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The Evaluation of Laser Irradiation Therapy in the Treatment of Osteoarthritic Knee

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Objective: To show that infrared laser irradiation has valuable effect in management of knee osteoarthrosis.

Design: A study of 30 patients with bilateral knee osteoarthrosis grades 3 and 4. The patients were divided into two groups. The study group received traditional exercise and laser therapy while control group received traditional exercise.

Setting: Study was conducted in Dallah Hospital, Saudi Arabia.

Results: The study group has shown a significant pain relief and improved range of motion particularly among patients above 50 years.

Conclusion: The use of laser irradiation followed by exercise has marked effect on relieving pain and increasing range of movement of the osteoarthritic knee.

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Osteoarthrosis is the most common joint disease in human being[1,2]. Evidence of osteoarthrosis can be found in radiographs of as many as 80 % of people who are more than 55 years old, at least 10 % of them have significant pain, seeking active treatment[3].

In primary osteoarthrosis, increased intraarticular hydrostatic pressure has been claimed to impair blood supply of joint structures by compressing the synovial capillaries. This may be a factor contributing to persistent inflammation and destructive process[4,5].

Laser beam is a new kind of anti-inflammatory treatment and has pain relieving effect in chronic arthritis[6]. Diode laser developed more than ten years ago had been used regularly in the treatment of painful symptoms arising from arthritis and gave good result[7].

Helium-neon, gallium-arsenide, and neodymium glass lasers have been documented as an effective method to provide pain relief and enhance wound healing[7-10]. It was reported that in laser biostimulation, low power stimuli excite physiologic activity, moderately strong ones favor it, strong ones retard it, and very strong stimuli arrest it[11,12].

Infrared (IR) laser radiation with a peak intensity of 30 wp (watt peak) can penetrate to a maximum depth of approximately 40 mm and cause analgesia[10,13,14]. Accumulation of infrared laser energy (photons) in the enzyme system of cells intensifies their activity and causes the macrophages or mast cells to become more active, increasing the rate of metabolism[13].

Our aim is to show that IR laser followed by exercise has valuable effect in the management of knee osteoarthrosis.

METHODS

Thirty patients with bilateral knee osteoarthritis of grades three and four[5] participated in this study. They were assigned into equal study and control groups. The mean age of the study group was 44 years (range 32-60 years) and the mean weight was 104.5 kg (range 83-120 kg). In the control group the mean age was 45 years (range 33-59 years) and the mean weight was 104.4 kg (range 82-120 kg).

Patients with neurological conditions affecting lower extremity function, recent muscular strain or ligamentous sprain around the knee joint were excluded. Diagnosis of osteoarthrosis was documented by clinical and radiological examination.

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None of the patients was under medical treatment for osteoarthrosis and none had a history of light sensitivity. Each patient assumed stable level of activity during the treatment time.

Each patient was assessed at the beginning of the first session and at the end of the last session regarding pain and functional activity (standing from sitting, distance walked without stopping, pain during climbing stairs, pain on walking, pain while sitting on chair and night pain). Our assessment was interpreted according to the scores of scale rating of pain[12]. Also, the patient was physically examined for painless active range of extension, painless active range of flexion and muscle strength by measuring the maximum weight lifted by extensor mechanism and pulled by knee flexors.

Each subject in the study group received traditional exercises in addition to laser therapy whereas the control group received only the same traditional exercises. Both groups received treatment three times per week for four weeks.

The traditional exercises were in the form of quadriceps femoris sitting exercise, straight-leg raising exercises, terminal extension exercise through short arc of motion, terminal extension exercises combined with straight-leg raising and hamstring stretch exercise. All patients in both study and control groups were able to perform these exercises three different times a day.

The edges of the knee cap were palpated and the laser applicator was held vertically so that it described a conical shape as it was moved around the knee cap during the treatment session. An area three or four cm^2 wide was treated in this way around the knee cap. A treatment by infrared laser of 30 wp and 5 KHZ for 8 minutes was applied per each knee cap. While the patient is in prone position the hollow of the knee received also laser therapy for another eight minutes.

The specifications of infrared laser irradiation apparatus used are shown in Table 1.

Table 1. The specifications of infrared laser irradiation apparatus used in the study

Specification	*Details*
Main voltage	120 volt/60 herts (HZ)
Laser light	infra-red
Wave length	904 x 10 meter
Pulse duration	200 x 10 second
Pulse frequency	1-5000 HZ
Intensity effective value	0-3 milliwatt
Intensity peak value	0-30 wp
Dimension	165 mm width, 400 mm depth, 180 mm height
Weight	5.5 kg

The laser beam has a diameter of around 23 mm at a distance of 5 mm from the applicator, yielding an irradiated area of 4 cm^2. A protective laser goggles was used as a safety measure.

RESULTS

The study was performed on 30 patients of bilateral knee osteoarthrosis. They were divided into two groups, the study (6 males and 9 females) and the control (7 males and 8 females) groups.

Table 2. **Comparison between control and study groups regarding physical examination before treatment**

Physical Examination	*Control*		*Study*	
	Mean	*SD*	*Mean*	*SD*
Active range of flexion *	102.86	15.93	93.46	19.97
Active range of extension *	-13.14	6.44	-11.6	6.36
Flexure muscles strength **	1.83	0.64	1.97	0.78
Extensor muscles strength **	1.8	0.55	1.8	0.73

*SD = Standard Deviation, * = in degrees, ** = in kilogram*

Table 2 shows active range of flexion and extension and muscles strength of both groups before treatment which indicates no significant difference.

The group treated with laser and exercise has shown statistically significant improvement in the range of motion of flexion and extension. With regard to the effect on muscles strength of both flexures and extensors of the knee joint, there was no statistically significant difference between the two groups (Table 3).

There was a marked effect on reducing pain and in improving functional activities in the study group which was statistically significant while in the control group the improvement was not (Table 4 & 5) appreciable.

Table 3. **Comparison between control and study groups regarding physical examination after treatment**

Physical Examination	*Study*		*Control*			
	Mean	*SD*	*Mean*	*SD*	*T*	*P**
Active range of flexion	30.26	15.2	8.26	5.75	5.2	<0.0001
Active range of extension	17.47	4.3	4.66	8.3	8.3	<0.0001
Flexure muscles strength	1.6	0.66	1.43	0.46	0.95	<0.1
Extensor muscles strength	1.2	0.41	1.05	0.46	0.84	>0.2

* *Significant at P <0.05*

Table 4. **Effect of treatment in study group on pain and overall functional assessment**

	Mean Dif	*SD*	*SE*	*T*	*P**
Standing from sitting	-1.93	0.59	0.15	12.6	<0.0001
Distance walked without stopping	-1.4	0.51	0.13	10.6	<0.0001
Pain during climbing stairs	-1.9	0.59	0.15	12.6	<0.0001
Pain on walking	-2.06	0.26	0.07	31.0	<0.0001
Pain while sitting on chair	-2	0.65	0.16	11.8	<0.0001
Night pain	-1.6	0.6	0.16	9.5	<0.0001

* *Significant at P <0.05* *SE - Standard error*

In the study group, patients above the age of 50 had shown better improvement than patients below that age regarding the active range of flexion (Table 5).

Table 5. **The effect of treatment in the study group regarding different age groups**

Physical Examination	*Group 1 (32-49 yrs)*		*Group 2 (52-60 yrs)*			
	Mean improvement	*SD*	*Mean improvement*	*SD*	*T*	*P**
Active range of motion flexion	24.37	14.7	37	13.6	1.7	<0.05
Active range of motion of extension	17	5.08	18	3.6	0.4	<0.3
Flexure muscles strength	1.80	0.7	1.4	0.6	1.12	>0.1
Extensor muscles strength	1.25	0.27	1.14	0.55	0.48	>0.3

* *Significant at P <0.05*

DISCUSSION

Osteoarthrosis is commonly accompanied by symptoms such as pain, tenderness, decreased range of motion, and muscle weakness[1,2,3,5]. The laser beam is a new modality of anti-inflammatory treatment and does not induce any damage as incurred by non steroid anti-inflammatory drugs and infiltration with corticosteroid[6-12].

Pain relief after laster therapy may be attributed, according to Walker, to the release of the neurotransmitter serotonin and endogenous opiates. This was indicated by the increase in the 24 hour urinary secretion of 5 hydroxy indoleacetic acid, the degradation product of serotonin[12,15].

Bassleer et al and others proved that infrared laser can increase synthesization of cartilage proteoglycan and type II collagen which enhance regeneration of articular cartilage and in turn improve pain and mobility in osteoarthritic knee[7,10,13,14].

Basford et al used low energy helium-neon laser as a treatment of thumb osteoarthrosis without exercise therapy. They use it for 15 seconds at 0.9 milliwatt at four points around the carpometacarpal, metacarpophalangeal and interphalangeal joints. Their study revealed that changes in the range of motion, pain, joint tenderness, grip and pinch strength and activity level did not significantly differ between the study and control groups. They concluded that if low energy laser treatment is to be effective, correct laser and parameter choice will be important[8].

Bieglio applied an infrared laser of minimum peak power 25 watt and frequency 700-1200 hertz as a method of treatment of pain of spinal origin in 129 patients with radiologic evidence of osteoarthrosis at cervical, thoracic or lumbar regions. His therapy was found to be an effective method of treatment for acute or chronic pain and had marked effect in improving the mobility of the spine[6]. Same results as that of Bieglio in osteoarthrosis of the spine were obtained in our study in knee osteoarthrosis. However, we followed laser irradiation by traditional exercises which was not used by Bieglio.

Our results of improving pain and functional activities are also comparable to the results of Goldman et al and Myordomo et al which all suggested that laser stimulation is an effective method of pain relief and improvement of functional status[14,16].

It is our observation that patients above the age of 50 had a significant increment of active range of knee flexion compared to the younger age group. This is in contradiction to the results of Carbrero et al and others who mentioned that young patients showed a better response to laser[9,10,15]. We attributed our observation to the effect of laser on reducing the effusion which was a prominant manifestation in aged patients.

CONCLUSION

The use of laser irradiation followed by exercises has a marked effect on relieving pain and increasing the range of motion of the osteoarthritic knee. The improvement in the range of knee flexion is expected to be more prominant in the older age group.

To obtain the ideal results from laser therapy in knee osteoarthrosis, we recommend, in conjunction with traditional knee exercise, eight minutes application of invisible infrared laser of intensity peak value 30 wp and pulse frequency 5 KHZ to both knee cap and hollow of the knee.

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