THE EFFECT OF KINESIOTAPING ON VELOCITY IN SWIMMERS

Fethiye Baskoy[1], Deniz Yuce[2], Gul Baltaci[1]

Hacettepe University,

Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation; Faculty of Medicine, Department of Preventive Oncology

Correspondence for address:

Gul Baltaci, PT.Ph.D Profoessor, CKTI

Private Guven Hospital Dept of Physiotherapy and Rehabilitation

Paris Cad. No. 58 06550 Kavaklidere-Ankara-Turkey

e-mail: gul.baltaci@guven.com.tr

This study was supported by Kinesiotaping Research Committee.

Abstract

PURPOSE: To determine immediate effect of kinesiotaping application to shoulder muscles of swimmers ages ten to fifteen years on velocity and whether KT is affected on water or not.

MATERIAL AND METHOD: Thirty elite swimmers (mean age: 13 years) voluntarily participated in the study. Critical Swim Speed test was used for measuring the velocity over middle-distance (400m) and sprint (50m) all of the swimmers Tests were done before and after 45 minutes the KT application. During swimming lower extremities of the swimmers were blocked by using pull-boy. The number of arm strokes per length was recorded. The application of KT for upper trapezius, deltoid and latissimus dorsi muscles in the freestyle swimming were chosen muscle facilitation technique bilaterally. For comparisons between dependent groups Wilcoxon Signed Ranks were used.

RESULTS: No statistically significant differences were found before and after the application of KT in 50 meters' scores and arm strokes ($p>0.05$). There was no statistically significant differences between 400m scores and arm strokes during swimming over 400m distances with and without KT application ($p>0.05$).

CONCLUSION: No positive immediate effect of kinesiotaping was seen on velocity in young swimmers.

KEY WORDS: Swimming, kinesiotape, velocity, performance.

INTRODUCTION

Swimming is a popular recreational and competitive sport for participants in all age groups (1). Speed and performance are very important for competitive swimmers. There are a lot of factors affecting these swimmers' performance. Some of them are central nervous system, muscular strength, power, velocity and interaction between them (1, 2).

Great performances in sprint swim events are related, in part, to ability of the muscles of locomotion to generate mechanical power. Although the relationship is not necessarily perfect, it is generally true that the greater the muscle mass (greater cross sectional area), the greater the instantaneous force that can be generated (2).

There is a significant relationship between speed and force because fiber-shortening velocity is an important factor in determining muscle force output that provide swimmers to move forward through the water effectively. In addition, it has been suggested that changes in power following a training program are most evident at the velocity at which the muscle is trained (2, 3).

Upper and lower body strength is very important for swimmers' performance (2, 3). Especially, swimming requires upper body strength because the arms provide the power to propel the body through the water. On the other hand, masters' level swimmers may use the shoulders in an overhead position up to 11,000 times per week of training (4).

Because of searching for the effect of upper and lower body strength on velocity and performance, Hawley et al did a study. In this study all swimmers were evaluated over 50m and 400m distances during which the number of arm strokes per length were recorded. They found that there was highly significant relationship between sprint swim speed and mean power of the arms and legs and the effect of upper body strength on velocity was more than lower body. As a result, they proved muscle power predicted freestyle swimming performance.

The kinesiotaping (KT) method was developed by Kase in Japan in the 1970s, and its use has become increasingly popular in different sports and for rehabilitation of various musculoskeletal disorders (6). According to Kase et al, KT may be beneficial in enhancing muscle function, inhibiting muscle activity, improving circulation of blood and lymph, and decreasing pain through neurological suppression. Proprioceptive effects of KT have been also suggested (6, 7). KT may be used in water and swimming but it is necessary to be applied 30-40 minutes prior to activity (8).

Despite its widespread use, the mechanisms by which KT exerts its hypothesized effects have not been clearly demonstrated and there is a paucity of evidence demonstrating the method's effectiveness (6). In particular, there has been little exploration of its effect on strength and there is no study on the effect of KT in the water. The purpose of this study was to determine the immediate effect of KT muscle facilitation technique applied to shoulder muscles of swimmers on velocity in the water.

METHODS

Thirty swimmers (13 women, 17 men) from two different swimming clubs who are trained with their regular training programs in their clubs (mean age: 13 years; min-max: 10-15 yrs), (mean weight: 50.5kg; min-max: 35-80 kg), (mean height: 161.5 cm; min-max: 144-181 cm) participated in this study. Pools were used for the study at which athletes were trained. Swimmers were informed about what they should do before and during the applications. They were tested with 'Critical Swim Speed Test' over 400m and 50m distances. Each swimmer warmed up 10 minutes with their regular warming programs before the tests. After warming they firstly swam over 400m distance and than secondly 50m distance with only their upper extremities and their scores were recorded with stopwatch. During swimming the use of the lower extremities were prevented by using pull-boy. At the same time the number of the arm strokes were taken and used in the evaluation. After 50m swimming, 10 minutes' time were given to the athletes again to dry and change their swimsuit. After than KT were applied to the swimmers and they were given 45 minutes' rest time before going into the water. They warmed up again 10 minutes after the rest period with the tape and tests were repeated over 400m and 50m distances. Scores and arm strokes were recorded. Upper trapezius, deltoid and latissimus dorsi muscles functioning during freestyle swimming on the upper body were chosen for the application of KT (9, 10).Muscle facilitation technique were applied to these muscles bilaterally (8) (Figure 1-4).

KT Applications

Upper Trapezius: 'I' strip from upper trapezius' origin to insertion were used for KT muscle stimulation technique. Measures were done and appropriate length of kinesio tex tape were cut. Swimmers were positioned on head flexion, rotation and lateral flexion to the opposite side, shoulder depression and horizontal abduction. Anchor were adhered to trapezius' origin (Linea nuchae superior, protuberentia occipitalis externa, and processus spinosus of all cervical spines) with no tension and activated. By following the upper trapezius with 15-50% tension, the end of the tape were attached to upper trapezius' insertion(one third of the lateral clavicle or one third of the acromial part of the clavicle) with no tension and activated.(8, 14)(Figure 1, 3, 4)

Deltoid: 'Y' strip from deltoid's origin to insertion were used for KT muscle facilitation technique. Measures were done and appropriate length of 'Y' tape was cut. Swimmers were positioned on elbow flexion, shoulder 90 flexion. Anchor of 'Y' were adhered to Deltoid's origin (one third of lateral clavicle, acromion of scapula, lateral edge of spine of scapula) with no tension and activated. For anterior deltoid; swimmers' shoulder were positioned on horizontal abduction and external rotation. By following anterior deltoid (from origin to insertion) with15-50% tension, the end of the tape were attached to deltoid tuberosity with no tension. For posterior deltoid; shoulder were on horizontal adduction, by continuing along posterior deltoid with 15-50% tension of posterior tail, the end of the tape were attached to deltoid tuberosity and all of the tape were activated. (8, 14).

Latissimus Dorsi: Y strip from latissimus dorsi's origin to insertion were used for KT muscle stimulation technique. Measures were done from sacrum (distal medial iliac crest) to axilla. Tape were anchored to latissimus dorsi's origin (distal –medial iliac crest, over thoraco-lomber fascia) without tension and activated. In position of lumbar spine flexion, shoulder 180degrees flexion, for upper edge of latissimus dorsi; by positioning shoulder at horizontal abduction therapist continued along the sacral, lumbar and 6-12 throcal spine spinosus and then angulus inferior scapula with 35% tension and attached the end of the tape to sulcus intertubercularis of humerus with no tension. Activate adhesive by rubbing the KT. For lower edge of latissimus dorsi, shoulder were positioned at horizontal adduction, by following dorsal- medial iliac crest ,lateral of 9-12 ribs with 35% tension, the end of the tape were attached to sulcus intertubercularis of humerus with no tension. Adhesive were activated by rubbing the KT (8, 14) .

Testing Procedure

Critical Swim Speed Test (CSS): It is defined as the maximum swimming speed that can theoretically be maintained continuously without exhaustion (11-13). Critical Swim Speed Test is a test that has been proven the validity and reliability (15). The test can be used for determining the performance of swimmers and their training programs (11-13). This test requires the athlete to swim 400m and, following a rest, 50m as fast as possible. Firstly the athlete warms up for 10 minutes. After warming up first part of the test requires the athlete to swim 400 m. The athlete gets into the pool. The assistant gives the command “GO”, starts the stopwatch and the athlete commences the test. The assistant stops the stopwatch and records the time when the athlete completes the 400m (T2). The athlete has 10 minutes recovery. The other part of the test requires the athlete to swim 50 m after recovering. The athlete gets into the pool again. The assistant gives the command “GO” starts the stopwatch and the athlete commences the test. The assistant stops the stopwatch and records the time when the athlete completes the 50m (T1) (11-13).

Calculation of CSS: CSS = (D2 - D1) ÷ (T2 - T1) (D1 = 50, D2 = 400, T1 = time for 50m in seconds and T2 = time for 400m in seconds) (11- 13)

Evaluation method used in the study was determined and applied according to ‘Critical Swim Speed Test’ but 400m and 50m scores were calculated one by one. These values were compared without using the formula in the test procedure because of bringing into the open the immediate effect of KT more prominently (5).

Statistical Analyses

SPSSv18. (Chicago, IL) software was used for statistical analysis in the study. In presentation of the data included in this study the median values (25 percentile-75 percentile) were used for numeric data. For comparisons between dependent groups Wilcoxon Signed Ranks were used. In the statistical analysis a significance level of $p < 0.05$ was accepted.

RESULTS

There were no statistically significant differences in 50 meters’ scores and arm strokes over 50m distances before and after the application of KT ($p>0.05$). There were no statistically significant difference in 400m scores and arm strokes between with and without KT application ($p>0.05$).

DISCUSSION

The hypothesis of this study showed any positive acute impact of KT on the velocity of swimmers in short and middle distances in the water. Muscle strength and power output released in the water by the muscle strength have a significant effect on improving the velocity and performance. Muscular and neurological stimulation are important factors for advancing muscle strength and muscle power output (2). One of hypothesized effects of kinesiotaping is to enhance muscle strength (6). It provides this with KT facilitation technique via muscular and neurological stimulation (8). According to this information, we thought that KT might be a new factor in enhancing the velocity.

By doing this study, we tried to find out if KT enhanced the velocity and performance by the means of improving the muscle function and strength and if it is valid in the water or not (6- 8).

Competitive swimmers are divided into two groups: Sprinters and endurance swimmers. The fastest swimmers in the water are clearly the 50m freestylers who are called with sprinters. The swimmers with the most endurance are the swimmers who have the ability to swim fast for a long time. In order to sprint, the muscles of locomotion need to be able to generate very high mechanical power output in short periods of time. For endurance swimmers, the limb musculature must be able to produce much less peak power so they can sustain relatively moderate power output for a long time (2). Because of these differences between sprinters and endurance swimmers, their traits and muscle fiber types which they use while swimming show changes. Muscle fibers are classified as type 1 (slow-twitch fibers) and type 2 (fast-twitch fibers). Slow – twitch fibers have low ATPase activity and take longer to reach peak tension. Type 2 fibers have high myofibriller ATPase activity and also have high maximum velocities of shortening so it is defined as fast-twitch fibers. (2) .For these reasons muscle fiber types are very important for sprint and endurance swimmers' performance. We tested swimmers in both sprint and middle distances to find out how KT effect these different muscle fibers and whether KT application becomes effective in different distances or not or which distance KT becomes more effective than the other by stimulating these two different types of fibers. But we didn't categorize the swimmers as sprinter and endurance swimmers while testing them in 50m and 400m. We only looked how swimmers were affected before and after KT application in two different distances regardless of their traits. To separate the swimmers according to their traits (or distance that they swim in competition) may give us more detailed results to see the effect of KT on fiber types in future studies.

Competitive swimming consists of four strokes and these swimmers uses both upper and lower extremities in moving forward through the water. Shoulder and arm mechanics are similar in the freestyle, butterfly, and backstroke (9). Much of the forward propulsion created during the pull-through phase of these strokes is the result of lift forces produced by the traversing motion of the hand and forearm. Shoulder adduction and internal rotation are important in stabilizing the shoulder and allowing the body to be moved forward over the hand during swimming (9). Analyze performed by Pink describes the electromyographic and cinematographic findings of 12 shoulder muscles fulfilling functions we mentioned before (9) in competitive swimmers without shoulder pain. The results show the three heads of the deltoid and the supraspinatus functioning in synchrony to place the arm at hand entry and exit, the rhomboids and upper trapezius to position the scapula for the arm, the pectoralis major and latissimus dorsi to propel the body, the subscapularis and serratus anterior as muscles with constant muscle activity, the teres minor functioning with the pectoralis major, and the infraspinatus active only to externally rotate the arm at mid-recovery. This information is important to design optimal preventative and rehabilitative exercise programs (10). Three of these muscles including deltoid, upper trapezius and latissimus dorsi were chosen to apply for KT according to this knowledge. Therefore; KT application may be done to some of these 12 muscles functioning during freestyle except for three muscles chosen in this study.

There are some studies on swimmers' performance and velocity. Papoti et al searched the effect of taper on swimming force and performance on fourteen competitive swimmers. Their training cycle consisted of a basic training period (endurance and quality phases) of 8.5 weeks, with 5,800 minutes/day (-1) mean training volume and 6 day/week (-1) frequency; and a taper period (TP) of 1.5 weeks' duration that incorporated a 48% reduction in weekly volume without altering intensity. Swimming force (SF) and maximal performance over 200-m maximal swim (Pmax) before and after taper were measured in this study. Results showed that TP improved mean swimming velocity, but the percentage of velocity was not more than the percentage of SF after taper (16).

Girold et al did a study to compare the effects of dry-land strength training with a combined in-water resisted- and assisted-sprint program in twenty-on swimmers. These training continued 12 weeks and the swimmers performed 6 training sessions per week. They were randomly assigned to 3 groups: the strength (S) group that was involved in a dry-land strength training program where barbells were used, the resisted- and assisted-sprint (RAS) group that got involved in a specific water training program where elastic tubes were used to generate resistance and assistance while swimming, and the control (C) group which was involved in an aerobic cycling program. They found significant increases in swimming velocity, and strength of elbow flexors and extensors both in the S and RAS groups (17).

Toussaint and Vervoorn investigated the effect of a new training device called POP (Push Off Point) on 22 swimmers by divided them into two groups as training and control groups including normal training program. The training group showed a significantly greater improvement in force, velocity and power. The MAD-system was used for measuring these parameters. Increasing occurred in distance per stroke in free swimming. The training group showed a significant improvement in race times for 50 m, 100 m and 200 m by using a specific training device (18).

There has been little exploration of the effect of KT on strength. Slupik et al reported a preliminary effect on quadriceps peak torque and electromyographic activity in healthy subjects (19). Aktas et al compared the effect of knee brace, kinesiotaping and combined application of them on muscular strength and functional performance of 20 healthy subjects. In this study Muscular strength of Quadriceps was tested with isokinetic dynamometer at a speed of 180 degrees per second and jump performance was tested by measuring hop distance in three different conditions. They found that KT application increased muscle strength and functional performance more than the other applications (20). In contrast, other researchers compared KT with placebo or no taping and failed to find a significant difference.

Fu et al found that quadriceps muscle strength neither decreased nor increased after KT application on the anterior thigh of 14 healthy athletes. In this study Y-shaped KT was applied to the anterior thigh of these subjects. Concentric and eccentric muscle strengths were measured by an isokinetic dynamometer at a speed of 60 and 180 degrees per second under 3 conditions: without taping, immediately after taping, and 12 hours after taping, with the tape still in situ. Peak torque and total work of quadriceps and hamstring muscles were evaluated. (21).

Chang et al found no significant differences in the maximal grip strength between no taping, placebo taping, and KT applied on the forearm of 21 healthy male college athletes. Subjects randomly received 1 of the 3 taping conditions in this study. I-shaped KT strip applied across the belly of the common wrist flexor muscle fibers with no tension, and KT Y-shaped strip applied from insertion to origin of wrist flexor muscles with 15%-20% stretch tension. The outcome measure consisted of maximal isometric grip strength, measured by means of the JAMAR hydraulic hand dynamometer immediately after tape application. The mean value of 3 trials was recorded for analysis. (22) We tried to take an advantage of the mechanism of KT in these studies (19-22) by using same techniques (KT facilitation technique) in our study. We found same results with the results of Fu and Chang in point of the effect of KT although our study is different from them in many ways.

There is no study showing the effect of KT in the water. So we firstly wanted to see immediate effect of KT in the water. This study may become important because it is a new study added to limited number of studies about the effect of KT on increasing the muscle function and strength. Beside, this is a study that related to the effect of KT in the water.

Although it was not found any positive effect of KT on the velocity of swimmers in short and middle distances in the water, this study may offer a new insight to swimmers and physiotherapists in enhancing swimmers' performance. But better to reveal these effects of KT we think it may be useful to conduct studies including a long-term effect of KT and studies in which swimmers are divided into groups as sprinter and endurance swimmers. On the other hand it can be practiced with the different age groups of swimmers to determine the group in which KT becomes more effective. In addition to these, using electromyographic evaluation methods displaying muscle activity in these studies may be objectively beneficial.

REFERENCES

1. Troup JP. The physiology and biomechanics of competitive swimming. Clinics in Sports Medicine. 1999;18(2):268-285.

2. Stager JM, Tanner DA. Swimming (Handbook of sports medicine and science). 2. ed. Bloomington; USA; 2005.

3. Kyröläinen1, Avela1 H.J, McBride2 J. M, et al. Effects of power training on muscle structure and neuromuscular performance. Scandinavian Journal of Medicine & Science in Sports. 2005;15(1):58–64.

4. Magnusson SP, et al. Strength Profiles and Performance in Masters' Level Swimmers. American Journal of Sports Medicine. 1995;23(5):626-631.

5. Hawley JA, Williams M. M, Vickovic M. M, et al. Muscle power predicts freestyle swimming performance. Br J Sports Med. 1992; 26(3):151-155.

6. Vercelli S., Sartorio F, Foti C, et al. Immediate Effects of Kinesiotaping on Quadriceps Muscle Strength. Clinical Journal of Sport Medicine. 2012;22(4):319-326.

7. Firth B, Dingley P, Davies E, et al. The Effect of Kinesiotape on Function, Pain, and Motoneuronal Excitability in Healthy People and People With Achilles Tendinopathy. Clinical Journal of Sport Medicine. 2010; 20(6):416-421.

8. Kase K, Wallis J, Kase T. Clinical Therapeutic Applications of the Kinesio Taping Method. 2nd ed. Tokyo, Japan: Ken Ikai Co; 2003.

9. Richardson AR. The biomechanics of swimming: the shoulder and knee. Clin Sports Med. 1986;5(1):103.

10. Pink M. The normal shoulder during freestyle swimming. An electromyographic and cinematographic analysis of twelve muscles. Am J Sports Med. 1991;19(6):569-76.

11. Ginne, E. The application of the critical power test to swimming and swim training programmes. National Sport Research Centre. 1993.

12. Maglischo EW. Swimming fastest. 1993;569-571.

13. Mackenzie B. 101 Evaluation Test. 2005;17-18.

14. Taner D. Functional Anatomy. 2. ed. Ankara, Turkey; 2000.

15. Wakayoshi K,Ikuta K, Yoshida T, et al. Determination and validity of critical velocity as an index of swimming performance in the competitive swimmer. Eur J Appl Physiol. Occup. Physiol. 1992; 64(2):153-157.

16. Papoti M, Martins L, Cunha S, et al. Effect of taper on swimming force and swimmer performance after an experimental ten-week training program. Journal of Strength and Conditioning Research. 2007;21(2):538-542.

17. Girold S, Maurin D, Dugué B, et al. Effects of dry-land vs. resisted- and assisted-sprint exercises on swimming sprint performances. J Strength Cond Res. 2007;21(2):599-605.

18. Toussaint HM, Vervoorn K. Effects of specific high resistance training in the water on competitive swimmers. Int J Sports Med. 1990;11(3):228-33.

19. Slupik A, Dwornik M, Bialoszewski D, et al. Effect of Kinesio Taping on bioelectrical activity of vastus medialis muscle. Preliminary Report. Orthophedics Traumatology Rehabilitation. 2007;9:644–651.

20. Aktas G, Baltacı G. Does kinesiotaping increase knee muscles strength and functional performance? Isokinetic and Exercise Science. 2011;19(3):149-155.

21. Fu T, Wong AM, Pei Y, et al. Effect of Kinesio taping on muscle strength in athletes—a pilot study. J. Sci. Med. Sport. 2008;11:198–201.

22. Chang HY, Chou KY, Lin JJ, et al. Immediate effect of forearm Kinesio taping on maximal grip strength and force sense in healthy collegiate athletes. Physical Therapy in Sport. 2010;11:122–127.