Low Intensity Laser Therapy Versus Cryotherapy in Treatment of Juvenile Rheumatoid Arthrirtic children

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ABSTRACT

Purpose: *the purpose of this study was to compare between the effects of low intensity laser therapy (LILT) and cryotherapy in controlling knee joints passive range of motion and swelling in children with polyarticular juvenile rheumatoid arthritis (JRA).* ***Materials and Methods:*** *Thirty children with polyarticular JRA (18 girls & 12 boys) ranged in age between 7 to 13 years with the mean of their ages were 11.5±1.5 years participated in this study. They were divided randomly into two groups of equal number (15 patients in each group). Each patient in the two groups was evaluated before and after eight weeks of treatment. Patients in study group (I) treated by Gallium-Alluminium Aresenide (Ga-Al-As) diode laser irradiation on both knee joints alternatively, while patients in the study group (II) were treated by using cryotherapy in a form of ice packs on both knees. Patients in both groups were under their medical treatment (NSAID).* ***Results:*** *The results showed statistically significant difference in passive ROM and joint circumference measured from the middle and five centimeters above the upper border of the patella in each group after treatment application. The results also showed a statistically significant difference among both groups regarding passive range of motion after treatment (P>0.05). Statistically insignificant difference among both groups regarding knee joints circumference was shown after treatment application (P<0.05). Conclusion: it was concluded that both cryotherapy and LILT are effective modalities in controlling the JRA symptoms when the patient is under proper pharmacological management with more effective control of joint range of motion in favor to LILT.*

Key words: *low intensity laser therapy, cryotherapy, juvenile rheumatoid arthritis.*

INTRODUCTION

JRA is the most common rheumatic disease of childhood. It is a disease or group of diseases characterized by chronic synovitis and associated with a number of extra-articular manifestations. It is also called Still disease, Juvenile chronic polyarthritis, and chronic child-hood arthritis. It differs from adult by being started with both articular and extra-articular manifestations. The disease resulted from infection with undefined microorganisms that represents hypersensitivity or auto-immune reaction to unknown stimuli[1].

JRA is chronic and painful clinical condition that leads to progressive joint damage, disability, deterioration of quality of life and often complicated by other manifestation of systemic diseases that shortened life expectancy and even mild damage may results in irreversible damage and permanent disability[2].

Conservative management of JRA which include (medical and physical therapy treatment) attempts to control the clinical

manifestations of the disease, to prevent deformity, maximize function and minimize the disability and handicap that result from the underlying impairment or disease[3]. Physiotherapy plays an important role in the management of patients with JRA, low Intensity laser therapy (LILT), is recommended as a useful adjuvant therapy. It has recently been popularized in the treatment of various rheumatological, neurological, and musculoskeletal disorders such as osteoarthritis, rheumatoid arthritis, fibormylagia, carpal tunnel syndrome, rotator cuff tendonitis and chronic low back pain[4].

Laser therapy has been reported to be complementary to drug therapy for patients with juvenile rheumatoid arthritis (JRA). It is considered as a safe, effective and side effective-free adjunctive therapeutic modality for intractable, chronic and other types of pain[5]. Experimental and clinical studies emphasize that Ga-Al-As laser rays of relatively low power density and wave lengths and with great penetration capacity are effective in treatment of JRA. It was concluded that laser therapy exerts positive influence on the immune system and inflammatory responses at the synovial membrane level. Laser therapy application is based on radiation & monochromatic light that is able to alter cellular and tissue function in a manner dependent on the characteristics of light itself[6].

Cryotherapy is the local or systemic application of cold for therapeutic purposes. It is useful adjuncts for treatment of musculoskeletal injuries and rheumatoid arthritis as it helps in decreasing pain, and muscle spasm, with low side effect[7]. Cryotherapy is often used as adjunct in treatment of JRA by rehabilitation specialists. Heat loss is increased by peripheral vasodilatation. The initial reaction to application of cold is vasoconstriction involving 1- direct and persistent constriction of the superficial blood vessels locally 2- an immediate general vasoconstriction by reflex action through the central nervous system, and 3- a delayed generalized vasoconstriction as a result of activation of the posterior hypothalamus by the cool venous blood returning to the general circulation from the cooled skin[8].

Therefore the current study aimed to compare between the effect of LLLT and cryotherapy in controlling knee joints range of motion and swelling in children with Juvenile rheumatoid arthritis (JRA).

SUBJECTS AND PROCEDURES

Subjects

Thirty children with polyarticular JRA (18 girls and 12 boys) participated in this study. Their ages ranged from 7 to 13 years with the mean of their ages were (11.5± 1.5) they were selected from outpatient clinic of faculty of physical therapy Cairo University. Patients were selected according to the following criteria:

- Presence of arthritis in five or more joints during first six months of the disease.
- Presence of inflammatory synovial fluid, tenosynovitis or bursitis.
- Symmetrical arthritis, the degree of involvement was varied and Cardinal hallmark signs and symptoms of joints involvement were marked by pain, swelling, and morning stiffness.
- Ability to walk without assistance or assistive device.

Patients were divided randomly into two groups of equal numbers (15 patients in each group).

Procedures

1- Assessment procedures for treatment outcomes:

a) Range of motion of both knee joints: by using Beok plastic manual geniometer, passive range of motion of knee joints in both flexion and extension was measured from prone position.

b) Joint circumference: tape measurement was used for measuring the circumference of the knee joints for detection the degree of joint swelling. Joint circumference was measured from the middle of the patella and five centimeters above its upper edge.

2- Treatment procedures:

a) Treatment for GI (LILT):

Patients in this group received 12 successive sessions of Ga.Al.As diode LASER (produced from Endolaser 476 Enraf Nonius, Nertherlands apparatus with 830 nm wave-length, power output of 50mW) for four weeks period by rate of 3 sessions per week. Laser was applied on a semi flexed hip and knee joints from supine position. Eight points were determined (4 on medial side & 4 on lateral side). Laser was applied with continuous wave, energy density of 0.1 j/cm2, mean power 30 mw and area of laser beam = 0.4 cm2. Treatment time was 50 sec/point and radiation started for each point of the treated 8 points on both knees alternatively.

b) Treatment for GII (cryotherapy):

Children in this group were treated by using ice application. Ice packs that contained crushed ice at -15c° were applied on both knees from the supine position with semi-flexed hips and knees. Enough towels were applied for skin protection. The duration of application was 10 minutes for each joint.

Data Analysis

All variables were describes as mean and standard deviation. Paired t-test was done to detect changes of the measured variables before and after treatment application in each group. Unpaired t test was used to test changes for range of motions and angular displacement between two groups. The level of significant was set at P less than 0.05.

RESULTS

In the current study the comparison between LILT and cryotherapy on controlling ROM and the degree of joint swelling in both knees in children with polyarticular juvenile rheumatoid arthritis were evaluated before and after treatment application in both groups. Comparing mean values of the measured variables before and after treatment in each group showed a statistically significant difference. Also comparing mean values among the study groups after treatment showed also a statistically significant difference regarding joint range of motion and statistically insignificant difference concerning joint swelling (P>0.05).

Thirty children with polyarticular juvenile rheumatoid arthritis (18 girls and 12 boys), aged between (7 to 13 years), included in the trial and all of them completed the study period. There was non statistical significant differences (P>0.05) in demographic characteristic included age, diseases duration and body mass index for children involved in study as in table (1).

Table (1): Baseline characteristics of children in both groups.

Variables	Group I (LLLT)	Group II (Cryotherapy)	P-value
	X ±SD	X ±SD	
Age (years)	11.6±1.59	11.9±1.49	>0.05
Diseases Duration (Months)	3.3±0.8	3.26±0.4	>0.05
Body mass index (Kg/m^2)	15.74	15.71	>0.05

Table (1) illustrates that there was statistically insignificant difference among both groups regarding the demographic characteristics before treatment application which indicates the homogeneity of the samples.

Results for the study group I (LILT):

This table shows a statistically significant difference of passive range of motion of both right and left knees in both flexion and extension movements after treatment by LILT as illustrated in figure (1).

Table (2): Mean values of both Rt and Lt knee joints passive ROM before and after treatment in GI (LILT).

	Rt knee flexion		Rt knee extension		Lt knee flexion		Lt knee extension	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
X ± SD	118.27±11.61	126.60±12.23	99.40±15.76	107.83±14.44	117.80±9.5	125.33±7.9	95.53±7.69	103.53±7.59
MD	8.33		8.43		7.53		7.67	
t-value	2.243		4.94		4.77		2.714	
P-value	0.033		0.050		0.024		0.011	
	S		S		S		S	

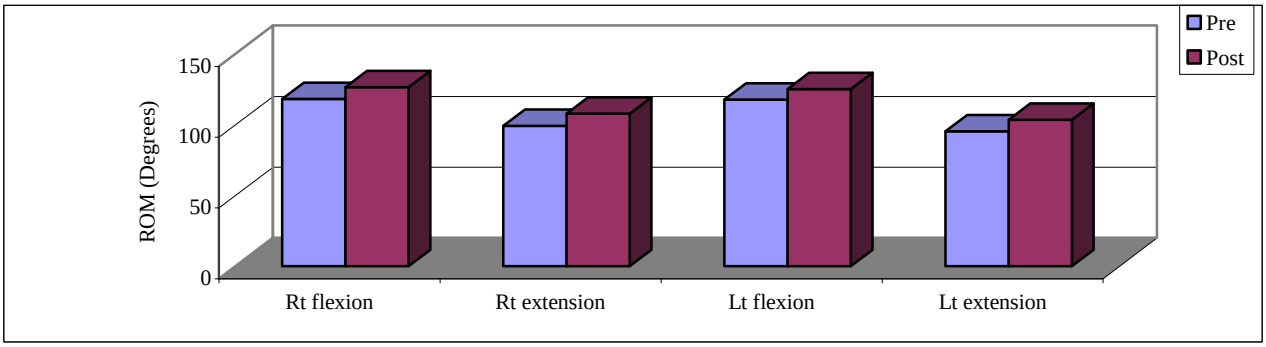

Fig. (1): The mean values of passive knee range of motion (Rt. & Lt), before and after treatment for GI (LLLT).

Table (3): Mean values of both Rt and Lt knee joints circumference (from the middle of patella and 5cm above its upper border) before and after treatment in GI (LILT).

	Rt knee swelling				Lt knee swelling			
	Mid patella		Above patella		Mid patella		Above patella	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
X ± SD	31.05±5.26	29.38±4.87	31.43±5.75	30.43±5.45	30.00±4.15	28.37±4.11	30.93±4.22	29.34±4.08
MD	1.22		1.00		1.633		1.5	
t-value	5.40		1.025		7.59		8.35	
P-value	>0.05		0.314		>0.05		>0.05	
	S		NS		S		S	

As illustrated from table (3) and figure (2) the mean differences of 1.22 and 1 for right knee and 1.63 and 1.5 for left knee measured from he middle of the patella and five centimeters above its upper surface respectively showed a statistically significant reduction in the degree of joint swelling after application of LILT treatment.

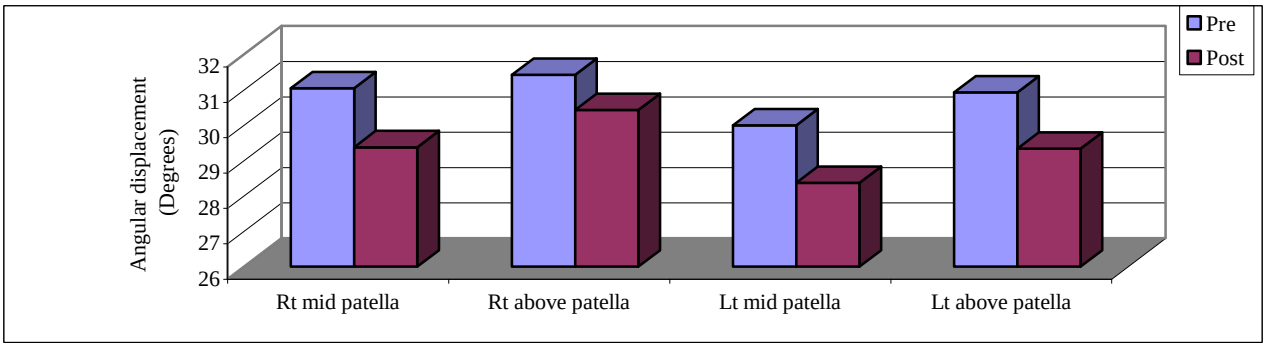

Fig. (2): Mean values of both Rt and Lt knee joints circumference (from middle of patella and 5cm above its upper border) before and after treatment in GI (LILT).

Results for the study group II (cryotherapy):

This table shows a statistically significant difference of passive range of motion of both right and left knees in both flexion and extension movements after treatment by cryotherapy as illustrated in figure (3).

Table (4): Mean values of both Rt and Lt knee joints ROM before and after treatment in GII (cryotherapy group).

	Rt knee flexion		Rt knee extension		Lt knee flexion		Lt knee extension	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
X ± SD	115.27±10.87	119.53±10.54	97.8±15.08	102.2±14.12	110.4±8.39	115.20±9.29	95.00±7.31	103.33±7.71
MD	1.33		4.4		4.2		8.33	
t-value	0.765		5.69		6.14		6.30	
P-value	>0.05		>0.05		>0.05		>0.05	
	S		S		S		S	

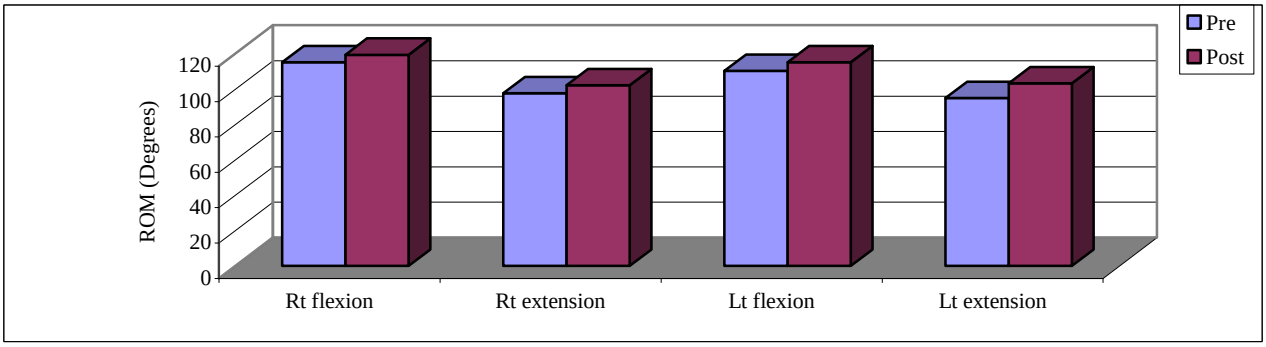

Fig. (3): The mean values of passive knee range of motion (Rt. & Lt), before and after treatment for GII (Cryotherapy).

Table (5): Mean values of both Rt and Lt knee joints circumference (from mid of patella and 5cm above patella) before and after treatment in GII (cryotherapy).

	Rt knee swelling				Lt knee swelling			
	Mid patella		Above patella		Mid patella		Above patella	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
X ± SD	30.33±4.69	28.93±4.85	31.43±5.73	30.63±5.80	29.5±4.16	28.07±4.24	30.47±4.73	29.47±4.53
MD	1.4		1.092		1.433		1	
t-value	8.98		5.87		7.21		5.68	
P-value	>0.05		>0.05		>0.05		>0.05	
	S		S		S		S	

As illustrated from table (5) and figure (4) the mean differences of 1.4 and 1.092 for right knee and 1.433 and 1 for left knee measured from he middle of the patella and five centimeters above its upper surface respectively showed a statistically significant reduction in the degree of joint swelling after application of cryotherapy treatment.

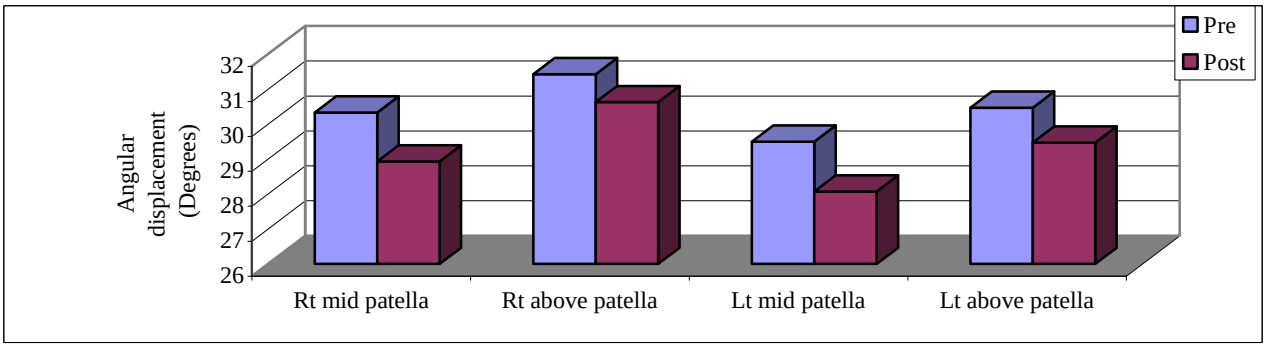

Fig. (4): Mean values of both Rt and Lt knee joints circumference (from the middle of patella and 5 cm above its upper border) before and after treatment in GII (cryotherapy).

Comparison between both study groups after treatment

This table shows a statistically significant difference of passive range of motion of both right and left knees in both flexion and extension movements after treatment between both groups as illustrated in figure (5).

Table (6): Mean values of both Rt and Lt knee joints ROM between both GI & GII after treatment.

	Rt knee flexion		Rt knee extension		Lt knee flexion		Lt knee extension	
	GI	GII	GI	GII	GI	GII	GI	GII
X ± SD	126.7±12.12	119.5±10.5	107.2±14.34	102.60±14.1	125.33±7.9	115.20±9.29	103.33±7.17	98.00±6.57
MD	7.13		5.67		5.57		5.33	
t-value	1.72		1.09		7.05		2.04	
P-value	0.094		0.087		>0.05		0.051	
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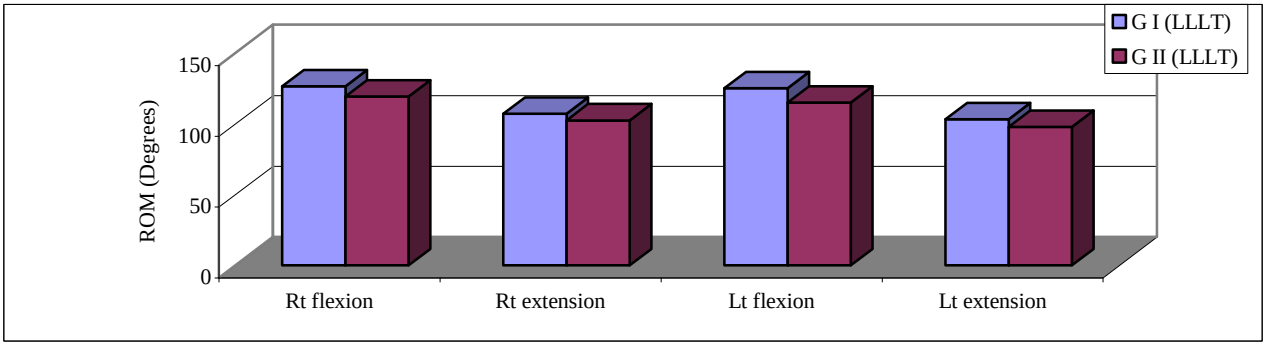

Fig. (5): Mean values of passive knee range of motion (Rt. & Lt), after treatment between GI (LLLT) & GII (cryotherapy) after treatment.

Table (7): Mean values of both Rt and Lt knee joints circumference (from mid of patella and 5cm above its upper edge) after treatment between both groups GI & GII.

	Rt knee swelling				Lt knee swelling			
	Mid patella		Above patella		Mid patella		Above patella	
	GI	GII	Pre	Post	GI	GII	GI	GII
X ± SD	30.43±5.45	30.63±5.86	31.40±4.01	31.17±4.10	28.37±4.11	28.07±4.25	29.43±4.08	29.47±4.53
MD	0.2		0.23		0.3		0.03	
t-value	0.1		0.735		0.2		0.02	
P-value	0.923		0.468		0.846		0.983	
	NS		NS		NS		NS	

This table illustrates statistically insignificant difference regarding the joint circumference among both groups from the middle and five centimeters above the upper border of the patella after treatment as illustrated in figure (6).

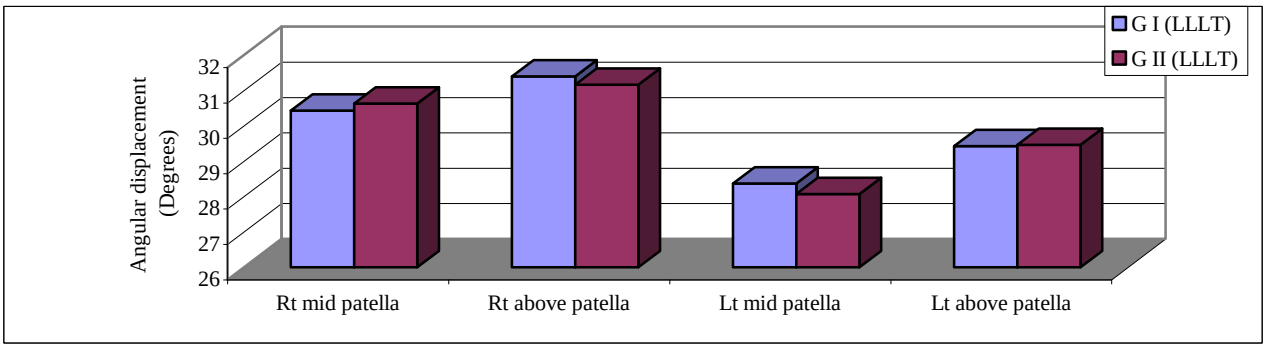

Fig. (6): Mean values of both Rt and Lt knee joints circumference (from mid of patella and 5cm above patella) after treatment between both groups GI & GII.

DISCUSSION

Juvenile rheumatoid arthritis (JRA) is one of the most common rheumatic diseases of childhood. Laser therapy has been reported to be complementary to drug therapy for adult patients with rheumatoid arthritis. This study was conducted to compare between LILT and ice therapy in controlling the manifestations of JRA. The results of the current study showed a

statistically significant improvement in both study groups after application of both LILT and cold therapy with more improvement in passive range of motion in the group that was treated by LILT.

This improvement can be attributed to the concept that laser radiation of relatively low power density and wavelengths able to penetrate tissues in early stages of JRA which was beneficial in reducing the symptoms of the disease as Laser therapy's analgesic effect could be attributed to the release of the neurotransmitter serotonin and endogenous opiates. Also it may be referred to the aggregation effect and the immune response, as LILT has both immuno-suppresive and immuno-stimulative effects. Science some of the pathogenic mechanisms of the rheumatoid arthritis may be related to loss of control by supressors T-cells, the possibility that laser radiation as an immuno-stimulative can stimulate suppressor T-cells and also in regaining this loss of control. Also in view of the autoimmune anti-body production by patients with rheumatoid arthritis, there is possibility that laser radiation can be immuno-supressive, and therefore decrease some of this overactivity, specially of the B-lymphocyte[9,10].

Analgesic effect of cold could reduce inflammatory symptoms and pain associated with RA that interferes with a person's functional ability. It has been show that the topical application of cold decreases skin, muscle and intra-articular temperature. Cold therapy is thought to reduce pain and swelling by many mechanisms, including vasoconstriction, which decreases the capillary permeability and metabolic demand of the cells, decreasing pain producing spasticity of the muscle spindle, strengthening collagen by increasing stiffness; and decreasing motor and sensory nerve conduction velocities[11].

Many of physical-chemical effects inside the tissue depend on the cellular membrane condition, as well as on its mechanical deformations and electrochemical potential. These membrane characteristics are strongly determined by the outer conditions, such as the temperature and ion concentration in the aqueous solution surrounding the membrane. It is obvious that any outer stimulus like laser radiation could affect these outer conditions that will affect the cellular membrane status through optical non-homogeneity factor that lead to imbalance of some process at the membrane level like the osmotic overpressure on the membrane, which can lead to its deformation[12].

Results of the current study indicate that laser radiation of relatively low power density and wavelengths able to penetrate tissue in early stage of RA and it is beneficial in reducing the symptoms of the disease as pain, knee joint range of motion which was reflected on the whole gait cycle during walking and denoted improved functional activities and psychological condition of the patient. Also the gained results denoted that cryotherapy can reduce the symptoms of RA by decreasing the intra-articular knee temperature[13].

The results obtained from trial of Stelian et al., 1993[14] suggested that LLLT may be useful in reducing pain and disability associated with knee arthritis. In contrast, in a double blind placebo controlled study, Bulow et al., 1994[15] detected no differences between the actively and the placebo treated group. As well as Tascioglu et al., 2004[16] failed to demonstrated significance effect of Gal-Al-As diode laser in pain and mobility in patient with knee osteoarthritis. In contrast with this finding Agamber et al., 1992[17] reported a significance improvement in knee joint pain and mobility after exposure to 820 nm low level laser.

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الملخص العربي

مقارنة بين تأثير الليزر المنخفض الشدة واستخدام الثلج في علاج الأطفال المصابين بالروماتويد المفصلي

الهدف من البحث : أجريت هذه الدراسة لمقارنة تأثير كلآ من الليزر المنخفض الشدة واستخدام الثلج في علاج الأطفال المصابين بالروماتويد المفصلي في التحكم في المدى الحركي لمفصل الركبة أثناء الثني والفرد وكذلك محيط الركبة . **مواد وأساليب البحث :** تم إجراء البحث على ثلاثون طفلا ممن يعانون من االروماتويد المفصلي تراوحت أعمارهم بين 7 و 13 عام وبلغ متوسط أعمارهم 11.5 سنة وقد تم تقسيم العينة عشوائياً إلى مجموعتين (15 طفل في كل مجموعة) وقد تلقت المجموعة الأولى العلاج بالليزر منخفض الشدة على مفصلي الركبة بينما تلقت المجموعة الثانية العلاج عن طريق التبريد باستخدام كمادات الثلج على مفصلي الركبة أيضاً وقد تم قياس كلآ من المدى الحرك ي لمفصل الركبة أثناء الثنى والفرد وكذلك محيط الركبة من منتصف صابونة الركبة و5 سم أعلى حافتها العليا . وقد أظهرت النتائج تحسن اً إكلينيكياً ملحوظاً في المدى الحركي لمفصل الركبة أثناء الثنى والفرد وكذلك انخفاض تورم الركبة بعد انتهاء العلاج في كل مجموعة على حده. كما أظهرت النتائج وجود فروق ذات دلالات إحصائية بين المجموعتين بالنسبة للمدى الحرك ي لمفصل الركبة لصالح مجموعة الليزر . وقد توصلت الدراسة إلى أن تطبيق أي من الليزر المنخفض الشدة أو كمادات الثلج في يؤدى إلى تحسن وظائف الركبة عند الأطفال المصابين بالروماتويد المفصلي .

الكلمات الدالة : العلاج بالليزر منخفض الشدة - التهاب المفاصل الروماتزمي عند الأطفال - العلاج بالثلج .