



Original Article

The effects of high intensity laser therapy on pain and function in patients with knee osteoarthritis

GOOK-JOO KIM, PT¹⁾, JIOUN CHOI, MS, PT¹⁾, SANGYONG LEE, PhD, PT²⁾,
CHUNBAE JEON, PhD, PT³⁾, KWANSUB LEE, PhD, PT⁴⁾*

¹⁾ Department of Rehabilitation Science, Graduate School, Daegu University, Republic of Korea

²⁾ Department of Physical Therapy, UI University, Republic of Korea

³⁾ Department of Physical Therapy, The Most Holy Trinity Hospital, Republic of Korea

⁴⁾ Department of Physical Therapy, The Kang Hospital: 1013 Nowon-ro 3ga, Buk-gu, Daegu 706-170, Republic of Korea

Abstract. [Purpose] The purpose of this study was to examine the effects of high intensity laser therapy (HILT) on pain and function in patients with knee osteoarthritis. [Subjects and Methods] In this study, an experiment was conducted on 20 subjects who were divided into the control group (n=10), which would receive conservative physical therapy (CPT), and the experimental group (n=10), which would receive effects of high intensity laser therapy after conservative physical therapy. All patients received their respective therapies three times each week over a four-week period. In terms of the intensity of the high intensity laser therapy, it was applied to each patient in the tibia and femoral epicondyle for five minutes while the patient's knee joint was bent at around 30° and the separation distance between the handpiece and the skin was maintained at around 1 cm. The visual analogue scale was used to measure pain, and the Korean Western Ontario and McMaster Universities Osteoarthritis Index was used for functional evaluations. [Results] The comparison of differences in the measurements taken before and after the experiment within each group showed a statistically significant decline in both the VAS and the K-WOMAC. The comparison of the two groups showed that the high intensity laser therapy group had statistically significant lower scores in both the visual analogue scale and the Korean Western Ontario and McMaster Universities Osteoarthritis Index than the conservative physical therapy group. [Conclusion] High intensity laser therapy is considered an effective non-surgical intervention for reducing pain in patients with knee osteoarthritis and helping them to perform daily activities.

Key words: Knee joint, Osteoarthritis, High intensity laser therapy

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INTRODUCTION

In developed countries, the rapid aging of populations has resulted in rapid increases in musculoskeletal diseases that are caused by degenerative changes in the bones and joints. Among the many degenerative diseases, osteoarthritis, along with some other musculoskeletal diseases, is reported as one of the most common to result from aging¹⁾. Patients with knee osteoarthritis exhibit various symptoms, including pain, muscular atrophy, stiffness, and limited range of motion (ROM)²⁾. Indeed, pain is a major symptom of osteoarthritis; it is related to the excessive use of joints and is relieved by resting³⁾. Treatments that could completely cure knee osteoarthritis have not yet been developed. Therefore, the goal of clinical treatments is to relieve pain, maintain or improve the function of joints⁴⁾, and reduce the stiffening or deformation of joints. Treatments for

*Corresponding author. Kwansub Lee (E-mail: pt1026@nate.com)

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knee osteoarthritis can be divided into surgical and non-surgical therapies. Among the various non-surgical therapies, high intensity laser therapy (HILT), which is non-invasive, has recently become popular. HILT delivers a high energy output into the tissues, and its optical energy forms dynamic vibrations in the tissues. This then generates photochemistry effects, such as increasing the oxidation of mitochondria and facilitating the formation of adenosine triphosphate (ATP) and eventually leads to the fast absorption of edemas and the removal of exudations through increased metabolism and blood circulation⁵. However, laser treatments on musculoskeletal diseases have generally involved low level laser therapy (LLLT), and studies on HILT remain inadequate. Therefore, in this study, we have conducted an experiment to prove the effects of HILT on patients with knee osteoarthritis.

SUBJECTS AND METHODS

The subjects of this study were 20 patients, aged from 55 to 75, whose attending doctors had diagnosed them with knee osteoarthritis based on clinical findings and images taken using X-ray equipment. These subjects were selected from among the patients who had either been hospitalized at S Orthopedic Hospital, in Daegu, or who had visited the hospital as outpatients. This experiment was conducted after fully explaining the purpose of the study and the entire process of the experiment to the subjects and obtaining their consent. The study also included a signed consent form, according to the ethical standards of the Declaration of Helsinki. Ethical approval for the study was granted by the Institutional Review Board of Youngdong University.

The selected patients with knee osteoarthritis were randomly divided into two groups. The conservative physical therapy group (CPTG, n=10), which was the control group, was treated with conservative physical therapy (CPT), and the high intensity laser therapy group (HILTG, n=10), the experimental group, received both CPT and HILT. All subjects were treated three times each week for a four-week period. The CPTG was, on average, 65.5 ± 4.0 years of age, 159.9 ± 8.2 cm in height, and 61.6 ± 10.4 kg in weight. The HILTG was, on average, 65.3 ± 4.2 years of age, 159.3 ± 7.4 cm in height, and 62.0 ± 11.0 kg in weight. The CPT performed on the control group consisted of hot pack treatment for 20 minutes, interferential current therapy for 15 minutes, and deep heat diathermy using ultrasonic waves for five minutes. For the experimental group, HILT was performed after the same CPT had been applied. With the patient's knee joint bent at around 30° , a high intensity laser was applied in the tibia and femoral epicondyle for five minutes, using a HILT device (HEALTRON, United Technology Inc., Israel). A separation distance of around 1 cm between the handpiece and the skin was also maintained throughout the treatment. The intensity of the HILT was level 2, the frequency was 11 Hz, and the total amount of delivered energy was $1,500 \text{ mJ/cm}^2$.

The visual analogue scale (VAS) was used in the study to identify the degree of pain, and the Korean-Western Ontario and Macmaster University Osteoarthritis Index (K-WOMAC), which had been developed to evaluate patients with osteoarthritis in the lower limbs, was used for functional evaluations. The VAS and K-WOMAC measurements were taken for both the control and the experimental group, using the same methods before the experiment and four weeks after the experiment. For the statistical analysis of this study, the paired t-test was performed to examine changes within each group, and the independent sample t-test was performed to compare the two groups. In this study, SPSS/PC Ver. 13.0 was used for statistical processing, and the statistical significance level was set at $\alpha=0.05$.

RESULTS

The comparison of the changes within each group showed a statistically significant decline in both the VAS and the K-WOMAC. In addition, the comparison of the two groups showed that the CPTG had statistically significant higher scores in the VAS and K-WOMAC than the HILTG (Table 1).

Table 1. Comparison of the VAS and K-WOMAC within each group

	Group	Pre	Post
VAS (point)	CPTG**	7.2 ± 1.2	5.8 ± 1.1
	HILTG**	7.3 ± 0.6	$3.1 \pm 0.7^{\dagger\dagger}$
K-WOMAC (point)	CPTG**	37.8 ± 5.4	31.9 ± 6.5
	HILTG**	36.1 ± 8.0	$17.2 \pm 6.2^{\dagger\dagger}$

VAS: visual analog scale, K-WOMAC: Korean Western Ontario and McMaster Universities Osteoarthritis Index, CPTG: Conservative physical therapy group, LTG: Laser therapy group, *Paired t-test, [†]Independent sample t-tests, **, ^{††}p<0.01, *, [†]p<0.05

DISCUSSION

Because of the chronic pain they experience, patients with knee osteoarthritis show declines in their ability to use their joints, which results in a weakening of muscle strength. Since this destabilizes the joints and physical function is reduced, the motion that is required for the patients' daily activities becomes limited⁶⁾. Therefore, this study was conducted to identify the effects of HILT on pain and function in patients with knee osteoarthritis.

Santamato et al. conducted a comparative study on the effects of HILT and ultrasound therapy on 70 patients with shoulder impingement syndrome and reported that HILT showed greater effects on pain⁵⁾. The present study has shown a similar result. When the patients with knee osteoarthritis who had been placed in the experimental group were treated with HILT for four weeks, they exhibited statistically significant effects in terms of the VAS. The mechanism behind this result may be as follows: as the optical energy of the high intensity laser penetrated the affected area and spread into the tissues, photochemistry effects were generated, including the oxidation of mitochondria and the facilitation of the formation of ATP. This then increased metabolism and facilitated blood circulation following the expansion of blood vessels and lymphatic vessels. Eventually, unnecessary liquids that had accumulated in the body were reabsorbed and exudations were quickly removed⁵⁾.

In this study, the function of patients with knee osteoarthritis was measured using the K-WOMAC, and there was a statistically significant difference between the measurements of those in the HILTG and the CPTG. A study conducted by Kheshie et al. compared the effects of HILT and LLLT on 53 female patients with knee osteoarthritis and reported that HILT was more effective in relieving pain and improving function. This result supports the result of the present study⁷⁾. However, our study has some limitations. It had a small number of subjects because it targeted only those patients who had visited our hospital over a four-week period. It also did not have full control over the daily activities of the subjects. In addition, the long-term results of these treatments have not been identified. Therefore, a variety of future studies should be conducted to compensate for these limitations.

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