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Effective Bone Regeneration Treatment Of Low-Level Laser

Hong Duyen Trinh Tran[1*], Minh Thai Tran[1], Ngoc Dung Tran Thi[1], Tam Anh Pham Tran[2], To Ni Phan Van[3]

[1] University of Technology, VNU-HCM
[2] Flinders University
[3] Waseda University
tt_hd2005@hcmut.edu.vn

Abstract

This experimental study aimed to evaluate if the effect simultaneously wavelengths of 780 nm and 940 nm enhances bone regeneration of the broken bone. Experiments on pets: 14 dogs, were randomly divided into 2 groups: group I (low-level laser therapy) and group II (control). The results showed that dogs in group I had better bone regeneration and bone marrow formation than the control group. Then, we treated 25 patients with different fracture levels. They agreed to enjoy our method. After treatment, the fracture is no longer visible on X-ray film. The majority of patients after treatment only feel no pain or mild pain. This suggests that osteoblasts are positively affected when projected by low-level laser. It is very practical for the treatment of older patients because osteoblasts grow slowly than osteoclast.

1 Introduction

The musculoskeletal system forms the skeleton for the human body, which is responsible for lifting and mobilizing. Additionally, the skeletal system also has the function to create blood cells, fat reserves, mineral salts. The most common method of treating fractures is a cast, splint, or screw, etc. However, there are some inadequacies: for these treatments, after waiting for recovery, the patient has almost no movement at the site of the injury, so it is easy to lose sensation and muscle atrophy in these areas. There are cases of pain caused by patients refusing to exercise, leading to long-term pressure ulcers, even respiratory infections, blood vessel obstruction, decreased urination reflexes. Therefore, after being fixed at a broken position, the patient must be self-conscious, persistent, pain-proof, restore joint movement, maintain muscle strength, and the rate of bone healing will increase by exercise.[1] From these issues, we offer a new direction in our research that is the use of the two-

wavelength effect simultaneously due to two types of semiconductor lasers working at 780nm and 940nm wavelengths, which impact the fracture site. We conduct experiments on dogs do to initially evaluate the efficiency of the two wavelengths effects simultaneously. This is an important step for us to treat different types of fractures for patients.

2 The Equipment

Low-level semiconductor laser equipment (Figure 1) is used in our research which is belong to the national research "B96.20.TĐ.06" of the Laser Technology laboratory - Ho Chi Minh City University of Technology. We use a low-level semiconductor laser device with a treatment head that is combined with two lasers working at 780nm and 940nm to create a two-wavelength effect simultaneously. The frequency of treatment is 50Hz. The level is 18 mW. This effect is radiated treatment directly to the skin surface in the damaged area.

Figure 1: The low-level semiconductor laser equipment

3 Model of Dog Fracture Treatment

3.1 Objective

14 male and female dogs are randomly selected, about 2-3 years old, average weight from 6 - 10 kg, healthy, flexible. They are raised under the same conditions (food, water, care) and are divided into two groups: Group I (laser): includes 10 dogs, group II (control): 04 dogs. The dog has a broken leg and a cast. Dogs in group I after cast, the broken leg is treated with a low-level laser. Dogs in the other group had broken legs for bone healing without treated with low-level lasers.

3.2 Methods

A course of treatment is 21 days. Each treatment is 30 minutes. The recognition of bone healing results of the two groups was assessed by the results of X-ray film at the times: after cast, after 14 days of treatment, after 21 days of treatment.

3.3 Results

After 14 days of the experiment (Figure 2), the bone marrow of the dog in group 1 is formed faster than that of the other group. We observe the fracture in group II at that time. At the end of the treatment, we recognized the formation of bone in group I become smoothy than that of the other group. Bone marrow has established in group II at the end of therapy.

Figure 2: X-ray results at day 1 (time 1), day 14 (time 2) and day 21 (time 3) of dogs in group I and group II

4 Clinical Treatment for Patient

4.1 Materials

After the good results obtained in the treatment of experimentally in dogs, we combined with the doctor to perform the treatment for patients. Patients included 25 people (11 women and 14 men), they voluntarily participated in the research program. Our research method is clinical experiments.

13 patients under the age of 20 years. Because at this age, they exercise constantly, so the fracture due to injury is inevitable. 7 patients over 60 years old. At this age, the aging occurs rapidly, leading to bone weakness of these patients, brittle, so just a minor bump can also cause fractures. 5 patients in the age range (21 - 40) years, this is the working-age, so the fracture will greatly affect daily labor.

4.2 Methods

A course of treatment consists of 21 days. Depending on the degree of fracture that patients are treated with one, two or three-courses. (Figure 3).

Figure 3: The difference position in fractures is treated by low-level laser

4.3 Experiment

The evaluation of treatment efficacy is based on the results of an X-ray of the patient before and after the end of treatment with low-level semiconductor lasers. Besides, the pain symptoms of the patient are examined and record by the doctor through the Mankoski pain scale [14] – This scale is used numbers and corresponding descriptions of pain so you can be sure that you and your healthcare provider understand one another (Table 1).

	Score	Description
No pain	0	Pain-Free
Minor Able to adapt to pain	1	Very minor annoyance - occasional minor twinges.
	2	Minor annoyance - occasional strong twinges.
	3	Annoying enough to be distracting.
Moderate Interferes with many activities	4	Can be ignored if you are involved in your work, but still distracting.
	5	It can not be ignored for more than 30 minutes.
	6	It can not be ignored for any length of time, but you can still go to work and participate in social activities.
Serve The patient is disabled and unable to function independently	7	Makes it difficult to concentrate, interferes with sleep You can still function with effort.
	8	Physical activity is severely limited. You can read and converse with effort. Nausea and dizziness set in as factors of pain.
	9	Unable to speak. Crying out or moaning uncontrollably - near delirium.
	10	Unconscious. Pain makes you pass out.

Table 1: Allina Health Pain Assessment Scale

4.4 Results

The patient is checked for the different symptom pains by the questionnaire of the Mankoski pain scale. The classification of patients is shown in table 2 at the before of treatment, after the first course and after the last course.

Level pain	Score	Before treatment (B)	After the first course (A1)	After the last course (A2)
No pain	0	0	0	11
Minor	1 – 3	0	9	10
Moderate	4 – 6	6	12	3
Serve	7 – 10	19	4	1

Table 2: Classify patients according to the Mankoski pain scale

From table 2, before treatment, most patients are immoderate pain level to severe pain. After the doctor and physician referral for treatment with low-level laser, patients agree to treat by our method. They expect positive treatment results before surgical. After the first course, the number of patients at severe pain decreased – only have 4 patients in this case when compared to before treatment (19 cases), the majority of patients feel pain on moderate (12 cases) and minor (9 cases). After the last course, only 1 patient feels severe pain, the majority of patients feel minor (10 cases) and 11 patients have no pain.

We used the IBM SPSS statistics 22 software that assesses the reliability of the low-level laser method. We used Paired Samples T-Test Output for each pair (B – A1; B – A2; A1 – A2) with 95% Confidence Interval of the Difference (table 3).

		Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Pair 1	B - A1	3.025	1.449	0.162	0.000
Pair 2	B - A2	5.313	1.269	0.142	0.000
Pair 3	A1 - A2	2.288	0.996	0.111	0.000

Table 3: Paired Samples Test with 95% Confidence Interval of the Difference

In table 3, 95% Confidence Interval of the Difference, the value sig. approximately 0 (<0.05) when we compare each pair. The data correlate with each other. Measurements show that the use of low-level semiconductor lasers therapy for bone regeneration. This method has been highly effective which reduced pain rapidly. These are crucial results that we apply this method to the community.

Figure 4: Results before and after treatment of L6 patients (82 years old)

Figure 4 is an X-ray picture of the wrist of an 82-year-old patient before and after treatment. Patients with wrist fractures, feeling sharp pain and could not move. After treatment, she no longer felt pain and her hands were able to move. Observing the results of the X-rays, we found that there was no fracture in the wrist bone position.

Figure 5 shows the results of an X-ray of a 65-year-old patient, the thumb bone of the hand is broken, the finger is swollen, unable to move before and after treatment. After 3 treatments, the broken finger was completely recovered and the hand was flexible again.

Figure 5: Results before and after 3 courses of treatment of L23 patients (65 years old)

5 Discussions

Using low-level laser in continuous mode impact on the position of the mouse fractured tibia effective fast bone healing through biological stimulation on osteoblasts in a short time [2]. Using a laser with the wavelength of 830nm with appropriate projection dose on osteoblasts also brings positive effects on the crystalline chemical composition of the bones (from 44.14% to 54.57%), Alkaline Phosphatase activity in osteoblasts increased, mitochondria increased sharply, and the density of osteoblasts increased [3-8]. Several other studies also use low-level lasers (650nm, 670nm, 680nm, 780nm, etc.) to evaluate the repair of bone defects with the recorded results of inhibiting the inflammatory process, increases bone repair, wound rapid recovery in the short term (21 days or 30 days) [9-18]. Especially, the treatment is carried out on animals with bone defects and diabetes, when using the low-level laser with 808nm and 904nm wavelengths to evaluate bone healing for diabetic animals; results showed that low-level laser accelerates bone healing. [19, 20].

6 Conclusions

From the results of research on dog treatment and clinical treatment of patients, we have recorded no cases of adverse effects on patients' health. The use of the two-wavelength effect in the treatment of fractures indicates that bone formation occurs more rapidly when interacting with a low-level laser on the site of a fractured bone. This is a useful treatment for elderly patients who have a new bone creation process slowly.

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