Guasha improves the rating of perceived exertion scale score and reduces heart rate variability in male weightlifters: a randomized controlled trial

Wang Xingze, Chen Peijie, Huang Xingyu, Wang Yingying, Yang Jinsheng, Wichai Eungpinichpong, Yang Yuming, Uraiwan Chatchawan

OBJECTIVE: To evaluate the effects of Guasha therapy on the rating of perceived exertion (RPE) scale score, and heart rate variability (HRV).

METHODS: A randomized controlled trial of Guasha (skin scraping) was compared with a sham scraping group and control group. Sixteen sessions within an 8-week period were completed. Sixty-five male weightlifters who had undergone normal weightlifting training for a mean of 5 years before study commencement were recruited. The RPE scale score of "snatch", "clean and jerk" maneuvers (85% of one-repetition maximum), and HRV were measured before and after the intervention.

RESULTS: The RPE scale score for snatch, clean and jerk were reduced significantly after intervention in the Guasha group and sham group. However, there was a significant difference in the low frequency (LF) domain and LF/high frequency (HF) ratio ($P < 0.05$): the LF domain decreased, and the LF/HF ratio decreased.

CONCLUSION: Guasha could be used to reduce the RPE scale score, and increase the response to HRV. Guasha could be considered as an alternative to some types of recovery from sports training.

INTRODUCTION

To improve the effects of training, sports coaches look for ways to aid recovery from fatigue. Thai traditional massage, acupuncture, and "tui na" (traditional Chinese massage) are considered appropriate and effective methods to aid recovery from fatigue. The speed of recovery from muscle fatigue after each training session is important for weightlifters.

Another form of traditional Chinese therapy, "Guasha", is defined as the physiotherapy of scraping repeatedly on a certain body area using a blunt, spoon-like object. Guasha increases the temperature of local skin,
the volume of blood perfusion, and the microcirculation in healthy subjects, and reduces muscle pain in patients with chronic neck pain. Moreover, a study in rats has suggested that Guasha increases the activity of superoxide dismutase, bilirubin concentration, and white blood cell count. Guasha can be used to improve players’ ability by reducing the weight sensation and release of creatine kinase.

Heart rate variability (HRV) is a key marker used to evaluate fatigue severity. Physiologic studies have shown that, in general, high variability of the inter-beat interval corresponds to enhanced activity of the parasympathetic nervous system, whereas low variability of the inter-beat interval suggests strengthened activity of the sympathetic nervous system. The rating of perceived exertion (RPE) scale is a measurement of the level of perceived exertion (RPE) scale is a measurement of activity of the sympathetic nervous system. Moreover, a study suggested that, in general, high variability of the inter-beat interval corresponds to enhanced activity of the parasympathetic nervous system, whereas low variability of the inter-beat interval suggests strengthened activity of the sympathetic nervous system.

The present study was a randomized controlled trial. Study design
The present study was a randomized controlled trial. For individuals who met the inclusion criteria (The subjects who have been no injury in the last 6 months, no smoking, no alcohol, no history of hormone therapy, and no current health problem), subjects at the same level were allocated randomly (using the method of stratified random allocation) to the Guasha group (GG), sham scraping group (SSG), or control group (CG) (Table 1). Duration of 8 weeks (16 sessions) was chosen to observe the responses to Guasha on participants. A flow diagram of the trial is shown in (Figure 1). All Guasha therapists have been trained and had certificate about Guasha therapist.

Monitoring of normal weightlifting training
Only the coach controlled weightlifting training. The coach did not know which group the participants were in. This experiment took place in November and December 2013, and January 2014. Each weightlifting training session had three parts: warm up; main part of training; relaxation training (participants massaged each other). The volume of weight training increased during the study, and the training program with regard to intensity/volume is shown in Table 2.

Participants
The study cohort was 65 male weightlifters from the Weightlifting Training Center in Jiangxi Province (China). Two participants were lost in the GG and SSG, because of injury and family matters (Figure 1). Participants underwent a physical examination to exclude health problems or injuries. At baseline, the mean age was (20.6 ± 1.7) years, mean weight was (75.3 ± 20.3) kg, mean height was (172.7 ± 6.4) cm, and mean body mass index was (23.7 ± 2.4) kg/m². Duration of pre-study training was (5.8 ± 0.6) years, and mean athletic level was (2.0 ± 0.6). Titles of athletes in China are “international master of sports” (1+), “master of sports” (1), “first grade” (1), “second grade” (2), “third grade” (3), and “young athlete” (4). All weightlifters were informed about the nature and risks of the experimental procedures before they provided written informed consent to participate. The study proposal was approved by the Ethical Committee of Khon Kaen University (Khon Kaen, Thailand) and the Chinese Clinical Trial Registry (ChiCTR-ICR-15006302) in Chengdu (China).

Guasha intervention
The instruments used to carry out Guasha were a buffalo-horn scraper and a skin lubricant (Jinlongkang; Scraping Cupping Research Institute, Beijing, China) to reduce friction. The head, neck, and back of each participant were scraped about 45° between the scraper and skin. Scraping was done at 08:30-11:30 on Thursday and Sunday, two sessions per week for 8 weeks, for a total of 16 sessions (Figure 2). Definitions of Guasha and sham scraping are shown in Table 3. The number of strokes was 60 for the head, neck (60), whole back (40), upper back (40), middle back (40), and lower back (20). Total duration of Guasha was 20 min.

**MATERIALS AND METHODS**

**Study design**
The present study was a randomized controlled trial. For individuals who met the inclusion criteria (The subjects who have been no injury in the last 6 months, no smoking, no alcohol, no history of hormone therapy, and no current health problem), subjects at the same level were allocated randomly (using the method of stratified random allocation) to the Guasha group (GG), sham scraping group (SSG), or control group (CG) (Table 1). Duration of 8 weeks (16 sessions) was chosen to observe the responses to Guasha on participants. A flow diagram of the trial is shown in (Figure 1). All Guasha therapists have been trained and had certificate about Guasha therapist.

**Monitoring of normal weightlifting training**
Only the coach controlled weightlifting training. The

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**Table 1 Number of participants at each athletic level**

<table>
<thead>
<tr>
<th>Athletics level</th>
<th>Symbol</th>
<th>Training period (average years)</th>
<th>Guasha group (n)</th>
<th>Sham group (n)</th>
<th>Control group (n)</th>
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<tbody>
<tr>
<td>International masters of weightlifting</td>
<td>++</td>
<td>&gt;10</td>
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<tr>
<td>Masters of weightlifting</td>
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<tr>
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<tr>
<td>Third grade level</td>
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<tr>
<td>Young athletes level</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>21</td>
<td>23</td>
<td>21</td>
</tr>
</tbody>
</table>

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**Definitions of Guasha and sham scraping**

Guasha

- **1+** - International master of sports
- **1** - Master of sports
- **2** - First grade
- **3** - Second grade
- **4** - Third grade

Sham scraping

- **2** - First grade
- **3** - Second grade
- **4** - Third grade
- **5** - Young athlete

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**Further details on study procedures and outcomes**

The study design, inclusion criteria, and outcome measures are further described in Table 1. The study was approved by the Ethical Committee of Khon Kaen University (Khon Kaen, Thailand) and the Chinese Clinical Trial Registry (ChiCTR-ICR-15006302) in Chengdu (China). The study cohort was 65 male weightlifters from the Weightlifting Training Center in Jiangxi Province (China). Two participants were lost in the GG and SSG, because of injury and family matters (Figure 1). Participants underwent a physical examination to exclude health problems or injuries.
Pressure of Guasha by therapists was classified as "mild" [(487 ± 21) g] and "moderate" [(626 ± 11) g] based on measurements taken using an electronic kitchen scale. "Sha" describes stasis within the tissue as well as the petechiae raised from Guasha signifying liberation of that stasis in GG, however, only red on the skin in SSG. Safety during the present study was based on the Guasha standard.

20, 21 CG participants were trained during normal conditions without scraping. Data collection was at a mean of 27 °C without direct sunlight, infrared radiation, or indoor-outdoor ventilation. 22 Humidity was 50%-60%. Guasha interventions were undertaken in a laboratory rehabilitation room in the clinic of the Weightlifting Training Center in Jiangxi Province. Participants ate breakfast, lunch, and dinner in the same restaurant in this venue training center to maintain the same quality of nutrition during this study.

**Measurement of the RPE scale score**
The RPE Scale was used to measure the "weight sense" of each participant 2 weeks before and 2 weeks after the experiment. "Normal" weightlifting training does not start at ≈ 2-3 h in the afternoon from Monday to Saturday. Intensity of training was 40%-95% of one-repetition maximum (1 RM), including some sets of training [e.g., warm up, main training sets ("snatch", "clean and jerk", "squat", etc.)].
Figure 2 Locations of surface skin scraping in our study

Measurement of HRV
Recording of HRV was from the chest wall for 5 min using Biofeedback 2000™-e (v4.2; Schuhfried, Vienna, Austria). The sampling frequency was 100 Hz. The red-electrode cable was attached to the left chest in the area of the fifth rib and the blue-electrode cable to the right chest. The reference-electrode cable was attached to the Adam’s apple. Environmental requirements were to avoid too-bright light or too-loud noise in the morning, and to avoid caffeine for at least 2 h and for 2 h after breakfast. The participant maintained a comfortable sitting position during the measurement. He did not talk or move, and did not close his eyes or fall asleep. Low frequency (LF) activity and high frequency (HF) activity were measured before and after the intervention with a HRV monitor (Bioforce, Ames, IA, USA). Breathing was guided so that the participant breathed normally throughout the period of measurement in relaxing conditions.25,26

Statistical analyses
Paired t-tests were applied to compare within-group differences (0 week and 8 weeks). Analyses of variance were used to compare baseline differences in each group. Analyses of covariance were used to compare post-test differences in each group. Data are the mean ± standard deviation (\( \bar{x} \pm s \)). Data analyses were carried out using SPSS 17.0 (IBM, Armonk, NY, USA). \( P < 0.05 \) was considered significant.
RESULTS

RPE scale score

A significant difference in the RPE scale score for snatch, and clean and jerk (85% of 1RM) before and after intervention in the GG (0.000), SSG (0.006), and CG (0.113) for 8 weeks was noted. Data from the three groups showed no significant difference in the RPE scale score before intervention (P > 0.05). After treatment, participants in the GG and SSG showed a significant reduction in the RPE scale score. That is, in the GG, the value for snatch changed from 17.3 ± 0.7 to 14.2 ± 0.9 (P < 0.05) and that for clean and jerk changed from 18.4 ± 1.0 to 16.2 ± 1.3 (P < 0.05). In the SSG, the snatch changed from 17.2 ± 0.9 to 16.0 ± 0.9 (P < 0.05), and the clean and jerk changed from 18.4 ± 0.8 to 17.3 ± 0.9 (P < 0.05) (Table 5). However, changes in the RPE scale score in the GG were greater than those for the SSG. There was no significant difference within the CG (0.113). Nevertheless, there was a significant difference between the GG and SSG (0.000) or CG for RPE (0.000) scale scores.

Frequency domain of HRV

Changes in the frequency domain of HRV were not significantly different before and after Guasha (P < 0.05) in the GG. Values for LF and HF domains, and the ratio of LF/HF before Guasha were 0.076 ± 0.024, 0.252 ± 0.053, and 0.324 ± 0.164, and changed to 0.065 ± 0.023, 0.25 ± 0.042, 0.265 ± 0.089, respectively, after Guasha intervention. Also, values for LF and HF domains, and the ratio of LF/HF before sham scraping were 0.077 ± 0.017, 0.253 ± 0.045, and 0.318 ± 0.116, and changed to 0.084 ± 0.018, 0.237 ± 0.038, 0.366 ± 0.109 after sham scraping (Table 6). These data revealed that the HF domain remained stable in the GG, but declined in the SSG. Moreover, the LF domain declined in the GG, but increased significantly in the SSG (0.02). Furthermore, the same trend was shown in the LF/HF ratio. There was a significant difference in the LF domain and LF/HF ratio (P < 0.05) in the GG and SSG, and also in the LF domain within the CG (0.03). Furthermore, there was a significant difference between the GG and SSG, and GG and CG (P < 0.05), for HRV.

DISCUSSION

RPE scale score decreased after Guasha under normal weightlifting training

The RPE Scale is a measurable subjective perception referring to the amount of effort expended while participating in training. Studies have shown that the RPE scale score is an index to evaluate perceived exertion in...
exercise testing, training, and rehabilitation, and has been validated against objective markers of exercise intensity. The RPE scale score can reflect exercise intensity because it has been suggested that combined psychologic and physiologic changes during severe training provide important indicators for monitoring of training. Studies have demonstrated that the RPE scale score increases after training without intervention. However, Bing et al. demonstrated that point-sticking therapy alleviated the symptoms induced by exercise-induced fatigue by measuring the RPE scale score and biomarker levels. Furthermore, changes in RPE scale scores correlate with changes in lactate levels, maximal oxygen consumption, and heart rate in post-exercise recovery.

The present study demonstrated that the RPE scale score decreased with Guasha under normal weightlifting training. The change in the RPE scale score for snatch was from 17.3 ± 0.7 to 14.2 ± 0.9 in the GG. The subjective perceived exertion from the same intensity load (85% of 1RM) decreased, so this could affect changes in the weightlifting skill, strength gain, or neural control of the participants. These changes could be due (at least in part) to the effects of Guasha. There was also a significant decrease, from 17.1 ± 0.9 to 16.1 ± 0.9, in the SSG. Moreover, there was no significant change in the CG. Again, the subjective perceived exertion from very difficult to less difficult demonstrates an increase in weightlifting ability. This could result from the effects of weightlifting training alone (without “true” Guasha). Furthermore, a similar phenomenon occurred in measurements for the clean and jerk maneuvers.

HRV reflects fluctuations in the atrioventricular conduction superimposed on the P-P interval. It has been shown that beat-to-beat changes in RR intervals reflect the variability of the sinoatrial node quite accurately. HRV has emerged as a multidisciplinary area of research mainly due to continuous interactions between engineers, physicians, and physiologists. Akselrod et al. demonstrated that the sympathetic and parasympathetic activities of the autonomic nervous system make frequency-specific contributions to the spectrum of heart rate power in pharmacologic interventions. HRV can be expressed in two ways: the time domain, and the frequency domain with a normal pattern. Moreover, the analysis of the frequency domain (i.e., LF, HF, LF/HF ratio) describes the periodic oscillations of the heart rate signal decomposed at different frequencies, and provides information on the relative intensity in the sinus rhythm of the heart. The LF domain represents parasympathetic and sympathetic influences. Fluctuations in the LF band are periodic oscillations of the arterial blood pressure as a result of rhythmic contractions of blood vessels that offer resistance to blood flow. LF power in normalized units is considered to be a marker of sympathetic nervous activity. Furthermore, the LF component is modulated by the sympathetic and parasympathetic nervous systems. The HF band reflects how the heart rate adapts to the respiratory rhythm. Parasympathetic nervous activity contributes to HF power. The LF/HF ratio is regarded to represent

<table>
<thead>
<tr>
<th>Item</th>
<th>GG</th>
<th>SSG</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Difference (95% CI)</th>
<th>P value</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Difference (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF (Hz)</td>
<td>0.076 ± 0.024</td>
<td>0.065 ± 0.023</td>
<td>0.01 (−0.008, 0.029)</td>
<td>0.238</td>
<td>0.077 ± 0.017</td>
<td>0.084 ± 0.018</td>
<td>−0.008 (−0.014, −0.001)</td>
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<tr>
<td>HF (Hz)</td>
<td>0.252 ± 0.053</td>
<td>0.254 ± 0.042</td>
<td>0.007 (−0.028, 0.043)</td>
<td>0.656</td>
<td>0.253 ± 0.045</td>
<td>0.237 ± 0.038</td>
<td>0.018 (0.005, 0.03)</td>
<td>0.010</td>
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<tr>
<td>LF/HF ratios</td>
<td>0.324 ± 0.164</td>
<td>0.286 ± 0.089</td>
<td>0.058 (−0.04, 0.158)</td>
<td>0.22</td>
<td>0.318 ± 0.116</td>
<td>0.366 ± 0.109</td>
<td>−0.051 (−0.09, −0.13)</td>
<td>0.013</td>
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</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>GG</th>
<th>GG and SSG (post-test)</th>
<th>GG and CG (post-test)</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Difference (95% CI)</th>
<th>P value</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Difference (95% CI)</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>LF (Hz)</td>
<td>0.075 ± 0.019</td>
<td>0.088 ± 0.021</td>
<td>−0.015 (−0.022, −0.005)</td>
<td>0.036⁶</td>
<td>−0.019 (−0.035, −0.0035)</td>
<td>0.018³</td>
<td>−0.027 (−0.033, −0.0046)</td>
<td>0.001⁴</td>
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<tr>
<td>HF (Hz)</td>
<td>0.254 ± 0.047</td>
<td>0.214 ± 0.053</td>
<td>0.055 (0.039, 0.074)</td>
<td>0.004⁶</td>
<td>0.012 (−0.018, 0.042)</td>
<td>0.427</td>
<td>0.049 (0.021, 0.073)</td>
<td>0.001⁴</td>
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<tr>
<td>LF/HF ratios</td>
<td>0.351 ± 0.192</td>
<td>0.512 ± 0.114</td>
<td>−0.203 (−0.032, 0.017)</td>
<td>0.002²</td>
<td>−0.10 (−0.18, −0.027)</td>
<td>0.009⁹</td>
<td>−0.271 (−0.314, −0.182)</td>
<td>0.002⁴</td>
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</tr>
</tbody>
</table>

Note: GG: Guasha group; SSG: sham group; CG: control group; CI: confidence interval. *within group, P < 0.05, †between-group, P < 0.05.
the proportion of sympathetic and parasympathetic activity. Moreover, it has been thought to reflect the balance between the sympathetic and parasympathetic nervous systems, or to reflect modulations in the sympathetic nervous system. There is a change in the HF and LF domains under normal exercise. A reduction in the HF component and an increase in the LF component of the power spectrum of the HRV has been shown to be related to fatigue: the HF domain declines and the LF domain increases.\(^1\)\(^2\) Chalencon et al.\(^3\) demonstrated the relevance of change in the frequency domain of HRV as a valuable tool to assess physiologic training-induced responses, and to optimize athletic performance. Moreover, they showed that using performance or the HF domain as the systems output provided the same information on the fatigue of an athlete. Vigorous training can suppress parasympathetic power by lowering the HF domain, whereas sympathetic power is increased by increasing the LF domain in HRV.

Our study showed that the LF domain decreased in the GG, but increased significantly in the SSG and CG. However, the HF domain remained stable in the GG, but decreased significantly in the SSG. Moreover, the LF/HF ratio decreased in the GG, but increased in the SSG and CG. These phenomena suggest that Guasha facilitates parasympathetic power and suppresses sympathetic activities. Chen and coworkers demonstrated that the LF domain in HRV was enhanced after weightlifting training.\(^4\) Oreshnikov and colleagues showed that the LF/HF ratio is increased due to weightlifting training.\(^5\) Increased HRV has been observed if a decrease in the LF/HF ratio occurs, and is indicative of increased parasympathetic activity. The LF domain decreased, but the HF domain remained stable, and the LF/HF ratio decreased with Guasha under normal weightlifting training. Furthermore, there were significant differences in the LF domain and the LF/HF ratio of HRV in the three groups. This phenomenon may be because Guasha modulated the balance between the sympathetic and parasympathetic nervous systems, or modulated the sympathetic nervous system.

Our study had three main limitations. First, having a standard procedure for sham scraping is challenging. It is difficult to standardize the location and pressure of scraping, and communication with participants. A Guasha therapist seeks to treat diseases and to promote good health, so asking him/her to undertake sham scraping in our study was difficult. Participants may have undergone Guasha many times before, and may have been able to ascertain if the therapist was using a lower pressure than before. Also, communication with participants would be difficult if the Guasha therapist wanted weightlifters in the SSG to believe that they were receiving Guasha. Second, 85% of 1RM in weightlifting skill and measurement of maximum values were difficult to control for each participant. We set up specific tests because this skill testing (six times in 2 weeks) had never been done in normal weightlifting training conditions before, so participants were worried about fatigue or the possibility of injury. Finally, the sample size may have been underestimated owing to small numbers of weightlifters with the desired athletic level in China. Also, this study did not relate to women weightlifters owing to their small number in China.

Despite these limitations, further studies can be set up with a standardized sham-scraping protocol, RPE scale score, standard intensity and training volume, and more participants. Results of the present study demonstrated that Guasha decreased the RPE scale score significantly and increased the HRV response. Hence, could be considered as an alternative to some types of recovery from sports training.

**ACKNOWLEDGEMENTS**

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