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ACUTE EFFECT OF KINESIOTAPE APPLICATION ON SHOULDER MUSCLE STRENGTH IN MALE WHEELCHAIR BASKETBALL PLAYERS

ORIGINAL ARTICLE

ABSTRACT

Purpose: Shoulder muscle strength is vital in wheelchair basketball. This study aimed to determine the acute effect of Kinesiotaping on shoulder muscle strength of wheelchair basketball players.

Methods: A total of 12 wheelchair basketball players were included in the study. The mean age of the athletes was 31.17±7.85 years and the mean body mass index was 25.41±6.96 kg/m^2. Athletes were assessed before and after the Kinesiotape application on deltoid muscle and shoulder. Muscle facilitation technique was applied to the deltoid muscle. Isokinetic parameters of the deltoid muscles of athletes were measured using a Cybex NORM isokinetic dynamometer. Measurements were taken for flexion and abduction movements on both dominant and non-dominant shoulders. In isokinetic measurement, five repetitions at 60°/s and 10 repetitions at 180°/s for shoulder muscle strength were performed. Peak torques and total works were calculated.

Results: An increase of the peak torque and total work were found on dominant and non-dominant shoulders of all athletes on flexion and abduction movement at 60°/s and 180°/s with Kinesiotaping ($p<0.05$).

Conclusion: The Kinesiotape application on shoulders could increase the isokinetic muscle strength of the wheelchair basketball players. This study has shown that the Kinesiotaping application may be used to support muscle strength.

Key Words: Athletic Tape; Disabled Persons; Muscle Strength.

ERKEK TEKERLEKLİ SANDALYE BASKETBOLCULARINDA KİNEZYO BANT UYGULAMASININ OMUZ KAS KUVVETİ ÜZERİNE AKUT ETKİSİ

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Tekerlekli sandalye basketbolunda omuz kas kuvveti önemlidir. Bu çalışma, tekerlekli sandalye basketbol oyuncularında Kinezyo bantlamanın omuz kas kuvveti üzerine akut etkisinin incelenmesi amacıyla gerçekleştirildi.

Yöntem: Araştırmaya 12 erkek tekerlekli sandalye basketbol oyuncusu dahil edildi. Bireylerin yaş ortalaması 31,17±7,85 yıl ve vücut kütle indeksi ortalaması 25,41±6,96 kg/m^2 idi. Bireyler deltoid kasına ve omuza uygulanan Kinezyo bantlama öncesi ve sonrasında değerlendirildi. Deltoid kası üzerine kas fasilitasyon tekniği uygulandı. Bireylerin deltoid kası izokinetik ölçümleri Cybex NORM izokinetik dinamometre ile yapıldı. İzokinetik ölçümler hem dominant hem de dominant olmayan omuzun fleksiyon ve abdüksiyon hareketleri için yapıldı. İzokinetik ölçümlerde 60°/sn, beş tekrar ve 180°/sn 10 tekrar izokinetik omuz kuvveti testi uygulandı. Tepe tork ve toplam iş hesaplandı.

Sonuçlar: Çalışmanın sonuçları değerlendirildiğinde, tüm bireylerin dominant ve dominant olmayan ekstremitelerinde 60°/sn ve 180°/sn'deki fleksiyon ve abduksiyon tepe tork ve toplam iş değerlerinde Kinezyo bantlama sonrası artış bulundu ($p<0,05$).

Tartışma: Omuz bölgesine yapılan Kinezyo bant uygulamasının tekerlekli sandalye basketbol oyuncularının izokinetik kas kuvvetini artırabileceği belirlendi. Bu çalışma Kinezyo bant uygulamasının kas kuvvetini desteklemek amacıyla kullanılabileceğini göstermektedir.

Anahtar Kelimeler: Atletik Bantlama; Engelli Bireyler, Kas Kuvveti.

INTRODUCTION

Wheelchair (W/C) basketball is the most popular sport among Paralympics Sports. This sport includes moderately high-intensity activities requiring explosive power and speed. A successful basketball throw in W/C basketball requires actively and coordinated use of upper extremity muscles, especially shoulder complex muscles (1). The W/C basketball is specifically characterized by high-intensity propulsion and maneuvering along with quick passing, rebounding, and reaching overhead for throwing (2). The deltoid muscle has a vital role for W/C athletes. The deltoid muscle helps flexion and abduction of the shoulder. Strong shoulder flexion and abduction muscle strength would increase the athletic performance, and provide more W/C using in athletes without fatigue during the sport (3).

The most reliable method to determine the shoulder muscle strength profile is isokinetic dynamometers. The most important feature of these dynamometers is to determine the peak torque during the function by applying particular positions for the athletic performance of athletes (4,5). Isokinetic measurements are performed through electromechanical instruments that may show changing resistance at constant angular velocity and every angle of movement. Angular speeds may be adjusted as follows: slow speed (30°/s-60°/s), medium speed (90°/s-120°/s), and high speed (180°/s-300°/s). While low angular speeds are more available for measuring resistance ability of individuals against the given strength; medium and high angular speeds allow to evaluate the muscle capacity and endurance. One of the most common speeds used to measure endurance capacity is 180°/sec angular velocity due to the very repetitive principle with low load; the angular speed of 60°/sec shows the concentric strength capacity more clearly (6).

Kinesiotape (KT) is a clinical tape developed by Dr Kenzo Kase, chiropractic specialist in the 1970s. The taping that was introduced in 1973 has some advantages, including improving sensorimotor function through improving proprioceptive feedback, changing motion strategies, and providing mechanical support (7). Dr Kase has developed the KT that may be left on 24 hours in a day for up to five days because other types of taping limit joint range of motion and may be worn for just a few hours (8). The fascia tissue is brought to the fore as an organ of the body. Neurophysiological responses arising from the stimulation of the fascia and fascia-related structures are directed to increase the benefits of the treatment in the KT method (9).

It is not clear yet whether KT increases muscle stimulation. Studies on muscle strength are also ongoing, like as studies on other effects of KT pain, muscle activity, balance, edema, and proprioception (10-13). The enforcement methods on athletes and non-athletes have been investigated in many studies in the literature. The studies have demonstrated that Kinesiotaping increases shoulder muscle strength on symptomatic and asymptomatic individuals (14,15). Although there are studies of physically disabled athletes related to KT in the literature, no previous study about wheelchair basketball players has been conducted. This study that we have performed in W/C athletes would contribute to literature (16). This study aimed to determine the acute effect of Kinesiotaping on shoulder muscle strength of W/C basketball players.

METHODS

Study Design

The study was carried out at the Veterans Physical Therapy and Rehabilitation Training and Research Hospital between January and March 2015. Approval was obtained from Selçuk University School of Physical Education and Sports, Non-Interventional Clinical Research Ethics Committee for the study (Approval Date: 04.12.2014 and Approval Number: 29). An informed consent form was obtained from individuals, and all procedures were carried out according to the Helsinki Declaration.

Participants

Totally 12 male athletes playing in the TSK Karagücü W/C Basketball Team participated voluntarily the study. Twelve athletes accepted to participate in the study providing an informed consent form. Athletes with at least two years of active sports years and who did not have any diagnosed diseases related to the shoulder joint were included. Athletes with acute muscle spasms, dermatologic disease, effusion and severe pain in the shoulder joint within

last year, and who underwent orthopedic surgery in the shoulder joint, and those with any accompanying cardiovascular problem were excluded from the study. Measurements were performed at 18-20°C room temperature between 9.00 a.m. and 4.00 p.m.

Kinesiotaping Application

The KT procedure was performed through 5 cm wide Kinesio® Tape (Kinesio Tex Gold, Kinesio USA, Albuquerque, NM, USA). The KT application was applied to both dominant and non-dominant deltoid muscle according to the technique by an experienced physiotherapist having Kinesio® Tape Applicator Certificate. Taping was applied on sitting position. Factors (cream, sweat, hair) on the skin surface that would prevent the tape from sticking were avoided. The first piece of the KT was cut "Y" shape, and it was applied on the deltoid muscle by 15-25% tension through the muscle facilitation technique. The second piece of the tape was cut with "I" shape and applied on the glenohumeral joint by applying 50-75% tension for mechanical correction (9) (Figure 1). The KT may change the joint stability and movement biomechanics through mechanical support. The purpose of preferring mechanical correction technique in our study was to enlarge the subacromial space and increase the circulation. It is believed that when KT is implemented at high tension through correction technique, skin receptors are stimulated, and proprioception perception increases (17). The purpose of using the Y-shaped strips was that W/C basketball players frequently use abductor muscles of the shoulder (3).

Isokinetic Test Protocol

The isokinetic measurements of the shoulder flexion and abduction muscles of W/C basketball players were performed by the Cybex NORM isokinetic dynamometer (Lumex Inc., Ronkonkoma, New York, USA), which reliability and validity have been evidenced with many publishing (18,19). The expert researcher performed measurements. After a 5-minute warm-up on an arm cycling ergometer, the athletes were instructed for stretching exercises towards the shoulder joint for 3-5 minutes before the test. Each athlete was motivated during the measurement (20). Athletes were assessed before and immediately after the Kinesiotape application on deltoid muscle and shoulder.

Figure 1: Kinesiotaping application. First strip (Y-shape surrounding deltoid muscles for muscle facilitation), second strip (I-shape, mechanical correction for glenohumeral joint).

Before the tests, the isokinetic dynamometer was set according to the physical properties of each athlete. The isokinetic measurement was applied as described in the user manual of Cybex Norm Isokinetic dynamometer. Regarding ensure the effectiveness of the KT, the athletes were measured 30 minutes after the KT application (21). The familiarization was done initially in three repetitions at 60°/s, followed by the test performed in five repetitions at 60°/s. The athlete then passed the familiarization process at 180°/s speed, performing four repetitions at this speed, followed by the official test consisting of 10 repetitions at 180°/s (22). Three trials for each test were applied to W/C basketball players. A three-minute break time was given between the two angular speed tests. The highest of three repetitions was recorded for peak torque analysis. The flexion/extension tests were performed according to the manufacturer's protocol, with the athlete in the supine position and the axis of rotation of the shoulder joint aligned with the axis of rotation of the dynamometer arm. The abduction/adduction movements were evaluated in the sitting position, and the trunk and pelvis were stabilized with belts. The arm was positioned in the coronal plane, in neutral rotation and with the elbow in full extension. The axis of rotation of the humeral head was aligned with the axis of rotation of the dynamometer lever arm (23). Same tests were repeated for both extremities.

Table 1: Characteristics of the Athletes.

Characteristics	Athletes (n=12)	
	Mean±SD	Min-Max
Age (years)	31.17±7.85	18-41
Active Sports Years (years)	8.50±5.65	2-15
Body Mass Index (kg/m²)	25.42±6.96	18.40-45.60

Statistical Analysis

The SPSS 25.0 program (IBM SPSS Statistics version 25.0, IBM Corp. Armonk, New York, USA) was used for statistical analysis. The descriptive statistics of the athletes were expressed as mean±standard deviation. The variables obtained from the pretest-posttest measurements were expressed as median (IQR 25-75). The Wilcoxon signed-rank test was used to compare the isokinetic strength parameters before and after the KT application. The minimum required sample size for the study was calculated using G*Power Software (Version 3.0.10 University of Dusseldorf, Germany). The smallest sample size with 0.80 effect size, 5% type I error, 80% statistical power conditions was calculated as 12 W/C basketball players. The calculation formula is based on one-tailed calculations.

RESULTS

Twelve athletes who met the inclusion criteria participated in the study. The mean age of the athletes was 31.17±7.85 years, the mean duration of sports was 8.50±5.65 years, and the body mass index was 25.42±6.96 kg/m^2. The dominant side of the 11 athletes was determined as right, while the dominant side of one athlete was identified as the left. The characteristics of the athletes are shown in Table 1.

The strength produced after taping was significantly higher than the strength produced before taping in comparison of the peak torque values obtained at a speed of both 60º/s and 180º/s in the dominant and non-dominant shoulder, both in flexion and abduction ($p<0.05$) (Table 2).

Table 2: Comparison of Peak Torque Values before and after Kinesiotape Application Obtained at 60º/s and 180º/s Speeds of Dominant and Non-Dominant Shoulder.

Peak Torque (Nm)		KT	Median (IQR 25-75)	p
Flexion (60º/s)	Dominant	Pre	59.00 (43.50-76.50)	0.015*
		Post	65.50 (49.50-78.75)	
	Non-Dominant	Pre	52.00 (32.75-63.25)	0.026*
		Post	51.50 (37.00-66.25)	
Abduction (60º/s)	Dominant	Pre	65.50 (50.00-85.50)	0.003*
		Post	70.00 (55.25-88.25)	
	Non-Dominant	Pre	55.00 (40.50-62.00)	0.006*
		Post	58.50 (46.00-63.50)	
Flexion (180º/s)	Dominant	Pre	46.00 (38.00-60.00)	0.002*
		Post	50.00 (42.00-64.25)	
	Non-Dominant	Pre	38.00 (25.75-48.00)	0.004*
		Post	38.50 (33.50-51.25)	
Abduction (180º/s)	Dominant	Pre	55.50 (42.25-69.00)	0.003*
		Post	60.50 (43.00-76.25)	
	Non-Dominant	Pre	48.00 (32.75-51.00)	0.017*
		Post	49.00 (36.50-52.75)	

*p<0.05. IQR: Interquartile Range. KT: Kinesiotaping.

Table 3: Comparison of Total Work Values before and after Kinesiotape Application Obtained at 60º/s and 180º/s Speeds of Dominant and Non-Dominant Shoulder.

Total Work (Nm)		**KT**	**Median (IQR 25-75)**	**p**
Flexion (60º/s)	Dominant	Pre	74.00 (61.25-90.50)	0.002*
		Post	80.00 (65.25-94.00)	
	Non-Dominant	Pre	62.00 (46.75-79.25)	0.018*
		Post	66.50 (44.5-84.25)	
Abduction (60º/s)	Dominant	Pre	81.00 (63.00-130.50)	0.016*
		Post	84.00 (69.25-131.75)	
	Non-Dominant	Pre	68.00 (48.75-86.25)	0.002*
		Post	73.00 (51.50-90.50)	
Flexion (180º/s)	Dominant	Pre	62.00 (45.00-77.00)	0.016*
		Post	65.50 (49.25-79.50)	
	Non-Dominant	Pre	49.00 (38.50-65.75)	0.022*
		Post	50.00 (41.25-68.25)	
Abduction (180º/s)	Dominant	Pre	70.00 (49.00-108.75)	0.005*
		Post	71.00 (53.25-114.75)	
	Non-Dominant	Pre	54.00 (43.00-78.25)	0.003*
		Post	57.00 (43.25-82.50)	

*p<0.05. IQR: Interquartile Range. KT: Kinesiotaping.

The average total work values improved after the KT application of both 60º/s and 180º/s in the dominant and non-dominant shoulder, both in flexion and abduction (p<0.05) (Table 3).

DISCUSSION

It was determined that KT application onto the shoulder increased the performance of shoulder during flexion and abduction in W/C basketball players.

Flexion and abduction momentums are required to push the wheel forward in W/C basketball sports. Therefore, propulsion and returning phases are often performed since these movements are frequently needed in sports competitions and training sessions. Athletes want to strengthen the muscles that realize such movements. Exercises and electrical stimulation methods are used to increase muscle strength (24). The KT application may also use among the athletes to increase strength. Alkan and Yakut investigated the effects of lumbar soft orthosis and KT on pain, trunk muscle endurance, and sports-specific physical performance in disabled table tennis athletes. They concluded that arm and trunk muscle coordination was crucial for sportive performance in W/C table tennis players. It was emphasized that KT application is vital in disabled individuals (16).

Although KT has recently been extremely popular, there is a lack of evidence on how to use KT for muscle performance. The question that some KT techniques would facilitate the appearance of more considerable muscle strength has been a conflicting topic for recent years. Defenders of the technique claimed that placement of the KT from the muscle origin would result in an increase in muscle strength. Although underlying physiological principles were not explained convincingly, the cutaneous stimulation including type 2 mechanoreceptors which adopt slowly located in the deep dermis may cause a more considerable uptake of the motor unit and result with an increase in the muscle strength (25). The applied tape tension varies according to the targeted benefit in KT. A 0-10% tape tension for myofascial effects, 10-15% for muscle inhibition, 15-25% for muscle facilitation, 25-35% for correction, 50-75% for ligament-tendon correction and mechanical correction techniques, 75-100% for mechanical correction and ligament correction techniques are applied with a 5 cm 0% tension from the beginning and end of the applied tape (17). Donec et al. evaluated the effects of taping on maximum grip strength and key pinch strength in

healthy subjects. The authors applied the KT from origin to insertion of muscles with 15% to 25% tension. They found that key pinch strength increased after 30 minutes, and maximum grip strength increased after 1-hour later. The authors have not observed any change in the placebo and control groups (26). In our study, the KT was applied with 15% to 25% tension to provide muscle facilitation. Kase et al. reported that the application direction of the KT facilitates or inhibits of muscle activation (17). The application of the tape from the insertion to the origin may cause motor neuron inhibition through stretching the Golgi tendon organ located in the insertion part of the muscle due to the elastic retraction feature of the tape, and it would cause muscle spindle reflex contraction in the taping from the origins of the muscle to the insertion (27). We applied the taping from the origin to insertion to provide muscle relaxation in our study.

It is accepted that KT increases the activity of motor neurons with stimulated skin mechanoreceptors in theory (28). Sensorimotor feedback is provided by taping, and patients often state that they had symptom relief, increased stability of the associated joint. Skin compatibility and more comfortable movement are ensured through the elasticity of KT. Therefore, decreased pain, facilitation or inhibited muscle strength, and increased range of motion are observed.

Different results were obtained from the studies investigating the effects of the KT application on muscle strength. The KT application on knee extensors was improved peak torque in healthy individuals (28). In another study, the KT improved jumping performance and knee extension peak torque at 180°/s in both dominant and non-dominant extremities (29). Aktas et al. recommended that mechanoreceptor stimulation with KT could provide tactile improvements to build muscle function in healthy people (29). Karatosun et al. examined the effects of KT on quadriceps and hamstring muscles in 20 healthy individuals. The study concluded that KT application provided significantly better results in the first peak torque and total work of flexor muscles immediately after the application, 24 hours after the application, and after five days (30). Similar to their study, we found that the peak torque and total work improved immediately after the KT application.

In recent years, KT has been widely used not only to increase performance in athletes but also to increase physical capacity in healthy individuals (31). In a study conducted by Mostert-Wentzel, the effects of KT on the explosive muscle strength of gluteus maximus of male athletes were examined (32). It was observed that muscle strength increased significantly in the KT group 30 minutes after the KT application. Similar to this finding, the measurement of KT application after 30 minutes increased in muscle strength in our study. Applications performed using KT method raise the skin in the application area and provide increasing of subcutaneous tissues area, thereby such applications cause reducing pain in the injured muscles and joints, and increase blood and lymph circulation (33). Csapo and Allegre analyzed 19 studies conducted on the effect of KT on muscle strength. They reported that eight of the studies had shown a significant increase in muscle strength with KT. On the other hand, 11 of the studies were reported that there was no significant difference between placebo or control (25). It has been assumed that KT facilitates rapid increases in muscle strength by providing a concentric pull on the fascia that could stimulate muscle contraction (33,34). In another theory, KT has been thought to affect muscle strength by increasing muscle activity with its facilitator effect (12,17). Although encouraging and non-encouraging results on muscle strength were reported in the literature, a more extensive series of individuals should be tested to reveal improving the effect of KT. Furthermore, some studies were showing that KT application does not affect muscle strength. Keenan et al. reported that they did not have a statistically significant superiority on shoulder muscle strength compared to placebo taping of individuals with subacromial impingement syndrome (35). Buke et al. reported that there was no significant change after taping, but a significant result was obtained on trunk muscles of female athletes after 48 hours (36). The measurements were taken after 30 minutes to ensure the activation of KT in our study differs from the Buke et al. We thought that a specific time might be needed to achieve KT activation.

The use of a single group pretest-posttest design

was a limitation in our study. A comparison could not be made due to the absence of the control group. In our study, we evaluated 30 minutes after KT application. The effects of KT application could be re-evaluated a few days after since studies were examining its effects after 48 hours (27,36). Studies could be performed for various branches such as football, athletics, and competition sports.

In conclusion, an increase in muscle strength was observed immediately in W/C basketball players who applied KT. Therefore, we suggest that the KT could contribute to muscle strength in W/C athletes who use the upper extremity excessively. Studies using placebo and different taping techniques in athletes participating in various sports could contribute to the literature.

Sources of Support: None.

Conflict of Interest: The authors declare that they have no conflicts of interest.

Ethical Approval: This study was approved by the Ethics Committee of Selçuk University School of Physical Education and Sports, Non-Interventional Clinical Research Ethics Committee (Approval Date: 04.12.2014 and Approval Number: 29). The study was conducted following the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all participants.

Peer-Review: Externally peer-reviewed.

Author Contributions: Concept - BSÜ, AS; Design - BSÜ, AS; Supervision – BSÜ, AS; Resources and Financial Support - BSÜ, AS; Materials – BSÜ; Data Collection and/or Processing – BSÜ; Analysis and/or Interpretation - BSÜ, AS; Literature Research - BSÜ, AS; Writing Manuscript - BSÜ, AS; Critical Review - BSÜ, AS.

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