



The effect of manual physical therapy and perturbation exercises on balance in knee osteoarthritis

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Abstract

Background: Osteoarthritis has long been considered a “wear and tear” disease leading to loss of cartilage. Osteoarthritis of the knee is the most common form of arthritis and leads to more activity limitations than any other disease, especially in the elderly. Recently, impaired proprioceptive accuracy of the knee has been proposed as a local factor in the onset and progression of radiographic knee OA.

Subjects: 30 subjects with diagnosed cases of OA Knee above 38 years. Both males and females were included.

Method: Out of 30 participants 15 were in group A which received Manual physical therapy and 15 in group B which received Manual physical therapy along with perturbation exercises. The intervention protocol was carried for 3 weeks – 3 days per week. Initially step up test was recorded for balance evaluation. KOOS was taken as outcome measure. After the intervention again step up test was evaluated for Balance evaluation.

Result: When manual physical therapy and manual physical therapy along with perturbation exercises were compared, manual physical therapy along with perturbation exercises showed greater improvement on all the outcome measures. For manual physical therapy along with perturbation exercises improved from–Pain 29.38+9.03 to 33.45+8.98, Symptoms 34.35+9.06 to 38.34+9.11, ADLs 28.25+8.79 to 32.17+8.74, Sports and recreation function 12.09+7.57 to 17.20+6.76, Knee related QOL 27.48+8.90 to 31.82+8.88. Perturbation exercises also showed significant improvement in balance on step up test which improved from 6.67+3.81 to 10.27+3.28.

Conclusion: Addition of Perturbation exercises to Manual Physical Therapy shows greater improvement in OA Knee patients. Perturbation Exercises do improve balance in patients with OA Knee.

Keywords: manual physical therapy, perturbation exercises, KOOS, step up test, range of motion

Introduction

Osteoarthritis (OA) has long been considered a “wear and tear” disease leading to loss of cartilage. Osteoarthritis (OA) of the knee is the most common form of arthritis and leads to more activity limitations (e.g., disability in walking and stair climbing) than any other disease, especially in the elderly^[1]. At the knee—a key weight bearing joint required for walking, stair climbing, and sitting, and a joint commonly affected by osteoarthritis either on one side or both^[10]. Recently, impaired proprioceptive accuracy of the knee has been proposed as a local factor in the onset and progression of radiographic knee OA (ROA). Additionally, proprioceptive impairments could be a cause of knee pain or activity limitations in knee OA patients^[1]. It is a common cause of pain and disability, especially in the elderly^[10].

Common signs and symptoms of knee OA include knee pain, tenderness, joint stiffness and decreased muscle strength. In addition, individual with knee OA often exhibit poor neuromuscular control, slower walking speed, decreased functional ability and increased susceptibility to fall^[7].

Knee Proprioception

There is no single accepted definition of proprioception. It is mostly defined as a conscious and/or unconscious perception

of position and movement of an extremity or a joint in space. Knee proprioception derives from the integration of afferent signals from proprioceptive receptors in different structures of the knee and is also influenced by signals from outside the knee (e.g., from the vestibular organs, visual system, and cutaneous and proprioceptive receptors from other body parts). Muscle spindles are thought to be the most important proprioceptive receptors of the knee^[1]. Proprioception encompasses the senses of joint position and joint motion. These senses originate from the stimulation of specialized nerve-endings or mechanoreceptors in the joint capsule and ligaments.

Three presumed functions of knee proprioception have been described in the literature. Firstly, it is hypothesized that proprioceptive information is used to protect the knee against excessive and possible injurious movements via reflex responses. Secondly, proprioceptive accuracy of the knee is supposed to be needed to stabilize the knee during static posture. Thirdly, it is hypothesized that knee proprioception is important in coordinating complex movement systems and precise knee joint motions^[1].

Perturbation training may be valuable, it can increase pain and inflammation when performed in the standing position. Perturbation exercise prescription in a seated position.

Perturbation exercises may increase joint load in the knee [2]. Another treatment strategy for knee OA is the manual physical therapy approach, it is based on clinical reasoning and includes highly specific passive manual techniques and therapeutic exercises that support and reinforce those techniques [2]. In the context of this approach, the integration of perturbation exercises as a multimodal treatment may lead to improved perturbation training tolerance. Manual therapy has been reported to act, in part, by inhibiting and modulating pain or altering the acute inflammation in response to exercise. This may lead to an increase in exercise tolerance that would otherwise be lacking or diminished without the combination of manual therapy [2].

‘Balance’ is defined as ‘the ability to maintain a position within the limits of stability or base of support and so would be classified by the International Classification of Functioning, Disability and Health as an activity. There are also a number of measurement tools, such as measures of weight distribution or postural sway that measure balance impairments. One of the test is Step up test. Step-up tests reached the required standards and are usable in clinical practice.

KOOS is developed as an instrument to assess the patients opinion about their knee and associated problems. KOOS consists of 5 subscales; Pain, other Symptoms, Function in daily living (ADL), Function in sport and recreation (Sport/Rec) and knee related Quality of life QOL [5].

Material and Method

The study was approved by the Institutional Ethical Committee at Tilak Maharashtra Vidyapeeth, Pune. Subjects recruited for this study were informed of the purpose of the study.

Total 30 participants were included with an Age group of 38 and above, satisfying the inclusion and exclusion criteria. The study included both males and females. Out of 30 participants 15 were in group A and 15 in group B. Participants in group A received Manual physical therapy and group B received Manual physical therapy along with perturbation exercises. The intervention protocol was carried for 3 weeks – 3 days per week. There were no adverse events or reports of acute flare-ups during treatment or within 72 hours after each treatment in any subject. Initially step up test will be recorded for balance evaluation.

Two groups will made. Group A will be given Manual Physical Therapy and Group B will be given Manual Physical Therapy along with perturbation exercises.3 weeks protocol. 3 days per week. KOOS will be taken as outcome measure. After the intervention again step up test will be evaluated for Balance evaluation.

Result

1. KOOS scale – manual physical therapy

Table 1: Pain

	Pre	Post
Mean	29.59	31.39
S.D.	6.68	6.65
p value	<0.0001 Extremely Significant	

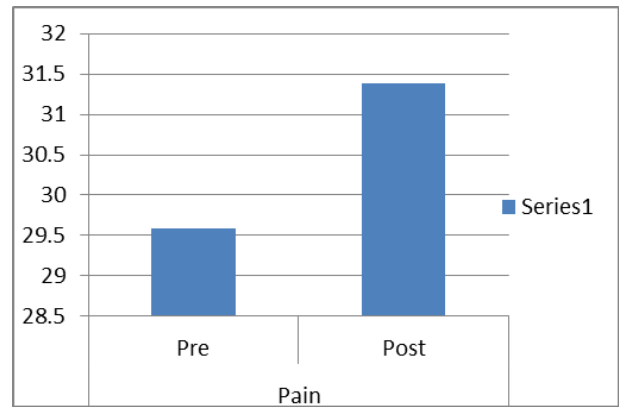


Fig 1

Table 2: Symptoms

	Pre	Post
Mean	34.09	36.15
S.D.	7.02	6.97
P value	<0.0001 Extremely Significant	

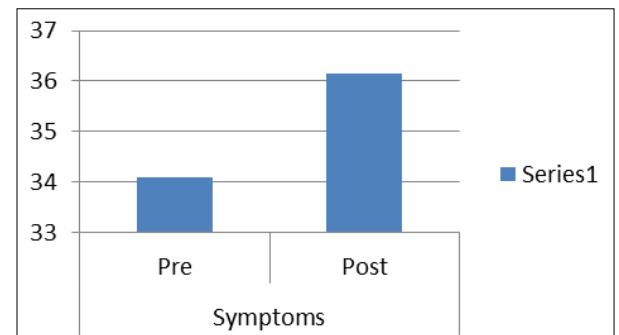


Fig 2

Table 3: Activity of Daily Living

	Pre	Post
Mean	27.77	29.72
S.D.	6.35	6.36
p value	<0.0001 Extremely Significant	

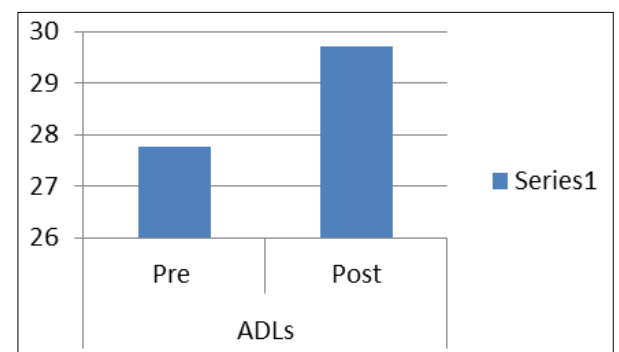


Fig 3

Table 4: Sports and Recreation Function

	Pre	Post
Mean	12.72	14.67
S.D.	5.05	4.97
P value	<0.0001 Extremely Significant	

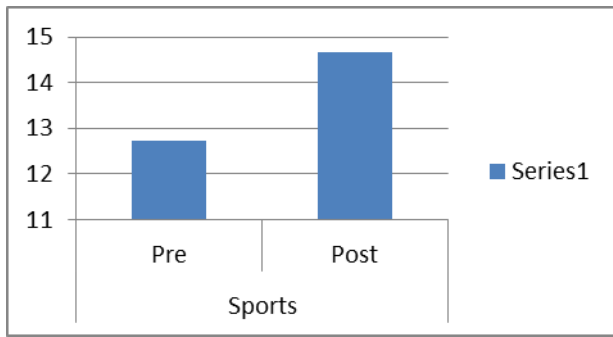


Fig 4

Table 5: Knee Related Quality Of Life

	Pre	Post
Mean	27.51	29.38
S.D.	6.55	6.49
P value	<0.0001 Extremely Significant	

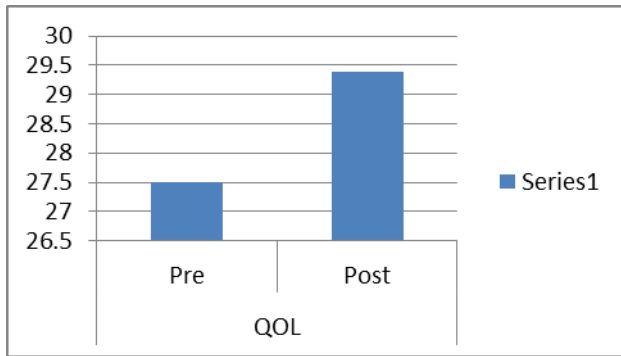


Fig 5

2. KOOS Scale - Manual Physical Therapy with Perturbation exercises

Table 6: Pain

	Pre	Post
Mean	29.38	33.45
S.D.	9.03	8.98
P value	<0.0001 Extremely Significant	

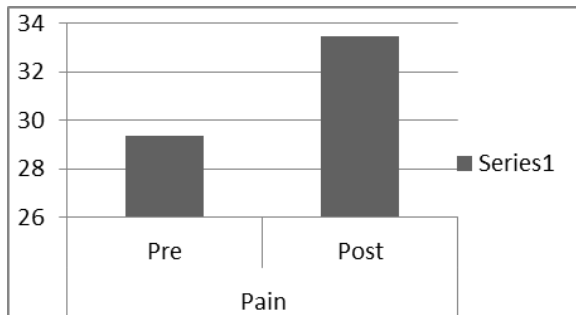


Fig 6

Table 7: Symptoms

	Pre	Post
Mean	34.35	38.34
S.D.	9.06	9.11
P value	<0.0001 Extremely Significant	

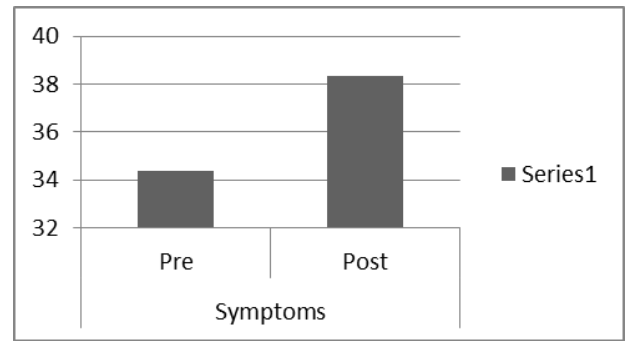
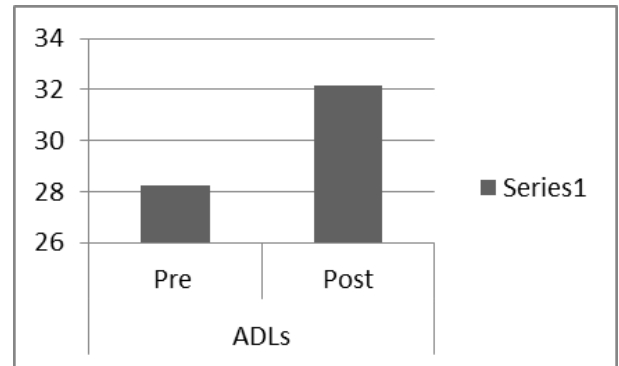


Fig 7

Table 8: Activity of daily living.

	Pre	Post
Mean	28.25	32.17
S.D.	8.79	8.74
p value	<0.0001 Extremely Significant	



Graph 8

Table 9: Sports and Recreation Function

	Pre	Post
Mean	12.09	17.20
S.D.	7.57	6.76
p value	0.0001 Extremely Significant	

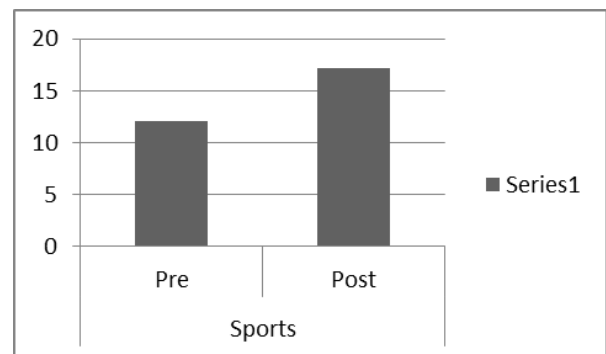
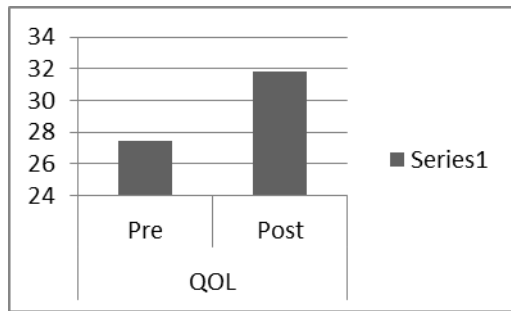


Fig 9

Table 10: Knee Related Quality Of Life

	Pre	Post
Mean	27.48	31.82
S.D.	8.90	8.88
p value	<0.0001 Extremely Significant	



Graph 10

3. KOOS Scale - Comparison between Manual Physical Therapy and Manual Physical Therapy with perturbation exercises.

Table 11: Pain

	Manual physical therapy		Manual physical therapy with perturbation exe	
	Pre	Post	Pre	Post
Mean	29.59	31.39	29.38	33.45
S.D.	6.68	6.65	9.03	8.98
p value	<0.0001 Extremely Significant		<0.0001 Extremely Significant	

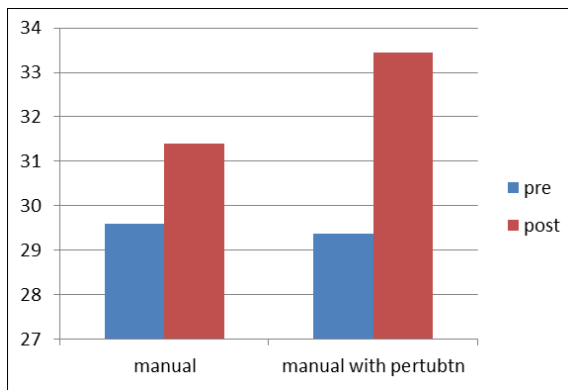


Fig 11

Table 12: Symptoms

	Manual Physical Therapy		Manual Physical Therapy with Perturbation Exe	
	Pre	Post	Pre	Post
Mean	34.09	36.15	34.35	38.34
S.D.	7.02	6.97	9.06	9.11
p value	<0.0001 Extremely Significant		<0.0001 Extremely Significant	

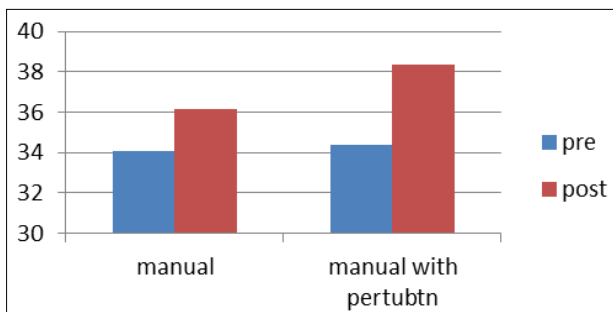


Fig 12

Table 13: Activity of daily living

	Manual Physical Therapy		Manual Physical Therapy with Perturbation Exe	
	Pre	Post	Pre	Post
Mean	27.77	29.72	28.25	32.17
S.D.	6.35	6.36	8.79	8.74
p value	<0.0001 Extremely Significant		<0.0001 Extremely Significant	

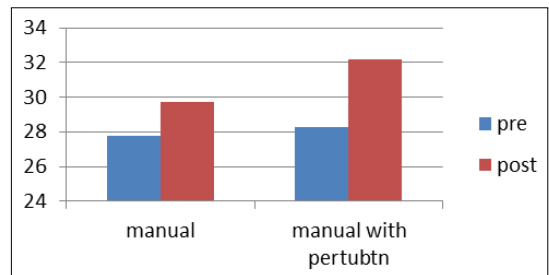


Fig 13

Table 14: Sports and Recreation Function

	Manual Physical Therapy		Manual Physical Therapy with Perturbation Exe	
	Pre	Post	Pre	Post
Mean	12.72	14.67	12.09	17.20
S.D.	5.05	4.97	7.57	6.76
p value	<0.0001 Extremely Significant		0.0001 Extremely Significant	

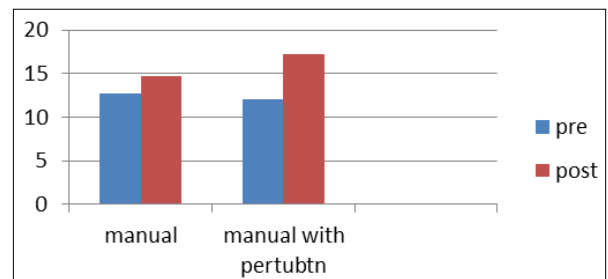


Fig 14

Table 15: Knee related Quality Of Life

	Manual Physical Therapy		Manual Physical Therapy with Perturbation Exe	
	Pre	Post	Pre	Post
Mean	27.51	29.38	27.48	31.82
S.D.	6.55	6.49	8.90	8.89
p value	<0.0001 Extremely Significant		<0.0001 Extremely Significant	

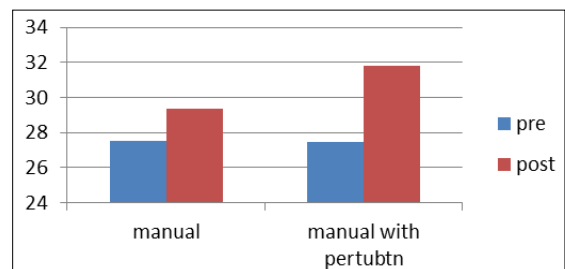


Fig 15

4. Step Test – Manual Physical Therapy

Table 16

	Pre	Post
Mean	5.8	7.6
S.D.	2.85	2.61
p value	<0.0001 Extremely Significant	

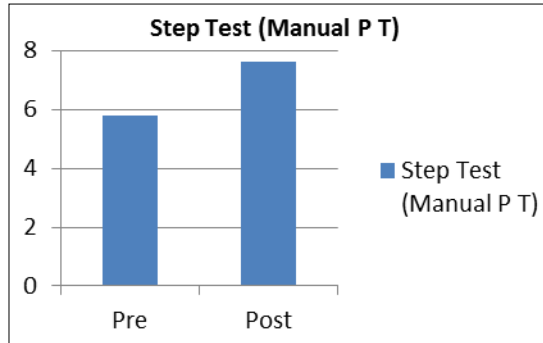


Fig 16

5. Step Test – Manual Physical Therapy with Perturbation Exercises

Table 17

	Pre	Post
Mean	6.67	10.27
S.D.	3.81	3.28
p value	<0.0001 Extremely Significant	

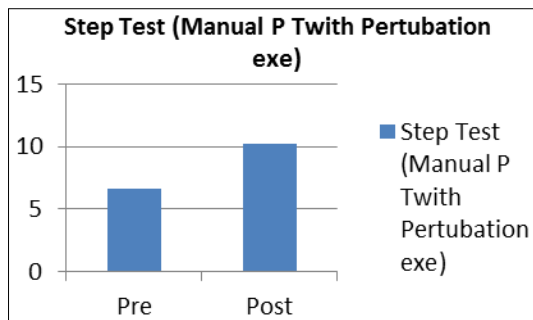


Fig 17

6. Step Test – Comparison between Manual Physical Therapy and Manual Physical Therapy with perturbation exercises

Table 18

	Manual Physical Therapy		Manual Physical Therapy with Perturbation Exe	
	Pre	Post	Pre	Post
Mean	5.8	7.6	6.67	10.27
S.D.	2.85	2.61	3.81	3.28
p value	<0.0001 Extremely Significant		<0.0001 Extremely Significant	

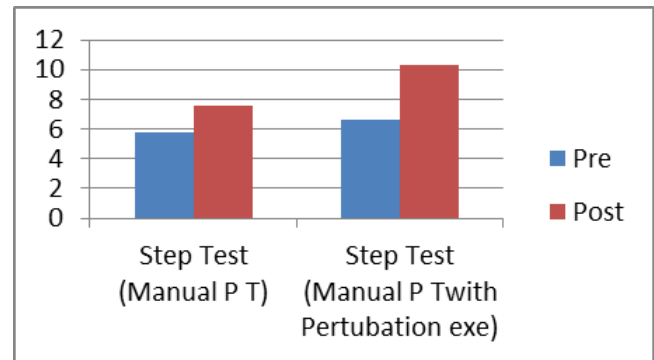


Fig 18

7. Range Of Motion – Manual Physical Therapy

Table 19

	Pre	Post
Mean	74	79
S.D.	19.65	20.96
p value	<0.0001 Extremely Significant	

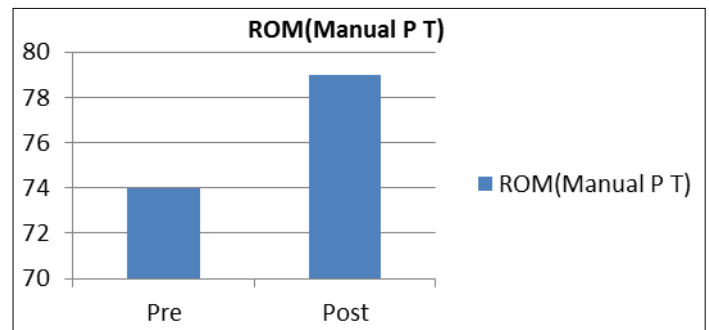


Fig 19

8. Range Of Motion – Manual Physical Therapy with Perturbation exercises

Table 20

	Pre	Post
Mean	85	92.6
S.D.	15.01	16.04
p value	<0.0001 Extremely Significant	

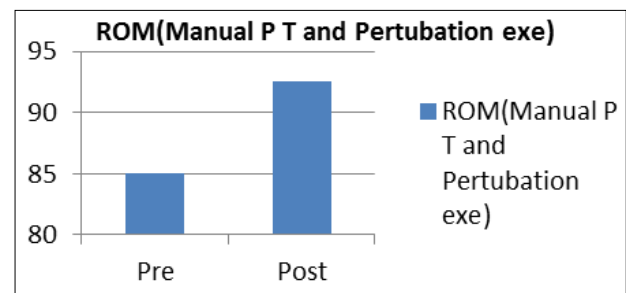


Fig 20

9. Range of Motion - Comparison between Manual Physical Therapy and Manual Physical Therapy with perturbation exercises

Table 21

	Manual Physical Therapy		Manual Physical Therapy with Perturbation Exe	
	Pre	Post	Pre	Post
Mean	74	79	85	92.6
S.D.	19.65	20.96	15.01	16.04
p value	<0.0001 Extremely Significant		<0.0001 Extremely Significant	

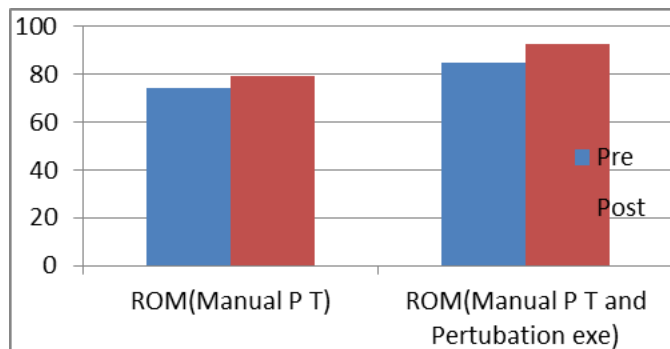


Fig 21

Discussion

The purpose of this study was to evaluate outcomes associated with the addition of proprioceptive exercises to an already established manual physical therapy approach. If this therapy is appropriate for addressing proprioceptive impairments, its delivery in conjunction with a manual physical therapy approach can be well tolerated then this combined intervention could be a focus for future studies^[2].

Total 30 participants were included with an Age group of 38 and above, satisfying the inclusion and exclusion criteria. The study included both males and females. Out of 30 participants 15 were in group A and 15 in group B. Participants in group A received Manual physical therapy and group B received Manual physical therapy along with perturbation exercises. The intervention protocol was carried for 3 weeks – 3 days per week. There were no adverse events or reports of acute flare-ups during treatment or within 72 hours after each treatment in any subject

The Outcome Measures included Knee Injury and Osteoarthritis Outcome Scores (KOOS), Step Up Test, Range of Motion.

The Knee Injury and Osteoarthritis Outcome Score (KOOS) is a questionnaire designed to assess short and long-term patient-relevant outcomes following knee injury. The KOOS is self-administered and assesses five outcomes: pain, symptoms, activities of daily living, sport and recreation function, and knee-related quality of life. The KOOS meets basic criteria of outcome measures and can be used to evaluate the course of knee injury and treatment outcome. KOOS is patient-administered, the format is user-friendly and it takes about 10 minutes to fill out^[6].

Step-up is used to assess balance. This test reached the required standards and are usable in clinical practice.

Fig 1.2.3.4.5 describes the Pain, Symptoms, ADLs, Sports and recreation function, Knee related Quality of life component of KOOS scale respectively of Group A i.e. participants who received Manual physical therapy. The mean of Pain Pre-treatment was 29.59+-6.68 which increased to 31.39+-6.65 post treatment with p value <0.0001 which means extremely significant. That of symptoms, the mean increased from 34.09+-7.02 to 36.15+- 6.97 with p value <0.0001. In ADLs the mean increased from 27.77+-6.35 to 29.72+-6.36 with p value <0.0001. In Sports and Recreation Function mean increased from 12.72+-5.05 to 14.67+-4.97 with p value <0.0001. And in Quality of Life it increased from 27.51+-6.55 to 29.38+-6.49 with p value <0.0001. In KOOS 0 means no problem and 100 means severe problem thus as the % increases the condition improves. This means the pain gradually reduced. Thus this showed significant improvement in Condition.

Fig 6,7,8,9,10 describes the Pain, Symptoms, ADLs, Sports and Recreation Function, Knee related Quality of life component of KOOS scale respectively of Group B i.e. participants who received Manual physical therapy along with perturbation exercises. The mean of Pain Pre-treatment was 29.38+-9.03 which increased to 33.45+-8.98 post treatment with p value <0.0001 which means Extremely Significant. That of Symptoms, the mean increased from 34.35+-9.06 to 38.34+-9.11 with p value <0.0001. In ADLs the mean increased from 28.25+-8.79 to 32.17+-8.74 with p value <0.0001. In Sports and Recreation Function mean increased from 12.09+-7.57 to 17.20+-6.76 with p value 0.0001. And in Quality of Life it increased from 27.48+-8.90 to 31.82+-8.88 with p value <0.0001. In KOOS 0 means no problem and 100 means severe problem thus as the % increases the condition improves. This means the pain gradually reduced. Thus this showed significant improvement in Condition.

Fig 11, 12, 13, 14, 15 shows comparison of KOOS Scale between the two groups. On studying the Tables and graphs, Group B i.e. Participants who received Manual Physical Therapy along with perturbation exercises showed greater improvement than Group A.

Fig 16 describes the Step up test amongst Group A. The pre-treatment mean of step up test was 5.8+-2.85 which increased to 7.6+-2.61 with p value of <0.0001 i.e. Extremely Significant.

Fig 17 describes the Step up test amongst Group B. The pre-treatment mean of step up test was 6.67+-3.81 which increased to 10.27+-3.28 with p value of <0.0001 i.e. Extremely Significant.

Fig 18 shows comparison of Step up test between the two groups. On studying the Tables and Graphs, Group B i.e. Participants who received Manual Physical Therapy along with perturbation exercises showed greater improvement than Group A.

Fig 19 describes the Range of motion amongst Group A. The pre-treatment mean of ROM was 74+-19.65 which increased to 79+-20.96 with p value of <0.0001 i.e. Extremely Significant.

Fig 20 describes the Range of motion amongst Group B. The pre-treatment mean of step up test was 85+-15.01 which increased to 92.6+-16.04 with p value of <0.0001 i.e. Extremely Significant.

Fig 21 shows comparison of Range of motion between the two groups. On studying the Tables and Graphs, Group B i.e. Participants who received Manual Physical Therapy along with perturbation exercises showed greater improvement than Group A.

Manual physical therapy as an effective treatment approach for knee OA has been well established. It has been shown to improve pain and function for at least 1 year, in multiple settings, and in patients with or without concurrent meniscus tears. There is no solid consensus on the exact mechanisms resulting from manual physical therapy that result in therapeutic benefits. However, it is likely that it works through both biomechanical and neurophysiological mechanisms. The clinical trials that demonstrated the effectiveness of manual therapy for improving pain and function in patients with knee OA did not speculate on specific potential mechanisms other than suggesting that the effects of manual therapy may be derived from treating the spectrum of tissues in and around the knee and other related body regions. Manual physical therapy has also been reported to inhibit and modulate pain, induce a controlled inflammatory response that initiates healing and influences processing of pain and alter acute inflammation in response to exercise. These could all contribute to decreased pain from muscle contraction, improving tolerance for exercise. Joint mobilizations also may modulate proprioceptive input to joint structures, prime the joint and surrounding muscles for optimal response to strengthening programs, and improve muscle control and reaction times^[2].

The addition of carefully applied perturbation exercises within the context of a manual therapy approach may be well tolerated and a reasonable treatment delivery strategy. These results lay groundwork for future research to directly compare a manual therapy approach with and without perturbation exercises, a manual therapy approach with perturbation exercises to a functional exercise approach with perturbation exercises, and to investigate other outcome measures that appropriately measure balance, proprioception, stumble response, and ultimately falls^[2].

Conclusion

Addition of Perturbation exercises to Manual Physical Therapy shows greater improvement in OA Knee patients. Perturbation Exercises do improve balance in patients with OA Knee.

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