well as to assess the overall permanence of therapy results. Plano-valgus foot is an anatomical and functional disorder of the body [1] statics and dynamics. It may develop at every stage of one's life since the very moment of acquiring the ability to walk. Morphologically, it is characterised by falling of the longitudinal arch of the foot [2], which is mainly based on the static insufficiency and calcaneus deviation. Additionally, plano-valgus foot is accompanied by abduction of the forefoot [3]. Few academic publications prove that KT might constitute a beneficial form of adjunctive therapy in terms of flat foot correction in children. The method was devised at the beginning of the 1980s and is based on applying special K-Active Tapes, with parameters that carry similar characteristics of human skin [4], over various body parts. Until recently, scientific studies regarding the use of KT in posture correction [5] have not been taken up frequently. Also, only relatively little information of scientific value concerning the method has been reported. Studies presented in publications comprise various issues in the field of paediatrics, from malfunctions [6], posture disorders, the nervous system diseases [7] to child injuries [8]. Yet, none of the aforementioned studies depict research on the use of KT in treating static plano-valgus foot in children. Studies published so far have proved KT might be useful within numerous fields of medicine, and with each passing year the number of studies concerning the efficacy of elastic tapes is constantly growing. Many authors pinpoint that they have implemented KT as a supplementary method [9, 10], which was to support the improvement programme. The aim of the present paper is to evaluate the KT role in therapy of static plano-valgus foot in children between 5 and 7 years of age.

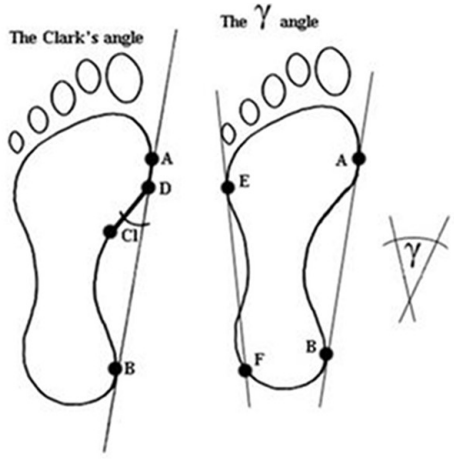

Fig.1 Method of outlining the Clark angle and the γ angle

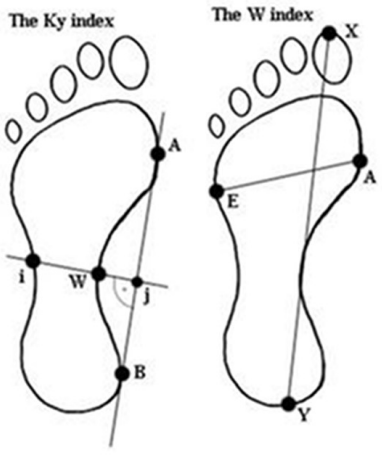

Fig.2 Method of outlining the Ky and W indices

MATERIAL AND METHODS

The study involved 120 children aged 5 to 7, of whom 44 (36.67%) were girls and 76 (63.33%) were boys, and was carried out between the years 2010 and 2011. All of the enrolled children met the following criteria:

- aged between 5 and 7 years;
- had been diagnosed by a specialist in medical rehabilitation as having a

bilateral plano-valgus foot;
- had no contradiction regarding either kinesiotherapy or KT application;
- did not use any orthopaedic equipment.

Exclusive criteria were:
- any neurological disorder;
- obesity;
- scoliosis.

The children were divided strictly in the order they first attended the clinic, into 4 groups, each of 30 children. In each group the following procedure was followed:
Group 1. Kinesiotherapy by a therapist for 30 minutes, 3 times/week.
Group 2. As above, plus the application of KT which was changed 3 times/week.
Group 3. The application of KT, changed 3 times/week only.
Group 4. Controls, i.e. children who did not receive treatment.
Kinesiotherapy was performed individually with a therapist for 30 minutes. Exercises were based on strengthening the weakened muscles, i.e.: tibialis anterior and posterior, flexor hallucis longus and fingers. The foot and the pelvic girdle are a biomechanical whole. Therefore, to gain full correction of the feet, muscles that stabilize the pelvis (abdominal and gluteus muscles) are strengthened during the exercises. Initially, the exercises were carried out in suspension, gradually moving to the feet, remembering the correct alignment of the three points of support: heel, head and the metatarsal and the head of the metatarsal bone.

Treatment lasted 3 months. The shape of each foot was determined by the use of an electronic podoscope before and after the course of treatment and for the third time 4 months later in order to evaluate the permanence of any results. The feet were measured while standing still with both feet on the electronic podoscope.

The children in Groups 2 and 3 were subject to the appropriate application of K-Active Tapes (Nittko Denko, Japan). In Group 2 the tape was applied immediately after kinesiotherapy three times per week and in Group 3, without kinesiotherapy, only with the tape which was changed 3 times/week.

The tapes were removed by the parent the night before each visit, when bathing the child, to reduce the discomfort of removal. In order to strengthen the tape's adhesion antiseptic PreTape Tuffner glue was applied in a spray to the sole of the foot.

During examinations 5 applications of KT were simultaneously implemented:

I. Supination of the foot:
1. Aim: to turn the foot, raise the medial arch of the foot, increase the vaulted roof of the foot and stabilize the head of the talus.
2. Manner of application:
   a. From the posteromedial side located below the knee to the external side of the foot, loosely without any tension (Fig. 3).

Fig. 3. Application of KT to supine the foot through the external side of the foot

b. The foot is placed passively supine, without any tension and the plaster is applied to the medial side to the foot below the medial malleolus (Fig. 4).

Fig. 4. Application of KT to supine the foot by the heel

c. The end of the tape is applied to the lateral malleolus and needs holding for a while at 75% tension of the plaster. The tape is applied around the dorsal and plantar parts of the forefoot. Next, the plaster is loosely attached to the dorsal aspect of the foot (Fig. 5).

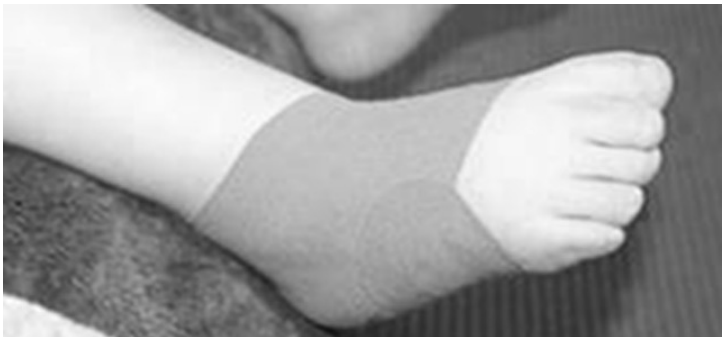

Fig. 5. Application of KT to supine the foot through the dorsal part of the foot

II. Application to the anterior tibial muscle:

1. Aim: to support the function of the anterior tibial muscle.
2. Manner of application: One end of the tape is applied to the dorsal side of the forefoot and the other to the anterolateral side below the knee (Fig. 6).

Fig. 6. Application of the KT to the anterior tibial muscle

III. Application to the gastrocnemius muscle:

1. Aim: to activate and increase the strength of the gastrocnemius muscle.

2. Manner of application: The KT is first applied loosely to the plantar side of calcaneus and, holding it in place with 25–75% tension, we attach it near the Achilles tendon. Next, the gastrocnemius muscle is loosely covered with two pieces of tape (Fig. 7).

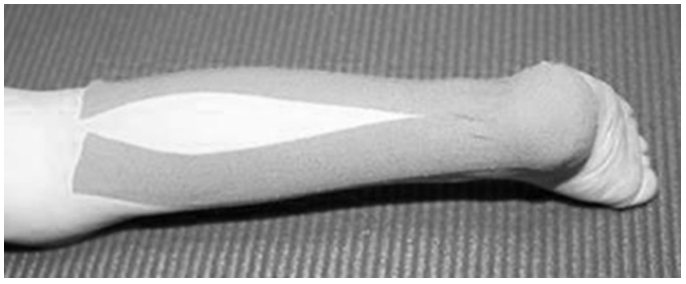

Fig. 7. Application of KT to the gastrocnemius muscle

DATA ANALYSIS

Statistical analyses were performed with the use of STATISTICA 10.0 statistical software (StatSoft®). Owing to the nature of the quantitative variables analysed as well as their composition, a variant from the regular, non-parametric tests was applied in the statistical analysis, i.e. Friedman's test for dependent trials and Kruskal–Walli's test for independent trials [11]. A probability of $p<0.05$ was considered statistically relevant. To obtain more distinct transparency of the received test results, statistically irrelevant p values were excluded.

RESULTS

The results of the study are presented in the form of text and tables. Descriptions concerning changes in the parameters determining the shape of the foot were provided for each group in the three sessions of the analysed examinations (I–II and II–III). Tables 1 and 2 show the statistically vital alterations of all the parameters values in most of the examined groups for all these study periods. No essential shift of the Cl angle value between Groups 2 and 3 as well as between Groups 2 and 4 was identified at the end of the 3 months.

Table 1. Comparison of the arithmetic mean (M) values in the I–II study period

Differences of parametres	Left/Right foot	Group 1 (n = 30)	Group 2 (n = 30)	Group 3 (n = 30)	Group 4 (n = 30)	p
Cl angle	L	4.00	10.00	11.93	-5.03	< 0.0001
	R	4.10	10.30	10.10	-3.80	< 0.0001
Ky Index	L	-0.05	-0.10	-0.11	-0.01	< 0.0001
	R	-0.05	-0.12	-0.10	0.02	< 0.0001
γ angle	L	-0.33	-1.67	-0.77	0.10	0.0010
	R	-0.27	-1.50	-1.10	0.17	0.0024
W Index	L	0.08	0.12	0.14	0.00	0.0058
	R	0.04	0.13	0.14	0.00	< 0.0001

Cl, Clark's angle; Ky, Sztriter-Godunow index; γ, γ angle; W, Wejsflog index; L, left; R, right; p, probability

Tables 2. Comparison of the arithmetic mean (M) values in the II-III study period

Differences of parametres	Left/Right foot	Group 1 (n = 30)	Group 2 (n = 30)	Group 3 (n = 30)	Group 4 (n = 30)	p
Cl angle	L	-1.10	5.70	5.47	4.77	0.0005
	R	0.80	5.77	4.57	6.63	0.0625
Ky Index	L	-0.04	-0.08	-0.07	-0.08	0.2954
	R	-0.07	-0.05	-0.05	-0.08	0.8977
γ angle	L	0.03	-0.77	0.50	0.00	0.058
	R	0.03	-0.37	-0.23	-0.30	0.5114
W Index	L	0.08	0.12	0.14	0.00	0.0058
	R	0.04	0.13	0.14	0.00	< 0.0001

Cl, Clark's angle; Ky, Sztriter-Godunow index; γ, γ angle; W, Wejsflog index; L, left; R, right; p, probability

On the grounds of the test finding, it can be seen that discrepancies in the Ky index values within separate study periods change in a statistically irrelevant manner in all groups apart from the left and right foot between sessions II and III. Changes in the Ky index value of the left foot between study periods I and II concerned Groups 2 and 4, and Groups 3 and 4.

The analysed groups differ from one another in terms of discrepancy values for all the study periods concerning the γ angle, apart from the right and left foot between study periods II and III, yet these differences demonstrate changes between Groups 1 and 2, as well as between Groups 2 and 4. Differences in the W index values, within individual study periods, for all the groups analysed changed in a statistically relevant manner, apart from the left foot in study periods II and III. In this same study period there was a significant change in the W index in the right foot between Groups 1 and 2. Changes regarding discrepancies in index values are primarily noticeable between Groups 2 and 4, as well as between groups 3 and 4. No statistically significant alterations between Groups 2 and 3 were found.

The statistical analysis of the differences describing each foot within particular study periods demonstrated a substantial influence of the study period on the determined parameters, except for the Clark's angle of the right foot, for sessions II and III the Ky index as well as γ angle of the left and right foot, and the W index of the left foot. This dependency is normal as therapy was not being conducted between the first and second examinations.

A comparison of the analysed groups based on special attention to the value differences during individual study periods found comparable changes of the

Clark's angle values in Groups 2 and 3. KT, combined with kinesiotherapy, displayed only a tendency to provide better results. This relation also occurs with reference to the majority of parameters with the exception of the W index. The most subtle difference in particular parameter values between the study periods was obtained in Groups 1 and 4. The correlation between the groups in which KT was applied confirms the impact of this method on the parameters determining the shape of the foot.

Statistical analysis of the parameter value differences describing a foot within particular study periods revealed that KT, in combination with kinesiotherapy, shows a lasting outcome after the therapy's completion, as evidenced by minor alterations of parameter values determining the shape of foot in study period II.

To sum results up, it can be stated that the most essential variations were observed in Group 2. Lower results were obtained in Group 3. In Groups 1 and 4, changes only at the lowest level of statistical significance were found or were not observed at all. Negative values presented in tables which described the difference of the Clark's angle value as well as index W point out an undesirable variation. Deterioration in the clinical condition of the foot was noticed in Group 1 within II and III study periods, and in Group 4 within study periods I and II. As far as the KY index and γ angle are concerned, negative values indicate an advantageous modification.

DISCUSSION

Not only is KT a method which is gaining more and more widespread recognition, but its employment within various fields of rehabilitation is also intensifying. The majority of the available studies primarily concern adults. A. Yasukawa is known as the forerunner of implementing the use of KT amongst children. Together with her co-workers [6], she has proved the impact of KT on the muscle tone distributions in infants and children suffering from disorders of the chewing apparatus. In 2006 she carried out pilot studies with the use of KT in the rehabilitation of children who had been afflicted by spinal cord injury, tumours and encephalitis [8]. Yasukawa, along with Kase and P. Martin, published a study [4] devoted to the employment of tapes in paediatrics.

Above all, KT is applied as adjunctive therapy. Preliminary information on the simultaneous use of KT in combination with therapies of other types was put forward by Shim et al. [9]. By conducting research on rabbits, they investigated the flow of lymph within the animals' hind leg while applying these tapes. They revealed statistically significant changes of the parameters concerning the speed of lymph flow when KT was an adjunct to passive exercises. Our results confirm these findings, as the most noticeable variations were identified in a group of children to whom adhesive tape was used as an adjunct to kinesiotherapy. The findings of our study are in line with those of Grudzień [12]. In her paper concerning the application of the Proprioceptive Neuromuscular Facilitation (PNF) method, involving KT in the treatment of Scheuermann's disease, she accentuated the value of tape adhesion after corrective exercises were completed. Grudzień claims that the use of KT strengthens the corrected posture. In our studies regarding assessment of the effectiveness of tape as adjunctive therapy in children with static plano-valgus foot, post-kinesiotherapy application was also applied. Thus, it can be concluded that the use of KT, in

conjunction with other physiotherapeutic methods, is justified, as it aims at increasing their overall efficacy.

To date, only one publication describing the use of KT in treating static plano-valgus foot has been published, that of Fernández et al. [13]. The authors examined 15 persons with flat feet who additionally complained about pain in the area of the tibialis posterior muscle. The pain was measured on the VAS scale and the stage of calcaneus pronation was also examined. 24 hours after tape adhesion was applied to the tibialis posterior muscle, a statistically significant decrease in pain was identified, yet no change in the heel pronation was exhibited.

During our investigations, after 3 months of having KT applied in order to enhance calcaneus supination, we found a statistically significant improvement in the deviation angle of the calcaneus. Therefore, it can be assumed that 24-hour use of the tape and its application on the tibialis posterior muscle only was not sufficient to achieve satisfactory results where plano-valgus foot is concerned. These studies were conducted on adults whose foot disorders were long established and whose soft tissues were no longer flexible, and therefore unable to allow correction of calcaneus inversion, but feasible when treating pre-school children. Furthermore, only 15 persons were involved in their study which might have had an influence on the statistical analysis of their results.

CONCLUSIONS

KT, in combination with kinesiotherapy, as well as in its separate use, proves to be an effective method of treating static plano-valgus foot in children aged between 5 and 7. It is also more effective than the application of kinesiotherapy alone and works by triggering changes in the parameters determining the arch of the foot and calcaneus inversion.

The application of KT, either alone or together with kinesiotherapy, produces an outcome which persists after therapy is completed.

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