Effect of Kinesiology Taping on Upper Torso Mobility and Shoulder Pain and Disability in US Masters National Championship Swimmers: An Exploratory Study

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Abstract

Objective: The purpose of this study was to observe changes in shoulder pain and upper-extremity functional movement after kinesiology taping (KT) in competitive swimmers.

Methods: Seventy-six healthy participants competing in the US Masters Swimming 2017 National Championship participated in the study. Participants performed functional movement of shoulder flexion along with Disabilities of the Arm, Shoulder, and Hand index assessments for the shoulder before and 30 minutes after application of KT.

Results: A change in the functional movement assessment was observed after KT application when compared to the pre-KT application (33.56 ± 1.39 cm vs 35.35 ± 1.52 cm, $P < .001$). A statistical significant change for pain and disability scores of 2.17 was observed (12.29 ± 1.22 vs 10.12 ± 1.16, $P < .01$).

Conclusion: For the participants in this study, KT changed shoulder pain and active functional movement scores significantly in swimmers. (J Manipulative Physiol Ther 2019;42:247-253)

Key Indexing Terms: *Chiropractic; Athletes; Shoulder; Fascia; Kinesthesis*

Introduction

Shoulder pain in competitive swimmers is a common and debilitating problem. The prevalence of shoulder pain in the competitive swimming population has been reported as high as 91%, with 23% to 38% of competitive swimmers experiencing shoulder injuries each year.[1,2] The most common source of shoulder pain reported in clinical practice is subacromial pain, which is nontraumatic shoulder pain localized around the acromion that intensifies when lifting the arm, similar to swimming strokes.[3]

Injury often occurs in swimmers' shoulders because long-term swimming puts excessive overhead arm movement on the shoulder, which has been shown to predispose the shoulder to mechanical impingement, glenohumeral instability, thoracic outlet syndrome, microtrauma, laxity, and fatigue.[2,4-6] Long-term swimming can also change the normal motion and muscle patterns of the shoulder. Anterior muscle hypertrophy with pectoralis minor tightness can lead to forward shoulder posture, scapular anterior tilt, internal rotation, and increased thoracic flexion, all commonly found in overhead sports such as swimming.[5] Thus, to perform shoulder movement functions, the structures of the pectoralis minor, posterior shoulder, and thoracic spine must maintain a level of flexibility and muscular strength.[7]

Despite the known prevalence of shoulder injuries in swimmers, there is a lack of knowledge regarding the best methods of prevention and treatment.[2] Often shoulder injuries become so extensive for swimmers that they use pain medications to manage their shoulder pain or cease the sport altogether.[8] Current treatment recommendations include resistive exercise, neuromuscular retraining, stretching, and taping where necessary.[7] Shoulder and thoracic taping is frequently used in the management of shoulder pain and as a part of injury prevention and performance strategies in sports, such as swimming.[9] Yet, to the authors' knowledge, there has been no published literature on taping of the shoulder or upper torso in swimmers.

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During recent years, scientific research has demonstrated a growing interest in elastic and anaelastic adhesive taping techniques. The mechanisms of kinesiology taping (KT) still need to be elucidated; however, there has been support of KT for postural issues and shoulder pain.[9] Therefore, the short-term change on overhead movement of the upper torso in swimmers was of interest in this study. Specifically, the purpose of this exploratory investigation was to examine the short-term outcomes on functional movement of the upper torso and shoulder pain after the wearing of KT. It was hypothesized that there would be an improvement in functional movement and a decrease reported shoulder pain after KT.

Methods

Participants

For this study, participants of a club-level swim team over age 18 and under age 60 were recruited. Participants consisted of swimmers competing in the 2017 US Masters Swimming National Championships and currently participating in full team practices. Recruitment occurred through the US Masters Swimming Medical Association emails to the swimmers participating in the national event. This study was done as a paired examination.

Exclusion criteria consisted of potential participants who had shoulder instabilities including active labrum tears, massive muscle tears, scoliosis, and Scheuermann's disease. Swimmers who had shoulder surgery in the past 12 months were not allowed to participate in the study, along with any swimmer that had been in a noncompete status owing to any injury. Owing to age-related disc degeneration, the study was limited to those under age 60.[10,11] Other exclusions included those with adhesive allergies, any open wounds, cancer, muscle weakness conditions, or bone softening conditions such as osteopenia. Those with previous cervical or thoracic spine surgery, current elbow or wrist conditions, prior fractures, or infection of the shoulder or upper back region were also excluded.[12]

Ethics

The study protocol was reviewed and approved by Concordia University-St. Paul institutional review board, and all participants were in accordance with the institutional review board and Health Insurance Portability and Accountability Act guidelines. All participants signed a written informed consent and release form.

Procedure

Participants completed an upper-extremity pain survey followed by an upper torso functional assessment. Subsequently, KT was applied to the thoracic fascial manipulation point of the pectoralis. Specifically, tape was placed on the insertion point of the pectoralis minor on the coracoid process and adhered centrally, inferior of the clavicle. After 30 minutes of wear, participants performed another upper-extremity pain survey and functional assessment after the removal of tape. Sex and age were recorded for each participant.

Pain Questionnaire

The Sports/Performing Arts Module of the Disability of the Arm, Shoulder, and Hand (DASH) score was used to assess pain. This index has been used by the National Collegiate Athletic Association as an outcome measurement tool to look at both shoulder pain during daily activity and overall in swimming athletes.[1,13] The DASH has been the most extensively studied shoulder questionnaire when compared with other shoulder methods.[14-16] Results were calculated using the DASH instructions, and the resulting scores were on a continuous scale (Institute for Work and Health, Toronto, Ontario, Canada).

Shoulder and Upper Back Movement Assessment

The functional movement assessment used for this study was prone shoulder flexion; this is a movement of raising the arms up over the head. This has been shown to be a valid measurement tool for swimmers engaged in repetitive overhead rotational movements where functional range is important.[17,18] Specifically, the functional assessment in this study targets the functional ability of the serratus anterior and the pectoralis minor for the abduction of the scapula. This is often a weakness in rounded shoulder posture in individuals such as swimmers.[19,20]

Prone shoulder flexion measurements were executed by participants keeping their nose, abdomen, and legs touching the ground with arms and elbows straight followed by a lifting of their extended arms palms down as high off the ground as possible.[21] To control for various sized participants, the acromioclavicular joint distance of each participant was measured and their hands were placed to that distance on a ruler. A second ruler was used to measure the height the participant could raise their ruler from the floor (see Supplementary Appendix, Image 1). The resulting scores were on a continuous scale.

Taping Protocol

Kinesiology tape was placed bilaterally on the pectoralis major insertion located inferior to the distal clavicle by anatomical landmarks. Palpation points were assessed within the span of distance between those anatomical landmarks, a common area for compression friction tenderness.[22] The tape was applied with a 50% to 60% longitudinal stretch and with the participant's arm in active arm extension of 45° (see Supplementary Appendix, Image 2). According to previous studies, the tape mimics the qualities

Table 1. *Sex Results for Each Testing Category Pre- and Post-KT Application ± SE.*

Sex	Male	Female	Total
N	49	27	76
Pre-kinesiotape			
DASH (0-100)	10.27 ± 1.15	15.96 ± 0.69	12.29 ± 1.22
Functional (cm)	30.61 ± 1.72	30.50 ± 2.15	30.56 ± 1.40
Post-kinesiotape			
DASH	8.26 ± 1.01	13.48 ± 0.69	10.12 ± 1.16
Functional (cm)	34.74 ± 1.78	36.50 ± 2.87	35.35 ± 1.52

DASH, Disability of the Arm, Shoulder and Hand; *KT*, kinesiology taping; *SE*, standard error.

of the skin and after approximately 10 minutes the participants do not perceive it on their skin.[23] All taping was applied by a single investigator trained in KT methodology. Tape was removed 30 minutes postapplication. During the 30-minute wear period, the athletes were not given specific instructions on what to do given the competition settings. Participants' activities during the 30 minute wear period were recorded as nonactive or active. Active classified those who warmed up, cooled down, or were performing pre-race exercises.

Statistical Analysis

After exploration of the data with Shapiro-Wilk tests and Levene's test for equal variances, it was found that the data were not normally distributed and did not display equal variances ($P < .05$). In addition, although the data were taken from independent samples for each analysis, the data were not drawn from a random sample. Therefore, nonparametric tests were performed. Specifically, Wilcoxon signed-rank and Mann-Whitney U tests were used to evaluate the difference within times and between groups, respectively. The false discovery rate algorithm was used to adjust the α level to control the potential familywise error rate that may occur when conducting multiple tests.[24] Results are displayed as means ± standard error of means, and P values equal to or less than the corrected .007 α level were considered significant. Cohen's d was calculated to determine the effects sizes for the respective changes. The following guidelines were used to interpret the results: 0.2 is a small effect size, 0.5 is a moderate effect size, and 0.8 is large effect size.[25]

Results

Table 1 summarizes the results for the 2 different measures for the various groups. Seventy-six participants completed the investigation: 27 women and 49 men. Twenty-two participants were active during the 30 minutes with KT, and 54 participants were nonactive. Based on a previous investigation exploring the changes that occur on the DASH score after KT application, a sample size of 17 was needed to achieve 95% power.[26] Therefore, based on these calculations, our sample size was large enough to detect significant changes in the variables of interest.

DASH

There was a significant difference between times for the DASH score when groups were combined ($P < .001$; Cohen's $d = .21$; Fig 1B). The DASH scores decreased an average of 2.17 points. There were no other significant findings between groups overall or at any time point ($P > .007$).

Functional Movement

When the groups were combined, there was a significant difference in pre- and postfunction score ($P < .001$; Cohen's $d = 0.37$; Fig 2). The functional movement increased an average of 4.80 cm for all participants. These outcomes demonstrate an increased movement range post-KT wear time. There were also no other significant differences found for the functional movement scores ($P > .007$).

Discussion

This exploratory study aimed to determine if KT applications could change pain or functional movement for swimmers. Kinesiology tape application was found to provide statistically significant changes in competitive swimmers for overhead functional movements and pain scores with a brief period of use (30 minutes).

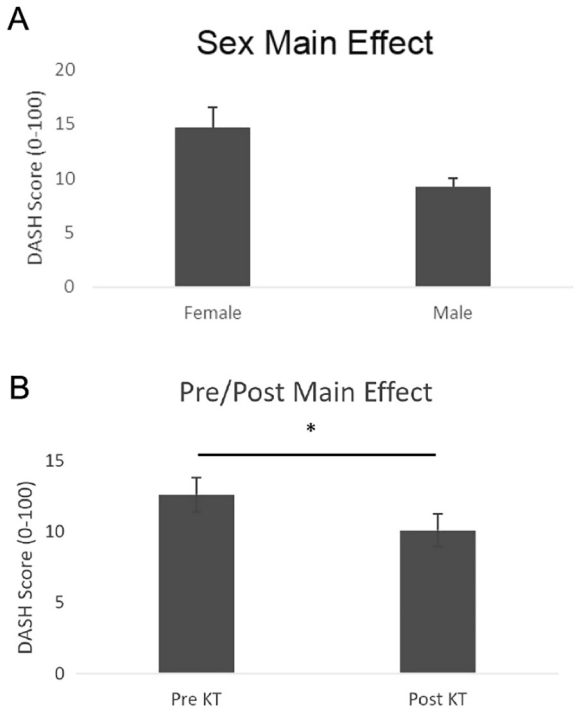

Fig 1. *(A) Average DASH scores across time for female and male respective groups. (B) Pre- and postvalues for active and nonactive and both sexes for the assessment main effect of the DASH score. The asterisk indicates* P < *.007.* DASH, *Disability of the Arm, Shoulder and Hand;* KT, *kinesiology taping.*

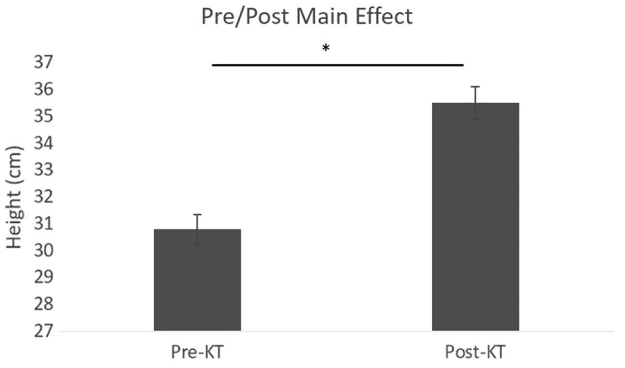

Fig 2. *Pre- and postmain effect values for the average for both the active and nonactive and sex groups for the assessment main effect for the functional movement tests The asterisk indicates* P < *.007.* KT, *kinesiology taping.*

To date, there is not a comprehensive study done on swimmers with KT despite the prevalence for shoulder pain in swimmers. Kinesiology tape is prohibited during competitive swimming events and is difficult for swimmers to keep on for extended periods of time. For these reasons, many swimmers and clinicians have shied away from its use in shoulder injury patients. Oftentimes swimmers shoulder complaints are addressed with surgery, rehabilitation, or are not treated.

Studies have shown increases in athletic performance outcomes in the first 0 to 45 minutes of wearing KT, similar to the current findings in functional movement assessment.[27] Most of the previous studies looked at factors of KT and examining the lower extremities. This study looked at the bilateral range of motion in overhead movement, a function important to swimmers. To the authors' knowledge, there has been little prone shoulder flexion functional assessment done on swimming populations in the current literature. This study was unique in creating a functional movement assessment particularly for swimming motion.

The change observed in this study for functional movement could be attributed to short-term KT wear owing to the reported ability KT has to enhance muscle length and decrease muscle tone.[27,28] One hypothesis related to muscle change occurring from KT is the possible effects on fascial rigidity. When fascial rigidity is addressed, stretch of the muscle spindle can be altered.[28] The muscle spindle length may then be lengthened, and movement patterns could be restored for proper muscle activation and support for the shoulder joint anatomy and kinematics.

A change in muscle length can affect the biomechanics of the shoulder movements and posture. This correlates with the common rehabilitation protocol for rounded shoulder posture and pain including pectoralis minor stretching.[5] Specifically, taping has been shown to be helpful in restoring some of the flexibility and pain-free range of motion (ROM) in the scapula, shoulder, neck, and upper back, which, with the changes observed in the present study, could improve swimming stroke shoulder flexion.[9,29,30]

The changes in pain observed in this study suggest that KT could be a viable option to decrease pain and increase function for competitive swimmer's shoulder pain and disability. A reported decline in pain scores could be attributed to the theory of fascial manipulation used in this study.[22,28] Kinesiology taping may help with fascial coordination and alter the space surrounding the area of pain and inflammation to help restore superficial blood flow and decrease pressure.[22] However, because there was not a control sham application included in the methodology of the current study, a placebo effect to pain reduction cannot be discounted.

Kinesiology taping may also provide positional stimulus signaling to the central nervous system.[31] The tape has been theorized to stimulate mechanoreceptors blocking free nerve endings signaling to decrease pain.[31] Proprioceptive feedback increases balance, posture controls, and general movement patterns.[32] Increasing proprioception to the shoulder or thoracic spine can cause increased awareness, and pain-inducing movements may be more readily recognized during activities and further exacerbation avoided.

Taping the shoulder could also be done to address the thoracic component of forward head posture. This is important in this study because upper thoracic kyphosis can cause increased shoulder pain at angulations of 40° to 50°.[33-35] After shoulder injuries, back injury is the second

most prevalent injury in Division I swimming.[36] Thus, it has been postulated that swimming increases the risk of both shoulder injuries and hyperkyphosis.[37] The relationship between shoulder pain and the spine is uncertain.[33] However, the effect of changing thoracic posture on shoulder ROM has been noted in several studies.[38-41]

The results of this study suggest that initial changes in pain may be due to the proprioceptive feedbacks of the taping methods.[30] Taping of the fascial manipulation point on the pectoralis minor may have slight changes to active ROM, and help in pain management. If this is possible, it may help decrease the hypertonicity of the pectoralis minor, which is one of the main sources of shoulder pain and anterior upper back posture.[9]

An intriguing secondary finding in this study was that although not significant, the 27 female DASH scores were higher than the 49 male scores in averages. The change in pain scores after wearing KT was relatively consistent between the sexes. Overall, the literature suggests that men and women differ in their responses to pain, with women having increased pain sensitivity and risk for clinical pain.[42] Although the specific etiological basis underlying these differences is unknown, it is proposed that multiple biological and psychosocial processes are contributing factors.[42] This study appears to support the growing body of literature suggesting a difference exists between the sexes. With a larger, more equal sample size, a significant difference between sexes may emerge in the current data.

Limitations

This study was performed on a convenience sample; therefore, it does not include a random sample and thus cannot be generalized to the entire swimming population. Secondly, there was no control group, thus this paper cannot infer causality. Moreover, the lack of a sham taping procedure lends to the possibility of a placebo effect on DASH and functional movement assessment. Also, activities were not controlled for the 30 minutes of KT application among participants. Furthermore, the retention of KT application benefits was not investigated. Future studies could control activities during the taping application, differ in tape placement application, or provide longer wear times of the KT to potentially observe greater changes and great effect sizes. There have been previous studies that show that KT has beneficial effects on athletic performance up to 72 hours after application.[43] Furthermore, future research could locate areas of difference between pain and pain-free groups and provide interventions to affect those areas. This could result in studies more specifically designed to treat the source of swimmers' shoulder injuries.[44]

Future Research

The implications of KT for pain relief, postural long-term changes, and muscle length changes are still ambiguous. Despite the uncertainty, the implications of this study suggest that the noninvasive therapy of KT may be a potential tool in decreasing pain and increasing functional movement for US Masters swimmers at the national championship. The data appear to suggest that the application of KT may be an added option to treat shoulder pain and mobility issues. Future research could explore the effects of KT on the nervous system and the other possible physiological effects, such as fascial changes in kinetic movement patterns.

Conclusion

For the swimmers in this study, KT significantly changed shoulder pain and active functional movement scores.

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Contributorship Information

Concept development (provided idea for the research): J.H.H.
Design (planned the methods to generate the results): J.H.H., J.D.O.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): J.D.O.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): J.H.H.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): J.H.H., J.D.O., B.L.D.
Literature search (performed the literature search): J.H.H.
Writing (responsible for writing a substantive part of the manuscript): J.H.H.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): J.D.O., B.L.D.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jmpt.2018.11.009.

Practical Applications

- Findings from this study suggest that KT changes shoulder pain and active functional movement scores in competitive swimmers.
- Kinesiology taping could be considered before engaging in more invasive treatment options.

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