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Acute effects of Gua Sha on thoracolumbar fascia thickness and related physiological parameters in healthy young people: A randomized controlled trial

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Abstract

This study explores the potential mechanism of single Gua Sha therapy on thoracolumbar fascia thickness and related physiological parameters in 66 healthy individuals randomly assigned to a 15-min Gua Sha group or a 15-min rest control group. Thoracolumbar fascia thickness, pressure pain threshold, tissue hardness, skin temperature, lumbar spine flexibility, stress index, and heart rate variability were assessed before and immediately after the interventions. The results revealed a significant reduction in thoracolumbar fascia thickness in the Gua Sha group (Left side: a reduction of 0.06 mm, $p<0.05$, effect size 0.14; Right side: a reduction of 0.09 mm, $p<0.05$, effect size 0.22). Skin temperature also increased significantly (mean difference: 0.64 °C, 95% CI: 0.57–0.71, $p<0.001$), and thoracolumbar fascia improved (mean difference: 0.75, 95% CI: 0.27–1.22, $p<0.01$), suggesting a softening effect of Gua Sha on the fascia. However, contrary to the hypothesis, the Gua Sha group showed a decreased pressure pain threshold and increased tissue hardness. Both interventions effectively reduced the stress index and enhanced heart rate variability, although there were no significant differences between the groups ($p>0.05$). In conclusion, this study found that a single session of Gua Sha therapy could induce a subtle but significant reduction in thoracolumbar fascia thickness and improve specific physiological parameters in healthy individuals, but the unexpected findings regarding the pressure pain threshold and tissue hardness require further investigation to elucidate the underlying mechanisms, offering insight into Gua Sha's possible mechanisms.

Keywords: Gua Sha, lumbar flexibility, heart rate variability, tissue hardness, pressure pain threshold, thoracolumbar fascia, skin temperature.

1. Introduction

As an essential deep fascia connecting the trunk, the thoracolumbar fascia (TLF) plays a key role in maintaining trunk stability, transmitting muscle strength, and protecting internal organs [1]. However, prolonged poor posture, long-term sitting and lack of movement, and chronic injuries can easily lead to adhesion and contracture of the TLF, leading to a series of problems such as chronic low back pain and shoulder and neck pain [2]. The role of fascia in chronic pain is gaining greater attention. Research indicates that specific physical therapy techniques such as myofascial release [3], fascia therapy, hot compresses [4], and massage [5, 6] can alleviate pain by loosening fascial adhesions and enhancing fascial mobility.

Gua Sha is a traditional Chinese medicine therapy utilizing a specialized tool to repetitively scrape the skin's surface, resulting in local redness or purple patches. This process aims to dredge meridians, promote blood circulation, remove blood stasis, expel evil spirits, and detoxify the body [7]. The technique can stimulate skin receptors, activate the nervous system, and elicit a series of physiological effects. TLF thickening is associated with low back pain, and Gua Sha has been traditionally used to alleviate this issue despite its unclear mechanism. Furthermore, studies indicate that Gua Sha can enhance blood circulation in muscle tissue and mitigate skeletal muscle pain [8, 9]. However, there is still insufficient empirical evidence to determine whether these benefits extend to deep fascial tissue, particularly the thickness of TLF.

Additionally, heart rate variability (HRV), an important measure of autonomic nervous system homeostasis, is shown to be influenced by the nerve endings in the fascia, which perceive mechanical stimuli and affect autonomic function through nerve reflexes, ultimately impacting HRV [10]. Gua Sha, as a physiotherapy treatment, may modulate autonomic function and influence HRV through neuroreflex pathways [11]. Consequently, this study is designed to measure both TLF thickness and HRV to explore the dual effects of Gua Sha on the fascia and autonomic nervous system.

This study aims to investigate the acute effects of Gua Sha on TLF thickness and related physiological parameters, including pressure pain threshold (PPT), tissue hardness, skin temperature, lumbar spine flexibility (LSF), stress index, and HRV, in healthy young individuals. The findings of this study are expected to provide initial evidence regarding the potential mechanisms of Gua Sha on TLF and inform future research on its clinical applications for musculoskeletal disorders. It is hypothesized that a single Gua Sha session can reduce TLF thickness and improve the aforementioned physiological parameters.

2. Materials and methods

2.1 Study design

This study adopted a randomized controlled trial design and was conducted in a designated laboratory space at the School of Physical Education of Gannan Normal University from October 15 to 31, 2024. Before the start of the study, ethical approval was obtained from the Ethics Committee of Khon Kaen University, Thailand (approval number: HE67217) and the Medical Ethics Committee of Ganzhou Traditional Chinese Medicine Hospital (approval number: GZSZYYKYLL20240083). In addition, the protocol has been registered with the Thailand Clinical Trial Registry (registration number: TCTR20241124004). This study strictly adhered to the ethical principles outlined in the Declaration of Helsinki [12] and the Good Clinical Practice Guidelines [13].

2.2 participants

The recruitment information in this study was released through social media platforms such as Weibo, QQ, and WeChat, and students were recruited from the faculty and staff of Gannan Normal University and surrounding residents. All participants signed informed consent to accurately convey the research information.

Inclusion criteria: Healthy participants aged 18–29 years, Body mass index (BMI) of 18.5–24.9 kg/m^2, with no history of low back pain, inflammation, or injury in the past three months.

Exclusion criteria: Pregnancy, breastfeeding, menstruation, lower back skin ulcers, bleeding or inflammation, and those receiving other forms of physical therapy or massage within one week.

2.3 Randomization and blinding

All subjects who met the inclusion criteria were randomly assigned to either the Gua Sha group or the control group, with equal sample sizes in each. Random assignments were ensured by research assistants randomly selecting lots from opaque containers. The study flow strictly followed the CONSORT 2010 statement guidelines [14].

Due to the nature of the Gua Sha intervention, a double-blinded design could not be used. However, strict measures were taken to minimize bias. Data collection was performed by uniformly trained researchers using standardized operating procedures and objective measurement tools to reduce the influence of subjective factors on the results.

2.4 Sample size

The sample size was determined based on the results of a previous pilot study. The pilot study evaluated the impact of a single 15 min Gua Sha treatment on TLF thickness in healthy volunteers (n = 12). Ultrasonography indicated TLF thickness of 3.17 ± 0.46 mm before Gua Sha and 2.77 ± 0.52 mm after. The effect size, Cohen

’s d, was 0.8148. Taking into account an α level of 0.05, a power of 0.85, and a 10% dropout rate, the sample size was calculated using the G*Power software [15]. A total of 66 participants were required.

2.5 Intervention

The participants in the experimental group lay prone on the treatment bed. The intervention was conducted on the subjects by a Gua Sha therapist with ten years’ experience who performed alone. First, the therapist applied olive oil to the lower back of the subjects; the Gua Sha range was from the seventh thoracic vertebra to the coccyx. The intervention lasted 15 min. The specific range of Gua Sha is shown in Figure 1. The order of Gua Sha is along the bladder meridian on both sides of the spine. First line, about one inch is scraped away from the spine, from the seventh thoracic vertebra to the fifth lumbar vertebra. The second line, about three inches, is scraped away from the spine, from the first lumbar vertebra to the fifth lumbar vertebra. The third line, about the fifth lumbar vertebra, is scraped down to the coccyx.

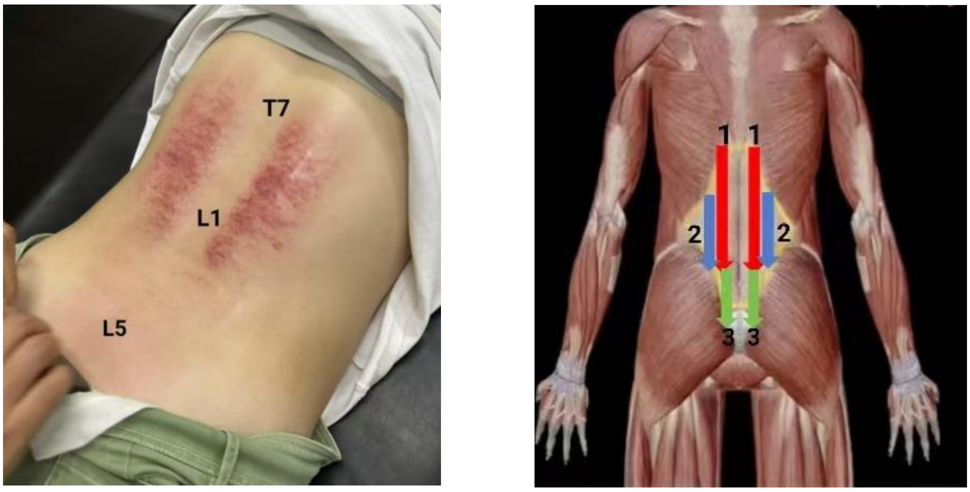

Figure 1 Scope of Gua Sha intervention in the experimental group.
Note: T7: seventh thoracic vertebra; L1: first lumbar vertebra; L5: fifth lumbar vertebra.

The buffalo horn Gua Sha board was used to scrape the skin on the chest and waist from top to bottom, adopting the method of flat tonic and flat diarrhea, gradually increasing the pressure. To quantify the Gua Sha pressure as much as possible, the AlgoMed system was used for measurement, based on the pilot experiment results, combined with participant comfort feedback, with Gua Sha pressures set at a range from mild (487 $\pm$ 21 g) to moderate (626 $\pm$ 11 g). This pressure range has been validated to be not only suitable for healthy people[11] but also to ensure that the depth of Gua Sha reaches the fascial layer.

Control group subjects were kept prone in bed for 15 min in the same setting without any intervention. Subjects in both groups were advised to drink a glass of warm water after the treatment and take a shower four hours after Gua Sha.

2.6 Measurement Procedure

2.6.1 Baseline Measurement

The age, height, and weight of all participants were obtained using standardized measurement tools. Height and weight were measured using the G-Tech G610 height and weight meter, with blood pressure and heart rate measured using the Omron HEM-7120 electronic blood pressure monitor. Participants were required to rest for 5–10 minutes before measurement. BMI was calculated from the measured data to ensure the participant’s weight was within a healthy range relative to their height.

2.6.2 Outcome measurement

To evaluate the immediate effect of Gua Sha on TLF thickness and related indicators, the following measurement sequence was used: skin temperature, PPT, tissue hardness, fascia thickness, HRV, and LSF.

The Konted C10 medical ultrasound imaging system equipped with a 7.5-14 MHz linear probe was used to measure the thickness of the TLF in B mode and 3.0 cm display depth. The reliability of ultrasound measurement for fascia thickness has been confirmed in many studies [16, 17]. Sagittal measurements were performed 2 cm lateral to the midpoint of the interspinous ligament of the lumbar L2-L3 spine to enhance accuracy. The TLF at this measurement position is parallel to the skin, and the angle change is small, providing a reliable measurement method [16, 18].Using MY USG software, four representative locations were selected for thickness measurement on each ultrasound image, with the average value taken to reduce measurement error.

The Algometer Combo tissue hardness tester (OE-220, Japan) was used to measure the tissue hardness of the subjects three inches away from the third and fourth lumbar vertebrae. This method has shown good reliability in previous studies (ICC=0.97) [19]. During the measurement, a plastic disk measuring 10 cm in diameter was placed vertically on the marked point, with pressure applied until the tissue became deformed and the required force value was recorded. Each measurement point was repeated three times, and the bilateral average was taken.

The PPT measurement site was located at the bladder meridian beside the third-fourth lumbar vertebrae. The measurement was performed by trained researchers using a pressure gauge (Algometer). The pressure started at about 1 kg/cm^2 and gradually increased at a constant speed until the subject felt pain and then stopped immediately. At this time, the force value (kg/cm^2) displayed by the pressure gauge was recorded. All measurements were conducted by the same researcher using the same model of pressure gauge to ensure consistent results. Previous studies have confirmed the high reliability of this measurement method (ICC=0.77–0.94) [20]. Each measurement point was measured three times, with the average of the data taken from the left and right sides calculated as the final result.

A Hikvision DS-2TP31B-3AUF infrared thermal imager (Origin: Hangzhou Hikvision) was used in this study to measure the lumbar skin temperature of the subjects. The instrument has a wide temperature measurement range of -20 ° C to 350 ° C and a resolution of 60×120 and can measure the infrared radiation emitted by the skin in a non-contact manner. According to the product parameters, the clinical repeatability of the instrument is ± 0.2 ° C with a resolution 0.1 ° C, indicating high measurement accuracy and reliability [21].

A modified Schober test, a reliable clinical method for assessing LSF (ICC=0.83–0.94), was used [22]. Participants stood with their feet approximately 30 cm apart. A horizontal mark was placed on the L5 spinous process, while two more marks were made 5 cm below and 10 cm above it. The participants bent forward to the maximum extent with both knees straight. The distance between the top and bottom marks was measured three times at intervals of 30 seconds, and the average was calculated. This value was then subtracted from the initial 15 cm distance for analysis.

This study used the uBio Macpa device to quantify the HRV of the subjects since it is an important indicator reflecting the activity of the autonomic nervous system, closely related to an individual's physiological and psychological state. The reliability of this device has been confirmed by several studies [23-25]. This study analyzed the collected HRV data in the time and frequency domains to assess the autonomic nervous system activity level in the subjects and explore its relationship with stress levels. The instrument was attached to the participant’s index finger, and HRV data were automatically recorded and analyzed after 2.5 min.

2.7 Data collection and analysis

The data in this study were statistically analyzed using SPSS 28.0 (IBM Corporation, Armonk, NY, USA). The Kolmogorov-Smirnov test was used to test the normality of continuous variables. According to the normal data distribution, a paired sample t-test or Wilcoxon test was used to test the differences in each index before and after the intervention and the Hedges correction to estimate the effect size. To better compare the differences between groups, one-way covariance analysis or Mann-Whitney U test was performed with the baseline as a covariate. All statistical tests were two-tailed, and $P > 0.05$ was considered significant.

3. Results

3.1 Basic information of participants

A total of 78 volunteers signed up to participate. After strict screening, 66 volunteers who met the inclusion criteria were included in the data analysis. The specific screening process is detailed in Flowchart 2. Due to the particularity of the research location, 87.9% of participants were students from the School of Physical Education of Gannan Normal University, and most of them were professional athletes engaged in sports for a long time

According to the research results, no significant differences existed between the Gua Sha and control groups in terms of gender, age, height, weight, BMI, systolic blood pressure, diastolic blood pressure, and heart rate ($P > 0.05$). These findings indicate that the two groups were well-matched at the baseline, minimizing the potential confounding effects of these variables on the study outcomes.

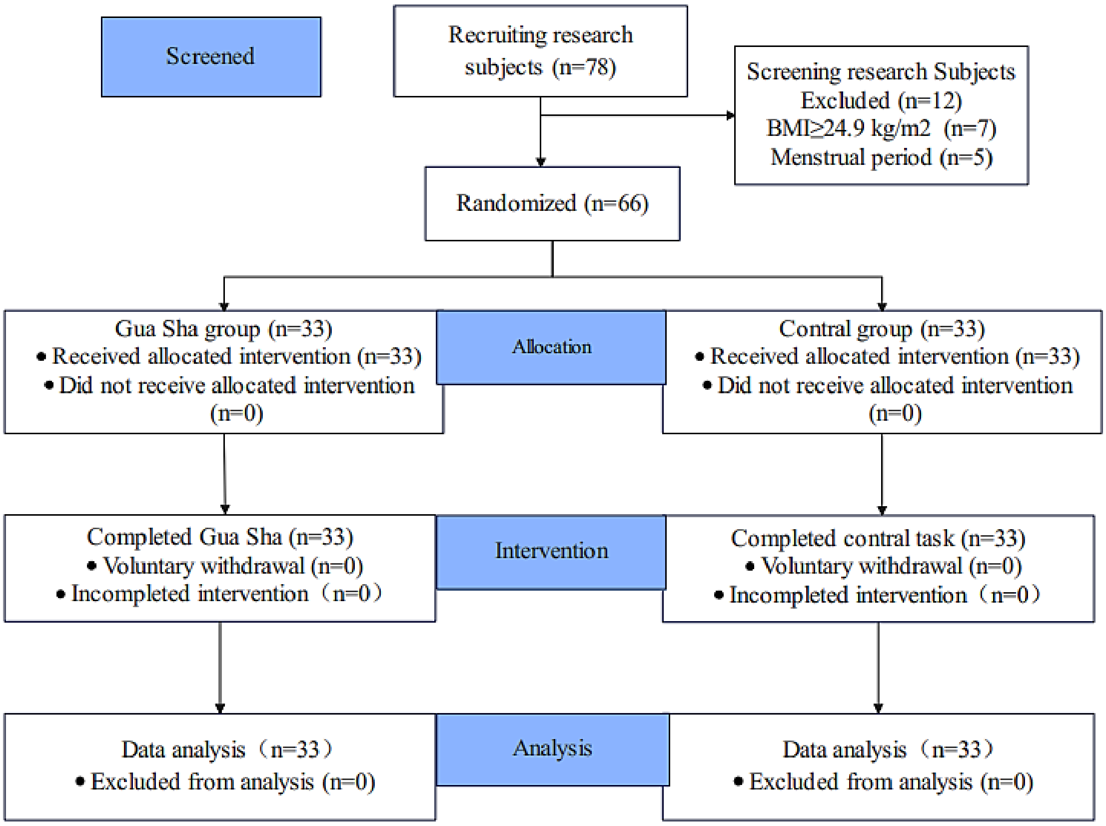

Figure 2 Flow chart of the experimental intervention study.

3.2 Primary outcomes

According to Table 1, the Gua Sha group showed a significant reduction in both left and right TLF thickness after the intervention ($p < 0.05$). Specifically, the left side decreased from 2.88 ± 0.31 mm to 2.82 ± 0.31 mm (a decrease of 0.06 mm, $p = 0.02$, effect size = 0.14), while the right side decreased from 2.90 ± 0.33 mm to 2.81 ± 0.40 mm (a decrease of 0.09 mm, $p = 0.02$, effect size = 0.22). Despite the absolute changes being modest, notably, the participants were primarily young, physically active athletes, a finding that suggests Gua Sha may have specific fascial softening effects. In contrast, the control group showed no significant changes in TLF thickness throughout the intervention period ($p > 0.05$).

Table 1 Within group comparison on TLF thickness using paired T-test.

Outcomes	Group	Baseline	After	Mean difference（95%CI）	t	*p*-value	Effect size
Left TLF thickness	GG	2.88 ± 0.31	2.82 ± 0.31	0.06 (0.01,0.11)	2.53	0.02	0.14
	CG	2.90 ± 0.45	2.91 ± 0.45	, -0.02 (-0.11,0.08)	-0.35	0.73	0.26
Right TLF thickness	GG	2.90 ± 0.33	2.81 ± 0.40	0.09 (0.02,0.17)	2.45	0.02	0.22
	CG	2.90 ± 0.46	2.91 ± 0.40	, -0.01 (-0.11,0.09)	-0.26	0.80	0.28

Note: GG: Gua Sha group; CG: Control group; TLF: Thoracolumbar fascia; CI: confidence interval; $p < 0.05$ is a significant difference.

Furthermore, Table 2 shows no significant difference in TLF thickness between the Gua Sha and control groups after the intervention ($p > 0.05$), suggesting that the observed fascial thinning may be directly attributed to the Gua Sha intervention.

Table 2 Between group comparison on TLF thickness, skin temperature, PPT, LSF, tissue hardness, and stress index using ANCOVA and Mann-Whitney U test with baseline as covariate.

Index	Group	Baseline (mean±SE)	After intervention (mean±SE)	After intervention adjust (mean±SE)	Mean difference（95%CI）/Median (IQR)	F/Z	*p*-value	Effect size
Left TLF thickness（mm）	GG	2.88 ± 0.31	2.82 ± 0.31	2.83 ± 0.04	-0.08 (-0.18, 0.02)		0.115	0.039
	CG	2.90 ± 0.45	2.91 ± 0.45	2.90 ± 0.04		F=1.82		
Right TLF thickness (mm)	GG	2.90 ± 0.33	2.81 ± 0.40	2.81 ± 0.07	-0.10 (-0.30, 0.09)		0.293	0.017
	CG	2.90 ± 0.46	2.91 ± 0.40	2.91 ± 0.07		F= 3.22		
Skin temperature（℃）	GG	35.94 ± 0.03	36.73 ± 0.02	36.74 ± 0.02	0.66 (0.59, 0.72)		<0.001	0.86
	CG	35.98 ± 0.03	36.09 ± 0.03	36.08 ± 0.02		F=372.2		
PPT (kg/cm²)	GG	7.63 ± 0.36	7.24 ± 0.30	7.01 ± 0.17	0.73 (0.24, 1.22)		0.004	0.12
	CG	6.96 ± 0.29	6.06 ± 0.25	6.28 ± 0.17		F= 8.69		
LSF (cm)	GG	6.63 ± 0.17	7.20 ± 0.19	7.11 ± 0.09	0.56 (0.30, 0.82)		<0.001	0.22
	CG	6.48 ± 0.15	6.34 ± 0.12	6.55 ± 0.09		F=18.06		
Tissue hardness (N/mm²)	GG	52.86 ± 0.63	54.62 ± 0.62	54.18 ± 0.64	0.98 (-0.84, 2.81)	F= 1.16	0.286	0.018
	CG	51.68 ± 0.73	52.76 ± 0.97	53.20± 0.64				
Stress Index (score)	GG	31.73 ± 1.20	32.18 ± 1.28	32.26 ± 1.10				
	CG	32.06 ± 1.21	29.94 ± 1.16	29.86 ± 1.10	2.39 (-0.72, 5.50)	F= 2.36	0.129	0.036
SDNN (mHz)	GG	65.12 ± 4.77	71.84 ± 4.28	69.77 ± 3.12				
	CG	58.47 ± 3.46	71.21 ± 3.76	73.28 ± 3.12	-3.51 (-12.37, 5.35)	F= 0.63	0.432	0.01
RMSSD (mHz)	GG	48.86 ± 3.68	54.88 ± 3.70	53.13 ± 2.75				
	CG	42.84 ± 3.00	51.41 ± 2.94	53.17 ± 2.75	-0.04 (-7.85, 7.78)	F= 0.85	0.993	0.00
LF (ms)	GG	7.95 ± 0.13	8.04 ± 0.14	8.05 ± 0.13				
	CG	8.02 ± 0.11	8.11 ± 0.12	8.10 ± 0.13	-0.05 (-0.41, 0.31)	F= 0.08	0.783	0.001
HF (ms)	GG	6.86± 0.12	6.82 ± 0.11	6.78 ± 0.10				
	CG	6.71 ± 0.11	7.03 ± 0.12	7.08 ± 0.10	-0.30 (-0.59, -0.01)	F= 4.26	0.043	0.063
LF/HF Mann-Whitney U	GG	1.16 ± 0.02	1.18 ± 0.02					
	CG	1.19 ± 0.02	1.16 ± 0.01		1.20 (1.10, 1.20)	Z= -0.69	0.49	

Note: GG: Gua Sha group; CG: Control group; TLF: Thoracolumbar fascia; PPT: Pressure pain threshold; LSF: lumbar spine flexibility; SE: Standard Error; SDNN: Standard Deviation of NN intervals; RMSSD: Root Mean Square of Successive R-R Interval Differences; LF: Low frequency; HF: High frequency; ANCOVA: Analysis of Covariance; $p < 0.05$ (statistically significant difference).

3.3 Secondary indicators

According to Figure 3 and Table 2, compared with the control group, the skin temperature of the Gua Sha group increased significantly after the intervention (mean difference: 0.64 ° C, 95% CI: 0.57–0.71, $p < 0.001$), while the LSF also significantly improved (mean difference: 0.75, 95% CI: 0.27–1.22, $p < 0.01$). There were significant differences between the two groups ($p < 0.05$), indicating that Gua Sha can effectively promote local blood circulation and improve tissue flexibility. However, the PPT in the Gua Sha group decreased while tissue hardness increased, which was not in line with expectations. A significant difference in PPT values was also found between the two groups, but no significant difference in tissue hardness ($p > 0.05$).

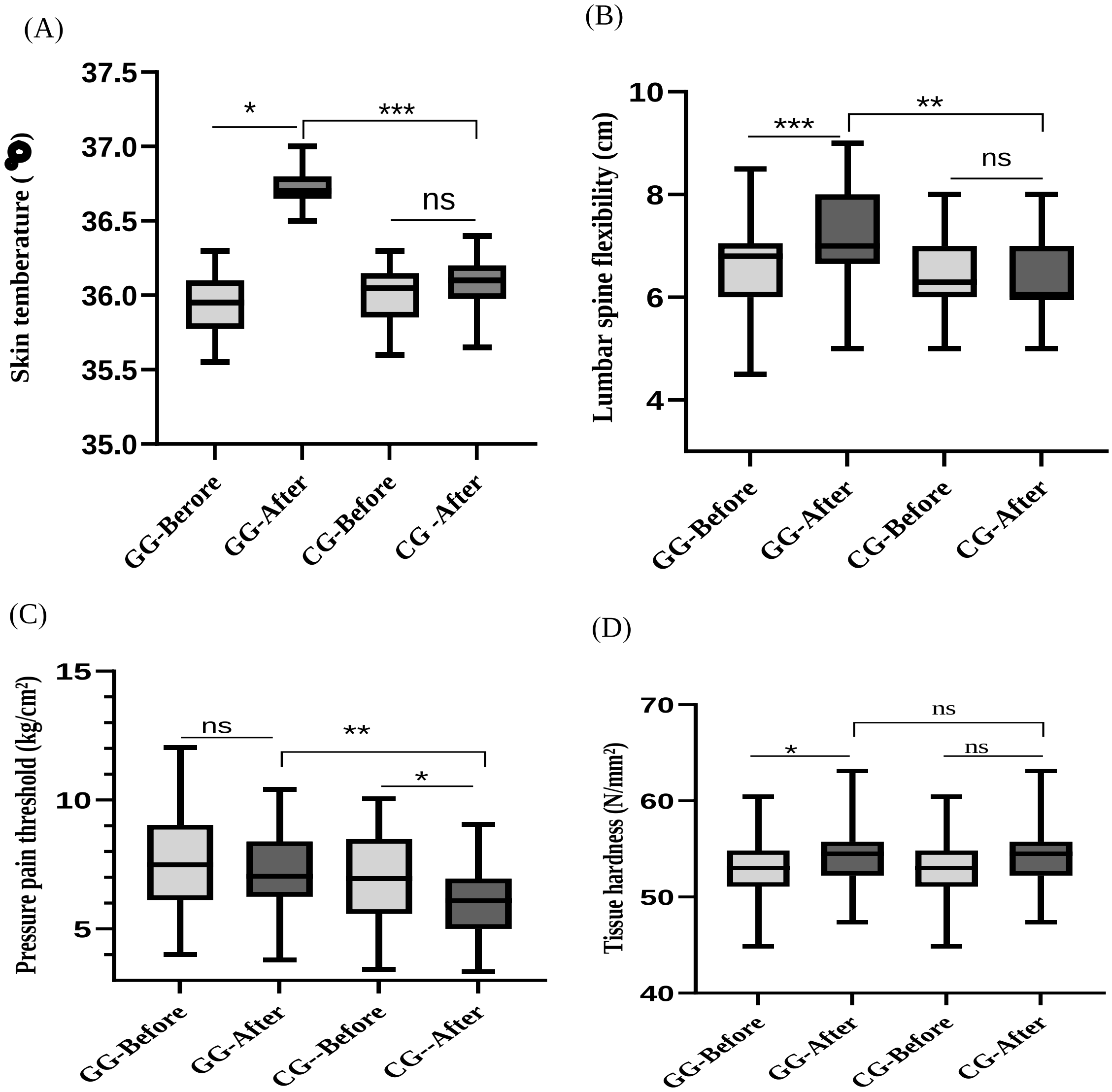

Figure 3 Box plot showing the impact of the two intervention methods on skin temperature, tissue hardness, LSF, and PPT. (A) Skin temperature (B) Lumbar spine flexibility (LSF) (C) Pressure pain threshold (PPT) (D) Tissue hardness; GG: Gua Sha group; CG: Control group; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ns: no significant difference.

Additionally, this study explored the effects of Gua Sha versus rest alone on stress index and HRV. The results (Figure 4 and Table 2) revealed that after the intervention, the stress index of both the Gua Sha group and control group was observed to decrease. However, only the control group showed a statistically significant difference ($p < 0.05$), with no statistically significant difference between the two groups. This suggests that both Gua Sha and the control group intervention can effectively reduce the stress index, while the two intervention methods demonstrated comparable stress-reducing effects.

In the frequency domain analysis of HRV, low-frequency (LF) components increased, high-frequency (HF) components decreased, and the LF/HF ratio increased in the Gua Sha group, but these changes did not reach statistical significance. In contrast, the HF component in the control group increased significantly ($p < 0.05$), and the increase was significantly higher than in the Gua Sha group ($p < 0.05$). The significant changes in the control group suggest an association between relaxation and a more pronounced parasympathetic nerve activation.

The HRV time domain analysis showed an upward trend for standard deviation of NN intervals (SDNN) and root mean square of successive R-R interval differences (RMSSD) in both groups after the intervention. However, the increase in the control group was statistically significant ($p < 0.05$), with no statistically significant difference between the two groups. These results indicate that the observed changes in the Gua Sha group may necessitate longer intervention periods or larger sample sizes to achieve statistical significance.

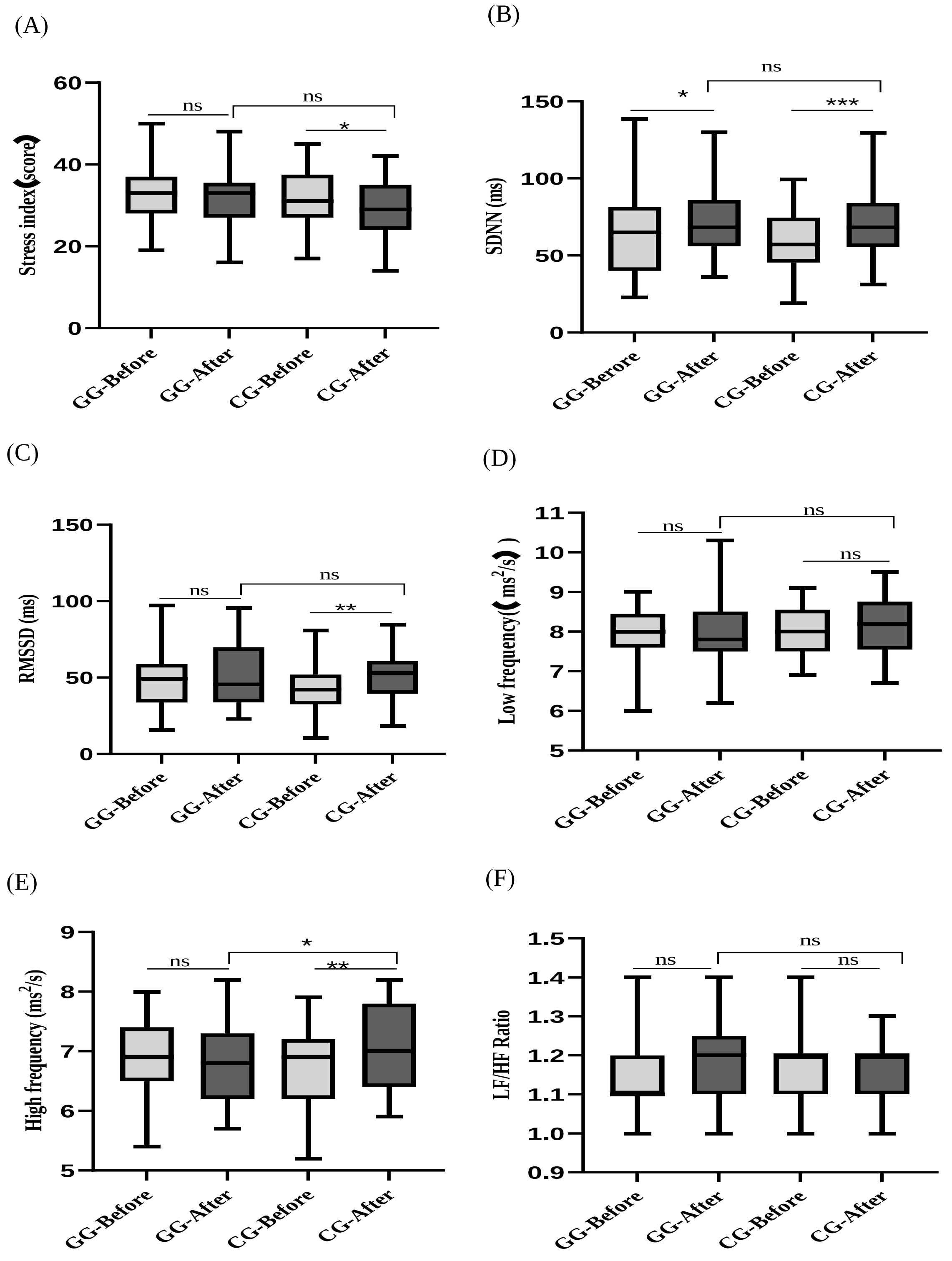

Figure 4 Box plot shows the impact of the two intervention methods on stress index and heart rate variability. (A) Stress Index; (B) Standard Deviation of NN intervals (SDNN) ; (C) Root Mean Square of Successive R-R Interval Differences (RMSSD); (D) Low Frequency (LF) ; (E) High Frequency (HF) ; (F) LF/HF Ratio; GG: Gua Sha group; CG: Control group;* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ns: no significant difference.

4. Discussions

This study is the first to use ultrasound to measure the effects of Gua Sha on fascia, revealing that a single session of Gua Sha could significantly reduce TLF thickness, accompanied by increased skin temperature and improved LSF.

The Gua Sha intervention effectively reduced participants' TLF thickness by 0.06 mm on the left and 0.09 mm on the right. This finding is consistent with the pilot study and confirms the potential clinical value of Gua Sha therapy in improving fascial thickness. However, compared with the pilot study (TLF thickness decreased by 0.34 mm and 0.4 mm, respectively), the reduction in fascial thickness caused by this intervention was smaller. This may be because, firstly, the average age of the participants was relatively young, potentially meaning that their fascia tissue had not yet experienced significant age-related degeneration. Secondly, most of the participants were athletes engaged in long-term sports training and their fascia tissue may be in a relatively healthy physiological state due to long-term regular exercise. The tissue adaptability caused by long-term training may make the fascia tissue less responsive to the mechanical stimulation generated by Gua Sha. This phenomenon is known as the "ceiling effect" in psychology [26]; that is, when the initial level of the subjects is already very favorable, it may be difficult to produce significant effects with further intervention measures, emphasizing the importance of considering baseline conditions when interpreting experimental results.

Gua Sha improves TLF thickness in healthy adults. This result is consistent with the finding that a single myofascial massage [27] significantly reduced TLF thickness in 16.71% of patients with low back pain ($t(82) = 14.13$; $p<0.0001$), and Devantéry et al. [28] who found that a single myofascial technique reduced TLF thickness in patients with chronic low back pain (from 1.90 ± 0.50 mm to 1.88 ± 0.52 mm). These methods contribute to the reduction of TLF thickness by applying pressure and stretching to the fascial tissues, which may affect TLF thickness through various mechanisms, such as improving blood circulation, breaking down adhesions and scar tissue, decreasing the level of inflammatory factors, and increasing the fascia's elasticity.

Interestingly, this finding differs from Chao et al. [5] who found through a randomized controlled trial that after 15 min of percussion massage at a frequency of 30 Hz on the back of healthy men, the thickness of the fascia increased by an average of 0.02 mm, although the difference was not significant. Gua Sha softens the fascia by an average of 0.06 mm, which may be attributed to its unique therapeutic mechanism, which promotes the flow of tissue fluid through mechanical stimulation and nerve reflexes, accelerating the repair and regeneration of tissues. In contrast, the repeated stimulation of percussion massage may cause mechanical tension in tissue hubs or surgery, increasing the fascia's thickness.

The skin temperature and LSF increased significantly after Gua Sha, strongly supporting the positive effects of Gua Sha on local circulation and tissue function. The increase in skin temperature indicates a rise in local blood flow, while the improvement in LSF reflects the enhanced elasticity of the soft tissue in the waist. These results are consistent with Gua Sha's improvement of posterior chain flexibility in patients with Parkinson's disease [29].

Unexpectedly, the PPT of the Gua Sha group decreased while the tissue hardness increased. These results are in contrast to those of previous studies showing that electrical stimulation of the cutaneous nerve combined with stretching can reduce pain and muscle hardness [30]. This phenomenon may be related to the complex action mechanism of Gua Sha. Although repeated mechanical stimulation may cause a temporary increase in tissue hardness, the local tissue damage, inflammatory response, and increased sensitivity of the central nervous system caused by Gua Sha are more likely to be the main reasons for the increase in tissue hardness and the decrease in pain threshold [31, 32]. Specifically, Gua Sha stimulation may cause tissue edema and increase tissue hardness with mechanical stimulation, potentially also causing local nerve endings to become sensitized, reducing tolerance to pain. Since participants are young athletes with good physical fitness and are more sensitive to stimulation, the above effects may be amplified. These findings suggest that the effects of Gua Sha on human tissues are more complex, and the mechanisms need to be further explored.

Both the Gua Sha group and the control group were effective in reducing the stress index, and an improvement in HRV indicators was observed, indicating that both interventions could actively relieve stress and regulate the autonomic nervous system. However, there was no significant change in the Gua Sha group, while the control group demonstrated a more significant effect on HRV improvement, with the time and frequency domain analyses showing a statistically significant difference ($p < 0.05$). It may be that Gua Sha triggered a certain degree of stress response while immediately relieving stress, partially offsetting its positive effect on HRV. Xingze Wang et al. found that a single Gua Sha session promoted HRV changes in healthy men and weightlifters, but the effect was more significant in healthy men [11], suggesting that individual differences may affect the regulatory role of Gua Sha on the autonomic nervous system.

It is important to differentiate between acute and chronic effects when considering the relationship between HRV and TLF thickness. While this study examines the acute effects of Gua Sha, revealing potentially conflicting immediate responses, the chronic influence of HRV on TLF may be more pronounced. Specifically, autonomic nervous system function may indirectly affect fascia thickness by modulating muscle tone and vasomotor activity. Studies have shown autonomic nervous system dysfunction to be associated with chronic pain and fascia tension [10]. Overactivation of the sympathetic nervous system can increase muscle tension and constrict blood vessels, potentially affecting local blood circulation and nutrient supply to the fascia [33]. Consequently, Gua Sha may indirectly reduce fascia thickness and enhance lumbar spine mobility by modulating autonomic nervous system function over time.

Based on the foregoing results of Gua Sha on various physiological indicators and previous studies, the authors speculate that Gua Sha may affect fascia thickness and related indicators through the following mechanisms.

Firstly, improved blood circulation. Gua Sha may induce neurogenic vasodilation by stimulating skin receptors, leading to increased blood flow to the TLF [9]. This enhanced blood circulation aids in delivering nutrients and oxygen and promotes the removal of metabolic waste products and tissue remodeling and repair, potentially contributing to the reduction in TLF thickness.[34].

Secondly, improved lymphatic circulation. Gua Sha may stimulate lymphatic drainage and reduce interstitial fluid accumulation and edema within the fascial planes [35]. Chao et al. found that percussion massage can reduce the echo intensity of the TLF in healthy people [5]. Likewise, it is possible that the combined effects of Gua Sha in improving microcirculation and lymphatic drainage create a more favorable environment for fascial activity and may contribute to the observed reduction in TLF thickness.

Thirdly, Neuromodulation. Gua Sha stimulates nerve endings in the fascia, causing the release of neurotransmitters and endorphins, thereby regulating pain perception and muscle tone. Studies have shown that Gua Sha can reduce the basal tension of muscles and relieve muscle spasms, thereby indirectly affecting the tension state of fascia [36]. Furthermore, Gua Sha can also promote the release of endogenous analgesic substances, such as endorphins, which have analgesic and anti-inflammatory effects, thus improving the elasticity and flexibility of the fascia [32]. Notably, Gua Sha can also stimulate the autonomic nervous system, adjusting the balance between sympathetic and parasympathetic nerve activity. Studies have demonstrated that Gua Sha can attenuate sympathetic nerve excitability while augmenting parasympathetic nerve activity [11]. This autonomic modulation may contribute to pain reduction by adjusting the pain threshold, thereby enhancing patient comfort and facilitating active functional exercise, which is conducive to fascial repair [37, 38].

Fourthly, mechanical effects. The mechanical force generated by Gua Sha can directly act on the fascia tissue, causing the fascia fibers to be stretched and slide, thereby improving the flexibility and elasticity of the fascia. Its pressure and friction can stimulate the fascia's mechanical receptors, trigger the mechanical transduction pathway, decompose fascia adhesions, promote the production of lubricants such as hyaluronic acid, and improve fascial sliding. This is consistent with the effectiveness of mechanical fascia stimulation confirmed by self-fascial release and percussive massage therapy studies, such as improving hamstring and back flexibility [5, 39]. Gua Sha, as a method of fascial release, facilitates the breakdown of fascial adhesions and restrictions, thereby enhancing flexibility.

This study has a few limitations. Firstly, the participants were primarily healthy individuals, which limits the generalizability of the results to other populations, such as the elderly or those with chronic low back pain. Secondly, only the effect of a single Gua Sha session was measured. The impact of multiple sessions remains unknown. Future studies should focus on patients with chronic low back pain, as their fascial status might be more sensitive to Gua Sha. Thirdly, limitations of the measurement tools. Although this study used a variety of objective tools to evaluate the effect of Gua Sha, the measurement results could have limitations due to measurement errors. For example, ultrasound imaging could be affected by the operator’s experience and image quality, with HRV results potentially affected by factors such as the subject's mood and breathing pattern. Future studies may strictly control these factors to improve the reliability of the results.

5. Conclusions

A single session of Gua Sha in healthy young adults significantly, though subtly, decreased TLF thickness. This finding, alongside a significant increase in skin temperature and LSF, supported the initial hypothesis and suggests Gua Sha's potential to prevent fascial adhesion. However, the effects of Gua Sha on PPT, tissue hardness, and HRV are complex and likely to involve the interaction of multiple factors, such as neural, inflammatory, and mechanical responses. Future studies should further explore its action mechanism and focus on the long-term effects in patients with chronic low back pain.

6. Ethical approval

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the Human Research Ethics Center of Khon Kaen University (No. HE67217) and the Medical Ethics Committee of Ganzhou Traditional Chinese Medicine Hospital (No. GZSZYYKYLL20240083).

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8. Conflicts of Interest

The authors declare no conflicts of interest.

9. References

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