feature

The Weak Link

Determining the cause of an injury or performance deficit with the kinetic chain concept

These hockey players are shown performing a two-foot squat, the one on the right with good success and the one on the left not so much so. This movement screen assesses the mobility and stability of the entire body. (Thighs should be parallel to the floor and the tibia should be parallel to the torso.)

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The kinetic chain, sometimes referred to as the myofascial chain, is a concept that has existed for many years, as evidenced in older versions of anatomy textbooks. Currently, the term has gained considerable notoriety through the works of Wolf, Vleeming, Snijders and Mooney, and the concept has earned further popularity through its incorporation into various soft tissue technique strategies.

Basically, it can be thought of as the antithesis to the dogmatic perspective that muscles possess purely osseous origins and insertions. Instead, this concept considers the possibility of muscles blending into each other via fascial connections, forming a continuous myofascial sling spanning multiple articulations. Direct proximity and similar fibre orientation are considered prerequisites, the latter only possible in a dynamic state or in certain instances (i.e., pectoralis major and biceps brachii with the arm abducted to 160°, such as when hanging from an overhead bar).

A thorough knowledge of functional anatomy and biomechanics allows the practitioner to treat muscular and articular dysfunctions in sequence or as links in the myofascial chain. Specifically, the kinetic chain is most often described as starting from the iliotibial band (ITB), which has a tenuous origin between the gluteus maximus and tensor fasciae latae (TFL). The structure of the ITB causes it to come under tension not only when the gluteus maximus or TFL contract, but also when the vastus lateralis expands radially. These muscular interactions are prominent in the stance phase of gait. As the ITB travels distally, it is typically described as having three major insertions (lateral patella, head of the fibula, and Gerdy's tubercle), although it is most robust at Gerdy's tubercle where it meets the tibialis anterior.

The chain continues with tibialis anterior traversing under the first metatarsal, where

it meets the peroneus longus, which is crucial to gait. The peroneus longus shifts weight medially, locks the cuboid (helping to complete supination), and plantarflexes the first metatarsal-phalangeal joint.

The chain follows peroneus longus proximally to the fibular head where it then blends into the biceps femoris muscle of the hamstring group. Biceps femoris is then followed up to its attachment at the ischial tubersoity where it joins the sacrotuberous ligament. To no surprise, studies have shown that more tension in the biceps femoris results in increased tension in the sacrotuberous ligament.

Dr. Scott Howitt works with a college baseball pitcher to restore appropriate external rotation, keeping in mind that the kinetic chain ends with the latissimus dorsi muscle, which is an internal rotator and adductor.

The sacrotuberous ligament then becomes confluent with the dorsal sacroiliac ligament (DSIL) at the sacroiliac (SI) joint. The DSIL then has further attachments to the gluteus maximus, the erector spinae muscles and the mutifidus at the ipsilateral spine facets. DSIL is also part of the deep lamina of the thoracolumbar fascia, which is confluent with the superficial layer in the lower lumbar and sacral areas of the spine.

The superficial and deep layers of the thoracolumbar fascia become confluent, so the DSIL blends in with this former layer. Interestingly, the nature of this superficial layer is such that it crosses the midline of the body at L3-L4, continuing the chain on the contralateral side, thereby linking contralateral limbs.

The thoracolumbar fascia connects with the latissimus dorsi of the contralateral arm from which this chain began, and finally the latissimus dorsi inserts onto the intertubercular groove of the humerus, thus ending the myofascial chain.

CLINICALLY CONSIDERED SLINGS

Other clinically considered slings include the functional front and functional back lines as described in Myers' text Anatomy Trains. The functional front line begins with the distal attachment of the pectoralis major from the intertubercular groove to the fourth and fifth ribs where it meets the external oblique and rectus abdominus. This line extends inferiorly to the pubic bone where fibres continue to the pubic symphysis and cross over to join with the adductor longus tendon on the contralateral side. The adductor longus meets the short head of the biceps femoris at the linea aspera, ending this line.

The functional back line also begins at the intertubercular groove with the latissimus dorsi crossing the midline as it blends into the thoracolumbar fascia. Amongst numerous aforementioned connections, this fascia has continuity with the gluteus maximus. The gluteus maximus inserts on the lateral aspect of the femur where it meets the vastus lateralis. The vastus lateralis then links the patella with the tibial tuberosity via the patellar tendon, marking the end of this line.

PRACTICAL RELEVANCE

The practical relevance of the kinetic chain is that dysfunction in one muscle or joint along the myofascial chain or sling may actually manifest itself in any other linked muscle or joint. This approach necessitates the examination of each structure in the chain in order to correctly and thoroughly ascertain the origin of the pain or dysfunction.

After a needs assessment, a practitioner should determine which fascial chain the patient utilizes in their particular sport or recreational activities. To completely treat sports injuries and/or improve sports performance, the assessment of any athlete should incorporate an analysis of tension within the kinetic chain and functional lines. Identification of the pathological structures may be accomplished through observation of key movement patterns such as hip extension and abduction (muscle imbalance in motion), orthopedic testing such as the Thomas test and active straight leg raise (increased tissue stress), movement screens such as a squat or arm abduction (movement capabilities), and perhaps a sport-specific analysis (gait, swing, etc.).

Correction of a dysfunction or "weak link" within the chain generally begins by first stretching and then strengthening of the aberrent tissue. Stretches should always precede the strengthening exercises so that length and tension in the kinetic chain are maximized, allowing the patient to create optimal motor patterns. Addressing joint stability and proximal strengthening is the beginning point for therapeutic interventions designed to create a solid or stable platform on which distal strength can be built. It is nearly impossible to achieve maximal efficiency and co-ordination in an extremity during active movements if stability is lacking in the core (lumbar-sacral spine, scapular-thoracic spine, and/or cervical spine). Conversely, faulty biomechanics and pathology in the extremities may be compensating for spinal dysfunctions.

Practitioners who fully understand the myofascial chain can help their patients' muscles and joints perform better and with greater efficiency, thereby preventing, minimizing or correcting injuries. More than treating resultant pain or lack of function that originally brings a patient into your office, practising from a kinetic chain perspective adds insight into the cause of an injury or performance deficit. The root of the problem is brought into focus.•