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Molecular & Cellular Biomechanics 2025, 22(3), 261.
https://doi.org/10.62617/mcb261

Article

Effect of acupuncture and moxibustion, cupping, and medicated thread moxibustion on biomechanical responses in sports injuries

Yuanyuan Qiao[1], Jie Kan[2,*], Shijun Xu[2,3,*], Ling Li[4], Cong Zeng[3]

[1] School of Physical Education and Health, Yulin Normal University, Yulin 537000, China
[2] Physical Education College, Guangxi University of Science and Technology, Liuzhou 545006, China
[3] Sports Department, Liuzhou Institute of Technology, Liuzhou 545616, China
[4] School of Arts and Sciences, Nanning College of Technology Nanning, Nanning 530100, China
*** Corresponding authors:** Jie Kan, 504545082@qq.com; Shijun Xu, xushijun2008@126.com

CITATION

Qiao Y, Kan J, Xu S, et al. Effect of acupuncture and moxibustion, cupping, and medicated thread moxibustion on biomechanical responses in sports injuries. Molecular & Cellular Biomechanics. 2025; 22(3): 261. https://doi.org/10.62617/mcb261

ARTICLE INFO

Received: 23 July 2024
Accepted: 30 October 2024
Available online: 13 February 2025

Abstract: Purpose: This study explored the clinical effect of acupuncture and moxibustion therapy, cupping therapy, and Zhuang medicine thread moxibustion therapy on cell and molecular biomechanics within the context of sports pains and injuries. **Method:** Divided athletes who experienced pain and injury symptoms during training into two groups and received traditional Chinese medicine treatment and conventional therapy respectively, and compared the therapeutic effects; The visual analogue scale was used to evaluate pain level, diagnose pain and injury severity, and evaluate efficacy. **Result:** Comprehensive therapy had excellent efficacy for mild patients, and moderate-to-low intensity training could be performed during recovery. The traditional Chinese medicine treatment group's efficacy in delayed onset muscle soreness, mild injury, and severe injury was significantly better than that of the conventional treatment group ($P \leq 0.05$). **Conclusion:** The amalgamation of these therapies engenders an integrated effect of treatment effect. It may potentially modulate cell and molecular biomechanics by, for instance, influencing the mechanical properties of cells and extracellular matrices. This could rectify aberrant biomechanical signaling associated with injury, enhance cell adhesion and migration for tissue repair, and optimize the mechanical milieu conducive to tissue regeneration. It clears blockages, unblocks meridians, alleviates pain, and promotes the proper circulation of *Qi*, blood, and body fluids. The comprehensive therapy is characterized by simplicity, manageability, and effectiveness. The integration of traditional Chinese and Western medicine can more efficaciously address campus sports injuries, foster the healthy progression of school sports, and capitalize on the unique prerogatives and functions of traditional Chinese medicine in the domain of cell and molecular biomechanics.

Keywords: acupuncture and moxibustion; cupping therapy; medicated thread moxibustion of Zhuang (MTMZ); visual analogue scale (VAS); biomechanical signaling

1. Introduction

Acupuncture and moxibustion, cupping therapy, and Zhuang medicine thread moxibustion have been part of the extensive and profound Chinese medicine culture and have unique effects on sports injuries. Qiu and Zhang treated 30 patients with shoulder joint soft tissue injury with acupuncture and moxibustion, and the effective rate was 96.67% [1]. Yang Xiaoyong randomly divided 60 patients with rotator cuff injuries into an acupuncture group and a medication group, with 30 patients in each group. The effective rate after treatment was 100.00% in the acupuncture group and 33.00% in the medication group [2]. Yan and Chen used scraping combined with cupping therapy to treat joint meniscus injuries, which can alleviate muscle spasms

and activate the immune system [3]. According to observations, the therapeutic effect of cupping therapy on soldiers with lumbar myofascial pain syndrome was 93.33% after 2 weeks of treatment (Wang et al.) [4]. Fan Xiaoting et al. used the medicated thread moxibustion of Zhuang to treat pain symptoms, and the therapeutic effect was significant [5,6]. These traditional Chinese medicine therapies are usually combined with massage, External Application of Herbal Medicine, and other therapies to better demonstrate their therapeutic effects. In the context of Healthy China, actively integrating traditional Chinese medicine's clinical treatment into sports injury rehabilitation is an innovative way to integrate physical and medical models. This is especially true because sports activities are the main way college students enrich their extracurricular cultural life and engage their bodies and minds [7]. Various university sports events are important in campus culture, often capturing all teachers and students' attention. In contrast to high school's "healthy sports" and "happy sports" [8], universities advocate the Olympic spirit of "higher, faster, stronger" [9]. In pre-competition training, however, new students were likely to experience pain and injuries due to lack of guidance and inexperience when faced with a heavy sports workload. These circumstances had adverse effects on their physical and mental health and on their enthusiasm for sports participation [10]. To win rankings and honors, teachers and students have focused on athletes' performance in training and competition while neglecting their physical condition, the main external factor leading to a large amount of sports pain and injuries [11]. When athletes experienced pain or injury, they were seen to lack self-judgment and effective response measures. They usually chose routine treatments, for example, massaging with medicinal wine, applying ointment, infrared light therapy, and taking oral anti-inflammatories and painkillers [12,13]. This treatment's therapeutic effect was not ideal, however. Faced with a great number of sports pains and injuries in a short time, limited school medical resources were stretched beyond capacity. Diagnosing pain injuries and their severity and providing reasonable scientific treatment was a problem worth the medical staff's in-depth exploration. This study aims to leverage the effective treatment of traditional Chinese medicine for sports injuries with the assistance of modern medical equipment. Through comprehensive application of acupuncture and moxibustion therapy, cupping therapy, and medicine thread moxibustion of Zhuang (MTMZ) therapy, this study diagnosed and treated the sports pain and injuries that occurred during college sports meetings and also supplemented the school's lack of medical resources. In this study, we analyzed the efficacy and diagnosis of comprehensive therapy, fully leveraged traditional Chinese medicine's (TCM's) unique value in sports injuries' clinical treatment, and explored the following issues: 1) efficient use of comprehensive therapy to diagnose sports pain and injuries and to select corresponding treatment methods; 2) evaluation of comprehensive therapy through comparison with conventional therapy; 3) discovery of comprehensive therapy's mechanisms; 4) Collaboration between universities and hospitals will promote effective comprehensive therapy training, integrating traditional Chinese medicine health preservation into the high-quality development of ethnic work and serving society.

2. Research objectives and methods

2.1. Research subjects

Among the athletes preparing for their school sports event at Liuzhou Institute of Technology, 65 patients who had sports pain and injuries during the pre-competition training period were randomly selected as the research subjects.

2.2. Materials and methods

Materials: Silver needle for acupuncture, cupping jar, medication thread, small mouthed bottle, 95% alcohol medicated cotton, matches, physical therapy infrared baking lamp.

Methods: This study was conducted during the autumn semester sports meet, 65 athletes who developed symptoms were divided into two groups using a random number table method. Of these athletes, 11 suffered from sports pain, 14 from delayed onset muscle soreness (DOMS), 20 from mild injuries, and 20 from severe injuries. Among them, 33 cases were in the control group, and 32 in the observation group. The observation group was treated with acupuncture and moxibustion, cupping therapy, and MTMZ once or twice, and the control group was treated with conventional therapy to compare the two methods' effects.

First, the two groups' pain levels of motor soreness, DOMS, mild injury, and severe injury were evaluated using the visual analogue scale (VAS) [14]. After diagnosis of pain and injury, treatment was performed. The athletes' injuries and recovery were investigated and observed at intervals of 0.5 days in the morning and afternoon during two training periods. The longest observation period was 28 days, and the time required for recovery training and recovery was counted. Using the analysis software SPSS19.0., and compare and analyze the VAS scores of motor pain and injury, total days of recovery training and recovery time, the mean value, and other data between the two groups for motor pain and injury. Use independent sample single tailed T-test to evaluate the treatment effect of traditional Chinese medicine comprehensive therapy and conventional therapy, with a significance level set at 0.05.

Statement regarding approval/exempt status: This study was approved/exempted by the ethics committees of the authors' institutions, the Liuzhou Institute of Technology and the Guangxi Zhuang Autonomous Region Brain Hospital.

3. Results

3.1. Symptom diagnosis and treatment selection

Using VAS to score injuries, two major categories of symptoms, pain and injury, were first classified based on their scores and then subdivided. VAS was used to identify pain points, with a rating scale of 0–10 points (based on the patient's pain level during examination), as follows: VAS = 0: painless; VAS $\leq$ 3: mild pain, tolerable; 4 $\leq$ VAS $\leq$ 6, pain and negative sleep effects, tolerable; 7 $\leq$ VAS $\leq$ 10, gradually intensifying pain that is unbearable and affects appetite negatively [15]. If pain intensity exceeds a score of 5 points, an athlete cannot persist in training. Training can continue with a score of 2–5, but the pain will affect performance. Other auxiliary

training or low-load-intensity training can be arranged according to the individual situation, but if pain worsens, training should be suspended.

First, we looked for pain points and searched for tenderness points at the localized area. If pain points were scattered and could not be determined, then VAS ≤ 2 indicated normal movement (See **Table 1**). If muscle strength decreased slightly, the diagnosis was exercise soreness. After diagnosis, cupping therapy was used first, which had a significant therapeutic effect on mild motor soreness [16]. We applied liquid medicine on the sore area's surface to prepare for cupping and then applied cupping therapy (pressing the patient's skin with the left hand, holding the cup with the right hand, and pushing it up and down or left and right), combined with flash cupping (quickly clasping the jar to the area that needs to be pulled out and then immediately lifting the jar up and down multiple times) [17]. After treatment, the patient rested for about half an hour to relieve pain. After treatment, patients resumed low-load-intensity training after resting for 0.5–1 day; the pain disappeared after 1.5–2.5 days. These athletes relieved from exercise-induced soreness after one cupping treatment.

Next, the patient rested for 30 min to an hour after cupping and the pain subsided quickly, but if noticeable tenderness remained, then the VAS ≤ 2 diagnosis, which is commonly misdiagnosed as DOMS, was revised. DOMS pain points were more concentrated than those of exercise-induced soreness, with obvious tenderness, greater pain intensity, normal (with injury) behavioral disorders, significant decrease in muscle strength, and sometimes even disturbed sleep and mental state ($3 \leq VAS \leq 6$). After this diagnosis, cupping therapy was also used. Used the pain points found by cupping to scientifically selected points for acupuncture and moxibustion treatment according to the distribution of main points and matching points along the meridians [18]. After inserting the needle according to the VAS score, techniques such as twisting, lifting, and breathing were used to enhance the treatment's effect [19]. After one treatment of cupping therapy and acupuncture and moxibustion, the patient could resume low-load-intensity training after a rest of 1.5–3 days; the pain disappeared after 3–6 days. If the pain relief was not obvious, we supplemented once with MTMZ.

Mild injury is shown in **Table 1**, with a score of $4 \leq VAS \leq 7$ and overlapping with DOMS, required initial diagnosis by identifying pain points and pain types. Mild injury was characterized by concentrated pain points and the location's self-perception, persistent pain, fever or redness in the pain area, and the inability to exercise normally. After diagnosis of mild injury, cupping at a fixed position was used to locate the pain point. After cupping and rest of approximately 15 min, acupuncture and moxibustion therapy was administered, after which the patient again rested for about 15 min before MTMZ, with the location selected based on the VAS score and injury site. Zhuang medicine advocates the "Three Ways and Two Roads" theory [20]. The Three Ways are the grain way, the waterway, and the airway; the Two Roads are the "Dragon Road", that is, the human body's blood channels, and the Fire Road, the body's sensing channels or nervous system. The "Two Roads" are pathways for the exchange of the body's heat sources with neural receptors and skin. Therefore, the moxibustion along the "Two Roads" medication line can make the Dragon Road and Fire Road unobstructed, promote the transformation and distribution of *Qi* and blood, regulate and nourish the body, and achieve the effect of treating pain [21]. If the pain was relieved after 30 min of moxibustion, treatment was considered complete. If pain

relief was not obvious, infrared light therapy was used to end the session. Training could then resume within 1 to 7 days, and the pain disappeared within 4–10 days.

Table 1. Diagnosis and comprehensive therapeutic effects of sports pain and injury (d, $n = 32$).

Types of Injury and Pain	Number	VAS: 0–10 (Types)	Trainable days	Mean value	Rehabilitation days	Mean value
Motor soreness VAS ≤ 2	6	2	0.5	0.67	1.5	1.83
		1	0.5		1.5	
		1	0.5		2	
		2	1		1.5	
		1	0.5		2	
		2	1		2.5	
DOMS 3≤ VAS ≤6	7	3	1.5	2.07	4	4.29
		4	2		4	
		3	2		4	
		5	2.5		5	
		6	3		6	
		5	2		4	
		4	1.5		3	
Mild injuries such as strain, sprain, and dislocation 4 ≤ VAS ≤ 7	10	5 (dislocation)	1.5	3.35	5	6.90
		4 (dislocation)	2		6	
		6 (strain)	3		10	
		5 (sprain)	4		7	
		7 (strain)	5		10	
		4 (sprain)	3		5	
		5 (dislocation)	1		4	
		5 (strain)	3		7	
		7 (sprain)	7		10	
		5 (strain)	4		5	
Severe injuries such as strain, sprain, and dislocation VAS > 7	9	8 (dislocation)	3	5.33	8	9.89
		9 (strain)	5		12	
		8 (dislocation)	4		7	
		9 (strain)	7		14	
		10 (sprain)	5		10	
		8 (dislocation)	4		7	
		9 (sprain)	7		9	
		8 (strain)	6		10	
		10 (sprain)	7		12	

Severe injury (VAS > 7) was characterized by concentrated and persistent pain points, inability to move, and obvious redness, swelling, or subcutaneous bruising in the painful area. For severe injury, the protocol was to apply the whole set of comprehensive therapy, as follows: find the pain point, apply cupping therapy, acupuncture and moxibustion, and moxibustion with the Zhuang medicine line. According to the pain relief status, another MTMZ could be applied, and infrared light

therapy could be used to end the treatment. Training could resume within 3–7 days; the pain disappeared within 7–14 days.

Table 2. Diagnosis and conventional therapeutic effects of sports pain and injury (d, n = 33).

Types of Injury and Pain	Number	VAS: 0–10 (Types)	Trainable days	Mean value	Rehabilitation days	Mean value
Motor soreness VAS ≤ 2	5	1	0.5	0.90	1.5	1.90
		1	0.5		1.0	
		1	1		1.5	
		2	1		2.5	
		2	1.5		3	
DOMS 3≤ VAS ≤6	7	4	2.5	2.86	5	5.14
		3	2		4	
		4	3		5	
		4	3		5	
		6	4		6	
		3	1.5		5	
		5	4		6	
Mild injuries such as strain, sprain, and dislocation 4 ≤ VAS ≤ 7	10	4 (dislocation)	3	4.80	5	9.30
		5 (strain)	5		8	
		5 (dislocation)	5		12	
		6 (strain)	6		8	
		7 (sprain)	6		14	
		5 (strain)	4		7	
		4 (dislocation)	2		5	
		6 (sprain)	4		8	
		6 (strain)	7		12	
		4 (sprain)	6		14	
Severe injuries such as strain, sprain, and dislocation VAS > 7	11	9 (dislocation)	5	7.73	12	14.73
		8 (sprain)	7		18	
		8 (dislocation)	6		8	
		10 (sprain)	9		15	
		9 (strain)	14		28	
		8 (dislocation)	7		10	
		8 (strain)	7		10	
		10 (strain)	6		12	
		10 (sprain)	12		21	
		9 (strain)	7		18	
		8 (dislocation)	5		10	

3.2. Evaluation and comparison of treatment effects

Use of VAS, acupuncture and moxibustion, and cupping moxibustion comprehensive therapy can quickly and efficiently diagnose pain and injury. We used cupping to help locate pain points, to classify accurately the pain and injury diagnosed,

and to provide conditions for later selection of reasonable, scientific treatment methods. According to **Figure 1** combined with **Table 2**, it can be seen that in treatment of exercise-induced soreness, the average time for recovery training in the observation group (comprehensive therapy) was 0.67 days, slightly better than the average time of 0.90 days for conventional therapy. In the observation group, the average time for pain to disappear was 1.83 days, slightly better than 1.90 days in the control group; overall, the therapeutic effects were similar. For DOMS, the average recovery training times for the observation and control groups was $2.07 \leq 2.86$ days, and for pain disappearance, $4.29 \leq 5.14$ days. For mild injuries, the average recovery training time between the observation and control groups was $3.35 \leq 4.80$ days, and for pain disappearance was $6.90 \leq 9.30$ days. For severe injuries, the average recovery training time between the observation and control groups was $5.33 \leq 7.73$ days, and for pain disappearance was $9.89 \leq 14.73$ days. Changes in *P*-values in **Figure 2** reveal that as symptoms of pain injury worsened, significant differences in efficacy between the two therapies became increasingly evident. Rehabilitation time shortened, indicating the obviously increasing efficacy of comprehensive therapy.

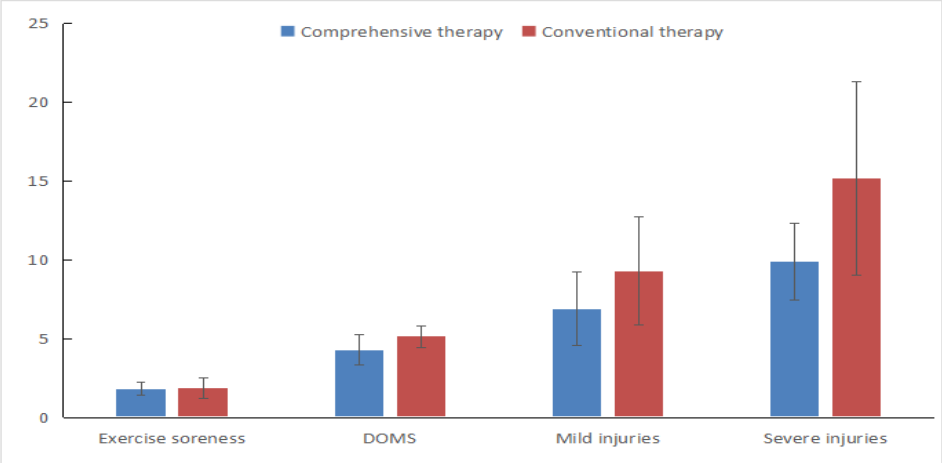

Figure 1. Comparison of effects between comprehensive and conventional therapies.

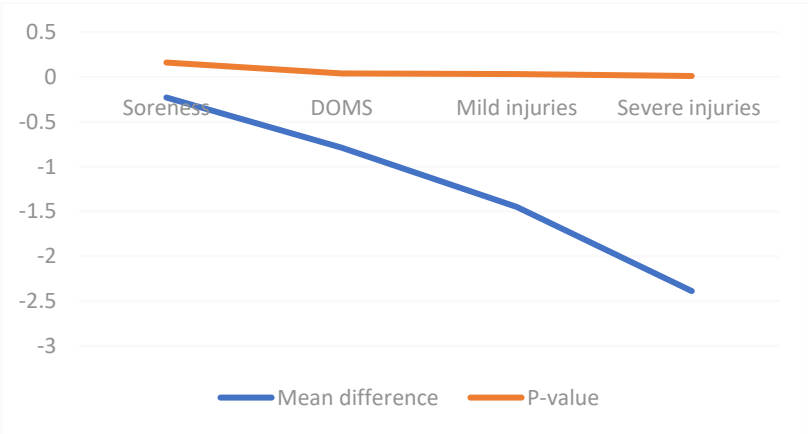

Figure 2. Significant difference in efficacy (P) and change in the mean difference in rehabilitation time between comprehensive and conventional therapies.

Using the number of days of low load training d as an indicator to evaluate the therapeutic effects of the two therapies, independent sample *t*-test was used to obtain

Table 3. In the comparison of exercise induced soreness treatment between the observation group using comprehensive therapy and the control group using conventional therapy, the test result $P > 0.05$ indicates that there is no statistically significant difference in the efficacy of the two therapies, indicating that the efficacy of comprehensive therapy and conventional therapy is equivalent in this type of mild treatment; However, in the treatment of delayed muscle pain, mild injury, and severe injury, the test result was $P < 0.05$, indicating a statistically significant difference in the efficacy of the two therapies. This indicates that the comprehensive therapy has a significantly better therapeutic effect on these three types of injuries than the control group, and the efficacy is more significant in severe injury. The rehabilitation effects of the two therapies were evaluated using the number of days of pain disappearance as an indicator, and similar results were obtained (see **Table 4**), which also demonstrated the advantages of traditional Chinese medicine.

Table 3. Comparison of recovery training time between two therapies (d).

Therapy	Motor soreness	DOMS	Mild injury	Severe injury
Comprehensive therapy	0.67 ± 0.26	2.07 ± 0.53	3.35 ± 1.76	5.33 ± 1.50
Conventional therapy	0.90 ± 0.42	2.86 ± 0.94	4.80 ± 1.55	7.73 ± 2.87
Mean difference	−0.23	−0.79	−1.45	−2.39
P-value	0.16	0.04	0.03	0.01

Table 4. Comparison of rehabilitation effects between two therapies (d).

Therapy	Motor soreness	DOMS	Mild injury	Severe injury
Comprehensive therapy	1.83 ± 0.41	4.29 ± 0.95	6.90 ± 2.33	9.89 ± 2.42
Conventional therapy	1.90 ± 0.65	5.14 ± 0.69	9.30 ± 3.43	14.73 ± 6.03
Mean difference	−0.07	−0.85	−2.4	−5.31
P-value	0.40	0.04	0.04	0.01

In the diagnosis of motor soreness, DOMS, mild injury, and severe injury, the average scores of the observation were 1.50 ± 0.55, 4.29 ± 1.11, 5.30 ± 1.06, and 8.78 ± 0.83, respectively. The average scores of the control group were 1.40 ± 0.55, 4.14 ± 1.07, 5.20 ± 1.03, and 8.82 ± 0.87, respectively (see **Table 5**). The differences between the two groups were 0.10, 0.14, 0.10, and −0.04, indicating that the two treatment methods had a small difference in VAS scores, and the test results showed $P > 0.05$. The results showed that the two therapies did not have statistical significance in VAS scores. The difference indicates that during the experiment, the scores and grouping of the two groups were reasonable, avoiding the interference of irrelevant variables.

Table 5. Comparison of VAS scores between two therapies.

Therapy	Motor soreness	DOMS	Mild injury	Severe injury
Comprehensive therapy	1.50 ± 0.55	4.29 ± 1.11	5.30 ± 1.06	8.78 ± 0.83
Conventional therapy	1.40 ± 0.55	4.14 ± 1.07	5.20 ± 1.03	8.82 ± 0.87
Mean difference	0.10	0.14	0.10	−0.04
P-value	0.39	0.41	0.42	0.46

3.3. Treatment mechanism of comprehensive therapy

3.3.1. Mechanism of motor pain and DOMS treatment

From an exercise physiology perspective, DOMS refers to the feeling of muscle pain or discomfort that occurs after engaging in habitual exercise. The degree of discomfort occurs in the first 24 h after exercise, reaches its peak at 24–72 h, gradually alleviates, and disappears in 5–7 days, representative theories have included "lactate theory", "muscle spasms theory", "injury theory", "inflammation theory" and "enzyme escape theory" [22,23]. Since Hough discovered DOMS in 1902, there has been a lot of related research, and there is no unified explanation for the DOMS mechanism yet exists at home or abroad, and DOMS prevention and treatment measures are not truly effective [24]. From the perspective of energy supply, vigorous exercise relies mainly on glycolysis for energy supply. Insufficient oxygen supply generates lactic acid through glycolysis to release energy, which is used for ATP enzyme synthesis [25]. Due to the lactic acid in muscles cannot be further converted into sugar, approximately 17%–25% of lactic acid diffuses into the bloodstream and synthesizes liver glycogen or glucose through lactate circulation in the liver, thereby avoiding muscle lactate accumulation [26]. Increased exercise load that prevents the body's adaptation can lead to lactate accumulation. The hydrolysis and synthesis of ATP consume a large amount of O_2 + energy, and produce a large amount of CO_2 and metabolites (including lactic acid). See the following formula:

$$\text{ATP} + H_2O \xrightarrow{\text{Hydrolase}} \text{ADP} + \text{Pi} + \text{Energy (for muscle utilization)},$$

$$\text{ATP} + \text{C} \xleftarrow{\text{Creatine kinase}} \text{ADP} + \text{CP} + \text{Energy (decomposition of three major energy substances)}.$$

With increased exercise load, fat and protein gradually participate in the energy supply, producing acidic substances that cause loss of homeostasis in the intramuscular environment, decreased pH value, and decreased enzyme activity due to temperature rise, leading to metabolic disorders [27]. Hydrolysis and synthesis of ATP are hindered, obstacles in elimination of metabolites leads to muscle tissue soreness. Lactic acid accumulation may be a factor in DOMS [28]. Muscle soreness, DOMS, and injury are progressive developmental processes turning point around DOMS. The inflection point effect of DOMS is consistent with the VAS grading order of pain and injury.

From the perspectives of TCM and Zhuang medicine, the mechanism of DOMS is not yet clear. According to its symptoms, it is often attributed to muscle pain or fatigue. Exercise-induced muscle soreness was not simply a buildup of creatine (lactate) but mainly a process of expansion, contraction, and reconstruction between the fascia and muscles [29,30]. The pathogenesis of traditional Chinese medicine is often related to the depletion of essence and *Qi*, excessive load on muscles, bones, and flesh, resulting in damage to muscles and meridians, loss of blood supply, and blockage of meridians, leading to obstruction that causes the pain [31]. In this process during continuous explosive movements, the fascia suddenly increases tension, and the body's *Qi* (Essential-*Qi*) and blood flow in and out are obstructed; the "Three Ways and Two Roads" are obstructed, resulting in temporary obstacles and causing injury and soreness [32]. Due to various uncertain factors, making DOMS diagnosis difficult and prone to misdiagnosis. It requires a preliminary diagnosis by VAS combined with

a rest after cupping. Traditional Chinese medicine, based on the therapeutic mechanisms of "communication" and "balance", provides new ideas for treating pain caused by "dysfunction" in the body's circulatory function and metabolic disorders.

3.3.2. Pain finding and cupping therapy mechanism

Cupping therapy uses a wide skin contact surface and negative pressure generated by combustion to adsorb on the body surface, causing local capillary congestion or even rupture in the subcutaneous area. Rupture of erythrocytes can lead to epidermal congestion and hemolysis, resulting in production of histamine and histamine-like substances that circulate through the body to stimulate the damaged area, enhance its functional activity, and enhance the body's resistance [33]. The negative pressure formed by cupping is adsorbed on the body's surface, reaching deep into the skin to form "suction" of the fascia and "tension" after loosening the cupping; thus, the damage point is explored and treated simultaneously. As shown in **Figure 3a**, cupping therapy usually causes a local phenomenon similar to blood stasis (*Sha*), a functional disorder that leads to *Qi* stagnation and obstruction. *Sha* differs from stasis in that it has pain relief and functional recovery, but when blood stasis occurs, pain worsens and dysfunction occurs. Cupping therapy unblocks meridians, promoting *Qi* and blood circulation, reducing swelling and pain, dispelling wind and cold, and restoring fascia. Cupping has a long history in ancient China, as early as the silk book *52 Disease Prescriptions* written during the Western Han Dynasty and recording the "Jiao Method" or cupping therapy [34]. In addition, cupping therapy was popular in ancient Greece and Rome [35].

The main way to find pain points is to check before treatment. In the local area of pain, there are tenderness points in the tense fascia. After contact with cupping, the local pain will worsen. This is the point of injury. After cupping, compared with normal skin, there will be cupping marks, and in severe cases, there may be blood cupping marks, as shown in **Figure 3b**.

(a) **(b)**

Figure 3. The process of comprehensive therapy. **(a)** Cupping and Sha appearance; **(b)** Treatment with cupping after finding pain points.

3.3.3. Injury mechanism of acupuncture and moxibustion combined with cupping

In TCM, a sports injury is commonly termed a "muscle injury", referring to imbalance in the movement of *Qi* and blood during exercise. *Qi* and blood compress from the muscles and pass through the fascia to generate a force toward movement, while forming a lubricating fluid to complete the action [36]. After the exercise is completed, these body fluids quickly penetrate through the fascia, returning to the muscles and then entering the bloodstream to complete metabolism [37]. Muscle injury is caused by obstruction in this process. Through acupuncture and moxibustion to regulate Qi and blood, and cupping to regulate body fluid, the injured fascia can be restored through repeated processes of cupping and loosening to restore normal operation of *Qi*, blood, and athletes to recover their sports functions quickly and to repair and adjust minor fascia injuries during sports.

3.3.4. Principle of Zhuang medicine thread moxibustion treatment and its promoting effect on exercise

Zhuang medicine is based on yin and yang, and its core theory is the synchronization of heaven, earth, and human *Qi* [38]. The Three ways and Two Roads theory was established in the partial introduction of TCM meridian theory. The Three Ways refer to the grain way (digestive system), the waterway (urinary system), and the airway (respiratory system); the Two Roads refer to the Dragon Road (circulatory system) and the Fire Road (nervous system), and the core of Three ways and Two Roads is "unblocked" to guide the line moxibustion therapy of Zhuang medicine [39]. A medicinal thread is made from ramie, soaked in medicinal solution, and dried for later use. In therapy, the medication thread is ignited and then ignites the patient's surface acupoints to unblock the Dragon Road and the Fire Road. This achieves "unblocking" and promotes blood circulation, resolves blood stasis, reduces swelling, and disperses nodules [40]. Moxibustion of the skin with a medication line accelerates spatial circulation in the localized skin's subcutaneous tissue, restoring tendon and bone-joint systems to their normal positions and maximizing stimulation of kinetic energy. The promoting effect of the Zhuang medicine thread on exercise aims mainly to keep the body's bone-joint system and tendon system in optimal circulation, ensuring that *Qi* and blood supply energy to bone, muscle, and tendon systems or that various pumps are in an optimal state during exercise [41].

4. Discussion

4.1. Diagnosis of sports injuries and efficacy of comprehensive therapy

Sports pain and injury result from a combination of subjective and objective factors, for instance, environmental impact, lack of self-protection awareness, inadequate health guidance, and lack of medical support [42,43]. Strengthening sports health education and self-protection awareness, popularizing scientific exercise methods, and paying attention to physical recovery can prevent occurrences of sports pain and injury. Once pain and injury occur, training should stop immediately for diagnosis and treatment to avoid the condition's worsening. During the athlete's disease, physical work should be abandoned. The comprehensive therapy of

acupuncture and moxibustion, cupping therapy, and MTMZ uses fewer medical resources, and one to many athletes can be treated simultaneously, thus diagnosing and treating mass sports injuries quickly and achieving better medical effects [44]. Implementation of combined TCM and conventional medicine prevention and treatment measures, in conjunction with off-campus hospitals to cope with sudden groups of pain injuries, is worth promoting.

For treating mild symptoms such as sports soreness, comprehensive therapy and conventional therapy had similar therapeutic effects due to the body's ability to repair itself. In clinical treatment, conventional therapy is the main method, supplemented by TCM, which can more quickly and effectively treat sports soreness. For treating DOMS, mild injury, and severe injury, the observation group showed significantly better efficacy than conventional therapy in both individual and group settings, with the most significant recovery being from dislocation injury. Comprehensive therapy combines the advantages of efficiency and practicality, but it requires the practitioner to have excellent clinical skills.

4.2. Internal connection of the comprehensive therapy mechanism

Acupuncture and moxibustion, cupping therapy, and MTMZ therapy techniques that connected points and lines from cupping (see **Figure 3**) found pain points. Those points conformed to nerve fibers and muscle fibers' physiological characteristics and reflected the consistency of TCM's principles with those of modern medicine. Comprehensive treatment's operational process includes the following: finding the pain point, cupping, acupuncture and moxibustion, and MTMZ. During the process, *Qi* enters and exits the body with the movement of breathing, and blood undergoes ascending and descending metabolism through dietary absorption. *Qi* and blood are the source of body fluid, which is another application of *Qi* and blood. Cupping regulates the flow of body fluid in and out, acupuncture and moxibustion regulate the rise and fall of *Qi* and blood, and thread moxibustion links communication between inside and outside. The core principle of the Three Ways and Two Roads in Zhuang medicine is unblocking, which shares the same medical principles as the unblocking of traditional Chinese medicine meridians and blood vessels [45]. Pain leads to obstruction, damage to the body, and obstruction in the movement of *Qi* and blood in and out of the fascia and muscles, resulting in pain. For treatment of dislocation injury, the first step is to unblock the meridians and tendons through film observation and rapid reduction. The application of acupuncture and moxibustion points to stimulate the nerve reflex arc to cause local muscle contraction and body fluid movement to unblock the *Qi* and blood. MTMZ deeply stimulates the motor nerve center, reactivating normal operation of *Qi*, blood, and body fluids from the "point" to the "line", thus achieving rapid dredging of the veins and *Qi*, blood movement, and repair of the body without pain. This explains the most significant reason for comprehensive therapy's effect on dislocation injury.

4.3. Development trends of integrated traditional Chinese and Western medicine

Compared with conventional treatment, traditional Chinese medicine therapy

more effectively alleviated exercise-induced pain, especially with significant analgesic and rehabilitation effects on exercise-induced injuries. The combination of traditional Chinese and Western medicine can effectively treat sports injuries by leveraging their respective advantages, and has become a development trend. During the diagnosis period, if it is a serious injury, modern medical equipment such as X-rays and CT should be used to observe and diagnose whether there is bone dislocation and injury, in order to avoid safety hazards when implementing traditional Chinese medicine treatment. At the end of the treatment period, the use of infrared therapy with a baking lamp played a role in promoting blood circulation, removing blood stasis, reducing swelling, and dispersing nodules, fully demonstrating the rehabilitation effect of integrated traditional Chinese and Western medicine treatment. The consistency between the therapeutic effects of comprehensive and conventional therapies explains the unity of traditional Chinese medicine and modern medical principles.

5. Conclusion

Strengthening health education, improving self-protection awareness and arranging exercise load reasonably are the primary tasks to prevent large-scale sports injuries in schools [46]. If symptoms of sports injury occur, training should be stopped in a timely manner, scientific diagnosis should be made, and reasonable treatment should be adopted. Acupuncture and moxibustion, cupping therapy, and Zhuang medicine thread moxibustion combine to play a unique role in treatment of sports pain and injury, forming an integrated effect of treatment, from "point" to "line" to open the meridians, remove obstacles, and promote normal functions of *Qi*, blood, and body fluid to restore vitality. Integrated treatment promotes blood circulation, resolves blood stasis, swelling, and pain, and restoring body function. Comprehensive therapy can alleviate motor pain more effectively than conventional therapy, and a certain difference exists in the higher degree of rehabilitation, especially in pain relief and rehabilitation efficacy for sports injuries. The use of modern medical equipment as an auxiliary can better leverage the therapeutic effects of traditional Chinese medicine. Combining traditional Chinese and Western medicine to treat both symptoms and root causes, improving the efficacy of traditional Chinese medicine, and promoting the healthy development of school sports is also an effective way to promote the sustainable development of traditional Chinese medicine.

Author contributions: Conceptualization, YQ and JK; methodology, SX; software, LL; validation, CZ, YQ and JK; formal analysis, SX; investigation, CZ; resources, CZ; data curation, LL; writing—original draft preparation, SX; writing—review and editing, YQ; visualization, CZ; supervision, JK; project administration, JK; funding acquisition, CZ. All authors have read and agreed to the published version of the manuscript.

Funding: (1) Key Project of Guangxi Education Science "14th Five Year Plan" 2023 Funding (2023A123): Integrating Media to Assist the Teaching Practice Research of "Research, Competition, and Promotion of Learning" in the Teaching of Ethnic Sports embroidered Ball in Universities; (2) National Social Science Fund Western Project:

Theoretical and Practical Research on Ethnic Minority Sports Supporting High Quality Development of Ethnic Work (22XTY007); (3) 2022 Guangxi Higher Education Undergraduate Teaching Reform Project (2022JGB495): Research on the Construction of Mixed Online and Offline Courses for Ethnic Sports Throwing Embroidery Ball in the Context of Integrated Media; (4) Guangxi Higher Education Undergraduate Teaching Reform Project (2023JGA222): Digital Empowerment: Research on Teaching Reform Practice of Public Sports Club System in Higher Education Institutions with Efficiency Enhancement and Intelligent Promotion; (5) The 2020 Guangxi Philosophy and Social Sciences Planning Research Project: Research on the Application of Guangxi Ethnic Traditional Sports Health Culture and Health Promotion from the Perspective of Healthy China (20CTY002).

Availability of data and materials: The datasets generated by the survey research during and/or analyzed during the current study are available in the figshare repository. Copies of the data can be obtained free of charge via: https://figshare.com/account/items/24548863/edit. The datasets used and/or analysed during the current study available from the corresponding author on reasonable request; All data generated or analysed during this study are included in this published article.

Declarations: This study has obtained informed consent from all participants and/or their legal guardians.

Ethical approval: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

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