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INCAPACITATING DEGENERATION- Testing the efficacy of Laser therapy in comparison with Phonophoresis along with Quadriceps Strengthening Exercise in patients with Knee Osteoarthritis

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ABSTRACT

BACKGROUND: Knee osteoarthritis (OA) also known as degenerative joint disease of the knee is typically the result of wear and tear and progressive loss of articular cartilage. It is the most common in the elderly.

AIM: The aim of the study is to compare the effect of LASER therapy versus Phonophoresis along with quadriceps strengthening exercise in patients with knee Osteoarthritis.

METHODOLOGY: This was a cohort. study which took place between 6 to 8 weeks at ACS medical college and hospital. 50 samples were chosen by simple random sampling method.

RESULTS: On comparing Pretest and Post test within Group A & Group B on vas score, WOMAC Score and knee flexion ROM Score shows significant difference in the mean values at P ≤0.05.

CONCLUSION: This study revealed that there is more significant difference in LASER therapy along with quadriceps strengthening exercise is effective when compared to Phonophoresis along with quadriceps strengthening exercise on subjects with knee osteoarthritis. On comparing the mean values there is a significant improvement in reducing pain and ROM in patients with knee osteoarthritis.

Keywords: degenerative diseases, osteoarthritis, muscle strengthening exercises.

INTRODUCTION:

Knee osteoarthritis also known as degenerative joint disease, is typically the result of wear and tear and progressive loss of articular cartilage most common in the elderly. Knee osteoarthritis can be divided into 2 types-primary and secondary. Primary osteoarthritis is the articular degeneration without any apparent underlying reason, secondary osteoarthritis is the consequence of either an abnormal concentration of forces across the joint as with post-traumatic causes or abnormal articular cartilage such as rheumatoid arthritis (RA). Osteoarthritis is typically a progressive disease that may eventually lead to disability. The intensity of the clinical symptoms may vary for each individual[1&2]. Knee osteoarthritis is the most common type of arthritis diagnosed and its prevalence will continue to increase as life expectancy and obesity rises. Depending on the source 13% of women and 10% of men 60 years and older have symptomatic knee osteoarthritis. Among those older than 70 years of age the prevalence raises to as high as 40%, the prevalence of knee osteoarthritis in males is also lower than in female. Interestingly not everyone who demonstrates radiographic findings of knee osteoarthritis will be asymptomatic. One study found that only 15% of patients with radiographic findings of knee osteoarthritis were symptomatic. Not factoring in age, 240 cases per 100,000 people per year[3&4]. Correspondingly there are around (95% CI, 565.6-745.6) million individuals (40 years and older) with osteoarthritis in 2020 worldwide. In India it is the most prevalent joint disease with prevalence of 22% to 39% [5]. Knee osteoarthritis is classified as either primary or secondary, depending on its cause. Primary knee osteoarthritis is the result of articular cartilage degeneration without any known reason. This is typically thought of as degeneration due to age as well as wear and tear. Secondary knee osteoarthritis is the result of articular

cartilage degeneration due to known reason such as post traumatic, post-surgical, congenital or malformation of limb etc. The modifiable risk factors of knee osteoarthritis are articular trauma, occupation - prolonged standing and repetitive knee bending, muscle weakness or imbalance, & health – metabolic syndrome. The non-modifiable risk factors are gender-females more common than males, age, genetics & race. Although knee osteoarthritis is closely correlated with aging, it is important to note that knee osteoarthritis is not simply a consequence of aging but rather its own disease. This is supported by the difference seen in cartilage with both osteoarthritis and aging. Furthermore, the enzymes responsible for cartilage degeneration are expressed in higher amounts in knee osteoarthritis where as they are at normal level in the normal aging cartilage [7].

Phonophoresis is defined as the movement of drugs through skin into the subcutaneous tissue under the influence of ultrasound, it is also called as sonophoresis or ultra sonophoresis. The administration of nonsteroidal anti-inflammatory drugs by Phonophoresis is used to relieve pain hence phonophoresis plays a major role in pain relief. Phonophoresis has improved drug delivery by increasing cell permeability, enhancing drug diffusion through increased particle oscillations within the tissue and inducing drug molecule motion through radiation pressure forces. These lead to intercellular diffusion of drug molecules along with vibration of the cell membrane and its component from high-speed vibration. Anti-inflammatory and local anesthetic agents are applied in the form of phonophoresis aiming for management of pain and inflammation in the musculoskeletal conditions such as epicondylitis tendonitis, tenosynovitis and osteoarthritis[8&2]. The word LASER refers to the production of a beam of a radiation which differs from the ordinary light in several ways[9]. LASER is its effect on prostaglandin synthesis and thus it relieves inflammation. LASER is found to very effective in the healing of the connective tissues and thus it effective in the treatment of various arthritic conditions[9]. The European league against Rheumatism (EULAR) suggest that low level LASER therapy and exercises should be considered when planning optimal treatment for osteoarthritis. Indeed, low level LASER therapy induces photo chemical physiological actions in living tissues at the cellular level. Some of these effects includes cellular oxygenation, release of neurotransmitters associated with pain modulation and release of anti-inflammatory, endogenous mediators. Nonetheless, the clinical efficacy of low-level LASER therapy in the treatment of osteoarthritis is still debatable, while some authors have reported pain relief. These discrepancies may be associated with the parameters (wavelength, dose, time, area, technique) used in the treatment by different studies. Thus, it is necessary to define which parameter should be used to achieve optimum therapeutic response in patients with osteoarthritis.[9] Quadriceps strengthening exercises is effective in improving pain. Function & quality of life of patients with knee osteoarthritis. Quadriceps muscle weakness has been suggested to be a risk factor for the development of knee osteoarthritis[10&11] and previous studies revealed improvements in the relief of joint pain and stiffness and in improving QOL in patients with knee osteoarthritis by strengthening quadriceps muscle[12&13]. An isometric or static muscle contraction is defined as sustained muscle recruitment and activity with an increase in tension, that is accompanied by no change in the joint angle[14]. Thus, the act of incorporating an isometric training activity could be performed with minimal cost & advanced equipment compared to other strength training program. Isometric exercise is reported as a simple, safe and easily preformed exercise type which helps to accelerate the improvement of strength in muscles[15].

AIM OF THE STUDY

The aim of the study is to compare the effect of LASER therapy versus phonophoresis along with quadriceps strengthening exercise in patients with knee osteoarthritis.

METHODOLOGY

Study design**:** Cohort study
Study duration**:** 6 to 8 weeks
Study setting**:** ACS medical College and Hospital.
Sample size**:** 50 sample
Sampling method**:** Simple random sampling.

Inclusion criteria:

- Subjects with age group of 45 to 55
- Both male and female subjects
- Vas score above 6
- Pain during walking and limited ROM
- OA grade – grade 2 and 3

Exclusion criteria:

- Those who are not willing to participate
- Recent fracture
- Any recent history of knee injury

- Recent total knee replacement
- Instability or dislocation of the knee joint after total knee arthroplasty.

MEASUREMENT TOOL

- WOMAC (Western Ontario and McMaster Universities Osteoarthritis index)
- VAS (Visual Analogue Scale)
- Knee ROM using goniometer

PROCEDURE

The IRB (Institutional Review Board) approval was obtained. The subjects were selected on the basis of inclusion criteria and informed consent were obtained. After receiving informed consent demographic data were collected and based on the random sampling method the subjects were divided into 2 groups. Each group consists of 25 subjects. Group A were given LASER therapy along with quadriceps strengthening exercise for 5 days a week for 3 weeks duration, and Group B were given phonophoresis along with quadriceps strengthening exercise for 5 days a week for 3 weeks duration.

Isometric quadriceps strengthening:

Ask patient to lay in a supine position, then a rolled-up towel was put beneath the knee. The patients were instructed to maximally activate their thigh muscles press towards the rolled-up towel in order to straighten the knee and hold the contraction for 10 -15 sec for 10 repetitions per session.

FIG 1 ISOMETRIC QUADRICEPS STRENGTHENING

FIG 2 LASER THERAPY

PHONOPHORESIS :

Phonophoresis was given using diclofenac drug . For the continuous form, the maximum application period was 3 to 4 sessions per week for 4 weeks. The frequency used was 1MHZ with the intensity ranging from 1 to 2 W/Cm^2. The therapy application time ranged from 5 to 7 mins per session .

FIG 3: PHONOPHORESIS

FIG 4 GONIOMETER

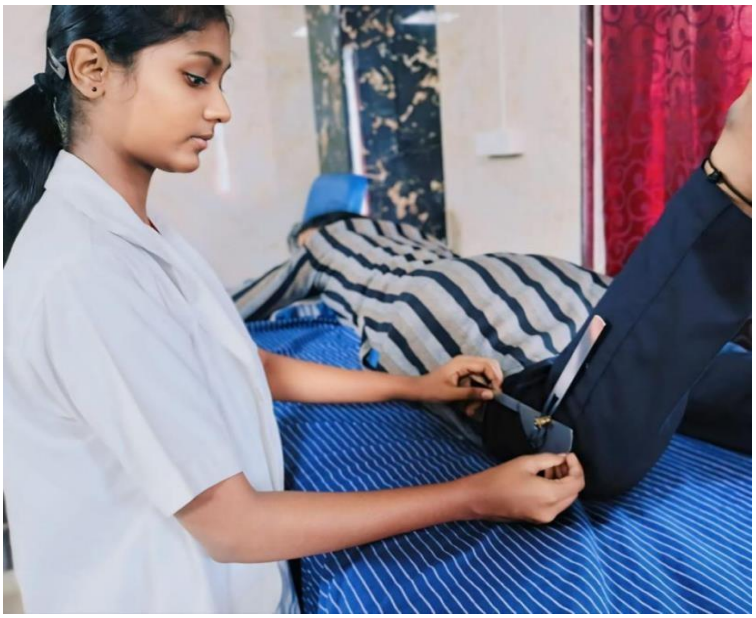


FIG 5 MATERIALS USED

RESULTS:

The collected data was tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS) version 24, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data. In this study, Shapiro Wilk test showed that the data was normally distributed on the dependent values at P > 0.05. Hence parametric test was adopted. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

On comparing the mean values of Group A & Group B on VAS Score, it shows a significant decrease in the post test mean values in both groups, but (Group) shows

4.72 ± 737 which has the lower mean value is more effective than (Group B) 5.76 ± 723 at P ≤0.05 Hence the null hypothesis is rejected.

On comparing Pretest and Post test within Group A & Group B on vas score, WOMAC Score and knee flexion ROM Score shows significant difference in the mean values at P ≤0.05.

TABLE-1 COMPARISON OF VAS SCORE BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST

TEST	GROUP - A		GROUP - B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	6.64	.700	6.76	.723	-.596	48	.554*
POST TEST	4.72	.737	5.76	.723	-5.03	48	.001**

(*- P > 0.05 - Not Significant) & (- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom (df) and p-value between Group A & Group B in pre test and post test.

This table shows that there is no significant difference in pre test values between Group A & Group B at P > 0.05The above table shows that statistically significant difference in post test values between Group A & Group B at P ≤ 0.05

GRAPH – I COMPARISON OF VAS SCORE BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST

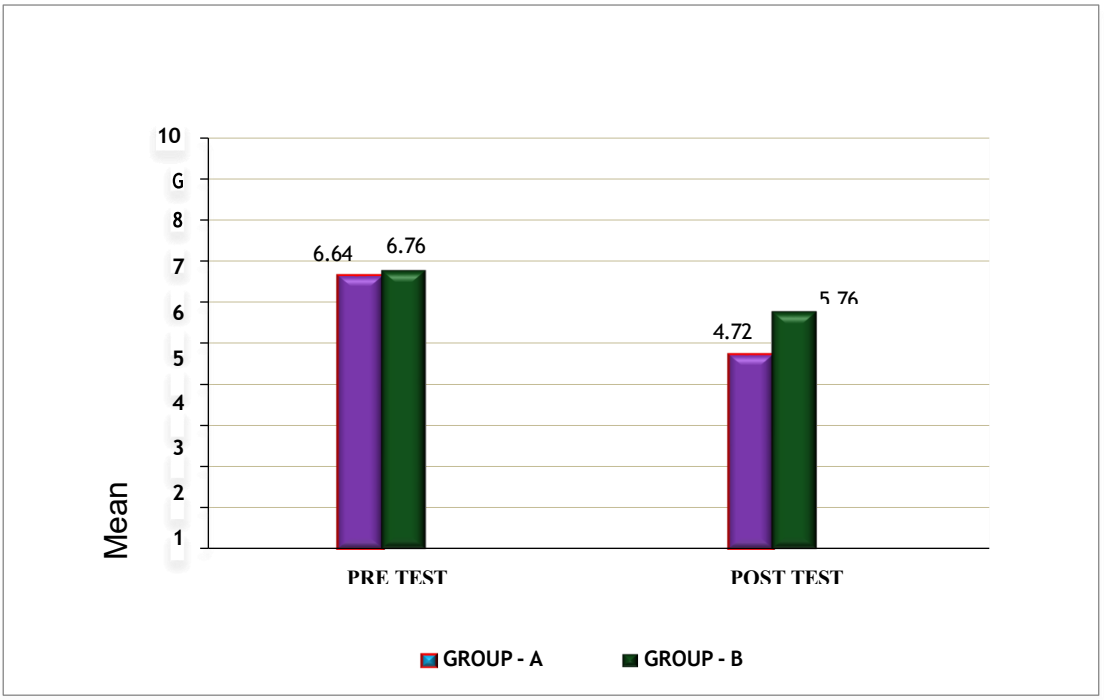
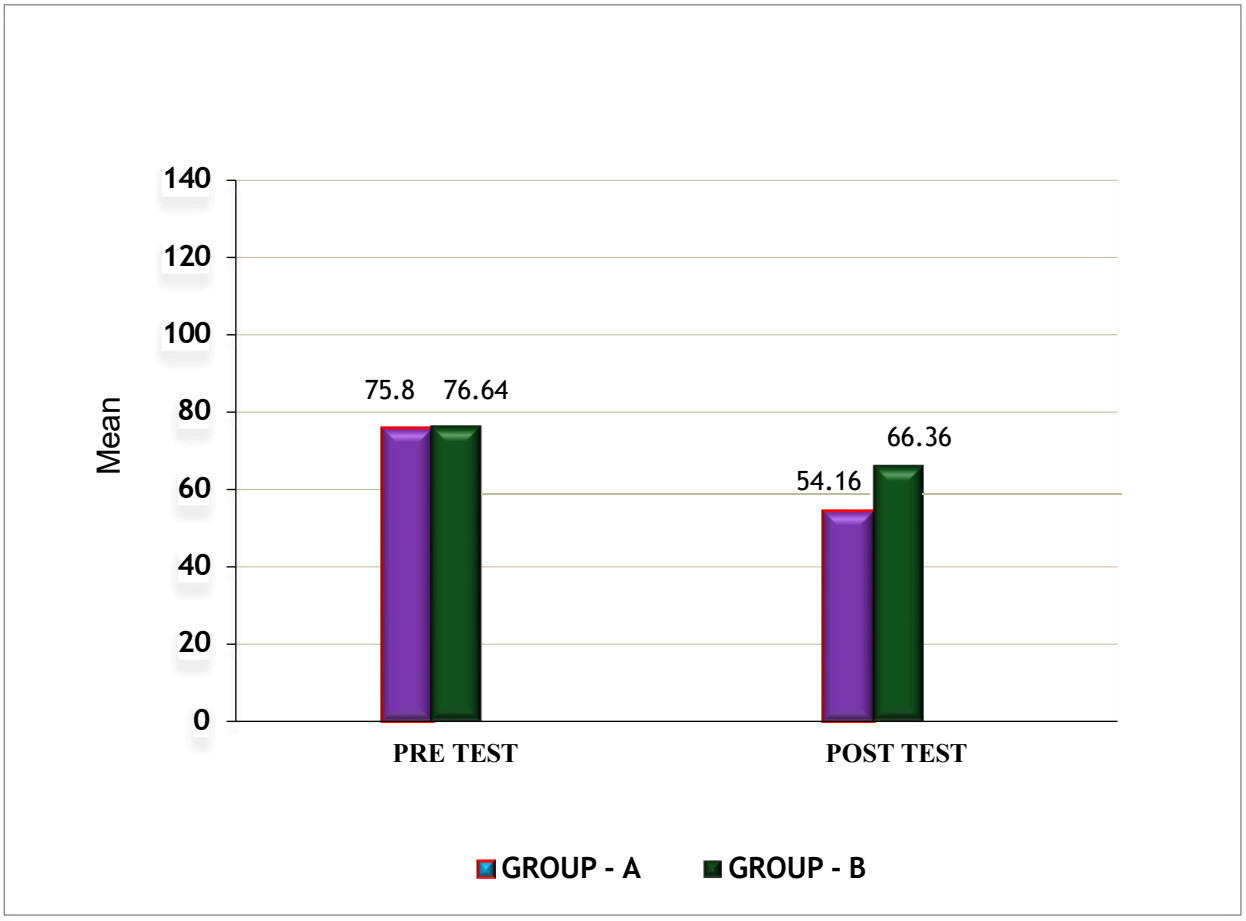


TABLE - 2: COMPARISON OF WOMAC SCORE BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST

TEST	GROUP - A		GROUP - B		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	75.80	5.00	76.64	6.36	-.519	48	.606*
POST TEST	54.16	5.98	66.36	7.14	-6.54	48	.001**

(*- P > 0.05 - Not Significant) & (- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom (df) and p-value between Group A & Group B in pretest and posttest.
This table shows that there is no significant difference in pre-t est values between Group A & Group B at P > 0.05
The above table shows that statistically significant difference in posttest values between Group A & Group B at P ≤ 0.05.



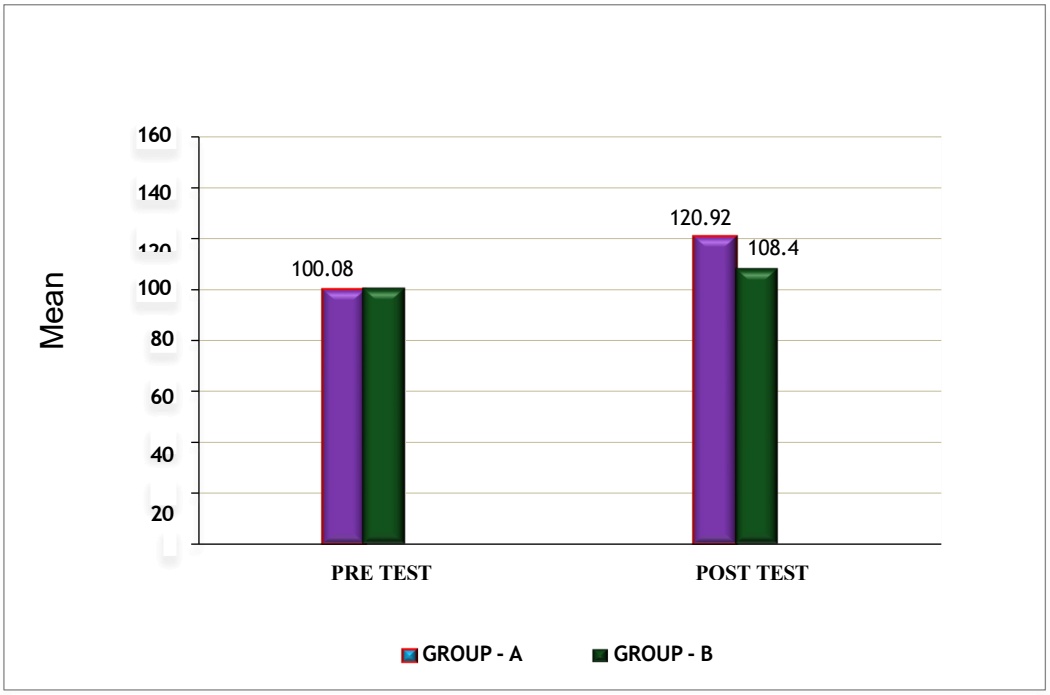
GRAPH – II COMPARISON OF WOMAC SCORE BETWEEN GROUP – A AND GROUP - B IN PRE AND POST TEST

TABLE – 3: COMPARISON OF KNEE FLEXION ROM BETWEEN GROUP – A AND GROUP- B IN PRE AND POST TEST

TEST	**GROUP - A**		**GROUP - B**		t - TEST	df	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	100.08	3.99	100.68	3.77	-.553	48	.583*
POST TEST	120.92	7.29	108.40	5.66	6.78	48	.001**

(*- P > 0.05 - Not Significant) & (- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom (df) and p-value between Group A & Group B in pre test and post test.
This table shows that there is no significant difference in pre test values between Group A & Group B at P > 0.05
The above table shows that statistically significant difference in post test values between Group A & Group B at P ≤ 0.05.



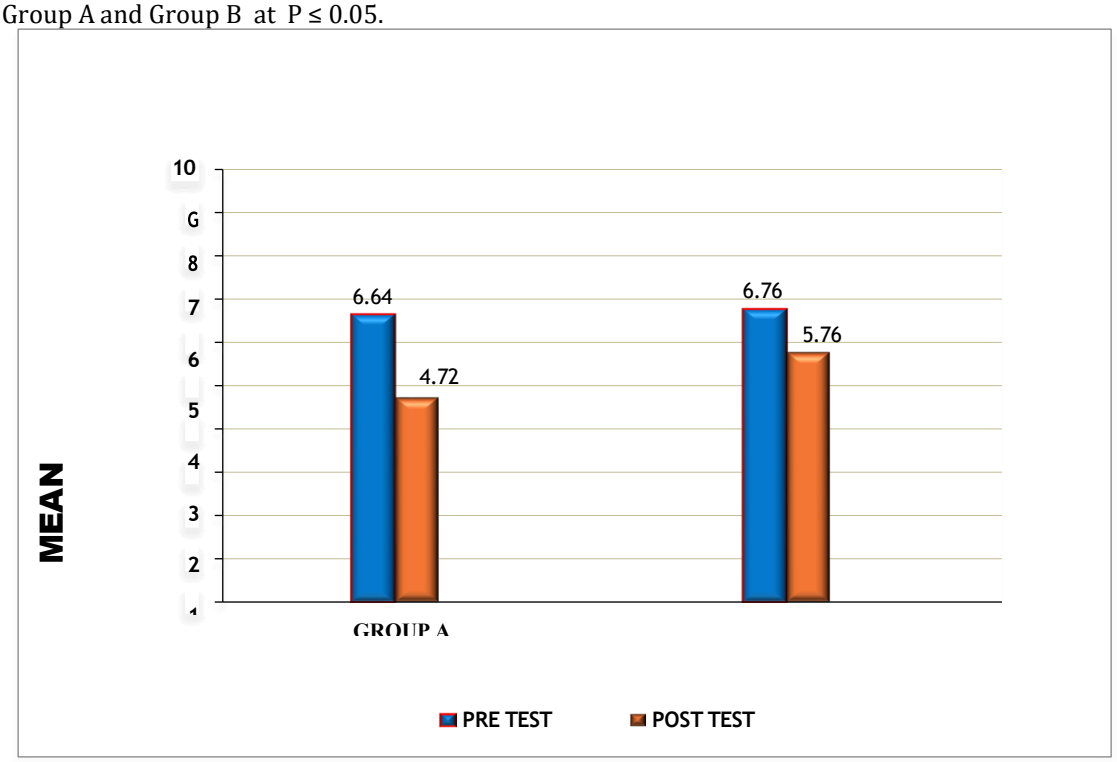
GRAPH – III COMPARISON OF KNEE FLEXION ROM BETWEEN GROUP – A AND GROUP- B IN PRE AND POST TEST

TABLE- 4 COMPARISON OF VAS SCORE WITHIN GROUP – A AND GROUP - B BETWEEN PRE TEST AND POST TEST

GROUPS	PRE TEST		POST TEST		t - TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
GROUP- A	6.64	.700	4.72	.737	19.46	.000**
GROUP- B	6.76	.723	5.76	.723	-10.01	.000**

(- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value between pre-test and post-test within Group – A & Group – B. There is a statistically significant difference between the pre test and post test values within Group A and Group B at P ≤ 0.05.



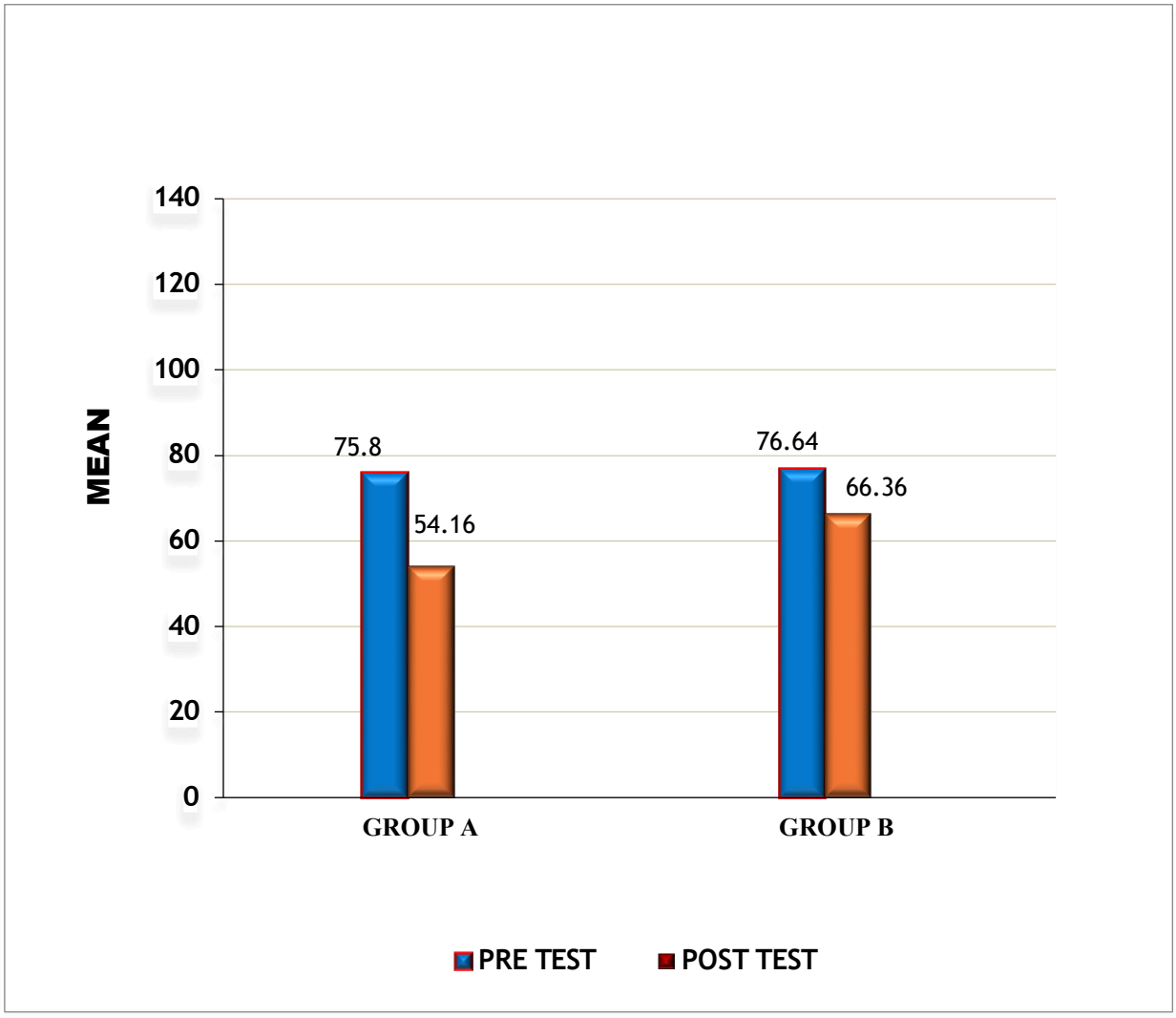
GRAPH – IV COMPARISON OF VAS SCORE WITHIN GROUP – A AND GROUP - B BETWEEN PRE TEST AND POST TEST

TABLE – 5 COMPARISON OF WOMAC SCORE WITHIN GROUP – A AND GROUP - B BETWEEN PRE TEST AND POST TEST

GROUPS	PRE TEST		POST TEST		t - TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
GROUP- A	75.80	5.00	54.16	5.98	-14.42	.000**
GROUP- B	76.64	6.36	66.36	7.14	15.18	.000**

(- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value between pre-test and post-test within Group – A & Group – B.
There is a statistically significant difference between the pretest and posttest values within Group A and Group B at P ≤ 0.05.



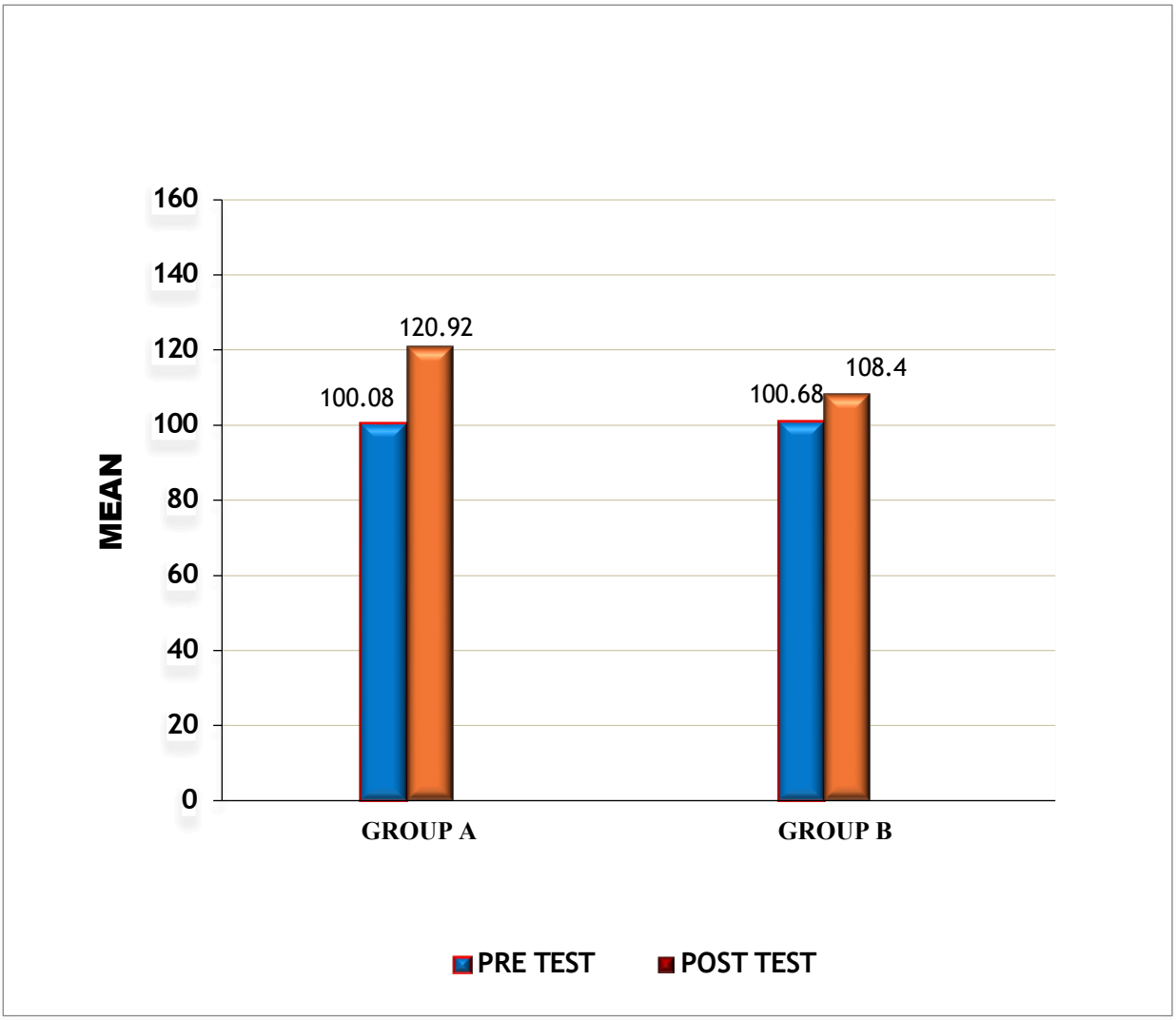
GRAPH – V COMPARISON OF WOMAC SCORE WITHIN GROUP – A AND GROUP - B BETWEEN PRE TEST AND POST TEST

TABLE – 6 COMPARISON OF KNEE FLEXION ROM WITHIN GROUP – A AND GROUP - B BETWEEN PRE TEST AND POST TEST

GROUPS	PRE TEST		POST TEST		t - TEST	SIGNIFICANCE
	MEAN	S.D	MEAN	S.D		
GROUP- A	100.08	3.99	120.92	7.29	15.59	.000**
GROUP- B	100.68	3.77	108.40	5.66	- 7.49	.000**

(- P ≤ 0.05 - Significant).**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value between pre-test and post-test within Group – A & Group – B.
There is a statistically significant difference between the pre test and post test values within Group A and Group B at $P \leq 0.05$.



GRAPH – VI COMPARISON OF KNEE FLEXION ROM WITHIN GROUP – A AND GROUP - B BETWEEN PRE TEST AND POST TEST

DISCUSSION

OA knee is the most common degenerative disease and knee is one of the common joint affected. It dominantly affects the elderly patients where the females are more affected than males. The symptoms are often associated with significant functional impairment as well as signs and symptoms of inflammation including pain, stiffness and loss of mobility thus, this study compared the effects of LASER therapy and Phonophoresis along with quadriceps strengthening exercise in patients with OA knee in improving the musculoskeletal functions and promoting ease in performing ADL's.
After applying LASER therapy almost all the patients presented a gradual decrease in pain after doing the quadriceps strengthening technique after which they were able to manage their activities of daily living. The values of pre-test and post-test mean values are compared. In this study group A LASER therapy and quadriceps strengthening exercise has showed significant increase in subjects with knee OA.
From the data analysis it showed that there was statistically significant reduction in pain and significant improvement in functional movements in all dimensions seen in group B. One study conducted by **Liz Saunders** showed that LASER treatment with the dose used in this study, and improving muscle force than ultrasound or advice alone. LASER was also found to reduce pain, disability, and tenderness significantly more than advice in the treatment of supraspinatus tendinosis.
In another study conducted by **Ayse Nur Oymak Soyal, Ummuhan Bas Aslan** concluded that diclofenac Phonophoresis and therapeutic ultrasound were determined to be effective on pain, range of motion and disability

in the treatment of patients but Phonophoresis was not found to be superior to therapeutic ultrasound. Previous studies on patients with soft tissues injuries including epicondylitis, tendinitis , tenosynovitis and knee OA have also known that Phonophoresis was not superior to therapeutic ultrasound.

In the study conducted by **Marjon Mason, Susan L.Keays and Peter A.Newcombe** showed that in isolation quadriceps strengthening and stretching resulted in more improvements than taping. Quadriceps strengthening resulted in significant improvements in three of the four pain measures, as well as isokinetic strength and pain-free eccentric control. It appears that tight quadriceps especially radio frequency (RF) is very common in pattelofemoral patients and thus muscles respond rapidly to stretching with a mean 12 cm improvement in only one week, this current study reinforces the value of quadriceps stretching, varied as described to each individual.

In the study conducted by **Jan Magnus Bjordal, Christian Couppe, Anne Elisabeth Ljunggren** concluded that low-level -LASER therapy has a biological action on tendon tissue when used with power density and dose with in a suggested optimal range. There is a highly significant correlation between the suggested optimal range and successful treatment result for subacute tendinitis. Low-level - LASER therapy appears to be an effective and safe alternative in the treatment of subacute tendinopathy if location specific dose and a valid treatment procedure is used.

In another study conducted by **Ferdi Yavuz, Iltekin Duman, Mehmet Ali Taskaynatan and Arif Kenan Tan** shows result suggest that efficiency of both treatments were comparable to each other in regarding reducing pain severity and functional disability in patients with subacromial impingement syndrome. Based on our findings, we concluded that low-level -LASER therapy may be considered as an effective alternative to ultrasound-based therapy in patients with subacromial impingement syndrome. Especially ultrasound-based therapy is contraindicated.

On comparing the mean values of Group A & Group B on VAS Score, it shows a significant decrease in the posttest mean values in both groups, but (Group) shows 4.72 ± 737 which has the lower mean value is more effective than (Group B) 5.76 ± 723 at P ≤0.05 Hence the null hypothesis is rejected.

On comparing Pretest and Post test within Group A & Group B on vas score, WOMAC Score and knee flexion ROM Score shows significant difference in the mean values at P ≤0.05.

From the data analysis it showed that there was statistically significant reduction in pain and significant improvement in range of motion, functional movements of all the dimensions seen in the group A. The finding of the study would help to relieve pain and improve ROM.

These values clearly indicated that there was statistically significant improvement in LASER therapy and quadriceps strengthening exercise.

The result shows that LASER therapy and quadriceps strengthening exercise was more effective than the Phonophoresis and quadriceps strengthening exercise. Hence our data supported null hypothesis is rejected and that there is a significant difference in group A in-knee osteoarthritis.

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On comparing the Mean Values of Group A & Group B on Knee Flexion ROM Score, it shows a significant increase in the posttest mean values in both groups, but (Group – A) shows 120.92± 7.29 which has the higher mean value is more effective than (Group B) 108-40 ± 5.66 at P ≤0. 05 Hence the null hypothesis is rejected.

On comparing Pretest and Post test within Group A & Group B on vas score, WOMAC Score and knee flexion ROM Score shows significant difference in the mean values at P ≤0.05.

From the data analysis it showed that there was statistically significant reduction in pain and significant improvement in range of motion, functional movements of all the dimensions seen in the group A. The finding of the study would help to relieve pain and improve ROM.

These values clearly indicated that there was statistically significant improvement in LASER therapy and quadriceps strengthening exercise.

The result shows that LASER therapy and quadriceps strengthening exercise was more effective than the Phonophoresis and quadriceps strengthening exercise. Hence our data supported null hypothesis is rejected that there is significant difference in group A in-knee osteoarthritis.

CONCLUSION

This study revealed that there is more significant difference in LASER therapy along with quadriceps strengthening exercise which is more effective when compared to Phonophoresis along with quadriceps strengthening exercise on subjects with knee osteoarthritis.
On comparing the mean values there is a significant improvement in reducing pain and ROM in patients with knee osteoarthritis.
So, this study suggested that LASER with quadriceps strengthening exercise is effective than phonophoresis with quadriceps strengthening exercise in knee osteoarthritis patients.

LIMITATIONS OF THE STUDY:

- Small sample size
- Short duration study
- Intervention was given for 3 weeks
- No long term follow up of the subject
- Study was performed only for the age groups 45 to 55.

RECOMMENDATIONS OF THE STUDY

- Study duration should be increased
- Sample size should be increased
- Intervention should be given for longer time
- Longer follow up is recommended
- Different protocols different age groups and different intervention are used for future study

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