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## Effect of Preoperative Physiotherapy Patient Education on Early Functional Mobility of Post-Operative Total Knee Arthroplasty Subjects

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### ABSTRACT

**Objectives:** The purpose was to determine the effects of preoperative physiotherapy patient education on early functional mobility of post-operative total knee arthroplasty subjects and implementation of preoperative Total Knee Arthroplasty (TKA) programs to shorten the length of stay and post-operative complications and improve the functional status.

**Materials and methods:** In this study, we allocated subjects into experimental and controlled group. The experimental group of 15 subjects were participated in preoperative physiotherapy program which they had to perform on non-operated leg along with an educational booklet of preoperative exercises, information regarding the surgery and its complications. Later, the same exercises were to be performed on operated leg with regular post-operative program. Whereas the controlled group of the remaining 15 subjects participated only in the post-operative physiotherapy rehabilitation program.

**Results:** Statistical analysis was performed using repeated measures ANOVA and unpaired t test. VAS, ROM, WOMAC and SF-12 scores were used to evaluate the pre and post assessment. Experimental group showed a significant improvement in the functional status, reduced length of hospital stay, decreased pain and less post operative complications. The experimental group had decreased intensity of pain, increased ROM, decreased disability ( $P < 0.0001$ ) respectively and improved functional status ( $P < 0.0002$ ) than compared to the controlled group, showing no significant difference in the controlled group.

**Conclusion:** Our study concluded that preoperative physiotherapy patient education along with post-operative rehabilitation program can reduce the post-operative complications, the length of hospital stay and improve the functional status of the subjects who underwent TKA.

**Keywords:** Total knee arthroplasty; Knee osteoarthritis; Preoperative patient education, Postoperative rehabilitation; Preoperative exercises, Early functional mobility

## INTRODUCTION

Osteoarthritis (OA) is known to be a non-inflammatory degenerative disorder of joints which is excessively prevalent in middle and old age groups. It is a pathological process in which there is progressive deterioration of articular cartilage triggered by 'wear and tear' and formation of new bone (osteophytes). It is observed typically in weight-bearing joints such as hip and knee, and the predisposing factors of OA are Obesity, hormonal and genetics [1]. Prevalence being 22% to 39% in India, more than 50% of adults are diagnosed with OA knee undergo Total Knee Arthroplasty (TKA), in order to relieve pain and improve function [2]. TKA is commonly indicated to be a painful surgical procedure that is used to replace weight-bearing surface of knee joint to relieve pain and disability. It is marked severe unremitting pain, failure of conservative management in arthritic conditions, meniscal and ligament tears, and cartilage defects, in young subjects to correct their valgus or varus deformity [1]. Complications correlated with TKA are deep venous thrombosis (DVT), infection, stiffness, loosening, and osteolysis. Patients are given stockings to wear for prevention of DVT, [3]. Three types of prosthesis are used for TKA - (i) Non constrained - where the patient's ligaments and muscles are used to provide the stability for the prosthesis, (ii) Semi- constrained - where it provides some stability for the knee and does not rely entirely on the patient's ligaments and muscles to provide stability, and (iii) Constrained - for patients whose ligaments and muscles are not able to provide stability for the knee prosthesis.

According to Kellgren and Lawrence classification [4], Grade 0 - No radiologic features of OA are present, Grade 1 - there is doubtful joint space narrowing and possible osteophyte lining, Grade 2 - there are definite osteophytes and possible JSN on antero-posterior weight-bearing radiograph, Grade 3 - there are multiple osteophytes, definite JSN, sclerosis, possible bony deformities, and Grade 4 - there are large osteophytes, marked JSN, severe sclerosis and definite bony deformity. Subjects that have severe OA of Grade 3 & Grade 4 and subjects with failure of conservative management undergoing TKA can be given preoperative physiotherapy. Subjects should be educated about preoperative measures, surgery, its post-operative complications and post-operative rehabilitation. Exercise being a cornerstone of effective rehabilitation after TKA and other surgical procedures, preoperative rehabilitation could also be implicated [5-13]. Patient should be educated about the exercises, should be taught to perform on contra-lateral (non-operative) limb and then ask to perform the same exercises on the operated limb to see the effects. There are many studies proven regarding post-operative physical rehabilitation given to subjects undergoing TKA. Preoperative patient education and pain control has been studied for subjects with total hip arthroplasty but few proven studies exist for preoperative measures for TKA.

**Aim:** To investigate the effects of preoperative physiotherapy rehabilitation and education program given to non-operated leg and its effects on functional mobility of operated leg undergoing TKA.

**Objectives:** To compare the effectiveness of physiotherapy care with the patients who have undergone preoperative physiotherapy education and to test a well-defined, feasible preoperative physiotherapy training program in measures of reduction of pain and post-operative complications, reduced length of hospital stay, and improved functional status upon undergoing TKA.

**Need for the study:** The purpose of this study was to determine the effectiveness of preoperative physiotherapy patient education on functional mobility of post-operative Total Knee Arthroplasty (TKA). Post-operative recovery from TKA in lieu of the above preoperative measures is expected to be manageable and comfortable from subject purview.

## MATERIALS AND METHODOLOGY

It was randomized controlled study which was conducted in Krishna Institute of Medical Sciences. 30 subjects were divided into two groups using random sampling method. A baseline treatment of post-operative rehabilitation was given to both the groups. Group A: 15 subjects (3 males, 12 females) with planned TKA received preoperative exercise program, patient education and regular post-operative physiotherapy rehabilitation. Group B: 15 subjects (8 males, 7 females) received only post-operative rehabilitation. The patients were selected on the basis of the inclusion and exclusion criteria. A written consent was taken and the purpose and procedure of the study was explained to the subjects. Detailed musculoskeletal evaluation was conducted to screen the subjects. Age group between 50-85 years with Grade III and Grade IV OA, both males and females were included in the study. Previous TKA, dementia, Parkinson's disease, use of any prosthetic devices for lower limb, congenital knee deformities and unwillingness to attend the treatment sessions were excluded from the study.

The experimental group received a set protocol of preoperative exercises that were demonstrated and taught for the contralateral (non-operative) leg to the subjects in one session. The preoperative exercises performed were -

1. Knee isometric exercises for quadriceps and hamstrings (10-20 repetitions, 5 times/day),
2. Straight leg raises (10 sets with hold of 5-10 seconds, 5 times/day, each leg),
3. Ankle pumping exercises (5-10 min, each leg),
4. Strengthening exercises for quadriceps, hamstrings, gluteal muscles and vastus medialis oblique muscle (10-20 repetitions, 5 times/day),
5. Stretching for quadriceps and hamstrings (4 sets with hold of 30 seconds, 5 times/day),
6. Resistance exercises for hip abductors using resistance band (10-20 repetitions, 5 times/day)
7. Balance training on parallel bar and balance board

The subjects were asked to be performed for a week prior to the surgery. The patient had to recall these exercises and perform the same on the ipsilateral (operated) leg along with the regular post-operative rehabilitation routine. The effect of this treatment were assessed immediately before the surgery  $T_{(0)}$ , post operatively on Day 1  $T_{(1)}$ , week 1  $T_{(2)}$  and week 4  $T_{(3)}$  [6]. All the contents were designed in an educational booklet and were provided to the experimental group after the educational session given by the therapist. The educational booklet included information on preoperative physiotherapy measures, preparing the subject for the surgery, about the surgical procedure, its post-operative rehabilitation and preventing post operative complications. Patients in the experimental group received preoperative exercises and patient education 1 week prior to the surgery and a follow-up was taken over a telephonic interview. The controlled group was not given any preoperative measures prior to the TKA. They only received rehabilitation. The baseline data were obtained from both the groups using VAS, ROM, WOMAC and SF-12 scales as outcome measures to assess the values and progression [14-19].

### Outcome Measures

Visual Analog Scale (VAS) - intragroup comparison (within group) using repeated ANOVA test

	VAS					
	$T_{(0)}$	$T_{(1)}$	$T_{(2)}$	$T_{(3)}$	P VALUE	F VALUE

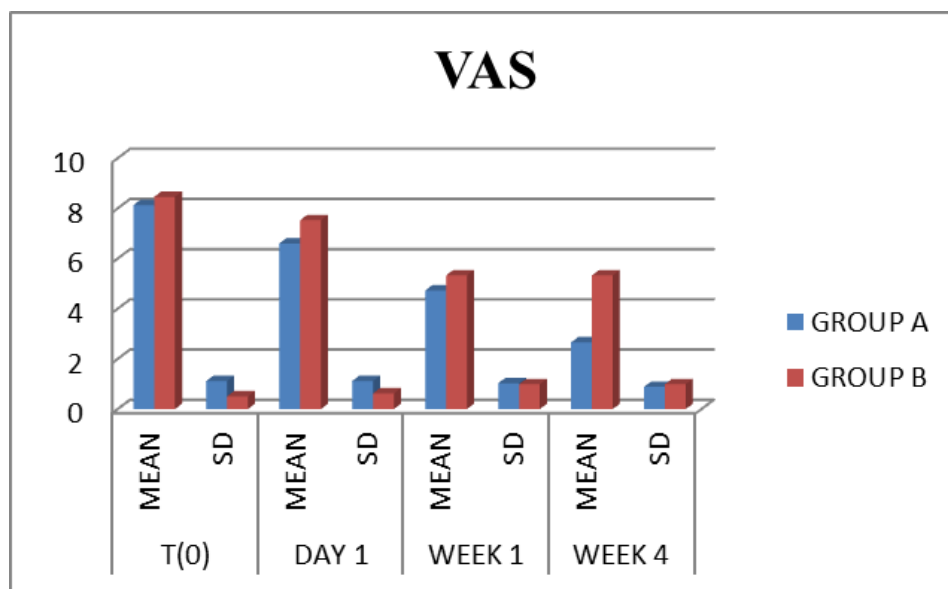
<b>GROUP A</b>	8.13 ± 1.12	6.6 ± 1.12	4.73 ± 1.03	2.66 ± 0.89	P < 0.0001	248.34
					P < 0.0001	258.05
<b>GROUP B</b>	8.46 ± 0.51	7.53 ± 0.63	5.33 ± 0.99	5.33 ± 0.99	P < 0.0001	164.87
					P < 0.0001	109.37

**Table 1:** Comparison of pre and post VAS scores within the group

Table 1 shows the comparison of mean and standard deviation of pre and post values of Group A and B.

In Group A, the mean VAS score on pre intervention was  $8.13 \pm 1.12$ , which was reduced to  $6.6 \pm 1.12$  on day 1 post session day 1, which then reduced to a mean score of  $4.73 \pm 1.03$  on week 1 and was finally reduced to a mean score of  $2.66 \pm 0.89$  on week 4. The P value was found to be <0.0001 which was extremely significant.

In Group B, the mean VAS score on pre intervention was  $8.46 \pm 0.51$  which was reduced to a mean score of  $7.53 \pm 0.63$  on post session day 1, which then reduced to a mean score of  $5.33 \pm 0.99$  on week 1 and remained the same on week 4. The P value was found to be <0.0001 which was extremely significant.



**Figure 1:** Comparison of pre and post VAS scores within the group. ROM - intragroup comparison (within group) using repeated ANOVA test.

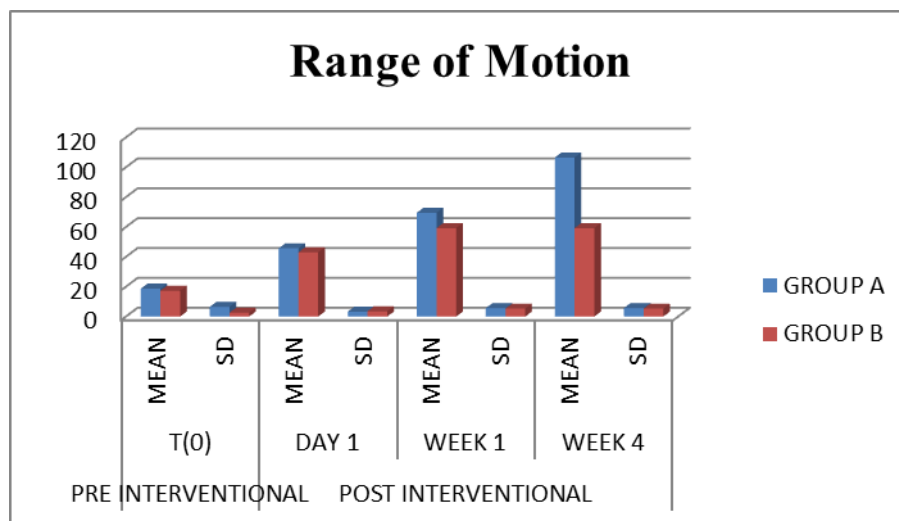
**Table 2:** Comparison of pre and post ROM scores within the group

	ROM				P VALUE	F VALUE
	PRE  (T <sub>0</sub> )	POST				
		(T <sub>1</sub> )	(T <sub>2</sub> )	(T <sub>3</sub> )		
GROUP A	18.66 ±  6.52	45.73 ±  3.32	69.53 ±  5.68	106.53 ±  5.68	P < 0.0001	910.08
GROUP B	17.33 ±  2.55	43.06 ±  3.57	59.26 ±  5.53	59.26 ±  5.53	P < 0.0001	656.57

Table 2 shows the comparison of mean and standard deviation of pre and post values of Group A and B.

In Group A, the mean ROM score on pre intervention was  $18.66 \pm 6.52$  which was increased to a mean score of  $45.73 \pm 3.32$  post session on day 1, which was then increased to a mean score of  $69.53 \pm 5.68$  on week 1 and was then finally increased to a mean score of  $106.53 \pm 5.68$  on week 4. The P value was found to be <0.0001 which was extremely significant.

In Group B, the mean ROM score on pre intervention was  $17.33 \pm 2.55$  which was reduced to a mean score of  $43.06 \pm 3.57$  post intervention on day 1, which was then, increased to a mean score of  $59.26 \pm 5.53$  and was then finally increased to a mean score of  $59.26 \pm 5.53$ . The P value was found to be <0.0001 which was extremely significant.

**Figure 2:** Comparison of pre and post ROM scores within the group

WOMAC - intragroup comparison (within group) using repeated ANOVA test.

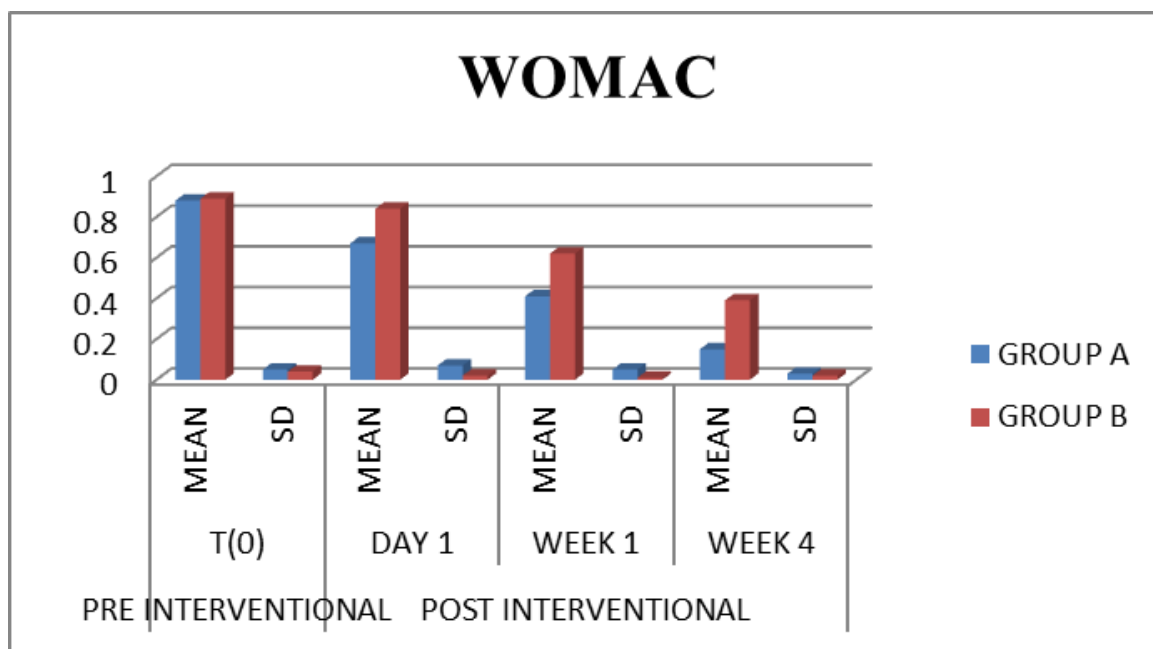
	WOMAC				P VALUE	F VALUE
	PRE (T <sub>0</sub> )	POST				
		(T <sub>1</sub> )	(T <sub>2</sub> )	(T <sub>3</sub> )		
GROUP A	0.88 ± 0.05	0.67 ± 0.07	0.41 ± 0.05	0.15 ± 0.03	P < 0.0001	572.75
GROUP B	0.89 ± 0.04	0.84 ± 0.02	0.62 ± 0.01	0.39 ± 0.02	P < 0.0001	1038.6

**Table 3:** Comparison of pre and post WOMAC scores within the group

Table 3 shows the comparison of mean and standard deviation of pre and post values of Group A and B.

In Group A, the mean WOMAC score on pre intervention was  $0.88 \pm 0.05$  which was reduced to a mean score of  $0.67 \pm 0.07$  post session on day 1, which was then, reduced to a mean score of  $0.41 \pm 0.05$  on week 1 and was then finally reduced to a mean score of  $0.15 \pm 0.03$  on week 4. The P value by was found to be <0.0001 which was extremely significant.

In Group B, the mean WOMAC score on pre intervention was  $0.89 \pm 0.04$  which was reduced to a mean score of  $0.84 \pm 0.02$  post intervention on day 1, which was then, reduced to a mean score of  $0.62 \pm 0.01$  on week 1 and was then finally reduced to a mean score of  $0.39 \pm 0.02$  on week 4. The P value was found to be <0.0001 which is extremely significant.



**Figure 3:** Comparison of pre and post WOMAC scores within the group

SF-12 - intragroup comparison (within group) using repeated ANOVA test.

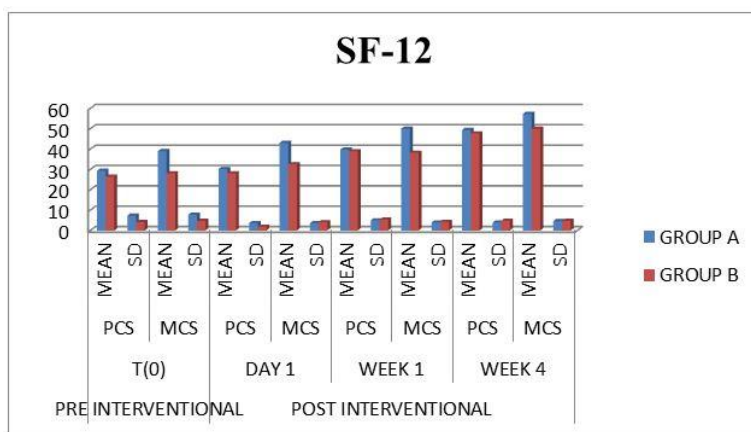
**Table 4:** Comparison of pre and post SF-12 scores within the group

	SF-12								P VALUE	F VALUE
	PRE  (T0)		POST							
			(T1)		(T2)		(T3)			
	PCS	MCS	PCS	MCS	PCS	MCS	PCS	MCS		
GROUP A	29.31 + 7.24	38.96 + 7.77	30.19 + 3.62	42.98 + 3.63	39.71 + 4.98	49.98 + 3.92	49.33 + 3.91	57.24 + 4.56	P < 0.0001	51.08
									P < 0.0001	53.28
GROUP B	26.42 + 4.14	28.06 + 4.69	28.08 + 1.80	32.50 + 4.06	38.88 + 5.33	38.15 + 4.21	47.64 + 4.81	49.93 + 4.71	P < 0.0001	105.4
									P < 0.0001	107

Table 4 shows the comparison of mean and standard deviation of pre and post values of Group A and B.

In Group A, the mean SF-12 score for PCS and MCS on pre intervention was  $29.31 \pm 7.24$  and  $38.96 \pm 7.77$  respectively, which was increased to a mean score of  $30.19 \pm 3.62$  and  $42.98 \pm 3.63$  on post session day 1, which then increased to a mean score of  $39.71 \pm 4.98$  and  $49.98 \pm 3.92$  on week 1 and was then finally increased to a mean score of  $49.33 \pm 3.91$  and of  $57.24 \pm 4.56$  on week 4. The P value was found to be <0.0001 which was extremely significant.

In Group B, the mean SF-12 score for PCS and MCS on pre intervention was  $26.42 \pm 4.14$  and  $28.06 \pm 4.69$  which was increased to a mean score of  $28.08 \pm 1.80$  and  $32.50 \pm 4.06$  on post session day 1, which then increased to a mean score of  $38.88 \pm 5.33$  and  $38.15 \pm 4.21$  on week 1 and was then finally increased to a mean score of  $47.64 \pm 4.81$  and  $49.93 \pm 4.71$ . The P value was found to be <0.0001 which was extremely significant.

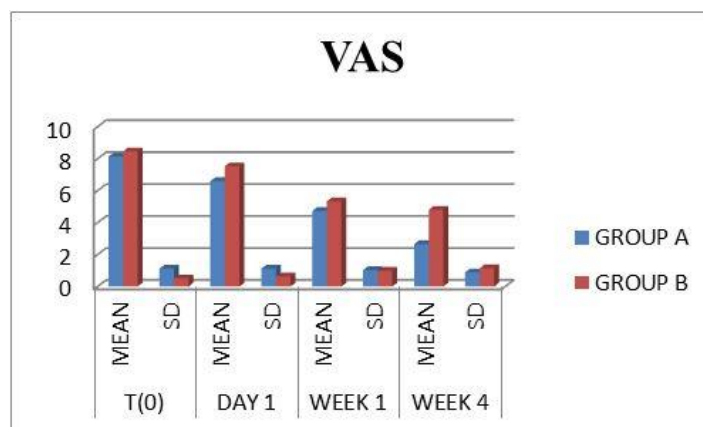
**Figure 4:** Comparison of pre and post SF-12 scores within the group

VAS - intergroup comparison (between groups) using unpaired t test.

**Table 5:** Comparison of pre and post-VAS scores between the groups

	VAS			
	T <sub>(0)</sub>	T <sub>(1)</sub>	T <sub>(2)</sub>	T <sub>(3)</sub>
<b>GROUP A</b>	8.13 ± 1.12	6.6 ± 1.12	4.73 ± 1.03	2.66 ± 0.89
<b>GROUP B</b>	8.46 ± 0.51	7.53 ± 0.63	5.33 ± 0.99	4.8 ± 1.14
<b>P VALUE</b>	0.3121	0.0104	0.1154	0.0001
<b>T VALUE</b>	1.039	2.803	1.627	5.332

Table 5 shows the inter-group comparison of VAS scores. Analysis was done using Unpaired 't' test. The t values for VAS on T<sub>(0)</sub> for group A and B was 1.039, on T<sub>(1)</sub> was 2.803, on T<sub>(2)</sub> was 1.627, and on T<sub>(3)</sub> was 5.332 respectively. The p value for VAS on T<sub>(0)</sub> for group A and B was 0.3121, on T<sub>(1)</sub> was 0.0104, on T<sub>(2)</sub> was 0.1154 and on T<sub>(3)</sub> was 0.0001. It indicates that preoperative program along with post-operative rehabilitation is extremely significant in reducing the pain in subjects that underwent TKA.

**Figure 5:** Comparison of pre and post-VAS scores between the groups

ROM - intergroup comparison (between groups) using unpaired t test.

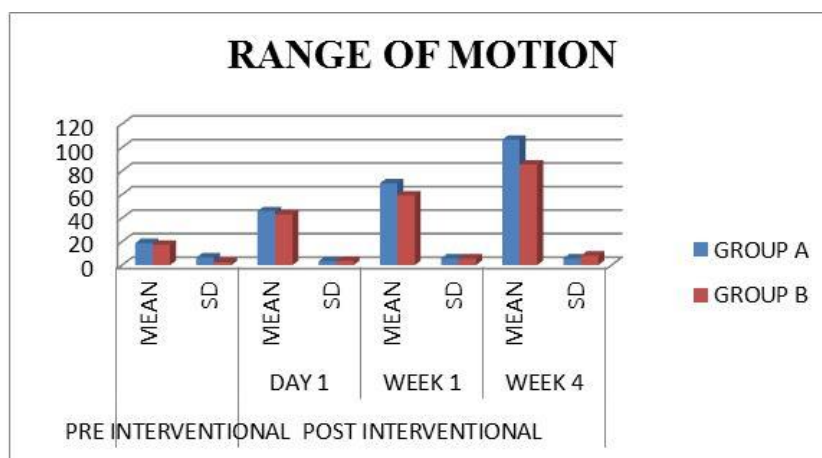
**Table 6:** Comparison of pre-pre and post-post ROM scores between the groups

	ROM			
	PRE	POST		
	(T <sub>0</sub> )	(T <sub>1</sub> )	(T <sub>2</sub> )	(T <sub>3</sub> )



<b>GROUP A</b>	18.66 ± 6.52	45.73 ± 3.32	69.53 ± 5.68	106.53 ± 5.68
<b>GROUP B</b>	17.33 ± 2.55	43.06 ± 3.57	59.26 ± 5.53	85.53 ± 8.01
<b>P VALUE</b>	0.4714	0.0432	0.0001	0.0001
<b>T VALUE</b>	0.7358	2.121	5.017	8.283

This table shows the inter-group comparison of scores. Analysis was done using Unpaired 't' test. The t values for ROM on T<sub>(0)</sub> for group A and B was 0.7358, on T<sub>(1)</sub> was 2.121, on T<sub>(2)</sub> was 5.017 and on T<sub>(3)</sub> was 8.283. The p value for ROM on T<sub>(0)</sub> for group A and B was 0.4714, on T<sub>(1)</sub> was 0.0432, on T<sub>(2)</sub>, and T<sub>(3)</sub> was 0.0001 respectively. It indicates that preoperative program along with post-operative rehabilitation is extremely significant in increasing the ROM in subjects that underwent TKA.



**Figure 6:** Comparison of pre-pre and post-post ROM scores between the groups

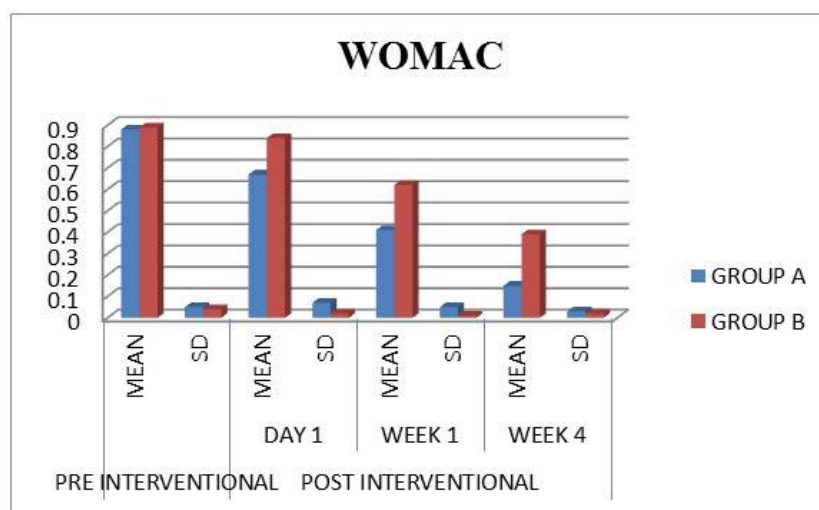
WOMAC - intergroup comparison (between groups) using unpaired t test.

**Table 7:** Comparison of pre-pre and post-post WOMAC scores between the groups

	WOMAC			
	PRE	POST		
	(T <sub>0</sub> )	(T <sub>1</sub> )	(T <sub>2</sub> )	(T <sub>3</sub> )
<b>GROUP A</b>	0.88 ± 0.05	0.67 ± 0.07	0.41 ± 0.05	0.15 ± 0.03
<b>GROUP B</b>	0.89 ± 0.04	0.84 ± 0.02	0.62 ± 0.01	0.39 ± 0.02
<b>P VALUE</b>	0.5505	0.016	0.0001	0.0001

<b>T VALUE</b>	0.5506	2.739	15.951	25.78
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This table shows the inter-group comparison of scores. Analysis was done using Unpaired 't' test. The t values for WOMAC on  $T_{(0)}$  for group A and B was 0.5506, on  $T_{(1)}$  was 2.739, on  $T_{(2)}$  was 15.951, and on  $T_{(3)}$  was 25.780. The p value for WOMAC on  $T_{(0)}$  for group A and B was 0.5505, on  $T_{(1)}$  was 0.0160, on  $T_{(2)}$  and  $T_{(3)}$  was 0.0001 respectively. It indicates that preoperative program along with post-operative rehabilitation is extremely significant in reducing the disability and improving their activities of daily living in subjects that underwent TKA.



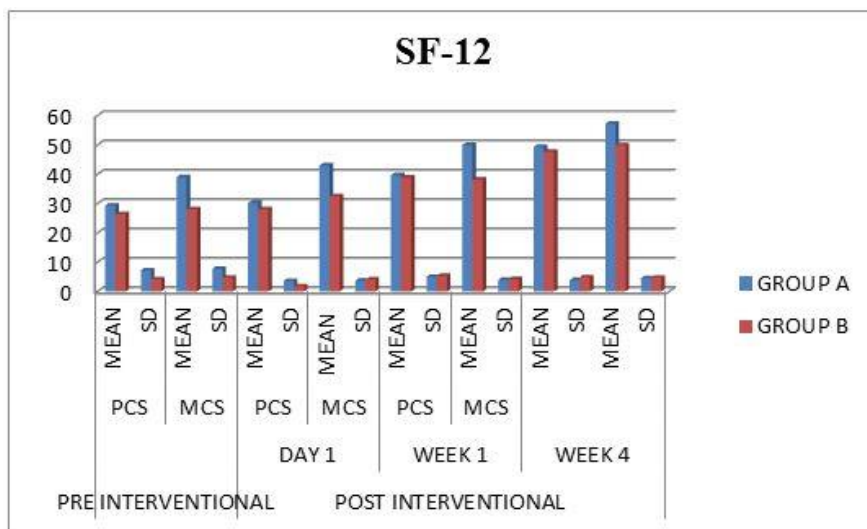
**Figure 7:** Comparison of pre-pre and post-post WOMAC scores between the groups.

SF-12 - intergroup comparison (between groups) using unpaired t test.

**Table 8:** Comparison of pre-pre and post-post SF-12 scores between the groups

	SF-12							
	PRE		POST					
	$(T_0)$		$(T_1)$		$(T_2)$		$(T_3)$	
	PCS	MCS	PCS	MCS	PCS	MCS	PCS	MCS
<b>GROUP A</b>	29.31 ± 7.24	38.96 ± 7.77	30.19 ± 3.62	42.98 ± 3.63	39.71 ± 4.98	49.98 ± 3.92	49.33 ± 3.91	57.24 ± 4.56
<b>GROUP B</b>	26.42 ± 4.14	28.06 ± 4.69	28.08 ± 1.80	32.50 ± 4.06	38.88 ± 5.33	38.15 ± 4.21	47.64 ± 4.81	49.93 ± 4.71
<b>P VALUE</b>	0.1933	0.0001	0.0568	0.0001	0.6629	0.0001	0.3007	0.0002
<b>T VALUE</b>	1.342	4.651	2.021	7.453	0.4407	7.965	1.056	4.319

This table shows the inter-group comparison of scores. Analysis was done using Unpaired 't' test. The t values for SF-12 on PCS and MCS on  $T_{(0)}$  for group A and B were 1.342 and 4.651 respectively, on  $T_{(1)}$  were 2.021 and 7.453, on  $T_{(2)}$  were 0.4407 and 7.965 and on  $T_{(3)}$  were 1.056 and 4.319 respectively. The p value for SF-12 on PCS and MCS on  $T_{(0)}$  for group A and B were 0.1933 and 0.0001, on  $T_{(1)}$  were 0.0568 and 0.0001, on  $T_{(2)}$  were 0.6629 and 0.0001 and on  $T_{(3)}$  were 0.3007 and 0.0001 respectively. It indicates that preoperative program along with post-operative rehabilitation is extremely significant in improving the functional status in subjects that underwent TKA.



**Figure 8:** Comparison of pre-pre and post-post SF-12 scores between the groups.

## DISCUSSION

This randomized controlled trial was done to compare the effects of preoperative physiotherapy patient education on functional mobility of post-operative TKA subjects. A well designed and feasible preoperative training program aims to improve the functional oriented outcome measures.

A randomized controlled study was done on 30 subjects who were planned to undergo TKA. The subjects were divided into Group A (experimental) and Group B (controlled) each. Assessments were performed immediately prior to the surgery  $T_{(0)}$ , on day 1 post surgery  $T_{(1)}$  on week 1  $T_{(2)}$  and on week 4  $T_{(3)}$ . The baseline data were obtained from both the groups using VAS, ROM, WOMAC and SF-12 scales as outcome measures.

Our findings were similar to a study conducted by Prakash Patel et al[8] and it suggested that men and women with grade II and grade IV OA could perform preoperative exercises prior to the surgery on non-operated limb and then perform the same on the operated limb. This reduced the post-operative pain and the length of hospital stay, improved the range of motion as well as the quality of life of the subjects that participated in the experimental group. Our findings contradict with previous studies reporting that preoperative patient education showed no significant improvement in maintaining the quality of life of the individuals.[5]

- Improvement of the subjects on day 1:
- ✓ The subjects could perform the basic exercises quite better than the other group that did not receive pre operative patient education under my guidance.

- ✓ The pain was reduced when compared to the pre assessment.
- Improvement of subjects on week 1:
- ✓ The subjects when assessed on week 1 could perform exercises much better than when assessed on day 1.
- ✓ The length of stay was reduced in patients that underwent preoperative measures.
- ✓ The pain was much reduced when compared to day 1 assessment.
- Improvement of subjects on week 4:
- ✓ The subjects could perform exercises independently when assessed on week 4.
- ✓ The subjects had no post-operative complications in this study.
- ✓ The pain was minimal when compared to week 1 assessment.
- ✓ The subjects were functionally independent to perform his/her daily activities.

There were similar studies done by Vaishali Jagtap and S. Shanmugam(2012), where they conducted a study to determine the effect of mechanical traction in osteoarthritis knee(2012) and reported that mechanical traction is more effective in decreasing pain and improving quality of life than using conventional therapy alone [20]. Also there were studies conducted by Sushmita Singh et al, where they had to investigate the effect of post isometric relaxation and reciprocal inhibition in osteoarthritis knee (2017) and they concluded that there was significant effect of combination of post isometric relaxation and reciprocal inhibition in osteoarthritis knee [21]. These studies showed that severe osteoarthritis knee can be managed conservatively. Relating our study with these studies, preoperative physiotherapy exercises and patient education showed reduction in length of hospital stay and intensity of pain and also showed improvements in the functional mobility and quality of life.

Our study had a few limitations. The cost of preoperative rehabilitation program was not evaluated. Also the study was conducted in a limited duration of time. A larger sample size could have made the study more reliable. We would also recommend including subjects with any other chronic arthritic conditions to perform in the study. In conclusion, the result of current study shows that combination of preoperative physiotherapy patient education along with post-operative knee rehabilitation has extremely significant effect over post-operative physiotherapy knee rehabilitation alone in management of Total Knee Arthroplasty subjects, both statistically and clinically. We expect that our preoperative exercise and patient education program prepares the patients for giving better results in the post-operative phase. Further studies can be done in order to determine the long term effects of this program and evaluate this TKA rehabilitation regimen.

### CONCLUSION

Various recent approaches are used in treating subjects of Total Knee Arthroplasty. But this study concluded that the combination of preoperative physiotherapy patient education along with post-operative physiotherapy rehabilitation was more effective in decreasing pain and improving quality of life than providing post-operative rehabilitation alone. It is also proved from this study that the combination of preoperative physiotherapy patient education along with post-operative physiotherapy rehabilitation has significant effect on pain, functional status and reduced length of hospital stay than compared to only post-operative rehabilitation.

### ACKNOWLEDGEMENT

We acknowledge the guidance and constant support of Dr. G. Varadharajulu, Dean, Faculty of Physiotherapy, Karad, Dr. Poonam Patil and Dr. Kakade SV, for help in statistical analysis.

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