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RESEARCH ARTICLE

MYOFASCIAL TRIGGER POINTS DISTRIBUTION PATTERN IN PATIENTS POST TOTAL KNEE REPLACEMENT

[1,*]Enas Mohammed Atyia, [2]Samah Saad Zahran and [3]Mohamed Serag Eldein Mostafa

[1]Physical Therapist at General Faiyoum Hospital, Egypt
[2]Lecturer, Department of Musculoskeletal Disorders and their Surgery, Faculty of Physical Therapy, Cairo University, Egypt
[3]Associate Professor, Department of Physical Therapy for Basic Sciences, Faculty of Physical Therapy, Cairo University, Egypt

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ABSTRACT

Background: Knee pain is one of the major sources of pain and disability in developed countries and is the primary indication for total knee replacement (TKR) in patients with Osteoarthritis (OA).
Purpose: To assess myofascial trigger points (MTrPs) distribution pattern in muscles around the knee joint pre and post-treatment program in patients post TKR.
Design: pre - posttest experimental design.
Methods: Fifty female and male patients post TKR. Their age ranged from 50-80 years old. All patients were observed and assessed for the distribution of the MTrPs in muscles around the knee joint pre and post-treatment program. All 50 patients were randomized equally to 2 groups: group A (experimental) received myofascial release (MFR) and exercises and group B (control) received exercises only. Assessment was done by transparent grading sheet to locate MTrPs accurately during our assessment pre and post-treatment.
Results: There was a significant decrease in MTrPs numbers in group A post treatment compared with that pre-treatment ($p < 0.05$).
Conclusion: MFR is effective treatment for MTrPs in patients post TKR.

INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis, with symptomatic disease (pain) of the knee affecting 6% of all people older than 30 years of age, increasing to approximately 10% at 65 years of age, with further increases thereafter (Shah *et al.,* 2005). Knee pain is one of the major sources of pain and disability in developed countries, particularly in aging populations (Felson *et al.,* 1987), and is the primary indication (94%) for total knee replacement (TKR) in patients with OA (Arendt-Nielsen *et al.,* 2010). Symptoms arise in OA patients, not only from the joint but also from the surrounding soft tissues. It was demonstrated that patients with knee OA have a reduced muscle function and myofascial trigger points (MTrPs) develop all around, as in OA of other joints (ankle, hip, etc.). MTrPs are probably the main cause of pain in many joint diseases (Fisher and Pendergast, 1997). There are reports stating that many patients with spurs, lipping and joint space narrowing become pain free when their MTrPs are treated, indicating the role of musculoskeletal tissue in the pain associated with OA (Bajaj *et al.,* 2001). MTrPs are common in lower limb muscles in patients with knee OA (Bajaj *et al.,* 2001), and several papers have emphasized the importance of treating these MTrPs to relieve pain in knee OA (Bajaj *et al.,* 2001; Feinberg and Feinberg, 1998).

Corresponding author: **Enas Mohammed Atyia,**
Physical Therapist at General Faiyoum Hospital, Egypt.

As well as the prevalence of myofascial pain in all patients presenting with chronic pain is very high (ranging from 35% to 95%) (Fishbain *et al.,* 1986). Henry *et al.,* (2012) found that all the patients in their study had MTrPs in the vastus medialis obliquus and gastrocnemius muscles, and 92% of patients experienced significant pain relief with trigger point injections at the first visit, indicating that a significant proportion of the OA knee pain was myofascial in origin. It is suggested that the increased MTrPs and pain referral from MTrPs may be due to a persistent nociceptive input from the OA joints resulting in central sensitization and leading to an increased responsiveness of dorsal horn neurons processing input from the joint and possibly other tissues such as muscle (Bajaj *et al.,* 2001). TKR has shown to be an effective treatment for knee pain due to knee OA, providing patients with improvements in function and in quality of life with low complication rates (Grayson, and Decker, 2012). However, it has been reported that in the first month after surgery almost half of the patients have significant pain (>40 in visual analogue scale) (Brander *et al.,* 2003). Since a single treatment of MTrPs within the context of a TKR surgery has proven to be effective in pain reduction after the intervention, it could be conceivable that a more complete treatment program of MTrPs, either before or after the surgery, could be of major help to reduce pain in these patients. Research is needed to test this hypothesis (Mayoral *et al.,* 2013). Nearly ninety percent of patients receive excellent pain relief from symptoms caused by degenerative diseases of the knee with TKR. However, approximately 10 percent of patients complain of pain like or worse than initial pre-operative complaints (Dellon *et al.,* 1995). Some of the causes of persistent pain include mechanical malfunction of the arthroplasty, infection, sympathetically maintained pain syndromes, and post-operative nerve entrapment (Feinberg and Feinberg, 1998). Mayoral *et al.,* (2013) and Feinberg and Feinberg, (1998**)** found that myofascial pain contributes to the incidence of post-TKR pain when orthopedic causes of component dysfunction has been ruled out.

These myofascial pain syndromes, caused by muscular trigger points are amenable to treatment by trigger point injection (Feinberg and Feinberg, 1998) and by dry needling of the MTrPs (Mayoral *et al.,* 2013). Patients may experience persistent post-TKR pain from chronic postural and gait abnormalities resulting from degenerative diseases of the knee, as well as from surgical trauma or abnormal gait and muscle function following surgery (Feinberg and Feinberg, 1998).

MATERIALS AND METHODS

The study was conducted from September 2017 to August 2018. Fifty female and male patients post TKR, their age ranged from 50-80 years; the participants were selected from the physiotherapy outpatient clinic of EL-Sheikh Zayed Specialized Hospital. Before enrollment in the study, patients signed an informed consent. All 50 patients were randomized equally to 2 groups: group A (experimental) received myofascial release (MFR) and exercises and group B (control) received exercises only. The patients were enrolled based on the following inclusion and exclusion criteria:

Inclusion criteria

All patients had the following prior to participation in the study:

- Pain for at least one month after TKR not relieved by oral medications and/or conventional physical therapy techniques.
- Age between 50-80 years.
- Patients post TKR due to OA.
- Cemented TKR.
- Patients who undergone conventional cemented TKR through a medial parapatellar approach and a midline skin incision at least 1 month ago.
- Persistent pain despite conventional physical therapy techniques.

Exclusion criteria

- Any other surgical procedure of the lower limbs in the previous 6 months
- Rheumatoid arthritis
- Initiation of opioid analgesia or corticosteroid or analgesic injection intervention for hip or knee pain within the previous 30 days
- Physical impairments unrelated to the hip or knee preventing safe participation in exercise and/or manual therapy, such as body weight greater than 120 kg and neurogenic disorder.
- Orthopedic evaluation revealed no instability and/or mechanical dysfunction of the arthroplasty.
- Absence of infection.

Assessment procedures

The distribution of persistent MTrPs in all muscles around the knee joint pre and post-treatment program has been assessed using transparent grading sheet, the thigh was divided into 4 sides (anteromedial, anterolateral, posteromedial and posterolateral) and divided the leg into 2 sides (anterior, posterior). Then each side was divided into three thirds (upper, mid and lower) by using a digital ruler and according to the total length of each patient thigh and leg.

Trigger Point Examination

The sequence of sides and sites examined were randomized to minimize order effects. One physiotherapist assessed the MTrPs in the lower limbs. The criteria for the detection of MTrPs was based the presence of tenderness and 'jump sign' (Simons *et al.,* 1998; Travell and Simons, 1983.). All operated lower limbs were palpated for the presence of MTrPs by examining the local twitch reaction (LTR), taut bands, nodules, and the pattern of pain radiation and pain referral (Bajaj *et al.,* 2001). 'Flat palpation' and 'skin rolling' using a cross-fiber palpation method was used to examine the presence of taut bands, whereas, deep palpation along the length of the same muscle fibers was used to identify the presence of a nodule at the MTrPs. A (LTR) was seen and/or felt as a contraction of the fibers in the taut band lasting as long as one second (Travell and Simons, 1983).

Transparent grading sheet

This sheet was used to locate MTrPs and grantee the exact application of manual techniques to the same target point during the treatment sessions. The sheet is made of transparent malleable plastic to conform to thigh contour; divided into 1 cm², 30 cm in length enumerated from 1 to 30; 20 cm width enumerated alphabetically from A to T (Gomaa *et al.,* 2016) (Fig.1).

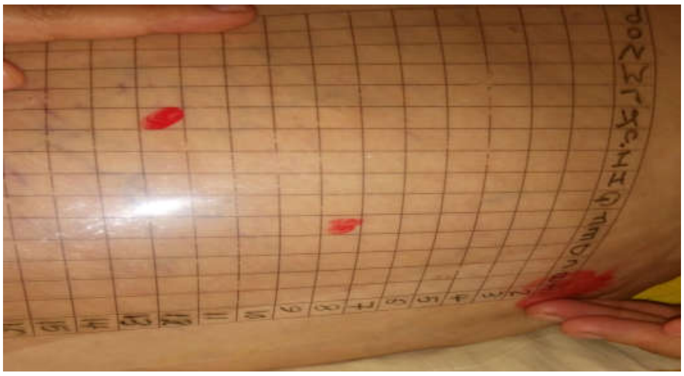

Figure 1. Transparent grading sheet

Transparent grading sheet placement

For the assessment of replacement consistency of MTrPs in the thigh region, the A30 square will be used as a reference mark over the lateral femoral epicondyle while the first column (A30-A1) was fitted to the line extending to the greater trochanter with the rest of the sheet one time anteriorly and the other posteriorly (Fig.1). For assessment of MTrPs in the leg the reference points will be the head of the fibula and lateral malleolus, and it will be repeated anteriorly and posteriorly. Nearly similar method of grid sheet was used by Sarrafzadeh *et al.,* (2012).

Treatment procedures

Timing protocol

After the patient completed the baseline evaluation; the patient started the treatment program the next day according to each patient's allocation. We randomized all 50 patients equally to two groups: group A (experimental) received MFR and exercises and group B (control) received exercises only. Exercise session duration ranged between 20-30 min; each other day for four weeks. MFR added between 10-40 min to the session duration depending on the number of MTrPs targeted. This timing was recommended based on Simons *et al.,* (1999) who stated that manual methods are more likely to require several treatments and the benefits may not be as fully apparent for a day or two.

MFR technique

The MTrPs release technique was the second step following Palpation and locating (Clay and Pounds, 2003). We located MTrPs according to the patient complain and by using the algometer and the transparent grading sheet. MTrPs could be found anywhere in the quadriceps, hamstrings, ITB, hip adductors, or gastrocnemius muscle.

Ischemic compression technique (Trigger Point Pressure Release)

This technique consisted of applying a relevant pressure by the pad of the therapist's thumb on the skin of the patient, to get contact with the fascia while putting the MTrPs halfway between the fingers (index and middle) to keep it from sliding to one side during the release (Alvarez and Rockwell, 2002). The therapist's thumb remained in contact with the skin overlying the MTrPs for the entire procedure to ensure accurate re-location of pressure for MFR (Fig. 2) (Fryer and Hodgson, 2005). Patients received a MTrPs pressure release technique over each MTrP that were found. The pressure was maintained on each MTrP for 30 s - 1 min**.** The pressure was released when there was a decreased tension in the MTrPs or when MTrPs were no longer tender or when one minute was elapsed, whichever would occur first (Travell and Simons, 1983; Simons *et al.,* 1999). The total time of successive pressures was five minutes or more (upon each MTrP) until the release was felt by the therapist's thumb (Andrade and Clifford, 2001).

Fig. 2. Ischemic compression technique

Exercise Program

We used the intensive functional rehabilitation (IFR) program that was established and tested by Moffet *et al.,* (2004) in subjects whom underwent a first TKR. During the sessions, subjects were supervised and knee joint responses (range of motion, pain, and effusion) were monitored to adjust and optimize the intervention. Each session included 5 components: warm-up, specific strengthening exercises, functional task-oriented exercises, endurance exercises, and cool-down (Table 1). The specific strengthening exercises were performed in a supine or seated position, consisting of maximal isometric pain-free contractions (knee extensors and flexors), at different angles of knee flexion, and dynamic (concentric-eccentric) contractions against gravity (hip abductors). The functional exercises have different degrees of difficulty and complexity according to (1) the amount of weight bearing (partial to total support on the operated leg), (2) support (with or without upper limb support), (3) side (bilateral or unilateral exercise), (4) resistance (with or without external load), and (5) complexity (isolated or combined motion). Endurance exercises were walking, biking,or both, for a progressive duration of 5 to 20 minutes. In the first 2 weeks, more attention was given to the warm-up, specific strengthening, and cool-down exercises, because they are less demanding on the knee joint. Simple functional exercises and endurance exercises of short duration (5min) were also started. During the second phase of rehabilitation, more time was spent practicing functional task-oriented exercises with increasing degrees of intensity anddifficulty. The duration of the endurance exercises was gradually increased from 5 to 20 minutes.

Table 1. IFR program for TKR

Warm-up and stretching exercises
1. Global flexion-extension of the lower limb
2. Alternated dorsal plantarflexion of the ankles
3. Stretching of the hamstrings
4. Mobility exs of the neck, upper limbs, and back
Specific strengthening exercises
1. ISOM knee extensors: flex 0°, flex 30°, flex 60°, flex 90°
2. ISOM hamstrings: flex 0°, flex 30°, flex 60°, flex 90°
3. CONC-ECC hip abductors
Functional task-oriented exercises
1. Get up and sit down
2. Knee extensor strengthening in standing with TheraBand
3. Controlled bilateral knee flexion-extension in standing
4. Climbing on a platform or a flight of stairs
5. Walking backward, on a slope and/or laterally while crossing lower limbs
7. Walking in place, with large amplitude of hip and knee flexion and upper-limb movements
Endurance exercises
1. Walking
2. Stationary cycling
Cool down
1. Slow walking
2. Stretching exs

Statistical analysis

Descriptive statistics and t-test were conducted for comparison of subject characteristics between both groups. McNemar's test and Chi- squared test were conducted for comparison of MTrPs distribution between pre and post treatment in each group and between groups. The level of significance was set at $p < 0.05$. All statistical measures were performed through the (SPSS) version 22.

RESULTS

Subject characteristics

Table (2) showed the mean ± SD age, weight and height of group A and B. There was no significant difference between both groups in the subject characteristics ($p < 0.05$).

Frequency distribution of trigger points

The total number of MTrPs in the thigh pre-treatment in group A was 68 points and that of group B was 61. The total number of MTrPs in the leg pre-treatment in group A was 34 points and that of group B was 30. The total number of MTrPs in the thigh post treatment in group A was 22 points and that of group B was 48. The total number of MTrPs in the leg post treatment in group A was 19 points and that of group B was 28. The highest number of MTrPs was in the posterolateral aspect of the thigh and posterior aspect of the leg.

Within group comparison

Comparison of frequency distribution of MTrPs between pre and post treatment within group A revealed that there was a significant decrease in the numbers of MTrPs in all aspects of the thigh and leg post treatment compared with that pre-treatment ($p < 0.05$); while in group B there was no significant difference in the numbers of MTrPs between pre and post treatment ($p > 0.05$) (Table 3).

Table 2. Comparison of subject characteristics between Group A and B

	x̄±SD		MD	t- value	p-value
	Group A	Group B			
Age (years)	65.72±7.16	64.88±7.37	0.84	0.4	0.68*
Weight (kg)	93.6±9.06	92.52±9.14	1.08	0.41	0.67*
Height (cm)	168.84±8.85	165.52±8.64	3.32	1.34	0.18*

x̄, Mean; SD, Standard deviation; MD, Mean difference;
p value, Probability value; *, Non-significant.

Table 3. Comparison of frequency distribution of trigger points between pre and post treatments of group A and B:

Trigger points distribution		Pre	Post	$\chi2$ value	p-value
Group A		N(%)	N(%)		
Thigh	AnteroMedial	8 (12%)	2 (9%)	2.44	0.03**
	AnteroLateral	17 (25%)	6 (27%)	3.31	0.001**
	PosteroMedial	20 (29%)	6 (27%)	3.74	0.0001**
	PosteroLateral	23 (34%)	8 (37%)	3.87	0.0001**
Leg	Anterior	13 (38%)	7 (37%)	2.44	0.03**
	Posterior	21 (62%)	12 (63%)	3	0.004**
Group B					
Thigh	AnteroMedial	6 (10%)	3 (6%)	1.73	0.25*
	AnteroLateral	13 (21%)	11 (23%)	1.41	0.5*
	PosteroMedial	18 (30%)	13 (27%)	2.23	0.06*
	PosteroLateral	24 (39%)	21 (44%)	1.73	0.25*
Leg	Anterior	10 (33%)	9 (32%)	1	1*
	Posterior	20 (37%)	19 (68%)	1	1*

χ^2, Chi squared value; p value, Probability value;
*, Non-significant; ** Significant

Between group comparison

There was no significant difference in the distribution of MTrPs in the aspects of thigh and leg between group A and B pre-treatment ($p > 0.05$). Post treatment there was a significant decrease in the numbers of MTrPs of posteromedial and posterolateral aspects of the thigh and the posterior aspect of leg in group A compared with that of group B ($p < 0.05$), while there was no significant difference in the distribution of MTrPs in anteromedial, anterolateral aspects of the thigh and the anterior aspect of the leg between group A and B ($p > 0.05$) (Table 4).

Table 4. Comparison of frequency distribution of trigger points between group A and B:

Trigger points distribution		Group A	Group B	$\chi2$ value	p-value
Pre		N (%)	N (%)		
Thigh	AnteroMedial	8 (12%)	6 (10%)	0.39	0.52*
	AnteroLateral	17 (25%)	13 (21%)	1.33	0.24*
	PosteroMedial	20 (29%)	18 (30%)	0.43	0.5*
	PosteroLateral	23 (34%)	24 (39%)	0.35	0.55*
Leg	Anterior	13 (38%)	10 (33%)	0.72	0.39*
	Posterior	21 (62%)	20 (37%)	0.13	0.71*
Post					
Thigh	AnteroMedial	2 (9%)	3 (6%)	0.22	0.63*
	AnteroLateral	6 (27%)	11 (23%)	2.22	0.13*
	PosteroMedial	6 (27%)	13 (27%)	4.15	0.04**
	PosteroLateral	8 (37%)	21 (44%)	13.87	0.0001*
Leg	Anterior	7 (37%)	9 (32%)	0.36	0.54*
	Posterior	12 (63%)	19 (68%)	4.15	0.04**

χ^2, Chi squared value; p value, Probability value;
*, Non-significant; ** Significant

DISCUSSION

The first purpose of the study was to assess the frequency distribution of MTrPs in all 50 patients post TKR before any intervention. The second purpose of the study was to compare the frequency distribution of MTrPs between pre and post treatment within each group (Group A and B). The statistical analysis revealed no significant difference in the distribution of MTrPs in the aspects of thigh and leg between group A and B pre-treatment ($p > 0.05$). All 50 patients of both groups showed a similar pattern of MTrPs distribution in all aspects of thigh and leg pretreatment. The statistical analysis revealed a significant decrease in the numbers of MTrPs in all aspects of the thigh and leg post treatment compared with that pretreatment ($p < 0.05$) in group A (MFR and exercises group); while in group B (exercises group) there was no significant difference in the numbers of MTrPs between pre and post treatment ($p > 0.05$). These results confirmed the role and importance of MFR in MTrPs treatment because MFR produced a significant decrease in the numbers of MTrPs post treatment. On the other hand, exercises only weren't enough in MTrPs treatment and didn't produce a significant decrease in the numbers of MTrPs post treatment. Most recently, Moraska *et al.,* (2017) reported similar results to our results. They conducted a study that assessed the effects of single and multiple massage treatments including MFR on pressure-pain threshold (PPT) at MTrPs in people with myofascial pain syndrome expressed as tension-type headache. They concluded that Single and multiple massage including MFR applications increase PPT at MTrPs. The pain threshold of MTrPs have a great capacity to increase; even after multiple massage treatments additional gain in PPT was observed. Our Results came in the same line with Balasubramaniam *et al.,* (2014) whom studied the effect of work station modification with MFR therapy on pain and lumbar flexion range of motion (ROM) in mechanical low back pain in desk job workers. They concluded that the work station modification along with MFR was very effective in improving ROM and reducing pain. Other study was done by Tang, (2014) to determine whether manual therapy, specifically myofascial release technique (MRT) and Trigger Point Therapy (TPT) of the quadriceps, directly affects knee-extensor voluntary activation (VA) in patients with patellofemoral pain (PFP). They concluded that The TPT increased % VA, whereas MRT intervention and the control condition did not have any effect. Also, a study was conducted to determine the effect of self-myofascial release (SMR) via foam roller application on knee extensor force and activation and knee joint ROM. They concluded that an acute bout of SMR of the quadriceps was an effective treatment to acutely enhance knee joint ROM without a concomitant deficit in muscle performance. They said that an acute bout of SMR increases ROM without a subsequent decrease in muscle activation or force (MacDonald *et al.,* 2013).

A study was conducted to compare the acute effect of SMR, postural alignment exercises, and static stretching on joint ROM. Their results demonstrated that an acute treatment of foam-rolling significantly increased joint ROM in participants when combined with either postural alignment exercises or static stretching (Roylance *et al.,* 2013). Recently a study conducted by Clark and Lucett, (2011) whom reported a self-administered version of SMR has been popularized using a foam roller that also serves as an inhibitory technique which decreases overactive myofascial tissue. Applying pressure to trigger points (the overactive part of the tissue) appeared to cause the Golgi tendon organ (GTO) complex to elicit an inhibitory effect on the muscle, allowing it to become less tense and more pliable, leading to an increase in joint ROM. A study done by Ajimsha *et al.,* (2012) came into agreement with our results. They investigated whether MFR reduces the pain and functional disability of lateral epicondylitis (LE) in comparison with a control group receiving sham ultrasound therapy in computer professionals. They found that the MFR group performed better than the control group. They concluded that MFR was significantly more effective than sham ultrasound therapy for decreasing the pain and functional disability of LE. It is also possible that pain relief due to MFR is secondary to returning the fascial tissue to its normative length by collagen reorganization; this is a hypothesis that merits investigation (Schleip, 2003). For further support of our findings, a RCT was conducted to determine the effect of MRT on pain symptoms and physical function in fibromyalgia syndrome. The experimental group showed a significant improvement in painful tender points, McGill Pain Score, physical function, and clinical severity.

The results suggested that MRT can be a complementary therapy for pain symptoms, physical function and clinical severity (Castro-Sánchez *et al.,* 2011). Licciardone *et al.,* (2004) confirmed our results. They conducted a clinical trial to determine the efficacy of osteopathic manipulative treatment (OMT) including MFR in patients who recently underwent surgery for knee or hip OA or for a hip fracture. They concluded that OMT including MFR has also been advocated in the treatment of patients with hip fractures for pain control and to facilitate patients' return to a non-hospital environment in the geriatric population. For further support of the current study results, a RCT to assess OMT including MFR as a complementary therapy for patients undergoing elective knee or hip arthroplasty was performed. They found that Compared to control subjects, Patients receiving OMT including MFR in the early postoperative period negotiated stairs earlier, required less analgesia, gained a decrease in pain perception had shorter hospital stays, ambulated farther on postoperative days and ambulated greater distances than did control group patients (Jarski *et al.,* 2000). The results of RCT conducted by Andersson *et al.,* (1999) supported our results. They performed a clinical trial of OMT including MFR in patients with low back pain. They found that the osteopathic-treatment group required significantly less medication (analgesics, anti-inflammatory agents, and muscle relaxants) and used less physical therapy. They concluded that osteopathic manual care including MFR and standard medical care have similar clinical results in patients with sub-acute low back pain. However, the use of medication is greater with standard care. This agreement could be due to that MFR produces improvement of painful, firm or overtired muscles by hastening the waste products removal and momentarily increasing the local blood supply. It is a combination of technique designed to relax, release, and stretch soft tissues. This augments local circulation, stimulates lymphatic system and increases the flexibility and ROM of the stiff joint. It also helps to normalize the muscle tone, relaxing the muscles (Albright *et al.,* 2001). MFR attempts to restore the abnormal alignment of the body, regain lost motion and reduces pain. It effectively breaks down the tissue resistance, erase tissue trauma and re-educates the functionality of the desired body positions (Stuart, 2003). This low load sustained stretch gradually, over time, allow the myofascial tissue to elongate and relax, thus allowing increased ROM, flexibility and decreased pain (Shah and Bhalara, 2012). Results of the current study showed a similar pattern of MTrPs distribution in all aspects of the thigh and leg pretreatment in all 50 patients of both groups. It revealed no significant difference in the distribution of MTrPs in the aspects of thigh and leg between group A and B pretreatment. Results of the current study showed more significant frequency distribution of MTrPs in the lateral hamstrings (biceps femoris) and calf muscles than the medial hamstrings (semimembranosus and semitendinosus), quadriceps and tibialis anterior muscles.

The most common pre treatment MTrPs didn't appear in muscles of the anterior thigh (quadriceps) which are the site of operation incisions but appeared in muscles of the posterior thigh and posterior leg (hamstrings and calf muscles). Accordingly, we can say that pre operative factors and problems like muscle weakness and strain, chronic postural and gait abnormalities, instability, functional disability, stiffness, poor positioning, restricted ROM, pain itself, obesity and hyperalgesia may be more important factors than the surgical procedures or incisions of TKR itself in the formation of MTrPs. So, we should take all of these factors into consideration, focusing on them in the rehabilitation program post TKR and treated them before TKR surgery to gain the best post operative results. Comparing the distribution of MTrPs before and after treatment we found a significant decrease in the numbers of MTrPs in all aspects of the thigh and leg post treatment in group A (MFR and exercises group) while in group B (exercises group) there was no significant difference in the numbers of MTrPs between pre and post treatment in all aspects of the thigh and leg. MTrPs are common in lower limb muscles in patients with hip and/or knee OA and several papers have emphasized the importance of treating these MTrPs to relieve pain in OA of both joints (Bajaj *et al.,* 2001; Feinberg and Feinberg, 1998). Since a single treatment of MTrPs within the context of a knee replacement surgery has proven to be effective in pain reduction after the intervention, it could be conceivable that a more complete treatment program of MTrPs, either before or after the surgery, could be of major help to reduce pain in these patients. Research is needed to test this hypothesis (Mayoral *et al.,* 2013).

Recommendation: Additional research is recommended to investigate the effect of MFR on MTrPs in patients post total hip replacement.

Conclusion: MFR and exercises had a superior effect on MTrPs compared to exercises only. Exercises program alone had no significant effect on MTrPs.

Conflict of interests: We declare that we didn't receive any financial support from any institution or company.

Abbreviations

CONC-ECC: Concentric-Eccentric contraction
GTO: Golgi tendon organ
IFR: Intensive functional rehabilitation
ISOM: Isometric contraction
ITB: Iliotibial band
LE: lateral epicondylitis
LTR: local twitch reaction
MD: Mean difference
MFR: Myofascial release
MRT: Myofascial release technique
MTrPs: Myofascial trigger points
OA: Osteoarthritis
OMT: Osteopathic manipulative treatment
PFP: Patellofemoral pain
PPT: Pressure-pain threshold
RCT: Randomized controlled trial
ROM: Range of motion
SD: Standard deviation
SMR: Self-myofascial release
TKR: Total knee replacement
TPT: Trigger point therapy
VA: Voluntary activation

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