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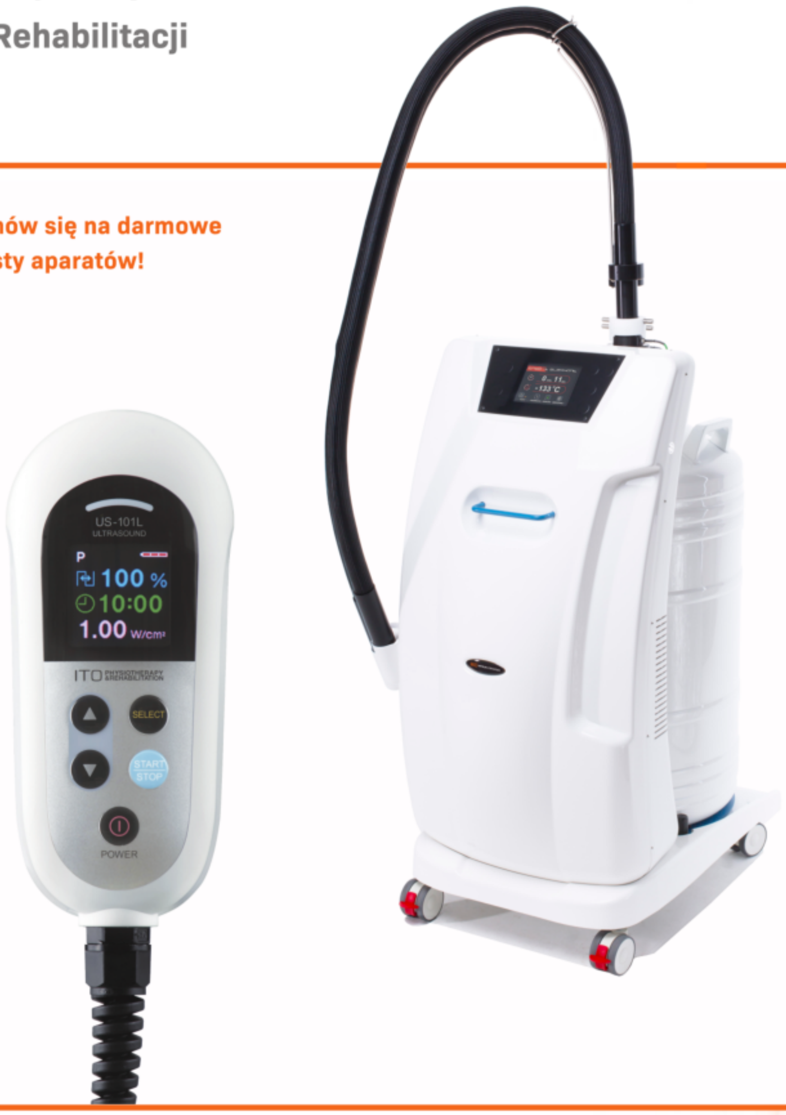

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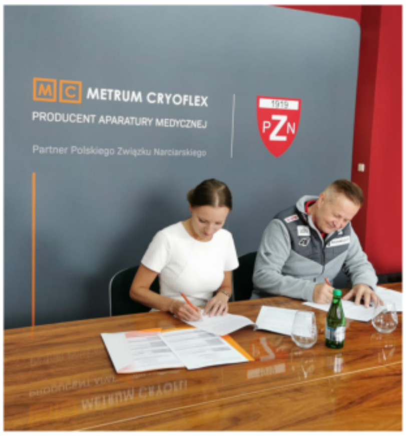

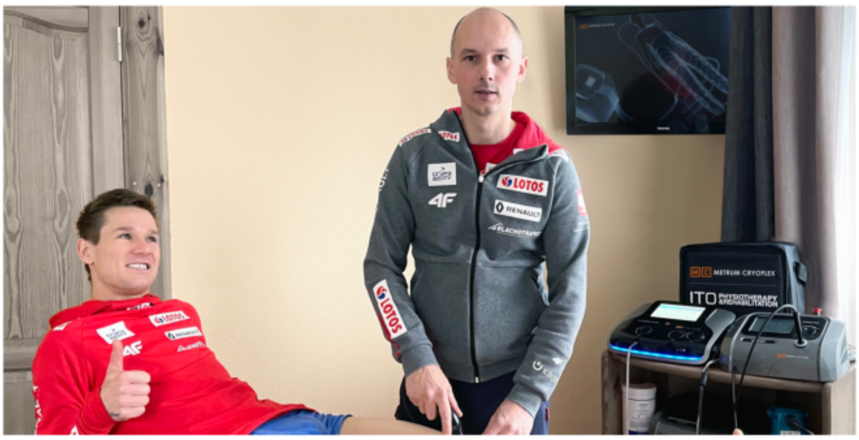

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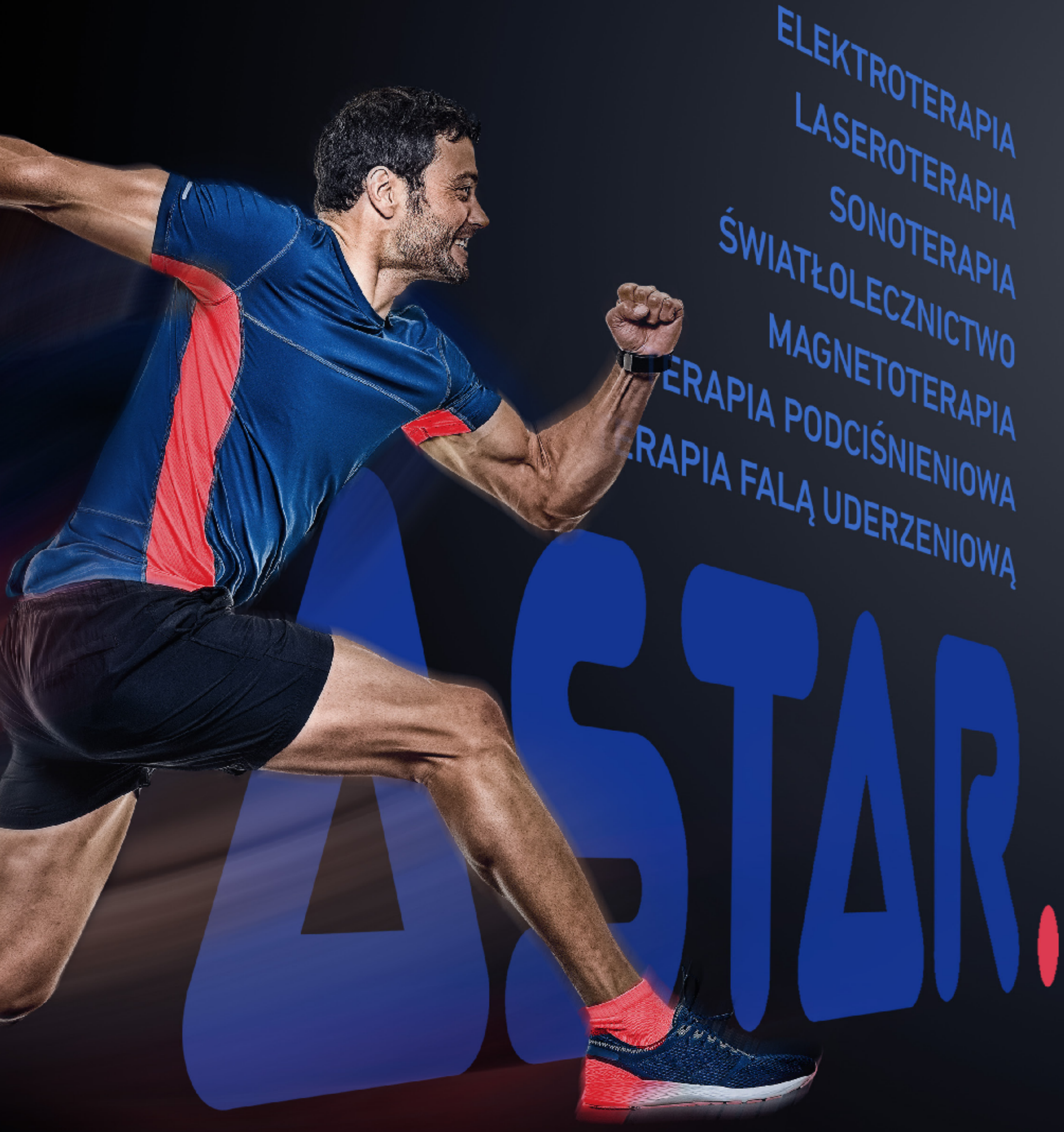

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Effect of Diode Laser 905 nm and Fascial Distortion Model on the Copenhagen hip and groin outcome score on Groin adductor strain in Handball athletes: Single-Blinded Randomized Control Trial

Wpływ lasera diodowego o długości fali 905 nm i terapii FDM (Fascial Distortion Model) na wynik pomiaru biodra kopenhaskiego i pachwiny po przeciążeniu przywodziciela pachwiny u zawodników piłki ręcznej: randomizowana próba kontrolna z pojedynczą ślepą próbą

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Abstract

Aim. Groin pain related to adductor strain in athletes is a common problem in sports medicine as much as groin injuries. The purpose of the present study was to investigate effect of diode laser and Fascial Distortion Model (FDM) on groin adductor strain in handball athletes. Materials and Methods. Forty handball male and female athletes with adductor groin strain were divided randomly into two groups. The experimental group (A) received (Diode laser 905 nm), FDM and medical treatment, while control group (B) received the sham laser, FDM and medical treatment. Outcome measures included the Copenhagen hip and groin outcome score (HAGOS) and pressure algometry. Results. both groups showed significant difference in the post treatment outcome measures, but the experimental group showed a more significant improvement than the control group with p-value > 0.05. Conclusion. the results imply that treatment of adductor groin strain in handball athletes by FDM and diode laser (905 nm) [LLLT] is more effective than FDM alone.

Key words:

Adductor strain, Diode Laser, Fascial distortion Model, HAGOS

Streszczenie

Cel. Ból pachwiny związany z przeciążeniem przywodzicieli u sportowców jest częstym problemem w medycynie sportowej, podobnie jak kontuzje pachwiny. Celem niniejszej pracy było zbadanie wpływu lasera diodowego i terapii FDM na przeciążenie przywodziciela pachwiny u zawodników piłki ręcznej. Materiały i metody. Czterdziestu zawodników piłki ręcznej płci męskiej i żeńskiej z przeciążeniem przywodziciela zostało losowo podzielonych na dwie grupy. Grupa eksperymentalna [A] była poddawana działaniu lasera diodowego 905nm, terapii FDM i leczeniu medycznemu, podczas gdy grupa kontrolna [B] była poddawana działaniu lasera pozorowanego, terapii FDM i leczeniu medycznemu. Pomiary wyników obejmowały punktację punktową biodra i pachwiny [HAGOS] i algometrię ciśnieniową. Wyniki. W obu grupach wykazano istotną różnicę w pomiarach wyników po leczeniu, ale grupa badana wykazała bardziej znaczącą poprawę niż grupa kontrolna z wartością p > 0,05. Wniosek. Wyniki sugerują, że leczenie przeciążenia przywodziciela u sportowców piłki ręcznej za pomocą terapii FDM i lasera diodowego (905 nm) [LLLT] jest skuteczniejsze niż zastosowanie samej terapii FDM.

Słowa kluczowe

przeciążenie przywodziciela, laser diodowy, terapia FDM, HAGOS

Introduction

Hand ball is played in 199 countries by over 20 million players worldwide in over 800,000 teams over the years [1]. Hip and groin injuries in handball have received less attention compared to other sports as football [2]. The groin pain related adductor strain in athletes is the most common problem in sports medicine accounting for 10% of all visits to sports medicine centers, while groin injuries account for 5% to 28% of all athletic injuries [3]. Acute groin injuries are usually located to the musculo-tendinous junction, but in some cases the tendon itself is the site of injury [4, 5] and the most acute injury in the groin is to adductor muscles especially adductor longus [5].

In recent years, LLLT has emerged as an effective method for muscle injuries treatment and has become increasingly common in clinical practice, especially in the fields of physical therapy and sports medicine as well as different fields of traditional medicine, explaining therapeutic effects on various types of biologic tissues[6].They have opened up new prospects for better treatments in arthritis, joint or tissue inflammation, pain-relief, because of the ability of their wavelengths to match the requirement of the medical treatment to optimize the effectiveness [7].

The FDM is a new anatomical model used to diagnose and treat various musculoskeletal injuries as they are thought to be the result of specific alterations of body's fascial [8]. It was developed to improve current treatments by basing them on a more anatomical approach as a pulled muscle. Also, FDM does not treat diagnosis such as tendinitis, but it treats the anatomical fascial distortion involved [9].

Also, the Copenhagen Hip and Groin Outcome Score (HAGOS) is a valid and reliable measurement quality for assessment of symptoms, activity limitation, participation restriction and life quality in physically active young to middle age with hip or groin pain by questionnaires [10]. Moreover, pressure algometry is a valid and reliable measure [11, 12] with wireless capability and smaller digital pressure sensors that help quantify a patient's pressure pain threshold [13, 14]. So, the aim of the present study was to investigate effect of diode laser (905 nm) and Fascial Distortion Model on function and pain level on groin adductor strain in handball athletes.

Materials and Methods

This was a single blinded randomized pre-post experimental control design that included forty handball athletes with adductor groin strain. It was conducted in Al-Ahly Club outpatient clinic. This study was approved by National Institute of Laser Enhanced Sciences, Cairo University (Cu-NILES/23/20) and by PACTR with a registry number of PACTR202008911789002. Also, the patients signed an informed consent form prior to participation in the study, after the purpose and procedures of the study were fully explained to all patients in accordance with the principles set forth in the Helsinki Declaration.

Participants and randomization

A sample size of 40 participants out of sixty (male and female) in each group was determined by conducting a preliminary power analysis with a power 80%. So, patients referred by an orthopedist were simply randomly assigned into two groups, A and B to avoid bias using an envelope prepared by an independent subject with random number generation of 20 participants in each group with an allocation ratio of 1:1. The patients were referred from the orthopedist of the handball team when diagnosed as acute second stage groin adductor (grade II) during playing handball. And their ages ranged 12-24 years of both sexes. They were excluded if had any athletic injuries as sport hernia and osteitis pubis, hip joint injuries avulsion or stress fracture.

Outcomes measures

Outcomes measures included HAGOS (The Copenhagn Hip and Groin outcome scores) to assess hip functional activity and pressure algometry to assess pain threshold. The outcome measures were applied before treatment and after completing 6 sessions.

Pressure pain threshold [PPT] by pressure algometer

A valid and reliable [15] portable Wagner Force One Model FDIX 50TM, Wagner Instruments, Greenwich, Connalgometer was applied by the trained physiotherapist to measure PPT and tolerance levels of groin painful and trigger points through a 4-digit LCD screen with 3 buttons keypad and a 1cm2 round rubber tip. The test was performed where is the patient in supine lying position as the round rubber tip was pressed vertically at two tender points (Point 1 and point 2) on the proximal attachment of the pubic ramus [16]. The Wagner FPIX™ digital algometer detected the patient's minimum pressure that induced pain in tender points of tissue.

Copenhagen hip and groin outcome score (HAGOS)

HAGOS is a self-reported scale containing six items scored separately considering symptoms (7 items), pain (10 items), ADL (5 items), physical function in sport and recreation (8 items), PA (2 items) and hip and/or groin-related quality of life (5 items). The past week is taken into consideration when answering the questions. Standardized answer options are given (5 Likert boxes)] and each question gets a score from 0 to 4, where 0 indicates no problem. The six scores are calculated as the sum of the items included, and then raw scores are transformed to a 0–100 scale, with zero representing, there are extreme hip and/or groin problems and 100 representing no hip and/or groin problems, as it is common in orthopedic scales. Scores between 0 and 100 represent the percentage of total possible score achieved [10].

Intervention

Group A received a program of Chattanooga Gallium Aluminum Arsenide Diode Laser (wavelength 905 nm) over three sessions per week as a total of six sessions for two weeks' period by three sessions per week in addition to medical treatment Ambezim-G 5 mg (Trypsin 5 mg + Chmotrypsin) and Fascial Distortion Model (FDM). While group B included 20 patients who received sham laser and FDM and medical treatment Ambezim-G 5 mg (Trypsin 5 mg + Chmotrypsin) only, over two weeks.

Gallium Aluminum Arsenide Diode Laser

Low- Level Laser Therapy (Chattanooga Gallium Aluminum Arsenide Diode Laser – Italy) with a wavelength of 905 nm, average power of 70.5 mw, maximum frequency of 30000 HZ, energy per pulse of 2.35 mJ, peak power of 13.5 W, beam surface at laser aperture of 12.5 mm^2 and pulse width at 50% of peak power of 155 ns was used. A contact laser technique was applied on medial side of thigh at adductor muscle tendon on its insertion on the pubic bone and at the length of muscle according to points of pain determined by patient and also according to trigger points of which muscle injured from adductors group such as pain patterns of adductor longus and brevis muscles, pectineus, and gracillis muscles] for three sessions per week over two weeks' period [17].

Fascial Distortion Model (FDM)

The specified distortions were applied with standard protocol as defined by the FDM, using subtypes (Trigger band technique). FDM techniques are characterized by apply motions and precise, aggressive pressures using hand contacts (either a thumb or whole hand contact) for treatment the identified distortion. The trigger band technique was applied with the patient in a comfortable supine lying position then the therapist determined with palpation the points of pain, through the verbal expression of patient, where the distortion is located that was described as a "burning" or "pulling" pain along a linear course and palpated as a wrinkling in the cross band of the adjoining trigger band and was noted in adductor groin strain [Peas which are smooth and are obviously pea-sized found in thighs]. The accompanying body language was a sweeping movement with one or more fingers along trigger band pathway. After locating the distortion, it was corrected along its entire pathway by using physical force from the physician's thumb twist till untwisting is felt [18].

Statistical analysis

The IBM SPSS statistics 22 software was used for statistical analysis. The analysis of data for this study was done using descriptive statistics and a 2×2 mixed model Analysis of Variance (ANOVA) with two groups (experimental vs. control) as the between subject factor and two times for measuring the dependent variables (pre-treatment and post- treatment) as the within subjects factor. The P-value was set at 0.05. Before data analysis Shapiro–Wilk test and Levene's test were used to test the normal state of the data and the equality of variances, respectively. The differences in demographic characteristics for both groups were assessed using unpaired t-tests. A sample size of 20 participants in each group was determined by conducting a preliminary power analysis with a power 80%.

Results

There were 20 participants in each group and their demographic data is represented in Table [1]. There was no statistically significant difference between both groups in demographic data. Shapiro–Wilk test and Levene's test revealed no violations of the assumptions of normality and homogeneity of variance for any of the dependent variables. Descriptive statistics of HAGOS score and pressure algometer at 2 points are presented in Table [2]. All pre-treatment dependent variables are showed no significant difference between the two groups ($P > 0.05$).

Table 1. Demographic characteristics of the participants

Characteristics	Experimental group	Control group	P-value
Age [years]	18.85 ± 3.15	18.55 ± 3.83*	0.78
Height [cm]	59.45 ± 7.87	58.6 ± 9.4	0.75
Weight [kg]	162.1 ± 6.97	160.3 ± 7.32	0.43
BMI [kg/m^2]	22.53 ± 1.94	22.63 ± 1.91	0.86

Table 2. Descriptive statistics of HAGOS score and pressure algometer at 2 points for both groups pre-treatment and post-treatment

Variables	Group	Pre treatment	Post treatment
HAGOS score	Experimental	287.72 ± 22.26*	108.7 ± 7.81
	Control	290.45 ± 25.77	143.34 ± 14.65
Pressure Algometer Point 1	Experimental	2.24 ± 0.47	4.13 ± 0.31
	Control	2.34 ± 0.55	3.12 ± 0.66
Pressure Algometer Point 2	Experimental	2.47 ± 0.58	4.21 ± 0.35
	Control	2.58 ± 0.5	3.16 ± 0.58

**Mean ± SD: standard deviation*

The 2×2 mixed-model ANOVA analysis demonstrated significant improvements in HAGOS score for both groups after treatment as the main effect of time was statistically significant ($p < 0.0001$), but experimental group showed significant improvement than the control group post treatment as the main effect of group was statistically significant ($p < 0.0001$) and time × group interaction effect was also significant ($p < 0.0001$) as explained in Table [3].
The Pressure Algometer at Point 1 showed significant improvements in both groups after treatment as the main effect of time was statistically significant ($p < 0.0001$) and also, the experimental group showed significant improvement than the control group at post treatment as the main effect of group was statistically significant ($p < 0.005$) and time × group interaction effect was also significant ($p < 0.0001$) as explained in Table [3].
Similar results were obtained for Pressure Algometer at Point 2 as there was significant improvement in the Pressure Algometer Point 2 for both groups following treatment as the main effect of time was statistically significant ($p < 0.0001$) and also, experimental group showed significant improvement than control group at post treatment as the main effect of group was statistically significant ($p < 0.003$) and time × group interaction effect was also significant ($p < 0.0001$) as explained in Table [3].

Table 3. Results of a 2 X 2 mixed-model ANOVA

Source of variance		F-value	P-value
HAGOS score	Between subjects [Group]	17.76	<0.0001*
	Within subjects [Time]	1636.66	<0.0001*
	Time X group	15.66	<0.0001*
Pressure Algometer Point 1	Between subjects [Group]	8.82	<0.005*
	Within subjects [Time]	539.44	<0.0001*
	Time X group	95.11	<0.0001*
Pressure Algometer Point 2	Between subjects [Group]	10.39	<0.003*
	Within subjects [Time]	253.69	<0.0001*
	Time X group	64.52	< 0.0001*

**Significant at α < 0.05*

Discussion

The present study was designed to determine the effect of Diode laser (905 nm) and Fascial Distortion Model (FDM) on HAGOS groin adductor strain in Handball athletes, the investigated outcome measures were conducted pre-treatment and at the end of second week post- treatment (after 6 sessions). Regarding the HAGOS score, had a significant difference in favor of group A. As for the two algometry points, there was also a significant difference pre and post in favor of group A. So, the results imply that treatment of adductor groin strain in handball athletes by FDM and diode laser (905 nm) is more effective in reduction of pain at trigger points and function than FDM alone.
So, applying laser to trigger points reduces tenderness and relaxes contracted muscle fibers [19]. Thus, this would be associated with increased oxygen delivery to hypoxic tissues [20]. According to Agung et al, five minutes of LLLT results in increased blood flow that subsequently increases nitric oxide locally and systematically, causing increased blood vessel diameter, inhibiting other inflammatory mediators, including prostaglandin E and cyclooxygenase, and also promotes endogenous opioid release and increases serotonin [21, 22].
This noninvasive, low-cost, easy-to-administer form of therapy can help reduce the use of medications, and associated side effects [23] but the choice of irradiation and treatment parameters by LLLT, such as wavelength, power output, beam area, total energy, irradiation time, frequency of treatment, mode of application, and the onset of treatment, are crucial to achieving positive effects in the treatment of muscle injuries [24].
And also, inhibition of action potentials where there is approximately 30% neural blockage within 10 to 20 minutes of application suppressing synaptic activity in second order neurons, so that cortical areas of the pain matrix would not be activated [25].Furthermore, laser applied to trigger points reduces tenderness and relaxes contracted muscle fibers [18].
Also, almost articles reported beneficial effects of LLLT in the treatment of acute muscle injuries, by modulation of the inflammatory process and [26, 27, 28, 29, 30] the stimulation of

blood vessels [31, 32] remodeling of the extracellular matrix [27, 29, 30] and stimulation of the proliferation of new muscle fiber to enhance muscle repair process after strain [25, 31, 32, 33] through its ability to limit the inflammatory response and attenuate oxidative damage [34].
Additionally, both vitro and vivo studies have confirmed that LLLT stimulates the regeneration of muscle tissue through the activation of satellite cells by introducing them in the cell cycle that promoted its proliferation and progression to the status of new muscle fibers [35].
Furthermore, applying thumb pressure on muscle fascia could remove solid cross-links at the nodule points, changing the membrane viscosity to a liquid state increasing the flexibility of the fascia [muscles and tendons], restoring the condition of the peripheral nervous system, promoting relaxation, improving function, resulting in reduction of excited pain afferent fibers sensation and eventually, promotes fascial relaxation, and blood rushing into muscle [36, 37]. Other studies suggested on fascia, and its properties that the mechanical forces generated by manual therapies, such as Fascial Distortion Model, may stimulate fascial mechanoreceptors, which may, in turn, trigger tonus changes in connected skeletal muscle fibers [38].
However, some authors [39, 40] believe that the benefits experienced from FDM was due to nonspecific factors while another explanation was due to activation of neuro physiological modes of action caused by the sensation of intense pain induced by pressure from therapist's thumb on the site of injury[43, 44, 45, 46, 47, 48].
The results of the present study were in accordance with results obtained by Min K, et al 2019 who found that the FDM was the most effective and rapid treatment method used compared to self-myofascial release and myofascial release after four weeks of treatment on neck range of motion and pain [49]. Also, by Schulze. C et al., 2014 who reported that FDM could increase speed without pain in patients with medial tibial stress syndrome (MTSS) [50]. Additionally, Fink et al. 2012showed that FDM had a significantly better result than the manual therapy in the treatment of shoulder pain syndromes [51].
Also, Rainer E2009, attributed in a study that a treatment following the principles of FDM is effective in treating patients with chronic low back pain as their functional status, pain, finger-floor distance improved and intake of analgesics reduced [52].
On the contrary, Thalhamer C 2017 was against FDM, as reported in a systematic review focusing on the clinical proofs of concept for FDM treatment techniques in musculoskeletal medicine, that FDM is based on a biomechanical/structural paradigm [53]. However, there is no evidence that all musculoskeletal-conditions are amenable to the laws of biomechanics and peripheral tissue pathology [39, 40].
This study was limited by the obtaining the results of either Diode laser (905 nm) or FDM alone due to combining LLLT to FDM and medical treatment. So, it is recommended to investigate the effect of LLLT and FDM alone and to investigate the effect of LLLT with different sport injuries, different wavelengths and power of LLLT. Also, studies combining the effect of Diode laser to other types of FDM such as Cylinder Distortion the athletes are recommended.

Conclusion

It could be concluded that both Diode Laser 905nm and Fascial Distortion Model together are effective in the treatment of acute groin adductor strain in handball athletes. So, the results could help physiotherapists to consider a proper treatment for adductor groin strain in handball athletes rather than consuming time and effort in other techniques that could be less effective.

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