Effect of Eccentric Muscle Training to Reduce Severity of Delayed Onset Muscle Soreness in Athletic Subjects

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Eur J Gen Med 2009; 6(4): 213-217

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ABSTRACT

Aim: *To verify whether "Eccentric muscle training of quadriceps femoris muscle in athletes will be effective in minimizing the incidence and severity of delayed onset muscle soreness (DOMS)". Long distance runners suffer with delayed onset muscle soreness. Many interventions have been tried and reported.*

Methods: *Forty long distance male runners between 18-25 years of age were included in this study. They were equally categorized in two groups. Control group consisted of the subjects who were given only stretching exercises. The experimental group was given eccentric repetitive low intensity eccentric muscle training of quadriceps femoris muscle along with stretching exercises. Visual Analog Scale (VAS) pain scale and Functional Independence Measure Score (FIMS) were used as prognostic tools. The data collected was analyzed with the help of unpaired "t" test and chi square test.*

Results: *Experimental group showed improvement in pain scale compared to control group (t value= 2.02 at p< 0.05). FIMS showed significant improvement in experimental group (t value= 2.02 at p< 0.05).*

Conclusion: *Eccentric training of quadriceps femoris muscle can be incorporated into warm up program for the long distance runners to reduce delayed onset muscle soreness.*

Key words: *Muscle soreness, Eccentric exercises, Flexibility exercises, Long distance runners.*

INTRODUCTION

Delayed onset muscle soreness (DOMS) is a common restricting factor for performance of athletes as it causes low muscle power output leading to poor performance of athletes in competition. DOMS becomes noticeable in muscle bellies and myotendinous junction approximately after 12 hours to 24 hours of strenuous exercise and requires about 1 week to resolve.

Unfamiliar and unaccustomed activities regardless of fitness level of an individual cause DOMS. DOMS is frequently seen in beginners and novice trainers of physical activities, dropouts of physical activities and the athletes with new exercise programme.

The symptoms of DOMS include pain, limitation at range of motion, decreased force output and infrequent muscle swelling.

Eccentric exercises have been reported to be effective in reducing DOMS (1). American college of sports medicine has prescribed norms of eccentric exercises in preventing DOMS (2).

The objective of present study was to evaluate role of eccentric exercises in reducing DOMS amongst male athletes.

MATERIALS and METHODS

This comparative study for role of eccentric muscle exercise in DOMS was conducted on 40 male athletes who were student of Ranibai Agnihotri College of Physical Education at Wardha, Maharashtra State, India. Local Ethical Committee approval was obtained before study. The inclusion criteria were as under:

1. Age between 18-24 years,
2. Males only,
3. Long distance runner of 1500 meter and above,
4. Athletes with no history of injury to quadriceps femoris and hamstring muscle,
5. Athletes with no history of medication of recent past.

These athletes went through preliminary questionnaire pertaining to their awareness of DOMS, its management and its effect on efficiency of performance. The written informed consent was taken.

These athletes were included in study of simple randomized sampling method. They were divided in two groups of 20 each; group A as control and Group B as experimental group. Group A and Group B subjects were trained for 14 days of general warming and jogging exercises for 5 minutes.

Group A subjects were given conventional method of stretching exercises of lower extremity for hamstring, quadriceps, illiotibial band, tensorfaciae latae, glutei, calf and adductors. Each stretch was for 15 seconds on each side.

Group B subjects underwent specific dynamic flexibility exercises for quadriceps femoris apart from stretching exercises. These exercises were performed in a down and back fashion over 15 yards (13.716) meter. These flexibility exercises administered were working as eccentric activity of quadriceps femoris muscle.

These dynamic flexibility exercises included leg cradle, forward lunge, backward lunge, lateral lunge, drop lunge, butt kicks, carioca and backward reach run.

Subjects in-Group B were administered these exercises with repetition and duration of these exercises was gradually increased. Plyometric and weight training exercises were avoided during this period.

The subjects from both Group A and Group B went for an athletic competition after 14 days of training programme. The presence and severity of DOMS was recorded after 48 hours of competition of athletic event amongst subjects.

Visual analog scale (VAS) was applied for pain in both groups for comparison. It is a 10 cm long non- segmental horizontal line and measures the magnitude of pain at the time of testing done after the treatment for both control and experimental group and it was used after 48 hours of athletic event. Functional independence measure score (FIMS) was also applied in both groups to assess the degree of functional performances of athletes after the 48 hours. The performance was assessed by the subjects ability to do Activities of Daily Living (ADL) which included grooming, bathing, dress upper body, dress lower body, toileting, bed, chair, toilet, tub or shower, walking, stairs, expression, social interaction, problem solving memory. The score was calculated as : 0-Totally Incapacitated,

1. Only Able to do 25%,
2. Only able to do 50%,
3. Only able to do 75%,
4. With Supervision,
5. Can do Activities with Device,
6. Can do Activity Unaided.

RESULTS

Mean age of control group (Group A) was 21 years while mean age of experimental group (Group B) was 22 years. Other variable of height, weight and body mass index for their mean values in group A and group B did not vary much. The mean weight in control group (group A) was 56.4 kg. and in experimental group (group B) was 54.8 kg (Table 1).

The comparison of the muscle soreness in control and experimental group has shown that the control group had the higher number of subjects (11) with soreness than the experimental group (7), at the end of one week. The mean±SD of duration of soreness for control group was 2.55±5104 and for experimental group was 2.0±0.9176 at $p< 0.05$ (Table 2).

The observation regarding the other treatment apart from medication prior to study has shown through questionnaire that in control group there were 15 subjects who took massage while in experimental group there were five subjects who took massage prior to the beginning of study. The questionnaire also revealed that eight subjects in control group were taking some kind of medication while there were only three subjects who took medication in experimental group. The details of the medications taken were

Table 1. *Mean age, height, weight and Body Mass Index (BMI).*

Parameter	*Experimental group*	*Control group*	*P value*
Age	*21.65±1.35*	*20.90±1.07*	*p> 0.05*
Height	*5.54±0.10*	*5.58±0.12*	*p> 0.05*
Weight	*54.80±3.24*	*56.45±3.28*	*p> 0.05*
BMI	*19.95±1.236*	*20.34±0.833*	*p> 0.05*
Duration of participation in sports	*3.93±1.44*	*3.23±0.62*	*1.94 Not-Sig p> 0.05*

Table 2. *Comparative table showing no. of athletes and duration of soreness in control and experimental group.*

Duration of soreness	*Experimental group*	*Control group*	*Total*	*P-Value*
Few Hrs (0)	*1*	*-*	*1*	*13.42 Significant*
One Day (1)	*5*	*-*	*5*	*p< 0.05*
Two Day (2)	*7*	*9*	*16*	
Upto 1 WK (3)	*7*	*11*	*18*	
Total	*20*	*20*	*40*	
Mean	*2.0*	*2.55*		
SD	*0.9176*	*0.5104*		
95% confidence Limit $\bar{x} \pm 2SE(\bar{x})$	*2.0±0.9176*	*2.55±5104*		

X^2 tabulated value = 7.82, Degrees of freedom = 3.

not recorded as the questionnaire circulated for this study did not consider it a significant criterion.

It was observed that 17 subjects continued playing after DOMS in experimental group while nine athletes continued playing after DOMS in control group, before the induction of the training programme.

Dynamic flexibility exercises had shown improvement in athletic performance of athletes and recession of the symptoms of the DOMS and increase in the efficiency was recorded in the 13 athletes in the experimental group. There were six athletes in the control group who could achieve an increased efficiency with routine stretching exercises.

Visual analog scale (VAS) for the pain had revealed that the DOMS associated pain had reduced remarkably with dynamic flexibility exercise in experimental group than in the control group (Table 3).

The comparison of FIMS between experimental and control group has shown that a significant rise at the performance was achieved in experimental group athletes than the control group athletes (Table 4).

The eccentric exercises have shown the over all increase in performance of the athletes as well as decreased incidence of DOMS amongst the athletes who have undergone these exercises.

DISCUSSION

This study aimed at finding the efficacy of eccentric muscle training to the quadriceps femoris muscle in reducing the severity of DOMS in athletes; subjects had the parallel result with other studies conducted on the subject.

DOMS has been cited as the most frequently experienced sequel to marathon race participants and weight lifting competition (3). It has also been shown that light eccentric exercises protect the athletes against DOMS. The study of Balnave and Thompson (4) had revealed that training of eccentric muscle exercises as a basic warm-up programme can protect the athletes from impaired or apparent muscle damage (4). This view has also been supported by studies of Schwane et al. (5) The findings in the present study are much similar to the inferences of above studies, stressing the major role of eccentric muscle exercises as a part of warm up programme prior to any athletic activity.

Hortobagyi T et al. (6) worked on adaptive response to quadriceps muscles lengthening and shortening in humans. This study (6) shows that adaptation to training with eccentric contraction is associated with greater neural adaptation and muscle hypertrophy than the concentric exercises. Johansson et al. (7) has contradicted that eccentric exercises have preventing effect on muscle soreness, tenderness and force loss. Armstrong (8) has expressed similar view except that the previous specific training of involved muscle may be preventive for DOMS (8). The present study with the help of visual analog scale has a contradictory finding to above study. The present study shows that the DOMS is preventable to some extent and muscle tenderness can be lowered by eccentric muscle exercises.

The findings in present study show that efficacy of eccentric muscle training of the quadriceps femoris muscle reduce the severity of DOMS in athletic subject. The eccentric muscle exercises therefore may be administered as additional component in the warm up programme of the athletes. Especially eccentric muscle exercises may be vital in decreasing DOMS of quadriceps muscle in the long distance runner.

***Table 3**. Comparative average values of VAS and its SD in both experimental and control group.*

VAS	*Experimental group*	*Control group*	*p values*
Mean	*4.0*	*8.0*	*12.105 Significant*
SD	*0.7779*	*1.2565*	*p< 0.05*
95% confidence limit x±2SE (x)	*4.0±0.3478*	*8.0±0.5619*	

***Table 4**. Comparative average values of FIMS and its SD in both experimental and control group.*

FIMS Score in %	*Experimental group*	*Control group*	*p values*
Mean	*98.95*	*92.7*	*8.26*
SD	*1.276*	*3.13*	*Significant p< 0.05*
95% confidence limit x±2SE (x)	*98.95±1.276*	*92.7±1.399*	

Acknowledgement

Authors are thankful to Dr. Arvind Bhake, Professor of pathology, JNMC, DMIMS Sawangi (M), Wardha

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