Comparison of Effectiveness of KT And Athletic Massage On Induced Delayed Onset Muscle Soreness [DOMS] In Quadriceps Of Normal Healthy Individuals

Vaishnavi C*, Dr. Ajit D,**

*Masters In Sports Physiotherapy Student, **Professor, Head Of The Department, Department Of Sports Physiotherapy, D Y Patil University School Of Physiotherapy, Navi Mumbai, India 400706

Abstract: Background: Almost every individual who performs unaccustomed eccentric exercise experiences Delayed Onset Muscle Soreness [DOMS].The current study compared the effectiveness of KT and athletic massage on induced DOMS in quadriceps muscle of normal healthy individuals. Objectives: 1] To assess the efficacy of KT + Athletic massage when compared to athletic massage alone in terms of Quadriceps strength and Maximal Voluntary Isometric Contraction (MVIC) measured 48 hours post intervention. 2] To compare- the change in perceived soreness 48 hours post intervention-between the two groups. Material and Methods: 20 individuals (7 males, 13 females, mean age 22 ± 2.24 in control group and 22± 1.84 in experimental group) were included. DOMS was induced with deep squats performed until moderate soreness was perceived. The experimental group received athletic massage with KT. The control group received athletic massage only. The effects were compared 48 hours post intervention using surface EMG and dynamometry. Result: Perceived soreness reduced significantly (p=0.026, using t-test) in the experimental group. No significant effect on MVIC and strength in both the experimental and control group (using one-way ANOVA). Conclusion: 1] The KT + Athletic (experimental group) intervention showed no effect on the Quadriceps strength and MVIC measured 48 hours post intervention. The athletic massage group (control group) showed a decrease in Quadriceps strength measured 48 hours post intervention and no effect on MVIC measured 48 hours post-intervention. 2] KT and athletic massage used in combination reduced perceived soreness measured 48 hours post intervention when compared with athletic massage alone. Clinical implication: As DOMS affects one's performance in sports and exercise, its treatment will help attain optimal performance during these activities. [Chiddarwar V Natl J Integr Res Med, 2020; 11(4):47-54]

Key Words: Delayed Onset of Muscle Soreness[DOMS], Kinesiotaping[KT], MVIC, Surface EMG, Quadriceps.

Author for correspondence: Vaishnavi Chiddarwar, Department of Sports Physiotherapy, D Y Patil University School of Physiotherapy, Navi Mumbai- 400706, E- Mail: vaishnavi.chiddarwar@protonmail.com

Introduction: Unaccustomed, eccentric exercises as a part of resistance training program cause muscle soreness in almost every individual. Exercise induced muscle soreness falls into two categories viz: acute onset and delayed onset. Delayed onset of muscle soreness (DOMS) is triggered when the fast twitch fibre is damaged due to unaccustomed eccentric exercise; the DOMS begins at 12 to 24 hours after the exercise and reaches the highest level at 48 to 72 hours after the exercise[1]. Swelling, dull pain, decreased ROM and decreased muscle strength are some of the consequences of DOMS that influence the activities of daily living.

It's important to recognize the symptoms of DOMS and form an understanding on how its presence influences training programs to help maintain a progressive and safe routine. Beginners are likely to experience muscle soreness due to unaccustomed stress to the muscle and connective tissue while, athletes can experience DOMS on resuming their seasonal training, bouts of high intensity training or competition. DOMS are classified as a type I muscle strain[2].

Kinesiology taping (K-Taping) is a taping technique that nowadays is frequently applied in pathologies of the musculoskeletal system especially in the field of sports injuries.

K-Taping has been widely used to: reduce swelling as it augments blood and lymphatic circulation, reduce pain, protect joint and soft tissue structures post- acute injuries and enhance muscle strength recovery post exercise.

Massage is widely used as a treatment modality for recovery from muscle fatigue and injuries[3]. It is probably one of the most popular treatments for after sport recovery. However, the effect of massage on DOMS has shown to have conflicting evidence in the literature where, a study showed no effect of an 8-minute massage on DOMS[4] while, another study concluded that massage therapy may alleviate DOMS due to its ability to enhance local blood and lymph flow. The findings about the effect of massage remain inconclusive and conflicting [5].

Prevention and treatment of DOMS at the initiation of an exercise program after a short or long period of inactivity has been either

ineffective or, at best, marginally successful. Hence, there is a need to find out an effective treatment method to treat delayed onset of muscle soreness (DOMS).

Although there exists literature on use of KT and athletic massage for treating DOMS, there is scarce literature on the combination of KT and athletic massage. The current study was hence, aimed at comparing the effectiveness of KT with athletic massage.

Material & Methods: Push-pull dynamometer (Baseline®) (Test- retest reliability intraclass correlation co-efficient 0.85-0.99 , mean concurrent validity 0.78-0.93, Surface EMG (SEMG) setup- tripolar flat surface electrodes, Biograph infiniti dynamap suite combined with procomp infiniti encoder to record, replay and review SEMG[6], Waterloo Footedness Questionnaire. (Reliability 0.869, Moderate construct validity), Kinesiotapes (Kinesio®Tex Classic, color: Black), Perceived soreness scale[3], Static cycle, Metronome, Stopwatch, Pen/marker, Goniometer, Measuring tape.

Individuals: Estimated Sample Size: 20 subjects.

Study Setting: Sports physiotherapy Department of School of Physiotherapy, DY Patil University.

Research Design: Experimental

Type Of Sampling: Purposive.

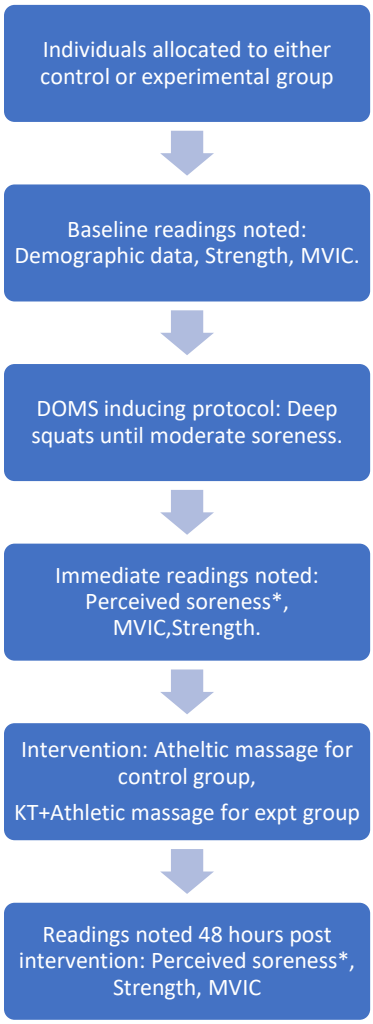
Inclusion Criteria: Healthy, consenting individuals both males and females in the age group of 18-25 years. As it was easier to establish a baseline and induce DOMS in healthy, consenting individuals.

Exclusion Criteria: 1] Presence of or history of any neurological, orthopaedic or neuromuscular condition affecting the lower limb. 2] Individuals engaged in a regular, structured exercise program either moderate or high- intensity.

Procedure: School of Physiotherapy's Institutional Review Board Ethical Committee (IEC) approval was taken. All individuals meeting the inclusion criteria signed an informed consent form. The procedures followed were in accordance with the ethical standards of the committee. Individuals were orally explained the steps in the procedure of the study. The following is the flowchart showing the procedure:

*Perceived soreness scale: The individuals rated their perceived soreness on a 0-100 scale.

"0- No soreness, 25- Mild soreness, 50- Moderate soreness, 75-Severe soreness, 100-Worst pain you can imagine."3



Procedure For Measuring The MVIC [Maximal Voluntary Isometric Contraction]: MVIC was recorded using surface EMG (sEMG). The skin was cleaned to minimize the resistance and the thigh was adequately exposed. The markings were made for electrode placement using goniometer, measuring tape and a pen/marker. SENIAM guidelines (Surface Electromyography for Non-Invasive Assessment of Muscles) were abided by for the electrode placement and recording [7].

The individual was seated with the knee supported at 10 degrees of flexion and was asked to extend the knee against the examiner's resistance. The effort was co-ordinated to the beats of a metronome [1Hz] and was continued and held for 5 seconds.

Exercise Protocol For Inducing DOMS In The Quadriceps Muscle: The individuals performed a 5-minute warm up on the static cycle followed by 6 sets of 10 repetitions of deep squats until exhaustion, each set was followed by a 1-minute break and each repetition was done 5 seconds apart[8].

The protocol was repeated until the individual was exhausted and perceived moderate soreness (≥50) on the perceived soreness scale.

Procedure For Athletic Massage: A standard 10-minute massage application was done over the dominant thigh of the individual immediately after the completion of the exercise protocol. The individual comfortably laid supine on a plinth with the thigh adequately exposed, the 10-minute massage application consisted of effleurage (stroking) of the thigh, knee to inguinal region; petrissage (kneading) of the thigh, friction to the thigh, thumb petrissage and repeat effleurage. The therapist kept the depth and rate of massage as consistent as possible[3].

Procedure For Kinesiotaping: The skin was cleaned before KT application. The Kinesio I strip with tails was measured and cut. Individual in supine position. Anchor was applied with no tension to ASIS. The therapeutic zone extended as far as the musculotendinous junction. 15-35% of tension was applied in therapeutic zone.

The adhesive was then activated in stretched position. At musculotendinous junction the tails were separated to surround the patella. The end of the tape was applied with no tension at Tibial tuberosity and the adhesive was activated in stretched position[9].

Data Analysis: Data analysis was performed using the statistical package- GraphPad Instat (GraphPad Software, Inc) version 3.0, 32 bit for Windows. The data was checked for normality using the K-S test.

The data passed the normality test and showed parametric distribution. Repeated measures ANOVA for intra-group was used for MVIC and Strength.

t-test was used for perceived soreness. Percentage change in parameters was used for inter-group comparison.

Results: Results are as deminstrated in table -1 to Table -4 and Image 1 to Image 4 as follows:

Table 1: Demographic Variables:

Characteristics	Control	Experimental
Male (n)	3	4
Female (n)	6	7
Male : Female	1:2	4:7
Age(In Years) (Mean± SD)	22 ± 2.24	22 ± 1.84

Figure 1: Mean of Perceived Muscle Soreness Of Quadriceps Muscle In Control (Athletic Massage Group) Immediately After DOMS Inducing Protocol And 48 Hours Post Intervention

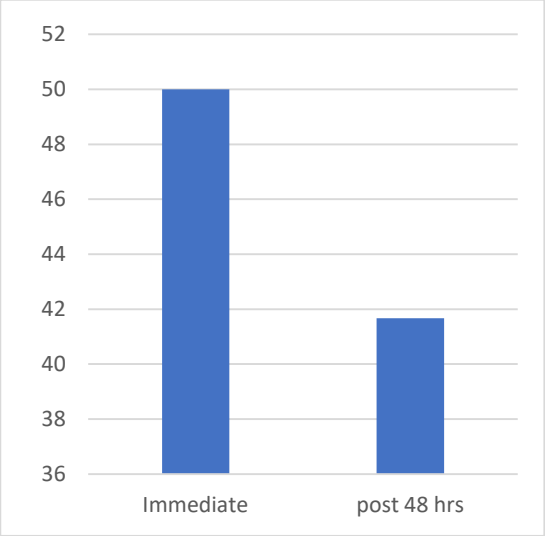


Figure 2: Mean of Perceived Muscle Soreness Of Quadriceps In Experimental Group (Athletic Massage + KT Group) Immediately After DOMS Inducing Protocol And 48 Hours Post Intervention

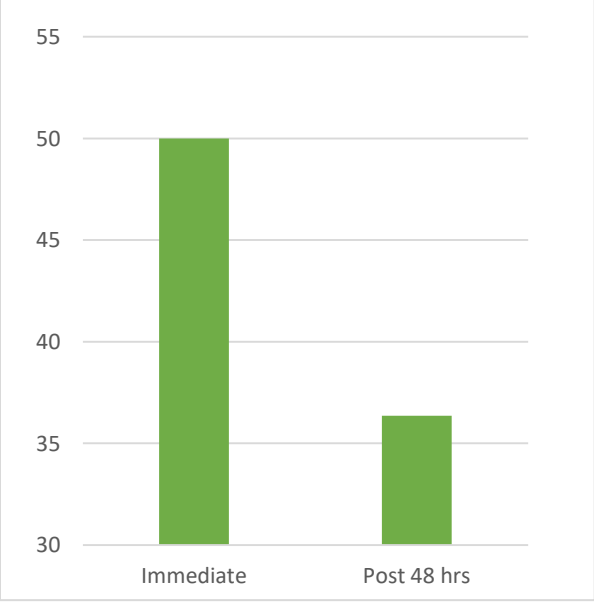
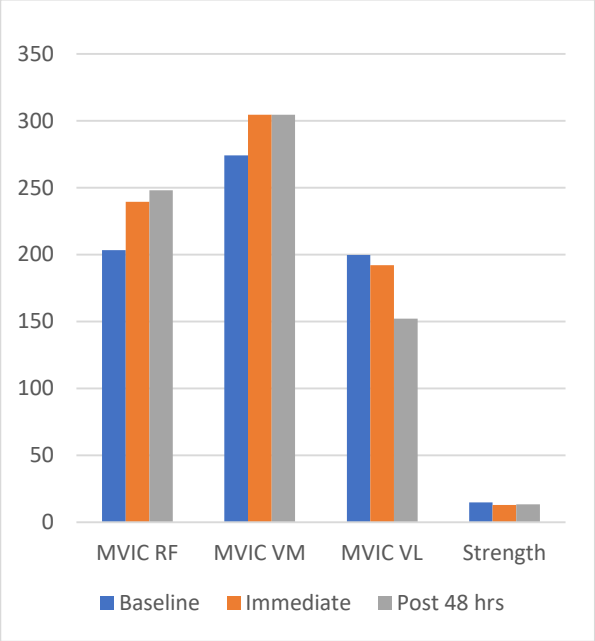


Figure 3: Means of MVIC And Strength Of Quadriceps In The Control Group (Athletic Massage Group) At Baseline, Immediately After DOMS Inducing Protocol And 48 Hours Post Intervention



*MVIC RF: Maximal Voluntary Isometric Contra- ction of Rectus Femoris.**MVIC VM: Maximal Voluntary Isometric Contra- ction of Vastus Medialis.***MVIC VL: Maximal Voluntary Isometric Contra- ction of Vastus Lateralis. . Strength in Kg as measured with Dynamometry.

Figure 4: Means of MVIC And Strength Of Quadriceps in the Athletic Massage+KT Group [experimental group] at Baseline, Immediately After DOMS Inducing Protocol And 48 Hours Post Intervention.

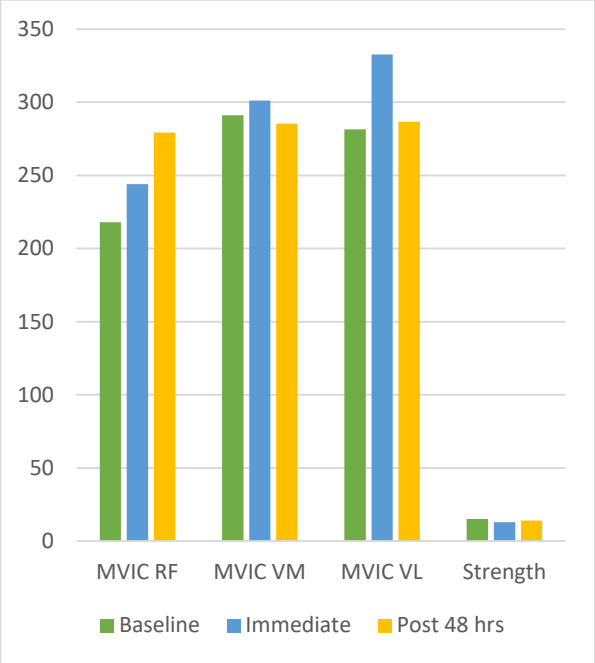


Table 2: Percentage Change Of Variables From Baseline To 48 Hours Post-Intervention.

Variables	Experimental Group	Control Group
MVIC RF	+24.64%	+19.8%
MVIC VM	-1.92%	+10.48%
MVIC VL	+1.82%	-27.02%
Strength	-6.95%	-11.8%
Perceived Soreness	-15.90%	-8.83%

(+) Indicates Percentage Increase in The Variable.
(-) Indicates Percentage Decrease in The Variable.

1] Effect of Kinesiotaping on Perceived Muscle Soreness of Quadriceps Muscle: Perceived muscle soreness decreased by 15.90% in the experimental group and showed a statistically significant change $p<0.05$ ($p=0.0261$). The perceived muscle soreness reduced only by 8.83% in the control group and was not statistically significant ($p=0.195$).

2] Effect of Kinesiotaping on Quadriceps Strength: There was a decline in quadriceps strength 48 hours post intervention in both the experimental and control group. The decline was statistically significant ($p<0.05$, $p=0.0187$) in the control group. The decline was not statistically significant in the experimental group.

3] Effect of kinesiotaping on Maximal Voluntary Isometric Contraction (MVIC): There was no statistically significant change in the MVIC of the Rectus Femoris, Vastus Medialis and Vastus Lateralis in the experimental group and in the control group.

Discussion: In the present study, comparison of effectiveness between kinesiotaping (KT) and athletic massage was done on induced Delayed Onset of Muscle Soreness (DOMS)in quadriceps muscle of 20 normal, healthy individuals who were not engaged in any structured exercise program or regular physical activity at the time of the study.

Perceived Soreness: Statistically significant decrease in perceived muscle soreness ($p<0.05$, $p=0.0261$) [as represented in Figure 2] was recorded in the experimental group which received athletic massage and kinesiotaping when compared with the control group individuals who received athletic massage only. The reduction in perceived soreness in the

control group was not statistically significant as p> 0.05 (p=0.1950). This is consistent with findings of a previous study where application of KT was found to be effective in reducing muscle soreness in quadriceps muscle of non-athletic volunteers when compared with the control group who received placebo taping [10]. The two reasons specified for reduced perceived soreness in the study were 1] Golgi Tendon Organ (GTO) activation and autogenic inhibition.2] Increase in metabolic activity due to muscle contractions.

Table 3: Athletic Massage Group Variables

Variable	Baseline (Mean± SD)	Immediately After DOMS Protocol	48 Hours Post Athletic Massage	Confidence Interval Lower To Upper (95%)			P-Value	Significance
				Baseline	Immediately After DOMS Protocol	Post 48hrs		
MVIC RF	203.38± 68.04	239.39± 118.22	248.10± 143.3	151.1 to 255.7	148.5 to 330.3	137.9 to 358.2	0.146	NS
MVIC VM	274.14± 117.21	304.66± 172.31	304.48± 156.73	184.0 to 364.2	172.3 to 436.97	184.0 to 424.9	0.712	NS
MVIC VL	199.74± 112.38	192.10± 100.55	152.19± 73.94	113.4 to 286.1	114.8 to 269.4	95.3 to 209.0	0.066	NS
Strength	14.8± 2.74	12.78± 2.65	13.33± 1.19	12.8 to 16.9	10.7 to 14.8	12.4 to 14.2	0.018	S*
Perceived Soreness		50	41.67±17. 68		50	28.1 to 55.2	0.195	NS

Table 4: KT+Athletic Massage Group Variables

Variable	Baseline (Mean± SD)	Immediately After DOMS Protocol	48 Hours Post Athletic Massage	Confidence Interval Lower To Upper (95%)			P-Value	Significance
				Baseline	Immediately After DOMS Protocol	Post 48hrs		
MVIC RF	218.06± 74.03	243.9± 73.88	279.3.10± 131.87	168.33 to 267.79	194.33 to 293.59	190.76 to 367.93	0.067	NS
MVIC VM	291.01± 198.70	301.1± 169.44	285.4± 120.45	157.53 to 424.49	187.34 to 414.99	204.56 to 366.39	0.952	NS
MVIC VL	281.48± 124.55	332.6± 140.01	286.6± 118.85	197.81to 365.15	238.55 to 426.66	206.83 to 366.50	0.149	NS
Strength	15.01± 1.84	13±2.78	14±2.25	13.77 to 16.24	11.13 to 14.87	12.49 to 15.51	0.051	NS
Perceived Soreness		50	41.67±17.68		47.20 to 22.59	57.34 to 50.14	0.026	S*

*S – Significant
NS – Not Significant

It may also be associated with KT affecting subjective pain perception. In addition to KT, the test group also received athletic massage which enhances blood and lymph flow thereby aiding the clearance of the accumulated waste substrates [3].

The benefits of kinesiotaping are dependent on the stretch of the tape and the form of placement on the skin, which elicits: positional stimulus and correction of muscle function; improvement of fascial tissue alignment also known as the lifting effect; [11] facilitation of bodily fluid circulation; repair of injured tissues; sensory stimulation assisting or limiting movement[12]. These factors thereby possibly altered the subjective perception of pain and soreness by activation of cutaneous receptors, activation of sensory pathways in the nervous system and increased afferent feedback[13].

Influence Of K-Taping on Quadriceps Muscle Strength: There is a decrease in muscle strength of the quadriceps muscle 48 hours post exercise in both the groups with the decrease being statistically significant in the control group ($p<0.05$) ($p=0.0187$). This is similar to the findings noted in previous studies[10, 14].

This might be due to protective reflex inhibition caused by pain and inflammatory response. The literature shows that after a bout of unaccustomed eccentric exercise there is a reduction in strength which might be due to a decline in the inherent capacity of the muscle to produce force[15] This is also consistent with the findings of a previous study which noted no increase in muscle strength following application of kinesiotaping on quadriceps muscle[16].

The findings in this study do not support the previous possible mechanisms of KT which state that increase in muscle strength is due to increased blood flow to the muscle through the increased space between skin and muscle created by the application of KT. The findings of our study do not seem to agree with the preliminary study by Slupik et al who although did not measure strength directly, found the electromyographic recruitment of the vastus medialis to be increased after KT application[17].

Effect of Kinesiotaping on MVIC Of Quadriceps Muscle: The MVIC of Rectus Femoris (Channel A), Vastus Medialis (Channel B) and Vastus Lateralis (Channel C) post 48 hours of KT application did not show a statistically significant change in both the control and the test group. This could be because the KT application couldn't possibly stimulate adequate cutaneous receptors to increase the neuromuscular recruitment of the quadriceps muscle by interacting with motor control and altering the excitability of the central nervous system [18].

This is consistent with findings of a similar study performed by CAA Lins et al (2012) where immediate effect of KT application on neuromuscular function and lower limb function was studied [19].The findings of this study also corroborate with the findings by Fu et al,2007 who concluded that KT application on quadriceps muscle did not have an immediate effect on peak torque of the muscle[18].

One reason for these conflicting findings as explained by various authors could be the different eccentric exercise protocols followed in the studies which each result in different magnitude of damage in different muscle groups. A second reason being variation in response of different individuals to the same exercise protocol [20,21].

Conclusion: This study concluded that KT: reduced perceived muscle soreness measured 48 hours post intervention when compared with athletic massage and had no effect on quadriceps strength and Maximal Voluntary Isometric Contraction (MVIC) measured 48 hours post intervention.

Athletic Massage: decreased quadriceps strength measured 48 hours post intervention and had no effect on Maximal Voluntary Isometric Contraction (MVIC) measured 48 hours post intervention.

Clinical Implication: Muscle soreness often alters performance in sports and exercise. Use of techniques such as KT and athletic massage to alleviate DOMS can reduce the perceived soreness and can reduce the recovery time. This can aid the individuals to perform optimally in sports, recreational sports or exercise. KT is a valuable adjunct to reduce perceived muscle soreness due to induced DOMS.

Limitations: Repeated measurements and follow up after 48 hours post intervention up to 7-10

days post intervention (as soreness completely is said to subside by 7-10 days) were not done in the present study i.e carry over effect of the intervention was not studied. Objective measures of muscle soreness such as muscle damage markers (eg: Creatine Kinase) were not measured/ monitored in this study. The effect of KT was studied on induced DOMS only.

References:

1. Kisner Carolyn, Colby Lynn Allen. Therapeutic Exercise Foundations and Techniques. In:Vicky Humphrey, Mallory Skinner, FA Davis editors. Resistance Exercise for Impaired Muscle Performance. 6th ed. Philadelphia: FA Davis. 2012: 196-197
2. Burnett D, Smith K, Smeltzer C, Young K, Burns S. Perceived muscle soreness in recreational female runners. International journal of exercise science. 2010;3(3):108-116.
3. Zainuddin Z, Newton M, Sacco P, Nosaka K. Effects of massage on delayed-onset muscle soreness, swelling, and recovery of muscle function. Journal of athletic training. 2005 Jul;40(3):174-180.
4. Weber MD, Servedio FJ, Woodall WR. The effects of three modalities on delayed onset muscle soreness. Journal of Orthopaedic & Sports Physical Therapy. 1994 Nov;20(5):236-42.
5. Ernst E. Does post-exercise massage treatment reduce delayed onset muscle soreness? A systematic review. British journal of sports medicine. 1998 Sep 1;32(3):212-4.
6. Thought technology, Software Dynamap Suite, Canada, Thought technology, cited [2019, February 6] available from: https://thought technology.com/index.php/software/dynama p-suite.html
7. SENIAM, Sensor location, European Union, SENIAM [cited 2019, February 6] available from www.seniam.org/
8. Ozmen T, Aydogmus M, Dogan H, Acar D, Zoroglu T, Willems M. The effect of kinesio taping on muscle pain, sprint performance, and flexibility in recovery from squat exercise in young adult women. Journal of sport rehabilitation. 2016 Feb;25(1):7-12.
9. Kinesio IP,LLC,Kinesio Taping Assessments, Fundamental Concepts and Techniques, pp 107-108
10. Hazar Kanik Z, Citaker S, Demirtas CY, Bukan NC, Celik B, Gunaydin G. Effects of Kinesio-Taping on the Relief of Delayed Onset Muscle Soreness: A Randomized, Placebo-Controlled Trial. Journal of sport rehabilitation. 2018: pp 1-22.
11. Memon H, Shimpi A, Shyam A, Sancheti P. Can upper limb taping or exercises improve hand function, writing speed and self-perception of performance in adolescent school children?. International Journal of Adolescent Medicine and Health. 2018 Jul 31.
12. Lemos TV, Pereira KC, Protássio CC, Lucas LB, Matheus JP. The effect of Kinesio Taping on handgrip strength. Journal of physical therapy science. 2015;27(3):567-70.
13. Kruszyniewicz J, Skonieczna-Żydecka K, Sroka R, Adler G. The analgesic efficacy of Kinesiology taping in delayed onset muscle soreness (DOMS). Central European Journal of Sport Sciences and Medicine. 2016;1(13):73-9.
14. Weerapong P, Cheung K, Hume PA, Maxwell L. DOMS: An overview of treatment strategies. International SportMed Journal. 2004 Jan 1;5(2):98-11
15. Smith LL, Fulmer MG, Holbert D, McCammon MR, Houmard JA, Frazer DD, Nsien E, Israel RG. The impact of a repeated bout of eccentric exercise on muscular strength, muscle soreness and creatine kinase. British Journal of Sports Medicine. 1994 Dec 1;28(4):267-71.
16. Vercelli S, Sartorio F, Foti C, Colletto L, Virton D, Ronconi G, Ferriero G. Immediate effects of kinesiotaping on quadriceps muscle strength: a single-blind, placebo-controlled crossover trial. Clinical Journal of Sport Medicine. 2012 Jul 1;22(4):319-26.
17. Słupik A, Dwornik M, Białoszewski D, Zych E. Effect of Kinesio Taping on bioelectrical activity of vastus medialis muscle. Preliminary report. Ortopedia, traumatologia, rehabilitacja. 2007;9(6):644-51.
18. Fu TC, Wong AM, Pei YC, Wu KP, Chou SW, Lin YC. Effect of Kinesio taping on muscle strength in athletes—a pilot study. Journal of science and medicine in sport. 2008 Apr 1;11(2):198-201.
19. de Almeida Lins CA, Neto FL, de Amorim AB, de Brito Macedo L, Brasileiro JS. Kinesio Taping® does not alter neuromuscular performance of femoral quadriceps or lower limb function in healthy subjects: Randomized, blind, controlled, clinical trial. Manual Therapy. 2013 Feb 1;18(1):41-5.
20. Clarkson PM, Sayers SP. Etiology of exercise-induced muscle damage. Canadian journal of applied physiology. 1999 Jun 1;24(3):234-48.

21.Nosaka K, Newton M, Sacco P. Delayed-onset muscle soreness does not reflect the magnitude of eccentric exercise-induced muscle damage. Scandinavian journal of medicine & science in sports. 2002 Dec;12(6):337-46.

Conflict of interest: None
Funding: None
Cite this Article as: Chiddarwar V, D A. Comparison Of Effectiveness Of KT And Athletic Massage On Induced Delayed Onset Muscle Soreness [DOMS] In Quadriceps Of Normal Healthy Individuals. Natl J Integr Res Med 2020; Vol.11(4): 47-54