DYNAMIc TapE ®

Biomechanical evaluation and intervention is regularly incorporated into the management of musculoskeletal conditions. Alterations in kinetic and kinematic factors can be identified and addressing such factors can improve pain and function.

Greater magnitude and velocity of navicular drop has been associated with Medial Tibial Stress Syndrome[1]. Hip adduction and internal rotation is predictive of pain severity in Patellofemoral Pain Syndrome[2].

Similarly, those with poor outcomes post injury or surgery may demonstrate altered mechanics when compared with those with good outcomes or with the uninvolved limb. Those with patella tendinopathy reduce motion at the knee but exhibit increases at the hip during hopping activities[3]. Following ACL repair, those with poorer outcomes similarly demonstrate meaningful assymmetries at the hip[4]. Other factors such as fatigue can result in considerable changes even within a single event. Runners pre and post half marathon demonstrated a bilateral increase in navicular drop of 5mm and hamstring injuries often occur late in matches suggesting that fatigue may play a role[5,6].

Interventions such as Antipronation Taping can be effective at reducing navicular drop and in doing so reduce EMG activity in Tibialis Anterior and Tibialis Posterior presumably due to a reduction in loading[7].

The pain associated with tendinopathy is also load dependent - the more load, the more pain but furthermore load is credited as being the driver that progresses tendinopathy from an early, reactive tendinopathy through the stages of tendon dysrepair to a degenerative tendinopathy, as described by Cook and Purdham, 2009[8].

Orthotics, taping and bracing attempt to combat some of these changes, primarily by providing a passive restriction to motion or perhaps via neurophysiological mechanisms. They do not however provide a deceleration force, load absorption or assistance to motion. Furthermore, rigid, sports tapes can restrict motion and maintain correction, at least for short periods but in many athletic endeavours the restriction of movement interferes with the performance of complex skills or manouevres. Dynamic Taping, developed a little over 2 years ago, provides an additional tool that fills the gap that was present.

Dynamic Taping is a highly elastic tape that stretches in all directions. It has strong elastic recoil and is designed to provide a strong mechanical input (think bungee) while permitting full range of motion even during complex, multiplanar movements. Taping techniques can involve multiple joints, introduce rotation and cross the midline with no limitation to movement.

In order to achieve this, the viscoelastic Dynamic Tape stretches well over 200% and does not have a rigid endpoint like a kinesiology tape. It also stretches in all directions to allow full movement. As muscles have different angles of pennation, the four way stretch allows the tape to more closely mimic the function of the target muscle. Dynamic Tape is applied with the muscle or joint in the shortened position so that as lengthening occurs, the Dynamic Tape stretches and resists, thereby absorbing load and providing a deceleration force to reduce the eccentric demand on the muscle. Once deceleration is complete and shortening commences, the elastic potential energy is converted to kinetic energy to assist the transition to the concentric contraction.

Although strong neurophysiological effects are also suggested, it is this mechanical approach that guides the clinical reasoning. Tissues do not fail because of pain, they fail because of load. Dynamic Taping techniques aim to modify or manage the loading profile of the tissues. Dynamic Tape can absorb load directly by providing a deceleration force to reduce the eccentric demand on the affected muscle e.g. hamstring tear or indirectly by modifying the movement pattern as a whole or introducing an accessory motion at a joint e.g. Mulligan techniques.

Techniques are developed based on a thorough assessment and sound clinical reasoning. In addition to identifying aberrant movement patterns, the clinician must also consider the type and stage of the pathology and the demands placed on the injured tissue. Once a clear objective is identified, the technique is developed placing importance on elements such as the axis of rotation, line of pull relative to the axis, position and leverage. Re-evaluation follows to determine if the taping application has created the desired effect on movement and the subsequent effect on pain and function. The result can immediately be fed back into the clinical reasoning process to support or contradict one's primary hypothesis.
To illustrate this, consider a mid portion achilles tendinopathy.

Ryan et al, 2009 reported increased subtalar eversion in a group with achilles tendinopathy9. An indirect technique therefore would aim to reduce the subtalar eversion and consequent strain on the achilles tendon. A variety of techniques could be selected depending on assessment findings. One example would be to provide a hip extension and external rotation force to reduce the magnitude and velocity of hip internal rotation, adduction and consequent valgus collapse at the knee and foot.

A more localised alternative would be to

> “Dynamic Tape stretches well over 200% and does not have a rigid endpoint like a kinesiology tape”

address the navicular drop at the foot itself (Figure 1.) This technique provides a force vector to shorten the foot and raise the transverse arch. It also acts to resist calcaneal valgus. The technique is applied with the foot in plantar flexion, forefoot adduction, inversion and great toe flexion. An artificial windlass mechanism can be created by commencing on the great toe, using great toe extension to tension the tape thereby providing a longitudinal force to resist lengthening of the foot. Preliminary research suggests a shortening of the foot and raising of the arch in the magnitude of approximately 5mm can be obtained when assessing static foot posture.

Figure 1
Indirect Technique - Arch support technique decelerates navicular drop and assists re-supination of the foot.

The foot can however still move through full range of motion allowing it to accommodate to the supporting surface and to assist in dissipating ground reaction forces. In order to do this the foot must move through the resistance of the tape which is therefore well positioned to decelerate the navicular drop and to absorb load.

Figure 2
Direct Technique for Achilles Tendon - Longitudinal strip includes a 2″ PowerBand™ (2 x 2″ Dynamic Tape strips laminated together before application) and an additional 3″ cover strip to provide additional load absorption and to anchor the PowerBand™ on all sides. The transverse strip through the midfoot is applied to lift the navicular and provide a deceleration force to navicular drop. The achilles strip acts to provide more resistance into dorsiflexion and assistance into plantarflexion as well as creating a soft tissue offloading effect similar to a traditional 'box' offload technique.

Figure 2. shows a direct technique aimed at reducing the load through the calf/achilles tendon/plantar fascia unit. The tape is applied with the foot in plantar flexion and the knee in flexion. As the foot and ankle move into dorsiflexion, the tape stretches, providing a direct, deceleration force to reduce the eccentric demand on the calf/achilles tendon unit. As plantar flexion commences, the stored energy is re-injected to assist the transition into the concentric phase.

More load absorption can be achieved by the application of a PowerBand™. A PowerBand™ is made by laminating two or more layers of Dynamic Tape together before it is applied to the body. This binds the tape together and provides stronger resistance with excellent recoil and recovery properties. The decision to use a PowerBand™ is based on the size of the athlete, the stage of pathology and the demands that will be placed on the target tissues.

Although this is considered a direct technique as the tape acts to mimic the function of the calf/ achilles unit by decelerating dorsiflexion and assisting plantar flexion, it also contributes indirectly as the lines of pull will act to shorten the foot, raise the arch, decelerate the navicular drop and augment force closure to assist in providing a stable lever as re-supination occurs.

Direct techniques may be able to assist function in those with overly compliant tendons as seen in degenerative tendinopathies. In these cases the tendon loses its intrinsic energy storage and release capacity[10]. The Dynamic Tape can artificially provide this and athletes will often report a 'spring' in their step or 'zip' in their throw. Elongation of overly compliant tendons is also load dependent as is the associated pain[8]. Reducing load, particularly during cyclical loading may help to reduce elongation of these tendons and thereby maintain better force transfer and a more mechanically efficient system. This and many other effects are beyond the scope of this article but the reader is referred to the eLearning programme at www.dynamictape.com for a more thorough explanation.

Dynamic Taping is a mechanical approach which utilizes the 'spring like' load absorption and viscoelastic properties of this unique tape to manage the loading profile of weak, injured, overloaded or inhibited tissues. The clinical reasoning process will identify the aim of treatment and allow the development of a technique capable of addressing the specific needs of each individual client. In can therefore be incorporated into many management approaches to complement manual or exercise based therapies.

For more information visit www.dynamictape.com or www.facebook.com/dynamictape.

References

1. Rathleff MS, Kelly LA, Christensen FB, Simonsen OH, Kaalund S, Laessoe U. Dynamic midfoot kinematics in subjects with medial tibial stress syndrome. J Am Podiatr Med Assoc. 2012 May-Jun;102(3):205-12.

2. Nakagawa TH, Serrão FV, Maciel CD, Powers CM. Hip and Knee Kinematics are Associated with Pain and Self-reported Functional Status in Males and Females with Patellofemoral Pain. Int J Sports Med. 2013 Jun 14. [Epub ahead of print]

3. Souza RB, Arya S, Pollard CD, Salem G, Kulig K.Patellar tendinopathy alters the distribution of lower extremity net joint moments during hopping.J Appl Biomech. 2010 Aug;26(3):249-55.

4. Di Stasi SL, Logerstedt D, Gardinier ES, Snyder-Mackler L. Gait patterns differ between ACL- reconstructed athletes who pass return-to-sport criteria and those who fail. Am J Sports Med. 2013 Jun;41(6):1310-8

5. Cowley E, Marsden J. The effects of prolonged running on foot posture: a repeated measures study of half marathon runners using the foot posture index and navicular height. J Foot Ankle Res. 2013 May 24;6(1):20.

6. Opar DA, Williams MD, Shield AJ. Hamstring strain injuries: factors that lead to injury and re- injury. Sports Med. 2012 Mar 1;42(3):209-26.

7. Franettovich M, Chapman AR, Blanch P, and Vicenzino B. Augmented low-Dye tape alters foot mobility and neuromotor control of gait in individuals with and without exercise related leg pain. J Foot Ankle Res. 2010; 3: 5.

8. Cook JL and Purdham CR. Is Tendinopathy a continuu: A pathology model to explain the clinical presentation of load-induced tendinopathy.Br. J. Sports Med. 2009;43;409-416

9. Ryan M, Grau S, Krauss I, Maiwald C, Taunton J, Horstmann T. Kinematic analysis of runners with achilles mid-portion tendinopathy. Foot Ankle Int. 2009 Dec;30(12):1190-5.

10. Arya S, Kulig K. Tendinopathy alters mechanical and material properties of the Achilles tendon.
J Appl Physiol. 2010 Mar;108(3):670-5.