American Journal of Sports Science and Medicine, 2013, Vol. 1, No. 3, 33-36
Available online at http://pubs.sciepub.com/ajssm/1/3/1/

DOI:10.12691/ajssm-1-3-1

Effects of Elastic Wrist Taping on Maximum Grip Strength

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Received July 27, 2013; Revised August 07, 2013; Accepted August 10, 2013

Abstract In this study, we examined the effects of elastic wrist taping with different pressure levels on the maximum grip strength. The subjects were 20 healthy male university students. The tape was wrapped three times around the wrist at the radial and ulnar styloid process. Taping pressure was measured using a pressure measuring system for stockings and bandages. A pressure sensor was placed over the palmaris longus muscle tendon, 1.5 cm proximal to the palmar crease of the subject's wrist on the dominant upper limb. The following experimental conditions were assessed: control condition (CC), without attachments; sensor condition (SC), with an attached sensor and a cover tape with minimum pressure application (1–5 hPa); and four pressure conditions (PCs), with pressure applications of 30, 60, 90, and 120 hPa using elastic tapes. Grip strength was significantly greater for CC than for PCs. However, the overall decrease in grip strength was still relatively small. No differences were observed in the grip strengths among the four PC groups. Our results showed that grip strength exertion decreased on the application of higher pressures of elastic tape wrapping and that the degree of decrease was similar for all PCs above 30 hPa.

Keywords: *taping pressure, pressure-measuring system, palmaris longus muscle tendon, elastic taping*

Cite This Article: Kenji Takahashi, Shin-ichi Demura, Takanori Noguchi, Gou Demura, and Xu Ning, "Effects of Elastic Wrist Taping on Maximum Grip Strength." *American Journal of Sports Science and Medicine* 1, no. 3 (2013): 33-36. doi: DOI:10.12691/ajssm-1-3-1.

1. Introduction

Wrist taping (Figure 1) is used in competitive sports such as sumo wrestling and judo to prevent wrist disorders and injuries. Wrist taping limits the excessive motion of the wrists [1,2,3]. However, it was reported that the exertion ability of the wrists was limited. Kauranen et al. [4] reported that wrist taping decreases the motor performance parameters such as simple reaction time, choice reaction time, and tapping speed. It also decreases the isokinetic strength during wrist flexion and ulnar deviation. Rettig et al. [5] reported that taping of the fingers or wrist joint does not affect grip strength, but that taping of both the fingers and wrist decreases grip strength.

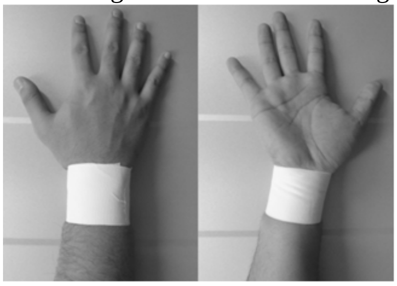

Figure 1. Wrist taping

Taping techniques to both inhibit and facilitate strength have been developed [6]. The inhibition effects were confirmed by studies on the upper parts of the trapezius muscles [7] and the shoulders of subjects with suspected shoulder impingement syndrome [8] as well as by the electromyographic (EMG) activity of subjects while stepping up and down the stairs [9,10]. In the strength facilitation technique, Alexander et al. [11,12] reported that taping decreased and rather than increasing the Hoffman reflex amplitude. Also, it decreased further with taping pressure. These results indicate that strength exertion may not increase but decrease with taping. Therefore, it is highly possible that fixed taping decreases athletic performance.

Constantinou and Brown [1] pointed out the necessity to control taping pressure when they examined the effects by reviewing other studies. Introducing different pressure levels in the same taping method influences the strength exertion differently. The taping practitioner should be qualified as a trainer. Wilson et al. [13] and Pfeiffer et al. [14] controlled the taping effect by employing a qualified trainer. Hence, the qualified practitioner will need to adjust the taping pressure using an appropriate procedure and clarify the relationship between taping pressure (fixed strength) and strength exertion.

Alexander et al. [11,12] reported that taping with tension decreases the EMG amplitude compared with that without tension. Parkhurst & Burnett [15] suggested that bunching muscle fibres may interfere with actin/myosin cross bridging and therefore reduce muscle function, when across fibre taping combined with compression, tractioning or gathering of the overlying soft tissues. We hypothesized that grip strength exertion decreases with increased taping pressure. This study aims to examine the effects of wrist taping using elastic tapes on maximum grip strength by applying different pressures.

2. Methods

2.1. Subjects

The subjects were 20 healthy male university students (mean age: 20.6 ± 0.9 years; height: 170.2 ± 5.0 cm; body mass: 67.9 ± 10.7 kg; BMI: 23.4 ± 3.3) with more than five years of athletic experience. The subjects were categorized on the basis of the participated athletic events: baseball 7, soccer 4, badminton 2, track and field 2, judo 1, kendo 1, karate 1, tennis 1, and swimming 1.

The aim and procedures of this study were explained to all subjects in detail prior to the experiment and informed consents were obtained. This experimental protocol was approved by the ethics committee on human experimentation of the Faculty of Human Science, Kanazawa University (2012-18).

2.2. Devices

2.2.1. Elastic Tape

In this study, we used elastic tapes, rather than non-elastic tapes, because it was better for applying pressure to the body [16]. The elastic tape was 50 mm in width, made by Johnson & Johnson (New Brunswick, NJ, USA).

2.2.2. Pressure-Measuring Device

Wrist taping pressure was measured using a pressure measuring system for stockings and bandages (AMI3037-SB, AMI-Techno, Tokyo, Japan) (Figure 2). This system can measure pressure through clothes such as socks [17] and can detect the addition of constant pressure using an elastic bandage [18]. The measurement unit was hPa. According to the operation manual of the device, the measurable range was 1–200 hPa and the measurement error was ±3 hPa.

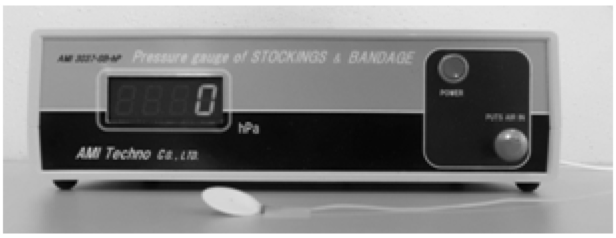

Figure 2. Pressure Measuring System for Stockings and Bandages (AMI3037-SB)

2.2.3. Measurement of Grip Strength

Grip strength was measured using a grip strength dynamometer (T.K.K. 5401 Grip-D, Takei, Tokyo, Japan) with the subject positioned in the following sitting posture: shoulder joint 30–60° forward flexion, elbow joint 15–45° flexion, and forearm in the middle position between pronation and supination based on the manufacturer's manual (Figure 3). The measurement unit was kg.

Figure 3. Measurement position of grip strength

2.3. Independent and Dependent Variables

A pilot study was performed on four subjects, two majoring in judo and two in track and field. The subjects taped their own wrists and performed the following three exercises without actually exerting grip strength: kumite (the act of grasping an opponent by the lapels of his judo outfit), bench press, and shot-put. The pressure imposed on the wrist was measured. The resulting pressure ranged between 40 and 210 hPa (kumite: 84–128 hPa, bench press: 47–115 hPa, and shot-put: 137–206 hPa).

Fentem et al. (19) reported that 96% of the veins are blocked when 30 mmHg (=40 hPa) of pressure is exerted on the lower limb by a bandage. Hence, it was inferred that a change occurs in the wrist when a pressure of more than 40 hPa was applied.

On the basis of these results, an independent variable was established for the six experimental conditions imposed on the wrist: control condition (CC), without attachments; a sensor condition (SC), with an attached sensor and a cover-tape with minimum pressure application (1–5 hPa); and four pressure conditions (PC), with applied pressures of 30, 60, 90, and 120 hPa using elastic tape. The dependent variable was the maximum of the two grip strength trials.

2.4. Procedures

The dominant upper limb was used as judged, according to Demura et al.'s [20] handedness inquiry. Before the experiment, the subjects performed wrist warm-up exercises to prevent injury. A pressure sensor was placed over the palmaris longus muscle tendon 1.5 cm proximal to the palmar crease of the wrist, and was fixed with a cover-tape (Figures 4a, b).

The wrist was taped three times at the radial and ulnar styloid process (Figure 4c). The tape was applied by an individual who was an athletic trainer (Japan Sport Association) and a judo physical therapist (Ministry of Health, Labor and Welfare, Japan), with more than ten years of clinical experience. Taping pressure was adjusted while monitoring values using the measuring device [18].

Each condition was adjusted to within an initial pressure of ±2 hPa.

Grip strength was measured twice in each experimental condition with more than a two-minute rest time between the trials. On the first day, CC was measured, while the other conditions were measured on subsequent days. Everyday one condition was measured at random. The experiment was performed during 9:00–12:00 in a laboratory at 26°C.

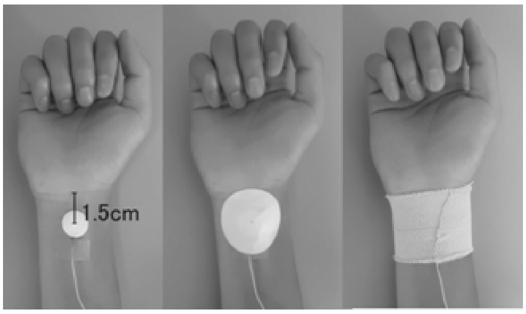

Figure 4. (a) only sensor, (b) sensor with cover tape, and (c) wrist taping with sensor and wrapped cover tape

2.5. Statistical Analysis

One-way repeated measures analysis of variance (ANOVA) was used to reveal the differences between the means of each condition. When a difference was found, a multiple comparison test was performed using Tukey's honestly significant difference method. Statistical significance (α) was set at a p value of <0.05. An effect size (ES) was calculated to examine the size of the mean difference. ES was interpreted as follows: <0.2 (small), >0.5 (intermediate), >0.8 (large). The statistical power analyses (1–β) for the one-way repeated measures ANOVA were calculated *post-hoc* analysis using G*Power 3.1.7 software (http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/) [23].

3. Results

Figure 5 shows the means and standard deviations of grip strength exertion in each condition, the results of the one-way repeated measures ANOVA, and the multiple comparison tests. A significant main effect was found: $F = 6.5$, $p \leq 0.05$, $\eta 2 = 0.25$. The multiple comparison tests showed that grip strength in CC was significantly greater than that in the four PCs. However, no significant differences were observed among the four PCs. ESs between CC and the four PCs were 0.41–0.49.

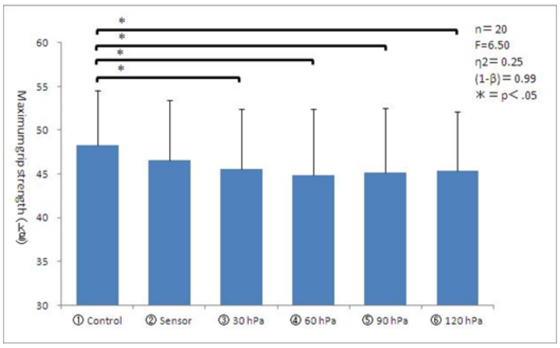

Figure 5. Means and standard deviations of grip strength exertion in six conditions, and the results of a one-way repeated measures ANOVA

These results indicate that grip strength exertion was decreased by introducing taping pressure greater than 30 hPa. We hypothesized that grip strength exertion was reduced more by greater amounts of pressure. This hypothesis was false.

The statistical power (1-β) was calculated by *post-hoc* analysis by using the G power, wherein the effect size was set as f = 0.2 for the test for homoscedasticity (Mauchly's test of sphericity), and the correlation coefficients between the respective conditions were assessed. No significant difference was observed in the results for the test for homoscedasticity (p = .15), thus, ensuring homoscedasticity. Moreover, the correlation coefficients (r) between conditions ranged from 0.85 to 0.96. The result showed a statistical power (1-β) of 0.99 and was ensured to be 0.8 or higher. The total date of 95% confidence interval was 42.76–49.17.

4. Discussion

We did not expect grip strength exertion to be reinforced by wrist taping with pressure. We confirmed that grip strength exertion actually decrease by taping with pressure and did not change when a sensor with only a cover tape was applied with minimum pressure application (1–5 hPa). In short, these results support Parkhurst & Burnett's reports [15]. Our results suggested that muscle contraction is affected by introducing pressure greater than a certain level to muscles and tendons, but the mechanism is unclear. In addition, it is possible that when increasing the pressure, even though a non-significant difference was found in the exertion values of grip strength, there is a certain threshold at which grip strength exertion decreases; when it crosses the threshold, a controlling response of grip exertion occurs. Thus, it is necessary to examine the effects of low pressures such as 10 and 20 hPa to clarify the threshold on grip strength exertion.

The degrees of reduced grip strength due to taping pressure were small: ES = 0.41–0.49. It is believed that taping has little effect on grip exertion in competition sequences that require explosive grip exertions, because the control of grip exertion by taping is not large. Cordova et al. [21] posed two questions: 1) Will such small decreases affect the performance of elite athletes? and 2) Do the benefits of preventing ankle injuries outweigh the small risks of detriment to performance? When considering the priority to prevent injury, taping with high pressure may be very effective. However, extended taping with high pressure causes congestion and negative effects on blood circulation [22]. Under 90 and 120 hPa conditions, a slight pressure change (1–3 hPa) in the heartbeat was observed. When pressure above 90 hPa was applied for a long time, there was a decline in the muscle temperature and numbness due to constricted blood flow. In addition, when the tape was applied too tightly, performance may be reduced because wrist movements are excessively limited. Hence, taping with high pressure is not necessarily recommended. In the future, it is necessary to discover the optimum pressure according to athletic characteristics by clarifying the relationship between blood flow and taping time.

5. Conclutions

This study examined the effect of different pressure of wrist taping using elastic taping on maximum grip strength. It is not appropriate to use elastic taping on wrists to reinforce grip strength. Conversely, wrist taping only slightly reduces grip strength exertion, but the impact on athletic performance may be small in competition sequences that require explosive grip exertions. Our results suggest that the limits on grip strength exertion from increasing taping pressure were similar across a range of pressure increases. It is believed that the range of wrist motion is limited as the taping pressure increases. Therefore, high-pressure wrist taping is recommended from the perspective of preventing disorders and injuries. However, because high-pressure wrist taping may limit the range of wrist motion excessively and cause constriction of blood flow, it will be necessary to adjust taping pressure according to the needs of the athlete and the sport.

References

[1] Constantinou M, Brown M. Therapeutic taping for musculoskeletal conditions. Elsevier: Churchill Livingstone, 2010.

[2] Reese D. Prophylactic wrist taping In: Pocketbook of Taping Techniques. R. Macdonald, eds. 1e. Elsevier: Churchill Livingstone 2010: 178-181.

[3] Yamamoto I, Ichimiya S, Kimamoto K, Morita H, Nakajima T, Suzuki A. Athletic taping for preventing injury was performed for healthy athletes before exercise. Bulletin of Nippon Sports Science University 15(2): 71-77, 1986.

[4] Kauranen K, Siira P, Vanharanta H. The effect of strapping on the motor performance of the ankle and wrist joints. Scand J Med Sci Sports 7: 238-243, 1997.

[5] Rettig A, Stube K, Shelbourne K. Effects of finger and wrist taping on grip strength. Am J Sports Med 25(1): 96-98, 1997.

[6] Morrissey, D. Proprioceptive shoulder taping. J Bodyw Mov Ther 4(3): 189-194, (2000).

[7] Morin, GE, Tiberio, D, Austin G. The effect of upper trapezius taping on electromyographic activity in the upper and middle trapezius region. J Sport Rehabil 6: 309-318, 1997.

[8] Selkowitz, DM, Chaney, C, Stuckey, SJ, and Vlad, G. The effect of scapular taping on the surface electromyographic signal amplitude of shoulder girdle muscles during upper extremity elevation in individuals with suspected shoulder impingement syndrome. J Orthop Sports Phys Ther 37(11): 694-702, 2007.

[9] McCarthy P, Fleming H, Caulfield B. The effect of a vastus lateralis tape on muscle activity during stair climbing. Man Ther 14: 330-337, 2009.

[10] Tobin, S, and Robinson, G. The effect of vastus lateralis inhibition taping technique on vastus lateralis and vastus medialis obliquus activity. Physiotherapy 86(4): 173-183, 2000.

[11] Alexander C M, Stynes S, Thomas A, Lewis J, Harrison PJ. Does tape facilitate or inhibit the lower fibers of trapezius? Man Ther 8(1): 37-41, 2003.

[12] Alexander C M, Mcmullan M, Harrison, PJ. What is the effect of taping along or across a muscle on motoneuron excitability? A study using triceps surae. Man Ther 13(1): 57-62, 2008.

[13] Wilson T, Carter N, Thomas G. A multicenter, single-masked of medial, neutral, and lateral patellar taping in individuals with patellofemoral pain syndrome. J Orthop Sports Phys Ther 33(8): 437-448, 2003.

[14] Pfeiffer RP, DeBeliso M, Shea KG, Kelley L, Irmischer B, Harris C. Kinematic MRI assessment of McConnell taping before and after exercise. Am J Sports Med 32(3): 621-628, 2004.

[15] Parkhurst T, Burnett C. Injury and proprioception in the lower back. J Orthop Sports Phys Ther 19(5): 282-295, 1994.

[16] Takeuchi Y, Sawada T, Taguchi D. Compression pressure between the elastic tapes and non-elastic tapes in the fixation [in Japanese]. The Quarterly Journal of Japan Society of Health Sciences 23: 147-151, 2007.

[17] Ooizumi Y, Matsuzawa E, Iida Kenichi. Establishment of evaluation methods of clothing pressure of high supported clothes- The relation between clothing pressure of stretch clothes measured on a dummy and the human body [in Japanese]. Bulletin of TIRI 2: 120-121, 2007.

[18] Hirai M. Clinical application of elastic stockings [in Japanese]. Japanese Journal of Phlebology 18(5): 239-245, 2007.

[19] Fentem PH, Marilyn G, Gooden BA, Yeung CK. Control of distension of varicose veins achieved by leg bandages, as used after injection sclerotherapy. BMJ 2: 725-727 1976.

[20] Demura S, Sato S, and Nagasawa Y. Re-ex-amination of useful items for determining hand domi-nance [in Japanese]. Arch Sci Med (Torino) 168: 169-177, 2009.

[21] Cordova, ML, Scott, BD, Ingersoll, CD, et al Leblanc, MJ. Effects of ankle support on lower-extremity functional performance. Med & Sci in Sports & Execise 37(4): 635-641, 2005.

[22] Hirai M. Elastic stockings and intermittent pneumatic compression in the prevention of deep vein thrombosis and pulmonary embolism [in Japanese]. Japanese Journal of Phlebolgy 14(1): 49-62, 2003.

[23] G*power 3.1.7 software. Heinrich Heine University Düsseldorf. (http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/).