The Effects of MSM Supplementation on Knee Kinetics during Running, Muscle Strength, and Muscle Soreness following Eccentric Exercise-Induced Quadriceps Damage

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INTRODUCTION

Runners are constantly seeking new approaches to optimize performance and training gains. Delayed onset muscle soreness (DOMS) is elevated following eccentric knee extensor damage (i.e., downhill running) [1]. Along with elevated DOMS, reductions in ankle and knee range of motion (ROM) and knee stiffness have been reported following eccentric knee extensor damage in the 48 hours following damage [1].

Strategies to reduce the duration of DOMS and associated changes in joint biomechanics are important for runners to ensure safe continuity in training. Many strategies have been suggested to speed up recovery. The degree of muscle injury may be influenced by nutritional interventions [2]. Methylsulfonylmethane (MSM) has anti-inflammatory properties [3] that may aid in reducing the duration of DOMS following muscle damage.

The purpose of this study was to investigate the effects of MSM supplementation on knee joint kinetics during running and DOMS following eccentric knee extensor damage. It was expected that the MSM intervention would reduce the negative effects of muscle damage on these variables compared to a placebo.

METHODS

Forty healthy, resistance trained men (age: 25.28±6.31 y, ht: 177.63±6.57 cm, BMI: 26.65±2.47 kg·m^{-2}) were recruited to participate. Subjects were randomly assigned in double-blind manner to one of two groups: MSM at 3 grams per day (n=20) or placebo (rice flour; n=20). Subjects underwent a one-month supplementation period prior to testing sessions.

Subjects were tested over a period of five consecutive days: Baseline, 0 hrs, 24 hrs, 48 hrs, and 72 hrs. All daily testing procedures were the same. For the muscle damage protocol subjects performed 10 sets of 10 repetitions (or reps to failure) of eccentric seated knee extension exercise on a 4-second count using 100% of concentric one-repetition maximum. Subjects were given a 2-minute rest period between sets.

Self-reported lower extremity muscle soreness was measured each testing day using a 10-point visual analog scale (VAS) rating for soreness during a body squat and passive knee flexion stretch. Muscle damage was quantified with maximum voluntary isometric knee extensor force using a load cell (MLP-1K, Transducer Techniques). The average of the force plateau of three maximal trials was used for analysis. An 8-camera motion analysis system (120Hz, Qualisys AB,) and a force platform (1200Hz, AMTI, Inc) were used to obtain 3D kinematic and ground reaction force (GRF) data, respectively. Subjects performed three over-ground running trials over a 20 m runway at 3.35 m·s^{-1} ±5% contacting the force plate with their right foot. Visual3D biomechanical analysis software suite (C-Motion, Inc.) was used to compute 3D kinematic and kinetic variables of the right limb during running. Sagittal knee stiffness was computed as the ratio of the change in extensor moment and knee flexion ROM. Since dependent variables were different between groups at baseline, data were normalized using the difference between baseline means.

Mixed design repeated measures ANOVA (Group x Time) were used to compare dependent variables. *Post hoc* paired t-tests were used for pairwise comparisons. Mann Whitney U test was used to compare the VAS rating of soreness results between interventions and test times (i.e., non-parametric data) ($P<0.05$).

RESULTS AND DISCUSSION

Maximal isometric force to assess muscle damage showed no interaction ($P=0.38$) or group effects ($P=0.85$) but showed a time main effect ($P<0.001$; Figure 1). Maximal force was reduced at every time point ($P<0.05$) compared to baseline except for 72hrs post ($P=0.12$). By 72hrs post damage, values returned to baseline for subjects in the MSM condition but remained approximately 8% below baseline for those in the placebo condition (Figure 1); however, the difference was not of statistical significance. DOMS during squat was not different between groups at any time ($P>0.05$) but was different at every time point compared to baseline ($P<0.001$). DOMS during passive stretch was lower in MSM group but remained elevated above baseline. These findings confirm that muscle damage and DOMS persist after 48 hrs [1] and that DOMS remain up to 72 hrs following muscle damage.

No interaction or group effects were found for biomechanical variables. Knee stiffness ($P=0.002$), knee moment ($P<0.001$), knee eccentric power ($P<0.001$) and loading rate ($P=0.02$) all showed time effects. All variables, except for loading rate, did not returned to baseline levels following damage (Table 1). Loading rate was decreased at 24, 48 and 72 hrs compared to 0 hrs, but not compared to baseline. Although not significant, loading rate was slightly higher than baseline at 0 hrs ($P=0.09$) which likely explains why 24 to 72 hrs were not different than baseline.

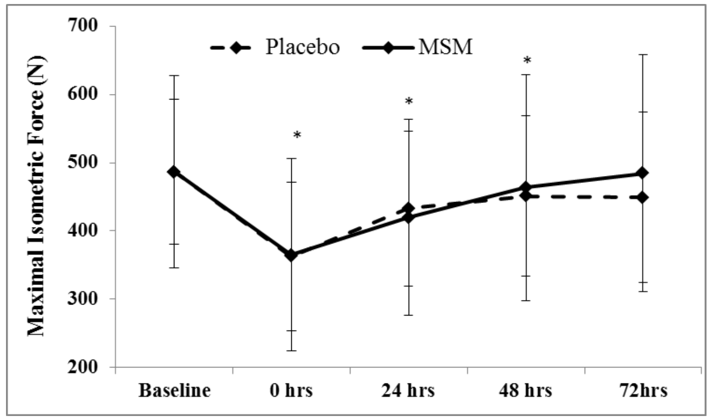

Figure 1. Maximal isometric knee extensor strength at each testing time. *: different than baseline.

CONCLUSIONS

Our findings suggest that MSM does not favorably influence knee biomechanics following eccentric exercise-induced muscle damage using knee extension exercise. MSM supplementation may positively impact muscle force recovery, as well as DOMS during passive stretch.

REFERENCES

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Table 1. Knee joint kinetics and peak instantaneous loading rate of the vertical GRF for each group at all five test times (mean ± SD).

		Baseline	0 hrs post	24 hrs post	48 hrs post	72 hrs post
Knee Stiffness [a,b,d]	**Placebo**	0.10±0.03	0.08±0.02	0.09±0.03	0.09±0.04	0.09±0.03
(Nm/kg/°)	**MSM**	0.10±0.02	0.08±0.02	0.09±0.02	0.09±0.01	0.09±0.02
Peak Knee Moment [a,b,c,d]	**Placebo**	2.74±0.47	2.30±0.57	2.57±0.63	2.46±0.53	2.52±0.58
(Nm/kg)	**MSM**	2.74±0.54	2.31±0.56	2.46±0.55	2.41±0.54	2.44±0.54
Peak Knee Power [a,b,c,d]	**Placebo**	14.5±3.2	11.8±5.1	13.1±4.3	13.3±4.1	13.59±4.0
(W/kg)	**MSM**	14.5±5.3	12.0±4.9	12.7±4.4	12.4±5.0	12.90±4.2
Loading Rate [e]	**Placebo**	86.5±27.3	88.8±25.8	84.8±24.8	86.0±28.1	84.5±26.9
(BW/s)	**MSM**	86.5±20.4	88.5±19.0	81.5±17.8	82.1±23.2	81.7±16.8

Notes: Time Main Effects: [a]: 0 hrs different than baseline; [b]: 24 hrs different than baseline; [c]: 48 hrs different than baseline; [d]: 72 hrs different than baseline; [e]: 24, 48 and 72 hrs different than 0 hrs