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THE RELATIONSHIP BETWEEN LATENT MYOFASCIAL TRIGGER POINT AND RANGE OF MOTION OF KNEE FLEXOR AND EXTENSOR MUSCLES

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Abstract

The study purpose was to assess the relationship between Latent Myofascial Trigger Point and range of motion in the lower limb of athletes. A lower Pain pressure threshold (< 25 lbs/cm^2) in muscles indicates the presence of a latent myofascial trigger point.

Materials and methods. Initially, the study involved 46 male Athletes (aged 20-23 years) as participants. The pain pressure threshold was measured by the pressure algometer (FPX 25 Wagner Instruments, Greenwich, CT, USA) to detect latent myofascial trigger points on the hamstring and quadriceps muscles. Out of 46 participants, 23 tested positive with a latent myofascial trigger point, and rest of them tested negative with a latent myofascial trigger point. All the participants measured knee flexor and extensor range of motion with the Kinovea software (version 0.9.5). In descriptive statistics, mean and standard deviation were used, and Pearson correlation was used to determine the relationship between the variables. The level of significance was set at 0.05.

Results. A significant correlation was found between Latent Myofascial Trigger Points and lower limb range of motion ($p < 0.05$), and it was also observed that the magnitude of correlation coefficient was very large (0.7–0.9).

Conclusions. Latent Myofascial Trigger Points impair sports performance by decreasing the range of motion of knee flexors and extensors. In light of this, Latent Myofascial Trigger Point should be considered a serious musculoskeletal disorder, and appropriate preventative measures should be taken by health professionals.

Keywords: Latent Myofascial Trigger point, Range of Motion, Flexibility, Pain Pressure Threshold.

Introduction

Myofascial pain syndrome (MPS) is one of the most common musculoskeletal disorders (Das & Jhajharia, 2022b), it is defined as a regional pain syndrome and characterized by myofascial trigger points (MTrPs). According to current research studies, MTrP is a hyperirritable spot, usually, in muscle fascia or in a taut band of skeletal muscle, which feels uncomfortable when compressed and can cause referred pain. It has been reported that biochemical changes occur within these points such as increased concentration of bradykinin, substance P, and tumor necrosis factor alpha which may in turn increase of stiffness within the taut band or trigger point (TrP) (Öztürk et al., 2022). There is an assortment of hypothesized causes for MTrPs, including trauma and overuse, joint dysfunction, and psychological factors such as stress. Recent research suggests the pathophysiology of MPS and sequelae of MTrPs begins with excessive stress or injury to muscle fibers. This results in a diminished amount of nutrients and available oxygen, which in turn leads to protective and involuntary muscle shortening, and finally, an increase in tissue metabolic demands. Adaptive lengthening and eccentric muscle strain are also potential sources of myofascial pain (Charles et al., 2019). Clinically, MTrPs are classified as active and latent MTrPs (Das & Jhajharia, 2022a). Latent MTrPs (L-MTrPs) do not cause pain (Cygańska et al., 2022), various authors stated in their article that L-MTrPs possible to experience limitations in

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range of motion (ROM) or deficiency in mobility (Charles et al., 2019; Öztürk et al., 2022; Walsh et al., 2019). In the field of sports and exercise, it is found that musculoskeletal injuries are the most common (Lee et al., 2020). Myofascial pain affects 37% of men and 65% of women, according to research (Xia et al., 2017), hence, MPS should be considered as a potential source of musculoskeletal pain (Wilke et al., 2018). From the research evidence, it is confirmed that athletes may develop MTrPs during their life (Kisilewicz et al., 2018). And also affect the potential performance of the athletes and may result in a damage to the muscle or muscle groups (Öztürk et al., 2022). Therefore, reduction of flexibility could be found in athletes. The American College of Sports Medicine has classified flexibility as a major component of physical fitness because it determines the maximum ROM of joints without causing injury (Nuzzo, 2020). Research evidence suggest that flexibility is a key factor in sports for performing, such as sprinting, jumping, agility and balance. It have been observed that physical and technical performance in sports (sprinting, jumping, agility, and balance) decreases when the technical movement is limited by muscle tightness or non-optimal ROM (Cejudo, 2021; Cejudo et al., 2020; Charles et al., 2019). During the swing phase of sprinting and the take-off phase of jumping, the knee joint extensor torque is a major determinant of rapid knee extension. Moreover, the knee extensor torque accelerates the body's centre of mass horizontally during sprinting and vertically during jumping and maintaining the height of the centre of mass during the stance phase while sprinting. On the other hand, knee joint flexors are important for joint stabilization. Therefore, knee joint extensors and flexors are one of the most important muscle groups for sprinting and vertical jumping performance (Diker et al., 2022). This knee flexion and extension movement are done by the help of hamstring and quadriceps muscles groups. Hamstrings muscle tightness is one of the major problems that can limit the movement of the knee and make it susceptible to injuries (Osailan et al., 2021) and quadriceps limited knee flexion ROM (Cejudo et al., 2020). Therefore, it is most important factor to identify whether L-MTrPs are the primary sources of reduction of ROM or not. Through the literature review it is found that there are no studies are available on athletes in hamstring and quadriceps muscles group. The relationship between MTrPs and ROM in the upper trapezius (Girasol et al., 2018) and gastrocnemius (Benito-de-Pedro et al., 2020) has been established. Most of the studies were done on sedentary population. Therefore, the purpose of this study to find out the relationship between L-MTrPs and ROM of knee flexor and extensor muscles.

Materials and methods

Study participant

This study included 46 national level players from Madhya Pradesh, India. G-power software was used to calculate sample size (Cordeiro et al., 2021) (Version 3.1.9.7), following were the criteria to consider for sample size determination: A 2-tailed hypothesis with 0.4 (Large effect), an error probability (1-β) of 0.80 and an α error probability of 0.05 provided an estimated sample size of 46 participants. For the equality of the sample size 23 L-MTrPs and 23 non-MTrPs subjects were selected on the basis of tested PPT of quadricep muscle group (Vastus lateralis, Rectus femoris, Vastus Medialis), and hamstring muscle group (Bicep femoris, semitendinosus, semimembranosus). Characteristics of the subjects were given in the table 1. Informed written consent was obtained by all athletes. Ethical approval was attained from the institutional ethics committee. The study was conducted at the Exercise Physiology laboratory of Lakshmibai National Institute of Physical Education, Gwalior, India.

L-MTrPs were diagnosed using the following criteria recommended by Simons et al: (I) muscles with a palpable taut band; (II) tenderness in an area that is hypersensitive; (III) In response to compression of the MTrP, referred pain is reproduced; (IV) jump sign (Zuil-Escobar et al., 2015). There was a difference in pressure pain threshold (PPT) of more than 4 lbs/cm^2 between the identical muscles on the opposite side, indicating MTrPs (Park et al., 2011). The L-MTrPs group was selected based on the following criteria: (I) Presence of L-MTrPs in the lower limbs (hamstring and quadriceps muscle groups). (II) Athletes were also required to be male (In sports requiring jumps, sprints, twists, turns, acceleration and deceleration, it is determined by these factors), those who participated in competitive sports (Participants in an official league or cup that participates in an organized training or match situation at least twice a week.). (III) Each of the subjects was a collegiate athlete who was in competition phase for their sport. (IV) PPT < 25 lbs/cm^2 (Cordeiro et al., 2021). Non-L-MTrPs were included based on the following criteria: (I) there are no palpable taut bands in the muscles. (II) PPT > 25 lbs/cm^2. Exclusion criteria: In addition to current injuries or illnesses, subjects who had sustained a lower limb or lower back injury within the previous three months were excluded from the study. Subjects with recent fibromyalgia diagnosis or treatment, vascular or neurological conditions, or MTrP (active or latent) treatment were excluded from the study. All subjects who met the criteria were informed about the study. In the first group, 23 subjects were purposively included who were tested positive for L-MTrPs.

Table 1 General characteristics of the subjects (N = 46)

Parameter	L-MTrPs (N=23)	Non-MTrPs (N=23)
Subject characteristics	Mean ± SD	Mean ± SD
Age (Years)	20.57±2.13	20.45±2.18
Height (Centimetre)	160.10±5.91	160.00±5.66
Weight (Kilogram)	52.40±5.16	59.80±5.81

Instruments

Pressure algometer (FPX 25 Wagner Instruments, Greenwich, CT, USA) was use for the evaluation of PPT, based on Cygańska et al., report, this device appears to be reliable et al. 0.90 (Cygańska et al., 2022) and Castien et al. also found that pressure algometer is reliable instrument for research (Castien et al., 2021). The software Kinovea® version 0.9.5 (downloadable free at https://www.kinovea.org/) used to measure the ROM, according to the group of researchers Kinovea is a valid and reliable tool that is able to measure accurately at distances up to 5 m from the object (Fernández-González et al., 2020; Puig-Diví et al., 2019).

Trigger Point Examination: Pressure algometer was used for the pain test by FPX 25 Algometer (Wagner Instruments, Greenwich, CT, USA). In this study, the pain threshold was defined in pounds/cm^2 and constant pressure was applied. A pressure threshold at which pressure sensations become painful is defined as the PPT (Ortega-Santiago et al., 2020). We determined the pain thresholds of selected muscle groups and the locations of the MTrPs, according to Cygańska AK et.al (Cygańska et al., 2022). A prone position was used to measure hamstrings and a supine position was used to measure quadriceps. The device should be applied at an angle of 90 degrees to the surface of the skin (Fig. 1), always starting from the right-side of the body. In response to experiencing the first distinct sensation of pain, subjects were instructed to say "STOP". Before measuring the actual points, the subject underwent a trial measurement of his forearm muscles. During each measurement, the same researcher read the results. Two measurements were separated by a five-minute interval. The subjects who met the L-MTrPs criteria were placed into group 1 (L-MTrPs Group). Those subjects whose L-MTrPs profile did not match the criteria were assigned to group 2 (Non-MTrPs Group). Muscle tests were conducted in the following order for each subject; Right and left quadricep muscle group (Vastus lateralis, Rectus femoris, Vastus Medialis), followed by right and left hamstring (Bicep femoris, semitendinosus, semimembranosus). The measurements were conducted one by one under the supervision of an expert physical therapist (10 years of experience). Each measure was separated by a 30-second rest and the mean of three trials was calculated. It has been shown that this method of evaluating PPT exhibits high inter- and intra-examiner reliability (Chesterton et al., 2007; Das & Jhajharia, 2022b).

Fig. 1. Evaluation of Latent Myofascial Trigger Point

ROM Examination: Each participant's video was recorded using a GoPro 9 action camera. The footage was taken from the sagittal plane and the frontal axis profile of the knee joint. Passive and reflective markers were positioned in certain anatomical regions of the lower limbs, such as the greater trochanter, external femoral condyle, and lateral malleolus, to quantify the lateral view angular displacement of the knee joint (eSilva et al., 2018; Fernández-González et al., 2020). The tripod-mounted camera was positioned 80 cm high and 1.5 metres distant from the participants. The tripod was positioned on taped marks on the floor to keep the same distance between the camera and the participants. Each individual completed a prescribed warm-up exercise that lasted 5 minutes prior to the test. The knee of each subject was positioned near the edge of the table while they lay prone on a table (Fig. 2). The individual was instructed to bend their knee as much as possible before extending it to determine the angle of knee extension and flexion. All videos were imported into a laptop and analysed using Kinovea software. In kinovea, three markers were positioned in the greater trochanter, external femoral condyle, and lateral malleolus. Additionally, an angle was positioned in the external femoral condyle. Two lines were also placed: one through the humerus bone and ending at the greater trochanter (stationary arm); the other through the tibia bone and ending at the lateral malleolus (movable arm). The junction of the two lines' angle was expressed in degrees.

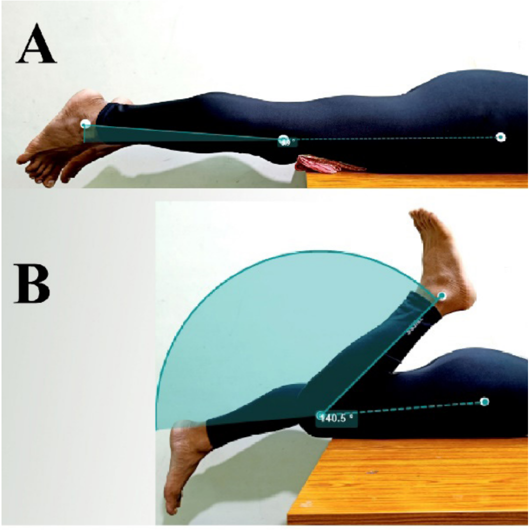

Fig. 2. Evaluation of Knee Range of Motion (A) Extension (B) Flexion

Statistical analysis

We conducted statistical analysis using IBM SPSS (version 26.0.0) data analysis software. Mean and standard deviation (SD) were used in descriptive statistics. Since the data did not deviate from the normality assumptions as shown by the Shapiro-Wilk test for the parametric test, therefore, we applied parametric test Pearson correlation to determine the relationship between L-MTrPs and ROM. The degree of the correlation between test measures was understood as trivial (≤0.1), small (0.1–0.3), moderate (0.3–0.5), large (0.5–0.7), very large (0.7–0.9), and almost perfect (0.9–1.0) (Martín-Fuentes & van den Tillaar, 2022). The level of significance was set at $p \leq 0.05$.

Results

To reach the goals of the study, descriptive statistics were performed, mean, SD and mean difference were used to represent the data and independent sample T-test was use to compare the significant difference between groups of PPT and ROM (table 2). From it was found the PPT and ROM of L-MTrPs and non-MTrPs groups were differ significantly at the level of 0.05.

Table 2. Descriptive statistics of PPT and ROM and Independent Samples T-Test of between L-MTrPs and Non-MTrPs Group.

			R.H	R.Q	L.H	L.Q
L-MTrPs	ROM	M±SD	134.11±0.87	2.72±1.28	134.49±1.12	3.56±1.07
N-MTrPs			139.05±0.88	0.96±0.52	138.23±1.18	0.90±0.48
	Mean Diff.		4.93	1.76	3.74	2.66
	Sig.		0.00	0.00	0.00	0.00
L-MTrPs	PPT	M±SD	17.71 ± 2.26	18.76 ± 1.81	19.05 ± 2.33	17.27 ± 2.74
N-MTrPs			27.16 ±1.16	27.09 ± 1.94	27.45 ± 1.57	27.23 ± 1.16
	Mean Diff.		9.45	8.32	8.40	9.95
	Sig.		0.00	0.00	0.00	0.00

H-Hamstring; Q-Quadricep; F-Flexion; E-Extension; R-Right; L-Left; M – Mean; SD – Standard Deviation; Mean Diff. – mean Difference

Table 3. Descriptive statistics and Pearson Correlation between PPT and ROM

	Descriptive Statistics		Correlation		
	Mean	SD			R. F (ROM)
R. H (PPT)	22.44	5.22	R.H (PPT)	Pearson Correlation	0.939**
				Sig. (2-tailed)	0.00
R.F (ROM)	136.58	2.70			
					R.E(ROM)
R. Q (PPT)	22.92	4.48	R.Q (PPT)	Pearson Correlation	-0.923**
				Sig. (2-tailed)	0.00
R. E(ROM)	2.23	1.58			
					L.F (ROM)
L.H (PPT)	23.25	4.71	L. H (PPT)	Pearson Correlation	0.866**
				Sig. (2-tailed)	0.00
L.F(ROM)	136.36	2.22			
					L. E(ROM)
L. Q (PPT)	22.25	5.48	L. Q (PPT)	Pearson Correlation	-0.580**
				Sig. (2-tailed)	0.00
L. E (ROM)	1.84	1.31			

**Correlation is significant at the 0.01 level (2-tailed)

In table 3 it was found that there was significant correlation between PPT and ROM at the level of 0.05. This result indicates that L-MTrPs in quadriceps muscles affect the extension ROM and L-MTrPs in hamstring muscles affect the flexion ROM significantly. And also observed that the magnitude of correlation coefficient was very large (0.7–0.9), because correlation coefficient between right hamstring PPT & right leg flexion ROM correlation coefficient was 0.939 (p-0.00), Right Quadriceps PPT & right extension ROM correlation coefficient was -0.923 (p=0.00), and left hamstring PPT & left flexion ROM correlation coefficient was 0.866 (p=0.00), and left Quadriceps PPT & left extension ROM correlation coefficient was -0.580 (p=0.00).

Discussion

The aim of this study to investigate the correlation between L-MTrPs and ROM in the lower limbs on athletes. In this study, it was confirmed that athletes also develop MTrPs, and that has been confirmed by previous studies as well (Benito-de-Pedro et al., 2019; Das et al., 2022; Kisilewicz et al., 2018). The independent samples T-test (table 2) shows that there was a significant difference between PPT in with L-MTrPs and non-MTrPs group, research evidence stated that lower PPT(<25 lbs), and more than 4 lbs/cm^2 as compared to the identical muscles in the opposite side indicate presence of L-MTrPs. After the evaluation of L-MTrPs, we investigate the ROM of knee flexor and extensor muscles, from the mean values it was observed that L-MTrPs group have lower flexion ROM than non-MTrPs group, that indicate the presence of L-MTrPs reduces the ROM of knee flexor muscles. Same findings observed in knee extensor muscle group, in this present study 0° angle consider as the best extension angle of knee, greater than 0° angle indicate lower in ROM. From mean value of knee extension, it was observed L-MTrPs group has higher angular value as compared with non-MTrPs group. Therefore, it was confirmed that the presence of L-MTrPs reduce the ROM of particular joint, and also reduce the PPT. After the implementation independent samples T-test it was found that the values of PPT and ROM are significantly differ from the L-MTrPs and non-MTrPs groups as the p-value is less than 0.05 (<0.05), and the Pearson correlation was use to check the relationship between L-MTrPs and ROM. The result suggest that L-MTrPs are significantly correlated with the ROM. In the hamstring muscles group, L-MTrPs and flexion ROM were positively correlated, which indicates that lower PPT decreases knee flexion ROM while higher PPT increases ROM. L-MTrPs in quadricep muscles decreased knee extension as well. Similarly, we found that L-MTrPs and extension were significantly correlated with each other (table 3). These finding were also supported by the existing literature, as few studies have been conducted on MTrPs on upper trapezius, which were publicized to reduce cervical ROM (Agung et al., 2018; Park et al., 2018; Toghtamesh et al., 2021). According to research evidence lower PPT indicate low in muscles elasticity and high in muscles stiffness, reduction ROM and, the occurrence L-MTrPs (Grabowski et al., 2018). Literature shows that the stiffness in muscles had decreased strength, increased discomfort and muscular soreness, as a result enhance creatine kinase release. These events are related to changes in microscopic structure of muscles therefore, sarcomere mechanics get stiff and compliant muscles during eccentric movements. L-MTrP affects motor activation patterns and reciprocal inhibition mechanisms, resulting in joint movement limitations and overloading (Das et al., 2022). From the literature joint ROM has a strong influence on athlete performance. There is considerable evidence that increases in ROM enhance performance of general sports skills, such as jumping, sprinting, and changing directions (Pereira et al., 2021). Muscle injuries are more prone to happen in addition to having low ROM (Knapik et al., 2019). Therefore, Sports performance is negatively impacted by L-MTrPs, as determined by this investigation. As a result, L-MTrPs reduce an athlete's performance due to limited physical performance, sports scientist should focus on and conduct research on this aspect is absolutely necessary. Additionally, create a training programme to ensure appropriate L-MTrPs prevention.

Conclusion

In According to our analysis, there is a strong correlation between L-MTrPs and ROM of lower limb muscles. A pressure algometer was used to evaluate MTrPs, and lower PPT showed that L-MTrPs were present (25 lbs/cm^2). As a result of this article, it has been concluded that athletes also develop L-MTrPs, and that these L-MTrPs decrease ROM, which negatively affects sports performance. From this research article, sportspersons, physiotherapists, and sports therapists gain knowledge about L-MTrPs.

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Conflict Of Interests

The authors declares that there is no conflict of interests.

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ЗВ'ЯЗОК МІЖ ЛАТЕНТНОЮ МІОФАСЦІАЛЬНОЮ ТРИГЕРНОЮ ТОЧКОЮ ТА ДІАПАЗОНОМ РУХІВ М'ЯЗІВ-ЗГИНАЧІВ І РОЗГИНАЧІВ КОЛІННОГО СУГЛОБА

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 4 табл., 39 джерел.

Метою дослідження було оцінити взаємозв'язок між латентною міофасціальною тригерною точкою та діапазоном рухів у нижній кінцівці спортсменів. Нижчий поріг больового тиску (<25 фунтів/см^2) у м'язах вказує на наявність латентної міофасціальної тригерної точки.

Матеріали та методи. Спочатку в дослідженні брали участь 46 спортсменів чоловічої статі (віком 20-23 роки). Поріг больового тиску вимірювали алгометром тиску (модель FPX 25, виробник Вагнер Інструментс, Грінвіч, Конектикут, США) для виявлення латентних міофасціальних тригерних точок на підколінному сухожиллі та чотириголовому м'язі. Із 46 учасників 23 дали позитивний результат тесту з латентною міофасціальною тригерною точкою, а решта з них дали негативний результат із латентною міофасціальною тригерною точкою. Усі учасники вимірювали діапазон рухів згиначів і розгиначів колінного суглоба за допомогою програмного забезпечення Kinovea (версія 0.9.5). В описовій статистиці використовували середнє значення та стандартне відхилення, а для визначення зв'язку між змінними використовували кореляцію Пірсона. Рівень значущості був заданий показником 0,05.

Результати. Було виявлено статистично значущу кореляцію між латентними міофасціальними тригерними точками та діапазоном рухів нижніх кінцівок ($p <0,05$), а також спостерігалося, що величина коефіцієнта кореляції була дуже високою (0,7–0,9).

Висновки. Латентні міофасціальні тригерні точки погіршують спортивні результати, зменшуючи діапазон рухів згиначів і розгиначів коліна. У світлі цього латентну міофасціальну тригерну точку слід вважати серйозним розладом опорно-рухового апарату, і медичні працівники повинні вживати відповідних профілактичних заходів.

Ключові слова: латентна міофасціальна тригерна точка, діапазон руху, гнучкість, поріг больового тиску.

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