Journal of Advanced Sport Technology 4(2):104- 113 Received: October. 9, 2020; Accepted: December, 29, 2020

Original Research

The Effects of Kinesio-tape through Facilitation of Hamstring and Inhibition of Quadriceps on Biomechanical Variables affecting Anterior Cruciate Ligament Injury When Landing in Active Healthy Young Women

Nader Nokhodchi[1*], Mahsasadat Hosseini[2], Zahra Attaran Iraj[3], Amirhessam Rahimi[4]

1. Department of Sport Sciences, University of Bojnord, Bojnord, Iran. Email: nokhodchi@ub.ac.ir, ORCID: 0000-0002-2100-0689
2. Department of Sport Sciences, Alzahra University of Mashhad, Mashhad, Iran. Email: mahsa.hosseini0033@gmail.com, ORCID: 0000-0003-1681-9451
3. Department of Sport Sciences, University of Bojnord, Bojnord, Iran. Email: zahraataran9@gmail.com, ORCID: 0000-0001-8198-7473
4. Department of Sport Sciences, University of Bojnord, Bojnord, Iran. Email: amirhesam49@gmail.com, ORCID: 0000-0003-4741-2777

ABSTRACT

The Anterior Cruciate Ligament (ACL) rupture is more prevalent among women due to several reasons such as women's different landing strategies. Today, many athletes use varying taping techniques to prevent ACL injury. This study aims to investigate the effect of facilitating hamstring and inhibiting quadriceps through Kinesio-tape on biomechanical variables that contribute to ACL injuries. The subjects included 18 active healthy women (age: 19.94±1.16 years, height: 167±2.14 cm, weight: 58.33±3.72 kg). Kinetics and kinematics data, including the angle of knee flexion and knee abduction in initial foot contact, maximum knee flexion and abduction, and peak anterior shear force, were collected in three conditions (without tape, with sham Kinesio-tape, and Kinesio-tape with facilitation of hamstring and inhibition of quadriceps) in landing maneuver. The Simi motion analysis system and the Kistler force plate were used to collect data. The results revealed that the application of the Kinesio-tape caused a significant increase in the angle of knee flexion in the initial contact and peak anterior shear force in a single leg drop jump ($P < 0.05$). In conclusion, this Kinesiotaping technique can affect some contributory variables to ACL rupture by increasing the angle of knee flexion and maximum shear force, hence lead to reduced rates of injury in active healthy women. However, it seems that this technique is unable to reduce the ACL rupture risk factors in the frontal plane.

Keywords: Kinesio-tape, Biomechanics, Anterior Cruciate Ligament

Corresponding Author: Nader Nokhodchi, Department of Sport Sciences, University of Bojnord, Bojnord, Iran. Email: nokhodchi@ub.ac.ir, Tel: 00989155061028; Fax: 009805137281887

Introduction

Anterior cruciate ligament (ACL) injury is one of the most common knee injuries among athletes. An ACL injury occurs in 1.6 elite athletes per 1,000 hours of activity (1). ACL injuries are two to six times more prevalent among women, especially in sports that are associated with landing, frequent rotation, and reduced acceleration (2). ACL injury is multifactorial in nature and occurs in women due to many external and internal factors, including anatomical differences, hormonal levels, biomechanical factors and neuromuscular mechanisms (3), however only neuromuscular and biomechanical factors be can adjusted from internal variables (4). Hewett et al. (2010) consider four neuromuscular defects as the underlying mechanisms of ACL injury, including ligament dominance, quadriceps dominance, leg dominance, and trunk dominance, which can affect the amount of load applied to ACL when performing sports skills. They exert effects via changes in functional strategies and muscle activation time (5). Quadriceps dominance occurs when the neuromuscular control strategies used to provide knee stability preferably activate the quadriceps muscles (5). Quadriceps dominance is defined as the balance between strength, and coordination of the extensor and flexor of the knee, which refers to the stabilization of the knee joint mainly by the quadriceps (6). Decker et al (2003) have showed that women had a more upright posture on the sagittal plane during landing (7). Recent studies have suggested that lower limb postures at initial contact, such as knee flexion and abduction, have the potential of exerting anterior shear forces or lateral shear forces (1,8). Electromyographic studies have also demonstrated that women use a different neuromuscular strategy from men, in which quadriceps muscle activity is significantly high and hamstring activity is significantly low (9,10) .Quadriceps causes the knee to be in an extension position, which increases the risk of ACL injury (11). On the other hand, the hamstring muscle action line can pull the tibia back and reduce the stress on the ACL. Thus, the activation of the hamstring can reduce the load on the passive structures of the knee and stabilize the knee relative to external loads (5) .In fact, the combination of increased quadriceps activity and decreased hamstring activity leads to an increased risk of ACL injury in women (12). Previous research has also shown that the amount of anterior shear force on the knee during landing is higher in women than men, which is due to greater knee extension during landing in women (13). Treatment of ACL rupture, whether via surgery or rehabilitation, can impose high costs on the person and the society; moreover, this injury can make the person vulnerable to secondary destructive joint injuries and also shorten his/her athletic life (14). Athletes have become encouraged to use a variety of aids, such as braces, sleeves, and bandages, to protect their joints from an ACL injury. Some studies have shown that these items might limit sports performance (15). However, today, the use of various taping methods, especially the Kinesio-tape, has been considered by athletes and physicians of sports teams as they are not typically associated with functional restrictions.

Kinesio-tape is a stretch band used daily in rehabilitation clinics by healthcare providers and by athletes to control pain, strengthen muscles and improve the condition of the body and joints (16-19). Using kinesio-tape as a therapeutic method is associated with several effects. It can inhibit hyperactive muscles and facilitating the weak muscle, increasing proprioception, and improving joint alignment, reduce pain, relieve pressure on stimulated nerve tissues, and change the pattern of muscle fiber recruitment (20). The effect of kinesio-tape on muscles varies according to the direction and tension of the tape. It is generally maintained that Kinesio-tape facilitates the muscle if applied from the origin of the muscle to its insertion, and inhibits the muscle if used from the insertion of the muscle to its origin (21). Also, if the kinesio-tape is pasted transversely or without stretching, it is called Sham (22).

As the use of kinesio-tape has prevailed, several studies have examined the effect of kinesio-tape on electrical activity and muscle strength. Although some studies emphasize the ineffectiveness of the kinesio-tape on muscle strength (23-26), some have reported an increase in electrical activity of the muscles due to the use of the kinesio-tape (27-29). However, it seems that the taping technique can be one of the factors affecting the strength and electrical activity of muscle. Hence, more recent studies have enquired into the effects of various Kinesio-tape techniques on biomechanical variables during various movements. Guner et al. (2015) investigated impact of quadriceps Kinesio-tape in a facilitative and inhibitory manner on the biomechanical variables of healthy young women in the gait cycle, reporting that none of the taping techniques had an effect on kinematic variables in the sagittal plane (30) .However, in their studies, Boonkerd and Limroongreungrat (2019) investigated the effect of kinesio-tape through ACL support technique on biomechanical variables during landing and jumping in healthy young men. In this taping technique, I-shaped kinesio-tape was used with the initial connection of the middle of the tape on the tibial tuberosity and stretching both ends of the tape by 75% of its initial length towards the inner and outer condyles of the femur. The results showed that this technique reduced abduction and rotation rates in the middle phase of the jump, although it was not effective in other biomechanical variables (31). However, the same researchers showed elsewhere (2019) that the use of the ACL support technique during landing in healthy young people can reduce the risk of ACL injury as it reduces the amount of knee abduction at the initial contact (32). The use of Kinesio-tape using the ACL support technique may not possibly reduce the risk factors for ACL injury in the sagittal plane. On the other hand, the biomechanical variables in the sagittal plane have a crucial role in ACL injury. Moreover, the facilitation of hamstring and inhibition of quadriceps can affect some risk factors for ACL injury during landing in women by increasing hamstring activity and decreasing quadriceps activity. This being said, it is necessary to investigate the effects of this taping technique vis-à-vis biomechanical variables affecting anterior cruciate ligament injury.

Material and Methods

This is a quasi-experimental study. The statistical population consisted of female undergraduate students in the field of sports sciences in Mashhad who met the inclusion criteria. Eighteen women were selected via convenience sampling and participated voluntarily in the study.

Inclusion criteria comprised calendar age from 18 to 22 years, no history of kinesio-tape use, no ligament and meniscus injury or history of surgery or arthroscopy in any of the knees, no history of lower limb fractures, no severe deformity Knee (e.g., genu varum, genu valgum). The circumstances and procedures of the study were introduced to the subjects. Thereupon, they signed written consent forms for participation in this research. Subsequently, coordination was made with the subjects for the time of the test. During the test, each subject warms up for five minutes on a stationary bike at a speed of 70 rpm and a resistance of 4% of body weight, and then performs stretching exercises on the anterior and posterior thigh and leg muscles under the supervision of a physical education instructor (33). Each subject landed on one foot from a 30 cm platform barefoot with the dominant leg on the center of the force plate, which was 15 cm away from the platform, in three conditions: without tape, with sham Kinesio-tape, and with Kinesio-tape through the facilitation of hamstring and inhibition of quadriceps (three repetitions for each condition). Before the tests, all subjects were taught on the identification of the landing protoco. Subjects were placed on the platform in a comfortable position, bearing full weight, standing on two feet with fixed arms. They were taught to drop themselves from the platform and perform a one-foot landing on the force plate and maintain balance on the same foot. To minimize the effect of learning on the research results, it was determined by lottery under what conditions each subject performed the landing operation (without tape, with kinesio tape in the mentioned method or with kinesio-tape sham). Between each attempt, 2 minutes were allowed for the subject and the laboratory operator to rest and prepare for the next test. To measure the variables of maximum knee flexion and abduction at initial contact and maximum anterior shear force, we used the motion analysis system (manufactured by SIMI, Germany with an accuracy of 0.5 mm of transfer motion and 0.5 degree of rotation in a space of 4*4 meters) using a KISTLER force plate device (model 9286BA made by KISTLER company in Switzerland with an accuracy of 1 N and the ability to measure -10 to +10 KN on the X and Y axes and -10 to 20 + KN on the Z axis). A frequency of 1,000 Hz was considered to collect the ground reaction force data. Moreover, two cameras were placed perpendicular to the sagittal and frontal planes to record movements at a frequency of 200 Hz. The desired sampling frequency for the cameras and the force plate met the requirements of the Nyquist sampling theorem, which considers the minimum sampling frequency to be at least twice the maximum moving frequency for the landing manoeuver. To determine the angles of the knee joint in frontal and sagittal planes, six passive reflective markers with a diameter of 20 mm were used during imaging. To measure knee angles in the sagittal plane, the markers placed on the greater trochanter, external epicondyle of the femur, and external malleolus. Moreover, to measure the knee angle in the frontal plane, the markers placed on anterior superior iliac spine and the middle of the distance between external epicondyle and internal epicondyle of femur and midpoint between the medial and lateral malleoli (34). The raw data were obtained using the residual analysis technique. Subsequently, the cutting

frequency was calculated for the camera information of 10 Hz and for the force plate 50 Hz, and the raw data was filtered using the Butterworth low-pass filter (35). Thereupon, trigonometric relations were built on to calculate the relative coordinates of the position of the lower limbs in the reference frame. Afterwards, the relative angles of the joint were calculated by subtracting the absolute angle of the proximal limb relative to the distal one (33). The tape used in the research is a kinesio-tape called Kindmax with a width of 5 cm made by Shanghai Sport Product in China.
Taping was performed with the person lying down while the thigh was 30 degrees and the knee 60 degrees flexion, and the quadriceps and hamstrings were not contracted. In order to facilitate the hamstring, the inverted Y-shaped kinesio-tape was used by applying 50% of the initial length of the tape from the origin of the muscle (below the gluteal fold) to the muscle insertion (below the knee joint and in line with the bicepsfemoris and semimembranosus). For quadriceps inhibition, two kinesio tapes were used. A Y-shaped kinesio-tape was used by stretching 25% of the initial length of the tape from the insertion of the muscle (tibia tubercle) and passing through the patella and surrounding the internal and external quadriceps to the proximal thigh. Also, an I-shaped Kinesio-tape was employed by stretching 25% from above the patella to the proximal of the thigh in the direction of the rectus femoris (30). For the sham kinesio-tape, the kinesio-tape was used in the same manner as for the two muscles but without any tension (22). One way repeated measures analysis of variance (ANOVA) was used as the primary statistical analysis test along with Mauchly's test of sphericity. Post-hoc tests were conducted using Bonferroni analysis. All data were checked for normality distribution using the Shapiro–Wilk test. The 0.05 was set as the F significance level. All statistical calculations were performed using SPSS 16.0 (SPSS, Inc., Chicago, IL).

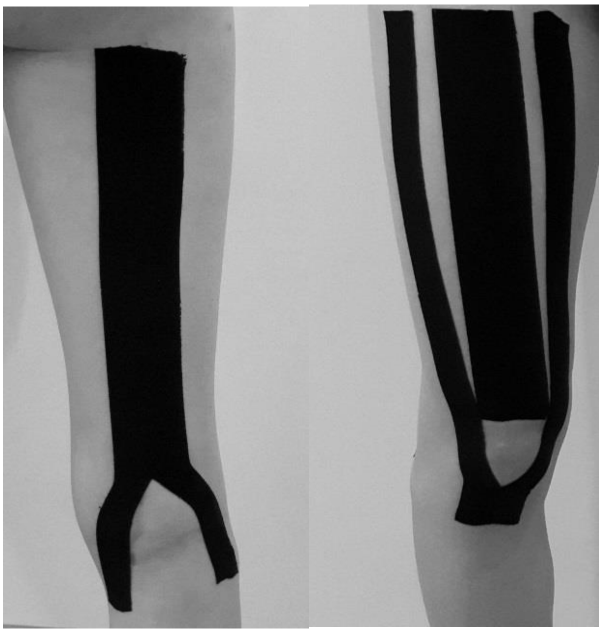

Figure 1. Facilitation of hamstring (left) and Inhibition of quadriceps (right) with kinesio-tape

Results

The results of Shapiro-Wilk test showed that the data related to the demographic information of the subjects (age 19.94±1.16 years, height 167±2.14 cm, weight 58.33 ±3.72 kg) and also, the research variables have a normal distribution. Due to the condition of compound symmetry by the mauchly test, we used the one way repeated measure ANOVA test to investigate the effect of kinesio-tape on biomechanical variables affecting anterior cruciate ligament injury in active young women.

Table 1. : Indicators of central tendency and dispersion and results of one way repeated measure ANOVA test

Biomechanical variables	Independent Variable	Mean(SD)	F	Sig.
Knee flexion at initial contact	Without tape	15.50(2.73)	6.426	0.004*
	Sham kinesio-tape	15.66(2.58)		
	Facilitation-Ihibition tape	16.05(2.64)		
Knee abduction at initial contact	Without tape	4.05(2.12)	2.161	0.131
	Sham kinesio-tape	3.94(1.62)		
	Facilitation-Ihibition tape	3.55(2.00)		
Max knee flexion	Without tape	34.66(2.80)	2.858	0.071
	Sham kinesio-tape	35.05(2.55)		
	Facilitation-Ihibition tape	35.11(2.56)		
Max knee abduction	Without tape	13.61(1.70)	0.642	0.532
	Sham kinesio-tape	13.33(1.68)		
	Facilitation-Ihibition tape	13.55(1.58)		
Max anterior shear force	Without tape	0.383(0.01)	18.622	<0.001*
	Sham kinesio-tape	0.378(0.01)		
	Facilitation-Ihibition tape	0.364(0.02)		

*Significant at $p<0.05$.

According to Table 1, the results of analysis of variance test with repeated measures showed a significant difference in the amount of knee flexion at the moment of initial contact and the maximum anterior shear force (posterior reaction force of the ground) during landing in three different modes (no tape, sham kinesio-tape and kinesio-tape by facilitating hamstring and quadriceps inhibition) ($p < 0.05$). However, based on the results of Bonferroni post hoc test (Table 2), this significant difference is due to the difference between facilitative and inhibitory kinesio-tape compared to the two states without tape and sham kinesio-tape ($p < 0.05$).

Table 2: The results of Bonferroni post hoc test

Biomechanical variables	I Variable	J Variable	Mean difference	Standard Error	Sig.
Knee flextion at initial contact	Without tape	Sham kinesio-tape	0.167	0.185	1.000
	Without tape	Facilitation-Ihibition tape	0556	0.166	0.012*
	Sham tape	Facilitation-Ihibition tape	0.389	0.118	0.013*
Max anterior shear force	Without tape	Sham kinesio-tape	0.005	0.003	0.168
	Without tape	Facilitation-Ihibition tape	0.019	0.004	<0.001*
	Sham tape	Facilitation-Ihibition tape	0.014	0.003	0.002*

*Significant at $p<0.05$.

Discussion

The main purpose of the current study was to investigate the effect facilitating hamstring and inhibiting quadriceps through Kinesio-tape on biomechanical variables that contribute to ACL injuries in healthy young active women. According to the results of the study, the use of kinesio-tape can affect some biomechanical factors including the amount of knee flexion at initial contact and the amount of anterior shear force.The mechanism of action of the Kinesio-tape in muscle facilitation is not fully understood. However, researchers have proposed two possible hypotheses. The first hypothesis emphasizes the increase of blood and lymph flow due to the lifting of the skin and, as a result, the increased space between the skin and muscle in the Kinesio-taped area. Another hypothesis maintains that Kinesio-tape stimulates skin mechanoreceptors by stretching and pressing the skin beneath it and thus activates the central nervous system regulatory mechanisms involved in increasing muscle stimulation (22). However, in the inhibitory state (the tape being applied from the insertion of the muscle to its origin), the Kinesio-tape probably creates a tensile force in the opposite direction of the muscle contraction and, along with the stimulation of the tendon organ, causes muscle inhibition (21).

Previous studies have placed great emphasis on the inverse relationship between knee flexion angle and ACL stress at the moment of initial contact (36), stating that further extension of the knee at initial contact increases ground reaction force and the increase of the force vector angle between the patella tendon and the tibial tuberosity coincide with the increase of the quadriceps eccentric contraction (37,38), which increases the anterior displacement of the tibia relative to the femur and thus increases the pressure on the ACL (38, 39) .Therefore, increasing the amount of knee flexion at initial contact as a result of using kinesio-tape can reduce the stress on the ACL.

Previous studies have also shown that the posterior ground reaction forces during landing are used as estimates of the stabilization of the sagittal plate of the knee joint and can be equated to the anterior shear force of the knee and the application of pressure to the ACL considered (40). Reducing the maximum anterior shear force can protect the ACL against excessive pressure(41). As can be seen in Figure 1, the posterior ground reaction force (FX) creates a flexor torque that must be counter by the activity of the quadriceps, then by creating an extensor torque (MK) and through the patellar tendon. Decreasing the posterior reaction force reduces the amount of torque required and the force of the quadriceps and then the patellar tendon. Decreased patellar tendon force can reduce the momentary anterior shear force applied to the ACL (42). Therefore, according to the results of the study, it can be said that the use of kinesio-tape to facilitate of hamstring and inhibition of quadriceps reduces the anterior shear force on the knee and reduces the risk of ACL injury .However, the results of the present study show that this taping technique cannot reduce the rate of knee abduction at the moment of initial contact and the maximum amount of knee abduction, which indicates the inability of this technique to reduce the risk of ACL injury on the frontal plate. Also, according to the research findings, since this taping method does not change the maximum flexion and abduction of the knee, using this technique only as a feed forward (anticipator) can reduce the factors affecting the injury ligament at initial contact, which is due to the effects of kinesio-tape on neuromuscular agents during landing. Since the first and most characteristic effect of kinesio-tape is on skin afferents, studies have shown that stimulation of skin afferents have an inhibitory effect on tonic (anti-gravity) motor neurons and a facilitating role on phasic motor neurons that stimulate neurons stimulating the motion neuron can elicit the response of Renshaw cells, but receive the most input from phasic motor neurons and exert the most inhibition on tonic motor neurons (43). Since the quadriceps muscles play a more anti-gravity and tonic role, and the hamstring muscles play a more phasic role, using the kinesio-tape of the simultaneous hamstring facilitation and quadriceps inhibition technique can improve neuromuscular activity at the initial contact. However, based on the results of the research, it seems that with the continuation of the landing maneuver due to the influence of other external factors such as other balancing strategies, this technique will not be able to reduce the risk factors for ACL injury .

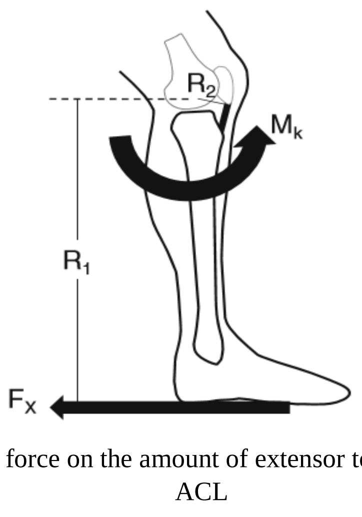

Figure 2: The effect of anterior shear force on the amount of extensor torque of the knee and the pressure on the ACL

Conclusion

According to the results of recent studies, ACL support technique with kinesio-tape cannot reduce the risk factors for ACL injury in the sagittal plate (31, 32). However, according to the results of the present study, simultaneous use of kinesio-tape to facilitate hamstring and quadriceps inhibition can cause changes in biomechanical variables affecting ACL injury in the sagittal plane during landing. Therefore, according to the research findings, it can be stated that healthy young active women can use this taping technique to reduce the risk of ACL injury with minimal interventions in movement limitation due to the use of other knee support equipment. However, since in the present study, the biomechanical variables affecting ACL injury have been investigated only in the frontal and sagittal planes, it is necessary to study the biomechanical variables in the transverse plane. Also, since the activity of the gluteal muscles and the back of shank can affect on ACL injury, a study is required to investigate the effects of taping these muscles on the factors affecting ACL injury.

Acknowledgements
The authors would like to thank all the participants who did their best to cooperate in the research.

References

1. Griffin LY, Albohm MJ, Arendt EA, Bahr R, Beynnon BD, DeMaio M, Dick RW, Engebretsen L, Garrett WE, Hannafin JA, Hewett TE. Understanding and preventing noncontact anterior cruciate ligament injuries: a review of the Hunt Valley II meeting. The American journal of sports medicine. 2006;34(9):1512-32.
2. Arendt EA, Agel J, Dick R. Anterior cruciate ligament injury patterns among collegiate men and women. Journal of athletic training. 1999;34(2):86.
3. Hertel J, Dorfman JH, Braham RA. Lower extremity malalignments and anterior cruciate ligament injury history. Journal of sports science & medicine. 2004;3(4):220.
4. Hewett TE, Myer GD, Ford KR, Heidt Jr RS, Colosimo AJ, McLean SG, Van den Bogert AJ, Paterno MV, Succop P. Biomechanical measures of neuromuscular control and valgus loading of the knee predict anterior cruciate ligament injury risk in female athletes: a prospective study. The American journal of sports medicine. 2005;33(4):492-501.
5. Hewett TE, Ford KR, Hoogenboom BJ, Myer GD. Understanding and preventing acl injuries: current biomechanical and epidemiologic considerations-update 2010. North American journal of sports physical therapy: NAJSPT. 2010;5(4):234.
6. Ford KR, Myer GD, Hewett TE. Valgus knee motion during landing in high school female and male basketball players. Medicine & Science in Sports & Exercise. 2003;35(10):1745-50.
7. Decker MJ, Torry MR, Wyland DJ, Sterett WI, Steadman JR. Gender differences in lower extremity kinematics, kinetics and energy absorption during landing. Clinical biomechanics. 2003;18(7):662-9.
8. Chappell JD, Creighton RA, Giuliani C, Yu B, Garrett WE. Kinematics and electromyography of landing preparation in vertical stop-jump: risks for noncontact anterior cruciate ligament injury. The American journal of sports medicine. 2007; 35(2):235-41.
9. Colby S, Francisco A, Bing Y, Kirkendall D, Finch M, Garrett W. Electromyographic and kinematic analysis of cutting maneuvers: implications for anterior cruciate ligament injury. The American journal of sports medicine. 2000;28(2):234-40.
10. Malinzak RA, Colby SM, Kirkendall DT, Yu B, Garrett WE. A comparison of knee joint motion patterns between men and women in selected athletic tasks. Clinical biomechanics. 2001;16(5):438-45.
11. Markolf KL, Wascher DC, Finerman GA. Direct in vitro measurement of forces in the cruciate ligaments. Part II: The effect of section of the posterolateral structures. The Journal of bone and joint surgery. American volume. 1993;75(3):387-94.
12. Huston LJ, Wojtys EM. Neuromuscular performance characteristics in elite female athletes. The American Journal of Sports Medicine 1996;24:427-36.
13. Chappell JD, Yu B, Kirkendall DT, Garrett WE. A comparison of knee kinetics between male and female recreational athletes in stop-jump tasks. The American journal of sports medicine. 2002;30(2):261-267.

14. Schlegel TF, Steadman JR. Knee orthoses for sports-related disorders. Atlas of Orthoses and Assistive Devices. 3rd ed. Philadelphia: Mosby. 1997:420-1.
15. Rishiraj N, Taunton JE, Lloyd-Smith R, Woollard R, Regan W, Clement DB. The potential role of prophylactic/functional knee bracing in preventing knee ligament injury. Sports Medicine. 2009;39(11):937-60.
16. Parreira PD, Costa LD, Junior LC, Lopes AD, Costa LO. Current evidence does not support the use of Kinesio Taping in clinical practice: a systematic review. Journal of physiotherapy. 2014;60(1):31-9.
17. Williams S, Whatman C, Hume PA, Sheerin K. Kinesio taping in treatment and prevention of sports injuries. Sports medicine. 2012;42(2):153-64.
18. GonzáLez-Iglesias J, Fernández-de-Las-Peñas C, Cleland J, Huijbregts P, Gutiérrez-Vega MD. Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: a randomized clinical trial. Journal of orthopaedic & sports physical therapy. 2009;39(7):515-21.
19. Jaraczewska E, Long C. Kinesio® taping in stroke: improving functional use of the upper extremity in hemiplegia. Topics in Stroke rehabilitation. 2006;13(3):31-42.
20. Joscha K, Julian M. What is the current level of evidence and the efficacy of medical taping on circulation, muscle function, correction, pain, and proprioception?. Amsterdam, the Netherlands, Professional Assignment Project, European School of Physiotherapy, Hogeschool van Amsterdam. 2010.
21. Kuo YL, Huang YC. Effects of the application direction of Kinesio taping on isometric muscle strength of the wrist and fingers of healthy adults—a pilot study. Journal of Physical Therapy Science. 2013;25;25(3):287-91.
22. Gomez-Soriano J, Abián-Vicén J, Aparicio-García C, Ruiz-Lázaro P, Simón-Martínez C, Bravo-Esteban E, Fernández-Rodríguez JM. The effects of Kinesio taping on muscle tone in healthy subjects: a double-blind, placebo-controlled crossover trial. Manual therapy. 2014;19(2):131-6.
23. Fu TC, Wong AM, Pei YC, Wu KP, Chou SW, Lin YC. Effect of Kinesio taping on muscle strength in athletes—a pilot study. Journal of science and medicine in sport. 2008;11(2):198-201.
24. de Almeida Lins CA, Neto FL, de Amorim AB, de Brito Macedo L, Brasileiro JS. Kinesio Taping® does not alter neuromuscular performance of femoral quadriceps or lower limb function in healthy subjects: Randomized, blind, controlled, clinical trial. Manual therapy. 2013;18(1):41-5.
25. Vercelli S, Sartorio F, Foti C, Colletto L, Virton D, Ronconi G, Ferriero G. Immediate effects of kinesiotaping on quadriceps muscle strength: a single-blind, placebo-controlled crossover trial. Clinical Journal of Sport Medicine. 2012;22(4):319-26.
26. Serrão JC, Mezêncio B, Claudino JG, Soncin R, Miyashiro PL, Sousa EP, Borges E, Zanetti V, Phillip I, Mochizuki L, Amadio AC. Effect of 3 different applications of Kinesio Taping Denko® on electromyographic activity: inhibition or facilitation of the quadriceps of males during squat exercise. Journal of sports science & medicine. 2016;15(3):403.
27. Hsu YH, Chen WY, Lin HC, Wang WT, Shih YF. The effects of taping on scapular kinematics and muscle performance in baseball players with shoulder impingement syndrome. Journal of electromyography and kinesiology. 2009;19(6):1092-9.
28. Słupik A, Dwornik M, Białoszewski D, Zych E. Effect of Kinesio Taping on bioelectrical activity of vastus medialis muscle. Preliminary report. Ortopedia, traumatologia, rehabilitacja. 2007; 9(6):644-51.
29. Murray H. Effects of kinesio taping on muscle strength after ACL-repair. J Orthop Sports Phys Ther. 2000;30(1):14.
30. Guner S, Alsancak S, Koz M. Effect of two different kinesio taping techniques on knee kinematics and kinetics in young females. Journal of physical therapy science. 2015;27(10):3093-6.

31. Boonkerd C, Limroongreungrat W. ACL kinesio taping on knee joint biomechanics during a drop vertical jump in healthy young adults. Gazzetta Medica Italiana-Archivio per le Scienze Mediche. 2019;178(9):632-9.
32. Limroongreungrat W, Boonkerd C. Immediate effect of ACL kinesio taping technique on knee joint biomechanics during a drop vertical jump: a randomized crossover controlled trial. BMC Sports Science, Medicine and Rehabilitation. 2019;11(1):32.
33. Chappell JD, Herman DC, Knight BS, Kirkendall DT, Garrett WE, Yu B. Effect of fatigue on knee kinetics and kinematics in stop-jump tasks. The American journal of sports medicine. 2005;33(7):1022-9.
34. Sorenson B, Kernozek TW, Willson JD, Ragan R, Hove J. Two-and three-dimensional relationships between knee and hip kinematic motion analysis: single-leg drop-jump landings. Journal of sport rehabilitation. 2015;24(4):363-72.
35. Kristianslund E, Krosshaug T, Van den Bogert AJ. Effect of low pass filtering on joint moments from inverse dynamics: implications for injury prevention. Journal of biomechanics. 2012;45(4):666-71.
36. Kernozek TW, Torry MR, van Hoof H, Cowley H, Tanner S. Gender differences in frontal and sagittal plane biomechanics during drop landings. Medicine & Science in Sports & Exercise. 2005;37(6):1003-12.
37. DeMorat G, Weinhold P, Blackburn T, Chudik S, Garrett W. Aggressive quadriceps loading can induce noncontact anterior cruciate ligament injury. The American journal of sports medicine. 2004;32(2):477-83.
38. Yu B, Kirkendall DT, Taft TN, Garrett Jr WE. Lower extremity motor control-related and other risk factors for noncontact anterior cruciate ligament injuries. Instructional course lectures. 2002;51:315.
39. Markolf KL, Burchfield DM, Shapiro MM, Shepard MF, Finerman GA, Slauterbeck JL. Combined knee loading states that generate high anterior cruciate ligament forces. Journal of Orthopaedic Research. 1995;13(6):930-5.
40. Yu B, Lin CF, Garrett WE. Lower extremity biomechanics during the landing of a stop-jump task. Clinical biomechanics. 2006;21(3):297-305.
41. van Dijck RA, Saris DB, Willems JW, Fievez AW. Additional surgery after anterior cruciate ligament reconstruction: can we improve technical aspects of the initial procedure?. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2008;24(1):88-95.
42. Nunley RM, Wright D, Renner JB, Yu B, Garrett Jr WE. Gender comparison of patellar tendon tibial shaft angle with weight bearing. Research in Sports Medicine. 2003;11(3):173-85.
43. Cochrane DG, Elder HY, Usherwood PN. Physiology and ultrastructure of phasic and tonic skeletal muscle fibres in the locust, Schistocerca gregaria. Journal of cell science. 1972;10(2):419-41.

چکیده فارسی

اثر کینزیوتیپ به روش تسهیل عضله همسترینگ و مهار عضله کوادری‌سپس بر متغیرهای بیومکانیکی مؤثر بر آسیب لیگامان متقاطع قدامی در هنگام فرود، در زنان جوان فعال سالم

نادر نخودچی[۱*]، مهسا سادات حسینی[۲]، زهرا عطاران ایرج[۱]، امیرحسام رحیمی[۱]

1. *گروه علوم ورزشی، دانشگاه بجنورد، بجنورد، ایران*
2. *گروه علوم ورزشی، دانشگاه الزهرا، مشهد، ایران*

عوامل متعددی از جمله استراتژی متفاوت زنان در هنگام فرود سبب شیوع بیشتر آسیب لیگامان متقاطع قدامی (ACL) در مقایسه با مردان شده است. امروزه ورزشکاران از انواع تکنیک های تیپینگ جهت پیشگیری از آسیب لیگامان استفاده می‌کنند. هدف از تحقیق حاضر بررسی اثر کینزیوتیپ به روش تسهیل همسترینگ و مهار عضله کوادری سپس بر منتخبی از متغیرهای بیومکانیکی مؤثر بر آسیب ACL در زنان جوان فعال سالم می باشد. بدین منظور اطلاعات کینماتیکی و کینتیکی ۱۸ زن جوان سالم (سن ۱/۱۶±۱۹/۹۴ سال، قد ۲/۱۴±۱۶۷ سانتی‌متر، وزن ۳/۷۲±۵۸/۳۳ کیلوگرم) شامل میزان فلکشن و ابداکشن زانو در لحظه تماس اولیه پا با زمین، حداکثر میزان فلکشن و ابداکشن زانو و حداکثر نیروی برشی قدامی در سه حالت: بدون تیپ، با استفاده از کینزیوتیپ شَم و کینزیوتیپ به روش تسهیل همسترینگ و مهار عضله کوادری سپس در هنگام فرود تک پا به وسیله سیستم پردازش حرکت SIMI و صفحه نیروKISTLER مورد اندازه گیری قرار گرفت. نتایج تحقیق نشان داد که استفاده از کینزیوتیپ سبب افزایش معنادار فلکشن زانو در لحظه تماس اولیه پا با زمین و کاهش حداکثر نیروی برشی قدامی شد($p<0.05$). با توجه به نتایج تحقیق می توان بیان داشت این تکنیک تیپینگ از طریق افزایش زاویه فلکشن زانو در لحظه تماس اولیه با زمین و کاهش نیروی برشی قدامی می تواند سبب کاهش احتمال بروز آسیب ACL در زنان جوان سالم شود. با این حال به نظر می رسد این تکنیک قابلیت کاهش عوامل خطرزای بروز آسیب لیگامان در صفحه فرونتال را ندارد.

.

واژه‌های کلیدی: کینزیوتیپ، بیومکانیک، لیگامان متقاطع قدامی