Factors for the development of trigger points

Introduction

The primary mean of locomotion which enables human and other animals to move on their foot is running. There are some regular points the gait cycle during which both the feet are not on the ground in running. Running has a" flight" phase during which neither limb is in ground contact.

Running gait can be divided into two phases in context to the lower extremity which is absorption, propulsion, initial swing and terminal swing.

As per electromyographic data suggests: – as speed increases, ilio-psoas, gluteus maximus, gluteus medius, hamstring and rectus femoris all developed larger peak forces throughout the stride cycle. The peak force exerted by gastrocnemius increases as speed increased from 3. 5 to 7m/sec but showed no significant changes thereafter. The peak force exerted by soleus also increased from 3. 5 to7m/sec, but furthermore t decreases till 9m/sec. soleus, gastrocnemius and vastus provides approximately 75% of the total vertical support impulse needs to accelerate where soleus alone contributes 50% of all. The vertical ground reaction force increases for speeds up to 7 m/sec is almost entirely of soleus whereas vastus to the vertical ground reaction force does not affect with increase in running speed. The rate of ankle plantar flexors shortening increases with the running speed and solus and gastrocnemius contracts at37% and 23% of their maximum shortening velocities respectively. as a result, only 30 and 40% of their peak

potentially developed by soleus and gastrocnemius respectively during sprinting. inspite of producing significant and large amount of forces

whetreas they did not contribute in knee-hip joint accelerations during swing phase.

if we compare sprinters with non sprinters; the previous one has greater thickness with longer fascicles of their gastrocnemius and vastus lateralis muscles on ultrasound imaging, than later one.(abe et al., 2001)

The plantar flexion moment arms were 25% smaller of sprinters than those of non-sprinters and this difference was highly significant. garth and miller examined 17 athletes who presented for treatment of incapacitating pain and soreness located posteromedially along the middle two thirds of the Symptoms were aggravated by repetitive wt. bearing which was referred to as shin splints. Due to excessively pronation caused by hyper mobile midfoot flexible pes valgus, muscular imbalance etc, the flexor digitorumlongus and flexor hallucislongus can become overloaded and vulnerable to develop trigger points in these muscles.

The lateral compartment syndrome is likely to develop in runners with excessive pronation and abnormally mobile subtalar joints can also be overloaded in high arched supinated foot with triceps surae weakness as well as can be suggestive of peroneus longus and brevis trigger points.

Myofascial trigger points:-Travell and Simons defined it as “ a hyperirritable contraction knot usually present within muscles or its fascia which produces pain on compression and can give rise to specific referred pain , motor dysfunction , and autonomic phenomena in a specified referred zone which rarely coincides entirely with dermatomal segment.

Trigger points are manually palpated with following characteristics including local twitch response, jump in sign, referred pain zones and autonomic phenomenal changes.

As suggested by Travell and simons in 1999 in their trigger point manual book, the etiology of trigger points involves all three factors that includes biomechanical, CNS, and local myofascial tissues.

As per microscopic and biopsy studies, which has been done of local myofascial tissue where there is presence of trigger points revealed and explained these contraction knots as round, large and, darkly staining fibers. presence of these knots causes significant increases in average

diameter of muscles.

spontaneous electrical activity (SEA) in TrPs have also seen and studied through electromyographic studies while adjacent muscle tissues were electrically silent which suggested and implicated neuromuscular junction and motor end plates interchangeable, nevertheless the motor end plates describes structure and the neuromuscular junction reflects function.

Gunn and Milbrandt in 1977 was first explicated and find correlation between motor end plates and trigger points also known as myalgic spots .

As stated by Travell and Simons in context to motor end plate dysfunction that due to excessively release of Ach from presynaptic nerve terminal leads to rapid activation of the nicotinic Ach receptors on the post synaptic terminal which results in muscle action potential and muscle contraction. Since this hypothesis of travell and simons was one way to interpret EMG

results but EMG for post synaptic fibers , there is increase in SEA in trigger points that could be a characteristics to the result of presynaptic, synaptic or post synaptic dysfunction and can be inherited or acquired.

As a general rule, factors for the development of trigger points includes muscle overuse or direct/ indirect trauma which may be the results of sustained low level or repetitive muscle contractions, eccentric/concentric, submaximal/maximal muscle contractions.

Although muscular damage is not necessary all the time for development of trigger points there may be injuries at the microlevel which includes damage of cell membrane , sarcoplasmic

reticulum with release of high amounts of ca2+ ions, and disruption of proteins like desmin, titin or dystrophin. Mechanical muscle contractions exceeding respective muscles capacity is defined as overuse. as we know that arterial capillary beds blood pressures approx 35mm hg at the beginning and venous capillary beds pressure at the end is 15mm Hg which used to be obstructed during muscle contractions and recovers with relaxation; known as muscular pump. However, Muscular metabolism is maintained by oxygen and glucose which faces crisis during sustained muscle contractions. Even contractions performed at only 10 % and 25 % of maximum voluntary contraction (MVC) may alter and produce impairment in blood circulation of muscles,

As per Otten ; pain and trigger points may be developed by increased or alterations in the pressure gradients during low level exertions(personal communications 2005).

During submaximal concentric contractions, ATP is utilized for 4-6 seconds initially from muscle’s storage and subsequentally it shifts to direct phosphorylation of ADP through creatinine phosphate. Stored ATP and CP provides enough energy and power for approx

14-16 sec but thereafter physiologically a short span of rest is needed to replenish the exhausted reserves of intracellular ATP and CP.

As a general rule if ATP demands are within the capacity of the aerobic pathway muscles can continue its activities for hours but as demand exceeds; anaerobic glycolysis will start contributing of the total generated ATP. This further leads to crisis of ATP and sustained sarcomere contractions starts the progression of trigger points.

The Eccentric contractions are commonly used to control the rate of movement in our body.

although there is no solid correlations between eccentric loading and development of trigger points.

Itoh et al found in their study in which middle finger extensor muscle was being eccentrically loaded. After 3 sets of exercise , one day and two days after exercises , findings were similar encapsulating tender taut bands which were painful on compression; suggests that eccentric loading may be correlated with development of trigger points.

There are biopsy studies also who confirms and suggest the role of eccentric contractions in disruption of cytoskeletal structures especially desmin , and titin (largest in our body); a protein which interconnects the adjacent

myofibrils and connects myosin filaments to the z-bands with a linkage to actin filaments ; respectively. Prolonged ecentric exercises enlarge the muscle fibers microscopically and all these enlarged fibers are exclusively fast glycolytic type(typeII) which considered as highly fatiguable and unable to regenerate ATP in early exercise period

It results a high stiffness state of fibers which on stretch disrupts leading to cytoskeletal and myofibrillar damage.

Apart from this in eccentric exercised muscles there is increase concentration of calcium due to sarcoplasmic reticulum disruption that keep actin and myosin molecules together an activates several mechanisms which may further damage cell membrane and cytoskeletal disruption and again the same results that is development of trigger points.

Jump in sign is an response to pressure applied on a trigger point which may leads to wincing, crying, or withdrawing by patients.

Local twitch response is a fleeting response or contraction of tense muscle fibers or group that traverse a trigger point on response to stimulation via snapping palpation or needling of trigger point or its surrounding area.

Referred autonomic phenomena: vasoconstriction (blanching), coldness sweating, pilomotor response, ptosis, and/or, hyper secretion that occur in a same region or area where trigger points refers pain and its sensations.

Referred pain zones: an area of pain which is entirely remote from its source. Generally in case of trigger points , specifically activated and central trigger

points and sporadically infrequently, conjoin entirely with the peripheral nerve distribution or dermatomal segments.

The lower extremity functional scale (LEFS) is a functional status questionnaire that aims to investigate the degree of difficulty a patient experiences in performing everyday tasks, due to disorders of his/her lower extremity. The LEFS consists of twenty items, each of which is scored on a 5-point scale (0 to 4) (appendix 1).

Beck depression inventory-ii is a depression measurement scale or an instrument to measure the emotional, motivational, somatic and cognitive symptoms observed in patients. this scale consist of 21 questions which is symptom related to quantify degree of depression in subjects usually it covers adolescents and adults and given in appendix 2.

VAS is a psychometric response scale and a measurement instrument for subjective characteristics or attitudes that cannot be directly measured. Respondents specify their level of agreement to a statement by indicating a position along a continuous line between two end-points.

Pressure algometer is force gauze with a rubber disk of 1 cm surface which is very helpful in clinical setup for diagnosing trigger points , fibrositis, myalgic spots as well as it helps in quantification of pressure pain threshold and Pressure pain threshold for measurement of normal and abnormal surfaces are given in appendix 3.