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EFFECT OF KINESIO TAPE VERSUS ATHLETIC TAPE ON MYOELECTRIC ACTIVITY OF ANKLE MUSCLES IN PATIENTS WITH CHRONIC ANKLE SPRAIN

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ABSTRACT

Background: Sprained ankle a common orthopedic injury. The standard treatment for ankle sprains remains nonoperative. Ankle taping was used to protect and prevent ligaments excessive strain. So, the current study aimed at investigating the effect of spa-care Kinesio tape versus standard white athletic tape on myoelectric activities (EMG) of ankle evertors (peroneus longus) and invertors (tibialis anterior) in a chronic ankle sprain.

Methods: A convenient sample of 30 patients with a chronic ankle sprain (18 females and 12 males) were included in this study. Their mean age ±SD was 24 ±1.2 years. Their height was 175±4.8 cm among men & 163±5.2 cm for females, and weight was 85±5.2 kg for males & 74±5.5 kg for women. It was a within-group design in which the same participant experienced the two types of taping compared to no taping condition. Root mean square (RMS) was measured while participants were moving the isokinetic dynamometer at an angular velocity of 120°/sec using concentric contraction mode through full ankle range of motion. The EMG (RMS) of evertors and invertors was measured immediately after the three taping ways (no tape, Kinesio tape, and athletic tape) with a one-week interval between each taping.

Results: Spa-care Kinesiotape significantly reduced evertors and invertors EMG (RMS) compared with no tape or athletic tape in patients with chronic ankle sprain. Mean± SD of the evertors was 0.7 (±0.1) for no tape and 0.58 (±0.2) for Kinesio tape. The P value was 0.000 for kinesiotape in evertors compared with no tape. Also, mean± SD of the invertors was 0.87 (±0.23) for no tape, and 0.54 (±0.1) for Kinesio tape and the P value was 0.001 for Kinesio tape in invertors compared with no tape.

Conclusion: Spa-care Kinesio tape may be useful for reducing EMG activity of ankle muscles in a chronic ankle sprain.

Keywords: Myoelectric activity, Kinesiotape, Athletic tape, Ankle muscles, Chronic ankle sprain.

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INTRODUCTION

A sprained ankle is a common orthopedic injury. Ankle sprains occur in both athletes and non-athletes. They can occur during sports or carrying out daily activities [1]. A lateral ankle sprain can lead to localized joint impairments that affect the whole musculoskeletal and sensorimotor systems [2]. It causes disability, recurrent injuries, and decreased life quality. However, the recurrent ankle injury is not different from the first acute sprain [3].

Chronic instability is the main result of acute ankle sprain [4]. It consists of three subgroups classified as mechanical instability, functional instability, and recurrent sprain [5]. Time consumption and cost can affect prevention and treatment programs. Despite the different rehabilitation programs, a repeated ankle sprain can occur [6]. So, more researchers are needed for treatment and reduction the ankle sprains incidence [7].

The primary way of treating ankle sprains is non-operative. So, early and functional rehabilitation remains the selected conservative management including peroneal muscle strengthening and proprioceptive training [8]. The peroneal muscles have a role as ankle primary evertors and dynamic stabilizers. There were conflicting results regarding the peroneal muscles latency in individuals with unstable ankles [9].

Ankle taping is considered as a mean to protect and prevent excessive ankle ligaments strain. Athletic trainers dealt with different taping types as white athletic tape and Kinesiotape. The white inelastic athletic tape is used for prevention of ankle injuries, but it has small wear time. On the contrary, Kinesiotape is mainly used for treatment and its wear time is 3-5 days according to the activity [10].

Non-elastic athletic tape improves peroneus longus muscle reactions by maintaining higher levels of muscle activities. It also enhances the peroneal muscle reaction time during experimental ankle sprain in patients with greater ankle stability [11]. According to Bernier (2000) [12], Kinesio tape could modulate ankle muscle physical processes as well. However, its real effects on muscle performance are still being investigated. Also, it increases muscle strength by improving the concentric pull on the fascia that causes more muscle contraction [13].

The white athletic tape was used to reduce ankle range of ankle motion thus preventing injuries. However, with physical exercises, it becomes loosened [14]. Most of the expected effects of taping are hypothesized, and there is little literature supporting its effects [15]. There was a lack in previous studies regarding the effect of both Kinesio tape and athletic tape on ankle muscle functions. So, the current study aimed to examine the impact of both spa care Kinesio tape and standard white athletic tape on the myoelectric (EMG) activity of ankle evertors and invertors (peroneus longus and tibialis anterior) in patients with chronic ankle sprain. The measured variable was the root mean square (RMS).

METHODS

Study Design

The study design was a within-subject experimental design in which one group of patients was tested at three taping modes (no tape, Kinesio tape, and athletic tape). The results were then compared to find out the effects of the two types of taping on the dependent variables. The dependent variables were the RMS value of peroneus longus and tibialis anterior muscles in patients suffering from a chronic ankle sprain.

Subjects

Thirty participants (18 females and 12 males) having chronic ankle sprain (six weeks post injury), with a mean age (±SD) of 24± 1.2 years were included in this study. Their mean height was 175±4.8 cm for males & 163± 5.2 cm for females. Their mean weight was 85±5.2 kg for men and 74±5.5 kg for women. The chronic ankle sprain was diagnosed by orthopedists who referred patients from five outpatient clinics and were informed of their inclusion and exclusion criteria. Patients were selected if they had grade four muscle strength (as assessed by manual muscle test), and good ankle muscle flexibility. They should not have taken analgesic drugs for one week before the time of testing.

Patients were excluded if they had any lower extremity acute joint inflammation or pain, recent fracture or surgery, abnormal ligament laxity, congenital deformities or neurological deficits. Patients with diminished sensation or skin irritation, concurrent use of any supportive devices, been involved in any previous training programs, abnormal foot postures were also excluded. All patients were tested at three taping modes; no tape, kinesiotape, and athletic tape. Each patient randomly selected the order of the tapping mode using simple random allocation method.

The EMG activities of ankle muscles were measured while patients were moving the isokinetic dynamometer. To avoid muscle fatigue induced by the isokinetic device which may affect the results, the assessment interval was seven days. All patients were given potential risks and benefits of the study. This work was carried out in according to the code of ethics of the World Medical Association (Declaration of Helsinki) for human experiments. All participants signed an informed consent form before participation and obtained acceptance from the Ethical Committee of Faculty of Physical Therapy was taken (NO: P.T.REC/012/00562).

PROCEDURE

EMG apparatus

The EMG activities of ankle evertors (peroneus longus) and invertors (tibialis anterior) were measured using the EMG MyoSystem 1400A, (Noraxon Inc, Scottsdale, USA). It consists of the main unit, EMG electrodes (disposable surface EMG electrodes and EMG active cable with its input channels), and computer unit. The bandwidth of the EMG channels was set at 1000 Hz. The filtering of EMG raw signals was done using a bandpass filter ranging from 10 to 500 Hz before sampling at 960 Hz and amplified using a differential amplifier. Common mode rejection ratio was 100 db. The EMG signals were full wave rectified and smoothened using RMS method. The RMS value was used as a mean to better reflect muscle actions levels at rest and activity. The measured signals were displayed on a multi-trace monitor of the computer setup.

Disposable Silver-Silver Chloride electrodes (Ag-Ag Cl) with an active surface area of 1 cm^2 were used to pick up the EMG activity of the tested muscles. They were secured in place with self-adhesive tape. Easily released protective papers were placed over the electrode side to keep the electrolyte paste of the disc in its position.

Two channels of the EMG active cable were used in the current study to record changes in the pattern of EMG signals of tibialis anterior and peroneus longus muscles. Each channel collects the data using two electrodes connected to a junction box. One of them is active and the second is the reference electrode. They all have a common ground electrode. The junction box is in turn connected to the EMG main unit. The main unit transfers the recorded signals to a computer with installed software to display, record, and analyze the data. Myoresearch XP master edition version 1.04.03 was used for data analysis of the raw EMG signals. The EMG signals were recorded while patients were moving the isokinetic dynamometer. Figure 1 shows EMG main unit and active cable with its input channels.

Figure 1: EMG main unit and active cable with its input channels.

Electrode placement

The participant skin was shaved and cleaned to reduce skin resistance for EMG signal pick up. The motor points of the tested muscles were determined and marked on the skin by a non-permanent ink marker. As suggested by electromyography and kinesiology association, electrodes were placed over the muscle belly, and the detection surface (two parallel bars) was in the direction of the muscle fibers. The maximum interelectrode spacing between the recording electrodes was two cm.

Tibialis anterior

A reference line was drawn from the tibial tuberosity to the inter-malleoli line, and the electrodes were oriented at 60-65° to this reference line [16]. The ground electrode was positioned at the tibial tuberosity. The electrodes were placed on the muscle belly lateral to the anterior edge of the tibia, following palpation during foot dorsiflexion and inversion [17].

Peroneus longus

A reference line was drawn between the fibular head and lateral malleolus so that the electrodes were oriented parallel to this reference line. The electrodes were placed at the junction of the proximal and middle third of the fibula on the most prominent part of the muscle [17]. Figure:2 shows electrode placement over the tested muscles.

Normalization of tibialis anterior muscles

Each participant was allowed to sit on the edge of the bed. The knee joint was 90 ° flexed to provide maximum resistance to ankle dorsiflexion and inversion. Manual resistance was given on the dorsum of the foot. Each participant was asked to dorsiflexion and invert his ankle as hard as possible and encouraged by continuous verbal commands. Each participant performed three maximum voluntary isometric contractions (MVIC) trials, and each trial lasted for six seconds, followed by two minutes rest period. The average of the RMS values of three MVICs of tibialis anterior muscle was used for normalization of the EMG recordings.

Normalization of peroneus longus muscle

The same procedure for tibialis anterior was done except that the manual resistance was given on the lateral border of the foot. Each participant was asked to evert the foot against maximum resistance.

$$\text{So, normalized EMG} = \frac{\text{EMG recorded during activity}}{\text{recorded at MVIC}}$$

Isokinetic device

Testing was done using the Biodex System 3 multi joint system for testing and rehabilitation (Biodex Medical System, Shirley, NY). Ankle attachment was selected. The angular velocity of 120°/sec, full ankle ROM, and concentric contraction mode were entered to the isokinetic software through the system controller.

Taping technique

Spa-Care Kinesio tape

Kinesiotape (Spa-Care) was used in this study. It was 5 cm width by 5m long for ankle taping. Two colored KT rolls were used (black for tibialis anterior, and piege for peroneus longus muscles). Taping was done according to the manual of Kenzo Kase's kinesiotaping [18]. Each patient sat on a taping table with relaxed legs. The tape was put on the stretched muscle from the origin to insertion.

The positioning of black kinesiotape on tibialis anterior muscle

The base of the tape was applied to the origin at the lateral tibial condyle and superior 2/3 of anterolateral surface of the tibia. Then the foot was stretched into plantar flexion and eversion, and taping was attached towards the insertion at the medial surface of medial cuneiform and base of the first metatarsal (Figure 2).

Figure 2: Electrode placement over the tested muscles

The positioning of piege kinesiotape on peroneus longus muscle

Similarly, peroneus longus muscle was taped from origin to insertion. The base of the tape was applied at the beginning of the muscle at the head and proximal 1/2 to 2/3 of the lateral side of the fibula. Then the foot was moved to inversion and dorsiflexion. The tape was placed behind the lateral malleolus to be attached to the lateral sides of medial 1st cuniform and 1st metatarsal (Figure 3).

Figure 3: Positioning of piege KT on PL muscle and black KT on TA muscle

The Kinesio tape was applied 20 minutes prior to testing to prevent tape loosening as if the activity occurs before this time; the tape may come off. When the testing procedure was accomplished, the tape was removed from the top down in the direction of body hair. The tape lifted from the skin while applying tension between the skin and the tape; then the skin was pushed away from the tape rather than pulling the tape away from the skin.

White nonelastic classic athletic tape

The white nonelastic classic athletic tape was used in this study for ankle taping. It was 5 cm width by 5 m long. The examined muscles were taped using the same manner as with applying kinesiotape (Figure 4).

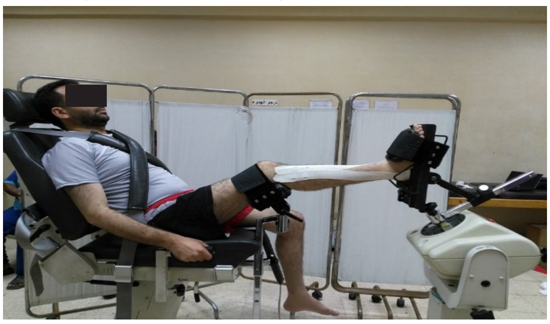

Figure 4: Positioning of AT on ankle muscles

Testing procedure

Each participant was allowed to randomly select the order of the taping modes using the simple random allocation method. During the no tape's session, each participant accomplished the EMG test without ankle taping. All tests were performed on the affected ankle, and no information about kinesiotape effect was given to the participants. The inter-assessment interval was seven days avoid muscle fatigue induced by the isokinetic assessments, which may affect the results.

The EMG data were picked up while participants were moving the isokinetic dynamometer to simulate the functional ankle movement better. The isokinetic dynamometer tilt was set to 60-70°. The dynamometer chair was rotated 90°, and the seat back angle was set at 70°. The participant sat on the adjustable seat of the Biodex isokinetic dynamometer system. A pad was placed under the tested leg thigh and secured with a strap. The tested lower leg was parallel to the floor, and the foot was secured to the inversion/eversion footplate attachment. Shoulder straps were then placed on the chest to secure the trunk.

Each participant was asked to grip the stabilization handles on either side of the chair for stabilization during measurement. Participant position was adjusted to align the ankle axis of rotation with the dynamometer shaft. Each participant performed five repetitions of ankle inversion and eversion during the full ankle ROM at an angular velocity of 120°/sec. The rest period was one minute between each repetition at the concentric contraction mode. Test protocol for EMG was selected from EMG apparatus software.

Data analysis

In the current study, the independent variables were the taping modes (no tape, kinesiotape, and athletic tape) and the dependent variables were EMG measures (RMS). Statistical Package for Social Science (SPSS) version 20 for Windows was used to perform all statistical tests.

Following data screening, the outliers of the dependent variables raw data were excluded in order not to violate the parametric assumption. Histograms with normal distribution curves showed that the data were normally distributed for all variables. Also, the skewness and kurtosis of all the collected data became less than the recommended value of one after excluding the outliers. Thus, it was concluded that the data had a normal distribution and parametric analysis could be conducted.

Repeated measures Analysis of Variance (ANOVA) was used for comparing the RMS of tibialis anterior and peroneus longus muscles among the three taping modes. The alpha level was 0.05 for the conducted statistical test.

RESULTS

Subject characteristics

The mean ±SD of age was 24±1.2 years for males and females. The height was 175±4.8 cm for men and 163±5.2 cm for women. Body mass was 85±5.2 kg for men and 74±5.5 kilograms for women respectively.

Effect of the three taping modes on EMG activity:

The EMG activity (RMS) of ankle muscles was assessed using three different taping modes: no tape, Kinesio tape, and athletic tape. Unit of measurement was a percentage of normalized EMG (%). Repeated measures ANOVA showed a significant difference in RMS among the three taping modes. Also, pairwise comparison using Bonferroni test showed a significant reduction in the peroneus longus and tibialis anterior EMG at kinesiotape compared with no tape. However, there was the insignificant difference between the no tape and athletic tape as well as between the kinesiotape and athletic tape (table1 and 2).

Table 1**:** Descriptive statistics, Sphericity, and Bonferroni tests of the evertors' EMG at the three taping modes.

Evertors EMG	No tape	Kinesiotape	Athletic tape
Mean ± SD	0.7 (±0.1)	0.58 (±0.2)	0.68 (±0.27)
Sphericity' s test			
F = 7. 24		**P = 0.001***	
Bonferroni test			
No tape vs. Kinesiotape		**P = 0.000***	
No Ttape vs. Athletic tape		**P = 0.280**	
Kinesiotape vs. Athletic tape		**P = 0.195**	

*significant

Table 2**:** Descriptive statistics, Sphericity and Bonferroni tests of the invertors' EMG at the three taping modes.

Invertors EMG	No tape	Kinesiotape	Athletic tape
Mean ± SD	0.87 (±0.23)	0.54 (±0.1)	0.82 (±0.2)
Sphericity' s test			
F = 8.22		**P = 0.002***	
Bonferroni test			
No tape vs. Kinesiotape		**P = 0.001***	
No tape vs. Athletic tape		**P = 1.000**	
Kinesiotape vs. Athletic tape		**P = 0.894**	

*significant

DISCUSSION

Up to the knowledge of the author, no previous researchers investigated the effects of Kinesio tape on RMS value in patients with chronic ankle sprain. Altan and Kanat[19] (2008) reported increased activity in the muscles that have been previously injured and subjects report significantly greater activity for these injured muscles. This increased activity has been caused by the abnormal mechanics which may leave the muscles vulnerable to further injury. However, compressing the musculotendinous area could decrease tendon movement and also muscle force production by the affected area [20]. Taping reduces muscular expansion and decreases muscle fiber force production [21]. When the overload forces are reduced, the ligaments have the opportunity to recover [22].

Root mean square value reflects the motor unit activity during contraction. So, it is used to indicate the electric signal that can be analyzed and processed by using the RMS value [23]. The EMG signal is mathematically treated to quantify the intensity and the duration of several signals. The relationship between the force and EMG signal tend to be linear in small muscles, but this relationship tends to be nonlinear in bigger muscles as they need more motor recruitment [24].

The primary outcome of the current study was that Kinesio tape reduced the EMG activity of the ankle muscles in patients with chronic ankle sprain. These results also offer preliminary support for the premise that Kinesio tape could be beneficial for these patients. Significant differences were observed when comparing Kinesio tape with no tape or athletic tape. These findings are consistent with some previous studies, which reported that Kinesio tape reduced the EMG activity of ankle muscles.

Taping reduced peroneus longus EMG activity by 39%. Inversion and eversion (Frontal plane motion) were reduced without affecting sagittal plane motion (plantar and dorsiflexion). So, the effects of ankle taping are decreased ankle ROM, improved proprioceptive functions, and increased mechanical stability [25].

Chung et al. (2003) [26] measured the effects of taping on ankle muscle activity in four situations (pre-taped, taped, walking on the treadmill, removal of tape) in drop landing. The EMG electrodes were placed on the soleus, tibialis anterior, vastus medialis, and biceps femoris muscles. Participants hopped on one leg from a 40 cm height onto a force plate. The ankle was taped followed by repetition of the hopping task and walking on a treadmill. The hopping task was again repeated following the removal of the tape. The soleus muscle showed a significant decrease in mean EMG in taping. So, taping can limit ankle motion, and reduced soleus EMG activity is related to increased ground reaction forces during landing. The reduced ankle ROM during landing caused less energy absorption the posterior ankle musculature and thus reduced ankle injury risk.

According to Diana et al. (1999) [27] the reduction of peroneal and gastrocnemius EMG activity caused by taping causes a decrease in the need for these muscles to stabilize the joint mechanically. The findings of the current study were in contrast with those of other researchers who found no effect of taping on peroneus longus EMG activity during a sudden inversion motion. Gross et al. (1994) [28] have noted that taping causes lesser restriction to movement than bracing.

Hopper et al. (2008) [29] measured the effect of bracing and taping on EMG activity when landing from a jump. The effect of taping associated with landing was limited to muscle activity reduction. Franettovich et al. (2008) [30] measured the primary effects of anti-pronation tape on EMG activity of tibialis anterior, tibialis posterior, and peroneus longus muscles on five participants during walking.

They walked on a treadmill before and after the application of the tape for about 10 min. The anti proation tape reduced the tibialis anterior and tibialis posterior muscle activity during walking which decreased the load of these muscles.

CONCLUSION

Kinesiotaping reduced EMG activity of ankle muscles thus improving their function and may prevent further injuries. The results of the current study showed that to achieve good physical performance and muscle strength, Kinesio tape should be one of the therapeutic modalities in the rehabilitation process of musculoskeletal disorders for patients with chronic ankle sprain.

The major restrictions of this study were the smaller sample size (30 patients), and the duration of tape application, which was not adequate to study the long-term effect of Kinesio tape and athletic tape. Therefore, future studies considering larger sample and long-term effects of Kinesio tape and athletic tape are recommended to overcome these limitations and to increase the generalizability of the findings.

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REFERENCES

[1] De Noronha M, Refshauge KM, Herbert RD, Kilbreath SL. Do voluntary strength, proprioception, range of motion, or postural sway predict occurrence of lateral ankle sprain? *Br J Sport Med*. 2006; 40:824-828.

[2] Maude B, Hélène M, Laurent JB, Marc P, Luc JH, Jean L. Alteration in global motor strategy following lateral ankle sprain. *BMC Musculoskeletal Disord.* 2014; 15:436.

[3] Wilkerson GB. Biomechanical and neuromuscular effects of ankle taping and bracing. *J Athl Train.* 2002; 37(4): 436-445.

[4] Eamonn D, Garrett FC, Brian C, Elizabeth JN , Chung-Wei C , Claire EH. Inclusion criteria when investigating insufficiencies in chronic ankle instability. *Med Sci Sports Exerc.* 2010; 42:2106-2121.

[5] Hertel J. Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. *J Athl Train.* 2002; 37(4):364-375.

[6] Kaminski TW, Buckley BD, Powers ME, Hubbard TJ, Ortiz C. Effect of strength and proprioception training on eversion to inversion strength ratios in subjects with unilateral functional ankle instability. *Br J Sports Med.* 2003, 37:410-415.

[7] Denyer JR, Hewitt NL, Mitchell AC. Foot structure and muscle reaction time to a simulated ankle sprain. *J Athl Train.* 2013; 48(3):326-30.

[8] DiGiovanni C, Brodsky A. Current concepts: lateral ankle instability. *Foot Ankle Int.* 2006; 27:854-66.

[9] Griffith J, Brockwell J. Diagnosis and imaging of ankle instability. *J Foot Ankle Clin.* 2006; 11:475-96.

[10] Yasukawa A, Patel P, Sisung C. Pilot study: Investigating the effects of Kinesiotaping in an acute pediatric rehabilitation setting. *Am J Occup Ther.* 2006; 60(1):104-10.

[11] Boyce S, Quigley M, Campbell S. A randomized controlled trial of the treatment of inversion ankle injuries using an elastic support bandage or an air cast™ ankle brace. *J Sports Med.* 2008; 39(2):91-96.

[12] Bernier JN. Quick reference dictionary for athletic training. New Jersey: SLACK 2002; 120:125.

[13] Hammer WI. Functional Soft-tissue examination and treatment by manual methods. *3rd ed. Boston.* 2006; *404-423.*

[14] Purcell SB, Schuckman BE, Docherty CL, Schrader J, Poppy W. Differences in ankle range of motion before and after exercise in 2 tape conditions. *Am J Sports Med.* 2009; 37(2):383-389.

[15] Yasukawa A, Patel P, Sisung C. Pilot study: Investigating the effects of Kinesiotaping in an acute pediatric rehabilitation setting. *Am J Occup Ther.* 2006; 60(1):104-10.

[16] Ball N, Scurr J. Electromyography normalization methods for high-velocity muscle actions: review and recommendations. *J Appl Biomech.* 2013; 29(5): 600-8.

[17] Ruiz-Muñoz M, Cuesta-Vargas A. Electromyography and sonomyography analysis of the tibialis anterior: a cross sectional study. *J Foot Ankle Res.* 2014; 7: 11.

[18] Kase K, Wallis J, Kase T. Clinical therapeutic applications of the kinesio aping method 2003. Tokyo: Kinesiotaping Association.

[19] Altan L, Kanat E. Conservative treatment of lateral epicondylitis: Comparison of two different orthotic devices. *Clin Rheumatol.* 2008; 27: 1015-19.

[20] Paula TK, Damien WA, Terry IG, Shane IK, Stephen C A, Jean MB, et al. Effects of the forearm support band on wrist extensor muscle fatigue. *JOSPT.* l999; 29 (11): 677-685.

[21] VanTulder M, Maalmivara A, koes B. Repetitive strain injury. *J Bone Joint Surgery.* 2007; 26 (36): 1815-22.

[22] Van De Streek MD, Van Der Schans CP, De Greef MH, Postema K. The effect of a forearm/hand splint compared with an elbow band as a treatment for lateral epicondylitis. *Prosthetics and Orthotics International.* 2004; 28: 183-9.

[23] Thiago YF, Jorge OE, José EP, Paulo RG, Silvio G, Rafaela OG, et al. Root mean square value of the electromyographic signal in the isometric torque of the quadriceps, hamstrings and brachial biceps muscles in female subjects. *J Appl Research.* 2010; 10(1):32-39.

[24] Zhou P, Rymer WZ. Factors governing the form of the relation between muscle force and the EMG: A stimulation study. *J Neurophysiology.* 2004; 92: 2878-86.

[25] Matthew DJ, Adrian BS, Tye SM, Samuel JC, Robert GL. Effects of preventative ankle taping on planned change-of-direction and reactive agility performance and ankle muscle activity in basketballers. *J Sports Sci Med.* 2015; 14(4) 864-876.

[26] Chung HY, Denis B, Hyeong D, Paul F. Effect of ankle

taping and exercise on EMG and kinetics during landing. *Phys. Ther. Sci.* 2003; 15:81-85.

[27] Diana MH, Peter M, Bruce CE. Landing in netball: effects of taping and bracing the ankle. *Br J Sports Med.* 1999; 33:409-413.

[28] Gross MT, Batten AM, Lamm AL, Lorren JL, Stevens JJ, Davis JM, et al. Comparison of Donjoy ankle ligament protector and subtalar sling taping in restricting foot and ankle motion before and after exercise. *JOSPT.* 1994; 19:3341.

[29] Hopper DM, McNair P, Elliott BC. Landing in netball: effects of taping and bracing the ankle. *J Med Sci Sports Exerc.* 2008; 40(4):593-600.

[30] Franettovich M, Chapman A, Vicenzino B. Tape that increases medial longitudinal arch height also reduces leg muscle activity: a preliminary study. *Med Sci Sports Exerc.* 2008; 40(4):593-600.

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