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Low Level Laser and Plasma Rich Platelets in Treatment of Hamstrings Strain

Authors
Omar Medhat Mounir Hagag[1], Dr Khaled Elsayed Ayad[2], Dr Hatem Mohamed El Azizi[3]
[1]M.Sc, Physical Therapy for Musculoskeletal Disorders and Its Surgery - Faculty of Physical Therapy-Cairo University
Email: *omar-hagag@hotmail.com, Mobile: 01005166614*
[2]Prfessor of Physical Therapy for Musculoskeletal Disorders and Its Surgery - Faculty of Physical Therapy-Cairo University
[3]Assisstant Professor of Radiology – Faculty of Medicine – Cairo University

Abstract
Purpose: *the purpose of this study was to compare between the effect of low level laser therapy and plasma rich platelets on recovery of hamstrings strain.*
Subjects: *Thirty male athletes diagnosed as grade I and II hamstrings strain.*
Methods: *Patients were distributed randomly into three groups. The first group (A) consisted of 10 patients who received plasma rich platelets. The second group (B) consisted of 15 patients who received laser treatment. The third group (C) consisted of 10 patients who received both treatments at the same time. Treatment was given as follow; group (A) PRP was injected second day after injury, group (B) laser was applied 3 times/week starting from second day after injury for 2 weeks, group (C) PRP was injected and laser applied from second day after injury. Patients were evaluated pre-treatment and post-treatment for pain severity, intramuscular edema measurement, muscle healing and function, and angle of peak torque of both hamstrings post treatment.*
Results: *there was no significant difference between all groups while there was a significant difference within each group.*
Conclusion: *No significant differences between low level laser therapy and plasma rich platelets on recovery of hamstrings strain.*
Keywords: *[laser, Plasma rich platelets, hamstrings strain]*.

Introduction

Muscle injuries are one of the commonest injuries affecting athletes(1). They account for up to 30 – 50% of the injuries in sports events(2,3). This injury often affects the myotendinous junction of superficial muscles spanning across two joints, such as the rectus femoris, semitendinosus, and gastrocnemius muscles(1). Hamstring muscle strains are among the most common injuries in sport, with a resultant high morbidity (4,5,3).

The muscle injury recovery process is slow and often changes the original mechanical properties of the damaged muscle. The goal of rehabilitation is to recover the muscle as fast as possible offering the lowest risk of injury recurrence(6).

The diagnosis and grading of muscle injury is usually made through a thorough clinical assessent, MRI and ultrasonography. Diagnostic ultrasound examination is often recommended as the method of choice for confirming and grading the muscle injury [7] (table 1).

Table (1) Grading of muscle strain injuries on ultrasound

Grade	Ultrasound findings
0	No ultrasound features seen.
1	Muscle edema only.
2a	Partial tears of muscle fibers, disruption involving <33%.
2b	Partial tears of muscle fibers, disruption involving≥ 33 – 66%
2c	Partial tears of muscle fibers, disruption involving≥ 66 - 99%
3	Complete tear of muscle.

Generally, according to injury severities, muscle injuries are often graded based on three-grade scale [8]:

- 1st degree: strain-contusion-tear of a few muscle fibers with minor swelling and discomfort and with no, or only minimal, loss of strength and restriction of movements. Mild strain may, be distressing to athlete.
- 2nd degree: tear- contusion that causes a greater damage to the muscle with a clear loss of strength.
- 3rd degree: tear-contusion in which tear extends across the whole cross section of the muscle resulting in a total lack of muscle function.

Traditional conservative treatments such as physical therapy, NSAIDs and corticosteroid injections have all inconsistently reported successful outcomes [9,10,11]. Physical therapy modalities may use are low level laser, ultrasound therapy, polarized light, ice, electrical stimulation. Low-level laser therapy (LLLT) is common modalities used for treating several skeletal muscle conditions [12,13]. Effectively reduce post injury inflammatory processes, stimulate the formation of new blood vessels, and accelerate soft tissue healing [14,15,16]. The action of LLLT is based on absorption of light by tissues, which generates a series of modifications in cellular metabolism [14,16].

Plasma rich platelets- (PRP) has been used medicinally since the 1970 [17] and is obtained from autologous blood because the platelet concentration in PRP is at least 5-fold greater than that in physiological blood. PRP is prepared by centrifuging autologous blood with anticoagulants, such as sodium citrate, which cause the blood to separate into 3 layers in the test tube: Platelet Poor Plasma (PPP), PRP and some red blood cells [17,18].

Blood platelets have no nuclei and are formed through megakaryocyte fragmentation of bone marrow. The physiological blood platelet count range is 200,000-400,000/µL. Blood platelets contain the following granules[17]: alpha - contains fibrinogen, thrombospondin, and growth factors; GFs, delta - contains serotonin, ionized calcium, pyrophosphate, adenosine triphosphate, and adenosine diphosphate, and lambda - lysosomes containing lysosomal enzymes.

It is an emerging treatment in the modern health sector known as 'orthobiologics'. The goal of this discipline is to enhance the body's innate ability to repair and regenerate. PRP therapy has lately gained a lot of attention as a safe, nonsurgical, biological treatment of osteoarthritis and musculoskeletal repair [19].

Purpose was to investigate the effects of low level laser therapy (LLLT) with and without injection of PRP on hamstring muscle healing and recovery after 2nd grade tear injury in professional athletes.

Patients, Materials and Method

Patient's Selection

Thirty male professional athletes aged between 20 and 35 years with hamstrings tear were included in the study. All players were assessed clinically and sonographically at baseline, and after 2 weeks.

Inclusion criteria for patients included were; male professional athletes, aged from 20 to 35 years old, 2nd degree hamstrings tear diagnosed clinically and sonographically, the injury either in musclotendinious junction or muscle bulk, the injury is acute and at one level.

We were exclude also anybody with; recurrent hamstring muscle injury, tendon injuries, diseases affect healing process (e.g. DM, Thyroid disease), blood diseases that affect platelets. Players were divided randomly into 3 groups, with 10 patients in each group as follows:

Group A (PRP injection group): PRP was injected second day after injury.

Group B (Laser group): laser was applied 3 times/week starting from second day after injury for 2 weeks.

Group C (laser and PRP): PRP was injected and laser applied from second day after injury.

Methods

Patients were assessed pre and post treatment for all outcome measures except angle of peak torque of hamstrings was compared to the sound hamstrings. Pain was assessed by visual analogue scale (VAS), angle of peak torque by isokinitic machine, function by Nirschl phase rating scale (NPRS) table (1), and healing (edema and size of tear) by ultrasonography.

Outcome Measures

Healing

Muscle healing assessed by ultrasonography for granulation tissue formation (size of tear) and intramuscular edema before and after treatment.

Angle of peak torque (APT):

The more decrease in the difference of angle of peak torque the more healing tissue strength reduced angle of peak torque of hamstrings is a risk factor for injury recurrence [20]

Function

Functional outcomes were analyzed using the Nirschl Phase Rating Scale (NPRS) [9,21] (Table 2).

Table (2) Nirschl Phase Rating Scale (NPRS)

Low level laser:

Phase	level of disability
1	Mild soreness or stiffness after activity with resolution of symptoms during 24 hours.
2	Mild soreness or stiffness prior to activity that is relieved by warming up; symptoms are not present during activity but return afterward and resolve during 48 hours.
3	pain that is present during activity without causing activity modification.
4	pain with the activity that cause modification.
5	pain that present during all activities and occurs during activities of daily living.
6	intermittent rest pain that doesn't disturb sleep.
7	constant rest pain that disturb sleep.

A laser device (EME, Italy), with wavelength of 905 nm, power 25 mW has been used in the study. The beam irradiated the injured area with 60 sec/point with dose 1 J/cm2. This dosage was selected to coincide with the clinical regimes most commonly used as judged by an informed inquiry of members of the Canadian Physical Therapy Association who are treating soft tissue injuries, and from review of the literature [22, 23].

PRP Injection Protocol

PRP Preparation

The blood was collected from arm veins of players. Autologous PRP then be separated from whole blood using centrifuge. The centrifugation results in the formation of two layers within the plasma: a platelets-poor plasma (PPP) component and PRP component. The PPP had been carefully removed; the remaining PRP was prepared for injection [24].

Injection of PRP

Players in this group received local injection of PRP on the injured hamstring which has been identified by both clinical palpation and ultrasonography.

Statistical Analysis

Prior to analysis, all data were screened for completeness. The collected data were organized, tabulated and statistically analyzed.

- Results are expressed as mean ± standard deviation (SD), median, minimum, maximum, number and percent.
- Kolmogorov-Smirnov test was utilized to assess the normality of distribution for tested variables before treatment. Accordingly, comparison between different variables in the three groups was

performed using either one way analysis of variance (ANOVA) test or Kruskal Wallis ANOVA test whenever it was appropriate.

- Pairewise group comparison (pre-treatment versus post-treatment) was performed Wilcoxon Signed Ranks test.
- Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value ≤ 0.05 was considered significant.

Results

There was no significant difference between group A, group B and group C, while there was a significant difference within each group when comparing between pre treatment and post treatment results (table 3) (Figure 1,2,3,4,5).

*Angle of peak torque = APT

* Nirschl Phase Rating Scale= NPRS

Table No (3): statistical data for the results pre and post treatment

	Group A (n= 10)	Group B (n= 10)	Group C (n= 10)	P value
Age	27.20 ± 3.71	27.10 ± 3.70	26.60 ± 4.25	0.934 (NS)
Height	176.80 ± 6.88	175.80 ± 7.71	176.30 ± 6.31	0.950 (NS)
Pain (Pre)	6.25 (5.20-8.10)	6.00 (4.70-7.50)	5.85 (4.30-7.10)	0.803 (NS)
Pain (Post)	0.65 (0.20-2.40)	0.75 (0.00-2.60)	0.35 (0.00-3.10)	0.408 (NS)
P value	0.005 (S)	0.005 (S)	0.005 (S)	
Sound limb (APT)	44.5 (38.0-52.0)	45.5 (39.0-49.0)	45.0 (39.0-50.0)	0.769 (NS)
Injured limb (APT)	43.0 (38.0-52.0)	44.0 (36.0-48.0)	45.0 (37.0-50.0)	0.744 (NS)
P value	0.038 (S)	0.034 (S)	0.034 (S)	
NPRS (Pre)	5.00 (5.00-7.00)	5.0 (5.0-7.0)	5.0 (5.0-7.0)	0.898 (NS)
NPRS (Post)	3.00 (2.00-4.00)	3.0 (1.0-4.0)	2.00 (1.00-4.00)	0.142 (NS)
P value	0.004 (S)	0.004 (S)	0.004 (S)	
Edema (Pre)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	2.0 (1.0-3.0)	0.999 (NS)
Edema (Post)	0.50 (0.0-1.0)	0.0 (0.0-2.0)	0.0 (0.0-2.0)	0.520 (NS)
P value	0.006 (S)	0.004 (S)	0.004 (S)	
Strain size (Pre)	26.0 (16.0-60.0)	31.0 (16.0-78.0)	25.5 (14.0-98.0)	0.650 (NS)
Strain size (Post)	1.0 (0.0-12.0)	2.5 (0.0-24.0)	0.0 (0.0-21.0)	0.249 (NS)
P value	0.005 (S)	0.005 (S)	0.005 (S)	

Data are expressed as median (minimum-maximum).
S= p< 0.05= significant.
NS= p> 0.05= not significant

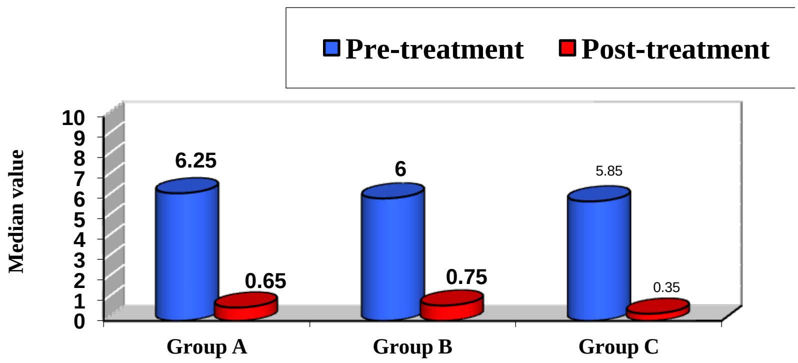

Fig.1 : Median values of pain in the three studied groups measured pre- and post-treatment

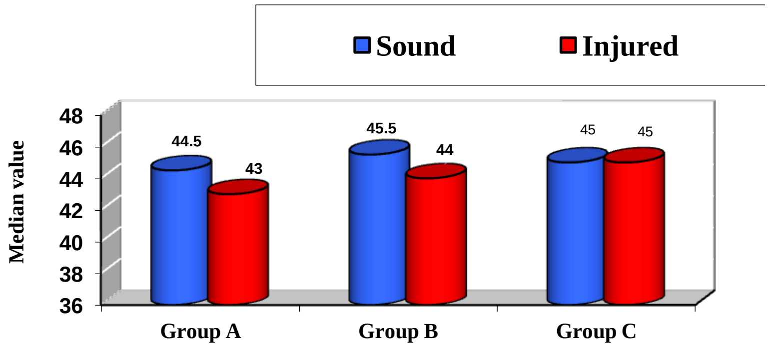

Fig. 2: Median values of injured and sound angles in the three studied groups.

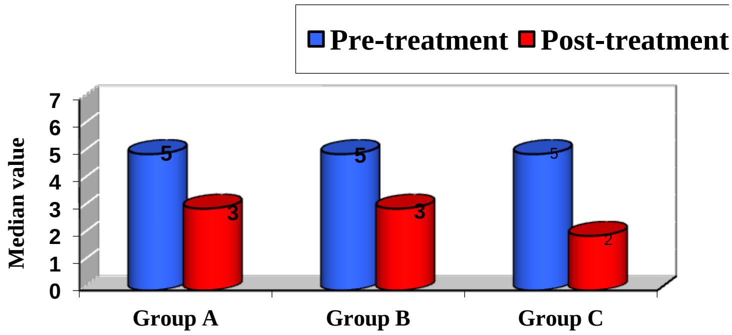

Fig.3 : Median values of Nirschl phase rating scale in the three studied groups measured pre- and post-treatment

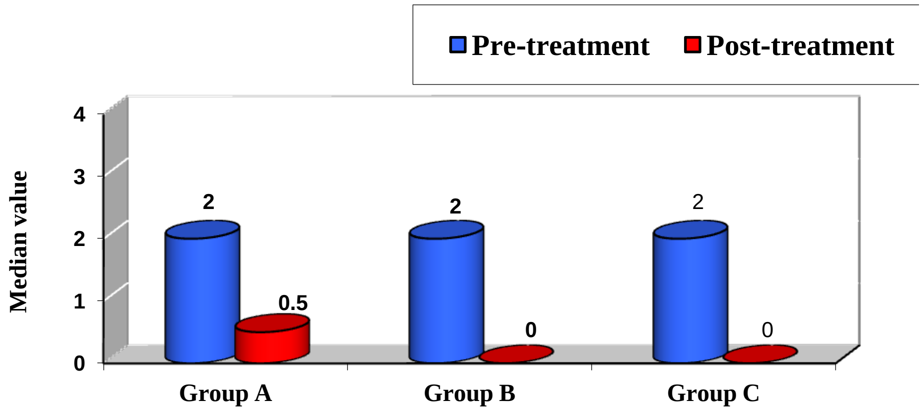

Fig 4 Median values of degrees of edema in the three studied groups measured pre- and post-treatment.

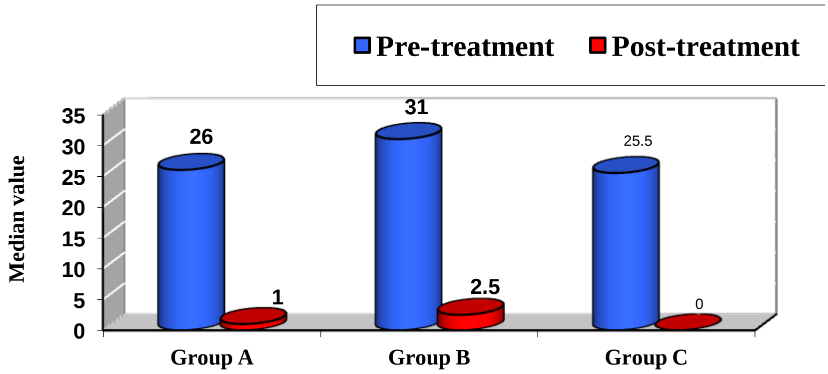

Fig. 5: Median values size in the three studied groups measured pre- and post-treatment.

Discussion

This study aimed to investigate the effect of low level laser therapy and plasma rich platelets in treatment of hamstrings muscle strain and our results showed an improvement in all groups but without a significant difference between groups.

Laser group showed an improvement in pain, function, angle of peak torque, and muscle healing (intramuscular edema, tear size). Our study results at healing are consistent with that of Renno et al., 2011[25], who conducted a study to compare the effects of low-intensity pulsed ultrasound (US) and low-level laser therapy (LLLT) on injured skeletal muscle after cryolesion by means of histopathological analysis and immunohisto-chemistry for cyclo-oxygenase-2 (COX-2). The result LLLT-treated animals presented minor degenerative changes of muscle tissue. Exposure to US reduced tissue injuries induced by cryolesion, but less effectively than LLLT. A large number of COX-2 positive cells were found in untreated injured rats, whereas COX-2 immunoexpression was lower in both LLLT- and US-treated groups.

Some studies have revealed that LLLT is capable of decreasing the inflammatory response and optimizing tissue repair in rats. [26,27] Tomasek et al. [28] stated that LLLT decreases the extent of edema and the number of inflammatory cells and increases the amount of collagen and elastic fibers in the wound-healing process, which might explain the positive effect of laser on tissue repair acceleration.

Our results corroborate those of Amaral et al.[29] who found that the He-Ne laser, at a dosage of 2.6 J/cm2, resulted in increased mitochondrial density and muscle fiber density in TA muscles as compared to a control group. Also, Cressoni et al. [30] showed that the AlGaInP laser treatment (785 nm), at 9 J/point, produced a decrease in the number of leukocytes in the inflammatory infiltrate at the injury site.

Hamilton et al [31] states that, the use of autologous plasma and GF technology in the management of soft tissue injury has some support from *in vitro* and animal studies. While its clinical use in muscle injuries remains in its infancy, it has the potential be a technically and fiscally viable tool for the practitioner.

A study by Hamilton et al., [32] aimed to review the evidence for the clinical utilization of autologous plasma products in the management of muscle strain injuries. Its method was a Systematic review using EMBASE and MEDL-INE (up to March 2010). His results showed that there is no level 1, 2, and 3 evidence for the use of autologous plasma products in muscle strain injuries. Furthermore, significant methodological limitations impact on the interpretation of the few published studies in this field. His results are opposite to ours.

Limitations

This study is limited to a relatively small sample size; the study was applied on 30 players which may interfere with results. So, we believe that there is a need to a research on a larger sample size which may show superiority of one treatment method on another.

Conclusion

Our study showed that, there was no significant difference between laser, plasma rich platelets, and combination between laser and PRP in treatment of hamstrings strain in athletes. Also all treatments showed significant difference within each group.

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