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RESEARCH ARTICLE

COMPARISON OF THE EFFICACY OF DIFFERENT DOSAGE OF LASER ON CLINICAL PROFILE OF PATIENTS WITH KNEE OSTEOARTHRITIS.

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Abstract

Background: Due to the lack of consensus on the dosage of laser which can be beneficial for the patients with knee osteoarthritis needs to be established.
Aim: The aim of the present study was to examine the effect of different doses of LASER in patients with knee osteoarthritis.
Study design: Experimental study design comparative in nature.
Sample size: 60
Procedure: Subjects in the age range of 40-65 years were recruited and divided randomly into 3 groups with group A receiving laser dose of 4 J/cm^2, group B receiving dose of 5J/cm^2 and group C receiving dose of 3 J/cm^2. Conventional physiotherapy and strengthening exercises was given to all the three groups. Whole procedure was continued for 2 weeks. Outcome measures included VAS, WOMAC, ROM of flexion of both right and left knees.
Results: The pre and post treatment readings of VAS, WOMAC and ROM of flexion of both knees showed significant improvement as evident from paired t-test score at 5% level of significance. The findings of ANOVA test showed significant difference of VAS and WOMAC among the three groups. Post-hoc analysis using Tukey's HSD showed that the mean difference was statistically significantly difference between group B with group A and C for both the VAS and WOMAC.
Conclusion: Though statistically the results came out to be significant in all the three groups but clinically more improvement was noticed in group B than in other groups. More studies are required to establish the dose used in group B i.e. 5J/cm^2.

Introduction:-

Osteoarthritis (OA) is the major musculoskeletal condition afflicting today's world. It is a progressive degenerative joint disease that initially affects joint and soft tissue with subsequent involvement of the underlying bone and inflammation of the contiguous synovium (Jogunola, 2013). It is the second most common rheumatologic problem and is most frequent joint disease with prevalence of 22% to 39% in India (Radha and Gangadhar, 2015).

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OA is much more prevalent in India than in west and accounts for as much more disability as any of other chronic conditions. The prevalence is high, especially among the elderly. With the increase in population of elderly, it has become the major health problem nowadays. Although advance osteoarthritis may occur in many young people in early 20's, the frequency of condition escalates markedly in advancing years (Mahajan, Verma and Tandon, 2005). Approximately one-third of direct OA expenditures are allocated for medication, much of which goes toward pain-related agents. Hospitalization costs comprise about 50% of direct costs, with most of these expenditures being consumed by a small proportion [5%] of OA patients who undergo knee or hip replacement surgery. Indirect costs for OA are also high, largely as a result of work-related losses and home-care costs. It is estimated that approximately 500 deaths are reported annually due to this menace and this number is most likely to be highly underestimated. In 2009, it was ranked fourth most common cause of hospitalization (Yucesoy et al., 2015). Knee osteoarthritis and similar diseases that are more frequently encountered in advanced years will become much more important from both medical and economic aspects (Kumar, 2012).

OA is multi factorial in aetiology, with both systemic factors as well as local factors contributing to the development of OA. Systemic factors include age, sex and genes and local factors include muscle weakness and joint deformity. There are certain other factors that contribute to OA like mechanical overloading, joint injuries, occupational loads in jobs requiring repeated or prolonged knee bending, knee mal-alignment, failure of the chondrocyte controlled internal remodelling system, extra cartilaginous factors such as synovial or vascular changes and genetic factors (Hafez et al, 2014; Shadab et al., 2014).

Pain is the first and predominant symptom, causing loss of ability and often stiffness. It is typically of insidious onset and is variable but later on it becomes continuous and may disturb sleep. As OA progresses, the affected joints appear larger, are stiff and painful. Pain often prevents the patient moving through full range and this could result in shortening of soft tissue structures so leading to further loss of movement and deformity. OA of the knee can cause a crackling noise called "crepitus", when the affected joint is moved or touched, and patients may experience muscle spasm and contractions in the tendons (Atkinson, Coutts and Hassenkamp, n.d.)

Traditional understanding and physical treatments of OA were based on the premise that pathological changes impaired normal mechanical joint function, giving rise to pain and disability, and that those interventions which corrected such dysfunctions would ameliorate patient symptoms (Hurley et al 1997). Therapeutic options for knee OA include non pharmacologic, pharmacologic and surgical interventions (Liana et al. 2004). Pharmacological management of osteoarthritis is mainly directed towards decreasing the symptoms of the condition and slowing or preventing the progress of the condition. Drug therapy in osteoarthritis has no effect on disease progression and is ancillary to the more general measures of pain control, which includes patient related instruction, joint protection and exercise (Sullivan and Schmitz, 2001). Non pharmacologic measures such as weight loss, joint protection techniques, physiotherapy and muscle-strengthening exercises have no inherent risk and minimal costs and are therefore advised for all patients (Liana et al 2004).

Physiotherapy is a major non-pharmacological intervention for knee osteoarthritis recommended by the American College of Rheumatology and the European League against Rheumatism (Jordan et al., 2003). To avoid or to reduce the side effects associated with NSAIDs, physical therapy agents are frequently used. Conventional physiotherapeutic management commonly includes LASER therapy, thermotherapy, therapeutic exercise, cryotherapy, and a variety of electrotherapeutic modalities, which includes transcutaneous electrical nerve stimulator (TENS) (Cheing, Chang and Chan, 2002) and ultrasound therapy (Kozanoglu et al., 2003).

Need of the Study:-

There are number of studies which advocated different doses of laser for different conditions. There is lack of consensus regarding the dosage of laser in cases of managing knee pain associated with knee OA; different authors advocate different doses of laser (de Bie, de Vet and Lenssen, 1998; Soriano and Rios, 1998; Bjordal et al., 2003 and Konstantinovic et al., 2010).

Due to this controversy regarding the dosage of laser for managing patients with knee pain, the research team tried to establish the dose that can be used in effectively in cases of knee osteoarthritis.

Aim of study:-
The aim of the present study was to examine the effect of different doses of LASER in patients with knee osteoarthritis.

Objectives:-
The objective of the present study was to estimate and compare the effects of different doses of LASER therapy on Pain, ROM and functional performance in patients with knee OA.

Methodology:-
Research design:-
The present study had experimental study design comparative in nature.

Research setting:-
This study was done in Outpatient Department of Physiotherapy, GianSagar Hospital and GianSagar College of Physiotherapy, Rajpura.

Sample size:-
60 patients

Sampling technique:-
Random Sampling Technique (lottery method)

Ethical approval and informed consent:-
This study was approved by the ethical committee of GianSagar group of institutes. All the subjects were duly informed about the procedure, duration of procedure and the associated risk factors and precautions involved in the study. A written informed consent was taken from all the subjects before the initiation of the study.

Inclusion criteria:-
1. Individual aged between 40 to 65 years
2. Bilateral or unilateral knee joint involvement
3. Mild to moderate pain rating on VAS scale
4. Radiographic evidence of grade 2 or 3 as per Kellgren-Lawrence scale.

Exclusion criteria:-
1. Any associated inflammatory condition of the knee
2. Presence of any peripheral and central nervous system disorders
3. Patient with metallic implant in or around the knee joint
4. Participating in another research study involving knee joint
5. Thermal insensitivity
6. Diabetes neuropathy
7. Patient's phobic to electricity.
8. Sensory loss due to other undiagnosed reasons.

Procedure:-
60 subjects were made part of the study based on the inclusion and exclusion criteria. After taking consent, the subjects were randomly divided into 3 groups named A, B and C with 20 subjects each.

Group A received Laser Therapy with dose $4J/cm^2$ (Soriano and Rios, 1998) and Conventional Physiotherapy.

Group B received Laser Therapy with dose $5J/cm^2$ (de Bie, de Vet and Lenssen, 1998) and Conventional Physiotherapy.

Group C received Laser Therapy with dose $3J/cm^2$ (Konstantinovic et al., 2010) and Conventional Physiotherapy.

Treatment was given for 5 days a week for 2 weeks. Baseline readings were taken of Pain, ROM and WOMAC scale on day 0. Post treatment readings were taken of the same variables at the end of 2 weeks.

The treatment intervention was given in three phases. First phase was warm up phase. Hot pack was given to affected knee for 15 minutes. After that stretching exercises were given for calf, hamstring and quadriceps muscle with 30 second hold and 3 repetitions.

Second phase was intervention phase. Laser treatment was given according to the dosage of different groups. The technique used for treatment was scanning method. Treatment time for the laser was 150 seconds per point. TENS was given to all the subjects for 20 minutes. Strengthening exercises was given to all the patients in 3 groups for 10 – 15 minutes. Strengthening exercise protocols include isometric exercise to quadriceps and hamstrings, straight leg raise and knee extension in high sitting. All the exercises were performed for 2 sets of 8 repetitions with 6 second hold.

Third phase was cool-down phase and it includes static bicycle was given for 5 minutes.

Variables:-

Independent variables:-

1. Strengthening Exercise protocol
2. TENS
3. LASER

Dependent variables:-

1. Pain scale (VAS)
2. Range of Motion (Goniometry)
3. Functional Performance (WOMAC scale)

Data analysis & Results:-

The data was analyzed using SPSS 16.0 software and Microsoft excel software of windows 7 ultimate. The data was calculated and presented as mean ± SD. Paired t-test was calculated to estimate whether the difference between the pre and post-treatment readings with group was statistically significant at 95% level of significance. ANOVA was also applied to estimate whether the efficacy of the different dosage of lasers was statistically significant at 95% level of confidence.

Table 1:-Comparison of mean age of participants

Parameter	Group A	Group B	Group C	ANOVA (F- score)	Significant/ non significant
Age	52.5 ± 8.60	50.65 ± 8.25	50.1 ± 7.58	0.48	Non- significant
Tabled value of F of (2,57) df at 5 % LOS is 3.16					

Table 1 indicates mean age of the participants in all the three groups. ANOVA was applied and the calculated value of F came out to be less than the tabled value at 95% level of confidence, which indicates that there was non-significant difference in the age of participants among different groups and all the three groups were homogenous.

Table 2:-Comparison of pre-treatment and post-treatment readings (mean ± SD) of VAS, WOMAC and ROM of right and left knee of group A

Group	Pre-treatment	Post – treatment	Paired t-test score	Significant / non significant
VAS	5.9±0.79	4.45±0.94	12.71	Significant
WOMAC	48.60±6.71	38.70±6.99	12.73	Significant
ROM Flexion (L)	108.25±11.76	113.05±9.44	5.27	Significant
ROM Flexion (R)	107.65±13.52	112.10±10.53	3.71	Significant
Tabled value of t – test of 19 df at 5 % LOS is 2.09				

Table 3:-Comparison of pre-treatment and post-treatment readings (mean ± SD) of VAS, WOMAC and ROM of right and left knee of group B

Group	Pre-treatment	Post – treatment	Paired t-test score	Significant / non significant
VAS	5.75±0.85	3.75±0.97	16.99	Significant
WOMAC	46.55±6.96	32.95±7.27	13.34	Significant
ROM Flexion (L)	113.70±11.36	120.10±8.06	5.49	Significant
ROM Flexion (R)	111.40±12.63	118.75±8.62	5.13	Significant
Tabled value of t – test of 19 df at 5 % LOS is 2.09				

Table 4:-Comparison of pre-treatment and post-treatment readings (mean ± SD) of VAS, WOMAC and ROM of right and left knee of group C

Group	Pre-treatment	Post – treatment	Paired t-test score	Significant / non significant
VAS	5.55±1.05	4.20±1.11	7.43	Significant
WOMAC	46.70±6.85	36.85±6.23	13.36	Significant
ROM Flexion (L)	109.50±11.14	113.60±9.20	5.39	Significant
ROM Flexion (R)	108.90±13.56	112.90±11.15	5.12	Significant
Tabled value of t – test of 19 df at 5 % LOS is 2.09				

Table 2, 3 and 4 presents the comparison of pre and post-treatment readings of VAS, WOMAC, range of motion of flexion of both right and left knees of groups A, B and C respectively. Paired t-test was applied to examine whether the improvement produced was statistically significant. The calculated value of t-score came out to be more than the tabled value of t at $P < 0.05$ for all the parameters indicating that the improvement produced was statistically significant.

Table 5:-Comparison of mean values of VAS, WOMAC and ROM of right and left knee among groups A, B and C

Parameters	F – value	P	Significant/ Non- significant
VAS	5.08	0.009	Significant
WOMAC	6.34	0.003	Significant
ROM Flexion (Left)	1.49	0.234	Non-significant
ROM Flexion (Right)	2.42	0.098	Non-significant
Tabled value of ANOVA at (2,57) df for 5 % LOS is 3.16			

Table 5 demonstrates comparison of VAS, WOMAC and range of motion of right and left knee among different groups. The calculated value of F indicates that there was statistically significant difference of VAS and WOMAC and statistically non-significant difference of range of motion of flexion of both right and left knee among the three different groups.

Table 6:-Multiple comparisons of VAS among different groups using Tukey HSD

(I) cat	(J) cat	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	**B**	-.55000*	.21965	.040	-1.0786	-.0214
	C	.10000	.21965	.892	-.4286	.6286
B	**A**	.55000*	.21965	.040	.0214	1.0786
	C	.65000*	.21965	.012	.1214	1.1786
C	**A**	-.10000	.21965	.892	-.6286	.4286
	B	-.65000*	.21965	.012	-1.1786	-.1214

Table 6 depicts multiple comparison of VAS among different interventional groups. The mean difference was calculated which indicated a statistically significant difference in VAS between group B with both groups A as well as C.

Table 7:-Multiple comparisons of WOMAC among different groups using Tukey HSD

(I) cat	(J) cat	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	**B**	-3.70000*	1.20754	.009	-6.6059	-.7941
	C	.05000	1.20754	.999	-2.8559	2.9559
B	**A**	3.70000*	1.20754	.009	.7941	6.6059
	C	3.75000*	1.20754	.008	.8441	6.6559
C	**A**	-.05000	1.20754	.999	-2.9559	2.8559
	B	-3.75000*	1.20754	.008	-6.6559	-.8441

Table 7 shows multiple comparison of WOMAC among different interventional groups. The mean difference was calculated which indicated a statistically significant difference in WOMAC between group B with both groups A as well as C.

Discussion:-

The present study was aimed to compare the effect of different doses of LASER along with conventional physiotherapy in patient with Knee Osteoarthritis. The study compared the effects of 2 weeks of different dose of LASER application in patient with knee osteoarthritis.

The findings of the present study indicate that statistically significant improvement in VAS, WOMAC and range of motion of flexion of both knees was noticed in all the three groups indicating that different doses of laser used in the study produced beneficial effect in all the three groups.

This result of betterment in pain score can be attributed to the fact that with application of LASER, there is an increase in serotonin (5-HT) levels. Serotonin acts as a chemical messenger that transmits nerve signals between nerve cells. There are also increases in Beta Endorphins, which decrease pain sensation. These increases can act to abolish pain at the receptor site (Pryor, 2011).

Another probable mechanism by which there is improvement in pain is that Nitric Oxide, which is critical for normal action potential in impulse transmission activity in nerve cell is also increased upon laser stimulation. Nitric oxide also has an effect on vasodilatation which enhances oxygenation. Other possible mechanism is that Bradykinins which can be prevalent in injured tissue induce pain sensation by stimulating nociceptive afferents. Laser therapy has been shown to decrease these peptides reducing pain levels. Therapeutic lasers can suppress the excitation of C - fibres, particularly in low velocity neural pathways from nociceptors. LASER application can also lead to increase in nerve cell action potential which gets reduced by injury or trauma. All of these proven cellular responses contribute to pain relief upon therapeutic laser treatment (Pryor, 2011).

The improvement in quality of life and range of motion are also probably related to the beneficial effect of laser on pain in patients with knee OA.

The finding of improvement of clinical symptoms in knee osteoarthritis is supported by the findings of numerous previous studies where the authors have also concluded beneficial effect of laser in knee OA on pain (Gur, et al., 2003; Rayegani, et al., 2012), quality of life (Alghadir, et al., 2014; Soleimanpour, et al., 2014) and ROM (Trelles, et al., 1991; Konstantinovic, et al., 2010).

The findings of beneficial effect of laser in patients of knee OA is not supported by the findings of Basirnia, et al., 1998 and Tascioglu, et al., 2004, where the authors concluded statistically non-significant improvement in pain, range of motion and quality of life in patients of knee OA.

The results of ANOVA showed statistically significant difference of VAS and WOMAC among different groups. The findings of post hoc analysis using Tukey's HSD test showed that the mean difference of VAS as well as WOMAC of group receiving 5 J/cm^2 was statistically significantly different from groups receiving 3 and 4 J/cm^2 dose of laser.

It is clear from the results and above discussion that though statistically result came out to be significant in all the age groups, but clinically more improvement was noticed in patients receiving laser dose of 5 J/cm^2 than the subjects receiving 4 J/cm^2 and 3 J/cm^2.
Hence it shows that low level laser therapy improves the knee range of motion, decreases pain and helps the patients to perform their ADL's with minimal discomfort and thus making them more functionally independent and improves their quality of life. Therefore, it is recommended that increased use of laser should be inculcated in the clinical practice for the betterment of patients with knee OA.

The present study has few limitations. Firstly, the present study was having small sample size. Secondly, the patient's medication status was not monitored. Lastly, long term follow-up of patients was not obtained.

Conclusion:-

Though statistically the results came out to be significant in all the three groups but clinically more improvement was noticed in group B than in other groups. More studies are required to establish the dose used in group B i.e. 5J/cm^2.

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Conflict of Interest:-
None

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None

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