Pulsed high-intensity laser therapy versus low level laser therapy in the management of primary dysmenorrhea

ALI A. THABET, PhD(1), ANWAR A. Ebid, PhD(1)*, MOHAMED E. EL-BOSHY, PhD(2), AFNAN O ALMUWALLAD(3), ELHAM A HUDAIMOOR(1), FATIMAH E ALSAEED(1), RAHAF H. ALSUBHI(1), RAHAF H. ALMATROOK(1), RAWAN F. ALIFRYY(1), SAJA H. ALOTAIBI(1), SHUROQ M. ALMALLAWI(1), WEJDNA O. ABDULLMUTALI(1)

1) Department of Physical Therapy, Faculty of Applied Medical Sciences, Umm AlQura University: PO Box 715, Umm Al-Qura University, Makkah 21421, Saudi Arabia
2) Laboratory Medicine Department, Faculty of Applied Medical Sciences, Umm Al-Qura University, Saudi Arabia

Abstract. [Purpose] To determine the effect of pulsed high intensity laser therapy (HILT) versus low level laser therapy (LLLT) in the treatment of primary dysmenorrhea. [Participants and Methods] This was a randomized clinical trial that included 30 females diagnosed with primary dysmenorrhea who were assigned randomly into two groups of equal numbers. The treatment was three sessions every cycle for three consecutive cycles, where group (A) received pulsed HILT and group (B) received LLLT. All participants were evaluated before and after treatment sessions by visual analogue scale (VAS) and at the end of treatment by pain relief scale (PRS). [Results] The results showed a significant decrease in the severity of pain in the two groups. Comparison between the two groups showed a statistically non-significant difference in the severity of pain and pain alleviation at the end of the treatment course. [Conclusion] Both pulsed HILT and LLLT are effective in the treatment of primary dysmenorrhea, with no significant differences between the two modalities.

Key words: Primary dysmenorrhea, Pulsed high-intensity laser, Low level laser

INTRODUCTION

Primary dysmenorrhea (PD) is a common gynecologic disease affects adolescents and women of reproductive age. It is characterized by cramp-like pain in the lower abdomen that may radiate to the thighs and lower back, which often occurs before or after the onset of menstrual bleeding[1]. The pain is sometimes accompanied by associated symptoms (such as diarrhea, nausea, fatigue, headache, and dizziness) that render patients incapacitated for 1 to 3 days each menstrual cycle[2–4], resulting in a restriction of daily activities[5–9], poor quality of sleep, and mood disturbance, which can lead to female school or work; thus, primary dysmenorrhea has a great impact on the quality of life[7,8]. The prevalence of dysmenorrhea is high, ranging from 45 to 93% of women of reproductive age[9,10], with the highest rates reported in adolescents[11,12]. The most accepted theories to explain the pain in women with PD are the production and excess release of prostaglandins through the endometrium during menstruation, causing uterine hypercontractility, hypoxia, and ischemia[13]. The primary dysmenorrhea is commonly treated with non-steroidal anti-inflammatory drugs, prostaglandin antagonists, and antispasmodic drugs. However, these treatments are accompanied by a number of side effects[14], including mild indigestion, decreased appetite, stomach pain, excessive bleeding, constipation, nausea, vomiting, itching, rash, dizziness, headache, and nervousness[15].

*Corresponding author. Anwar A. Ebid (E-mail: anwarandsafa@yahoo.com)

©2021 The Society of Physical Therapy Science. Published by IPEC Inc.

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: https://creativecommons.org/licenses/by-nc-nd/4.0/)
Studies on the effects of different physical movements on dysmenorrhea have shown controversial results\textsuperscript{16}. Exercise affects the level of steroid hormones in blood circulation, reducing pain intensity, duration, and use of medications\textsuperscript{17, 18}. Stretching and aerobic exercises have positive effects on primary dysmenorrhea, as reported in various studies\textsuperscript{19–21}. However, it takes considerable time for exercising to produce a temporary analgesic effect, and high-quality trials are needed to confirm this effect\textsuperscript{22}. Low level laser therapy (LLLT) is effective in treating painful conditions by raising β-endorphins, normalizing the speed of A-alpha nerve fibers rather than C-fibers, and increasing blood and lymph flow, resulting in elimination of waste metabolism from the area of pain\textsuperscript{23}. LLLT has a good effect in controlling primary dysmenorrhea, as it diminishes the production of prostaglandins E and F by superoxide dismutase hastening\textsuperscript{24–26}. Pulsed high-intensity laser therapy (HILT) is a recent rehabilitation therapy successfully used in orthopedic diseases and sports medicine, due to the speed of its efficacy and the permanent relief of pain with reduction of recovery time it produces\textsuperscript{27–29}. The analgesic effect is produced by high intensity pulsed applications, which create photomechanical waves that stimulate the A-fibers and close the gate for pain transition, and the biostimulation effect that stimulates cell growth and cell repair\textsuperscript{30–32}. Pulsed high-intensity laser therapy was effective in reducing primary dysmenorrhea, due to its significant effect in decreasing the severity of pain and prostaglandin levels in blood\textsuperscript{33}. The purpose of this study was to determine the efficacy of pulsed high-intensity laser therapy versus low-intensity laser therapy on primary dysmenorrhea.

PARTICIPANTS AND METHODS

This randomized clinical trial study was carried out after participants received a full explanation of the treatment protocol and signed a consent form. Research approval was obtained from the Ethics Review Committee of the Faculty of Applied Medical Sciences, Umm Al-Qura University. Inclusion and exclusion criteria were set as follow:

- Participants’ body mass index should not exceed 30 kg/m\textsuperscript{2}; participants should have no medical or psychological problems.
- No participants received medical treatment for menstrual pain during the study course.
- Married females with irregular menstrual cycles, endometriosis, pelvic inflammatory disorder, or low back pain were excluded.

A total of 30 female participants aged between 18 and 23 years and diagnosed with primary dysmenorrhea were randomized into two groups of equal number, where group A received pulsed HILT and group B received LLLT. The treatment was three sessions every cycle for three consecutive cycles. Participants were quizzed on the severity of pain using visual analogue scales (VAS) and the pain relief scale (PRS).

Visual analogue scale (VAS) is a valid and reliable scale\textsuperscript{34} in which 0 equal no pain, 1–3 equals mild pain, 4–6 equals moderate pain, 7–9 equals severe pain, and 10 equals unbearable pain. Participants themselves completed the scale before and after the end of each treatment course by marking the point that represented their perceived pain.

Pain relief scale (PRS) is a scale measuring the changing magnitude in pain intensity after treatment\textsuperscript{35} that is widely used clinically for the assessment of pain\textsuperscript{36}. In the PRS, 0 equals no relief, 1 equals slight relief, 2 equals good relief, 3 equals excellent relief, and 4 equals complete relief\textsuperscript{37}.

Participants in each group received the specified treatment on complaint of pain a day before the beginning of menstrual flow and on the first and second days after menstrual flow began.

Group A were treated with three pulsed HILT sessions every cycle for three consecutive cycles using a long pulse Nd:YAG laser from a LASERSIX ME 15W device (Sixtus italia srl) with pulsed emission 1,064 nm, peak power of 3 kW, energy density fluency from 810 to 1,780 mJ/cm\textsuperscript{2}. The HILT was applied with the dose of 6 J/cm\textsuperscript{2}, pulse duration of 120–150 msec, and a duty cycle of 0.1%, with a frequency of 10–50 Hz. The total average energy of the pulsed HILT application was 620 J, administered in three phases, from supine lying position on suprapubic region=300 J, initial phase (fast)=100 J, intermediate phase=100 J distributed at 5 points, final phase (slow)=100 J, from prone lying position on lumbosacral region (paraspinal) between L\textsubscript{3}–S\textsubscript{3}, initial phase (100 J): RT side 50 J + LT side 50 J, Intermediate phase (120 J): RT side (60 J) 3 points + LT side (60 J) 3 points, final phase (100 J): RT side 50 J + LT side 50 J.

Group B received three LLLT sessions every cycle for three consecutive cycles (a gallium–arsenide diode (GaAs) laser (BTL-5818SLM) was used). The LLLT was applied with the dose of 6 J/cm\textsuperscript{2}, power of 100 mw, area equal to 1 cm\textsuperscript{2}, and a duration of 1:15 min for 15 points, from supine lying position, 5 points on supra-pubic region, and from prone lying position, 10 points over lumbosacral region on L\textsubscript{4}–S\textsubscript{3} 5 points on each side. Descriptive statistics were used in the form of means, standard deviation (SD), and qualitative variable analytical experimentalizations, including the use of a student t-test to comparatively examine means prior to and following the treatment. A significance level of 0.05 was applied across each statistical examination.

RESULTS

As indicated in Table 1, pain severity in the HILT group before starting the treatment procedures was mild in two cases (13.3%), moderate in 10 cases (66.7%), and severe in three cases (20%). After treatment there was no pain in two cases (13.3%), mild pain in five cases (33.3%), moderate pain in seven cases (46.7%), and severe pain in one case (6.7%).
age of improvement was 33.27%. In Group B, before starting the treatment procedures, pain was mild in four cases (26.7%), moderate in six cases (40%), severe in five cases (33.3%), and unbearable in nine cases (45%). After treatment there was no pain in two cases (13.3%), mild pain in five cases (33.3%), moderate pain in five cases (33.4%), and severe pain in three cases (20%), with percentage of improvement at 29.42%. The mean difference within each group was significant (p<0.05), while the mean difference between the two groups was non-significant (p>0.05).

As indicated in Table 2, after the end of the treatment course, Group (A) participants reported complete relief in three cases (20%), excellent relief in one case (6.65%), good relief in seven cases (46.65%), slight relief in one case (6.65%), and no relief in three cases (20%). In Group B, after the end of the treatment course, there was complete relief in three cases (20%), excellent relief in six cases (40%), good relief in four cases (26.70%), slight relief in one case (6.65%), and no relief in one case (6.65%). The comparison between post mean value of pain relief after treatment showed non-significant (p>0.05) difference between the two groups.

**DISCUSSION**

Primary dysmenorrhea (PD) is a common gynecologic disease\(^2\), affecting 45 to 93% of women of reproductive age, characterized by cramp-like pain around the lower abdomen due to the excessive release of uterine prostaglandin, which cause ischemia and stimulation to nerve endings\(^3\). The purpose of this study was to compare the effects of pulsed HILT versus LLLT on primary dysmenorrhea. The results showed non-significant difference between the two modalities in comparing post mean value of pain relief after treatment (p>0.05); however, we found that both treatment modalities were effective (p<0.05) and safe in the management of primary dysmenorrhea.

These results are supported by Alayat MS et al.\(^3\), who concluded that the sedative effect of pulsed HILT might be an outcome of its ability to reduce the conduction of pain through Aδ and C-fibers and increase the production of morphine-mimetic substances.

The results also agree with the previous study that revealed as pulsed HILT would be an effective modality in the treatment of primary dysmenorrhea by decreasing the prostaglandin level in blood\(^3\) it can be used as an alternative conservative therapy for primary dysmenorrhea rather than medications that have numerous side effects. Also, these results are consistent with Thabet and Alshehri\(^3\), who conducted a randomized controlled trial on 40 women with mild or moderate degrees of endometriosis and concluded that pulsed HILT is an effective method of pain alleviation, reducing adhesions, and improving

| No. | %   | No. | %   | No. | %   | No. | %   |
|-----|-----|-----|-----|-----|-----|-----|-----|
| No pain | 0 | 0.00 | 2 | 13.30 | 0 | 0.00 | 2 | 13.30 |
| Mild pain | 2 | 13.30 | 5 | 33.30 | 4 | 26.70 | 5 | 33.30 |
| Moderate pain | 10 | 66.70 | 7 | 46.70 | 6 | 40.00 | 5 | 33.40 |
| Severe pain | 3 | 20.00 | 1 | 6.70 | 5 | 33.30 | 3 | 20.00 |

Mean ± SD: 5.20 ± 1.69, 3.47 ± 1.42, 5.20 ± 1.86, 3.67 ± 2.50

Improvement (%): 33.27%, 29.42%

p-value: 0.011*, 0.043*, 0.825**

SD: standard deviation; ttt: treatment; *Significant; **not-significant.

| No. | %   | No. | %   |
|-----|-----|-----|-----|
| No Relief | 3 | 20.00 | 1 | 6.65 |
| Slight Relief | 1 | 6.65 | 1 | 6.65 |
| Good Relief | 7 | 46.65 | 4 | 26.70 |
| Excellent Relief | 1 | 6.700 | 6 | 40 |
| Complete Relief | 3 | 20.00 | 3 | 20 |

Mean ± SD: 2.00 ± 1.36, 2.60 ± 1.12

p-value: 0.860**

SD: standard deviation; p-value: probability value; **not-significant.
the quality of life in women with endometriosis. The results are also in line with Thabet et al., who carried out a study to determine the effect of LLLT and pelvic rocking exercises in reducing the pain of primary dysmenorrhea, reporting that LLLT in combination with pelvic rocking exercises has an excellent effect in the management of primary dysmenorrhea.

The obtained results also agreed with those of Aras et al., who reported on the possible mechanisms of action of LLLT, which include endorphin secretion stimulation, reduction of interstitial fluid at the site of inflammation with a marked increase in vasodilatation, and improvement in local circulation. Also, the results concurred with those of Tortorici et al., who found that postoperative oral LLLT appears to offer better analgesic efficacy than preoperative administration after third molar surgery under local anesthesia, as well as before lower third molar surgery, during tooth extraction.

It was concluded that pulsed HILT and LLLT are both effective in the treatment of primary dysmenorrhea, while there was no significant difference between the two modalities.

The study was planned to include measurement of prostaglandin before and after the course of treatment for both group but due to certain limitation of the presence of corona virus (COVID-19) we couldn’t perform it.

**Funding**

This research received no specific grant from any funding agency, commercial enterprise, or not-for-profit institute.

**Conflicts of interest**

All authors declare no conflicts of interest.

**REFERENCES**

1. Burnett M, Lemyre M: No. 345-primary dysmenorrhea consensus guideline. J Obstet Gynaecol Can, 2017, 39: 585–595. [Medline] [CrossRef]
2. Unsal A, Ayraç U, Tozun M, et al.: Prevalence of dysmenorrhea and its effect on quality of life among a group of female university students. Ups J Med Sci, 2010, 115: 138–145. [Medline] [CrossRef]
3. Zannoni L, Giorgi M, Spagnolo E, et al.: Dysmenorrhea, absenteeism from school, and symptoms suspicious for endometriosis in adolescents. J Pediatr Adolesc Gynecol, 2014, 27: 258–265. [Medline] [CrossRef]
4. Ortiz MJ, Rangel-Flores E, Carrillo-Alarcón LC, et al.: Prevalence and impact of primary dysmenorrhea among Mexican high school students. Int J Gynaecol Obstet, 2009, 107: 240–243. [Medline] [CrossRef]
5. Chantler I, Mitchell D, Fuller A: Actigraphy quantifies reduced voluntary physical activity in women with primary dysmenorrhea. J Pain, 2009, 10: 38–46. [Medline] [CrossRef]
6. Banikarim C, Chacko MR, Kelder SH: Prevalence and impact of dysmenorrhea on Hispanic female adolescents. Arch Pediatr Adolesc Med, 2000, 154: 1226–1229. [Medline] [CrossRef]
7. Baker FC, Driver HS, Rogers GG, et al.: High nocturnal body temperatures and disturbed sleep in women with primary dysmenorrhea. Am J Physiol, 1999, 277: E1013–E1021. [Medline]
8. Dorn LD, Negriff S, Huang B, et al.: Menstrual symptoms in adolescent girls: association with smoking, depressive symptoms, and anxiety. J Adolesc Health, 2009, 44: 237–243. [Medline] [CrossRef]
9. Patel V, Tanksale V, Sahasrabhojanee M, et al.: The burden and determinants of dysmenorrhoea: a population-based survey of 2262 women in Goa, India. BJOG, 2006, 113: 453–463. [Medline] [CrossRef]
10. Latthe P, Latthe M, Say L, et al.: WHO systematic review of prevalence of chronic pelvic pain: a neglected reproductive health morbidity. BMC Public Health, 2006, 6: 177. [Medline] [CrossRef]
11. Parker MA, Sneddon AE, Arbon P: The menstrual disorder of teenagers (MDOT) study: determining typical menstrual patterns and menstrual disturbance in a large population-based study of Australian teenagers. BJOG, 2010, 117: 185–192. [Medline] [CrossRef]
12. Lindh I, Eliotström AA, Milsom I: The effect of combined oral contraceptives and age on dysmenorrhea: an epidemiological study. Hum Reprod, 2012, 27: 676–682. [Medline] [CrossRef]
13. Altunyurt S, Göll M, Altunyurt Ş, et al.: Primary dysmenorrhea and uterine blood flow: a color Doppler study. J Reprod Med, 2005, 50: 251–255. [Medline]
14. Liu CZ, Xie JP, Wang LP, et al.: Immediate analgesia effect of single point acupuncture in primary dysmenorrhea: a randomized controlled trial. Pain Med, 2011, 12: 300–307. [Medline] [CrossRef]
15. Marjoribanks J, Ayelleke RO, Farquhar C, et al.: Nonsteroidal anti-inflammatory drugs for dysmenorrhoea. Cochrane Database Syst Rev, 2015, (7): CD001751. [Medline] [CrossRef]
16. Metheny WP, Smith RP: The relationship among exercise, stress, and primary dysmenorrhea. J Behav Med, 1989, 12: 1246–1252. [Medline] [CrossRef]
17. Jahromi MK, Gaeini A, Rahimi Z: Influence of a physical fitness course on menstrual cycle characteristics. Gynecol Endocrinol, 2008, 24: 659–662. [Medline] [CrossRef]
18. Warren MP, Perlroth NE: The effects of intense exercise on the female reproductive system. J Endocrinol, 2001, 170: 3–11. [Medline] [CrossRef]
19. Azima S, Bakhshayesh HR, Kaviani M, et al.: Comparison of the effect of massage therapy and isometric exercises on primary dysmenorrhea: a randomized controlled clinical trial. J Pediatr Adolesc Gynecol, 2015, 28: 486–491. [Medline] [CrossRef]
20. Noorbakhsh M, Alijani E, Kohandel M, et al.: The effect of physical activity on primary dysmenorrhea of female university students. World Appl Sci J, 2012, 17: 1246–1252. [Medline]
21. Vaziri F, Hoseini A, Kamali F, et al.: Comparing the effects of aerobic and stretching exercises on the intensity of primary dysmenorrhea in the students of universities of bushehr. J Family Reprod Health, 2015, 9: 23–28. [Medline]
22. Matthewman G, Lee A, Kaur JG, et al.: Physical activity for primary dysmenorrhea: a systematic review and meta-analysis of randomized controlled trials.
23) Gold M: Laser principle, laser in medicine. New York: CRC Press, 2002.
24) Reda M, Zamzam M, Mohamed M: Effect of chronic exercise training on innate immunity and neuroendocrine hormones levels. Research submitted to the Department of Physical Medicine and Rehabilitation and Microbiology and Immunology, Faculty of Medicine, Ain Shams University, Cairo, Egypt, 2000.
25) Sabour A: Low level laser therapy in relation to primary dysmenorrhea. Thesis submitted for partial fulfillment of master’s degree in Gynaecology and Obstetrics, Faculty of Physical Therapy, Cairo University, 1996.
26) Sundell G, Milsom I, Andersch B: Factors influencing the prevalence and severity of dysmenorrhea in young women. Br J Obstet Gynaecol, 1990, 97: 588–594. [Medline] [CrossRef]
27) Fortuna D, Zati A, Mondardini P, et al.: Low level laser therapy (LLLT) ed efficacia clinica. Studi in doppio cieco randomizzato a confronto. Med Sport (Roma), 2002, 55: 43–50.
28) Dhavalikar M, Narkeesh A, Gupta N: Effect of skin temperature on nerve conduction velocity and reliability of temperature correction formula in Indian females. J Exerc Sci Physio, 2009, 5: 24.
29) Leal Junior EC, Lopes-Martins RA, Baroni BM, et al.: Effect of 830 nm low-level laser therapy applied before high-intensity exercises on skeletal muscle recovery in athletes. Lasers Med Sci, 2009, 24: 857–863. [Medline] [CrossRef]
30) Santamato A, Solfrizzi V, Panza F, et al.: Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of people with subacromial impingement syndrome: a randomized clinical trial. Phys Ther, 2009, 89: 643–652. [Medline] [CrossRef]
31) Pryor BA: Advances in laser therapy for the treatment of work related injuries. Current perspectives in clinical treatment and management in workers’ compensation cases. United Arab Emirates: Bentham Books, 2011.
32) Prouza O, Jeniček J, Procházka M: Class 4. Non-invasive laser therapy in clinical rehabilitation. Rehabil Fyz Lek, 2013, 20: 113–119.
33) Thabet AA, Elsodany AM, Battecha KH, et al.: High-intensity laser therapy versus pulsed electromagnetic field in the treatment of primary dysmenorrhea. J Phys Ther Sci, 2017, 29: 1742–1748. [Medline] [CrossRef]
34) Price DD, McGrath PA, Rafii A, et al.: The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain, 1983, 17: 45–56. [Medline] [CrossRef]
35) Lee JJ, Lee MK, Kim JE, et al.: Pain relief scale is more highly correlated with numerical rating scale than with visual analogue scale in chronic pain patients. Pain Physician, 2015, 18: E195–E200. [Medline] [CrossRef]
36) Hartrick CT, Kovan JP, Shapiro S: The numeric rating scale for clinical pain measurement: a ratio measure? Pain Pract, 2003, 3: 310–316. [Medline] [CrossRef]
37) Karampour E, Khoshnam E, Poordast T: The influence of stretch training on primary dysmenorrhea. Adv Environ Biol, 2012, 6: 3069–3072.
38) Alayat MS, Atya AM, Ali MM, et al.: Long-term effect of high-intensity laser therapy in the treatment of patients with chronic low back pain: a randomized blinded placebo-controlled trial. Lasers Med Sci, 2014, 29: 1065–1073. [Medline] [CrossRef]
39) Thabet AA, Alshehri MA: Effect of pulsed high-intensity laser therapy on pain, adhesions, and quality of life in women having endometriosis: a randomized controlled trial. Photomed Laser Surg, 2018, 36: 363–369. [Medline] [CrossRef]
40) Thabet AA, Hanfy HM, Ali TA: Effect of low level laser therapy and pelvic rocking exercise in the relief of primary dysmenorrhea. BJPT, 2008, 13: 41–52.
41) Aras MH, Omerzi MM, Güngörmüş M: Does low-level laser therapy have an antianesthetic effect? A review. Photomed Laser Surg, 2010, 28: 719–722. [Medline] [CrossRef]
42) Tortorici S, Messina P, Scardina GA, et al.: Effectiveness of low-level laser therapy on pain intensity after lower third molar extraction. Int J Clin Dent, 2019, 12: 357–367.