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Original Research

Immediate Effect of Kinesio Taping Application on the Balance of Recreational Futsal Players

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ABSTRACT

Background: Recreational sports are the most widely practiced type of sport worldwide. Recreational athletes use their sport as the satisfaction of personal needs in fitness. Futsal is a development of football which is the most popular sport in the world. In futsal there are many demands on individual technical and tactical skills that require a good balance. Kinesio taping stimulates *mechanoreceptors*, this stimulus can increase proprioception in normal tissue. Proprioception receptors are located in the skin, muscles and joints. For the distal extremities, receptors in the skin and joints become the most important factor. Increasing the ankle proprioception is important to improve balance that supports futsal players.
Objective: To determine immediate effect of kinesio taping on balance, immediately after the application of kinesio taping.
Method: This study was a randomized control trial. The subjects were divided into two groups, control group and treatment group. Balance was assessed by the mCTSIB (Modified Clinical Test of Sensory Integration on Balance) questionnaire. The control group performed the mCTSIB test without kinesio taping application, the treatment group performed the mCTSIB test with kinesio taping installed. Balance was measured before and after the intervention.
Results: The subjects were 44 recreational futsal players who were divided into two groups, control group (n=22) and treatment group (n=22). The average mCTSIB results in the control group showed an improvement of 1.45±2.59 with p=0.016. The average mCTSIB results in the treatment group showed an improvement of 24.27±1.49 with p=0.000. The results for the difference between pre-test and post-test scores showed a greater increase in the treatment group, this increase was statistically significant, with a value of p=0.000
Conclusion: There is a significant improvement in balance after kinesio taping application.

Keywords: *Ankle, Balance, Futsal, Kinesio taping, Mechanoreceptors, Proprioception*

INTRODUCTION

Football in its current form appeared in England in the mid-19th century. At this time, football is the most popular sport in the world. Football is a ball sport with many demands on the technical and tactical skills of individuals. Futsal is a development of the sport of football, in general almost the same as football. Futsal originated in Uruguay in 1930when Juan Carlos Ceriani created a 5-player version of football also called *mini soccer*.[1-4]

The most commonly practiced type of sport around the world is recreational sports.[5] Recreational athletes use their sport as satisfaction of personal needs in fitness. Recreational sports fans contain individual athletes or those who play the sport as community-based members.[6]

According to Dr. Kase, kinesio taping can increase stimulation to *mechanoreceptor*, This stimulus can increase stimulation of proprioception in normal tissues.[7] Proprioceptive receptors are located in the skin, muscles and joints. For the distal extremities, receptors in the skin and joints become the most important factor, while for the proximal extremities, receptors in the muscles become the most important factor.[8] Increasing ankle proprioception is important to improve the balance that supports futsal. The use of kinesio taping is done shortly before a football match; therefore, it is important to determine the immediate effect of kinesio taping on balance, immediately after the application of kinesio taping

METHOD

Design

This study used a randomized control trial research design. The research subjects were divided into two groups, namely the control group and the treatment group.

Research Subjects

Research samples were taken from subjects who had met the inclusion and exclusion criteria. All subjects who met the criteria for inclusion and exclusion of the study were included in the treatment group until the sample size was reached. The inclusion criteria were as follows: Healthy adult males, aged 17 – 24 years, play futsal 1-4x per month, can understand and follow the

examination instructions provided (Moca ina >26), willing to participate in research and sign research consent sheets (informed consent), own and use their own futsal shoes, vision 6/6 without glasses or corrected by using glasses, fatigue scale test scores of 10-20. Exclusion criteria were as follows: sensory disturbances in one or both legs of the subject from the results of physical examination, history of allergy to kinesio taping, futsal athletes, muscle strength of the lower extremities with a value of <5 on MMT examination, Romberg test with positive results. The drop out criteria were as follows: feel pain immediately after the installation of kinesio taping and if participant decides not to continue their participation in this study.

Procedure

Prospective research subjects who met the inclusion and exclusion criteria and were willing to participate in the research were asked to fill out an informed consent sheet. Research subjects who met the criteria were drawn to enter the control or treatment group. All subjects underwent mCTSIB examination. This session becomes the baseline. Control subjects performed mCTSIB examination again without kinesio taping installation immediately after mCTSIB baseline examination. For treatment subjects: both ankles of the study subjects were dried from sweat, if there was hair on the ankles, shaving was done first then kinesio taping (Leukotape K from BSN) with a width of 5 cm was installed on the extensor halucis longus muscle and extensor digitorum longus on both feet with tendon correction techniques (percentage of kinesio tape stretch was applied as in Figure 1). Immediately after the installation of kinesio taping (maximum 15 minutes), subjects performed mCTSIB examination with kinesio taping installed.

Statistical Analysis

Data were collected in data collection sheets and coded, tabulated and entered into applications on computers. Data analysis includes descriptive analysis and hypothesis testing. To compare subject characteristics between groups we used Fisher's exact test for categorical data, independent t test and Mann Whitney for numerical data.

Confounding variables were analyzed using logistic regression. The level of significance in this study is obtained if a p<0.05 value is obtained with a 95% confidence interval. Ethical clearance was given from the Medical Research Ethics Commission of Faculty of Medicine UNDIP/Dr. Kariadi Hospital Semarang with No.117/EC/KEPK/FK-UNDIP/IV/2023 and a license to carry out research from the Faculty of Medicine, Diponegoro University Semarang with number 663/UN7. F4.1/PP/IV/2023. The willingness of research subjects to be included in research was carried out in writing (informed consent) and they were given an explanation of the objectives, benefits, and effects that can occur due to research.

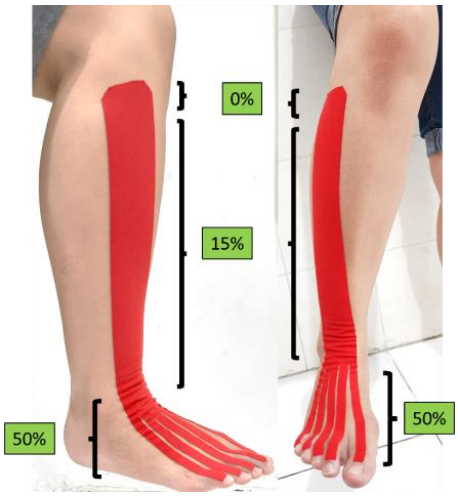

Figure 1. Kinesio Taping Application

RESULT

All subjects (44) carried out all research sessions to completion, without any subjects dropping out. None of the subjects reported any side effects from kinesio taping during or after the study. Variables were age (p=0.098), weight (p=0.487), height (p=0.172), and futsal frequency (p=0.762). From these results, it can be concluded that the research subject is a homogeneous sample (Table 1).

Table 1. Characteristics of the Research Subjects

Variable	Group		p
	Control (n=22)	Treatment (n=22)	
Age (years)	20.18 ± 1.18	19.5 ± 1.47	0.098§
Body weight (kg)	68.91 ± 13.57	65.5 ± 9.52	0.487¥
Body height (cm)	171.89 ± 5.83	169.64 ± 4.87	0.172§
Futsal Frequency /month			0.762±
1	2 (9.09%)	1 (4.55%)	
2	2 (9.09%)	3 (13.64%)	
3	4 (18.18%)	2 (9.09%)	
4	14 (63.64%)	16 (72.73%)	

Description : * Significant (p < 0.05); § Independent t; ¥ Mann Whitney; ±Fisher's exact

Table 2. *Balance Comparison*

mCTSIB	Group		P
	Control (n=22)	Treatment (n=22)	
Pre test	75.82 ± 8.47	74.77 ± 8.78	0.689§
Post test	77.27 ± 7.73	99.05 ± 8.81	0.000¥
P	0.016¶*	0.000¶*	
Difference	1.45 ± 2.59	24.27 ± 1.49	0.000§

Description: * Significant (p < 0.05); § Independent t; ¶ Paired t; ¥Mann Whitney

The average balance results of the control group before and after treatment with paired t-tests showed a significant difference with p = 0.016 with changes of 1.45 ± 2.59.

The average balance results of treatment group before and after treatment with paired t-tests showed a significant difference with p = 0.000 with changes of 24.27 ± 1.49.

In the post-test examination, there was an improvement in balance in both groups, the increase was statistically significant, with p=0.016 for the control group and p=0.000 for the treatment group. There was a significant difference in post-test results between the treatment group and the control group p=0.000. The results for the difference between pre-test and post-test scores showed a greater increase in the treatment group, this increase was statistically significant, with a value of p=0.000.

DISCUSSION

The foot is made up of 28 bones, which are divided into three parts. *The hindfoot* is made up of calcaneus and talus. The *midfoot part* consists of navicular, cuboid, and three cuneiforms. *The forefoot* consists of five metatarsals and 14 phalanges and two sesamoid bones. This bone is divided axially into three columns based on movement relative to the tarsometatarsal joint. The *medial column* consists of the medial cuneiform and the first metatarsal. The *intermediate column* consists of the medial and lateral cuneiform, the second and third metatarsals. The *lateral column* is made up of the fourth, fifth and cuboid metatarsals.[9]

There are 34 joints on the foot. The *ankle* joint is a *hinge joint* consisting of the tibia and fibula, which forms the ankle mortise which is articulated with the talus. The subtalar joint is made up of two or three joint surfaces called facets, which are glide joints in some orientation between the talus and calcaneus. The transversus tarsal joint (chopart) consists of two tarsal joints which are the change from *the hindfoot* to *the midfoot*. The second is the calcaneocuboid joint, which is a glide joint. The tarsometatarsal joint (lisfranc) is the boundary of the *midfoot*. These joints are planar in shape and line up in the same direction. These joints are made up of three cuneiforms and the tarsal bone articulates with five metatarsals. This joint is a shallow *ball & socket* joint . There are nine interhalangeal joints, which are *hinge* joints. The first finger has only one interphalangeal

joint, and the other finger has two interhalangeal joints. The other joints are not specifically enclosed in the midfoot and form a sizable surface between each cuneiform and its contact with the cuboid and navicular.[9]

Ligaments are soft tissue structures that connect bones and help determine the function and level of motion that joints are capable of. This structure helps determine the resting position of the legs. The ligaments are made up of highly organized collagen fibers that provide significant shock absorption to the legs. The ligament, like a bungee rope, dampens energy by stretching and releasing energy slowly as pressure is relieved. Although this characteristic is important for ligament function, it can also be the cause of ligament injuries. Too much force gained in a short period of time or gained over time can cause the ligament to stretch and not return to its original shape. These changes cause joint instability and structural damage.[9]

The ligaments provide support to the bones. The ligament is flexible but not elastic. This flexibility is necessary to allow joint movement, but the inelastic nature is necessary to keep the bones in position with each other and to provide protection to the joints. The ligaments prevent excessive joint movement.[10]

The extensor muscle hallucis longus, is a thin muscle located in the *profundus* between the anterior tibialis muscle and the extensor digitorum longus, origo in the fibula and interoseous membrane and insorcio in the phalang distal *digiti* 1 *pedis*. Its main function is for the one digit extensor of *the pedis*, but this muscle also aids in dorsiflexion and ankle inversion. This muscle is innervated by the deep peroneal nerve (L4, L5, S1).[10]

The extensor muscle digitorum longus is the most lateral muscle of the anterior leg muscle. This muscle attaches to the anterior fibula, interoseous membrane, and lateral condyle of the tibia, then descends and attaches to *the phlanx distal digits* 2-5. The extensor muscle digitorum longus serves primarily to extend the second to fifth toes, but it also aids in ankle dorsiflexion. The extensor muscle digitorum longus does not have an inversion/escalation role, because it crosses the joint through the center of the axis. These muscles are innervated by the deep peroneal nerve (L4, L5, S1).[10]

Dr. Kenzo Kase developed the kinesio taping method in the 1970s to find new ways to facilitate the body's natural healing process and extend the benefits of treatment after his patients left the clinic. [11]

Kinesio taping resembles the quality of the epidermis, is made of cotton fibers and is designed to stretch longitudinally up to 60% of its initial length. The thickness is

similar to the thickness of the epidermis. The material of cotton fibers serves for evaporation. The adhesive uses acrylic adhesive and activated adhesive with warm temperature. Acrylic adhesive has wavy grooves to resemble fingerprint-like qualities, this not only serves to lift the skin, but also reduces moisture. The combination of stretchability, thickness and adhesion allows kinesio taping to resemble the quality of the skin.[7]

The skin to be fitted with kinesio taping must be dry, and free of perfume, oil or lotion. Things that reduce the ability of acrylic adhesive will reduce the therapeutic ability and also reduce the time the kinesio taping can be properly installed.[7]

For the installation of kinesio taping, after the installation of *the anchor*, the target muscle or tissue is positioned in the maximum position of the patient's range of motion of the joint. Tissue stretching combined with the stretching ability of kinesio taping causes wrinkles in the skin.[7]

Correct stretch is the most important thing in kinesio taping applications. Each kinesio taping application technique requires a specific pull to get the best benefits. If the pull is too large, it will reduce the therapeutic effect and will cause problems such as tissue compression, wounds or irritation. In the initial application it is better to use a pull that is smaller than indicated. If the pull is right, the patient will feel a difference such as reduced pain, increased muscle function, and increased range of motion of the joint. The percentage of attraction in question is the percentage of 100% of the available taping attractions. For example, in a 10-inch long taping, with the taping ability to stretch a maximum of 40-60% of the initial length, the maximum pull will be 14-16 inches long. If 10 inch taping is to be pulled by 25%, it will be 11-11.5 inches.[7]

Kinesio taping affects *the skin's mechanoreceptors* which can increase proprioception.[7] Application of kinesio taping using *tendon correction* techniques using 50-75% tension of the available stretch. To use kinesio taping for the purpose of *mechanoreceptor* stimulation, use taping with a width of 5 cm. The application can provide the highest inward/downward pressure levels which provide stimulus to a large number of *mechanoreceptors*.[7] Researchers used tendon *correction* techniques because they were used to increase stimulus in tendon and ligament areas that increased stimulus to *mechanoreceptors*, while selection of extensor *digitorum* and *extensor haluccis longus* muscles because the muscle passes through 34 joints in the foot, it increases the stability of the ankle joint and the muscle has tendon inertions at the distal end of the foot; one of the most important things in balance is the ability to feel the position of the distal joints.[7, 12, 13]

Mechanoreceptors are sensitive to mechanical energy. Examples include skeletal muscle receptors that are sensitive

to stretching, receptors in the ear that contain fine hair that bends due to sound waves, and *baroreceptors* for blood pressure monitoring.[14]

The tactile (touch) receptors in the skin are *mechanoreceptors*. The mechanical force of the stimulus distorts the proteins of the nonspecific cation channels in the plasma membrane of the receptor, which causes the receptor potential to trigger the action potential in the afferent fibers. The sensory input from these receptors provides information to the central nervous system regarding the body's contact with objects in the external environment.

Proprioception is found in the skin, joints and muscles. For the distal extremities, the receptors in the skin and joints are the most important, while for the proximal extremities, the receptors in the muscles are the most important. The organ tendon golgi contributes to proprioception especially in terms *of sense of force* and *sense of heaviness*. [8] It provides information related to the position of the body part relative to other body parts and also related to body movement. For effective motor control, the central nervous system requires continuous information from proprioception.[14]

To perform planned, coordinated muscle activity, the brain regions that regulate motor output rely on afferen input from a wide variety of sources. For example, to be able to catch the ball, the motor system must create a sequential program that moves the body and positions the body correctly to catch, using predictions of the ball's movement from visual input. Many muscles work simultaneously and alternately on various joints to move the body position quickly while maintaining balance. In order to make a program suitable for muscle activity, the central nervous system must know the initial position of the body part and this information must be constantly obtained from the proprioceptive input related to the movement that has been started, so that movement adjustments can be made as needed.[14]

In this study there was an increase in balance in the control group and treatment group. The increase in balance in the treatment group was greater than the increase in balance in the control group and this difference was statistically significant. This is in line with research conducted by Carsten Müller.[15] The installation of kinesio taping increases *mechanoreceptors* in the skin, thereby increasing sensory input which affects the balance of the study subjects.[7, 14] Study subjects reported it took 5-10 minutes after the installation of kinesio taping to get used to it. After this time, the subject feels comfortable with kinesio taping attached.

Balance is influenced by many factors such as proprioception, motor coordination, visual acuity, muscle strength, pain, fatigue level, and the presence of vestibular

dysfunction. In this study, the installation of kinesio taping can improve balance and is statistically meaningful.

In this study there was an increase in both groups. This increase can occur due to the learning effect. Human behavior is influenced by experience, learning, and habits. Memory is the storage of acquired knowledge to be remembered later. Learning and memory form the basis by which individuals adapt their behavior to specific external circumstances. The storage of the information obtained is carried out in at least two stages: short-term memory and long-term memory. Short-term memory lasts for a few seconds to hours, while long-term memory is retained for days to years. In addition to short- and long-term memory, there is also working memory, or the so-called "erasable mind whiteboard." Working memory holds for a while and connects various pieces of information relevant to the current task. Through working memory, humans briefly store and process data for immediate use of both newly acquired information and related knowledge previously stored that is temporarily brought into working memory so that it can evaluate data that enter into context. This integrative function is essential for the ability to reason, plan, and make judgments. By comparing and manipulating new and old information, working memory allows people to string thoughts together in a logical order and plan future actions.[16]

This research protocol requires subjects to perform balance checks with a range of 4 to 12 times, if the research subjects successfully complete the examination up to the specified time in four conditions, then the subject is only examined four times, but if the subject cannot complete the examination in less than 30 seconds in each condition, then the examination can be repeated up to three times in each condition. By examining up to 12x the data capture, the subject already has a memory in the learning process that is used to constantly improve their balance.

RESEARCH LIMITATIONS

In this study, blinding was not carried out on the research subjects. Although randomization minimizes selection and confounding biases that interfere with studies, *blinding* minimizes the likelihood of prognostic differences between intervention groups. In the absence *of blinding*, knowledge of group tasks can influence the behavior of subjects in the study. Subjects who knew they were not in the treatment group were more likely to disobey the study protocol.[17] Subjects who knew they were part of the treatment group tended to seek better results that met the researchers' expectations.[18]

This study only examined at one time so that short-term effects can be assessed but long-term effects of kinesio taping installation cannot be assessed.

CONCLUSION

The use of kinesio taping has an immediate effect to improve balance in recreational futsal player.

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