

The Effects of Shoulder Kinesio Taping on Shooting Accuracy and Joint Position Sense in Female Archery Athletes

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Article Info

Received: 2019/01/09;
Accepted: 2019/03/10;
Published Online: 2019/03/20

DOI: 10.30699/fdisj.1.4.9

How to Cite This Article

Rajabzadeh B., Amiri A.,
Vasaghi-Gharamaleki B.,
Saneii S.H. The Effects of
Shoulder Kinesio Taping on
Shooting Accuracy and Joint
Position Sense in Female Ar-
chery Athletes. Function and
Disability Journal. 2019 (Win-
ter). Vol:1. No: 4 pages: 9-16

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ABSTRACT

Background and Objectives: Archery is a static sport and requires high degrees of accuracy and stability in the glenohumeral joint. Kinesio Tape (KT) is known as a technique for increasing joint stability and Joint Position Sense (JPS), with subsequent improvement in accuracy. The present study aims to investigate the effect of KT on shoulder JPS and accuracy in female archery athletes using Olympic recurve bows.

Materials and Methods: A total of 30 female archers with a mean age of 24.77±6.16 years and minimum of one year's experience of archery, volunteered to take part in the study. The repositioning angle test was performed on the shoulder JPS (of the drawing arm) at 30 degrees and 60 degrees of external rotation. In this test, the drawing arm shoulder was at 90 degrees of abduction and the elbow was at 90 degrees of flexion. Then, each participant shot three arrows from distances of 18, 30, and 50 meters, and their scores were recorded. Next, KT was placed on the deltoid and supraspinatus muscles, and repositioning test and shooting were repeated.

Results: KT positively affected archery scores ($P=0.004$, 0.000 , and 0.004 for 18, 30, and 50 meters, respectively). The results for absolute error in repositioning angle test showed an increase in JPS at 60 degrees of external rotation ($P=0.000$), but no significant difference was observed at 30 degrees of external rotation ($P=0.637$).

Conclusion: It appears that KT technique can be used to increase the shoulder joint JPS and improve archers' shooting accuracy.

Keywords: Joint position sense, Archery, Kinesio tape, Shooting accuracy, Shoulder external rotation.

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Introduction

Archery is a static sport that requires strength and stability of the upper limbs, especially the forearm and shoulder complex. Deftness in archery is defined as the ability to shoot an arrow toward the target accurately and at a given time. The stages of shooting an arrow include six phases: Bow holding, drawing, full draw, aiming, release, and follow through (Ertan, Kentel et al., 2003).

An archer forces the bow forward with one hand and statically watches the target (bow arm), while dynamically drawing the bowstring towards the face (drawing hand). These actions begin from the drawing phase and dynamically continue until release (Vithoulka, Beneka et al., 2010). The release phase must be balanced and very efficient to produce the desired result (Ertan, Kentel et al., 2003).

Shoulder complex, seen as the most important part

in archery, has a complex biomechanics in comparison to other joints, since it is a multi-sectional joint. Hence, to secure its normal biomechanics, it would need even more musculoskeletal coordination. The shoulder is the proximal segment in upper extremity, hence it has a great job in archery. Proximal stability is offered to allow the independent use of the arms and hands in manipulative and purposeful movement (Tudor, 1981). Also, the scapula and glenohumeral joint (shoulder) both function as a linkage and a segment in the kinetic chain (rather than in separation), acting to increase the kinetic energy and force generated, and transfer these forces to the distal segments where the smaller muscles can position the arm and hand to control the movement. This activation sequence allows for proximal stability and distal mobility in the kinetic chain (Kibler WB, 1991).

Proprioception is one of the important parts of this coordination which is the result of neural impulses originated from several mechanoreceptors flowing through the central neural system (Seo, Kim et al. , 2016). Kinesio Tape (KT) is currently used to increase proprioception (Drouin, McAlpine et al. 2013), which leads to an improvement in the Joint Position Sense (JPS), and also as a therapeutic support by physiotherapist in the process of rehabilitation. KT is believed to increase proprioception by balancing muscle tone, reducing pain and stimulating skin receptors (Ślupik, Dwornik et al., 2007). KT is dynamic, and athletes can use it at any time and in any place without disrupting routine exercises and activities (Wohlman , 2015).

Kinesio taping is a method that consists of applying an elastic adhesive tape over a target muscle, providing continual skin traction (Kase K, Wallis J et al., 2003). Kinesio taping has been widely and increasingly used in clinical and sports practice, although its effects are still not clear (Williams S, Whatman C, et al. 2012; Morris D, Jones D et al., 2013). Mülazımoğlu et al. (Mülazımoğlu, Afyon et al., 2018) have shown that using KT on the bow arm deltoid muscle can improve an archers' shooting accuracy.

External rotator muscles have a significant impor-

tance in each movement and in the process of stabilization of the shoulder joint in each plane. The incoordination of these muscles would lead to jerky movements and many injuries such as bursitis, tendonitis, impingement, etc. On the other hand, the movements needed in archery constitute of abduction, extension and external rotation. Supraspinatus is the muscle which abducts and externally rotates the shoulder and deltoid is the muscle extend that externally rotates the shoulder (Neumann DA, 2010).

Since one of athletes' main goals is to obtain higher scores, and that any measures in this respect is worthwhile, the present study aimed to investigate the effect of KT on the drawing arm deltoid and supraspinatus muscles to improve shooting accuracy.

Materials and Methods

This is an interventional and quasi-experimental study. The committee of ethics of Iran University of Medical Sciences has approved the research and its phases (ethical code: IR.IUMS.FMD.REC 1396.9411452003). The participants were archer athletes of Tehran archery clubs. Participation of all individuals, after providing complete information about the goal and method of the study, was completely voluntary. Written consent was obtained from all participants. Information related to participants are kept confidential and the experiments pose no threat to the participants. Criteria to participate in the study included no pain or soreness in tested shoulder, at least, 6 hours training per week and at least 1-year experience in archery (age 18-40), no history of injury (in other joints of the upper limb during last 6 months), surgery (in shoulder blade or upper limb joints), FHP or rounded-shoulder posture. The participants with inability in performing the study tests, disabling pain occurrence during the test, muscle weakness (assessed with MMT) or limited ROM in upper limb joints, were excluded from the study.

Shooting Method

The athletes shot three arrows from distances of 18, 30, and 50 meters. Scoring was carried out according to the regulations of the Archery Federation.

11. Shoulder Kinesio Taping and Accuracy in Archery Athletes

Movement Reconstruction

Although athletes are in a static standing position, their shoulder joint moves a lot, and the amount of this movement is different for different people. The range of shoulder joint movement in recurve archery and during maximum bow stretch is between 30 degrees and 60 degrees of external rotation. Hence, the 30-degree and 60-degree angles were reconstructed in the present study. To this end, the subjects were asked to lie down on the study bed in supine position, and a wristband was fastened on the subject's anterior distal part of the forearm, and an inclinometer was fixed

on the wristband, with the arm held at 90 degrees of abduction and 0 degrees of internal and external rotation (right arm for right-handed and left arm for left-handed people) and elbow at 90 degrees of flexion (figure 1). While the athletes' eyes were shut, their arm was held at 30 degrees external rotation for 5 seconds, and then returned to its initial position. After 15 seconds of rest, the athletes were asked to reconstruct the move three times. Next, the reconstruction of the move was repeated at 60 degrees. Mean score of the three repeats was used in statistical analysis.



Figure 1. starting position of the test

Kinesio-taping Method

Two strips of KT (Sports Tex(R), ISO 9001) with 10-15% tension were used to stabilize supraspinatus and deltoid muscles, and a third strip was fastened onto the first two to support them. The tension and methods of Kinesio Taping were similar to Kenso Kase technique (Kase, K et al., 2013). The two ends of the strips exerted no tension on the skin. The upper part of the body was undressed before fastening KT. The first KT was cut into an I-shape and attached onto the supraspinatus muscle. The anchor KT was placed 5 cm below the humerus greater tuberosity (without tension). To stretch supraspinatus, the subject's arm was first adducted behind the trunk, and then the neck was moved to the opposite side with a lateral flexion. KT was attached with a little tension on the skin along the supraspinatus. The upper end of KT was placed above the scapular spine at the upper corner and inside the scapula.

The second KT (for deltoid) was cut into a Y-shape and its starting end was placed on the skin 5 cm below deltoid tuberosity (without tension). The Y-shaped KT consists of anterior and posterior parts. To stretch the anterior deltoid, the subject's arm was adducted 45 degrees with some external rotation, and the anterior part of KT was placed on the skin to cover the anterior edge of the deltoid. To stretch the posterior deltoid, the shoulder joint was adducted and flexed, and the posterior part of KT was placed on the skin to cover the posterior margin of the deltoid.

The third KT was cut into an I-shape. To support the first two KTs, one end of the third KT was placed on coracoid process, and shoulder joint received a slight internal rotation. When KT reached the humerus midpoint, the arm was flexed, and the posterior part of KT was attached below scapular spine, such that KT passed over the first two KTs and stabilized them.



Figure 2. the first KT

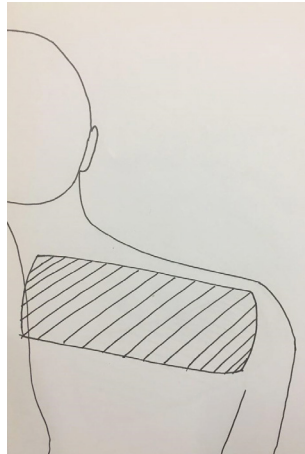


Figure 3. the second KT

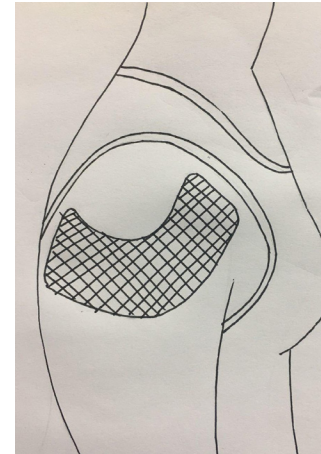


Figure 4. the third KT

Thirty minutes after applying shoulder KT, the subjects performed repositioning tests at 30-degree and 60-degree external rotation, and then shooting tests at distances of 18, 30, and 50 meters.

To prevent confounding effect of fatigue, a 30-minute rest was allowed between the first shooting test and the next tests (repositioning and accuracy tests after using KT). Moreover, all athletes shot arrows using the same bow and the same technique.

Data Analysis

The statistical tests were carried out in SPSS-21. Normal distribution of data was assessed using K-S test. Given the Federation's ordinal scoring method,

the sum of scores obtained was used in statistical analysis. Wilcoxon test was used to compare the results before and after applying KT, and Kruskal-Wallis test to compare the results at different distances. The value of absolute error was used for joint reconstruction error. Absolute error was calculated from the post-pre difference. Since the reconstruction error scores had normal distribution, paired t-test was used to compare the before and after results.

Results

Demographic details of the 30 female archers are shown in Table 1.

Table 1. Demographic features of participants (mean \pm SD) (N=30)

Demographic features	Statistic index	Min	Max	Mean	SD	P value in K-S test
Age (year)		18	39	24.77	\pm 6.16	0.635
Height (m)		1.50	1.76	1.60	\pm 7.34	0.810
Weight (kg)		45	80	60.87	\pm 8.36	0.587
Shoulder external rotation ROM (degree)		78	95	87.97	\pm 3.97	0.200
Shoulder internal rotation ROM (degree)		75	98	78.60	\pm 4.79	0.955

Table 2 presents reconstruction errors at 30-degree and 60-degree angles before and after KT.

Table 2. mean \pm SD of absolute error, before and after of KT (degree)

Variable	Statistic index	Mean	SD	Min	Max	P value in K-S test
Absolute error in 30°	Before	0.60	\pm 4.55	-5.60	7.47	0.303
	After	0.23	\pm 2.10	-4.17	6.50	0.871
Absolute error in 60°	Before	-5.91	\pm 6.52	-18.10	5.63	0.917
	After	-0.99	\pm 3.70	-9.77	4.03	0.400

13. Shoulder Kinesio Taping and Accuracy in Archery Athletes

Table 3 includes the paired t-test results of comparing absolute reconstruction errors at 30-degree and

60-degree showing the significant difference between these angles.

Table 3. Result of the paired-t test of the effect of KT on absolute error of repositioning 30° and 60° shoulder external rotation

Variables	Mean	SD	t	P value
absolute error of repositioning 30° shoulder external rotation	0.37	±4.31	0.48	0.637
absolute error of repositioning 60° shoulder external rotation	-4.92	±6.20	-4.35	0.000

Table 4 shows scores of three shootings based on the

Archery Federation scoring before and after KT.

Table 4. Descriptive and analytical information for earned points for three efforts of shooting, before and after of KT, in women archers by federation pointing scale (N=30)

Distances	Time	Federation pointing scale (total points)*			
		Median	Min	Max	P value
18 m	Before	26	22	30	0.004
	After	28	24	30	
30 m	Before	23	17	28	0.000
	After	27	23	30	
50 m	Before	23	17	28	0.004
	After	26	22	29	

*: information analysis by Wilcoxon test

The Wilcoxon test was used to compare shooting scores before and after KT, and showed significant differences at all three distances (18, 30, and 50 meters) ($P=0.004$, 0.000 , and 0.004 , respectively).

Discussion

According to the results obtained, KT had a significant effect on reducing absolute error in the reconstruction of the 60-degree angle, but made no significant difference at 30-degree angle. After using KT, the athletes shooting scores significantly improved at

all three distances (18, 30, and 50 meters).

Using KT can improve the shoulder joint JPS (Lephart and Jari, 2002). JPS is necessary for movement control. This component improves function, especially targeted activity. Improved movement accuracy requires reinforcement of JPS, which itself includes various parts such as sense, muscular balance, and brain integration. In the present study, KT was used to strengthen JPS by improving the sense in deltoid and supraspinatus muscles. Using KT appears to im-

prove shoulder JPS at 60 degrees of external rotation, but has little effect at 30 degrees of external rotation. Given the shoulder position in the drawing phase, using KT may have increased JPS at 60 degrees of external rotation, and thus improved the athlete's performance. In the recurve method, the athlete must apply maximum stretch on the bow in this phase and release the arrow immediately to prevent an error in the shooting angle.

Many studies conducted on various muscles have shown that KT can improve the shoulder JPS by increasing sensory afferent derived from muscles. For example, Burfeind et al. studied the use of KT on deltoid, biceps, and triceps, and Line et al. studied KT on transverse trapezius, supraspinatus, deltoid, and pectoralis major muscles. In all these studies, JPS improved after applying KT (Burfeind and Chimera 2015; Lin JJ, Hung CJ et al., 2011). Thus, irrespective of the site of application, KT seems to improve deep sense of the shoulder.

Numerous studies have reported that KT improves reconstruction of the joint at various angles during different movements. For example, JPS improved in reconstruction of flexion and external rotation in Burfeind et al. study (Burfeind and Chimera, 2015), and reconstruction at 90 degrees of abduction in Barzegar et al. study (BARZEGAR, DEHGHAN et al., 2015). Hence, the range or type of movement is not essential in JPS test.

According to Zanca et al. (Zanca, Mattiello et al., 2015) study, joint reconstruction at 50, 70, and 90 degrees of shoulder abduction in healthy people showed that fatigue, as a confounding factor, can disrupt JPS (Zanca, Mattiello & Karduna, 2015). In the present study, this effect was eliminated by allocating appropriate time intervals between measurements. Also, in a study by Aarseth, KT impaired the JPS of the shoulder in 90° shoulder elevation, which is just the opposite result from our study (Aarseth, Suprak, et al., 2015). However, there are some controversies in every field of science.

According to the present study results, the shooting accuracy improved at all distances after using

KT. Muller et al. (2015) and Mulazimoglu et al. (2018) also investigated the effect of KT on shooting accuracy. According to Muller et al. study conducted on semi-professional handball players, using KT on pectoralis major and subscapularis muscles improved the throwing speed and reduced accuracy (which comes in disagreement with the present study results) (Mülazımoğlu, Afyon et al., 2018; Müller and Brandes, 2015). The study conducted by Mulazimoglu et al. on archers showed that KT can improve shooting accuracy. They used Y-shaped KT on the bow arm deltoid muscle during a 4-week archery practice. Unlike Mulazimoglu et al. study, in the present study, the positive effects of KT on shooting accuracy were immediate. Thus, prolonged use of KT is not necessary to exert positive effects on accuracy, and improved shooting accuracy does not depend on the use of KT on the bow arm deltoid muscle.

Since athletes are in a standing position while shooting arrows, it is recommended that future studies investigate repositioning in sitting or standing position. The use of movement analysis system can help a more accurate data collection.

Conclusion

Given the present study results, this technique of KT, has an immediate effect on improving the shoulder joint JPS in external rotation repositioning and as a result, it can increase shooting accuracy of archer athletes at all distances.

Acknowledgement

This study was a part of MSc thesis supported and founded by Iran University of Medical Sciences grant.

The help of Mrs. Zahra Shams, Mr. Emad Khalaj, Mr. Saber Hosseini and Dr. Ali Farhadi and all the staff and athletes of Payam, Maham and Tirana archery clubs in recruiting the participants and data acquisition is appreciated.

Conflict of Interest Statement

The authors stated no conflict of interests.

15. Shoulder Kinesio Taping and Accuracy in Archery Athletes

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اثرات استفاده از چسب کینزیو در ناحیه شانه بر دقت تیراندازی و وضعیت مفصل در ورزشکاران زن تیراندازی با کمان

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اطلاعات مقاله

چکیده

زمینه و هدف: تیروکمان ورزشی ایستا و نیازمند درجات بالایی از دقت و ثبات در مفصل گلنوهومرال می باشد. کینزیوتیپ به عنوان روشی برای افزایش ثبات مفصل و افزایش حس عمقی مفصل در ناحیه و در نتیجه افزایش دقت شناخته شده است. هدف این مطالعه بررسی اثر کینزیوتیپ بر حس عمقی مفصل شانه و دقت تیراندازی در زنان ورزشکار رشته تیروکمان با کمان ریکرو المپیک است.

روش کار: ۳۰ ورزشکار خانم با میانگین سنی $24/77 \pm 6/16$ ، دارای حداقل یک سال سابقه فعالیت در رشته تیروکمان و به صورت داوطلبانه در مطالعه شرکت کردند. حس عمقی مفصل در آزمون بازسازی زاویه (بر روی شانه دست کشاننده زه کمان) و در زاویای ۳۰ و ۶۰ درجه چرخش خارجی شانه انجام شد. در این تست شانه دست کشاننده زه کمان در وضعیت ۹۰ درجه ابداعشن و آرنج آن در وضعیت ۹۰ درجه فلکشن قرار داشت. سپس از فواصل ۱۸، ۳۰ و ۵۰ متر و از هر فاصله سه تیر به سمت هدف پرتاب و نمره تیراندازی محاسبه شد. بعد از آن کینزیوتیپ بر روی عضلات دلتوئید و سوپراسپیناتوس اعمال شد. به دنبال آن، آزمون بازسازی و پرتاب تیر تکرار شدند.

نتایج: کینزیوتیپ تاثیر مثبتی بر روی نمره تیراندازی داشت (به ترتیب برای فواصل ۱۸، ۳۰ و ۵۰ متر مقدار P برابر بود با ۰/۰۰۴، ۰/۰۰۰ و ۰/۰۰۴). نتایج برای خطای مطلق در آزمون بازسازی زاویه، نمایانگر افزایش حس عمقی مفصل در ۶۰ درجه چرخش خارجی بود ($P = 0/004$) و تفاوت قابل ملاحظه‌ای در زاویه ۳۰ درجه چرخش خارجی مشاهده نشد ($P = 0/637$).

نتیجه‌گیری: به نظر می‌رسد می‌توان از روش کینزیوتیپ برای افزایش JPS در مفصل شانه و بهبود دقت تیراندازی در ورزشکاران تیروکمان استفاده کرد.

کلید واژه‌ها: حس عمقی، تیروکمان، کینزیوتیپ، دقت تیراندازی، چرخش خارجی مفصل شانه

تاریخ وصول: ۱۳۹۷/۱۰/۱۹
 تاریخ پذیرش: ۱۳۹۷/۱۲/۰۳
 انتشار آنلاین: ۱۳۹۷/۱۲/۲۹

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