Original Article

Comparison of the effects of static stretching and muscle energy technique on Hamstring flexibility, pain, and function in athletes with Patellofemoral pain

Zahra Rojhani-Shirazi[1], Mohamad Reza Salimifard[1], Fatemeh Barzintaj[1]*

[1] Department of Physical Therapy, School of Rehabilitation Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.

Correspondence: Fatemeh Barzintaj, MSc (PT); Department of Physical Therapy, School of Rehabilitation Sciences, Shiraz University of Medical Sciences, Shiraz, Iran. Tel: +989177204561, E-mail address: clinic2729 @ gmail.com

ABSTRACT

Patellofemoral Pain (PFP) is one of the common musculoskeletal disorders among athletes. Hamstring tightness is the most important problem in PFP. It leads to a hamstring injury that is the most common type of injury among athletes, resulting in their dysfunction. Until now, no studies have been conducted on the comparison of static stretching and Muscle Energy Technique (MET) in athletes with PFP. This study aimed to compare the effects of these two therapeutic techniques on hamstring tightness, function, and pain in athletes with PFP. This study was conducted on 66 high-level male athletes with PFP from various sports (soccer, volleyball, and basketball). The participants were categorized randomly into three groups: an experimental group of 22 participants (24.47±3.48 years) that received static stretching, another experimental group of 22 participants (23.13±4.14 years) that received MET, and a control group of 22 participants (23.56±4.49 years) that received no interventions. The training sessions were held five days a week for two weeks. The assessment was done before the training, immediately after the two-week training, and two weeks later. Active Knee Extension (AKE) test, Numerical Rate Scale (NRS), and Kujala test were used to evaluate hamstring flexibility, pain, and function, respectively.
Repeated measurement test showed significant improvements in hamstring flexibility, pain, and function in the MET and static stretch groups after the intervention ($P<0.05$). However, no significant changes were found in the control group. MET was found to be more effective than static stretch in the improvement of hamstring flexibility, pain, and function in athletes with PFP.

Keywords: athletes, Hamstring muscles, Patellofemoral pain syndrome, muscle stretching exercises, pain

Introduction

Patellofemoral Pain (PFP) is a common disorder among athletes [1], which accounts for 24-40% of all knee problems in sport medicine centers [2]. Hamstring tightness is normally detected in patients with PFP [3]. The hamstring is a type of muscle groups that tend to shorten [4]. Hamstring strain is a common soft tissue injury among athletes [5]. Hamstring flexibility reduces the risk of injury [6] and improves athletic function [7]. Muscle tightness leads to decreased performance [7]. Flexibility is an essential element of normal biomechanical functioning in sports [8]. To date, the evaluation of different types of stretching methods has revealed various results regarding the improvement of hamstring tightness. Coaches and trainers apply stretching techniques to reduce injury and improve athletes' performance [9]. Yet, it is necessary to find more efficient methods for improving the activity of athletes with PFP. Until now, no studies have been conducted on the comparison of static stretching and Muscle Energy Technique (MET) in athletes with PFP. Therefore, the present study aims to compare the effects of two therapeutic methods on hamstring flexibility, pain, and function in athletes with PFP.

Access this article online	
Website: www.japer.in	**E-ISSN:** 2249-3379

How to cite this article: Zahra Rojhani-Shirazi, Mohamad Reza Salimifard, Fatemeh Barzintaj. Comparison of the effects of static stretching and muscle energy technique on Hamstring flexibility, pain, and function in athletes with patellofemoral pain. J Adv Pharm Edu Res 2021;11(S1):33-38.
Source of Support: Nil, Conflict of Interest: None declared.

Materials and Methods

Participants

This randomized, controlled, prospective trial was conducted on 66 high-level athletes recruited from various sports (soccer, volleyball, and basketball). The inclusion criteria were aging 18-30 years, male gender, suffering from unilateral PFP in the dominant lower limb (knee pain when going up and downstairs and when kneeling and sitting with a bent knee for a long time and positive Apprehension Patella and Clarke's tests), obtaining 45-70 scores in Kujala test, obtaining 3-6 scores in the Numerical Rating Scale (NRS), and tight hamstring (inability to achieve greater than 160° of knee extension with the hip at 90° of flexion). The exclusion criteria of the study were having fractures or dislocations at least six months before the study, having a history of surgical operations of lower extremities, suffering from rheumatoid arthritis, taking sedative drugs, doing physical therapy treatments, and lack of complete attendance in the intervention sessions for more than two days.

A randomization list was electronically generated and used by an individual not involved in the recruitment, evaluation, or treatment processes. The participants were divided into three groups using random allocation: an intervention group (n=22) that received MET, another intervention group (n=22) that received static stretch, and a control group (n=22). It is worth mentioning that written informed consent was obtained from all participants. The study protocol was approved by the Ethics Committee of Shiraz University of Medical Sciences and was registered in the Iranian Registry of Clinical Trials (IRCT201608022391N23).

Procedure and intervention

The athletes were asked to lie in a supine position. Lumbar and opposite hip movements were further limited by the use of a 5 cm wide strap positioned across the anterior-superior iliac spines. The hip remained at 90° flexion with the fastened strap. In the MET group, the knee was passively extended until it reached the resistance point where the athletes performed a hamstring isometric contraction (50% of maximal voluntary isometric contraction), held for 10 seconds, and relaxed for 10 seconds. Next, the knee was held at a greater extension range by the therapist for 10 seconds. This technique was repeated three times with 10-second intervals [10]. In the static stretch group, the therapist passively raised the lower leg, extending the athlete's knee to the extension. The athletes were instructed to inform the therapist when a strong uncomfortable but tolerable stretch was felt. A constant stretch was maintained for 30 seconds. This technique was repeated three times with 10-second intervals [11]. The therapeutic methods were performed five days a week for two weeks. The assessment was done before the training, immediately after the two two-week training, and two weeks later.

This study was single-blinded; the therapist who performed the measurements and analyzed the data was blind to group allocation. In the control group, clinical tests were performed without any interventions. Yet, for ethical considerations, the control group participants were provided with some information about hamstring tightness and efficient techniques at the end of the study.

Outcome measures

Active Knee Extension (AKE) test

AKE is an active test considered as a gold standard for hamstring flexibility assessment [12]. In this test, the participant is placed in a supine position with the hip joint in 90° of flexion and then, the knee is extended actively. The first marker was placed on the greater trochanter, another on the lateral knee joint, and another on the apex of the lateral malleolus [13]. Pictures were taken **(Figure 1)** and transferred to the computer and knee extension were analyzed using the Image J software [14].

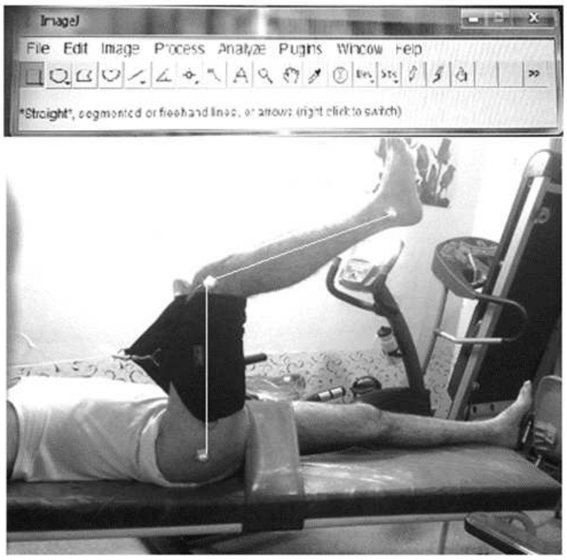

Figure 1. Analysis of knee extension using the Image J software

Numerical Rating Scale (NRS)

NRS is used for pain assessment [15]. In this assessment, the patient states the rate of one's pain from 0 to 10, representing no pain and the worst pain, respectively [16].

Kujala test

This test is used to evaluate the knee joint function in PFP [17]. It is a reliable questionnaire that contains 13 parts. The total score of the questionnaire is equal to 100, which shows the maximum function of the knee joint. Lower scores, on the other hand, indicate higher disability or involved function [18].

Statistical analysis

Statistical analyses were performed using the SPSS statistical software, version 22.0. Descriptive statistics were reported as means and standard deviations. A repeated measurement test was used to compare the clinical test measurements in each group three times. Besides, one-way Analysis of Variance (ANOVA) was applied to determine the differences among the study groups. In case of significant differences, Tukey's post-hoc test was performed. P≤0.05 was considered to be statistically significant.

Results and Discussion

The results showed no significant difference among the three groups regarding age, height, weight, and Body Mass Index (BMI) **(Table 1)**.

Table 1. General characteristics of the study participants

Baseline evaluation	MET group	Static group	Control group	P-value
Age (years)	23.13±4.14	24.47±3.48	23.56±4.49	0.550
Height (cm)	168.90±6.41	172.14±5.34	167.60±5.34	0.805
Weight (kg)	67.86±15.02	69.19±14.04	63.47±8.56	0.304
BMI (kgm-2)	23.53±3.51	23.15±3.08	22.50±2.27	0.507

BMI, body mass index; MET, muscle energy technique

Before the intervention, no significant differences were found among the three groups regarding any of the study variables. According to the results of the Levene test, the data followed a normal distribution. The results of the clinical tests before the intervention, immediately after the two-week training, and two weeks later have been presented in **Table 2**.

Table 2. Clinical test results in the three groups before the intervention, immediately after the two-week training, and two weeks later

Outcome measures	Pre-test	Post-test 1	Post-test 2	P-value
		Mean ± SD		
		MET group (n=22)		
AKE (degree)	142.08±2.10	162.37±2.23	166.02±1.59	<0.001
NRS (score)	4.04±0.29	2.36±0.27	1.86±0.23	<0.001
Kujala (score)	60.50±2.38	74.59±2.60	78.40±2.15	0.0001
		Static stretch group (n=22)		
AKE (degree)	141.32±2.81	147.83±3.23	150.28±2.95	<0.001
NRS (score)	4.63±0.25	3.45±0.29	2.86±0.23	<0.001
Kujala (score)	61.50±2.01	63.95±2.04	66.09±2.03	0.0001
		Control group (n=22)		
AKE (degree)	136.31±3.77	135.00±3.42	134.68±3.41	0.134
NRS (score)	4.31±0.26	4.59±0.24	4.68±0.25	0.148
Kujala (score)	56.31±1.97	56.31±2.04	56.22±2.01	0.793

AKE, active knee extension; NRS, numerical rating scale; MET, muscle energy technique

The results revealed significant differences regarding the outcome measures in both intervention groups from pretest to post-test 1 and post-test 2 (P<0.001). However, no significant difference was found in the control group from the pretest to post-test 1 and post-test 2 (P>0.05).

ANOVA was used to assess differences among the three groups. Accordingly, no significant differences were observed among the three groups regarding AKE, Kujala test, and NRS before the trial (P>0.05). Immediately after the two-week intervention **(Figure 2)**, however, a significant difference was found between the MET and static stretch groups concerning AKE (P<0.01), NRS (P=0.01), and Kujala test (P<0.01). Moreover, a significant difference was observed between the MET group and the control group concerning AKE, NRS, and Kujala test (P<0.001). Also, a significant difference was observed between the static stretch group and the control group regarding AKE (P=0.01), NRS (P=0.01), and Kujala test (P=0.04).

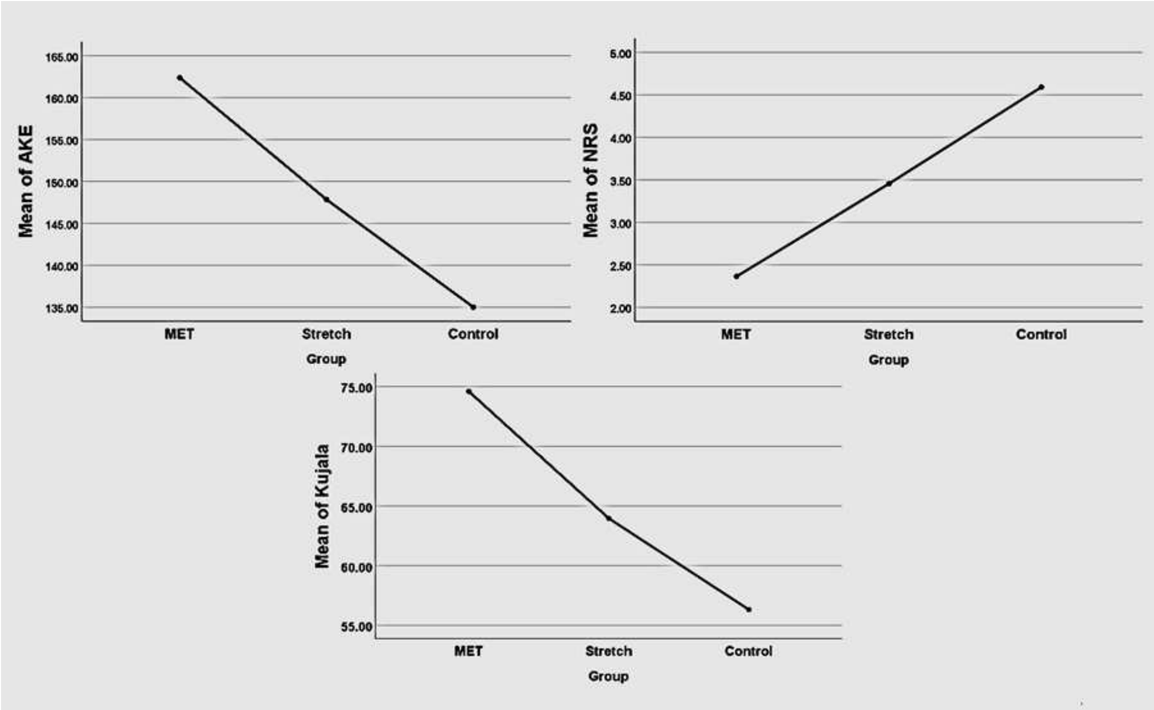

Figure 2. Multiple comparisons of AKE, NRS, and Kujala test immediately after the two-week training

After two weeks **(Figure 3)**, a significant difference was found between the MET and static stretch groups regarding AKE, Kujala test ($P<0.001$), and NRS ($P=0.01$). Additionally, a significant difference was observed between the MET group and the control group concerning AKE, NRS, and Kujala test ($P<0.001$). Furthermore, a significant difference was observed between the static stretch group and the control group regarding AKE, Kujala test, ($P<0.01$), and NRS ($P<0.001$).

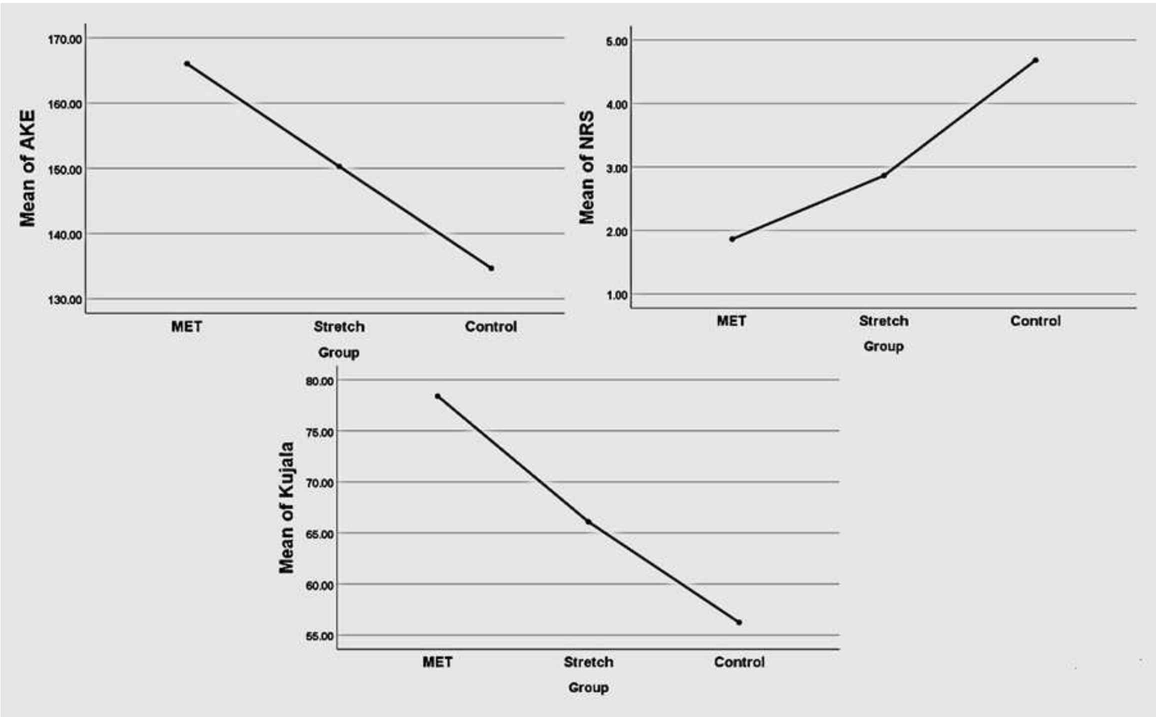

Figure 3. Multiple comparisons of AKE, NRS, and Kujala test after two weeks

Flexibility is an important factor in physical fitness [4]. Some trials have been performed to improve hamstring flexibility. In the present study, both MET and static stretch increased hamstring flexibility. Besides, a comparison of MET and static stretch showed that the former could be more efficient in the improvement of hamstring flexibility among the athletes with PFP. Odunayia et al. reported that static stretching could be significantly helpful in hamstring flexibility [4]. Similar results were also obtained by Nelson and Bandy. They revealed that the static stretch increased the muscle length significantly [7].

Consistently, Cheraladhan et al. demonstrated that MET was effective in lengthening the tight hamstring muscle [19]. MET could increase the muscle length by the combination of creep and plastic changes in the connective tissue [20]. Adel Rashad stated that MET resulted in greater improvement in hamstring flexibility compared to dynamic stretching [21]. The mechanism of MET for increasing the muscle length involves both neurophysiological (including changes to stretch tolerance) and mechanical factors (such as viscoelastic and plastic changes in the connective tissue elements of the muscle) [22]. The effectiveness of MET has been attributed to the inhibitory Golgi tendon reflex, as well [23].

The present study results showed a decrease in pain after the interventions. A reason for PFP is the increase in subchondral bone stress [24]. A tight hamstring causes increased patellofemoral compressive force [4]. This factor is decreased with the flexibility of the hamstring muscle, which was shown in this study in both intervention groups and more significantly in the MET group.

Increasing the athletes' function is a common goal for both athletes and sports medicine clinicians [25]. In the present study, both MET and static stretch increased function. Furthermore, a comparison of MET and static stretch indicated that the former could be more efficient in improvement of function among the athletes with PFP. In the same line, Odunayia et al. stated that muscle tightness was a limiting factor for optimal physical performance and an important factor for sports injury [4]. Post-isometric relaxation is the main mechanism of MET for increasing flexibility. Moreover, increased stretch tolerance affects the mechanism of MET [26]. Hence, MET is more efficient in comparison to static stretch.

In conclusion, the present study demonstrated that both MET and static stretching were effective in hamstring muscle pain, flexibility, and function among the athletes with PFP. Besides, MET was found to be more effective than static stretch in the improvement of hamstring muscle flexibility, pain, and function among the athletes with PFP. Yet, future studies are recommended to compare other stretching methods for improvement of hamstring tightness, pain, and function in athletes with PFP.

Conclusion

The present study concluded that both MET and static stretching are effective in relieving pain in athletes with PFP. Besides, MET was preferred over static stretching in improvement of hamstring tightness and athletes' function. Yet, future studies are recommended to compare other stretching methods to improve the hamstring tightness, pain and function in athletes with PFP.

Acknowledgments: The authors would like to thank the study participants for their support and cooperation. The authors would also like to thank Ms. A. Keivanshekouh at the Research Improvement Center of Shiraz University of Medical Sciences for improving the use of English in the manuscript.

References

1. Fredericson M, Yoon K. Physical examination and patellofemoral pain syndrome. Am J Phys Med Rehabil. 2006;85(3):234-43.
2. Insall J. Current Concepts Review: patellar pain. J Bone Joint Surg Am. 1982;64(1):147-52.
3. Dixit S, DiFiori JP, Burton M, Mines B. Management of patellofemoral pain syndrome. Am Fam Physician. 2007;75(2):194-202.
4. Odunaiya N, Hamzat T, Ajayi O. The effects of static stretch duration on the flexibility of hamstring muscles. Afr J Biomed Res. 2005;8(2):79-82.
5. Petersen J, Hölmich P. Evidence based prevention of hamstring injuries in sport. Br J Sports. 2005;39(6):319-23.
6. O'Sullivan K, Murray E, Sainsbury D. The effect of warm-up, static stretching and dynamic stretching on hamstring flexibility in previously injured subjects. BMC Musculoskelet Disord. 2009;10(1):37.
7. Nelson RT, Bandy WD. Eccentric training and static stretching improve hamstring flexibility of high school males. J Athl Train. 2004;39(3):254-8.
8. Hopper D, Decan S, Das S, Jain A, Riddell D, Hall T. Dynamic soft tissue mobilization increasesm hamstring flexibility in healthy male subjects. Br J Sports Med. 2005;39(9):594-8.
9. Streepey JW, Mock MJ, Riskowski JL, VanWye WR, Vitvitskiy BM. Effects of quadriceps and hamstrings proprioceptive neuromuscular facilitation stretching on knee movement sensation. J Strength Cond Res. 2010;24(4):1307-42.
10. Shadmehr A, Hadian MR, Naiemi SS, Jalaie S. Hamstring flexibility in young women following passive stretch and muscle energy technique. J Back Musculoskelet Rehabil. 2009;22(3):143-8.
11. O'hora J, Cartwright A, Wade CD, Hough AD. Efficacy of static stretching and proprioceptive neuromuscular facilitation stretch on hamstrings length after a single session. J Strength Cond Res. 2011;25(6):1586-91.
12. Davis DS, Quinn RO, Whiteman CT, Williams JD, Young CR. Concurrent validity of four clinical tests used to measure hamstring flexibility. J Strength Cond Res. 2008; 22(2):583-8.
13. Hamid MS, Ali MR, Yusof A. Interrater and intrarater reliability of the active knee extension (AKE) test among healthy adults. J Phys Ther Sci. 2013;25(8):957-61.
14. Myer GD, Ford KR, Hewett TE. New method to identify athletes at high risk of ACL injury using clinic-based measurements and freeware computer analysis. Br J Sports Med. 2010;45(4):238-44.

15. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual analog scale for pain, numeric rating scale for pain, mcgill pain questionnaire, short form mcgill pain questionnaire, chronic pain grade scale, short form bodily pain scale and measure of intermittent and constant osteoarthritis pain. Arthritis Care Res. 2011;63(S11):240-52.
16. Lowry CD, Cleland JA, Dyke K. Management of patients with patellofemoral pain syndrome using a multimodal approach: a case series. J Orthop Sports Phys Ther. 2008;38(11):691-702.
17. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M, Nelimarkka O. Scoring of patellofemoral disorders. Arthroscopy. 1993;9(2):159-63.
18. Watson CJ, Propps M, Ranter Z, Zeigler DL, Horton P, Smith SS. Reliability and responsiveness of the lower extremity functional scale and the anterior knee pain scale in patients with anterior knee pain. J Orthop Sports Phys Ther. 2005;35(3):136-46.
19. Sambandam CE, Alagesan J, Shah S. Immediate Effect of Muscle Energy Technique and Eccentric Training on Hamstring Tightness of Healthy Female Volunteers-A Comparative Study. Int J Curr Res Rev. 2011;3(09):122-6.
20. Ross AC. Hamstring injuries: Risk assessment and injury prevention. Ann Acad Med Singap. 2008;37(4):341-6.
21. Ahmed AR. A comparative study of Muscle Energy Technique and Dynamic Stretching on Hamstring Flexibility in Healthy Adults. Bull Fac Ph Th Cairo Univ. 2011;16(1):1-6.
22. Freyer G. Muscle Energy Technique: research and efficacy. In: Chaitow L, (Ed) Muscle Energy Techniques, third ed Churchill Livingstone, Edinburg. 2006;109-32.
23. Freyer G. Muscle Energy concepts- a need for change. J Osteopath Med. 2003;3(2):54-9.
24. Worrell TW, Smith TL, Winegardner J. Effect of hamstring stretching on hamstring muscle performance. J Orthop Sports Phys Ther. 1994;20(3):154-9.
25. Gerbino PG, Griffin ED, d'Hemecourt PA, Kim T, Kocher MS, Zurakowski D, et al. Patellofemoral pain syndrome: evaluation of location and intensity of pain. Clin J Pain. 2006;22(2):154-9.
26. Ballantyne F, Fryer G, McLaughlin P. The effect of muscle energy technique on hamstring extensibility: the mechanism of altered flexibility. J Osteopath Med. 2003;6(2):59-63.