Utilization of Kinesio Taping for Fascia Unloading

Daniel O'Sullivan, MExSci (Rehab) • Accelr8 Rehabilitation, Australia
and Stephen P. Bird PhD, AEP, CSCS, RNutr • Charles Sturt University, Australia

The emerging strategy of *fascia unloading,* defined as reducing tension in the interconnected fascia layers in response to the mechanical load applied to the tissue during movement,[1] has recently gained popularity as a potential method for enhancing injury rehabilitation and promoting muscular performance. Kinesio Taping (KT) is a therapeutic procedure that is believed to facilitate fascial unloading. The practice gained international exposure at the 2008 Beijing Olympic Games, where athletes from various sports (i.e., track and field, cycling, tennis, and badminton) wore kinesiotape (Figure 1). More recently, sports commentators have noted the use of KT by cyclists competing in the 2010 Tour de France and the 2011 Asian Football Confederation Cup in Qatar. Although KT is commonly used by elite athletes, the mechanism by which this technique alters fascial structures remains speculative. The purpose of this report is to describe fascia physiology and the theory of fascia unloading, with a focus on the use of the KT method during rehabilitation and its influence on exercise performance.

Key Points

- Fascia unloading techniques attempt to alter connective tissue responses to mechanical strain.
- Kinesio taping as a fascial unloading technique has become popular in the management of musculoskeletal injury.
- Research indicates that Kinesio taping improves pain levels and range of motion.
- Data supporting the effects of Kinesio taping on muscle power is inconclusive.
- Kinesio taping as a fascial unloading technique shows promise and warrants further investigation.

Fascia Physiology

Early reports referred to fascia, a connective tissue that surrounds and separates muscle tissue, as a covering for muscles that is a continuation of tendon with limited

Figure 1 Application of KT for the anterior knee and thigh.

function.[2] It was later described as an exoskeleton,[3] suggesting a greater physiological role. Some now suggest that fascia has contractile components,[4-7] which can integrate proprioceptive signals and assist in load bearing (e.g., the lumbar fasciae). Fascia has been described as having plastic properties,[8-11] because it deforms when a load is imposed and complete recovery of its normal state may take several hours.[12] The tissues that have primarily been studied include the thoracolumbar fascia, the iliotibial tract, and the plantar aponeurosis. Fascia myofibroblasts are cells that are capable of exerting continuous force over long periods of time,[4] which may influence the structural stability of the tissue. Myofibroblasts may represent an intermediate cell type between a smooth muscle cell and a fibroblast. The sustained contractile ability of myofibroblasts may play a role in chronic contractures, such as Dupuytren's contracture of the palmar fascia or adhesive capsulitis in the shoulder.[9,13] These cells are not stimulated to contract by a neural impulse, which suggests that they are not subject to conscious control. There appear to be two factors that induce long-duration, low-energy contraction of myofibroblasts: (a) mechanical tension within the tissue and (b) binding of specific cytokines and other agents (i.e., nitric oxide, histamine, mepyramine, and oxytocins) to cell membrane receptors.[9] Angiotensin and caffeine, which are calcium channel blockers, and norepinephrine and acetylcholine, which are neurotransmitters, have no effect on these cells. Direct neural stimulation of skeletal muscles by the somatic nervous system involves acetylcholine, whereas smooth muscles are activated by the parasympathetic nervous system through release of norepinephrine.[14] The fact that myofibroblasts do not respond to neural stimulation may have implications for therapeutic fascia loading and unloading techniques that may be used for pain management.

Fascia Loading

Long-duration contraction of the connective tissue may play a role in acute or chronic musculoskeletal pain. Fascia contraction occurs very slowly over a period of 20-30 minutes[15] and may be sustained for more than an hour before slowly subsiding. The contraction develops in response to a sustained load. The lower the pH (i.e., an acidic environment) causes myofibroblasts to contract.[5,7,16] Therefore, conditions such as a breathing pattern disorder, emotional stress, or consumption of acid-producing foods could induce a general stiffening of the fascia.[7,9]

Athletes often complain of muscular pain that is not caused by a specific traumatic incident. They often describe muscles as being locked, inferring that there is tightness within the affected limb. Muscle locking has been described in the literature as an eccentrically loaded muscle (locked long) or a concentrically loaded muscle (locked short).[17] Connective tissue can be remodeled by the positioning and movements of the body segments.[18] Repetitive movement of a specific muscle group can produce a thickening or shortening of the superficial and/or deep fascia surrounding the activated muscle, which may provide more stability and allow the muscle to generate more power.[19] During the process of fascia remodeling, inadequate lengthening (regular stretching) may produce a dysfunctional state that could increase risk for fascia tearing. The primary goal of the athletic trainer or therapist (AT) will be restoration of optimal functional status through (a) restoration of normal range of motion, (b) development of neuromuscular control, and (c) remediation of strength deficits.[20] Fascial manipulation[21,22] and KT are two therapeutic procedures that are increasingly implemented by ATs to assist in this process.

Fascia Unloading for Rehabilitation

Fascia damage (i.e., microtearing and/or inflammation) is believed to be common among athletes[12,23] and is believed to be under-diagnosed.[23,24] Only pathology in thick fascia bands, such as the plantar fascia, is easily identified through diagnostic imaging. Unlike muscle fibers, which signal a need for development of sarcomeres when heavily loaded,[25] fascia is extremely susceptible to microtears when stretched quickly (e.g., high-intensity eccentric loading).[26] If the fascia stretch is applied slowly over a long period of time, however, it may undergo plastic deformation. Skeletal muscle fibers can be described as relatively elastic, whereas fascia behaves more like a plastic material.[9] Although fascia microtears may cause discomfort, they may not be detectable through diagnostic imaging.[12,24] The fascia is innervated by free nerve endings that convey nociceptive neural signals.[12,27] In fact, nociceptors are most abundant in the skin and the outer layers of connective tissue.[9] A pain signal is transmitted from the fascia to the spinal cord, and ultimately to the brain,[28] but the exact pathway for transmission of the pain impulse can vary.[29] When healing is complete, nociceptive input should cease, but therapeutic intervention may be necessary to relieve chronic musculoskeletal pain.[28]

The repair process is initiated when a fascia injury occurs.[30] Proliferation and activation of fibroblasts results in the deposition of collagen at the location of the injury,[31] which is assembled into fibers that become aligned with mechanical tension in the tissue. If the tissue is immobilized, dense connective tissue forms.[32] KT may alleviate pain through a reduction in mechanical stress on the tissue (i.e., fascia unloading).[33] KT is applied in a manner that creates convolutions in the skin, which are believed to increase the interstitial spaces between sheets of fascia, thereby reducing stiffness, improving joint range of motion, and decreasing pain. Pain relief is believed to be mediated by a reduction in the mechanical load on free nerve endings within the fascia.

Kinesio Taping Method

The KT method of fascia unloading was developed by a Japanese chiropractor, Kenzo Kase, in the late 1970s.[33] The objective of KT is to facilitate muscle relaxation. When applying kinesiotape, the body segment is placed in a stretched position (Figure 2a), so that return to a normal resting position will create skin convolutions (Figure 2b). By lifting the skin, subcutaneous blood flow and lymphatic drainage are believed to be increased,[33] and it is believed to unload the underlying fascia, thereby reducing pain. KT has been theorized to affect the deep fascia layers,[34] which might decrease susceptibility to microtearing of the tissue.[12] KT may facilitate improved performance, especially in sports that require repetitive high-intensity muscular efforts and eccentric loading.

What Does the Research Indicate?

Studies of the therapeutic value of KT have yielded evidence of significant improvements in range of motion and reduction of pain (Table 1). A recent case report by Garcia-Munro et al.[35] addressed the use KT for treatment of myofascial trigger point pain in the shoulder (Figure 3). The authors reported that KT contributed to resolution of the patient's symptoms within a few days. Significant improvements in shoulder range of motion were observed after two days of treatment: shoulder abduction increased from 35° to 54° and shoulder flexion increased from 160° to 165°. Thelen et al.[36] reported an immediate reduction in shoulder pain that was elicited by abduction after the application of KT (Figure 4), but the effect was not retained beyond 3 days. The authors concluded that KT can have a short-term beneficial effect on shoulder range of motion.

(a)

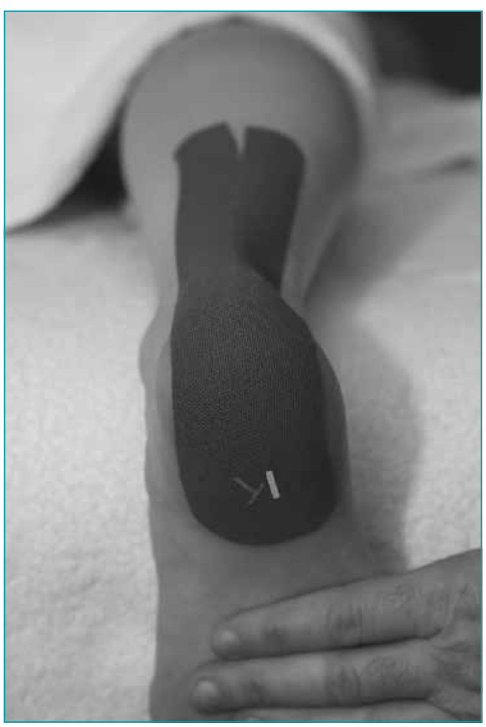

Figure 2a Application of KT with the foot dorsi-flexed.

(b)

Figure 2b Convolutions following KT application when the foot is in a neutral position.

TABLE 1. Summary of Research Reporting Therapeutic Benefits of KT

Author	Objective	Protocol	Subjects	Outcomes
Walsh[43]	KT utilized to facilitate the movement of the rotator cuff and scapula stabilizers to assist a neonatal brachial plexus injury.	Case study with a 20-week exercise program. KT was applied to the shoulders 2-3 days on 1-2 days off.	2-yr-old female	At 20 weeks, patient had full ROM, symmetrical shoulders, and an increase in size and mineralization of the humerus. Reconstructive surgery cancelled.
Garcia-Muro et al.[35]	Facilitate ROM of the right shoulder and decrease pain through the use of KT.	Case study with application of the KT to the right deltoid muscle in a v shape. The tape was only adhered to the patient for 2 days.	20-yr-old female	Initial application of the tape improved ROM, but no change in VAS. After 2 days, removal of tape further increase in ROM. After 9 days the patient reported no pain and ROM almost normal.
Gonzalez-Iglesias et al.[38]	Identify the short term effects of KT on patients with whiplash-associated disorders (WAD).	A KT group and Placebo-tape group was established. Baseline measures were taken before application of tape, immediately after tape application, and 24 hours after tape application.	41 patients with acute WAD	The KT group exhibited significant improvements immediately following the application of the KT and at a 24 hour follow-up. The improvements were small and may not be clinically meaningful.
Thelen et al.[36]	Determine the short term clinical efficacy of KT when applied to patients with shoulder pain.	A KT group and placebo-tape was established. Patients wore the tape for 2 consecutive, 3 day intervals.	42 subjects with shoulder impingement	There was an immediate improvement in pain and shoulder abduction in the KT group. In both the KT group and sham group, there was no difference in improvement after 6 days.
Slupik et al.[37]	To examine the effect of KT on the bioelectrical activity of the vastus medialis muscle.	KT was applied to support the medial head of the quadriceps muscle and left on for 24 hours.	27 healthy subjects	An increase in the bioelectrical activity of the quadricep muscle was reported after 24 hours. There was maintenance of this effect 48 hours after the removal of the tape. At 72 hours, the effect was still significant; however, it was lower than the effect after 24 hours.
Yoshida & Kahanov[44]	Examine the changes in ROM of the trunk flexors, extensors and lateral flexors when KT is applied to the lumbar region.	KT was applied to the lumbar region. ROM measurements were taken before and after the application of the tape.	30 healthy subjects	Trunk flexion improved by an average of 17.8cm. No other ROM indicators were significant.

Author	Objective	Protocol	Subjects	Outcomes
Yasukawa et al. [45]	Describe the use of kinesio taping method for the upper extremity in enhancing functional motor skills in children in an acute rehabilitation setting.	Many different tape applications to the 15 children. Upper limb functional movement was assessed before tape application, immediately after application, and 3 days after wearing the tape.	15 children with an acquired disability	Improvement in upper extremity control and function in all the children was significant after the application of the KT tape.
Osterhues[46]	Examine the effect of KT on a left knee patella lateral dislocation.	During a 4-week rehabilitation program, the tape was applied over the quadricep muscle. The tape was replaced every 3-4 days.	49-yr-old female	The KT decreased pain and enhanced quadricep activity during weight bearing activities.

Abbreviations: KT = Kinesio taping; ROM = Range of motion; WAD = whiplash-associated disorders.

Figure 3 **Application of KT for the deltoid, reinforced by a transverse strip.**

Figure 4 **Application of KT for rotator cuff tendonitis/impingement.**

There is limited research evidence pertaining to the effect of KT on strength. Slupik et al.[37] reported an increase in EMG activity of the vastus medialis after 24 hours of wearing kinesiotape in nine healthy, active individuals. Gonzalez-Iglesias et al.[38] used KT to treat patients with whiplash-associated symptoms (Figure 5) and reported a 23% reduction in neck pain immediately after kinesiotape application and improvement in cervical range of motion. The collective findings of these studies suggest that KT influences sensorimotor function.[33] KT-induced change in muscle tone could result from stimulation of mechanoreceptors, which results in reflexive activation of motor units in the same muscle that was the source of the neural stimulus. Only short-term KT has been studied. At present, any long-term effects of KT are unknown.

Figure 5 Application of KT for the cervical spine.

Not all studies have reported beneficial effects for KT. Briem et al.[39] recently reported that KT had no effect of activation of the peroneus longus muscle. Chang et al.[40] reported that KT had no effect on grip strength in healthy collegiate athletes. Fu et al.[41] reported similar findings for quadriceps strength. Chang et al. [40] postulated that an observed enhancement of grip force sense associated with KT may have been due to an effect on mechanoreceptors that facilitated the response to alteration in the length and tension of the muscle fibers. Such an effect may be beneficial to athletes who compete in sports that may require precise hand force control.[40] Firth et al.[42] examined the effect of KT on hop distance, pain, and motoneuron excitability in patients with Achilles tendinopathy and healthy individuals. KT of the Achilles tendon facilitated activation of the soleus and astrocnemius in healthy subjects after removal of the kinesiotape, but the effect was not observed for those with Achilles tendinopathy. Furthermore, KT did not have a significant effect on hop distance or pain.

Summary

Movement is essential for repair of damaged fascia. Dysfunction may result from microtearing of fascia, which may adversely affect athletic performance and increase susceptibility to further injury. KT appears to facilitate pain-free movement, which is a key rehabilitation goal. Motion needs to be initiated as soon as possible following injury to facilitate optimal healing.[30] Although some studies have failed to demonstrate a beneficial effect for KT, it may provide a fascia unloading effect that facilitates pain-free movement. The potential therapeutic benefits of KT warrant further investigation.

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Daniel O'Sullivan is with Accelr8 Rehab in Canberra, Australian Capital Territory, Australia.

Stephen Bird is with the School of Human Movement at Charles Sturt University in Bathurst, New South Wales, Australia.