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Wpływ zastosowania Kinesiotapingu na rozkład obciążeń stóp u osób po plastyce hallux valgus w ujęciu badań pedobaroskopowych

Kinesio Taping and its effect on weight distribution on feet after hallux valgus corrective surgery, assessed with the use of pedobaroscope

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Streszczenie

Wprowadzenie. Stopa jako jeden z ważniejszych elementów narządu ruchu człowieka jest szczególnie narażona na wszelkiego rodzaju urazy i przeciążenia. Jedną z dolegliwości w obrębie stopy jest paluch koślawy (hallux valgus). Leczenie hallux valgus obejmuje leczenie zachowawcze i operacyjne.
Cel pracy. określenie wpływu aplikacji taśm kinesiotaping na wartości obciążenia stopy i jej zasadność jako terapii wspomagającej po operacji palucha koślawego.
Materiał i metody. Badaniem objęto grupę 32 pacjentów po leczeniu operacyjnym palucha koślawego. Pacjentów przebadano na platformie sił reakcji podłoża. Wykorzystano oklejenie korekcji mechanicznej stosowane przy hallux valgus.
Wyniki. Obliczono poziom istotności dla wartości obciążeń operowanej kończyny oraz poziom istotności dla obciążenia przodostopia operowanej kończyny (kolejno: p=0,44, p=0,23). Obliczony wskaźnik korelacji dla obciążenia stopy operowanej z obciążeniem przodostopia tej kończyny po oklejeniu wykazał istotność statystyczną na poziomie p= 0,01.
Wnioski. Korekcja mechaniczna plastrami kinesiotaping jest skutecznym uzupełnieniem terapii lecz należy pamiętać, że jej nie zastępuje. Badania wskazują, że kinesiotaping wspomaga odtworzenie prawidłowego obciążania stopy oraz dociążenie I promienia stopy. Najlepsze wyniki w przeprowadzonych badaniach uzyskano podczas zastosowania w terapii obu oklejeń.

Słowa kluczowe:

Słowa kluczowe: kinesiotaping, hallux valgus, pedobaroskop, koślawość, rozkład sił reakcji podłoża

Abstract

Introduction. Our foot, one of the most important elements of the human musculoskeletal system, is particularly vulnerable to a wide range of strains and injuries. One of the common foot health problems is hallux valgus. The treatment of hallux valgus may involve both preservative and surgical procedures.
Research goal. Kinesio Taping and its effect on weight distribution on feet and its validity as supportive therapy after hallux valgus corrective surgery.
Material and methods. The study comprised 32 patients after hallux valgus corrective surgery. The patients were tested on the ground reaction force platform. Mechanical correction taping on hallux valgus was applied. **Results.** The level of significance of the load values on the operated limb was calculated as well as the significance of the load on the forefoot of the operated limb; respectively: p = 0.44, p = 0.23. The calculated correlation coefficient of the load on the operated foot and the load on the forefoot of the operated foot, following the application of Kinesio Taping presented statistical significance at the level of p = 0.01.
Conclusions. Mechanical correction using Kinesio Taping can serve as an efficient support to the main therapy. It must be remembered, however, that it ultimately it cannot be used as the treatment substitution. The concluded research indicates that Kinesio Taping helps to restore the proper load distribution on a foot and supports putting more weight on the first foot radius. The most encouraging results were obtained in the tests in which both tapes were used during the treatment.

Key words:

Kinesio Taping, hallux valgus, pedobaroscope, valgus, ground reaction force distribution

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Introduction

The foot is one of the most important elements of the human musculoskeletal system. It enables us to carry considerable static and dynamic loads, while standing and moving alike. The specific shape of the foot, allowing for the support of these loads, has been created in the process of evolution [1]. Nowadays, as a result of wearing shoes, the ability of a human foot to develop appropriate shape has been limited. Additionally, certain muscle groups, supported by inflexible shoes, cease to function as they should. One of the most common foot problems is hallux valgus. The biomechanical construction of a foot includes two distinctive arches, namely longitudinal and transverse, with three support points located on the side of the heel and the first and fifth metatarsal head [2]. The longitudinal arch supports the following muscles: tibialis posterior, flexor hallucis longus, tibialis anterior and flexor digitorium and hallucis brevis. There are about twenty muscles attached on the foot. Both long and short muscles (longis and brevis) are responsible for functioning of the 1st metatarsophalangeal (MTP I) joint. The long muscles include: extensor hallucis longus and flexor hallucis longus. The short muscles, on the other hand, include: flexor hallucis brevis, extensor hallucis brevis, adductor hallucis and abductor hallucis [3, 4]. When muscles supporting the arch are inefficient and the ligament connections weakened, the position of the above mentioned points may shift. This is caused by the formation of foot dysfunction. Hallux valgus can be both congenital or acquired. Dysfunction usually starts when the first metatarsophalangeal joint becomes hyperextended, causing varus position of metatarsal bone, excessive position of the head of this bone in the medial direction and rotation of the big toe towards the fifth metatarsal bone. As a consequence of this amended positioning, the base of the first metatarsal bone extends beyond the contour of the foot, which in turn leads to its exposure to constant pressure. As the malfunction progresses, deformation may occur within other structures too as a result of contractures and modified axis of the toe. All this leads to the formation of so called hammer or claw toes. As a result of the weakened peroneal longus muscle, the head of the first metatarsal bone ceases to lower when the foot is placed flat. Consequently, the second and third metatarsal heads receive the pressure. In addition, the soreness during the propulsion causes the change in foot positioning; it is now placed on its outer edge. Another consequence may by a complete stiffening of the forefoot, thereby disrupting proper biomechanics of the foot. Hallux valgus is more common in women, especially over 40-50 years of age; it is, however, also observed in men. The genes are believed to be primarily responsible for this ailment. For example, 94% of the daughters of women suffering from hallux valgus is vulnerable to this type of dysfunction [5]. Another important factor is the fact that women have a much lower ligament and muscle strength than men. Additional cause might also be uncomfortable footwear with narrow toes or high heels. Increased body mass is also considered to be one of the causes of this ailment; it leads to muscle fatigue and less pronounced foot arches. The treatment of hallux valgus may involve both

preservative and surgical procedures. Wherever the deformations are not too advanced and the changes seem to be reversible, it is recommended to use preservative therapy aimed at restoring normal functional condition of the foot. Preservative treatment may include:

• Physiotherapy, for example laser therapy, whirlpool massage, shock wave. These treatments are primarily aimed at pain reduction, inflammation reduction of synovial bursa, muscle relaxation and a reduction of excessive synovial bursa.

• Passive and active foot joint exercises. Foot positioning control exercises, initially conducted with a partial pressure on the foot, then with the full pressure on a stable ground and then on an unstable ground (sensorimotor cushions, balls) and Alfredson training to improve the eccentric work of gastrocnemius and soleus muscles.

• Manual therapy of the foot and big toe joints. First MTP joint mobilisation (flexion, extension and traction), mobilisation of the metatarsophalangeal joint and mobilisation of the hammer toe.

• Kinesio Taping: mechanical taping improving the position of the head of the first metatarsal bone rebuilding longitudinal and transverse foot arch and de-rotating the hallux.

• Making way for foot support on the head of the first metatarsal bone. Initially, the exercises should be conducted with a therapist and with the use of exercise tape resistance. The pressure is applied on to the plantar part of the head of the first metatarsal bone and control fulcrum exercises on the first metatarsal bone (with a tape) are conducted.

• Stretching of the tight muscle groups, including calf triceps muscle, extensor hallucis longus and hallucis adductor.

• Exercises aimed at strengthening weak muscle groups, especially the longus peroneal muscle.

• Training on correct application of pressure on feet and gait re-education.

Research aim

This paper focuses on the following research questions:

1. Do Kinesio Taping techniques affect feet load force reaction on the ground?
2. Are the values of the changes obtained statistically significant?
3. Can Kinesio Taping be qualified as supportive therapy for patients after the hallux valgus surgery?

Material and methods

The research was conducted between September and November 2015 in the Outpatient Clinic of the Solec Hospital, General Rehabilitation Day Centre. The tests were performed on a ground reaction forces platform on pedobaroscope. The static test results were analysed with the FreeStep software. The Kinesio tapes were applied by a qualified physiotherapist holding KT1 and KT2 training on tape application. The study comprised 32 patients, 29 women and 3 men, after the hallux valgus corrective surgery. The age of respondents ranged from 26 to 83, with the mean age value of 58. All respondents have completed the treatment process; the surgery was performed not later than 1 year prior to the study.

Fig.1. Patient examination on the ground reaction force platform

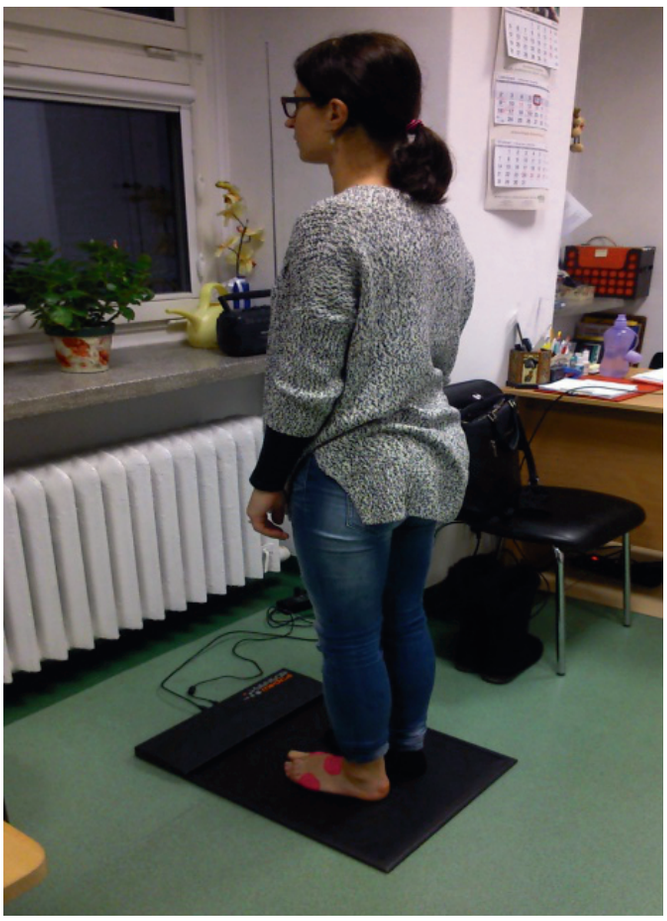

Fig.2. Static examination

Fig. 3. Tape application technique: mechanical correction of hallux valgus

Fig. 4. Patient tape application technique: arch supporting taping

In order to qualify to participate in the research all respondents completed a personal questionnaire and gave their consent. The first test was conducted on the ground reaction force platform, following the provision of thorough information about the course of the test. It was emphasised that the respondents shoukd keep a relaxed body posture during the test (Fig. 1). The test was conducted in its static version (Fig. 2) Then appropriate Kinesio Taping was applied. The taping techniques used were consistent with the provisions of the Kinesio Taping method. Mechanical correction taping was used with the tape tension of 75%, supporting the shaping of the transverse foot arch (Fig. 3) and the longitudinal foot arch. The other type of taping applied aimed at hallux valgus shape correction (mechanical correction, tape tension 50%) (Fig. 4) [6, 7]. The test on ground reaction force platform was repeated after the application of the Kinesio tapes, in exactly the same manner as the original examination.

Results

The research results in the FreeStep software (Fig 5) were analysed with STATISTICA programme. As the results showed normal distribution, Student's T-test for dependent variables was used for analysis (Fig. 6).

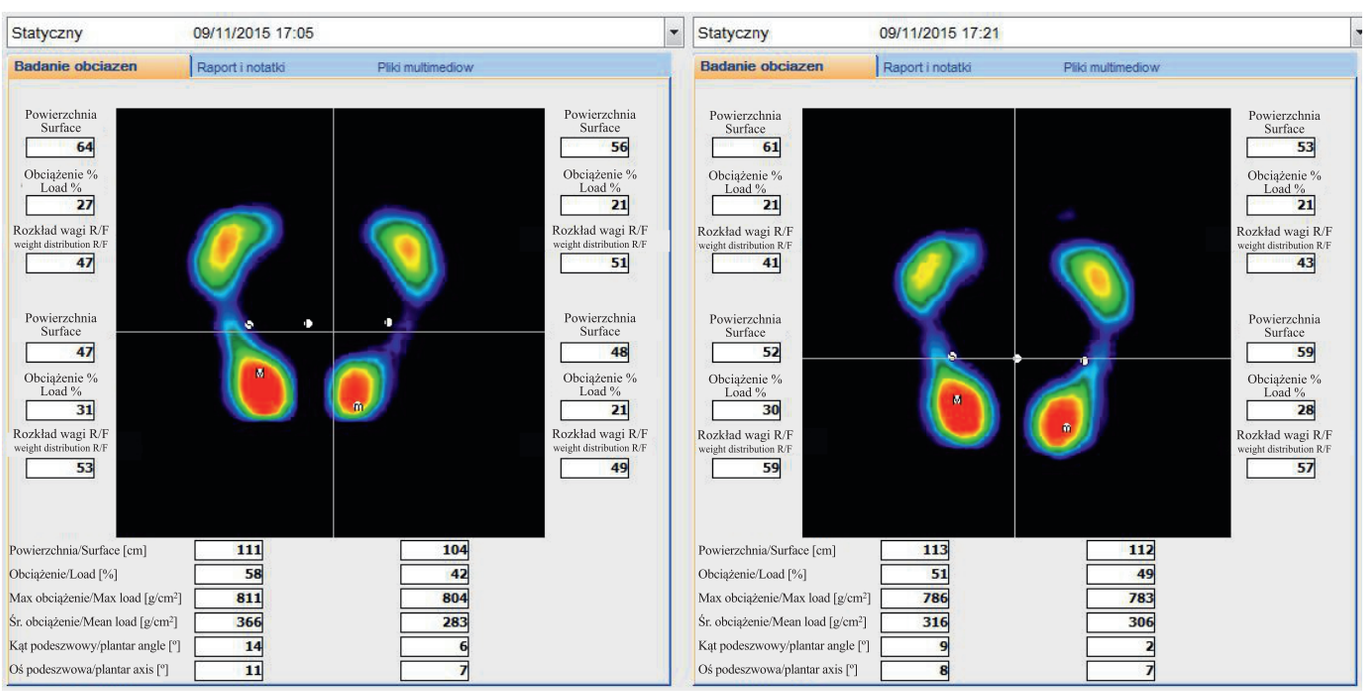

Fig. 5. A sample test result n = 1 in FreeStep (right foot)

1. The calculation of the level of significance for the load value on the operated limb ($p < 0.05$)
2. The calculation of the level of significance for the load value on the forefoot of the operated limb ($p < 0.05$)
3. The calculation of the correlation coefficient the load on the operated limb and on the operated forefoot variables.

The level of significance for the values of these variables was calculated. Both values presented no statistically significant differences; respectively: $p = 0.44$, $p = 0.23$.

(Table 1). However, the correlation coefficient the load on the operated limb and on the operated forefoot variables showed statistical significance at the level of p = 0.01 (Table 2, Fig. 7).

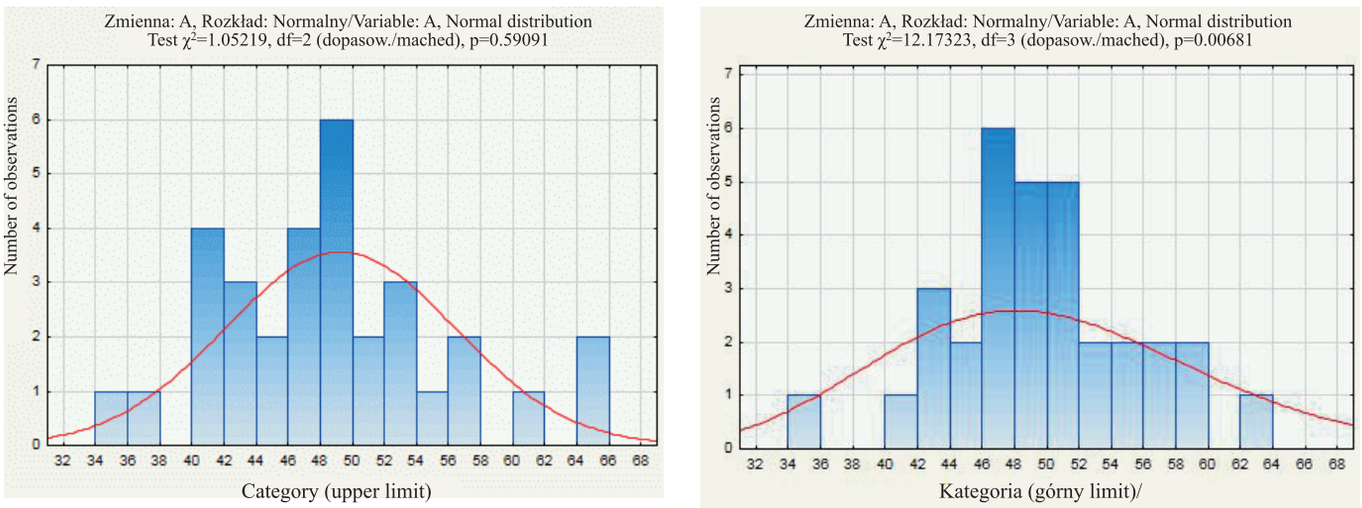

Fig. 6. Distribution graph for load test performed on the operated foot before taping (variable A) and after taping (variable B)

Table 1. T-Student test results: A - load on the operated foot before taping, B - load on the operated foot after taping, C - load on the forefoot of the operated limb before taping, D - load on the forefoot of the operated limb after taping

Zaznaczone różnice są istotne z p <,0500/The differences marked are significant p <0.0500

Variable	Mean	SD	Significant	Difference	SD difference	t	df	p	Confidence -95.000%	Confodence +95.000%
A	49.25000	7.157221								
B	50.12500	5.824033	32	-0.875000	6.389255	-0.774699	31	0.444387	-3.17857	1.428572

Test dla prób zależnych (Kopia zestawienie wyników_az2)/T-test for dependent samples (copy, result summary_az2)
Zaznaczone różnice są istotne z p <,0500/The differences marked are significant p <0.0500

Variable	Mean	SD	Significant	Difference	SD difference	t	df	p	Confidence -95.000%	Confodence +95.000%
C	43.90625	10.78338								
D	41.93750	10.77314	32	1.968750	9,149244	1.217252	31	0.232694	-1.32990	5.267404

Table 2. The correlation coefficient of the load on the operated foot and the load on the operated forefoot after the Kinesio Taping application

Variable	Forefoot before	Forefoot after
leg_before	0.120269	0.155421
leg_after	-0.102536	0.015038

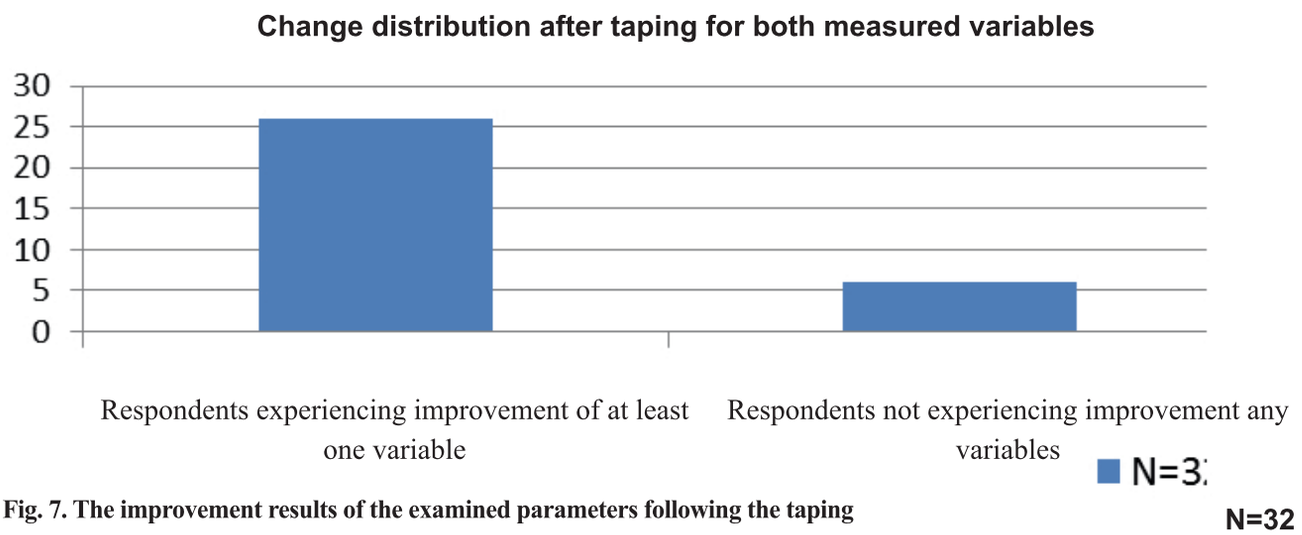

Fig. 7. The improvement results of the examined parameters following the taping

Discussion

The extensive use of Kinesio Taping is currently widely discussed and numerous reports are available. However, not many of them focus on presenting the effects of taping in the cases of hallux valgus type deformation. There are a few reports presenting a trial use of a mechanical correction on the foot aimed at reduction of heel pronation [8]. As indicated by Lugue-Suarez, current research affirms significant reduction of pronation as a result of taping. The results of another study demonstrate statistically significant reduction of hallux valgus following a one-month use of taping therapy [9]. This study was conducted on a group of respondents with nonoperative hallux valgus; the taping was used solely to reduce valgus angle and pain. On the other hand, there has been a number of reports published presenting the use of Kinesio Taping in the cases of ankle instability, with the aim of increase of joint proprioception and stabilisation [10, 11, 12, 13]. Other publications focus of comparison of the effects of hallux valgus surgical and preservative treatments [14].

Susanne T. Hawson [15] in her publication presents an example of hallux valgus taping treated as an element of the main treatment. No reports, however, have been found presenting Kinesio Taping applied in an attempt to reconstruct a healthy foot arch and reduce hallux valgus after the corrective surgery. Following this surgery, the maintenance of hallux valgus reduction obtained through the treatment is not sufficient. It needs to be remembered that hallux valgus is a multifaceted deformation, affecting transverse and longitudinal arches too.

Additionally, patients are used to putting less pressure on the painful metatarsal radius. This study took all these components into consideration, attempting to recreate possibly healthy foot position in order to support further improvement.

Conclusions

1. Mechanical correction may serve as an effective complement to the main therapy.
2. The load distribution on the operated after corrective surgery changes, as the patients often tend to "relieve" the foot.
3. Research indicates that Kinesio Taping support the recreation of the normal load on the foot and supports putting more weight on the first foot radius.
4. The most encouraging results are obtained with when both taping is combined in therapy; this has been confirmed by the results of the correlation.

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