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Original Research Article

Effects of Additional Kinesiotaping Over the Conventional Physiotherapy Exercise on Pain, Quadriceps Strength and Knee Functional Disability in Knee Osteoarthritis Participants- A Randomized Controlled Study

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ABSTRACT

Background: Osteoarthritis (OA) is a major public health problem. Prevalence of knee OA is 34-45%in Indian population with clinical symptoms of pain, reduced muscle strength and knee function.
Objective: This study to determine the effectiveness of additional kinesiotaping (KT) over the conventional physiotherapy on pain, quadriceps strength and functional disability in knee osteoarthritis participants.
Methods: A randomized controlled study.30 knee osteoarthritis individuals were recruited and randomly allocated in to two groups (conventional PT & kinesiotaping plus conventional PT; N=15 in each group). Both groups received the same conventional PT program of muscle stretching and strengthening exercises for 3 weeks and the KT group additionally received kinesiotaping at thrice per week for three weeks. All the groups underwent 3 weeks of supervised intervention program. NPRS, HHD and modified WOMAC for knee pain, quadriceps strength and knee functional disability were recorded at baseline and after three weeks of interventions.
Results: Comparing pretreatment and 3rd week values, significant improvements were found in pain, quadriceps strength and functional performance of both groups ($p<0.05$).The KT group had significantly better than the control group at the end of three weeks ($p<0.05$).
Conclusion: The addition of kinesiotaping to the CPT was capable of reducing pain, improving quadriceps strength and knee functional ability in knee OA participants.

Key words: knee OA, CPT, kinesiotaping, NPRS, HHD, quadriceps strength & modified WOMAC.

INTRODUCTION

Osteoarthritis (OA) is the most common form of degenerative joint disease affecting 15 to 40% of people aged 40 and above. [1] One hundred fifty one million people worldwide experienced OA was ranked sixth as a leading cause of moderate and severe disability. [2] The knee is the joint most frequently affected by osteoarthritis. OA knee is two times more prevalent than OA hips in people aged over 60 years and is a significant contributor of pain and mobility impairment in community-dwelling adults. [3] The prevalence rate of OA in both rural and urban India was ranging from 33% to 46 % of older adult population where female were more affected than men.

The quadriceps groups such as rectus femoris, vastus medialis, vastus lateralis, vastus inter medialis muscles are play an important role in controlling knee

motion, providing stability, and attenuating impact loading. [4] While quadriceps weakness is often the focus on tibiofemoral OA rehabilitation.

According to Lim et al. [4] during mechanical loading of the knee joint in dynamic activities such as gait, the ground reaction forces pass medial to the center of the tibiofemoral joint, creating a knee adduction moment force indicate loading in the medial knee joint compartment This is found to be majority in patients with medial compartment tibiofemoral OA. (Miyazaki et al, 2002). [5]

Recent research has focused on the pathomechanism of the quadriceps weakness in OA knee. quadriceps strength declines with aging which lead to functional impairment. [6] The correlation between quadriceps strength and tibio femoral arthritis pathophysiology is less certain. It is possible that pain, stiffness, reduced range of motion which leads to functional impairment. In some study report that chronic pain, deformity and prolonged immobility which may be causes of disuse atrophy. [7-9]

Mcnair and Rice colleagues stated that the mechanism of the reduced quadriceps strength due to following possibilities: 1) Arthrogenic muscle inhibition 2) swelling and 3) muscle atrophy. [10]

Quadriceps muscle Strengthening is an important interventions in preventing the disease progression and it ultimately helps in better pain free life. The various physiotherapy interventions are evidently proved that they help to improve the quality life of the OA knee patient. [11,12]

Current era focused on kinesiotaping rehabilitation. The kinesiotap application and working mechanism based on the principles of kinesiology, and also totally it differs with conventional taping. Kinesio tape, invented by Kenzoase it is a colourful elastic cotton strips with an acrylic adhesive tape. [13] Previous research study reports that kinesiotap has various therapeutic mechanism such as 1) to reduce pain, 2) swelling, 3) muscle spasms and improve the muscle tone. [14,15] Different studies revealed the effects of knee taping on minimizing pain intensity, increasing muscle strength, improving functional activities which enhance the quality of patients with knee OA and patella femoral arthritis. [16]

Hypothesis of this study was there is a statistical significant difference in kinesiotaping plus conventional physiotherapy exercises on pain, quadriceps strength and knee functional disability in knee osteoarthritis participants in local population.

MATERIALS AND METHODS

In this intervention Assessor blinded Randomized controlled study, after institutional ethical approval obtained, participants recruited through C.U. Shah physiotherapy musculoskeletal outpatient department the total 60 were interested to participate in the study. A total 30 OA knee study subjects who fulfilled selection criteria were recruited to this study. Using computer generated randomization [simple random sampling] method 30 participants were randomly assigned in to two groups (CPT & KT +CPT; n=15 in each group). The included criteria: 1) age group was 40 to 65 years old, 2) chronic OA with pain at least in one knee. (>4 weeks), 3) a prior medical diagnosis of knee osteoarthritis by an orthopaedician and physician 4) radiographic evidence of grade II & III of Kellgren and Lawrence criteria for knee osteoarthritis 5) participants with involvement of tibiofemoral arthritis unilateral involvement 6) pain intensity level between 6- 8 point of NPRS& 7) participants are able to walk independently without any assistive devices, ascend and descend at least a flight of stairs and 7) willingness to participate. [17-19]

The excluded criteria: 1) any acute inflammation, contracture or surgery affecting the knee. 2) cognitive problems (score <20 on the mini-mental state examination), 3) current participation in supervised physical therapy 4) pain during exercise or unstable medical conditions within the past 6 months 5) patient having received NSAIDS, injection or physical therapy within last 3months in knee joint 6) BMI > 30 patient who are not willing to cease medication 7) secondary osteoarthritis & 8) any skin allergy, local skin lesion and infection. [17-19]

Table –I: Demographic details

Variables	Control Group (n=15)	KT© Group (n=15)	p-value
	Mean ±SD	Mean ±SD	p > 0.05
Age (Y)#	51.26 ± 4.86	51.73 ± 5.10	0.800
Body height(cm)	158.27 ± 8.02	158.13 ± 9.44	0.967
Body mass(kg)	67.86 ± 9.55	62.00 ± 5.85	0.052
BMI(Kg/m^2)*	26.16 ± 3.14	24.54 ± 3.38	0.184
Duration (month)	08.86 ± 1.95	09.26 ± 1.94	0.579
Gender	Male = 26.67% Female = 73.33%	Male = 20.00% Female = 80.00%	
Affected limb	Right = 53.33% Left = 46.67%	Right = 46.67% Left = 53.33%	
**BMI=Body mass index,KT©=Kinesiotaping & Y#=years.*			

Sampling techniques: All 30 OA knee study subjects were randomly assigned in to two groups; control Group [group A]; received conventional PT (n=15) and Group B: experimental group received kinesiotaping plus conventional PT (n=15) and same allocation was done by using simple random sampling. (Computerized randomized table) (Figure 2)

Outcome measures: The pre-intervention outcome measures consisted of pain assessment using numerical pain rating scale(NPRS), quadriceps strength was assessed by using hand held dynamometer (HHD) and knee functional disability was assessed by using modified- Western Ontario McMaster (m. WOMAC).

NPRS is a self assessing questionnaire. It is an ordinal scale using a 10cm line and with 0 to 10 numbers marked over it in which 0 representing "no pain" and 10 representing "pain as bad as it could be." Each subject was asked to indicate on the scale the level of pain at their knee joint. The score was taken at baseline and post treatment. The subject would be writing on the scale him/ herself indicating as a subjective experience. [20]

The baseline® handheld dynamometer (HHD) is the device used to assess the isometric.

Muscle force (strength) of the muscles. Here the device was used to assess the strength of the quadriceps. In this study the patient was positioned in high sitting. HHD was placed distally to the knee joint against the therapist resistance ask the patient was extend the knee by isometrically. Then the isometric force was recorded either in kg or pounds. The same test repeated for 3 trails. Average of three trails score has been recorded. The HHD has been validated and determined to be reliable scale for muscle strength assessment in OA knee. [21] [Figure 7]

The modified western Ontario and McMaster universities OA index (m. WOMAC): the modified WOMAC is a subjective questionnaire used to assess patients with hip and knee osteoarthritis. It consists of 24 items. Pain has: 5items, Stiffness has: 2items &physical function has: 17 items .It is a good valid and reliable scale. [22]

Control group (Group A): The control group patient was received 1) Isometric Exercises for quadriceps each set of exercises consist of 10 repetitions [1rep=5sec hold, 10 repX3set]. 2) straight leg raising[SLR](10 rep,3sets), 3) Hip abductors strengthening (10 rep,3sets), 4)The last degree knee extension board

exercise training(10 rep,3sets), The progression was done when patient was eased to do exercises either by increasing repetition or frequency of exercises. 5) Self Hamstring stretching (static) (3sets, each stretch30 sec hold, between each set 5sec rests).3 therapy sessions per week, each session was 30minutes duration & for 3 weeks. [23] [Figure 2-6]

Experimental group (Group B): The Kinesio tape was applied with approximately 40% stretch of its maximal length on the 2 quadriceps group muscles based on the principle of activation technique. Here the direction of taping was applied origin to insertion of the muscles. Taping protocol was designed based on the principle of activation technique. [13] Kinesiotape was applied on the 2 quadriceps muscles1) for rectus femoris [RF] 'Y'strip was applied, 10cm bellow the anterior inferior iliac spine to the inferior border of the patella and 2) for vastus medialis [VM], the KT was applied 10cm bellow the intertrochanteric line to the medial border of the patella. Patient was positioned in supine with knee bending. [24] [Figure 8&9]

Also, according to Kase Wallis principles of KT, a gap of at least 30 min was given after the tape application to achieve a complete activation of the glue, which is believed to improve the performance of the kinesiotap on the quadriceps muscle. 3 therapy sessions per week [working alternative days], for total 3 weeks. After applied KT, all the OA knee study participants were undergone supervised conventional physiotherapy.

Statistical analysis: All statistical analysis was done using SPSS 16 for windows software. The level of significant was set at p=0.05. Descriptive analysis was used to calculate mean and standard deviation. The inter group comparison of demographic details were performed using independent's-t- test &Non parametric Mann Whitney 'U' test &for intra group comparison paired 't'-test & Wilcoxon Signed Rank test was used.

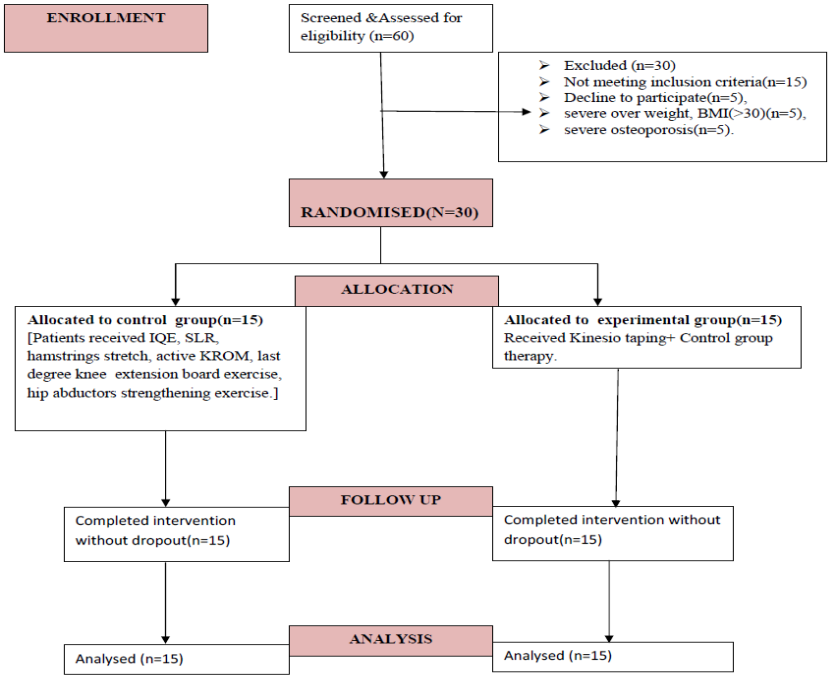

Figure: 1 [sampling flow chart]

Figure 2: (IQE)

Figure 3: (Straight legs raise exercise)

Figure 4: (hip abductors strengthening)

Figure 5 :(last degree knee ext board ex)

Figure 6: (self stretching of hamstrings)

Figure 7: (quadriceps strength by HHD)

Figure 8: KT for RF & VM [in knee flexion]

Figure 9: KT for RF & VM [in knee extension]

RESULTS

The demographic details (Age =0.800, Body Height: p=0.967, Body Mass :p=0.052, BMI: p=0.184 & Duration of the condition (p=0.579) of groups were homogenous with>0.05 (Table-I). pre treatment NPRS (p=0. 902), HHD (p= 0.613) and modified WOMAC (p= 0.852) shows no significant difference (p>0.05) and proves the pre treatment group homogeneity (Table-II) (Figure 11). Pre and post treatment comparison for NPRS (group A:P=0.11,Group B:P=0.001) and HHD (group A:P=0.011,Group B:P=0.000) did shows significant difference & modified WOMAC (group A:P=0.002, Group B:P=0.001) did shows significant difference. (Table- IV & V). It indicates that control group & kinesiotaping group was effective on pain, quadriceps strength & knee functional ability in knee OA subjects. Post treatment inter group comparison of NPRS (p=0.001), HHD (p=0.003) & modified WOMAC (p=0.001) shows significant difference (p<0.05) among groups. (Table–III). The additional KT group proves more significant improvement in NPRS, HHD and modified WOMAC compared to the control group.

Table-II: pre treatment group comparison

CONTROL GROUP(A)			KINESIOTAPING GROUP(B)		
Scales	**Mean**	**±SD**	**Mean**	**±SD**	**p-value**
NPRS	6.4	0.98	6.40	1.06	0.902
HHD	17.06	2.37	17.73	3.75	0.613
Mwomac	34.53	3.92	35.00	3.11	0.852

Table-III: post treatment group comparison

Control group(A)			KT group(B)		
Scales	**Mean**	**±SD**	**Mean**	**±SD**	**p-value**
NPRS	5.40	1.59	4.90	0.91	0.001
HHD	18.06	2.15	21.40	3.58	0.003
mWOMAC	30.73	4.33	25.53	3.58	0.001

TABLE-IV: pre &post treatment comparison (Group A)

Control group(A)					
PRE			**POST**		
Scales	**Mean**	**±SD**	**Mean**	**±SD**	**p-value**
NPRS	6.40	0.98	5.40	1.59	0.11
HHD	17.06	2.37	18.06	2.15	0.01
mWOMAC	34.53	3.92	30.73	4.33	0.002

TABLE-V: pre &post treatment comparison (Group B)

Kinesiotaping group(B)					
PRE			**POST**		
Scales	**Mean**	**±SD**	**Mean**	**±SD**	**p-value**
NPRS	6.4	1.06	4.90	0.91	0.001
HHD	17.73	3.75	21.40	3.58	0.000
mWOMAC	35.00	3.11	25.53	3.58	0.001

Table –VI: Intra Group NPRS, HHD and mWOMAC Comparison [group A&B]

CONTROL GROUP(A)					KINESIOTAPING GROUP (B)		
Scales		**Mean**	**±SD**	**P- Value**	**Mean**	**±SD**	**P-value**
NPRS	PRE	6.4	0.98	0.011	6.40	1.06	
	POST	5.4	1.59		4.90	0.91	0.001
HHD	PRE	17.06	2.37	0.001	17.73	3.75	
	POST	18.06	1.60		21.40	3.58	0.000
mWOMAC	PRE	34.53	3.92		35.00	3.11	
	POST	30.73	4.33	0.001	25.53	3.58	0.001

DISCUSSION

3weeks of additional KT conventional PT exercise led to the findings that KT treatments groups improved significantly in quadriceps strength (HHD), knee function and reduction in pain (NPRS), when compared to alone conventional physiotherapy exercise group (A). After analysis of pre and post treatment scores, it results interpreted that significant improvement (p<0.05) in KT groups. There was significant difference (p<0.05) in post treatment comparison between with KT group and control group. The findings of this study suggested that additional KT along with conventional PT is more beneficial in the treatment of knee OA. The additional KT training shows more effectiveness than that of control group in NPRS, HHD & modified WOMAC score.

The present study also showed that KT group had a more significant functional improvement (a decrease in pain from 6.4 to 4.9 points compared to 6.4to 5.4 points for the control group) and improvement in HHD (from 17.73 to 21.40and compared to 17.06to 18.06for the control group) and decrease in modified WOMAC (from 35.00 to 25.53 points compared to 34.53 to 30.73 points in the control group).

The current study primarily evaluated the effects of additional KT over conventional PT on pain, quadriceps strength& knee functional disability in knee osteoarthritis. The results indicate that additional KT significantly improves the quadriceps strength& knee functional ability and reduction of pain respectively in knee osteoarthritis.

Konishi et al reported that the cutaneous stimulation provided by the tape may have attenuated the 1a inhibitory afferent activity of the muscle by modulating the gamma motor neuron, thus, regulating the tone of the quadriceps muscle. By this mechanism, it is possible that the tape acted as a tone regulator rather than a tone facilitator. [25] According to Benjamin, in additionally, it has been found that the fascia also has contractile properties in addition to transmitting forces, influencing the mechanics of kinematics. [26]

The postulated mechanism by which KT could have increased the quadriceps strength, improved the performances in the functional activity and reduced pain experienced during tibio femoral joint function could be due to a central nervous system neural plasticity. Thelen dauber and stoneman found that the Tension exhibited by KT onto the skin provides an afferent cutaneous stimulation and is believed to stimulate the mechanoreceptors. [27]

This in turn is believed to modulate pain as proposed by the gate control theory where nociception carried by the small diameter nerve fibers is alleviated by the afferent feedback carried by the large diameter nerve fibers (Gonza´lez- Iglesias et al, 2009), thereby improving the performance in quadriceps strength and knee function. [28]

Strength of the quadriceps is important in knee osteoarthritis as it has the ability to predict the level of functional disability (McAlindon, Cooper, Kirwan, and Dieppe, 1993) [29] and activities of daily functioning (Whitney M, Ryan M, Robin M, 2008), [30-32] For subjects with knee osteoarthritis who are rehabilitated using an KT plus conventional exercise program was improved strength and physical function in OA knee. The additional Kinesiotaping is more beneficial to improve the strength of quadriceps and physical function in tibio femoral arthritis participants.

Limitations

1) Small sample size.
2) Long term follow up was not done.

Suggestion

1. This same study can be done on Kinesio tap application aiming to relieve the tightness of the vastus lateralis and hamstrings muscle in knee OA participants.

CONCLUSION

The addition of kinesiotaping to the conventional physiotherapy was capable of reducing pain, improving quadriceps strength and knee functional ability in knee OA.

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Conflict of interest: We declare that there were no conflicts of interest in the entire journey of the study.

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