Effect of Low Level Laser Therapy and Exercises in the Treatment of Pain and Functional Disability in Cases of Knee Osteoarthritis

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ABSTRACT

Background: Osteoarthritis OA is a widely spread disorder that may involve any synovial joint, but it mainly affects weight bearing joints, namely hip and knee. Treatments of knee OA mainly focus on pain and function. This is usually achieved by conservative, non pharmacologic therapies. Exercises are known to be effective in reducing pain, improve strength of quadriceps, improve knee mobility, and thus function. A recently introduced modality, Low intensity laser therapy (LLLT), is suggested to improve the condition of knee OA This study aimed to assess the efficiency of LLLT in conjunction with exercises in treatment of knee OA METHODS: sixty bilateral knees OA patients (22 males &38 females), of age range 45-65 years and mean 52 ± (6), were randomly selected and assigned to one of the three equal groups (20 patients each); group A. treated with laser and exercises, group B received exercises only and group C serves as a control group. Patients in experimental groups received 12 sessions (every other day). Assessment of pain was estimated by visual analog scale, and function by 50 feet walking speed. These assessment were done pre and post experimentally in group A & B, and in one month interval in group C. Results showed that significant improvement in pain and function occurred in both groups A&B compared to group C, but no significant difference was seen in between both groups. Conclusion: LLLT and exercise have been concluded to be no more efficient than exercise alone in treatment of OA of knee joint.

Key words: *OA, degenerative arthritis, LLLT, exercise therapy, knee pain.*

INTRODUCTION

Osteoarthritis (OA) has been reported to be one of the most common orthopedic disorders in the world. For instance, it has been reported that OA causes pain and dysfunction in 20 % of the elderly population over 40 years old in the United States. OA can affect any synovial joint; however its incidence is particularly high in weight bearing joints of the lower limbs[1].

Osteoarthritis, in most common cases, is of unknown etiology. However in some conditions it may occur secondary to other disorders, such as joint diseases, deformities, or traumas nearby or involving articular surfaces[2].

Most of the patho-physiological deficits seen in osteoarthritic patients have been described in literature including, pain, limited joint range of motion, and muscle weakness involving surrounding muscles. Despite this,

no treatment has been found yet that might stop the OA process, and therapeutic goals still focus on reducing pain and improving function[3].

Since symptomatic management still prevails, the usage of analgesic medications and non steroidal anti- inflammatory drugs is wide spread. However, prolonged use of such therapeutic interventions shows several adverse results, particularly in patients with concomitant renal, liver, or cardiac conditions. Thus it has been advised to use them only as adjuncts to non pharmacologic therapies[4].

Physical therapy programs have been directed towards reducing pain and improving functional activities of OA patients, with several modalities reported to be in use including, superficial and deep heat, TENS, Laser therapy, and exercises[5].

Therapeutic exercises have been reported to be effective in management of OA. It has been expressed that exercises are integral in reducing impairment, improving function, and preventing progressive disability[6]. A similar concept in the treatment of knee OA has been introduced that focus in quadriceps strengthening exercises in addition to general aerobic exercises with the primary aims of pain reduction and improving function[7].

Different forms of exercises programs either aerobic or resistance exercises, have been found efficient in improving disability measures, physical performance, and pain in elderly patients suffering from knee OA[8].

A quadriceps strengthening exercise have been compared to no intervention controls in a clinical trial, and was proven to be significantly better in reduction of pain and disability in the participating knee OA patients[9].

Of the various physical interventions used to relieve the symptoms of osteoarthritis (OA), low power laser therapy that has been reported to be extremely successful in Russia and Eastern Europe[10]. Low level Laser therapy (LLLT), 904 nm, has be reported to be the most appropriate laser type to be selected, when aiming to pain reduction. It has been reported that low-power laser acts on the prostaglandin (PG) synthesis, increasing the change of prostaglandin G2 and prostaglandin H2 into prostaglandin I2 (also called prostacyclin, or epoprostenol). The last is the main product of the arachidonic acid into the endothelial cells and into the smooth muscular cells of vessel walls, which have a vasodilating and anti-inflammatory action. This mechanism was postulated to underlie the good results achieved by using laser therapy in treating pain and inflammatory process in a variety of rheumatic pathologies, including rheumatoid arthritis and degenerative arthritis of the cervical spine[11].

Laser therapy has been suggested to reduce pain associated with knee OA when combined with optimal exercise regimen, acupuncture and TENS[5]. Laser therapy has, also, demonstrated events of posing some cartilage stimulatory properties in humans, with significant increase in proteoglycan synthesis, in particular with usage of 904 nm LLLT. This was in addition to suggested pain reduction and anti- inflammatory effects[12].

However despite the above benefit of laser therapy, assessing the effect of LLLT on cases of knee OA versus a placebo control group, authors came out with the conclusion that there were no significant differences in any of the variables studied (daily levels of pain, analgesic requirements, palpation tenderness and isokinetic quadriceps strength) found between the two groups before, during or after treatment. With regard to the patients' overall assessment there was a clearly

demonstrable positive effect of treatment in both groups. This is likely to be due to a placebo effect[13].

From the previous literature review it seems that LLLT effects on treatment of pain and improving function in Knee OA is not yet well established, despite it's wide suggested anti- inflammatory and analgesic effects. Therefore this study, aimed to identify the effect of LLLT on pain and function in Knee OA and determine whether LLLT in conjunction with exercises might add any significant improvement to these two vital parameters, pain and function, or not.

MATERIALS AND METHODS

Sixty OA patients (22 males and 38 females) whose age ranged between 45 and 65 years (mean 52 + SD 6), have been randomly selected from the orthopaedic out patients clinic, faculty of physical therapy, Cairo University, between June 1999 and February 2000. Patients have, then, being assigned randomly to one of the following groups; Group (A), 20 patients received laser therapy, and exercises, group (B) received exercises identical to those applied in group (A), and group (C) served as a control group.

Patients were included under the conditions that onset of OA was 5 years or more prior to the onset of the study. Both knee joints were involved, and body mass index beyond 29 (overweight and obese).

Patients were excluded in cases of presence of acute inflammation, previous joint infection, internal derangement of the knee joint, recent nearby fractures and joint stiffness, in addition to any neural affection that alters pain sensation, or perception.

Assessment was performed using visual analog scale (VAS) for pain severity, and 50-feet walking speed for knee function as will be further detailed in next section. In the other hand, ASA medical laser system- scanning mode, infrared laser 904nm, was used in treatment sessions for patients in group A.

Evaluation procedures

Each patient was interviewed at the beginning of the study, and given a full explanation of study objectives and procedures. Those who accepted to participate were asked to sign acceptance consent to participate prior to initial assessment.

Assessment, for all participants in the three groups, was done in two occasions; initial assessment prior to any treatment in experimental groups (A&B), then at the end of treatment sessions. In control group (C) assessment was done at inclusion and then one month later, a period similar to the treatment period in the other two groups but without any treatment intervention.

Assessment included pain assessment using VAS; a ten centimeter line marked zero to the left indicating no pain at all, and ten at the right hand side indicating intractable pain. Patient was asked to mark any point through out this line that he/she felt to best represent his current pain severity. Then the length from zero was measured to the closest millimeter[14].

Functional assessment was performed using 50-feet walking time. Patient was asked to walk the distance of 50 feet (about 15.24 meters) in the out patient clinic's corridor, starting from a standing start. Results were recorded in seconds[15].

Treatment procedures

Patients in experimental groups (A&B) received 12 sessions, 3 sessions per week (one session every other day).

In Group (A) Laser therapy was applied to both of the affected knee joints separately. Patient was placed in relaxed supine lying position, knee joints were semi- flexed to 20 degrees and maintained in this position using a soft cushion. Patient wore black goggles; skin over the treated area was thoroughly cleaned with alcohol. Scanner beam was adjusted cephalo-caudally from 5 cm above upper border of patella in this relaxed position, down to the greater tuberosity of tibia and medio-laterally from medial epicondyle of femur to the head of fibula. Duration of application was 18 minutes per treated knee joint, with energy output adjusted to 1.3 joules/cm2.

Exercise program included quadriceps setting exercises, terminal knee extension exercises, and flexion to extension exercise from semi reclined position. Repetitions for all three exercises were 30 repetitions in 3 sets (10 each) with resting durations in between equal in time to training period.

In group (B) same exercise program, was performed with patients under treatment.

In group (C) no treatment intervention was applied during the duration of one month, i.e. the experimental period.

RESULTS

This study has been directed towards identifying the effect of Laser therapy and exercises versus exercises alone in treating pain and improving function in OA patients.

Patients have been divided into three groups; group A received Laser and exercises, group B received exercises, and group C served as a control group.

Results of this study showed that pre experimental values for pain in patients of the three groups were not significantly different, which provides basis for post experimental comparison between the three groups. Comparison has been done using one way ANOVA (Table 1).

Table (1): ANOVA table for comparison between pre experimental pain values in the three groups.

	Mean	S.D.	F	P-value	F crit.
Group A	6.80	1.57	0.433373	0.650437	3.158846
Group B	6.85	1.39			
Group C	6.83	1.47			

P> 0.05

ANOVA results, also, have shown that post experimental values for pain in patients of the three groups indicated significant difference in pain reduction (Table 2). To identify the exact source of significant differences, test of least significant difference (LSD), indicated that there was no significant difference between laser and exercises in group A, and exercises only in group B. While both groups A and B were found to be significantly different compared to group C. Comparison between pre and post experimental means of pain intensity in the three groups is shown in fig. (1).

Table (2): ANOVA results of pain values obtained post experimentally between the three groups.

	Mean	S.D.	F	P-value	F crit
Group A	3.65	1.63	8.700647	0.000504	3.158846
Group B	2.65	1.76			
Group C	5.20	2.38			

P> 0.05.

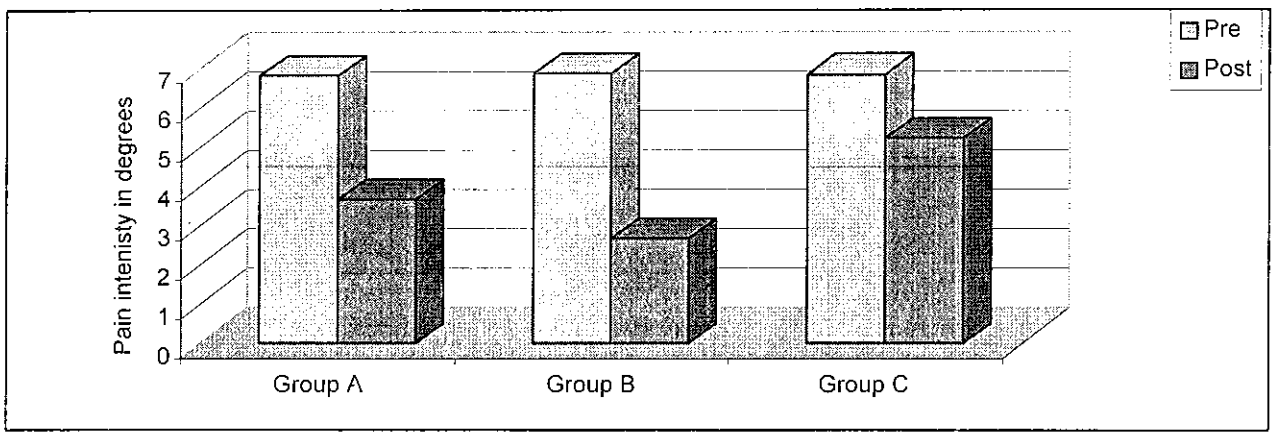

Fig. (1): Comparison between the means of pain intensity values in pre and post experimental assessments in the three groups.

As for 50 feet walking speed test, which was used to indicate functional capacity of OA patients in the current study, ANOVA test did not show significant difference between the groups pre-experimentally (Table 3).

Table (3): ANOVA table for comparison between pre experimental values for 50 feet walking in the three groups.

	Mean	S.D.	F	P-value	F crit
Group A	42.2	4.43	0.906442	0.409702	3.158846
Group B	44.75	6.82			
Group C	44.15	7.18			

P>0.05

Considering post experimental assessment for 50- feet walking speed for patient in the three groups under assessment ANOVA test has shown that there was significant difference between the obtained values in the three groups. LSD test has been applied to identify the source of significance, and it has been identified that groups A & B have no significant differences in between, while both differs significantly in improving function from the control group C (Table 4). Comparison between pre and post experimental means of 50 feet walking speed in the three groups is shown in fig (2).

Table (4): ANOVA results for comparison between post experimental values for 50- feet walking in the three groups.

	Mean	S.D.	F	P-value	F crit
Group A	31.2	5.29	18.69386	5.72E-07	3.158846
Group B	32.5	6.27			
Group C	41.45	5.71			

P>0.05

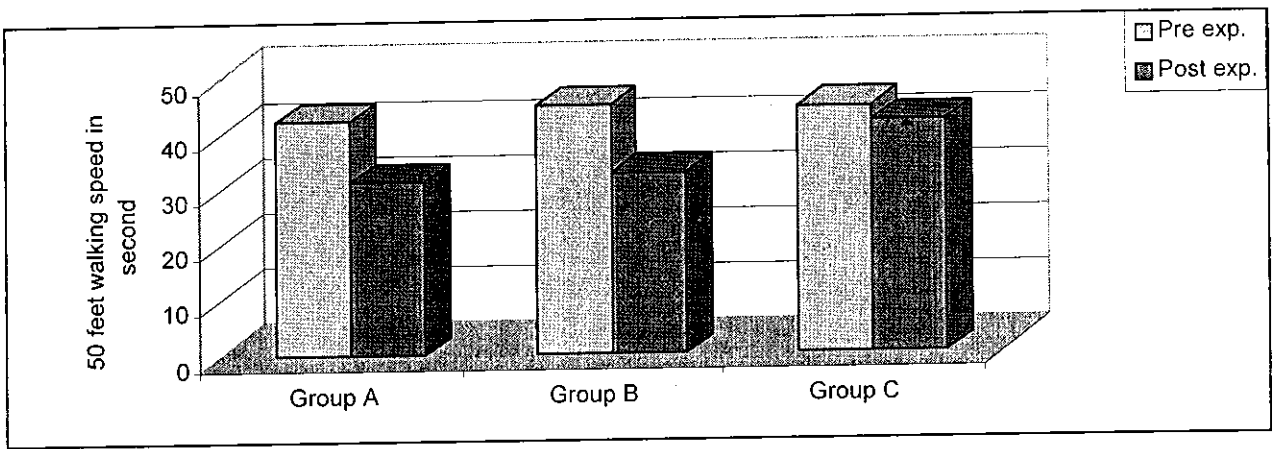

Fig. (2): Comparison between means of 50-feet walking speed in pre and post experimental assessments in the three groups.

DISCUSSION

This study has been conducted to investigate whether low level laser therapy (LLLT) would be helpful in reducing pain and improving function in cases of knee OA when used in conjunction with exercises therapy or not. The result showed that using LLLT together with exercises provides no significant improvement than applying exercises alone. However, both conditions have been significantly better when compared to control group, receiving no treatment.

This result agree with the findings of Bulow et al., (1994), who demonstrated that no significant difference has been found between LLLT and placebo group in pain intensity and function[12].

However, several researchers have pointed out that LLLT was found efficient in reducing pain . and inflammation in contradictory with results obtained in this study[5,10,11,12]. The first of which[5] is a literature review article, whose authors, concluded that available literature were insufficient to provide a conclusive decision about efficiency of any of the investigated modalities. The second[10], was more or less of the same opinion as the first. Authors indicated that there are only six clinical trials in this subject that can be found in literature, most of which showed no evidence of accuracy of their measurements, and their explanations were based on theoretical suggestions rather than a controlled experimental work. Authors, again, ensure the need for much effort to ensure results of LLLT

in degenerative arthritis. The third trial[11] was not a controlled clinical trial but rather a wide scale investigation of the effect of LLLT on a variety of painful pathologies including rheumatoid, epicondylitis, degenerative arthritis, and even ulcers. Both chronic and acute painful conditions included. In addition, their explanation of the mechanism of pain reduction by laser therapy has been adopted from theoretical backgrounds rather than laboratory analysis. The last study[12] who suggested a mechanism for LLLT in treating joint arthritis, concluded that LLLT is more efficient with rheumatoid arthritis than OA also, authors determined that several factors that include wavelength, treatment duration of LLLT, dosage, and site of application over nerves instead of joints should be investigated in controlled clinical trials before reaching a final judgment about effects of LLLT in the treatment of OA.

In relation to exercises, despite variations in types of exercises selected in different clinical trials involving treatment of OA[7,8], that involves aerobic and resistance exercises, in various isometric, isotonic and isokinetic forms, all authors[5,6,7,8,9] agree with the results of this study, which ascertain the efficiency of quadriceps training in pain reduction and improving function in knee OA patients.

CONCLUSION

Within LLLT parameters applied in this study, it has been concluded that LLLT has no significant role in improving pain and function in OA of the knee joint when applied in conjunction with exercises, than exercises alone. This view has been further augmented by the fact that LLLT equipments are, generally, of high costs. Besides it has been considered time consuming within sessions, as it was applied for over 36 minutes per session, particularly when compared to its relatively non satisfactory outcomes.

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الملخص العربي

تأثير الليزر منخفض الشدة و التمرينات في علاج الألم و الخلل الوظيفي في حالات خشونة مفصل الركبة الخلفية

تعد خشونة المفاصل من المشكلات واسعة الانتشار التي قد تصيب مختلف المفاصل الزلالية بالجسم وبخاصة التي تحمل ضغطا مرتفعا كالفخذ والركبة. ويركز علاج خشونة المفاصل أساسا على تحسين الألم والأداء الوظيفي. وهذا ما يتحقق غالبا بالطرق التحفظية اللادوائية . وتعرف التمارين العلاجية على اختلاف أنواعها، بالفاعلية في خفض الألم ، تحسين قوة العضلة الرباعية ، تحسين حركة مفصل الركبة، والأداء الوظيفي له. ويعد الليزر منخفض الشدة من الوسائل الحديثة التيتم تقديمها في هذا المجال. والذي يفترض أن يحسن حالة الألم والأداء الوظيفي . ولقد هدفت هذه الدراسة إلي تقييم فاعلية الليزر منخفض الشدة مع التمرينات في علاج خشونة مفصل الركبة. التجربة: تم اختيار ٦٠ مريضا يعانون من خشونة مفصلي الركبة (٢٢ رجلا و ٣٨ سيدة) تتراوح أعمارهم بين ٤٥-٦٥ (٥٢ ± ٦) سنة عشوائيا. وقد تم تقسيم، عشوائيا أيضا، إلى ثلاثة مجموعات متساوية (٢٠ مريض لكل مجموعة) كالتالي: المجموعة (أ) عولجت بالليزر والتمارين، المجموعة (ب) عولجت بالتمارين فقط، والمجموعة (ج) استخدمت كمجموعة ضابطة. هذا وقد تلقى المرضى في المجموعتين (أ، ب) ١٢ جلسة (٣ مرات أسبوعيا). و تم تقييم الألم وسرعة المشي (الأداء الوظيفي) قبل بدأ العلاج و بعد نهايته لكلتا المجموعتين. أما بالنسبة لمرضى المجموعة (ج) فقد تم التقييم مرتين أيضا و بفارق زمني شهر.النتائج: وقد أظهرت النتائج حدوث تحسن ذو دلالة في الألم والأداء الوظيفي لمرضى المجموعتين العلاجيتين مقارنة بمرضى المجموعة الضابطة. بينما لم يوجد فارق ذو قيمة بين نتائج مرضى المجموعتين العلاجيتين مقارنة ببعضهما البعض. الخلاصة: وقد أستخلص من هذا أن استخدام الليزر منخفض الشدة مع التمرينات ليس اكثر فاعلية من التمرينات وحدها في علاج خشونة مفصل الركبة ، وذلك في حدود أسلوب ، نوع ، شدة ، ومدة العلاج المستخدمة في هذه الدراسة.