

The Effectiveness of Kinesiotaping to Reduce the Incidence of Shoulder Impingement Syndrome in Baseball Pitchers who Perform Repetitive Overhead Movements: A Systematic Review

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Abstract

Shoulder Impingement (SIS) is one of the common causes of shoulder pain in overarm athletes and accounts for almost one third of shoulder injuries in baseball players. Kinesiotape (KT) is a stretch tape, which is used as an intervention for SIS with positive results. This systematic review evaluates current research evidence on the effects of kinesiotaping and determines whether KT should be considered when making decisions regarding injury prevention for baseball pitchers. A systematic literature search was performed and 27 peer-reviewed articles were included that are related to current practices for preventing shoulder injury in overhead athletes, biomechanics, the effects of KT on asymptomatic shoulders and other body parts and KT as an intervention after shoulder injury. The current research demonstrates that KT alters the biomechanics of the shoulder and in some cases has been an effective intervention for shoulder injury. No studies have found KT to have negative side effects; therefore, its use as an injury prevention technique is suggestive and should continue to be explored.

Keywords: Shoulder impingement syndrome, Kinesiotape, Overuse injuries

Introduction

Shoulder impingement syndrome (SIS) is one of the most common shoulder complaints in orthopedic clinics, as well as a common cause of shoulder pain in overarm athletes [1]. Of 371 athletes studied, 30% percent experienced shoulder pain during their career and 27% of the shoulder pain was due to shoulder impingement [2]. Shoulder impingement is defined as compression and mechanical abrasion of the rotator cuff structures as they pass beneath the sub acromial space during elevation of the arm [3]. The portion of the arc of motion where individuals with shoulder impingement commonly experience pain has been observed to occur between 60 and 120 degrees of humeral elevation [1].

The common changes that occur to scapular kinematics, when affected by SIS, include scapular winging when the arm is elevated, decreased upward rotation, decreased posterior tilt, and increased scapular upward translation [1]. Scapular mechanics need to be intact for baseball players to repetitively throw the ball with great force [1]. The “throwers paradox” defined by Wilk et al., refers to the fact that the

thrower’s shoulder must be loose enough to throw but stable enough to prevent injury[4] Alam et al., emphasized the ratio of external-internal rotator cuff muscle strength, specifically that the sufficient strength of the infraspinatus and teres minor muscles as external rotators being vital during the overhead throwing motion. They purport that to prevent joint distraction; these muscles are responsible for developing an approximation force on the upper arm at the shoulder equal to body weight [5]. While throwing, muscular forces in the shoulder reach up to 120% of maximal volitional isometric contraction[4].

In exploring the effect of KT on baseball players, it should be noted that competitive baseball players differ from non-athletes in their shoulder biomechanics. These differences have been measured in healthy competitive baseball players, and include increased upward rotation of the scapula at all points of humeral elevation and increased scapular retraction at 90°, which is associated with the cocking phase of throwing [6].

Adequate upward rotation of the scapula in overhead athletes requires periscapular strength and coordination. Therefore, scapular mechanics in overhead athletes has been the subject of much research. A summary of this research finds that scapular dyskinesia and medial scapular border prominence, or scapular winging, have been found in impingement patients[7]. Increased scapular posterior tilt and elevation have also been found among baseball players with impingement, as compared to baseball players with no history of shoulder pathology [7]. Figure 1 kinesiotape example for the shoulder. For illustrative purposes



Figure 1: Kinesiotape example for the shoulder.

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Non-stretch athletic tape functions to support a joint during movement. Rather than being structurally supportive similar to white athletic tape, KT is said to be therapeutic in nature, and it is believed to increase proprioception through increased stimulation to cutaneous mechanoreceptors [8]. KT is latex-free, composed of heat-activated 100% acrylic adhesive, can be worn in wet environments with the 100% cotton fibers quick drying, and has a long wearing time, lasting 3-4 days [2].

The literature is inconclusive on the specific effects of KT and its effects [9]. A systematic review displayed that KT had little or no effect when compared to other treatments or placebo taping [10]. There are proposed benefits of using KT over non-stretch tape which include creating a stimulus through the skin, which provides joint positional awareness by sending afferent signals from the ligaments, skin, muscles and tendons to the central nervous system. It aligns facial tissue, which creates an efficient muscle pull preserving energy. It creates more sub acromial space by lifting fascia and soft tissue above the area of pain/inflammation to release the loads on free nerve endings. KT is also believed to provide support and stability to muscles and joints without limiting range of motion and assist the body's natural healing process [9].

Prevention of injury is also a possible reason for wearing KT. KT used as an injury prevention strategy for America's Cup (yachting) athletes was found to significantly reduce the number of injuries per sailor and the rate of injury per day [11]. However, in this study, KT was implemented in conjunction with other strategies, such as range of motion exercises and ice baths, so it is not possible to discern the benefits of KT alone [11]. The effectiveness of KT for the prevention of SIS in baseball pitchers has not been the subject of clinical research. The aim of this study is to hypothesize the effectiveness of KT for the prevention of SIS in overhead baseball pitchers based on currently existing research and our knowledge of the biomechanics and disease processes of the shoulder. The pitchers of particular interest in this study are overhead throwing pitchers, which are defined as pitchers using their shoulders at humeral elevation of at least 90 degrees with the elbow flexed. This excludes all pitchers who throw the ball with a humeral elevation of less than 90 degrees, which is commonly known as sidearm pitching [4].

Methods

A literature search was performed on Google scholar, EBSCO, CINAHL, Cochrane Library, PubMed, and Google Scholar using the following terms: "kinesiotape"; "kinesiotaping for shoulder impingement"; "rotator cuff"; "tendinopathy"; "effects of kinesiotape on muscle strength"; "effects of kinesiotaping on muscle fascia"; "kinesiotaping for rotator cuff tendonitis"; "kinesiotape for dynamic stability"; "use of kinesiotape for overuse injuries". The searches were completed in June and July of 2016. Articles selected for review were those of original research performed since 2000 and included journal articles on shoulder impingement, rotator cuff injuries, and the effects of KT on proprioception, muscle activity, dynamic stability, and as a treatment for shoulder pain.

Results

A total of 27 articles were reviewed for this study. Five articles examined the current practices for preventing shoulder injury in overhead athletes; two studies looked at the biomechanics of healthy shoulders while another two investigated the biomechanics of pathological shoulders. Articles on kinesiotape including four articles on using KT on parts of the body other than the shoulder, seven articles

on the effects of KT on asymptomatic shoulders, and seven studies which used KT as an intervention after shoulder injury. Levels of evidence for each source are found in Table 1 [12]

Discussion

Thelen et al. reported immediate improvement in pain-free shoulder ROM when using KT on young, active patients with a clinical diagnosis of rotator cuff tendonitis/impingement. However, the results indicate these benefits do not last, as both KT and placebo taping groups reported similar results in shoulder pain intensity and disability after wearing the tape for three days [13]. This contradicts with the results of another study that found KT was more effective than other local modalities at the first week and was similarly effective at the second week of the treatment. This suggests that KT may be an alternative option in the treatment of shoulder impingement syndrome, especially when an immediate effect is needed [3].

Another strategy that has been implemented to treat SIS has been various methods of manual therapy and therapeutic exercises. Evidence based research was found concluding that therapeutic exercises for SIS include stretches of the upper trapezius, pectoralis minor and posterior capsule. Strengthening exercises of the serratus anterior along with musculature that promotes shoulder abduction, flexion, extension, external rotation and internal rotation also are proven treatments for SIS [14]. Manual therapy appears to increase either active or passive mobility of the shoulder. A trend was found favoring manual therapy for decreasing pain [15].

Simsek et al. examined the benefits of KT application in addition to exercise therapy and found that the application of KT improved pain and function after five days of treatment. After 12 days of treatment, the application of KT improved night and activity pain scores, function, pain-free abduction ROM and muscle strength with abduction [16].

It has been proposed that eccentric overload during the deceleration phase of throwing puts the posterior shoulder muscles at risk for injury. A recent study found that preseason weakness of external rotation, and specifically supraspinatus weakness, is associated with in-season throwing-related injury [17]. The baseball community has used this and similar research to support the use of external rotation strengthening programs, as well as preseason strength testing, to prevent injury in baseball pitchers.

Shakeri et al. performed a randomized, double blinded, placebo-controlled trial of the effects of KT on pain for patients with SIS. KT applied to patients with SIS had an immediate benefit with regards to pain, pain-free range of motion, and nocturnal pain [18]. Based on the benefit to pain free range of motion [19], we can hypothesize that KT alters the biomechanics of the shoulder in a way that reduces impingement and decreases the pain for patients that are already experiencing inflammation from SIS.

Selkowitz et al. found that KT was effective in decreasing EMG signal amplitude of the upper trapezius with functional activities that require shoulder elevation and abduction. KT was also found to significantly increase in EMG signal amplitude of the lower trapezius [20]. Joint position sense at the ankle was examined to determine if KT could be

Level of evidence for the articles used in this study based on the Oxford Centre for Evidence-Based Medicine Levels of Evidence [12]	
Level 1	11
Level 2	11
Level 3	6
Level 4	2
Level 5	0

Table 1: Level of evidence for the peer-reviewed articles examined in the systematic review.

used to improve proprioception [21]. Halseth et al. suggest that KT does not likely enhance proprioception when measured by joint position sense, but they did not specifically measure changes in cutaneous sense [8]. Aarseth et al. stated that KT decreased joint position sense at 90 degrees of elevation, but did not increase or decrease joint position sense at 50 or 110 degrees [21]. KT may actually negatively affect the joint position sense as it approaches 90 degrees of humeral elevation. However the tape that was applied did not have specific instructions on how and where it was applied [21].

Briem et al. reported significantly greater mean muscle activity when the ankles were taped with non-elastic tape compared to no tape, while KT had no significant effect. Neither stability level nor taping condition had a significant effect on time from perturbation to maximum activity of the fibularis longus, indicating that KT does not have an effect on stability or unconscious proprioception [22]. Frayson reports increased stiffness following initial application of KT and 24 hours of KT, suggesting KT can increase static joint stability [23].

Studies by Hsu et al. and Myers et al., showed an insignificant change of greater scapular upward rotation in a KT session at 90 degrees and 120 degrees of humeral elevation in baseball players [1,24]. The study also found that the KT elicited more muscle activity from the lower trapezius in the 60-30 degree arm lowering phase [1]. Symptomatic shoulders benefitted by identification of the position that created pain. Reducing the position that had a high prevalence of shoulder pain was shown to decrease pain significantly [25]. Wilk et al. assessed isokinetic strength in professional baseball pitchers. It is reported that an ER or IR ratio 72%-76% was present among healthy throwers [4]. The position and orientation of the scapula and SC joint has been shown to be different in baseball pitchers with a diagnosis of SIS, with increased SC elevation and scapular posterior tilting [10]. Lin et al. studied the effects of KT on healthy shoulders as it relates to EMG muscle activity and proprioceptive feedback [26]. The study found that upper trapezius and anterior deltoid activity decreased significantly, while serratus anterior activity increased significantly with the use of KT, as compared to the trials with no KT. Ujino et al. found that KT application may increase shoulder range of motion over a three day interval but when combined with stretch or stretch alone, no significant improvements were found [27].

Their measurement of proprioceptive feedback with and without KT found significant results suggestive of greater accuracy in repositioning of the shoulder with KT. Given the high degree of accuracy in competitive sports, along with the minimal changes in shoulder positioning that can cause dysfunction in the shoulder, we can hypothesize that KT has a practical application for the prevention of shoulder dysfunction and subsequent injury.

In trials conducted by Alam et al., KT showed minimal improvement in peak torque production at isokinetic speeds of 60°/s and 180°/s over placebo-tape and no-tape groups. KT was not shown to immediately increase internal rotation (IR) or external rotation (ER) upon application [2]. Oh et al. determined that KT improved peak torque for IR at isokinetic speeds of 60°/s and 180°/s, but no significant difference in ER was observed [28]. It was also shown that KT application significantly lowered the ER/IR ratio at 60°/s, but was not statistically significant at 180°/s. The results of this study indicate that KT was effective in increasing IR strength and restoring shoulder IR/ER balance ratio in patients experiencing rotator cuff tendinitis [5].

A systematic review performed by Drouin et al., showed minimal evidence that KT may improve certain performance outcomes such as grip strength, vertical ground reaction force, trunk flexion, and single-leg hop test and peak torque within 0-45 minutes of application. That said, the authors suggested that there is little evidence to support clinically significant improvements in strength, proprioception, or range of motion in healthy athletic individuals [9].

Another study showed that KT showed no better outcomes than other therapy interventions. In the study, KT tape was deemed to be not effective or no more effective than electrotherapy, sham taping, manual therapy, or exercises [10]. Therefore, the application of KT tape was deemed to not be clinically worthwhile for musculoskeletal injuries. However, the study does not address if KT tape could biomechanically benefit a healthy musculoskeletal system with no injured tissues.

While there has been an abundance of research on the use of KT as a treatment for shoulder impingement syndrome, there has not been any research on the use of KT to prevent the occurrence of SIS in baseball pitchers. SIS is one of the most common causes of shoulder pain in overhead athletes. When pitching, a tremendous force is produced and must be safely dissipated to prevent injury. Altered kinematics in the pitching motion can inhibit the safe dissipation of force during the deceleration of the arm, causing the head of the humerus to translate superiorly and pinch the rotator cuff structures between the head of the humerus and the underside of the acromion. It is believed that KT can be used to provide a positional stimulus through the skin, align facial tissue, reduce pressure on the rotator cuff structures by lifting fascia and soft tissue above the area of pain/inflammation, and provide sensory stimulation to assist or limit motion [29]. KT can also be used to alter EMG activity of shoulder girdle musculature, indicating it is possible to stimulate some muscles while inhibiting others [new 22,27,20,23]. Decreased posterior tilt of the scapula occurs between 45° and 90° of humeral elevation in subjects with SIS. It has been shown that KT taping over the lower trapezius tends to increase scapular posterior tilt when humeral elevation was less than 90° in subjects SIS [1]. This suggests that KT may assist in correcting the affected scapular movements, therefore helping the arm to function on a more balanced and stabilized scapula.

While there have not been any studies with KT used as a prevention tool in baseball pitchers, it has been tested on asymptomatic patients. Taping has been shown effective with increasing scapular external and upward rotations as well as posterior tilt in subjects that have had no previous shoulder issues [30]. Another study showed significant results in using KT to influence scapular tilt by increasing the upward tilt, thereby increasing the sub acromial space and decreasing the chance of impingement of subacromial structures [31]. These increases in motion were found in the scapular plane which is involved in the pitching motion, but a pitcher does not stay only in the scapular plane. Another study found that shoulder internal rotation and external rotation was increased in asymptomatic patients that had never previously been injured but decreased in those that are asymptomatic and been previously injured. Interestingly, this shows that taping can be used to increase range into internal and external rotation for those who are lacking the motion and want to gain range to reduce stress on tissues. However, it also shows that for those who have been injured but are now asymptomatic may benefit from using KT in order to decrease range of motion [32]. This stops those that are pain free and want to push their previous injury from potentially stressing tissues that are not completely healed. Based on this information, it is important to consider the athlete's previous injury status.

Based on the evidence given, KT applied to the shoulder has not been shown to have any negative side effects. Current evidence is not overwhelmingly conclusive that KT will prevent SIS in overhead throwing pitchers, but it is suggestive of injury prevention and KT can be safely added to injury prevention programs for these athletes. Hikita found that KT did not acutely affect throwing velocity. He suggests more research is needed on the prolonged effects and the possibility of KT increasing blood supply to the rotator cuff muscles [33].

Conclusion

Current research indicates that the use of KT in combination with a well-planned exercise program that addresses proper rotator cuff biomechanics may help prevent SIS in overhead throwing athletes.

Although current research is not conclusive for prevention, it has shown that KT can change the biomechanics and muscle activity of the shoulder girdle to make the shoulder joint more biomechanically efficient. No research has demonstrated that KT causes injury barring any allergies to the components found in KT. Research also supports that the use of KT while pitching does not slow down pitching velocity. More research is needed to determine if KT alone can be used as prevention for SIS.

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