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Case Study

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The Effect of Muscle Energy Technique in A Patient with Piriformis Syndrome: A Case Report

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Abstract

Background: The piriformis muscle, an integral component of the deep gluteal region, exhibits a distinctive anatomical arrangement, coursing from the anterior sacrum to the greater trochanter of the femur. Piriformis Syndrome is a neuromuscular disorder characterized by the irritation of the sciatic nerve due to anatomical variations or dynamic factors involving piriformis muscle which commonly affects between the age group of 30 and 60, although can occur in younger individuals. It is more common in women than in men.

Objective: The aim of this case study was to evaluate the effect of Muscle Energy Technique in a patient with Piriformis syndrome.

Method: A 25-year-old female diagnosed with Piriformis syndrome underwent physiotherapy intervention for six weeks involving MET along with conventional physiotherapy(stretching, strengthening, moist heat pack) focusing on pain, range of motion (ROM) of Hip joint, and function of lower limb. The outcomes were measured using Numerical Pain Rating Scale (NPRS), Hip Joint Goniometry and Lower Extremity Functional Scale (LEFS).

Results: The scores improved significantly for all three outcome measures indicating a reduction in pain, improvement in Hip joint range of motion and function of the lower extremity .

Conclusion: Piriformis syndrome is a debilitating condition that can significantly influence one's quality of life. This case report suggests that Muscle Energy Technique is beneficial in reducing pain, improving Hip ROM and enhancing function of lower extremity in patients suffering from this condition.

Keyword: Piriformis syndrome, Pain, Range of motion, function, Muscle Energy Technique.

Introduction

The piriformis muscle, an integral component of the deep gluteal region, exhibits a distinctive anatomical arrangement, coursing from the anterior sacrum to the greater trochanter of the femur.[1] This muscle function is to lift and rotate the Hip joint away from the body's midline, helping to shift the body weight from one foot to the other and maintain balance, during weight bearing activities, such as those involving eccentric loads, excessive Hip adduction and internal rotation can occur. When the gluteus maximus

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and gluteus medius are weak, the high eccentric loads transfers to the piriformis muscle, which can lead to the sciatic nerve compression or irritation.[2]

Piriformis syndrome (PS) is a neuromuscular condition characterized by symptoms that include Hip or buttock pain.[3] This pain and instability results from muscle spasm, inflammation or shortening causing sciatic nerve compression.[4] Symptoms are similar to sciatica and are often misdiagnosed as more common conditions like facet arthopathy, sacroiliitis, lumbar disc disease and radiculopathy.[5,6] The prevalence of piriformis syndrome among patients with low back pain or posterior thigh pain varies between 0.3%-6%.[7] Women are affected six times more than men and tend to present at a younger age whereas men usually present at an older age.[8] The purpose of this study was to study the effects of Muscle Energy Technique in a patient with piriformis syndrome. Muscle Energy Techniques (MET) is a manual therapy that uses the muscle's own energy through isometric contraction to relax the muscle via autogenic or reciprocal inhibition. Autogenic inhibition involves submaximal muscle contraction followed by stretching of the same muscle, while reciprocal inhibition involves submaximal contraction followed by stretching of the antagonist muscle. In this manner, it is possible that MET could improve Hip ROM and enhance the function of the lower extremity.

Case Description

A 25-year-old actress reported a deep pain in her back and buttock, sometimes radiating down to the back of her thigh, and discomfort during prolonged sitting, climbing stairs and after lifting heavy weights. The pain persisted in spite of 10 days bed rest and analgesics as prescribed by an orthopedician. MRI of spine revealed L5-S1 disc bulge, and patient was referred to physiotherapy.

The objectives of physiotherapy were to reduce pain, restore her Hip joint range of motion, improve and maintain the strength and enhance the activities of daily life. The treatment program involved pain management, targeted muscle contractions to improve flexibility, along with stretching, strengthening exercises. The sessions were conducted once per day, six days a week, for six weeks.

Clinical Findings

The patient presented with localized pain in the buttock sometimes radiating down the back of the thigh, resembling sciatica and exaggerated lumbar lordosis. On examination, tenderness was noted over the piriformis muscle and there was a restricted Hip range of motion notably in external rotation and abduction. Sensation was intact throughout the affected area. The special tests for piriformis syndrome namely Freiberg, Pace and FAIR test were seen to be positive. These test is used to assess piriformis syndrome to find out irritation on the sciatic nerve by the piriformis muscle. Freigberg test can be performed by making a patient lie down supine with the legs straight. The examiner passively internally rotates the hip. PACE and FAIR tests can be performed by making a patient sit on the edge of a couch or a chair with hips and knees flexed to 90 degrees, feet keeping flat on the floor. then the examiner places their hands on the lateral aspects of the patient's knees. Patient is then instructed to abduct and externally rotate their hips against the examiner's resistance. the test is considered to be positive if the patient experiences pain or discomfort in the buttock. Physiotherapy outcomes used to assess pain, Hip range of motion and function of lower limb were Numerical Pain Rating Scale (NPRS), Goniometry and Lower Extremity Functional Scale (LEFS) respectively. Pre-treatment, the patient scored 7/10 on NPRS, 55/80 on LEFS and a reduced Hip abduction and external rotation range of motion was noted.

Intervention

Table1: Rehabilitation protocol for Piriformis Syndrome

Weeks	Exercises
Week 1	1.Introduction to MET focusing on the piriformis muscle. 2.Gentle Post isometric relaxation (PIR)- starts with light contractions holding for 5-6 seconds, followed by stretching. 3.Reciprocal inhibition (RI)- isometric contraction of antagonist muscle hold for 5-6 seconds.
Week 2 Building foundation	1.Gentle contraction and light strengthening exercises 2.PIR- hold for 7- 10 seconds contractions, 3.RI- hold for 5-10 seconds, 4.Stretching for piriformis, Hip flexors, hamstring muscles. 5.Strengthening exercise for Hip and Gluteal muscles (Bridges, clamshell, side lying Hip abduction 10 repetition on each side)
Week 3 Increasing intensity	1.PIR: hold for 7-10 seconds contractions with 3-4 repetition per session. 2.RI: hold for 7-10 seconds contractions with 3-4 repetition per session.

Week 4 focus on strength and flexibility	1.PIR and RI (15-20 seconds hold), 2.Piriformis stretch, Hip flexor stretch, hamstring stretch(hold for 20-30 second), single leg bridge, clamshell, leg lifts, side lying abduction(15 repetitions)
Week 5 enhancing functional strength	1.PIR and RI (30 seconds hold), 2.Piriformis stretch, Hip flexor stretch, Hamstring stretch Lunges, leg lifts.
Week 6 Integration and maintenance	1.Resistance band exercise in bridges, clamshell and leg lifts to strengthen Gluteus maximus and medius. This helps to stabilize the pelvis, reduce strain on piriformis muscle and improves Hip stability.

Results And Discussion

A six week Muscle Energy Technique in the patient with piriformis syndrome had a positive effect on relieving pain, improving Hip range of motion and enhancing lower extremity function in the patient with piriformis syndrome. After a six-week intervention, based on the scores there was a significant improvement in Hip range of motion, Numerical Pain Rating scale and Lower Extremity Functional scale. The Hip range of motion, measured by a goniometer showed notable improvement. Flexion ROM improved from 0-90 degrees to 0-120 degrees, abduction improved from 0-25 degrees to 0-40 degrees, and external rotation improved from 0-40 degrees to 0-50 degrees. There was a marked reduction in pain levels, with the Numerical Pain Rating scale (NPRS) scores decreasing from 7/10 to 3/10. Additionally, function of lower extremity was also improved, with the Lower Extremity Functional scale (LEFS) scores improving from 55/80 to 70/80. These results show that the treatment is effective in improving Hip mobility, reducing pain, and enhancing overall lower limb function.

Studies on reciprocal inhibition Muscle Energy Technique (MET) and post isometric relaxation (PIR) in acute piriformis syndrome suggest several mechanisms, by which these interventions improve clinical outcomes. MET involves activating the antagonistic muscles to the piriformis, which induces reciprocal inhibition of the piriformis. MET reduces the muscle tension within the piriformis muscle by decreasing muscular hypertonicity and enhancing neuromuscular coordination, thereby helping in relieving the pain and improving Hip ROM.[9] Post isometric relaxation (PIR) initiates an isometric contraction of the piriformis muscle followed by a passive stretching. This sequence stimulates the autogenic inhibition, a reflex mechanism that decreases the muscle tone, thereby relieving a tension within the piriformis. Hence, patients experience reduced pain perception due to relaxed state of muscle. Moreover, it enhances the flow of blood to the muscle, facilitating the removal of metabolic waste products and supporting tissue healing. This improved circulation helps to enhance the flexibility and range of motion of Hip joint.[10]

Muscle Energy Technique (MET) treatment for piriformis syndrome provides significant advantages including pain reduction, improved Hip mobility, enhanced lower limb function, improved muscle coordination, and supports long-term recovery through increased blood flow and tissue healing.[11] MET is effective in treating both acute and chronic piriformis syndrome by reducing muscle tension and improving function. In rehabilitation, MET accelerates recovery from Hip injuries by enhancing coordination and reducing muscle tension and facilitating a return to normal activities.[12,13] MET offers a non-invasive and cost-effective approach for managing piriformis syndrome, as it does not require expensive equipment or surgical procedures. MET effectively reduces pain and improves function, thereby decreasing the need for costly pain medications with potential side effects.[14] Improved functional outcomes from MET also results in fewer health care visits and lower treatment costs, thereby enhancing patient's quality of life and reducing indirect cost associated with disability.[15]

The intervention improved the intended parameters but had limitations including the single case study design and inability to evaluate long-term effect of exercises. Future studies with larger sample size and long term effect follow-up could assess the carry-over effect of Muscle Energy Technique on piriformis syndrome.

Conclusion

A six-week Muscle Energy Technique intervention in a patient with piriformis syndrome was effective in relieving pain, improving Hip range of motion (ROM) and enhancing the lower extremity function. Further research could be conducted in a larger population, over a longer duration, using different outcome measures and with different exercise therapy interventions tailored for individuals with piriformis syndrome.

Patient Consent: A written consent was obtained from the patient.

Ethical Clearance: Obtained.

Name of the ethics committee clearing the study: Institutional Ethics Committee AJ Institute of Medical Sciences and Research Centre. Date: 25/06/2024 DCGI Reg. No. EC/NEW/INST/2020/741Number: AJEC/REV/195/2024

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Original Article

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Role of EMG Biofeedback on Ankle to Improve Balance in Young Old Geriatric Population - A Randomised Control Trial

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Abstract

Background: Falls in the elderly have become an significant public health issue. Approximately 30% of the older population falls once a year, with greater risk for older women. WHO addresses the situation as a public health issue because falls lead to injuries and fractures.[4] It is known that during quiet standing, sway of entire body is correlated highly with the ankle joint rotation and this explains why muscles crossing the ankle joint are able to provide sensory information necessary to maintain upright standing. The ankle strategy is particularly effective in responding to the small and slow perturbations, and these muscles play a crucial role in the fine-tuned adjustments needed for postural control during activities such as standing, walking, or other weight-bearing tasks. Electromyographic (EMG) biofeedback serves as precious physiotherapy tool in enhancing and optimizing the ankle strategy, particularly in the environment of balance and postural control. With the use of EMG-biofeedback, elderly individuals can be taught to manipulate previously uncontrollable or unfelt events by modifying the signals that are shown.

Method: Total 84 subjects participated in the study. Subjects were screened according to the inclusion and exclusion criteria. Baseline outcome measures which included the MiniBEST test and functional reach test were assessed. MiniBEST test is used for dynamic balance and functional mobility, it contains 14 items whereas functional reach test was used to assess static balance with outstretched hand. Subjects were randomly allotted into three groups. Group 1 was given balance protocol. Group 2 was given EMG Biofeedback with balance exercises. The group 3 was given only EMG Biofeedback, outcome measures were reassessed post intervention. This study showed that statistical and clinical significance was observed in all the intra-groups($p<0.05$). Within the group the study showed greater improvement clinically and statistically in Group 2. ANNOVA test showed Group 3 being more affective compared to other 2 groups.

Conclusion: The study concluded that EMG Biofeeback training should be included in along with exercise protocol to improve balance.

Keywords: Balance, ankle strategy, balance exercise program, EMG Biofeedback, ankle muscles, elderly population, geriatric.

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Introduction

The hallmark of a successful aging process is continuing to lead an autonomous life. The biopsychosocial approach views successful aging as a complex idea. Functional performance is significant in this framework because it establishes the capacity to keep your independence.

According to the WHO Report on Falls Prevention in Older Age, 28–35% of individuals aged 65 or older have a history of falls, while this rate increases to 32–42% among individuals aged 70 or older.[1,2] Some key factors contributing to the age-related decline in balance include: decreased muscle mass & strength, reduced bone density, sensory decline, Impaired ear function, degenerative neurological changes and side effects of medications[3].

Elderly people who have endured fall may suffer from a series of severe complications including hip joint fractures, which increase their morbidity and mortality rates and waste medical resources.[5]

It is known that during quiet standing, sway of the entire body is identified largely with ankle joint rotation and this explains why muscles crossing the ankle joint are able to give sensory information necessary to maintain upright-standing. The ankle strategy for balance primarily involves muscles that control movements around the ankle joint. Key muscles involved in the ankle strategy include:

1. Anterior Tibialis, located on the front of the lower leg and is responsible for dorsiflexion, This muscle plays a crucial role in controlling forward sway and preventing the foot from dropping excessively during the ankle strategy.
2. Gastrocnemius and Soleus:located in the calf and are responsible for plantarflexion. These muscles play a significant role in controlling backward sway by contracting to push the body forward and restore balance during the ankle strategy.

These muscles work in coordination to make adaptations at the ankle joint, helping to maintain equilibrium and prevent falls. The ankle strategy is particularly effective in responding to small and slow perturbations, and these muscles play a crucial role in the fine-tuned adjustments needed for postural control during activities such as standing, walking, or other weight-bearing tasks. The coordinated activation of these muscles and strategies ensures dynamic and adaptive responses to changes in body position and external disturbances, contributing to effective balance maintenance.

EMG biofeedback therapy is based on the enhancement of myoelectric signals attained from the muscles, which also are converted into visual and auditory signals with the aim to inform the individual about the activity of muscles.[9] EMG biofeedback involves the real-time measurement and display of electrical muscle activity through surface electrodes, providing individuals with visual or auditory feedback about their muscle contractions.[8,9,10]EMG-biofeedback supported exercise programs are suggested as they increase compliance with exercise and motivation of patients.[8]

The aim of the study was to assess the Role of EMG biofeedback on ankle to improve balance in young old geriatric population.

Materials & Methods

MATERIALS:

- STEPPER
- WOODEN CHAIR
- FOAM SURFACE
- INCLINE SURFACE

METHODOLOGY:

- STUDY DESIGN – Interventional Study
- STUDY TYPE – Randomised Control Trial (Multi group pre test post test design)
- TYPE OF SAMPLING – Simple Random Sampling (chit system)
- SITE OF STUDY– Physiotherapy OPD, Nanavati Max hospital
- SAMPLE SIZE - 84 (28 in each group)
- STUDY POPULATION – Young old Geriatric Population
- INCLUSION CRITERIA:– Geriatric patients with age 65 to 75 years.
- EXCLUSION CRITERIA:– Any known musculoskeletal / neurologic conditions which may hamper balance.Any systemic illness that may hamper balance.

PROCEDURE

Informed consent was taken from each individual prior the intervention. Following are the groups-

Group A - Protocol (Balance Exercises)

Each balance exercise will be done 10 repetitions *1 set. Foam surface will be introduced inthe 4th session and Blocking of Vision 8th Session onwards.

Group B - Protocol (EMG BF + Balance Exercises)

In addition to Balance exercises mentioned previously EMG Biofeedback training will be given for gastrocnemius and tibialis anterior muscles.

Group C - Protocol (EMG BF) : Only EMG Biofeedback training will be given for gastrocnemius and tibialis anterior

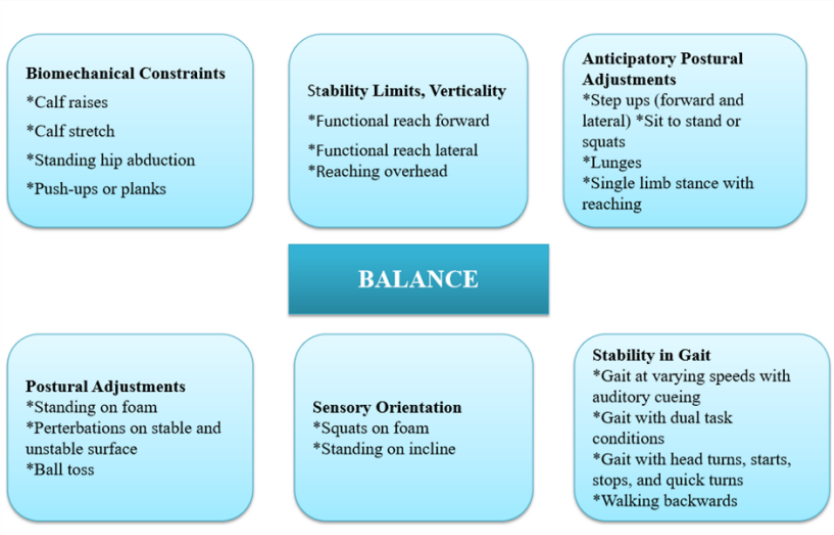

Figure 1: Horak Balance exercise

Table 1: EMG Biofeedback protocol

Activity	Mode	Repetitions	Intensity
Active movements	Open Display	1Set * 10 Reps Active Movements	Increase set threshold every alternate session by 10
Active movements	Open Display	1Set * 10 Reps Active Movements with 3sec hold	Increase duration of hold by 2 secs alternate session
Work Rest Mode	Open Display	Movement followed by rest pauses. 30 secs	Increase 10 secs every alternate sessions
Interactive games	Open Display	3 games - 60 secs each	Increase difficulty every 3rd session

Figure 2: Calf raise

Figure 3: Toe raise

Figure 4: Standing on one leg

Figure 5: Forward Lunges

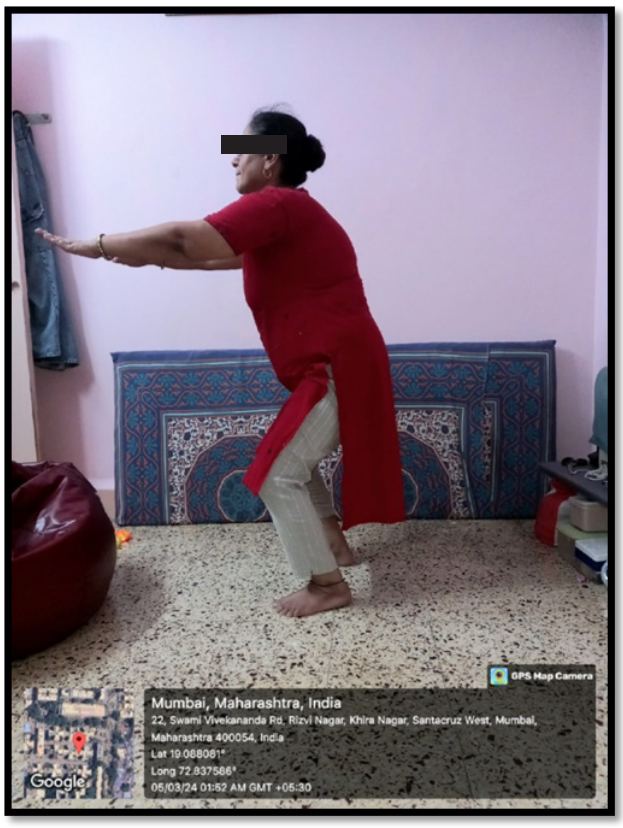

Figure 6: Squats

Figure 7: Standing hip abduction

Figure 8:Step up forward

Figure 9: Walking over obstacle

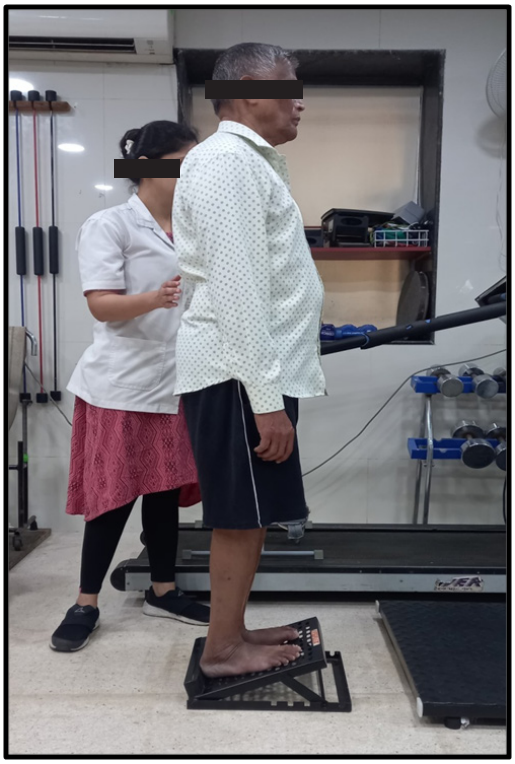

Figure 10: Standing on incline

Figure 11: Walking with head turns

Figure 12: Electrode placement for EMG Biofeedback

Figure 13: Playing EMG Biofeedback games

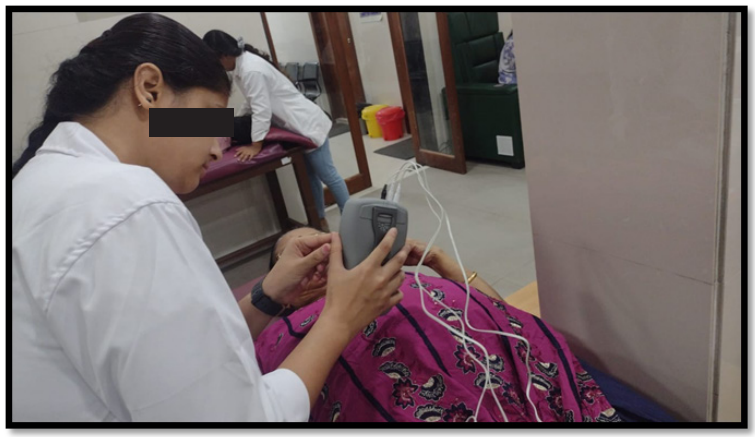

Figure 14: Teaching EMG Biofeedback games

Result

The Standard Package for Social Sciences (SPSS) version 29 was used for the statistical analysis. The intra- group data was analysed using paired t test. The inter group analysis was done using ANOVA test, followed by post HOC test. The results were considered significant if p</= 0.05 The baseline data for the participants in the study is as follows:-

TABLE 2 - Mean age with standard deviation

Group	Mean Age	Total Number
1	69.61±2.78	28
2	69.39±2.65	28
3	69.36±2.87	28

1. Results of, MiniBEST test Evaluation in intra groups showed both clinical and statistically significant improvements with a p-value of p=0.001
2. Results of, Functional reach test Evaluation in intra groups showed both clinical and statistically significant improvements with a p-value of p=0.001 that is less than p=0.05. Post Hoc analysis showed that within group results showed group 2 had significant results in comparison to Group 1 &3. The p value obtained for group 3 with group 1 was 0.28 and group 3 with group 2 was 0.006 showing that the performance of group 2 was clinically and statistically better than group 1 & 3

TABLE 3 - Data analysis of intra-group with Mean, Standard deviation and p-value:

OUTCOME MEASURE	GROUP 1		GROUP 2		GROUP 3		ANNOVA p-value
	pre	post	pre	post	pre	post	
Total MiniBEST	19.32±2.57	23.43±2.09	18.93±3.09	23.32±2.62	18.89±3.48	23.79±2.67	0.76
Paired t test	<0.001		<0.001		<0.001		
Anticipatory component	4.39±1.13	5.29±0.71	4.75±0.88	5.61±0.73	4.50±1.10	5.54±0.74	0.23
Paired t test	<0.001		<0.001		<0.001		
Reactive Postural Control	3.96±0.83	4.86±0.80	3.61±0.91	4.64±0.78	3.79±1.13	4.79±0.91	0.62
Paired t test	<0.001		<0.001		<0.001		
Sensory Orientation	3.93±0.66	4.93±0.71	3.32±0.90	4.50±0.83	3.14±1.07	4.71±1.04	0.19
Paired t test	0.023		<0.001		<0.001		
Dynamic Gait	7.04±1.23	8.36±0.87	7.25±1.55	8.57±1.37	7.46±1.17	8.75±0.84	0.38
Paired t test	<0.001		<0.001		<0.001		
Functional reach test	17.69±7.16	19.02±6.99	21.55±8.29	23.34±8.21	22.08±8.73	23.14±8.70	0.02
Paired t test	<0.001		<0.001		<0.001		

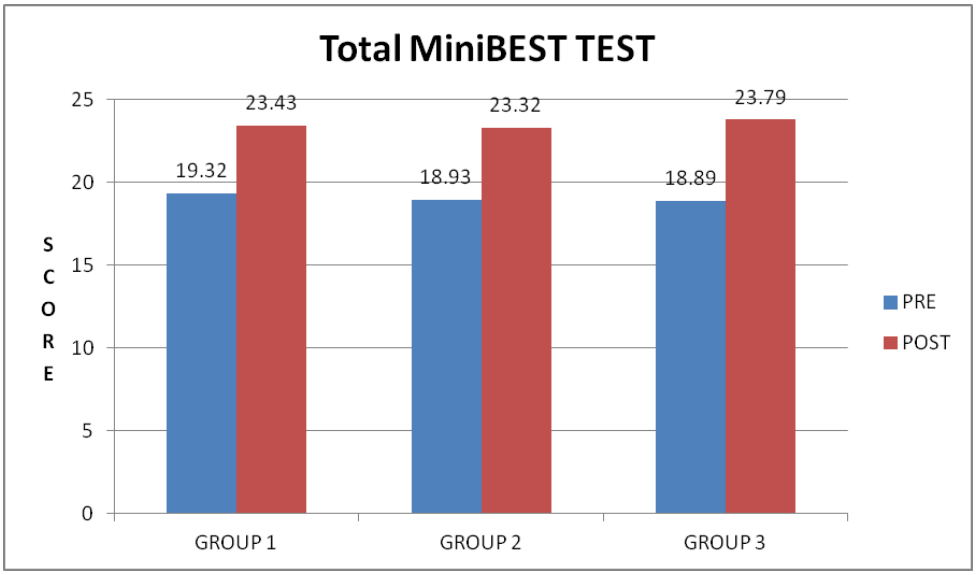

Figure 15: Total MiniBEST Test

TABLE 4 : Total MiniBEST TEST

Mini BEST TEST	PRE	POST	p-value
GROUP 1	19.32±2.57	23.43±2.09	<0.001
GROUP 2	18.93±3.090	23.32±2.625	<0.001
GROUP 3	18.89±3.489	23.79±2.672	<0.001

There was a significant change observed in the intra group values of the groups individually with a p value of <0.001 (i.e.p<0.005). However ANNOVA test did not show any statistical difference. The p value obtained was 0.765 (i.e. p> 0.005).

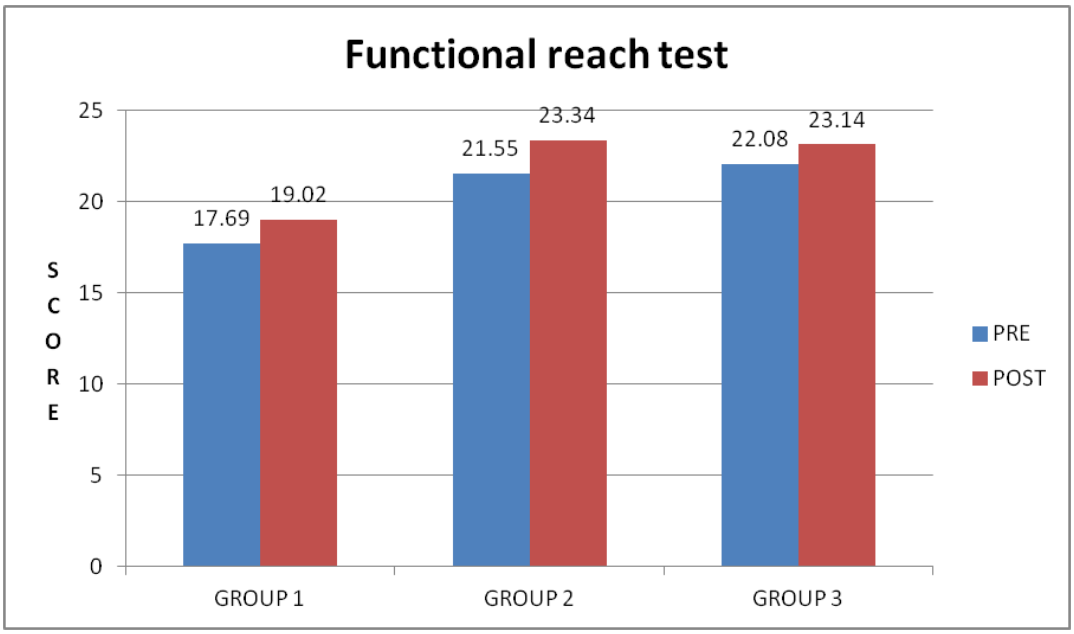

Figure 16: Functional reach test

TABLE 5: Functional reach test

FUNCTIONAL REACH TEST	PRE	POST	p-value
GROUP 1	17.69±7.16	19.02±6.99	<0.001
GROUP 2	21.55±8.29	23.34±8.21	<0.001
GROUP 3	22.08±8.73	23.14±8.70	<0.001

ANNOVA test of difference of means of functional reach test showed a significant change between the 3 groups. The p value obtained is 0.02 i.e p<0.05 .

Post hoc analysis showed group 2 had significant results in comparison to Group 1 &3. The p value obtained for group 3 with group 1 was 0.28 and group 3 with group 2 was 0.006 showing that the performance of group 2 was clinically and statistically better than group 1 & 3

Discussion

This study discussed the effect of EMG Biofeedback and balance exercises on ankle and sees how it affects structures around the ankle to improve balance in young old geriatric population. A set protocol of series of balance exercises and EMG Biofeedback series of exercise

MiniBEST test:

Figure 15 represents the statistical analysis of total MiniBEST test of 3 groupsStatistically and clinically all the 3 groups performed well in this according to the pre and post values. The score has increased significantly in all the 3 groups suggesting that the balance has improved. On analysing further, it shows that ANNOVA test did not show any statistical difference.

In conclusion, while all three groups demonstrated significant improvements in balance outcomes within their respective interventions, the lack of significant differences between groups as indicated by ANNOVA suggests that the outcome measure utilized may not have been sufficiently sensitive to detect the specific effects of EMG biofeedback on ankle joint training.

When the muscles around the ankle are weakened, balance ability is decreased. Exercises and EMG Biofeedback are known to activate the Ia group sense of muscles, activating functional muscle selectively and helps the function of antagonistic muscles thereby improving the role of muscles around ankle joints are critical for maintaining balance.[17]

In addition , biofeedback training can identify real-time vital signs seen by the patient themselves in this case ankle dorsiflexors and plantarflexors, thus it can enhance small increases in achievement towards goals, and rapidly facilitate the process of rehabilitation. Application of a game system using EMG biofeedback can induce correct movement through the use of EMG signals relating to weakened muscles, and improve motor performance by facilitating motor learning in real-time. Game system using EMG biofeedback may need proper timing of contraction and relaxation of muscles, control of neural networks of neuromuscular system, and accurate movement in order to control a game character through inducing muscle contraction,.[16]

Figure 2 represents the statistical analysis of the Functional reach test. The graph shows clinical and statistical significance in all the 3 groups individually. However, the inter group result shows Group 2 (Balance + EMG Biofeedback) was clinically and statistically better as compared to Group 1(Balance) and Group 3(EMG Biofeedback). During the FRT, an individual leans forward, the body's center of mass shifts, requiring the engagement of ankle muscles to counteract destabilizing forces and maintain an upright posture. Ankle dorsiflexors and plantarflexors, including muscles such as the tibialis anterior and gastrocnemius, play crucial roles in stabilizing the ankle joint and controlling movement during the reach task. The coordinated action of these muscles helps individuals maintain balance and stability while reaching forward.

Providing individuals with additional sensory information on their own motion, i.e. biofeedback, during training enhances movement performance. This is a better method of retraining muscle by creating new feedback systems. The study concluded that's using EMG biofeedback in adjunct to with conventional balance exercises showed significance as compared to functional task training with conventional.[18]

Conclusion

This study concluded, while all three groups demonstrated significant improvements in balance within their respective groups, the lack of significant differences observed between groups in the ANNOVA

The Limitations of the study include lack of Outcome measures that focus specific on ankle component.

Ethical Approval: Institutional ethical committee at Nanavati Max

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Original Article

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Dynamic Neural Mobilization Versus Proprioceptive Neuromuscular Facilitation on Grip Strength and UpperLimb Function in Sub-Acute Stroke Subjects

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Abstract

Background: Neural mobilization and Proprioceptive Neuromuscular Facilitation (PNF) help in reducing spasticity, improve muscle flexibility and balance, enhancing mobility and elasticity of the nervous system in stroke subjects.

Objectives: The objective of the study was to compare the effect of Dynamic Neural Mobilization and PNF on grip strength and upper limb function in sub-acute stroke subjects.

Materials and methods: 30 post-stroke subjects were recruited and were randomly divided into two groups. 15 subjects in Group A received Dynamic Neural Mobilization while 15 subjects in Group B received PNF. The treatment sessions were scheduled for 30 minutes per day, 5 times a week, for 4 weeks. Subjects were assessed for upper limb function and grip strength prior to- and post-intervention using Fugl Meyer Assessment-Upper Extremity (FMA-UE) subscale and Hand Held Dynamometer.

Results: Pre-test score of FMA-UE and grip strength were 33.60±7.13 and 2.92±1.07 in Group A and 32.60±9.85 and 1.70±0.68 in Group B respectively. The post-test scores of FMA-UE and grip strength were 41.00±7.07 and 5.12±203 in Group A and 34.13±10.40 and 3.32±0.82 in Group B. Within group comparison showed significant improvement in Group A and in grip strength of Group B subjects. FMA-UE in Group B did not show significant results compared to pre-test scores. Between groups comparison showed statistically significant improvement in Group A in both the outcomes.

Conclusion: Based on the results, it can be concluded that Dynamic Neural Mobilization was more effective than PNF in improving grip strength and upper limb function in subacute stroke subjects.

Keywords: Subacute stroke, Dynamic Neural Mobilization, Proprioceptive Neuromuscular Facilitation, Neurodynamics, Upper Limb Function, Grip Strength

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Introduction

Post-stroke, hemiplegia leading to upper extremity (UE) dysfunction,[1] is associated with activity limitation and reduced quality of life.[2] Voluntary control and functional arm movements are lost affecting activities of daily living (ADL).[3,4] Most tasks need co-ordination between both upper limbs requiring recovery of bilateral arm function.[5] After stroke, voluntary function recovers in first three to six months and then slows down with chronic phase.[1] Most individuals with mild paresis recover well but in individuals with severe paresis, only around 20% of the upper limb functions are recovered leading to secondary complications.[6]

Adverse tension is seen in the entire nervous system when nerves are affected limiting movement and adaptation capacity. Neural Mobilization attempts to restore normal neurodynamicswhich can restore the homeostasis in and around the nervous system and the structures around itthrough manual techniques and exercise.[7-11] Inspite of many motor therapies and their benefits, the paralyzed hand exhibits slow recovery.[12] Dynamic neural mobilization is an advanced version of the existing neural mobilization technique where dynamic movement in the paralyzed hand is performed. Improving upper limb function needs rehabilitation of not just proximal functions but also minute ones.[13]

Neuromuscular re-education involves proprioceptive facilitation.Proprioceptive impairment slows down motor re-education as sensory information from proprioceptors is transmitted via afferent neural pathways which forms the basis for cortical motor patterns that are reflected in muscle behaviour.[14] Proprioceptive Neuromuscular Facilitation (PNF) involves movements in diagonal patterns.[15] At cortical level, the facilitation positions increase evoked motor potentials, thus increasing the movement's effectiveness.[16,17] PNF generates greater changes in cortical activity, as assessed by absolute power levels in beta band of parietal cortex, a cortical region whose functions relate to the integration of motor information. This suggests possible beneficial effects of PNF at cortical level, further justifying its use in clinical practice.[18]

Neural mobilization is cost effective and reliable. Literature suggests the use of stretching the peripheral nerves through neural mobilization in central nervous system lesions. Neural mobilization was observed to be beneficial in reducing spasticity, improving range of motion and function in stroke subjects. Dynamic Neural Mobilization improved the mechanosensitivity of the nervous system and induced changes in its viscoelasticity.[19] Dynamic Neural Mobilization was studied extensively in the lower limb but there is a dearth of literature on its effect on upper limb function. Therefore, there exists a need to compare the effect of Dynamic Neural Mobilization and PNF on grip strength and upper limb function in sub-acute stroke subjects.

Methodology

38 male and female subjects with sub-acute stroke,[20]aged between 40-65 years were assessed and 30 subjects who met the inclusion criteria were recruited for the study. Subjects with 1st episode of stroke, Mini Mental State Examination (MMSE)score of 24 and above,[21] spasticity grade II or lower according to modified Ashworth scale and voluntary grading of ≥4 on the Brunnstrom stage of recovery were included in the study. Subjects with visual, auditory, or cognitive deficits who were incompatible with the treatment protocol, any other neurological comorbidities, and musculoskeletal complications in upper extremity that can restrict passive range of motion on the paralyzed arm, any cardiorespiratory complications and uncooperative subjects were excluded from the study. Informed consent was obtained from the subjects and Institutional Ethical Committee clearance was taken prior to the study. The subjects were assigned to one of the two groups and demographic variables such as age, gender, dominance, height, weight, BMI and side of affection were documented for all subjects. Prior to- and post-intervention, all subjects were assessed for upper limb function and grip strength using Fugl-Meyer Assessment-Upper Extremity **(**FMA-UE) subscale and Hand Held Dynamometer respectively which are valid and reliable tools.[22-28] Hand grip strength test was repeated three times and the best result was noted in kilograms of force.

Intervention used on the subjects

Subjects in Group A (n=15) received Dynamic Neural Mobilization for radial, median and ulnar nerves.The technique was performed as follows:

For radial nerve mobilization - The subject was in supine position. The shoulder was lowered toward same side while internally rotating shoulder, extending elbow, and pronating forearm and laterally flexing the neck to the opposite side. Therapist performed dynamic hyper-internal rotation of the subject's wrist every 2 seconds, for 20 seconds using metronome.

For median nerve mobilization - The subject was in supine position with shoulder and elbow at approximately 90° and wrist in extension. The therapist then fixed the subject's shoulder with one arm while externally rotating it, extending elbow, supinating forearm and finger and wrist extension and neck was laterally flexed to the opposite side. The therapist performed dynamic hyperextension of the distal area of subject's arm, once every 2 seconds, for 20 seconds, using metronome.

For ulnar nerve mobilization - The subject was in same position as the median nerve mobilization. The therapist externally rotated subject's shoulder with forearm pronation and wrist and finger extension, with neck flexed to the opposite side. The therapist performed dynamic hyperextension of the subject's wrist, once every 2 seconds, for 20 seconds using metronome.[9]

Subjects in Group B (n=15) received PNF exercises. Patterns chosen are used for ADL and may have higher strength gains which were Flexion/Adduction/External rotation and Extension/Abduction/Internal rotation.[29]

Participants in both groups received intervention for 30 minutes once a day, 5 days a week for 4 weeks along with conventional exercises for another 15 minutes which included manual dexterity exercises like grasp release, stacking cones, functional task practice when possible, and stretching/weight-bearing by the affected arm, and activities of daily living using the less-affected side.[30] Subjects were allowed to rest during the treatment session to avoid fatigue as and when required.

Results

Table 1: Distribution of subjects in both groups according to their age, gender, dominance, side affected, duration of stroke, BMI and type of stroke.

S.No.	Variables	Experimental Group	Control Group
		Mean±SD	Mean±SD
1	Age (in Years)	49.80±4.64	47.69±6.09
2	Gender (M / Fe)	11(73.3%)/4(26.7%)	9(60.0%)/6(40.0%)
3	Dominance (L/R)	1(6.7%)/14(93.3%)	2(13.3%)/13(86.7%)
4	Side Affected (L/R)	4(26.7%)/11(73.3%)	5(33.3%)/10(60.7%)
5	Duration of stroke (in Months)	3.60±1.99	3.67±1.76
6	BMI	25.0±2.62	26.81±2.73
7	Type of Stroke (Ischemic/Hemorrhagic)	12(80.0%)/3(20.0%)	12(80.0%)/3(20.0%)

Table 2: Range, mean and SD of outcome measures of subacute stroke subjects in Group-A

S.No.	Outcome Measures	Group-A (DNM)				Wilcoxon test/ Paired t-test	p-value
		Pre-test		Post-test			
		Range	Mean±SD	Range	Mean±SD		
1	FMA	22-48	33.60±7.13	31-58	41.00±7.07	z=3.413*	p<0.001
2	Grip strength	2-4	2.92±1.07	2.5-9.7	5.12±2.03	t=10.421*	p<0.001

Note: * denotes Significant (p<0.05), NS-Not significant (p>0.05)

Table 3: Range, mean and SD of outcome measures of subacute stroke subjects in Group-B

S.No.	Outcome measures	Group-B (PNF)				Wilcoxon test/ Paired t-test	p-value
		Pre-test		Post-test			
		Range	Mean±SD	Range	Mean±SD		
1	FMA	17-45	32.60±9.85	17-51	34.13±10.40	z=1.694, NS	p>0.05
2	Grip strength	1-3	1.70±0.68	1.9-5.0	3.32±0.82	t=6.546*	p<0.001

Note: * denotes Significant (p<0.05), NS-Not significant (p>0.05)

Table 4:Comparison of pre and post-test outcome measures of subacute stroke subjects in between the groups

S.No.	Outcome measures	Pre-test		Post-test	
		Group A	Group B	Group A	Group B
		Mean±SD	Mean±SD	Mean±SD	Mean±SD
1	FMA	33.60±7.13	32.60±9.85	41.00±7.07	34.13±10.40
2	Grip strength	2.92±1.07	1.70±0.68	5.12±203	3.32±0.82
Between group comparisons: Unpaired t-test/ Mann –Whiney U test		• FMA: z=1.437, p>0.05, NS • Grip strength: t=1.13, p>0.05, NS		• FMA: z=2.953, p<0.05, S • Grip strength: t=3.356, p<0.05, S	

Note: S denotes significant (p<0.05); NS – not significant (p>0.05)

Discussion

The aim of the present study was to compare the effect of Dynamic Neural Mobilization and PNF on grip strength and upper limb function in sub-acute stroke subjects. The baseline characteristics of age, gender, BMI were analyzed on frequency and percentage analysis with level of significance at 5% and were found to be statistically not significant ($p>0.05$). Based on dominance, duration of stroke and the side of affection, subjects were analyzed for statistical difference between the groups and were found to be homogenous. The results showed that subjects in both the groups were similar prior to the intervention.

When the pre and post-intervention results of Group A were compared, there was a significant improvement seen in these individuals in both the outcomes ($p<0.001$). The results of this study are in line with a previous study conducted by Jessica Castilho, et al who found improvement in the EMG motor activity and pain using upper extremity neural mobilization by improving retrograde axoplasmic flow which was seen to be abnormal in spastic muscles. Neural tension reduces adhesions of the nerve and surrounding tissue, thereby better recruitment of muscle fibres and motor activity, improving range of motion and flexibility.[31,32]

When the pre and post-intervention scores of Group B were compared, it was seen that the results were not significant for FMA-UE score ($p>0.05$) but a significant improvement was seen in grip strength ($p<0.001$). It was observed that there was altered performance in the wrist, hand and coordination and speed components of the FMA-UE scale while clinically assessing the subjects after intervention. Most of the subjects in this group were unable to perform the movements in specific components, while few partially completed the tasks with compensatory movements. In contrast, post-intervention grip strength was better than the pre-intervention scores. The findings are supported by previous literature which shows that PNF is effective in promoting neural and synaptic regeneration. PNF exercises can help in improving muscle tone by stimulating muscle proprioceptors and nerve roots, enhancing functional movement. Effect of irradiation from stronger to weaker muscles also helps in muscle tone and strength.[33]

When between the group comparison was done in pre-intervention scores, it was seen that there was no significant difference in the FMA-UE ($p>0.05$) and grip strength ($p>0.05$) scores signifying that both the groups were homogenous. Post-intervention, there was a significant improvement seen in both scores ($p<0.05$). Literature evidence suggests that Neural mobilization stimulates mechanical receptors, muscle spindles and Golgi tendon organs, but introducing dynamic movement to the technique can be more effective in activating them leading to better muscle activity.[19] It is also observed that PNF position, though not in a single trial brings change in the baseline muscle excitability through muscle stretch, influencing cortical and spinal activation before the voluntary movement leading to better performance[18] which could help in understanding the better improvement observed in Group A.

Although no subgroup differences were found in principal component loadings concerning age, paretic side and type of stroke, the results must be interpreted with caution when generalizing to a wider population. Dynamic Neural Mobilization can be used to promote smooth body movement and recovery of arm function for post-stroke individuals. Additional clinical studies are warranted to investigate the effects of dynamic neural mobilization on other parts of the body. Further investigations in this field might improve the knowledge on the impact of Dynamic Neural Mobilization on motor control.

Conclusion

Though both the groups improved significantly post-intervention, it was observed that Dynamic Neural Mobilization was more effective than PNF in improving upper limb function, post-stroke. The present study implies that Dynamic Neural Mobilization helps in improving body movement and arm function suggesting its application in post-stroke upper limb rehabilitation.

Ethical Clearance – Obtained from Institutional Ethical Committee of Padmashree Institute of Physiotherapy (Dated 11/03/2020 with Ref No. PIP/EC/11-07/03-2020).

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Original Article

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Effectiveness of Specific Quadriceps Modification and MET in Postoperative Phase I Rehabilitation Program of Fracture Shaft of the Femur

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Abstract

Objective: To assess the efficacy of specific quadriceps modification exercises and MET in phase I rehabilitation after surgical fixation of femoral shaft fractures: the study aims to reduce pain intensity, enhance knee range of motion (ROM), and improve quadriceps strength and control in the affected leg.

Background: The study aims to evaluate the outcomes of postoperative rehabilitation for femoral shaft fractures using MET and modified quadriceps exercises to address functional deficits during phase 1 recovery.

Design: A study was conducted with 10 subjects aged 18 to 70, divided into groups A and B (n=5 each). Post-surgery, range of motion (ROM), knee extensor strength, and pain levels (VAS) were assessed. Subjects underwent a 2-week postoperative rehabilitation program. Statistical analysis was performed to compare outcomes between day 1 and discharge.

Results: The study found significant improvements in both groups, with the experimental group showing greater reductions in pain, increased knee flexion in supine lying ($P \leq 0.001$) and short sitting ($P \leq 0.002$), extension ($P \leq 0.01$) ROM, as well as improved quadriceps strength and control.

Conclusion: The study indicates significant improvements in pain reduction, increased range of motion (ROM), and quadriceps muscle strength in both groups. However, the experimental group, which received MET and modified quadriceps exercises, showed greater improvements compared to the control group.

Keywords: Specific quadriceps modification exercises, MET, ROM, Femur shaft fracture

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Introduction

A femoral shaft fracture typically results from severe trauma like falls from heights, road accidents, direct impacts, or industrial mishaps. Given the traumatic nature and extensive surgical intervention involved, soft tissue damage is common, which can hinder patients' return to their prior level of function. Even after adequate bone healing, patients often experience ongoing impairments and functional limitations that persist long after the initial injury and surgery. Function limitations and impairments following femoral shaft fracture are often linked to soft tissue injuries sustained during trauma or surgery. These include hip abductor weakness causing a Trendelenburg gait, anterior knee pain, quadriceps femoris muscle weakness, and reduced gait and walking endurance. These issues stem from structural damage and inflammation, impacting mobility and functional recovery post-injury. Hip abductor weakness is assumed to be an iatrogenic complication of femoral intramedullary nailing, and open plating which involves a lateral approach to the femur with associated dissection of the vastus lateralis and inadequate postsurgical rehabilitation Quadriceps muscle is important in most weight-bearing functional activities and protect the structure of the knee. "Quadriceps femoris muscle weakness is common following femoral fracture, with or without surgical intervention. Peter Krustrup et al (2004)[38] describe quadriceps muscle weakness as an important contributor to disability. After a femoral fracture, there is a reduction in fast-twitch muscle fiber size in the quadriceps and these fibers are important in generating leg extensor power. D. A. Rice and P.J. McNair et al [28] describe that marked weakness of quadriceps muscle weakness is partly due to muscle atrophy and partly ongoing neural inhibition prevents the quadriceps from being fully activated, a process known as atherogenic muscle inhibition. The focus is on addressing quadriceps muscle inhibition (QMI) post-femoral surgery, where pain, inflammation, joint laxity, and structural damage contribute to AMI. This inhibitory condition limits quadriceps activation, potentially leading to muscle atrophy and hindering rehabilitation efforts. The rehabilitation program integrates conventional and experimental approaches, emphasizing isometric quadriceps contractions with ankle dorsiflexion, TheraBand exercises, and MET. MET includes post-isometric relaxation (PIR), utilizing Golgi tendon organs to relax muscles after contraction, facilitating muscle lengthening and enhancing mobility recovery. From the Golgi tendon organ, the afferent nerve impulses enter the dorsal root of the spinal cord and meet with inhibitory motor neurons impulse and therefore prevent further contraction, the tone decreases with results in the agonist relaxation and lengthening". [9, 25, 26, 25, 26, 34.] Specific quadriceps modifications consist of pain-free exercises such as ankle dorsiflexion, ankle dorsiflexion with inversion, use of a small wedge, and static weight lifts. This provides a faster progression of treatment and a subsequently shorter rehabilitation period.[29]

Methodology

An experimental trial was conducted on subjects aged 18 to 70 years who met specific criteria: internal fixation of femoral shaft fracture, unilateral leg involvement, and no complicating factors like head injury or soft tissue damage. Patients with bilateral involvement, neurovascular issues, or other medical conditions affecting the study protocol were excluded. Ethical approval was obtained from the research committee at the Himalayan Institute of Medical Sciences for Dr. Arun pathak on 26/06/2018, reference no. - SRHU/HIMS/RC/2018/167, and subjects provided informed consent. Ten eligible subjects were randomly assigned to either Group A (postoperative femur fracture rehabilitation program) or Group B (postoperative experimental exercise protocol). The McGill Pain Questionnaire (MPQ) assessed pain intensity, knee range of motion was measured using a Goniometer, and quadriceps muscle strength was evaluated with a modified sphygmomanometer. [14, 15, 16, and 17.] MPQ was taken on the post of day one and day of discharge, The modified sphygmomanometer (MST) demonstrated adequate criterion-related validity as well as test-retest and intern–rater reliability. It is a portable, inexpensive, and promising method to be used within clinical settings worldwide for the assessment of the strength of the LL.[18, 19, 20, 21, 22.] To measure quadriceps muscle strength patients are placed supine. An inflated cuff is placed under the popliteal fossa with the knee in position in 30^0 of flexion. The inflated bag was set to its load of 80 mmHg. The subject was asked to voluntarily contract their quadriceps muscle as much as possible by keeping the inflated cuff under the popliteal fossa. Three readings were taken and recorded and the meaning of it was considered as a maximum voluntary contraction. To measure the ROM at the knee, a universal Goniometer provides a simple objective assessment of a patient's initial status and progress depending on the reliability and validity of the measurements. [30, 31]

GROUP A Intervention: Phase I of the femur fracture rehabilitation protocol, spanning 1 to 2 weeks from postoperative day 1, included several key components. Patients received ice pack therapy over the incision for 15 minutes and kept their knee elevated in full extension to minimize swelling. Exercises focused on enhancing joint mobility with AROM and PROM exercises for the hip, knee, and ankle, alongside toe pumps. Aggressive pursuit of full knee extension aimed to prevent flexion contracture. Ankle movements (dorsiflexion, plantar flexion, eversion, inversion) were facilitated using Thera band in sets of 10 repetitions, 3 sets, twice daily. Quadriceps sets and gravity-minimized hip abduction slides were introduced to activate knee extensors and hip abductors, performed with 10 repetitions per set, 3 sets per session, twice daily. To prevent knee joint contracture, patients performed posterior lower extremity stretches and elevated the involved limb with the heel propped up for 10 minutes, 3-4 times daily. By the second day,

partial weight-bearing (25%) commenced using a walker, promoting gradual recovery and mobility. The uninvolved lower extremity was moved forward past the involved limb and the cycle was repeated [3,4,5].

GROUP B Intervention: Over a 2-week period, the femur fracture rehabilitation protocol included targeted interventions to promote recovery and mobility. Patients received ice pack therapy over the incision area and maintained knee elevation in full extension to reduce swelling. Exercises commenced immediately with isometric quadriceps contractions using ankle dorsiflexion, progressing to include ankle inversion and small wedge utilization under the knee joint for added challenge. Ankle pumps involving plantar flexion, dorsiflexion, eversion, and inversion were performed. Active assisted exercises for hip abduction, adduction, and knee bending were initiated, advancing to active range of motion exercises and stool or supine lying heel sliding as tolerated. On the second day, partial weight-bearing (25%) began with walker assistance, emphasizing gradual weight transfer and mobility. Post-isometric relaxation (PIR) exercises commenced on day 3, focusing on muscle contraction against resistance followed by relaxation cycles to enhance flexibility and recovery. This structured program aimed to optimize early rehabilitation outcomes following femur fracture surgery.

Statistical analysis

Data was analyzed using Microsoft Office Excel 2010 and Microsoft Office World 10 in Microsoft Windows Embedded 8.1 Industry Pro Build 9600. Intra and inter-groupanalyseswere done by using paired tests and independent t-tests and F – -testof two samples for variances in which the mean standard deviation (mean ±SD) of the variable was calculated. The level of significance wasset at $p \leq 0.05$.

Result

A total number of 10 subjects participated in the study. All subjects completed the study with no dropouts. There were no complications associated with either of the techniques during our clinical study with no subjects showing worsening pain or ROM.

The result of our clinical study is presented as inter and intra-group compression among two groupsbased on pain. The mean ageof Group Aand Group Bwas 15.81 ± 16.27 (range, 18 – 70) years respectively and the difference was not statistically significant (P = 0.8). Group A had 2 men, whereas Group B had 3 men, the two groups did not reach statistical significance (P = 0.878). The comparison among Group A and Group B based onthe BMI variable having mean ±SD of Group A and Group B were 2.0 ± 2.5. The difference was not statistically significant (P = 0.4).

Table 1: Comparison of pain and knee ROM within the two group

Compression of score	Group A			Group B		
	Post-op day 1	Day of discharge	P(within the group)	Post-op day 1	Day of discharge	P (within the group)
MPQ	7.8±1.13	4.2±1.4	0.001	7.8±1.13	3.46±1.36	0.001
ROM: Knee flexion (supine lying) Knee flexion (Short sitting) Knee extension in a short sitting	10±7.905	48±9.082	0.0001	22±9.08	88±16.8	0.0001
	46±8.21	*69±10.24*	*0.0008*	*49±7.41*	*111±7.41*	*0.0004*
	44±4.18	*29±5.47*	*0.013*	*40±7.07*	*8.4±1.14*	*0.0003*

Table 1 Comparison of pain and knee ROM within the two groups. There was an improvement in all the outcomes post 2 weeks in both groups. (P < 0.05).

The next data analysis involved the changes score of each of the outcomes measured between the two groups. Table 2shows changes in the pain intensity on the McGill pain questionnaire between the groups. The group shows statistical significance with P = 0.003.

Table 2: Comparison of change scores between the two groups

Compression	Group A	Group B	P value
MPQ	3.54±0.85	4.35±0.79	0.003
ROM			
Knee flexion (supine lying)	48±9.08	88±16.8	0.001
Knee flexion (short sitting)	69±10.24	111±7.41	0.0028
Knee extension	29±5.47	8.4±1.14	0.01
Quadriceps muscle strength	3.66±1.76	32.33±10.61	0.003

Table 2 shows changes in the flexion and extension ROM between the groups. The groups showed statistical significance with P= 0.05. Group B shows greater improvement in ROM extension (P = 0.01), flexion in supine (P =0.001), and extension in short sitting (P = 0.002).Table 2 shows improvement in quadriceps muscle strength by a Modified sphygmomanometer between the two groups with the P = 0.0003. However, Group B shows greater statistically significant improvement in the reduction of pain,increased knee ROM as wellincreased quadriceps muscle strength as compared with Group A.

Discussion

The study focused on comparing the effects of immediate post-operative application of Modified Isometric Exercise Therapy (MET) and quadriceps modification exercises on pain, knee range of motion (ROM), and quadriceps strength (QS) in femur shaft surgery patients. Both groups experienced reduced pain levels due to spinal block anesthesia, analgesic drugs, ice therapy, and limb elevation. However, the experimental group, which received MET and modified quadriceps exercises, showed greater pain reduction than the control group. MET induces hypoalgesia by activating muscle and joint mechanoreceptors, while ankle dorsiflexion inhibits quadriceps femoris contraction, reducing pain through the flexor withdrawal reflex.

In analyzing knee range of motion (ROM), both Group A and Group B showed significant improvements in flexion and extension, with Group B demonstrating greater gains. Specific quadriceps modification exercises and active straight leg raise (SLR) techniques were key in enhancing knee extension ROM by addressing muscle weakness and optimizing patellar tracking through improved Q angle and motor firing activation. Proprioceptive neuromuscular facilitation (PNF) techniques like post-isometric relaxation (PIR) and reciprocal inhibition (RI), facilitated by Modified Isometric Exercise Therapy (MET), also contributed to improved knee flexion ROM during the 12-day rehabilitation period. These processes involve physiological mechanisms that relax muscles post-contraction and enhance joint mobility effectively, influenced by stretch reflex and other neurological factors.: (a) Muscle spindles sensitive to change in length and speed of change in muscle fibers; (b) Golgi tendon organs that detect a prolonged change in tension"[8,9,10,25].

Stretching a muscle triggers muscle spindles, which signal the spinal cords posterior horn cells (PHC), activating anterior horn cells (AHC) to increase motor impulses and muscle tension. Golgi tendon organs respond to sustained tension by inhibiting AHC impulses, promoting muscle relaxation. Prolonged muscle stretches enhance flexibility by overriding protective contraction, whereas rapid stretches induce immediate muscle contraction without sustained inhibition. Isometric contractions lead to post-isometric relaxation (PIR) through spinal feedback, reducing muscle tone briefly to facilitate muscle length manipulation. Reciprocal inhibition (RI) involves the contraction of agonist muscles inhibiting antagonists, promoting effective muscle control with a refractory period lasting about 20 seconds, less powerful than PIR. Klingles and Schleip (2014) [36] suggest a hydraulic effect within connective tissue structures temporarily enhancing movement freedom or range of motion after stretching or isometric contraction.NP Whitehead et al (2001) [37] reported that changes in both the series elastic and parallel elastic elements of sarcomeres, occurring during the active and passive phase of MET, can be seen as potential contributions.

In our clinical study, specific quadriceps modification exercises over 12 days significantly increased quadriceps muscle strength despite initial challenges with pain and inflammation around the incision and knee joint, especially at the patellofemoral joint (PFJ). Correct execution of exercises, such as using ankle dorsiflexion (DF) to reduce quadriceps contraction force, helped alleviate pain. Ankle DF also stretched calf muscles antagonistically, easing knee extension discomfort. Incorporating wedges enhanced PFJ stability by optimizing patellar positioning, strengthening the VMO (vastus medialis obliquus) to prevent lateral patellar displacement. These modifications effectively targeted muscle strengthening and joint stability during rehabilitation. The greater range allows longer time for activation of VMO to reduce lateral tracking, PNJ pain, reduce inflammation of either the plica or the infrapatellar fat pads and hence increase VMO strength"[29].

Conclusion

The basis of the current study and results showed a significant improvement in the reduction of pain and an increase in knee ROM and quadriceps muscle strength by postoperative rehabilitation program following fracture shaft femur. The results appear significant within the group as well as among the group. The dropout rate and small size may preclude any definite conclusion and results. Therefore, MET and modified QSs with different ankle positions are found more effective in the phase rehabilitation period (over 10 to 12 days) than in the control group.

Ethical Clearance : ethical approval was obtained from the research committee at the Himalayan Institute of Medical Sciences, Doiwala, Dehradun from Dr. Arun pathak on 26/06/2018, reference no. - SRHU/HIMS/RC/2018/167, and subjects provided informed consent.

Conflict of Interest: There was no conflict of interest reported among all authors of this clinical research.

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Original Article

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Effectiveness of A New Visual Distraction Technique in Decreasing Kinesiophobia with Chronic Neck Pain

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Abstract

Background: Kinesiophobia or fear of movement is a cause of decreased level of activity in patients with chronic neck pain. Traditional forms of treatment, such as physiotherapy alone, can tackle problems of neck pain, but not kinesiophobia. This study aims to study the effect of visual distractiontechnique in the treatment of kinesiophobia.

Study design: Quasi experimental study.

Methods: A total of 43 participants with chronic neck pain and kinesiophobia were selected for the study. These participants underwent assessments on the NRS, Tampa scale and evaluation of cervical ROM. Assessment was done pre and post intervention of two weeks.

Results: A significant reduction in Tampa score and NRS scores was observed and improvement in cervical ROM were seen post intervention in all subjects.

Conclusion: The new visual distraction tool is effective in reducing kinesiophobia levels and NRS scores and improving cervical ROM in patients with chronic neck pain with kinesiophobia.

Keywords: chronic neck pain, kinesiophobia, cervical ROM, visual distraction

Introduction

Neck pain or cervicalgia is a common problem in about two-thirds of the population in the world [(1)]. The overall prevalence of neck pain in the general population ranges between 0.4% and 86.8% (mean=23.1%) [(2)]. The onset and course of neck pain is influenced by several personal and environmental factors such as muscle tension, tight structures, poor posture or conditions in which pressure is exerted on nerve roots and blood vessels [(3)]. Neck pain may be minor, short lived and easily ignored, it may come and go, or it may be constant and excruciating to a point that it interferes with daily activities. Its onset can be sudden due to an injury, or it may develop gradually over a period as a result of poor posture or wear and tear [(4)]. Depending on the duration, pain is categorized as acute, sub-acute and chronic. Acute pain arises due to injury or trauma to the tissue and is often short lived. Any pain lasting for more than 6 months is categorized as chronic neck pain. According to Fejer and Hartvigsen, chronic neck pain is a neuromusculoskeletal condition frequently associated with

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disturbances in the psychological state including anxiety, depression, kinesiophobia, catastrophizing which play an influential role in shaping pain responses [5]. Patients with chronic neck pain are reported with higher pain intensity and fear of movement. Avoidance of neck movement due to fear of pain is called kinesiophobia. Miller, Koli and Todd (1990) have described kinesiophobia as a situation where "a patient has an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury" [6]. While the terms pain related fear/fear of movement and kinesiophobia are often used synonymously. Kinesiophobia is a stronger concept and more phobic in nature, it is a non-proportionate fear that cannot be explained, and with a reaction to it that is out of volitional control [7]. In patients with chronic neck pain, kinesiophobia may lead to avoidance behavior resulting in hyper vigilance to bodily sensations, followed by disability, disuse and depression [8]. It can be speculated that high kinesiophobia degrees cause low physical activity levels. The gold standard instrument to measure kinesiophobia is the Tampa scale.Kinesiophobia and especially depression appear to be psychological states with a connection to the physical activity level of patients with chronic neck pain. According to the fear avoidance model, daily activities and functional capacity may be reduced to avoid pain in such cases. An untreated pain may lead to a negative spiral resulting in increased fear of movement, avoidance behavior and ultimately disuse, depression and further exacerbation of pain, thus making treatment important.[9,10] Traditional forms of treatment to treat chronic neck painmay not always address the problem of kinesiophobia. Some existing treatment methods for kinesiophobia are cognitive behavior therapy and attention diversion strategies such as mental imagery and virtual reality. However, they are expensive and require skilled personnel thus making them difficult toimplement in all settings. As visual distraction is proven to be effective for treatment of kinesiophobia, the current study was taken up to introduce a simple and inexpensive tool which works on the principle of visual distraction.

Materials and Methods

Study Design:A One group pretest- post-test (Quasi Experimental) design was implemented for the study.

Aim

To study the effectiveness of a new visual distraction technique in decreasing kinesiophobia associated with chronic neck pain.

Objectives

a. To assess pre intervention level of kinesiophobia (primary outcome measure), pain and cervical range of motion (ROM) (secondary outcome measure).
b. To assess post intervention level of kinesiophobia, pain and cervical ROM
c. To compare the effect of new visual distraction technique on levels of kinesiophobia, pain and cervical ROM pre and post intervention.

Hypothesis

Null hypothesis

There is no difference in the levels of kinesiophobia, pain and cervical ROM with the new visual distraction technique in subjects with kinesiophobia associated with chronic neck pain.

Experimental hypothesis

There is a difference in levels of kinesiophobia, pain and cervical ROM with the new visual distraction technique in subjects with kinesiophobia associated with chronic neck pain.

Participants

With an α =0.05, ß=0.2; Zα =1.96, Z1-ß =0.8416, σ =standard deviation of 1, estimated Δ = 0.6 ; the sample size was calculated to be 43.

Out of the patientswith chronic neck pain that were screened using the Tampa scale, 43 individuals who showed presence of kinesiophobia, and the rest were excluded from the study. The study spanned over a period of two weeks.

Inclusion criteria:

a. Patients suffering from neck pain with a duration of more than 6 months.
b. Presence of kinesiophobia as assessed on Tampa scale.
c. All genders and age groups between 18-60 years.
d. Previous history of physiotherapy intervention.

Exclusion criteria:

a. History of previous trauma/surgery of cervical spine, thoracic spine and/or upper extremity.
b. History of neurological and systemic musculoskeletal conditions.
c. Vertebrobasilar insufficiency.
d. Subjects with visual acuity deficits with corrective glasses.

Materials

The following materials were used for this study.

a. Universal goniometer: Full 360 degrees calibrated goniometer with a validity and reliability of 0.96 and 0.97 respectively.
b. Headband: The headband was fabricated from a nylon material and had adjustable Velcro straps to

accommodate the subject's head circumference. A loop was present at the top to mount the laser.

c. Laser: A commercially available and battery-operated laser was used which was mounted at the top of the headband.
d. Cardboard cutouts: Red wall mounts made up of chart paper were mounted on the wall, placed equidistant at one meter respectively for visual cues.
e. Tampa scale: The 17-item Tampa scale was used for the assessment of kinesiophobia. It has a reliability of 0.82 and validity of 0.70. The scale uses a 4-point Likert scale (Strongly Disagree-Disagree-Agree-Strongly Agree)Individual item scores range from 1-4, with the negatively worded items (4,8,12,16) having a reverse scoring (4-1).Scores above 37 (17-item) indicate kinesiophobia[11].
f. Numerical rating scale: It is a 11-point scale used for pain assessment with a reliability of 0.91 and validity of 0.95.

Procedure:

The study was presented and approved by the Institutional ethics committee. The participants of the study were provided with an information sheet stating the procedure/ risks / benefits of the study and were included only upon the receival of a written consent.

This was a quasi-experimental study. Participants satisfying the inclusion criteria were recruited from physiotherapy OPDs. The duration of the study was two weeks, and it was conducted in the physiotherapy OPD. All patients underwent a pre-intervention evaluation consisting of measurement of kinesiophobia on the Tampa scale, cervical ROM and Pain assessment. The 17 item Tampa scale had to be graded from 1-4 where 1=strongly disagree, 2= disagree, 3= agree, 4= strongly agree. It was a self-completed questionnaire with the scores ranging from 17-68 and higher scores indicating an increased degree of kinesiophobia. All cervical Range of Motions (ROM) including cervical flexion, extension, lateral flexion and rotation were assessed with a universal goniometer using standardized placements [11]. A Numerical Rating Scale (NRS) was used to assess pain. Patients thus selected underwent the followingintervention over a period of two weeks and the outcome measures were re assessed.

Positioning: The patients were treated in an OPD free from auditory and visual distraction. A red square was used as a reference point and mounted on the wall with 4 circular cut outs placed at 1 meter each in horizontal and vertical direction from this reference point. Facing the wall, the patient was seated on a stool 90 cm away from the wall and was made to wear a headband with a laser beam. The reference point was at the eye level of the patient, and neutral position the head and neck of the patient was ensured using a goniometer. (Figure1 & 2)

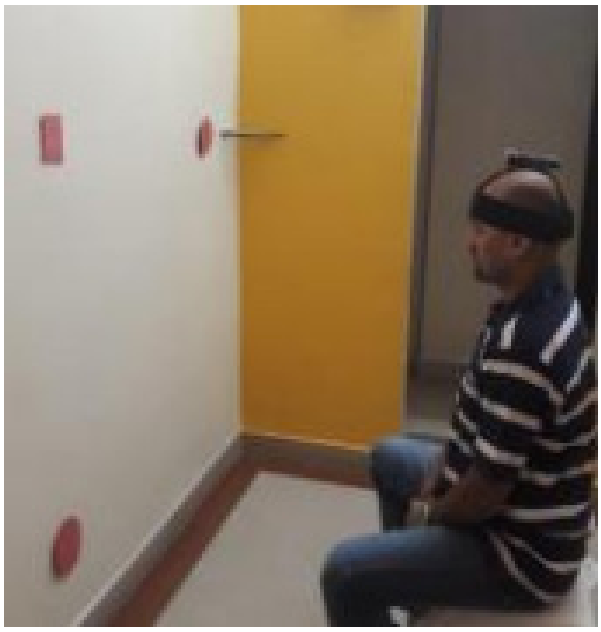

Figure1

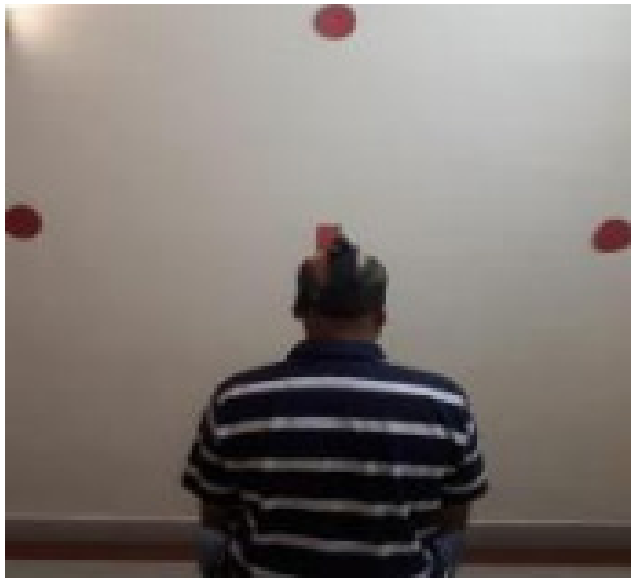

Figure2

Intervention: The patients were instructed to move the laser beam as far as possible in upward, downwards, left and right directions from the reference point, beyond targets marked for visual incentive. They were asked to perform ten repetitions on each side while the trunk was stabilized by the therapist. Sessions were repeated every day for a period of two weeks. No additional exercises were advised for the said intervention period and patients were asked to

report in case of any pain or discomfort in the neck during this programme. In any such case the intervention was discontinued, and traditional physiotherapy interventions were continued.

At the end of two weeks, Tampa scale, NRS and cervical ROM were reassessed, and analysis of data was performed.

Results and Discussion

Table 1: Non-parametric Data analysis with Wilcoxon signed rank test for Kinesiophobia and Pain:

	Kinesiophobia	Pain
	Tampa score (post_TMPA - pre_TMPA)	NRS
Mean Rank	22.00	22.00
Sum of Ranks	946.00	946.00
Negative Ranks	43	43
Positive Ranks	0	0
Ties	43	43
Z Score	-5.755	-5.747
P value (Asymp. Sig. (2-tailed)	0.000	0.000

Table 2: Data analysis for parametric data (cervical range of motion) using the paired t test

	pre_FLEXION - post_FLEXIO N	pre_EXTENSION - post_EXTENSIO N	*pre_rtrot - post_rtro t	*pre_ltrot - post_ltro t	*pre_rtSF - post_rtS F	*pre_ltSF - post_ltS F
Mean	-11.977	-27.209	-23.256	-23.488	-14.302	-14.419
SD	4.517	5.036	6.626	5.930	3.004	3.653
Std. Error Mean	.689	.768	1.011	.904	.458	.557
95% CI Lower	-13.367	-28.759	-25.295	-25.313	- 15.227	-15.543
95% CI Upper	-10.587	-25.659	-21.217	-21.663	- 13.378	-13.294
T score	-17.387	-35.431	-23.014	-25.975	- 31.218	-25.883
df	42	42	42	42	42	42
Sig. (2- tailed)	.000	.000	.000	.000	.000	.000

Abbreviations used in table *: rtrot: Right Rotation; ltrot: Left Rotation; rtSF: Right Side flexion; ltSF: Left side flexion

Discussion: In the current study, a new visual distraction technique was evaluated for its effectiveness in decreasing kinesiophobia in patients with chronic neck pain. Its effect on pain and cervical ROM in these subjects was also studied. To the best of our knowledge, this was the first study that used the laser pointer (used traditionally for the assessment of Joint repositioning error) as a simple, inexpensive visual distraction technique.

The following may be reasons for the changes obtained in the outcome measures:

Kinesiophobia:

From the data collected, comparisons were drawn between the pre and post intervention levels of the above parameters after a two-week intervention programme. There was a reduction in the post intervention Tampa scores of all 43 subjects as indicated by the negative ranks in table 1, with a p value <0.001.

The findings of the study indicate that the visual distraction technique has been effective in reducing kinesiophobia associated with chronic neck pain.It is proposed that the laser pointer and the setup, along with the instructions to carry the beam as far as is possible in the vertical and horizontal directions may have served as a diversion from the primary pain focus. Sullivan et al., (1998) suggested that interventions that assist patients in avoiding excessive focus on their pain sensations may be a viable means of reducing fear and catastrophizing, thereby facilitating the rehabilitation process. Attention diversion is one such strategy [12]. Distraction techniqueslike imagery modify a patient's perception of pain sensations, divert their attention away from it and allow them to focus the patient's attention on physical surroundings, thoughts or a scientific and detached observation of pain sensations. A patient experiencing pain could engage in mental activity or any other distracting activity [13]. Another explanation for the effectiveness of the technique may be provided by using the single channel theory (bottleneck) that suggests that parallel processing can be impossible for certain mental operations. When two tasks, physical and mental, require the same mechanism at the same time, there is a "bottleneck", and the performance of one or both tasks can be affected. Not forgetting the capacity sharing theory, which assumes that the processing capabilities or mental resources are divided between the tasks, meaning that there is limited capacity for processing information. [14] Based on the above-mentioned theories, it might be suggested that kinesiophobia subjects could have a reduction in Tampa values due to focusing on the new visual distractor and defocusing on fear. Thus, the instructions and visual incentive provided to move the neck as far as possible, beyond the markers, may have provided one such means to achieve the above and may have worked as a "Stealth exercise". Stealth exercises are a form of exercise wherein the patient is diverted away from the area of interest and towards some other engaging form of activity. Here the subjects were diverted from the area of pain/fear to a different and challenging background.

Pain:

The study showed that there was a decrease in the post intervention NRS scores in the subjects with a p<0.001.The decrease in the NRS levels can be attributed to the visual distraction techniques which caused a reduction in the pain and took the fear of movement away from the patients. The visual distraction technique using the laser beam may have worked by shifting the focus of the subjects from mind-crippling fear of pain to more goal orientation. Engaging in thoughts or activities that distract attention from pain is one of the most used and highly endorsed strategies for controlling pain. The process of distraction appears to involve competition for attention between a highly salient sensation (pain) and consciously directed focus on some other information processing activity. [15]

Cervical ROM:

The study showed an increase in the ROM of all movements at the neck. The cervical mobility was found to be reduced, to variable degrees, in all the subjects that participated in the study. This was partly attributed to the chronicity of the neck pain and partly, to the kinesiophobia associated with the pain. The improvements in the Cervical ROM in all directions can be attributed to the significant reduction the technique brought about in the levels of kinesiophobia and pain and not due to the movements attempted by the patients in those directions. It may be argued that the improved ROM may be, in part, because the patients performed movements in those directions while they attempted to move the laser beam farther away as possible. But the intervention in the present study was carried out for only 2 weeks while most studies evaluating the effectiveness of a mobility program propose the need of a duration of at least 4 weeks (1 month) [16]. Also, the patients were not instructed to perform any mobility exercises as a part of their home program.The movement for side flexion wasn't a part of the intervention program guided by the visual distraction tool, but nevertheless, showed a significant improvement post the intervention. This suggests that the improvement in cervical ROM occurred due to a decrease in Kinesiophobia and pain.

Conclusion

The current study proves the effectiveness of a new visual distraction technique in decreasing kinesiophobia as well as pain and improving range of motion associated with chronic neck pain. The less expensive visual distraction technique can be used as an adjunct with the conventional physical rehabilitation techniques in patients with kinesiophobia associated with painful musculoskeletal conditions in an OPD setting.

Source of funding: No financial support was obtained for the study and was self-funded.

Conflict of interest: The authors declare No conflict of interest.

Ethical Clearance: Was obtained from the Ethics committee of D.E. Society's Brijlal Jindal College of Physiotherapy, Pune DESBJCPPECR-3/ 15-03-2016

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Original Article

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Effect of Mulligan's Sustained Natural Apophyseal Glide and Positional Release Technique on Pain, Range of Motion and Headache Disability Among Subjects with Cervicogenic Headache.

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Abstract

Introdution: Cervicogenic headaches are unilateral frontotemporal headaches with clinical symptoms similar to migraine.A significant issue for many patients with upper cervical dysfunction is cervicogenic headache, which presents significant challenges for physical therapy management.

Objectives: To determine how well the positional release method and Mulligan's SNAGs effect on headache disability, pain, and range of movement in cervicogenic headache patients.

Methodology: A purposive sampling strategy was used in a quasi-experimental investigation. Individuals who met the selection criteria and had a clinical diagnosis of cervicogenic headache of were chosen and two groups were formed for cervicogenic headache. Group B received a home exercise program and positional release technique, while Group A received the Mulligan's SNAG program.

Outcome Measures: Pain, cervical rotation range of motion, headache disability index.

Results: A paired "t" test and an independent "t" test were used to evaluate the data at the 5% significance level. The pre- and post-test mean values indicate a decrease in headache severity. The post-test results showed a considerable variation for the outcome variables ofpain, range of motion, and headache impairment between the two groups; nevertheless, the group showed higher gains.

Conclusion: According to this study, patients with cervicogenic headaches who took Mulligan's C1-C2 sustained natural apophyseal showed improved pain relief, increased range of motion, and decreased headache disability.

Keywords: Cervicogenic Headache, Positional release & Mulligan's SNAG.

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Introduction

Among the common issues that people of all ages experience worldwide is headaches. Approximately 47% of people worldwide experience headaches, of which 15-20% have cervicogenic headaches. The population of women is more impacted than that of men [4:1][1,2].

The primary headache, which could be caused by a vascular or muscular lesion, and the secondary headache, which could be caused by something else entirely, such inflammation or head and neck trauma,are the two main categories into which the International Headache Society has classified the fourteen distinct types of headaches1.

Cervicogenic headaches (CGH) are headaches that result from a cervical spine musculoskeletal problem[3]. Sub-occipital cervical discomfort is linked to it. Cervicogenic headaches were initially classified by Sjastad as unilateral frontotemporal headaches with clinical symptoms like those of migraines (7).

Cervicogenic headaches typically appear clinically unilaterally, always on the same side; the most prevalent sites of pain origination are occiput-C1 and C1-C2[5].Ipsilateral shoulder or arm pain, reduced neck range of movement, and stiffnessare some of the various presentations of cervicogenic headaches. Pain is exacerbated by either neck movement or pressure on specific tender sites in the neck[4].Compared to patients with other conditions, those suffering from cervicogenic headaches have a lower quality of life.According to a review of the medical literature, patients who participate in regular exercise and physical conditioning programs seem to benefit the most from physiotherapy treatment methods for the long-term prevention and control of headaches[17].

Headache is currently the most frequent condition among people worldwide. Patients with cervicogenic headaches experience limitations in their daily activities, social engagement, and emotional anguish in comparison to those with tension-type headaches and migraines. Joint mobilization techniques have a wealth of evidence supporting them, but positional release techniques in the treatment of cervicogenic headaches have only a few published articles.

Nevertheless, it is necessary to compare the effects of joint mobilisation and soft tissue mobilisation approach because the pain is caused by abnormalities of the cervical spine as well as soft tissue structures.

Materials And Methodology

The study was carried out at the KMCH hospitals in Coimbatore in the department of physiotherapy and Rehabilitation. The KMCH medical centre, hospital, and ethics committee all granted their approval. EC/AP/871/12/2021 is cited. Before enrolment, all participants received a thorough explanation of the study's purpose, clinical benefits, and risks, and their informed consent was acquired.Thirty individuals who met the inclusion and exclusion criteria and had a diagnosis of cervicogenic headache were included in the study, both male and Men and female subjects between 18years and 30 years who had a history of unilateral neck and occiput pain were included in the study,pain aggravated by neck movements, tenderness of grade 2 in neck musculature, limited passive neck range of motion and a positive flexion rotation test.If a participant's headache was not of cervical origin, they were eliminated from the study. (i.e., migraine, tension type headache, Bilateral headache),patients with vertebrobasilar insufficiency, recent upper cervical fracture,recent head or neck trauma, cervical disc pathology, radiating pain from neck to upper extremities,An abrupt onset of a new, severe headache, headache associated with fever, skin rash, and a history of cancer, HIV, or other systemic illness, headache associated with focal neurologic signs other than aura, and new headache during or after pregnancy are among the symptoms that may be experienced.

Every individual who satisfied the study's inclusion requirements provided written, informed consent. To choose the subjects, a non-probability purposive sampling approach was employed. There were thirty subjects divided into two groups. GROUP A(n=15) received Mulligan SNAG technique along with home exercise Programme. Positional release method and a home workout program were given to GROUP B (n = 15). Treatment duration was 30-40 min /session for 2 days a week for 4 weeks.

To calculate the pain score, the numerical pain rating scale (NPRS) was employed.Goniometry was used to record cervical rotation ROM;the quality of life and headache impairment were measured using the headache disability index (HDI). The flexion rotation test examined the amount of rotation in C1–C2 by passively flexing the patient's head and then rotating it passively in either direction.To measure the range of motion, a smart phone with a compass application attached to the patient's head using Velcro straps was employed. Research has demonstrated the great intra- and inter-examiner dependability of this assessment procedure. Prior to the treatment, a baseline examination was conducted. (Figure: 1)

Figure: 1 Flexion rotation test.

Group A(experimental group) received mulligan SNAG. patient was positioned in a chair with the hands rest on their thigh. Therapist stood Antero -laterally to the patient in walk standing posture. The patient's head was gently

held in place by the therapist between his right arm and body. The middle phalanx of the little finger rests atop the spinous process of the C2 vertebra, while the right index, middle, and ring fingers encircle the base of the occiput. Overlying the right little finger is the lateral edge of the left thenar eminence. The therapist kept the cranium in neutral while gently applying pressure in a ventral direction to the spinous process of the C2 vertebra. For two days a week for four weeks, four glide repeats were administered and held for ten seconds at end range or the point of pain. The patient was instructed in C1–C2 self-sustained natural apophyseal glide in addition to home exercise. Fig:2

Figure: 2 SELF SNAG

Group B (experimental group) received positional release technique was given to sternocleidomastoid, levator scapulae, upper trapezius, rectus capitus posterior minor.

PRT for sternocleidomastoid

The therapist diagnosed the site of sternocleidomastoid muscle tension, and a positional release treatment was administered. The patient was lying down in a supine position. The patient's therapist stood behind them and felt the sternocleidomastoid muscle's painful spot. Using a pincer grasp, the therapist palpated the sternocleidomastoid muscle to identify a painful region while maintaining the muscle in the most comfortable posture. The therapist turned the patient's neck to the same side while keeping an eye on the tender spot with her index finger till the relief was sensed. (fig:3)

Figure: 3 positional releases for sternocleidomastoid.

PRT For Upper Trapezius

The therapist diagnosed an upper trapezius tension, at which point positional release technique (PRT) was administered. The patient was positioned in supine posture with no head rest and shoulder was abducted 90 degrees. Therapist stood behind the patient head. The subject's head was flexed laterally toward the trigger point while the therapist maintained the upper trapezius muscle in the most comfortable position. The therapist held her thumb in that position while keeping an eye on the trigger point with her index finger, applying pressure until she felt a release.(fig:4)

Figure :4 positional release for upper trapezius.

PRT For Rectus Capitis Posterior Minor

Positional release techniquewas administered when the therapist identified the rectus capitis posterior minor muscle as being tense.The patient was positioned in a supine lying posture with head off from the plinth and Therapist stood behind the patient and holds the patient head. With the rectus capitis posterior minor muscle in its most comfortable posture, the therapist palpated the area and used a pincer grasp to locate a painful point. The therapist used her index finger to keep an eye on the sore point and applied pressure by extending the neck until the patient felt release. (fig:5)

Figure :5 positional release for rectus capitis posterior minor.

PRT For Levator Scapulae

The patient was lying down in a supine position. With the patient's levator scapulae muscle in the most comfortable posture, the therapist stepped behind them and used a pin-

cer grasp to palpate the area to identify any painful spots. The therapist used her index finger to monitor the sore region and applied pressure, flexing to the same side of the neck until the patient felt relaxation.(fig: 7)

Figure :6 positional release for levator scapulae.

Three to four treatments were administered, with a 20-second break in between each. For four weeks, there were two treatment days per week. Along with positional release Neck strengthening and stretching exercise also taught to the patient.Home exercise program includes Chin tuck exercise, self-stretching for upper trapezius, self-stretching for levator scapulae and self-stretching for sternoclenomastoid muscle.

Result

Pre-test and post-test data to measure pain, range of motion and headache disability was collected by using numerical pain rating scale, goniometer and headache disability index. Both the independent and paired "t" tests were used to examine and interpret the recorded values. Before and after the intervention, the results within the group were interrupted using a paired "t" test, and the results between the groups were interrupted using an independent "t" test.

The recorded values were examined and interpreted using the independent and paired "t" tests. A paired "t" test was used to interrupt results within the group both before and after the intervention, while an independent "t" test was used to interrupt results between the groups.

Independent 't' test was used to measure and interrupt the values between groups, the posttest values of numerical pain rating scale which was used to measure the pain showed statistical significant difference across both groups, the posttest values of cervical rotation range of motion showed statistical significant difference across both groups and the posttest values of headache disability index scale which was used to measure the headache disability showed statistical significant difference across both groups. when the mean values were compared it was ascertained that group A (Mulligan C1-C2) sustained natural apophyseal glide) showed better improvement in reducing pain, improving range motion and reducing headache disability.

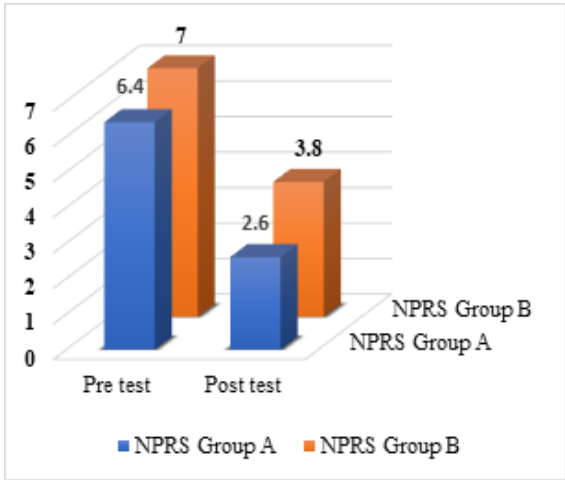

Figure: 7. Mean value changes in numerical pain rating scale (NPRS) scores for group A (mulligan SNAG) and group B (positional release)v

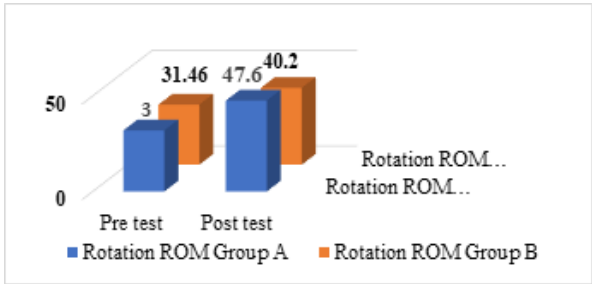

Figure:8. Mean value changes in cervical rotation range of motion scores for group A (Mulligan's SNAG) and group B(positional release)

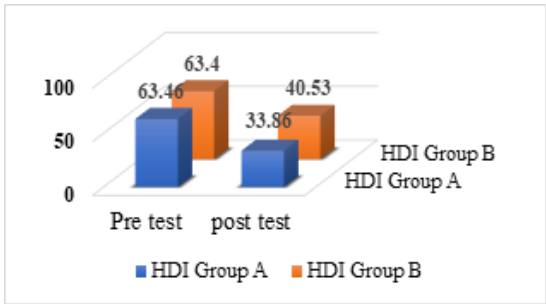

Figure:9.: Mean value changes in headache disability index scores for group A (Mulligan's SNAG) and group B (positional release)

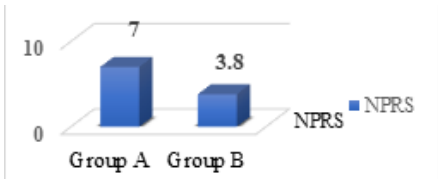

Figure: 10. Post- test values of Numerical pain ratind scale(NPRS) scores between group A(Mulligan SNAG) and group B (Positional release)

Figure:11. Post- test values of cervical rotation ROM scores between group A(Mulligan SNAG) and group B (Positional release)

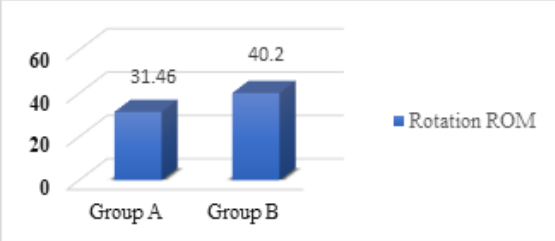

Figure: 12.Post- test values of headache disability index between group A(Mulligan SNAG) and group B (Positional release)

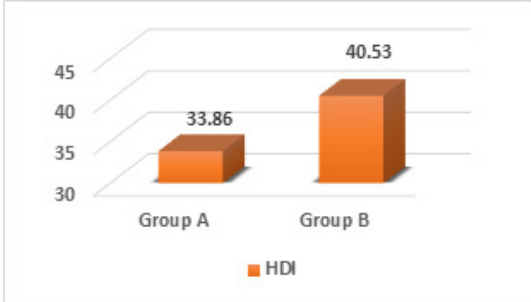

Table: 1 Independent 't' test analysis of pre – test and post – test of numerical rating scale

Outcome measure		Mean value ± S.D		Calculated 't' value	Table 't' value	Level of significance
Numerical pain rating scale	Pre test	Group A	Group B	1.89	2.048	P>0.05 insignificant
		6.4± 1.54	7±1.15			
	Post test	2.6±0.70	3.8±1.71	3.24	2.048	P<0.05 Significant

Table: 2 Independent 't' test analysis of pre – test and post – test of cervical rotation range of motion.

Outcome measure		Mean value ± S.D		Calculated 't' value	Table 't' value	Level of significance
Cervical rotation range of motion	Pre test	Group A	Group B	1.026	2.048	P>0.05 insignificant.
		32±5.29	31.46±5.03			
	Post test	47.6±5.44	40.2±4.41	4.244	2.048	P<0.05 Sigificant

Table: 3 Independent 't' test analysis of pre – test and post – test of Headache disability index

Outcome measure		Mean value ± S.D		Calculated 't' value	Table 't' value	Level of significance
Headache disability index	Pre test	Group A	Group B	0.32	2.048	P>0.05 insignificant.
		63.46±8.41	63.4± 7.68			
	Post test	33.86±6.98	40.53±8.82	2.43	2.048	P< 0.05 Significant.

Discussion

The study's objective was to determine whether positional release methods and Mulligan's SNAG were beneficial for treating cervicogenic headache patients during a four-week home exercise regimen. This assessment revealed that both groups had significantly reduced pain, improved range of motion, and decreased headache disability.

A persistent, recurrent headache is called a cervicogenic headache. According to Castein R (2019), the most prevalent origins of pain are the upper cervical joint segments,

occiput-C1 and C1-C2. Some writers proposed that the common cause of myofascial cervicogenic headache is the sternoclenomastoid muscle. Myofascial painful sites are seen in most people with cervicogenic headaches. According to Pfaffenrath et al., cervicogenic headache pain is thought to be a deep musculoskeletal pain that is carried by unmyelinated C-fibres.Because the nucleus caudalis in the spinal trigeminal tract is so close, pain impulses originating in the upper cervical roots are sent to the trigeminal area.

ROM reveals the investigation of segmental dysfunction. Flexion rotation test (FRT) was used to measure it; it has great sensitivity and acceptable reliabilityin identifying the restriction in C1/C2 rotation range. so, this study compares the joint mobilization technique and soft tissue technique in patients with cervicogenic headache.Adham A. Mohamed et al;2019 demonstrated that by modulating the afferent of aberrant signals originating from the upper cervical spine, SNAG mobilization for the upper cervical spine promotes stimulation of proprioceptors in both joints and muscle. They promote cervical SNAG as a non-invasive treatment option.

Kiran satpute et al;2021 imply that their research will strengthen the body of evidence supporting the use of manual therapy to treat headaches and improve clinical judgment. Neeti Christian 2017 they reported that Mulligan SNAGs has shown reduction in cervicogenic headache and its associated disability.

The severity of headache was measured by using headache disability index. Manual therapy groups showed more reduction in headache disability scores and it was useful in assessing the impact of headache. [18]

According to Susan A. et al. (2008), joint hypomobility will cause pain, which will further limit range of motion. This current study, which has demonstrated improvement in range of motion, pain, and headache impairment, supports the aforesaid notion.

Conclusion

This study shows significant difference in both groups, but in comparison, Mulligan's C1-C2 Sustained Natural Apophyseal Glide shows better result in reducing pain, improving range of motion and decreasing headache disability.

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Conflict of interest: conflict of interest was reported by the authors.

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Original Article

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Comparison of Primal Reflex Release Technique and Positional Release Therapy on Pain, Functional Ability and Ankle Range in patients with Plantar Fasciitis: An Experimental Study

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Abstract

Background: Plantar fasciitis (PF) is characterized by inflammation, fibrosis and structural deterioration of foot and there is pain over heel and plantar fascia. Plantar fasciitis pain is gradualin on set, sharp and diffusely located initially which later localizes to medialcal caneal tuberosity. Typically, pain ıs most severe in the morning which lessens with movement but intensifies with long-standing weight bearing. Plantar fasciitis has been experienced by 10% of the non-athletic population and most typically observed in weight-bearing activities. So, the aim was to study the effects of primal reflex release technique and positional release therapy on pain, functional ability and ankle range in patients with plantar fasciitis.

Method: Total 36 patients were recruited for the study as per the selection criteria and were divided into two groups (18 in each group). Group A was treated with primal reflex release technique (PRRT) along with conventional therapy and Group B was treated with positional release therapy (PRT) along with conventional therapy for 7 consecutive days. Intergroup analysis by independent t-test showed statistically significant improvement in pain and functional ability (P value ≤ 0.001).

Conclusion: Primal reflex release technique along with conventional therapy was found to be more predominant in improving pain and functional ability than positional release therapy along with conventional therapy. Also, Primal reflex release tech-nique along with conventional therapy and positional release therapy along with conventional therapy were equally effective in improving ankle range of motion.

Keywords: Primal Reflex Release Technique, Positional Release Therapy, Foot Function Index, Weight Bearing Lunge Test

Introduction

The fascia in the foot is made up of fibrous connective tissue that separates, supports, and attach muscles. It can be separated into the deep fascia and the superficial fascia. The superficial fascia on the plantar side is thick and has many fat-filled septations that act as a cushion for the foot.[1]

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The deep fascia on the dorsal side is thin and continues laterally and posteriorly to join the deep fascia onthe plantar side, which is known as the plantar fascia. The plantar aponeurosis is made up of the central portion of the plantar fascia; it begins proximally at the calcaneum and extends distally into five distinct bands that become the digital sheaths.[2]

The "windlass mechanism" is a well-known mechanical model to depict the plantar fascia's critical role in providing dynamic support to the foot during weight-bearing activi-ties.[3,4]This mechanism creates tension in plantar fascia as well as tension in several intrinsic and extrinsic toe muscles as the toes extend during terminal stance and preswing.[5]

Plantar fasciitis (PF) is characterized by inflammation, fibrosis and structural deterioration of foot and there is pain over heel and plantar fascia.[6]It is the result of degenerative irritation of the plantar fascia origin at the medial calcane-al tuberosity of heel as well as the surrounding perifascial structures.[7-9] The most common causes are overuse activi-ties or poor biomechanics, resulting in abnormal function-al pronation. A stiff subtalar joint or functional leg length inequality, obesity, training errors, improper foot wear and occupation requiring prolonged standing are risk factors of plantar fasciitis.[10]

PF pain is gradual in onset, sharp and diffusely locat-ed initially which later localizes to medial calcaneal tuberosity. Typically, pain is most severe inthe morning which lessens with movement but intensifies with long-standing weight bearing.[11,12]Primary symptoms include: description of throbbing, piercing or stabbing pain; inferior heel pain when bearing weight; pain that improves after brief activ-ity but worsens with prolonged activity.[13,14] The primary physical finding is tenderness on palpation at the medial calcaneal tuberosity, while some researchers suggest lim-itations in dorsiflexion and decrease in strength of intrinsic and extrinsic muscles present in individuals with PF.[15,16]

Primal reflex release technique is a therapeutic maneuver that falls under the regional interdependent approach to patient care and involves down regulating an overstimulated autonomic nervous system to minimize pain patterns.[17] By resetting over-aroused primal responses within the body, the paradigm is intended to treat the neurological system.[18] To block painful locations, the treatment requires repeatedly inducing deep tendon reflexes (DTR) that stim-ulate the skin. There is a five-step procedure for diagnosing and treating plantar fasciitis. The procedure includes neuro-muscular "resetting"of five locations, including the sacro-iliac joint (through the hip adductors), hamstring muscles, triceps surae complex, peroneal tendons and toe flexors.[19]

Positional release therapy is an osteopathic manual approach that aims to increase muscle flexibility by keeping the muscle in a shortened position to encourage relaxation rather than stretching or lengthening it. According to Wynn et al., PRT is an indirect myofascial approach with regard to tissue resistance that makes use of body alignment, the use of tender points to locate the issue, and monitoring of the therapeutic intervention. This mechanism is thought to result from spindle resetting and reducing in nociceptive impulses.[20]

Materials and Method

Study design:An Experimental study
Study population: Patients with plantar fasciitis
Study setting :Physiotherapy OPD sin Vadodaracity
Study period: 1 week (7 consecutive sessions)
Study duration:7 months (November 2023 –May 2024)
Sampling method: Convenient sampling method Sample size: 36 patients

The sample size was calculated by using Gpower software version 3.1.9.7. The main outcome variable taken into consideration for sample size calculation was foot function index. From the previous study conducted by Jadhav Adi-tietalin 2023"Comparative effectiveness of Gua Sha, Cryo stretch and positional release technique on tenderness and function with plantar fasciitis," the value for outcome vari-ables were (59.67 ± 5.94, 60.42 ± 6.08,7.36±1.03).Keep-ing the values of α error as 0.05(95% confidence interval) and β error as 0.2 (power of the study 80%), the calculated sample size was 36 (18 in each group) Inclusion criteria:

- Age: 40 to 60 Years[21]
- Gender:Both male and female
- Pain or tenderness in the medialarch of plantar fascia at the medial tubercle of calcaneum for more than 6 months
- Windlass test positive
- Patients willing to participate in the study Exclusion criteria:
- Pain or tenderness along lateral border of foot
- History of recent fractures around leg, ankle and foot
- Any lower extremity surgery
- Congenital foot deformities
- Infective skin conditions
- Impaired sensations around leg,ankle and foot
- Open wounds around leg, ankle and foot
- Patients who had taken cortico steroid injection in the heel preceding 3 months
- Any neurological and cardio vascular conditions which affected the out come measures and treatment protocol of the study

Materials used:

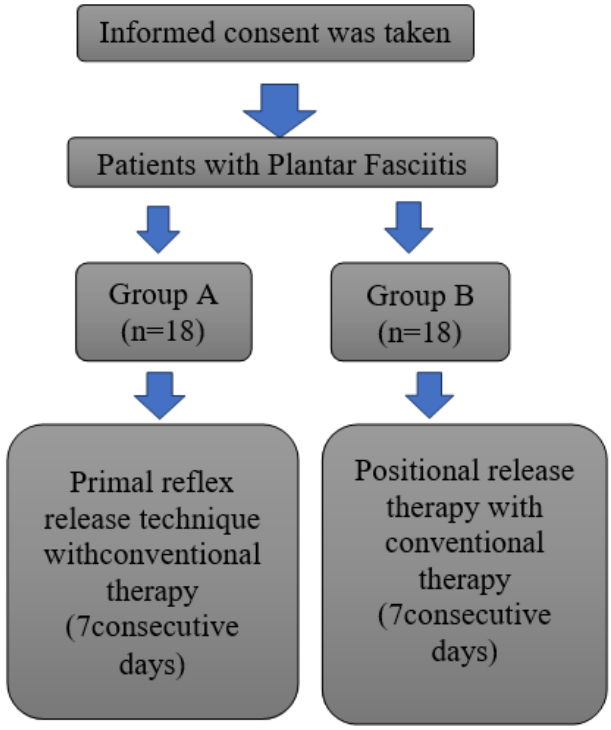
- Consent form
- Measure-tape
- Examination table
- Pen,pencil
- Cotton tipped applicators
- Table or stool
- Stop watch
- Foot function index (FFI)scale

Figure1: Materials used

Outcomes measures:

1. Foot function index (FFI): [ICC=0.96-0.73]
   It is a self-administered tool consisting of 23 items grouped into three sub-scales. The sub-scales were formed to provide information on three unique aspects of function-foot pain, dis-ability and activity limitation-as they are related to foot pathology.Any item which is marked as not applicable is excluded from the total possible. Higher scores indicating greater impairment.[22]
2. Weight bearing lunge test(WBLT): [ICC=0.93-0.99][23]
   Patient is in a standing position facing a wall with the test foot parallel with a tape measure secured to the floor with the second toe, center of the heel, and knee perpendicular to a wall, in order to make contact between the anterior knee andthe wall while keeping the heel firmly planted on the floor.They are instructed to conduct a lunge while holding this position.24 Every 1 cm away from the wall is equivalent to approximately 3.6 of ankle/subtalar dorsiflexion. Maximum lunge distance is definedas the distance of the great toe from thewall based on the farthest distance the foot is able to be placed without the heel lifting from the ground.

Figure2: Weight bearing lunge test



Group A:(Primal reflex release technique+ Conventional therapy)

The PRRT treatment involves five sequential steps target-ing specific areas for deep tendon reflex stimulation. The first step focuses on the above and below medial knee,second location was at the peroneal tendons with the patient holding the foot in eversion. The third and fourth steps in-volve releasing tension in the gastrocnemius and hamstring muscles through specific stimulation at patellar tendon and tibialis anterior and patellar tendon and hamstring muscle belly locations respectively. The final step includes a sus-tained maximal plantar flexion of the ankle with to e-gripping two cotton tipped applicators. Patients are instructed to maintain these positions even if cramping occurs, with the entire treatment lasting no more than five minutes.

Group B:(Positional release therapy+Conventional thera-py)

Patients were made to lie in supine with the affected limb off the plinth as the therapist applied firm pressure along the aponeurosis. Tender points were identified and gently pressed with fingertip pressure. The foot was then posi-tioned in complete plantar flexion, adjusted until a 70% reduction in tenderness was achieved, and held for 90 sec-onds with three repetitions.

Figure3:Positional Release Therapy

Conventional therapy:

- Ankle dorsiflexion exercise (10 repetitions,2sets)
- Ankle plantar flexion exercise(10 repetitions, 2sets)
- Standing calf stretch (30 seconds,3 repetitions)
- Curb/stair stretch (30seconds,3 repetitions)

Results and Discussion

Data was analysed by IBM SPSS 26 software and Microsoft Excel 2019. Prior to the statistical analysis test, data was screened for normal distribution by Shapiro-Wilk test. According to normality test, tests were applied for within group (ANOVA and Kruskal Wallis test) and between group (Independent t test and Mann Whitney U-test) analysis.

Table1:Base line data

GROUPS	**PRRT**	**PRT**
NO.OF PATIENTS	18	18
AGE	**MEAN±SD**	**MEAN±SD**
	48.16±4.6	49.05±5.5
GENDER	FEMALE:12	FEMALE:16
	MALE:06	MALE:02

Table2:Results of PRRTand PRT (Between group A and B)

OUTCOMEMEASURES		**PRRT (MEAN±SD)**	**PRT (MEAN±SD)**	**U/t VALUE**	**P - VALUE**	**REMARKS**
FFI%	1STweek	49.80±10.5	38.42±8.06	3.63	<0.001	Significant
	2NDweek	48.98± 10.35	36.57±7.83	4.05	<0.001	Significant
	4THweek	46.36± 10.20	34.92±7.57	3.81	<0.001	Significant
WBLT	RT 1ST week	5.60±2.82	4.80±2.46	-0.974	0.331	Notsignificant
	LT 1STweek	5.0±3.05	4.0±2.7	-1.197	0.231	Notsignificant
	RT2ND week	5.6±2.82	4.8±2.46	-0.974	0.332	Notsignificant
	LT2ND week	5.0±3.05	4.0±2.73	-1.197	0.231	Notsignificant
	RT4TH week	5.4±2.82	4.4±2.63	-1.080	0.281	Notsignificant
	LT4TH week	4.4±3.60	3.6±2.76	-0.875	0.381	Notsignificant

Here, the absolute difference was measured by Unpaired t-test for FFI and Mann Whitney U- test for WBLT (right and left).As shown in the figures 4 and 5, it showed statis-tically significant difference in FFI. But, for WBLT (right and left), it showed no statistically significant difference.

Hence, PRRT along with conventional therapy was found to be more predominant in improving pain and func-tional ability (FFI) than PRT along with conventional ther-apy. Also, PRRT along with conventional therapy and PRT along with conventional therapy were equally effective in improving ankle range of motion.

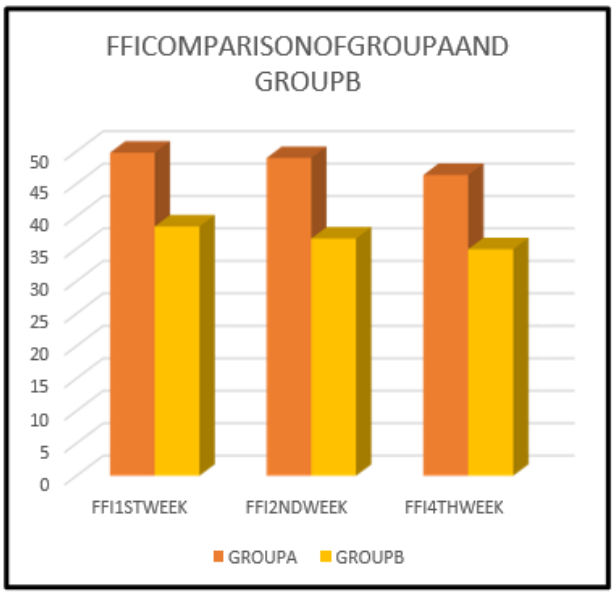


Figure 4:FFI-Mean difference between Group A and Group B

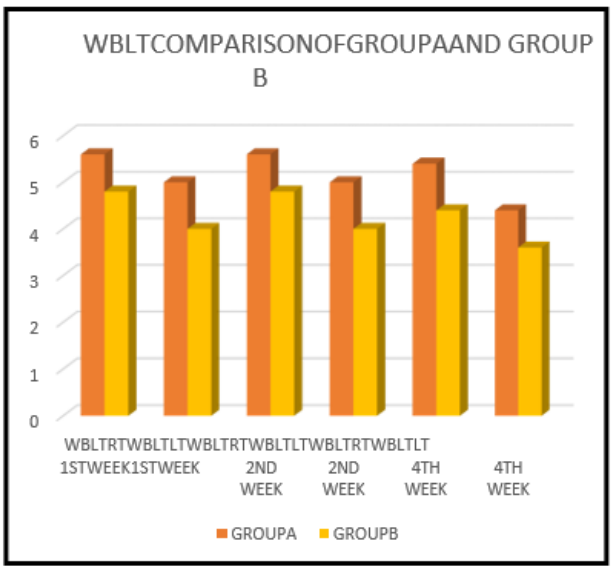


Figure5:WBLT-Mean difference between Group A and Group B

In this study, effects of primal reflex release technique and positional release therapy on pain, functional ability and ankle range of motion in patients with plantar fasciitis were examined. Pain and functional ability were assessed by foot function index (FFI) and ankle range was measured by weight bearing lunge test (WBLT).

First objective of this study was to determine the effects of primal reflex release technique on pain, functional abil-ity (FFI) and ankle range (WBLT) in patients with plantar fasciitis.

Primal reflexes control unlearned movement patterns and are triggered as protective defense mechanisms for the body.[25] Over stimulation of the nervous system can result in pain and dysfunction.[17,26] PRRT technique is intended to “down-regulate” the areas that are identified as “up-regu-lated” by the presence of nociceptive startle reflexes. The treatment involves 12 seconds of light sensation in the form of deep tend on reflexes that stimulate the skin to in-hibit the painful areas.

Bethany L. Hansberger et al. in 2015 did a study enti-tled “A novel approach to treating plantar fasciitis-effects of primal reflex release technique”. Total eight physically active subjects ranging in age from 18-40 years were tak-en. Five steps of primal reflex release technique in which treatment lasted approximately one minute for the first four steps and two to four minutes for fifth step. NPRS was administered pre and post treatment and at discharge. The disablement in the physically active scale (DPA) and patient specific functional scale (PSFS) were administered at initial evaluation and discharge. The follow up was done at two weeks, one month, two months after discharge. It was concluded that use of primal reflex release technique produced both immediate and long- term positive changes on NPRS, PSFS and DPA scale.[27]

Second objective of this study was to determine the ef-fects of positional release therapy on pain, functional abil-ity (FFI) and ankle range (WBLT) in patients with plantar fasciitis.

Al-Shawabka SA et al. (2013), in their study used PRT and reported that there is decrease in tender points by in-creasing pressure pain thresholds of trigger points in the upper trapezius muscle with mechanical neck pain pa-tients.[28] Wynne MM et al.(2006), demonstrated reduction in pain and improvement in functional ability using PRT in subjects with plantar fasciitis.[29]

Pattanshetty Renu et al. in 2015 organized a study on, “Immediate effect of three soft tissue manipulation tech-niques on pain response and flexibility in chronic plantar fasciitis”. Therapeutic ultrasound was given for a single session to all the groups and then manual techniques were provided. VAS and ankle range of motion were assessed pre and post intervention. It was concluded that myofas-cial release, positional release and passive stretching group with therapeutic ultrasound were effective in pain relief instantly and improving ankle range of motion in subjects with chronic plantar fasciitis.[30]

In the current study, patients were assessed at base line and follow up was taken at the end of 1st week, 2nd week and 4th week. The results showed statistically significant improvement in pain, functional ability (FFI) and ankle range (right and left) with the use of primal reflex release technique along with conventional therapy and positional release therapy along with conventional therapy (within group analysis).But, in between group analysis, primal re-flex release technique along with conventional therapy was found to be more predominant in improving pain and func-tional ability (FFI) than positional release therapy along with conventional therapy. Also, primal reflex release tech-nique along with conventional therapy and positional re-lease therapy along with conventional therapy were equal-ly effective in improving ankle range of motion.

Conclusion

The results of this study accepted the alternative hypoth-esis and showed statistically significant improvement in pain, functional ability and ankle range in patients with plantar fasciitis with the use of PRRT along with conven-tional therapy and PRT along with conventional therapy (within group analysis) by ANOVA and Kruskal Wallis test. But, in between group analysis by Unpaired t-test and Mann Whitney U-test, PRRT along with conventional ther-apy was found to be more effective than PRT along with conventional therapy.

Limitations

- The duration of treatmentwas only 1 week,which was relatively shortfor determining the long-last-ing effects in chronic plantar fasciitis.
- Advanced equipment was not used to assess func-tional disability and ankle ROM.
- Small sample size.
- Gender distribution was unequal.

Ethical clearance–Ethical clearance was obtained from the Institutional Review Board (PPC/OW/698/2023) from Pioneer Physiotherapy College, Vadodara.

Source of funding– Self

Conflict of interest-Nil

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Original Article

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Exercise Tolerance and Pulmonary Function among Middle Aged People with and without Diabetes Mellitus: A Pilot Study

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Abstract

Objective: To assess and to compare exercise tolerance and pulmonary function among middle aged persons with type 2 Diabetes Mellitusand without.

Methods: A total of 30 patients ,15 with type 2 diabetesand 15 age matched controls without diabetesrecruited from a tertiary hospital, participated in the study. Exercise tolerance and pulmonary function was assessed using six -minute walk test and spirometerrespectively, for both the groups.

Results: In the statistical analysis, the control group was seen to fare better in all the parameters. When analysed between groups using t test, FEV1, (t=11.350, p= <0.001) FVC (t=6.249, p= <0.001), FEV1/FVC (t=13.184, p=<0.001) and 6MWT (t=11.74100, p=<0.001) was found to be significantly different between diabetic and normal group. Analysis using chi square test showed a significant difference in lung function between diabetic and non-diabetic participants.

Conclusion: Middle aged non-diabetic individuals showed normal performance in exercise tolerance and pulmonary function, whereas the Diabetic population had reduced exercise tolerance and pulmonary function. This implies that middle age could be a crucial stage for early prevention of decline in pulmonary function and exercise tolerance and also to prevent future complications in type 2 diabetic patients.

Keywords: Pulmonary Function Test, Type 2 diabetes mellitus, exercise tolerance, middle aged individuals.

Introduction

According to the World Health Organizationtype II Diabetes mellitus (T2DM) is a chronic, metabolic disease characterized by elevated levels of blood glucose, which leads to serious damage to the heart, blood vessels, eyes, kidneys and nerves. The most common is type 2 diabetes, usually seen in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin.[1]TheInternational Diabetes Federation (IDF) estimated 537 million adults worldwide between the age of 20-79 (10.5% of all adults in this age range) By 2030.This estimate is projected to rise to 642 million by 2040, and the largest increases will come from the regions experiencing economic transitions from low-income to middle-income levels.The estimates

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in 2024 showed that By 2030 643 million people will have diabetes globally, increasing to 783 million By 2045.[2,3]

Middle age typically spans from around the age of 40 to 60, roughly halfway between early adulthood and old age and is often characterized by various life changes, including career advancement, family responsibilities, and possibly the onset of certain health concerns associated with aging.[4] It has been found that middle-aged diabetic people are substantially more likely than non-diabetics to experience cardiovascular complications.Compared to those without diabetes, those with type 2 diabetes had three times the chance of dying from cardiovascular disease and twice the risk of dying from any cause.[5]

The lungs are possible target organs in diabetic microangiopathy.[6] Loss of elastic recoil causes the small airways in the lungs to dynamically collapse during expirationand diabetes even alters the level of surfactants, which changes pulmonary function.The effectiveness of respiratory pump can be affected by diabetic myopathic and neuropathic alterations.Pulmonary function abnormalities may arise from excessive inflammatory responses in the lungs due to improper control of inflammatory processes. Patients with diabeteshave poor control of inflammation and have elevated levels of TNF alpha, ferritin, fibrinogen, and C-reactive protein. Autonomic neuropathy will damage the bronchial noradrenergic innervation and can disrupt the respiratory system's ability to operate and change the ventilatory response to both central and peripheral inputs.[7]

Pulmonary function tests (PFTs) are used to assess how the lungs work mechanically, based on standards from studies that account for age, height, and sex. Spirometry is the most useful and widely accessible test for assessing pulmonary function.[8] Spirometric indices can be simply interpreted by comparing them to established normal values, and they have undergone extensive validation.[9]

It has been proven that diabetes mellitus has adverse effects on the microvasculature, so it is quite probable that pulmonary functions may be affected in diabetes. Studies have shown that there is reduction in exercise capacity in patients with DM. It was found that diabetes influences the decrease in the strength and resistance of respiratory muscles, primarily the diaphragm.[10]

Exercise tolerance, exercise capacityand functional capacity are generally considered synonymous and indicate the maximal effort given during exercise testing. T2D Mis related with a number of co-morbidities including cardio-pulmonary disorders that have been found to significantly reduce exercise capacities.[11]

People with T2DMmay have a reduced capacity for exercise due to a number of causes, including insulin resistance, endothelial dysfunction, poor myocardial perfusion, cerebral blood flow, and oxygenation deficiencies. They may also experience alterations in cardiac and skeletal muscle activity.[12] Patients with type 2 diabetes often complain of fatigue and reduced exercise capacity.[13] The objective of the study is to assess and to compare exercise tolerance and pulmonary function among middle aged persons with type 2 Diabetes Mellitusand without.

The prevalence of diabetes is gradually increasing in all age groups, particularly in middle aged people. Pulmonary function and exercise tolerance are major areas in which this people may suffer deficiencies. Hence there is need for early identification of such persons with reduced exercise tolerance and pulmonary function will help in reducing and preventing complications. Further necessary interventions can be provided in order to improve their exercise tolerance and lung function.

Material And Methodology

A comparative observational study was carried out in a tertiary hospital at Mangaluru, Karnataka over a period of 12 months from June 2023 to May 2024. The study was conducted among middle aged individuals (40-60) years with self- report or physician diagnosed Type 2 DM with duration of more than a year. A total of 30 samples was estimated for this pilot study on the basis of the study conducted by Krzysztof kuziemski et.al.10 which includes 15 diabetic patients and 15 controls. Ethical clearance was obtained from the Institutional Ethical Committee. Informed consent was obtained from subjects prior to the study. Subjects were screened for inclusion and exclusion criteria and those who met the selection criteria were recruited in the study, using convenience sampling method.

Fifteen men and women diagnosed with Type 2DM more than 1 year, aged between 40-60 years without any history of smoking, metabolic or pulmonary condition were included in this study non diabetic males and females both aged between 40-60, non-smokers and no other pulmonary or metabolic conditions were the inclusion criteria for control group. Individuals with uncontrolled DM, diabetic foot, facial deformity, respiratory disorder and any other contraindication to exercise testing were excluded.

Spirometry was used to assess forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and FEV1/FVC ratio. Six-minute Walk test (6MWT) was used to assess exercise tolerance.[10] Assessing exercise tolerance using the 6-Minute Walk Test (6MWT) involves a comprehensive evaluation process that begins with thorough preparation and baseline assessments to ensure patient stability and safety. Before the test, clinicians review the patient's medical history and current medications, taking baseline vital signs such as heart rate, blood pressure, and oxygen saturation while explaining the procedure and reassuring the patient that they can take breaks as needed. Conducted in a controlled environment on a flat, straight surface, the test requires the patient to walk as far as possible in six minutes, with the clinician providing regular encouragement and closely monitoring for signs of distress. At the end of the six minutes,

the total distance walked is measured in meters, which serves as the primary outcome metric. Additionally, any symptoms reported by the patient during the test, such as shortness of breath, fatigue, or chest pain, are documented to provide qualitative context for the results. Post-test, vital signs are again recorded to observe any significant changes, and patients may be asked to rate their perceived exertion using standardized scales. The total distance walked is then compared to normative values adjusted for age, gender, and specific health conditions to evaluate functional capacity. This multifaceted approach allows clinicians to gauge overall exercise tolerance, identifying potential limitations in daily activities and informing tailored rehabilitation programs. The 6MWT can also be repeated periodically to monitor changes in exercise tolerance over time, providing essential insights for ongoing patient management and treatment adjustments, making it a crucial tool in clinical practice for enhancing patient care and recovery strategies.

An initial examination of demographic data and medical history was carried out. A brief introduction about the study procedure was explained to all subjects. Initially the demographic data including name, age and gender were collected. Information regarding T2DM was obtained from the Self-reported or physician diagnosed using glycated hemoglobin test (Hba1c) value 6.5% or above.

Each participant's exercise tolerance was assessed using the six-minute walk test and three trials of pulmonary function test with a spirometer (FEV1, FVC and FEV1/FVC ratio) on the same day, and best reading was taken into consideration. The session was completed within 20-25 minutes.

Statistical Analysis

The data was analyzed using Microsoft Excel and SPSS version 23.0.The categorical variables were presented as frequency, percentage and descriptive statistics using mean and standard deviation.Comparison ofexercise tolerance and pulmonary function between the groups was done using unpaired t test. A $p < 0.05$ was considered as statistically significant.

Results

The mean age of participants was 49.533±6.435 years and 51.800±5.375 years, in control group and diabetes group respectively. Both the control and diabetes group included 8 women and 7 men each.

The comparison of Forced Expiratory Volume in one second (FEV1) between the healthy and diabetic populations revealed stark differences in lung function, suggested that individuals with diabetes exhibit markedly lower FEV1 values compared to their controlgroup (Table 1). Also individuals with diabetes exhibit significantly reduced FVC compared to control group. A pvalue< 0.001 strongly suggest that individuals with diabetes exhibit a reduced FEV1/FVC ratio compared to their control counterparts. (Table.1)

The comparison of the 6-minute walk test results between a healthy population and a diabetic population revealed notable differences in physical endurance.The calculated t-value of 11.741 and p< 0.001shows that individuals with diabetes exhibit reduced exercise tolerance compared to their control group (Table.1)

Table.1: Comparison of FEV1, FVC, FEV1/FVC and 6MWT between Control group and diabetic group

		Group	Mean	SD	t - value	p - value	N
PFT	FEV1	Control group	3.384	0.524	11.350	p<0.001	15
		Diabetic group	1.471	0.390			
	FVC	Control group	3.445	0.522	6.249	p<0.001	
		Diabetic group	2.265	0.512			
	FEV1/FVC	Control group	97.527	1.179	13.184	p<0.001	
		Diabetic group	64.533	9.620			
Exercise Tolerance	6MWT	Control group	542.067	53.767	11.74100	p<0.001	
		Diabetic group	356.600	29.186			

100% of individuals in the healthy group had normal lung function, while in the diabetic group, 53.3% showed signs of obstruction and 46.7% showed signs of restriction. This disparity highlights a notable difference in the prevalence of lung function abnormalities between the two groups, suggesting potential respiratory complications linked to diabetes with p<0.001.Lung function analysis using chi square test showed a significant difference between diabetic group and control group. (table 2)

Table.2: Interpretation of lung function abnormalities

	Group		Total	Chi square	p value
	Healthy group	Diabetic group			
NORMAL	100.0%	0.0%	50.0%	30.000	p<0.001
OBSTRUCTION	0.0%	53.3%	26.7%		
RESTRICTION	0.0%	46.7%	23.3%		
Total	15	15	30		
	100.0%	100.0%	100.0%		

Discussion

Diabetes mellitus is a long-term metabolic disorder marked by high blood glucose levels. Over time, the heart, blood vessels, eyes, kidneys, and nerves can sustain damage from this condition.[1] The lungs are one of the most affect-ed organs in diabetes mellitus.[12] Long-term records of pul-monary complications from diabetes include a tendency towards infections, abnormalities in gas exchange, aspi-ration, pulmonary oedema, broncho motor dysregulation, irregular breathing during sleep, central hypoventilation, and abnormalities in lung mechanics. Reduced lung func-tion has been linked to elevated fasting blood glucose.[15]

The present study is a comparative observational study design, aimed to find the effect of exercise tolerance and pulmonary function among middle aged people with and without diabetes mellitus. The participants were assessed for exercise tolerance using six-minute walk test and pul-monary function with spirometer.In the present study, com-parison of the 6-minute walk test results between a healthy population and a diabetic population revealed notable dif-ferences in physical endurance, indicating that individuals with diabetes exhibit reduced physical endurance com-pared to their control group. Some previous studies have also noted decreased exercise capacity in patients with T2DM.[12,16] Exercise tolerance may be diminished in indi-viduals with Type 2 Diabetes Mellitus for a variety of rea-sons, such as insulin resistance, endothelial dysfunction, inadequate cardiac perfusion, reduced cerebral blood flow, and oxygenation deficits. They might also have changes in the activity of their skeletal and cardiac muscles. Aortic compliance plays a key role in controlling blood flow in the coronary arteries, which in turn influences myocardial work capacity and lowers exercise tolerance.[14]

The comparison of Forced Expiratory Volume in one second (FEV1) and Forced vital capacity (FVC) between the control and diabetic groups revealed considerable differences in lung function, the diabetic group having poorer lung function from the control group.Some previously available evidence also prints to to decreased FEV1 and FVC in T2DM patients when compared to age matched controls.[17,19,20]

Individuals with diabetes exhibited a reduced FEV1/FVC ratio compared to their control group. Tesema DG et al. and Niazi S.et al have also found decrease in mean FEV1/FVC in type 2 diabetics as compared to normoglycemic participants.[21,22] Reduced forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) in diabetic patients can be attributed to various mechanisms linked to the disease. Diabetes can lead to glycation of proteins in the lung tissue, causing stiffening and reduced elasticity of the lung parenchyma, which impairs lung function. Additionally, chronic hyperglycemia contributes to systemic inflammation and oxidative stress, further damaging lung tissue and function.[26] The reduced FEV1/FVC ratio observed in diabetic individuals may be attributed to diabetic neuropathy, microvascular complications, and obesity, which can collectively affect lung function.[27]

All the individuals in the healthy group had normal lung function, while in the diabetic group, 53.3% showed signs of obstruction and 46.7% showed signs of restriction. This disparity highlights a notable difference in the prevalence of lung function abnormalities between the two groups, suggesting potential respiratory complications linked to diabetes with p<0.001.Rajput S et al. (2023) have found that lung functions are likely to be reduced in individuals with type II DM. Mostly, lung dysfunction is mixed in nature (obstructive or restrictive pattern).[23] On the other hand Gautam R. (2011) showed that restrictive pulmonary disorder is more prevalent in Type 2 diabetes mellitus 24 and Rohling M et al. found that type 2 diabetes mellitus exhibit features of obstructive ventilation pattern indicating reduced lung function.[25]

The present study results indicate that people with T2DM can suffer from impaired lung functions, even in the absence of overt symptoms. Prompt control of diabetes and early identification of pulmonary impairment and reduced exercise tolerance is necessary for all persons suffering from T2DM. Since diabetic patients are at an increased risk of developing respiratory pathology in the form of restrictive and obstructive lung diseases, they should be advised to participate in pulmonary rehabilitation program and for improving exercise tolerance a minimum of 150 minutes moderate intensity physical activity should be followed on a daily basis along with proper diet.

This study had some limitations that must be acknowledged. They are the lack of analysis of cause - effect relationship and relatively small sample size. Further studies can address these shortcomings.

Conclusion

Impaired exercise tolerance and pulmonary function was seen among type 2 DM individuals when compared to the control group. management of individuals with type 2 diabetes mellitus can significantly enhance both exercise tolerance and pulmonary function. A tailored physiotherapy program that focuses on structured exercise, including aerobic, strength, flexibility, and balance training, not only improves physical capacity but also addresses specific limitations related to pulmonary health. Physiotherapists can educate patients on proper breathing techniques and posture, which are crucial for optimizing lung function during physical activity. Additionally, ongoing support and motivation from physiotherapists can foster adherence to exercise routines and promote healthier lifestyle choices. By integrating physiotherapy into comprehensive diabetes care, patients can achieve better health outcomes, improved functional capacity, and enhanced overall well-being.

Patient Consent: A written consent was obtained from the patient.

ETHICAL CLEARANCE: Name of the ethics committee clearing the study :Institu-tional Ethics Committee AJ Institute of Medical Sciences and Research Centre. Date: 13/06/2023 DCGI Reg. No. EC/NEW/INST/2020/741 Number: AJEC/REV/189/2023

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Original Article

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Reliability of Bi-Dimensional System of Facial Movement Analysis in Patients with Peripheral Facial Palsy.

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Abstract

Background: Peripheral facial palsy (PFP) is a condition that substantially alters facial function and has a noticeable impact on appearance. Precise evaluation of the level of functioning is required for objectivity in diagnosis of facial function and monitoring clinical changes while planning and evaluating therapeutic interventions for patients with PFP.

Objective: The present study was conducted with an objective to find out the reliability and internal consistency of the Kinovea software based bi-dimensional tool in objectively evaluating Peripheral facial palsy.

Methods: 40 Patients who were diagnosed with peripheral Facial palsy were categorized on stage of House Brackmann facial nerve grading scale. Landmarks were placed on face and image was captured in resting facial symmetry and video recording of different facial expressions like closing of eye, raising of eyebrows and smiling was performed by two different examiners. The data was processed by Kinovea software to measure different facial angles.

Results: The intra-rater reliability (re-test reliability) for the measurement of the facial angles using Kinovea software at rest and movement analysis on both the affected and nonaffected sides was excellent (Rest-ICC-0.94, α>0.95)(Movement- ICC-0.92, α>0.98).The reliability between raters on analysis at rest and movement in both the affected and non-affected side were also excellent (Rest-ICC->0.96, α>0.96), (Movement-ICC>0.86, α>0.87).

Conclusion: Two-dimensional motion analysis system using Kinovea software can be considered as a reliable method for the assessment of unilateral Peripheral Facial Palsy and can be used extensively to detect deviation in facial angles in resting and movement.

Keyword: Peripheral Facial Palsy, Kinovea software, bi-dimensional tool.

Introduction

Peripheral facial palsy (PFP) is a lower motor neuron lesion of facial nerve & Bell's palsy is one of the most common idiopathic causes of the Peripheral facial palsy.[1] The annual incidence of facial palsy is 20 to 30 cases per 100,000 in India that accounts for 70 % of unilateral facial

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palsy with equal rate in male and female.[2] People with facial paresis experience facial disfigurement and may find difficulty to convey emotions through facial expressions[3], closing eye, raising eye brow, smiling, oral incompetence, and have problem with eating, drinking and/or articulation. [4] In addition to physical complaints, patients suffer significant psychosocial consequences, sometimes leading to complete social isolation[5] and may have a negative impact on quality of life.[4]

A study done in UK reported psychological distress and maladaptive coping higher in women and younger patients along with low self-esteem.[5] There are different subjective evaluation tools used for grading facial movement[6] and this method evaluates facial abnormality through systematic visual inspection and evaluation of facial form and function hence limited by the expertise of the professionals administering them.[7] From 1955-2013 there are 17 subjective facial grading systems among which the House-Brackmann and Sunnybrook are two widely used scales to evaluate facial nerve paralysis. [7]

The main problem in these subjective evaluation lies in absence of reliable and precise facial function measurements. Hence The objective diagnosis of facial function would help in monitoring clinical changes, planning and evaluating therapeutic interventions and accurate conversation with other health care professionals with respect to patients with Facial palsy.[8,9] Objectivity is critical to compare the outcome of treatment efforts undertaken to restore the facial function in different medical specialties.[6] Facial Nerve Disorders Committee of the AAO-HNS have concluded in 2009 "further improvement of quantification of facial nerve function will require an objective rating scale. Additional advances in motion analysis software are expected and, when refined, should allow widespread use of consistent, repeatable, objective scoring".[10] Further it is emphasized that an objective and standardized tool is of great significance as a research tool for any medical or physiotherapeutic intervention treatment of FNP.[10] Many objective tools have not gained clinical use, mainly due to practical issues such as time-constraints, requirement of special equipment or techniques,[10] complexity and high cost of instrumentation. These limitations affect both research and clinical settings, making it challenging to use these tools as outcome measures.[11]

There are currently new, inexpensive 2D technologies available, some of which may match leading high-end reference systems in terms of precision. Kinovea is one such software, created in 2009 via the non-profit collaboration of several researchers, athletes, coaches and programmers from all over the world. It is a low-cost technology that is free 2D motion analysis software available for use in the open domain. [12] ***Kinovea software is designed with user friendly features making it accessible to individuals with minimal training or computer literacy and ensures that even those with limited technical experience can navigate through the application, collect the data and utilize it effectively.***

This tool evaluates the distance, angle, coordinates and spatial temporal parameters. [12] Although this software appears as a viable objective option to measure facial angles, it needs to be researched about its psychometric properties specific to the condition. Hence the present study was conducted to determine the reliability of Kinovea software in recording facial angles in Peripheral facial palsy as an objective outcome measure.

Material And Methods

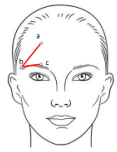
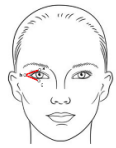
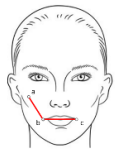
This study enrolled patients with unilateral peripheral facial palsy, aged between 20 and 60 years, recruited from neuro- physiotherapy outpatient departments or referred by qualified medical practitioners. Patients meeting inclusion criteria were those diagnosed with PFP for the first time and willing to participate, excluding cases of recurrent or bilateral palsy, upper motor neuron facial palsy, and other specific etiology presenting with sensory motor symptoms of the face. Ethical approval was obtained from the Institutional Ethics Committee of SDM college of Medical Sciences and Hospital (Ref no.-SDMIEC/2023/490). The study was conducted between May 2023 to June 2024.

The sample size was determined as per the epidemiology of peripheral facial palsy in India as mentioned by Gupta et al in their study. [2] The minimum sample size arrived at as per the sample size formula for cross-sectional study was 39. Hence the study included a total of 40 participants who were evaluated and data was recorded.

Patients were provided with detailed information sheet which explained the study procedure and various other frequently asked questions answered along with details of Principal investigator. Patients consent to participate in study was obtained using written informed consent duly signed by participants. Patients' demographic details were recorded and were graded on House-Brackmann facial nerve grading system.

Facial movements were evaluated using a smartphone-based video capture ***technique using the standardised method as described in previous studies. [13,14]*** Patients were seated comfortably with scapulae and occiput leaning back against back rest with feet touching the ground. Specific facial landmarks were marked for frontal, palpebral, and smile angles ***as mentioned by Gharib et.al. [13]*** Smart Phone was placed on tripod at distance one and half feet from the patient ***such as to capture the full face and facial expressions.*** Height of tripod was changed in accordance with the coverage of patient shoulder level before capturing. Videos were recorded at ***a standard resolution*** of 1920 × 1080 pixels and 60 frames per second (fps), [14] to ensure a clear capture of facial expressions.

Table 1: Facial landmarks placement

Sl. No	Facial angle	Landmark	Image
1	Frontal	a. Frontal Protuberance	
		b. External Eyebrow	
		c. Middle Eyebrow.	
2	Palpebral	a. Upper Eyelid	
		b. External Canthus	
		c. Lower Eyelid	
3	Smile	a. Zygomaticus	
		b. Right Commissure	
		c. Left Commissure	

Two qualified examiners trained about the accuracy of the procedure and placement of the landmarks, under the supervision of the Principal Investigator, performed assessments. Initial recordings included resting facial symmetry, followed by patient instructions to perform standard facial expressions (e.g., closing/opening eyes, lifting eyebrows, smiling with mouth closed). After capturing the video of all the facial expressions, the data was collected by principal investigator, who transferred it to the laptop and analysis was done using the Kinovea software. Kinovea, an open-source software licensed under GPLv2, facilitated accurate measurement and analysis of facial movement dynamics. The software's capabilities were leveraged to ensure standardized data collection and rigorous analysis across all study participants. Video data were analyzed for precise 2D motion analysis. Inter-rater reliability was assessed by comparing results from both examiners in a blinded manner. Test-retest reliability was evaluated by repeating assessments with the same examiner to ensure consistency of results. The methodology adhered to strict ethical guidelines, ensuring participant safety and confidentiality.

Results

Statistical analysis was done using JASP software version 0.18.3.0. The descriptive analysis was done and presented as percentage and mean for baseline characteristics such as age, gender, side of Peripheral facial palsy (PFP) and House Brackmann stage (HBS). Data analysis was performed using Intra- class correlation test to establish reliability of Frontal angle (FA), Palpebral angle (PA) and Smile angle (SA) as examined by examiners in resting and movement scenarios both on the affected as well as on non-affected sides.

The present study was conducted on 40 patients who consented to participate. Among the participants were, 50% (20) female and 50% (20) male participants, with mean age of 40.6±12.7 in an age range of 20- 60 years. 55% (22) of the patients presented with PFP on the right side and 45% (18) on the left side. (Table 2)All participants were subjectively graded on the basis of House Brackmann staging (Table -3).

Table 2: Demographic details of the study participants

AGE	**Values**	
Mean± SD	40.6± 12.7	
Minimum	20	
Maximum	60	
GENDER	**Counts**	**% of Total**
Female	20	50.0 %
Male	20	50.0 %
SIDE	**Counts**	**% of Total**
Right	22	55.0 %
Left	18	45.0 %

Table 3: House Brackmann Staging

FREQUENCIES OF HOUSE BRACKMANN STAGE			
HOUSE BRACKMAN STAGE	Counts	% of Total	Cumulative %
2	16	40.0 %	40.0 %
3	16	40.0 %	80.0 %
4	6	15.0 %	95.0 %
5	2	5.0 %	100.0 %

The Mean and standard deviation values for Frontal, Palpebral and Zygomatic (Smile) angles of both affected and non-affected sides at rest and movement evaluated using Kinovea software are listed in Table 4.

Agreement between Examiner-1 with Examiner-2 and Examiner 1 (Trial-1) with Examiner 1 (Trial-2) of various facial angles (FA, PA and SA) in resting and movement for both affected and non-affected sides was done using Intra class correlation analysis. The values are suggestive of very strong absolute agreement for all facial angles in resting and movement on 2 trials by Examiner 1 and between 2 Examiners suggesting excellent inter- rater and intra- rater reliability.

Table 4: Mean and SD values of FA, PA, and SA angles of both Affected and non- affected sides at rest and movement.

Resting Angles					Movement angles			
Sides	Parameters	Examiner	Mean	Std.Dev.	Parameters	Examiner	Mean	Std.Dev
Affected side	FA	E1	39.8	3.06	FA	E1	40.6	3.7
		E2	39.4	3.14		E2	40.7	3.76
		E1	39.8	3.16		E1	41.1	3.41
	PA	E1	35.2	5.74	PA	E1	16.2	4.6
		E2	34.7	5.5		E2	15.8	4.06
		E1	34.8	5.21		E1	16.5	4.5
	SA	E1	126.1	3.06	SA	E1	129.9	4.6
		E2	126.2	3.28		E2	129.7	4.52
		E1	125.9	3.18		E1	130.1	4.41
Non affected side	FA	E1	40.7	3.41	FA	E1	43.1	3.89
		E2	40.4	3.23		E2	43.4	3.65
		E1	41	3.63		E1	43.2	3.83
	PA	E1	34.8	5.7	PA	E1	10.4	1.31
		E2	34.4	5.64		E2	10.7	1.69
		E1	36	6		E1	10.4	1.31
	SA	E1	125	3.01	SA	E1	126.8	4.51
		E2	125.1	3.07		E2	126.5	4.63
		E1	124.5	3.23		E1	126.8	4.33

*FA- Frontal angle; PA- Palpebral angle; SA- Smile angle; E1- Examiner 1; E2- Examiner 2

The reliability and Internal consistency of the Kinovea software was further tested using the Cronbach's α which indicated excellent reliability for FA, PA and SA angles in resting as well as movement analysis for affected as well as non-affected sides. (Table-5).

The re-test reliability for the measurement of the facial angles using Kinovea software at rest and movement analysis on both the affected and non- affected sides was excellent (Rest-ICC-0.94, α>0.95)(Movement- ICC-0.92, α>0.98). The inter-rater reliability at rest and movement analysis on both the affected and non- affected side was also excellent (Rest-ICC->0.96, α>0.96), (Movement-ICC>0.86, α>0.87).

Table 5: The Intra class correlation (ICC) and Cronbach's α analysis for FA, PA and SA angles in resting as well as movement for affected as well as non-affected sides by Examiner 1 and 2.

		At Rest			On Movement			
Variable	Parameters	Examiners	ICC	Cronbach's α	Parameters	Examiners	ICC	Cronbach's α
Affected side	FA	E1 vs E2	0.978	0.981	FA	E1 vs E2	0.978	0.978
		E1 vs E1	0.971	0.988		E1 vs E1	0.962	0.985
	PA	E1 vs E2	0.979	0.981	PA	E1 vs E2	0.948	0.948
		E1 vs E1	0.958	0.982		E1 vs E1	0.929	0.964
	SA	E1 vs E2	0.974	0.973	SA	E1 vs E2	0.987	0.987
		E1 vs E1	0.986	0.993		E1 vs E1	0.987	0.994
Non- affected side	FA	E1 vs E2	0.96	0.961	FA	E1 vs E2	0.95	0.95
		E1 vs E1	0.986	0.986		E1 vs E1	0.999	0.999
	PA	E1 vs E2	0.975	0.976	PA	E1 vs E2	0.861	0.876
		E1 vs E1	0.942	0.952		E1 vs E1	0.996	0.997
	SA	E1 vs E2	0.98	0.98	SA	E1 vs E2	0.961	0.962
		E1 vs E1	0.958	0.963		E1 vs E1	0.993	0.993

*FA- Frontal angle; PA- Palpebral angle; SA- Smile angle; E1- Examiner 1; E2- Examiner 2

Discussion

This study aimed to assess the reliability and internal consistency of a bi-dimensional system for measuring facial angles using Kinovea software in patients with unilateral peripheral facial palsy. Kinovea, an open-source software, offers a user-friendly interface and does not require extensive training or expensive equipment [12]. Its ease of use and the ability to digitally store data for future reference make it a practical tool for clinical settings, facilitating quick and objective evaluations.

The results demonstrated that the bi-dimensional system using Kinovea software exhibited excellent inter-rater and test-retest reliability, with high internal consistency. This supports its potential utility in clinical practice for monitoring facial angles in patients with facial palsy.

In contrast to Kinovea, non-computerized tools for measuring facial asymmetry, as reviewed by Kleiss et al., include simple instruments like rulers and pens.[15] While these tools are inexpensive and easy to use, their psychometric properties—such as validity, reliability, and sensitivity—are not well-documented. [15] Manktelow et al. reported high inter-rater and intra-rater reliability (>0.89) with a handheld ruler, though their method had limitations, such as not accounting for movement direction [16]. Burres et al. employed facial electromyography along with handheld caliper for linear displacement measurements, which, while objective, proved complex and time-consuming, with limitations in assessing multiregional facial movements [17].

Among other 2-dimensional analysis tools, the Glasgow Facial Palsy Scale (GFPS) [18], OKAO Vision Facial Palsy Image [19], Facial Expression and Motion Analysis System (FEMAS) [20], Objective Scaling of Facial Nerve Function based on Area Analysis (OSCAR) [21], and Facial Analysis Computerized Evaluation System (FACE) [22] are notable. Tomat et al. used a facial reanimation measurement system that demonstrated high intra-rater and inter-rater reliability (intraclass correlation coefficients >0.9), although disadvantage of this system of evaluation was that it was time consuming. [11] Frey et al. utilized a 3-D measuring system with high specificity but faced challenges related

to calibration and time consumption [23]. Qualisys motion capture, a 3-D system, also showed high accuracy (ICC between 0.88 and 0.97) but required multiple high-speed cameras and reflective markers, [13]which posed practical challenges reported by Sir Charles Bell Society (SCBS) [15]. Hontanilla and Auba'spublished their 3D videography assessment with FACIAL CLIMA, which used reflective markers and infrared cameras, achieved high reliability [24] but required specialized equipment and was time-consuming [15].

Isono et al. used a landmark-based system with reflective markers, but noted the potential discomfort caused to patients [25]. In contrast, the practical and cost-effective nature of the facial landmarks used in open-source software like Kinovea, coupled with affordable camera options, makes the tool a viable alternative [12]. Further, Pueo et al. used Kinovea and demonstrated high reliability and validity using a smartphone for measuring vertical jump height, which made an impression of its feasibility and potential application for facial measurements [14]. Similarly, this study utilized a smartphone (1920 × 1080 pixels at 60 fps) to capture facial expressions, which was easy to use and upload data onto the software for further angular measurements.

However, the study is not without a few limitations. The Kinovea version 0.9.5 lacked immediate data access and internal storage options. The evaluation was limited to three facial angles (FA, PA, SA) in three facial zones, in the present study which may limit the generalizability of the results. Future research may explore additional facial angles and validate the Kinovea system against other quantitative methods, software applications, or scales. Further studies are also recommended to assess the software's effectiveness in detecting changes post-facial surgery, physical therapy, or spontaneous recovery.

Conclusion

Two-dimensional motion analysis system using Kinovea software can be considered as a reliable method for assessment of Peripheral Facial Palsy and can detect wide range of clinically significant deviation in facial angles. Results from inter-rater and test-retest reliability assessments provided robust insights into the reliability and reproducibility of the evaluation protocol. While we conclude that Kinovea software-based evaluation system is an objective tool, it is prudent that we use both quantitative measurement systems as well as qualitative experiences to obtain a complete holistic outlook of a patient with facial palsy and effectively plan the treatment and structured outcomes.

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Original Article

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Comparison of Physical Activity Level and Functional Capacity in Patients with Type 2 Diabetes Mellitus and Healthy Controls.

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Abstract

Background: Improved physical activity can enhance glycemic control, functional capacity, and overall quality of life for individuals with Type 2 Diabetes Mellitus (T2DM)**.** Despite the known benefits of exercise for type 2 diabetes, many individuals with this condition remain inactive and fail to meet recommended activity levels. There's a lack of specific data on the functional capacity of Indian individuals with type 2 diabetes.

Purpose: The aim of this study was to compare physical activity level and functional capacity in patients with T2DM and healthy controls.

Materials and Methods: In this study, thirty patients with T2DM and 30 age, gender, and BMI-matched healthy controls were enrolled in the study. All participants met the inclusion criteria and provided written informed consent. The physical activity level was assessed using International Physical Activity Questionnaire (IPAQ) and functional capacity was assessed with 6 Minute Walk Distance (6MWD). The IPAQ score, IPAQ sitting hours and 6MWD were compared between the 2 groups. Data was tested for normality. Unpaired t-tests were used to compare Age, BMI, and 6MWD between groups. Mann-Whitney U tests were used to compare IPAQ scores and sitting hours.

Results: The study demonstrates T2DM patients have reduced functional capacity as compared to control group. A difference of 68.4 meters in 6MWD [p=0.000] was observed with no difference in physical activity levels between the two groups.

Conclusion: T2DM patients have reduced functional capacity as compared to control group. The mechanism of impaired functional capacity appears to be associated with the disease process. Therefore, early exercise prescription and physical fitness for improving glycemic control and functional capacity in T2DM patients is essential.

Key words: Type 2 Diabetes mellitus, functional capacity and physical activity level.

Introduction

Hallmark of Type Diabetes Mellitus is insulin resistance with relative insulin deficiency [1]. T2DM constitutes about 98% of the total Indian diabetic population [2]. According to the Diabetes Atlas 2006, India had 40.9 million people diagnosed with diabetes and this number is expected to rise

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to 69.9 million by 2025 [3]. T2DM is largely precipitated by insulin resistance due to weight gain because of diet and lack of physical activity [4].

Physical activity is defined as any bodily movement produced by skeletal muscles which require energy expenditure and includes exercise and incidental activity [1]. Physical activity is crucial for managing diabetes. It enhances insulin sensitivity and glucose tolerance, leading to improved glycemic control [5, 6]. Additionally, it lowers the risk of diabetes-related complications like nephropathy, retinopathy, neuropathy, and cardiovascular disease [7]. According to the American College of Sports Medicine (ACSM) guidelines, individuals with T2DM require at least 150 min/week of moderate to vigorous aerobic exercise for achieving optimal cardiovascular disease risk reduction [8]. Despite the known advantages of exercise, most people with type 2 diabetes are inactive compared to those without diabetes [5, 6].

Functional capacity is referred as the capability of performing tasks and activities that people find necessary or desirable in their lives [1]. Presence of diabetes may independently contribute to reduced exercise capacity [9, 10]. However, most of the activities of daily living are carried out at sub-maximal levels of exertion. 6-Minute Walk Test (6MWT) is a valid measure of predicted exercise capacity and correlates with the capacity to carry out Activities of Daily living (ADL) [4, 13] Thus, 6MWT which is a sub-maximal test will better reflect the functional capacity [12, 13].

Majority of the diabetes patients are sedentary. Difficulty taking part in exercise, tiredness, being distracted by television programs, lack of time and lack of local facilities are main reasons for inactivity [7]. Functional capacity among T2DM patients is reduced due to poor glucose metabolism, poor blood perfusion of muscles at cellular levels and impaired aortic compliance and myocardial work capacity.

Measuring functional capacity allows us to examine the effects of a disease on the performance of an individual. Increase in physical activity will improve glycemic control in T2DM, leading to increase functional capacity and improved quality of life.

AIM

The primary objective of this study was to compare the physical activity level and functional capacity in patients with type2 diabetes mellitus and age, gender, and BMI-matched healthy controls.

Material And Methodology

It is a Cross sectional study conducted at Physiotherapy and Endocrinology Outpatient Department (OPD) of Tertiary Health Care General Hospital from January 2021 to June 2021 (Post-Ethical Approval). A total of 60 participants (30 T2DM patients and 30 age, gender and BMI matched healthy controls) who met the inclusion criteria were enrolled in the study after taking a written consent.

Inclusion Criteria For Patients With T2DM

- T2DM patients with disease duration ≤5 years.
- HbA1c level- All inclusive.

Exclusion Criteria For Patients With T2DM

- Patients with more than 60 years of age.
- One or more positive mark on the Physical Activity Readiness Questionnaire (PAR-Q) [17, 18].
- Presence of complications such as diabetic neuropathy, peripheral vascular disease, foot ulcer.
- Any musculoskeletal pain NRS>2
- Pregnant and lactating women.
- Unwilling to participate.

Inclusion Criteria For Healthy Individuals

- Healthy individuals with age, gender and BMI match

Exclusion Criteria For Healthy Individuals

- One or more positive mark on the PAR-Q.
- Any musculoskeletal pain NRS>2
- Pregnant and lactating women.
- Unwilling to participate.

Outcome Measures:

1. International Physical Activity Questionnaire [14].

   The IPAQ asks about three specific types of activity which are: walking, moderate-intensity activities and vigorous intensity activities. Score will be presented with Metabolic equivalent (MET)-minutes/week which is a continuous variable.

a. Walking MET-minutes/week =3.3×walking minutes× days
b. Moderate MET-minutes/week= 4×activity minutes× days
c. Vigorous MET-minutes/week=8×activity minutes× days

   Total physical activity= a +b +c MET-minutes/week

   The IPAQ instruments have acceptable measurement properties, at least as good as other established self-reports. The reliability of IPAQ short form is 0.76 and acceptable validity [15].

2. 6-Minute Walk Test [16].

   The 6MWT is a safe, easy to administer test which better reflects activities of daily living. It was performed using the American Thoracic Society (ATS) Guidelines. The 6MWD, which is the primary measurement, was used to measure the functional capacity.

Procedure

Approval from Institutional Ethics Committee (Protocol no.-ECARP/2020/32, Date-13.02.2020) and MUHS was sought prior to commencement of the study. The study was conducted in collaboration with Endocrinology Department of Tertiary Health Care General Hospital. Patients diagnosed with type 2 diabetes mellitus by the endocrinologists were screened for the study.

Out of 120 patients screened, 30 patients met the inclusion criteria and were enrolled in the diabetic group after taking their informed consent. Similarly, 80 healthy individuals (relatives of patients) who accompanied the patients to the physiotherapy OPD and office going staff working within the institute were screened and enrolled after getting their consent. Their random blood sugar was tested to rule out diabetes. Out of 80 individuals screened, 30 met the inclusion criteria and were included in the control group. Demographic and Anthropometric data of all the participants was noted. In the study group, sensory and motor examination of all diabetic participants was done. Sensory examination included touch awareness, pain perception, pressure perception, temperature awareness. Motor examination was done using manual muscle testing. The HbA1c value (from last 3 months report) was noted. If reports were not available, the HbA1c test was done in the Endocrinology laboratory.

Participants were asked to fill the IPAQ to assess the physical activity level and a 6MWT was performed to assess the functional capacity as per the ATS guidelines. The data was collected and results were analyzed.

Figure no 1: Subject performing 6 Minute Walk test.

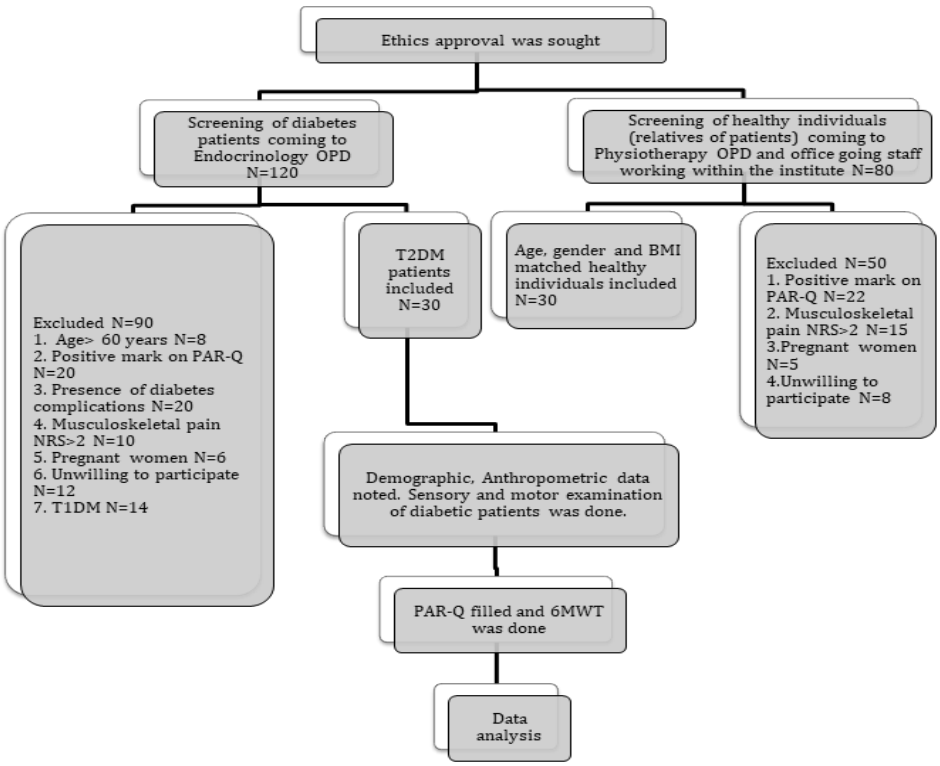

Figure no. 2 Consort flow diagram

Data Analysis

SPSS 16 software was used for data analysis. Data was tested for normality. Unpaired t test was used to compare Age and BMI between groups for matching. Unpaired t test was used to compare 6MWD between both groups.

Descriptive analysis of Age and BMI

	Group	N	Mean	Std. Deviation	Std. Error Mean
Age	Diabetic Group	30	44.7667	6.47373	1.18194
	Control Group	30	44.6333	6.18944	1.13003
BMI	Diabetic Group	30	26.9000	4.26550	.77877
	Control Group	30	26.9933	4.19087	.76514

Table No. 1: Descriptive analysis of Age and BMI. INTERPRETATION: Mean age of subjects with diabetes was 44.76 years ± 6.47 years and mean age of healthy adults was 44.63 years ±6.18 years. The mean BMI of subjects with diabetes was 26.9 kg/m²±4.26kg/m² and mean BMI of healthy adults was 26.99 kg/m²± 4.19 kg/m².

Gender Distribution

			Group		Total
			Diabetic Group	Control Group	
Gender	Female	Count	14	14	28
		% within Gender	50.0%	50.0%	100.0%
	Male	Count	16	16	32
		% within Gender	50.0%	50.0%	100.0%
Total		Count	30	30	60
		% within Gender	50.0%	50.0%	100.0%

Table No 2: Gender Distribution between Groups. INTERPRETATION: There were 16 males and 14 females in both groups. Both groups were matched with Gender.

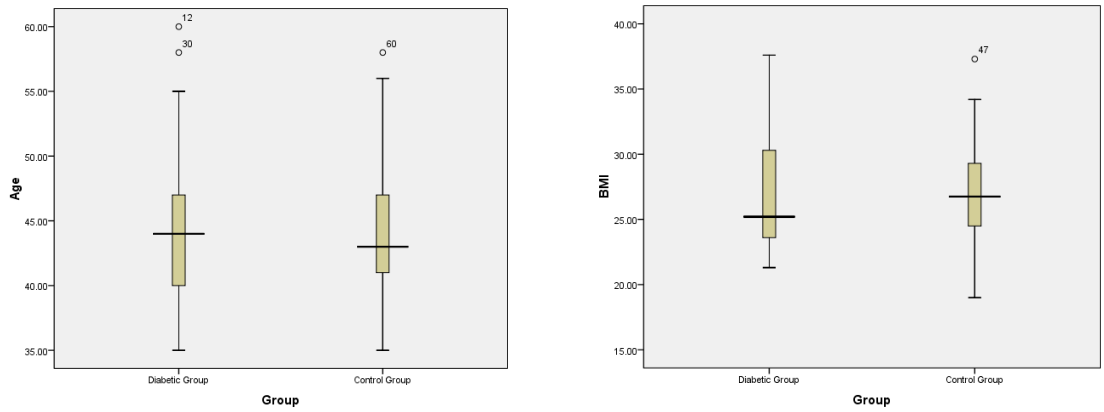

Figure No. 3: Boxplot of Age and BMI. INTERPRETATION: There is no significant difference between the groups with respect to age and BMI suggesting that both groups are matched.

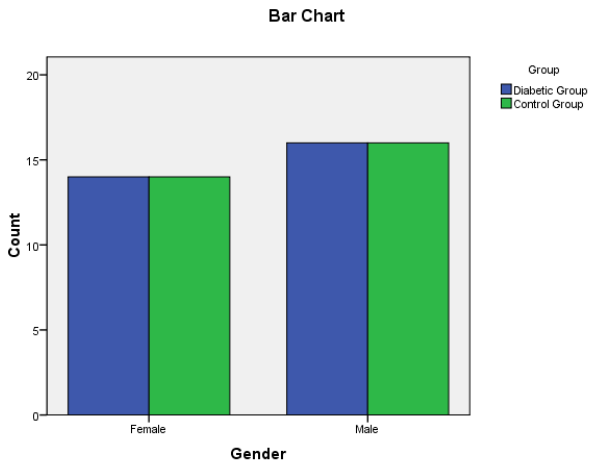

Figure No. 4: Bar Graph of Gender Distribution. INTERPRETATION: Both groups are matched with equal number of males and females. There were 16 males and 14 females in both groups.

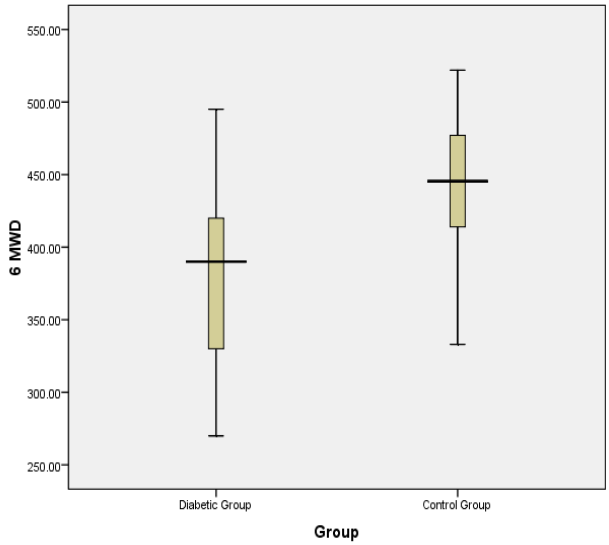

Figure No. 5: Boxplot of 6MWD: INTERPRETATION. The 6MWD in diabetic group is lesser than that of the control group. There is a significant difference of 68.4 meters between both groups (p=0.000).

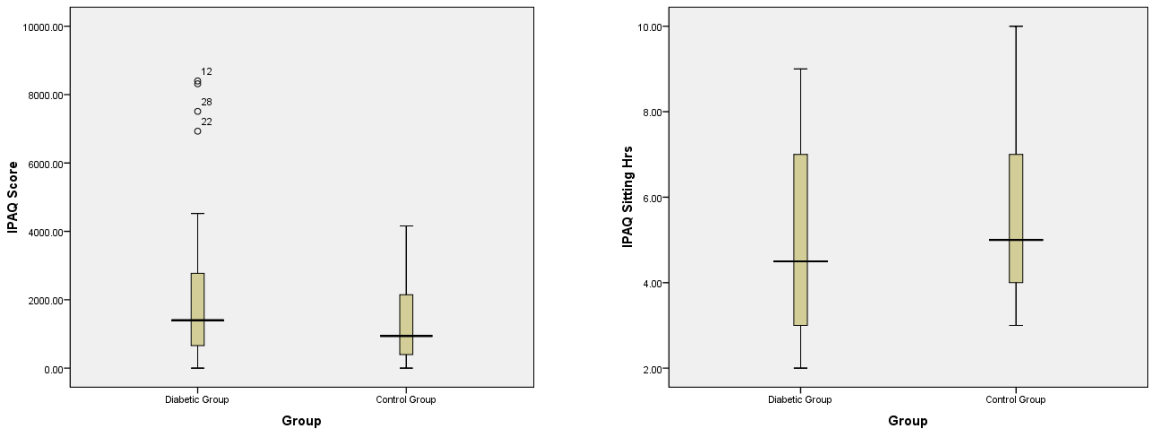

Figure No. 6: Boxplots of IPAQ Score and IPAQ sitting hours. INTERPRETATION: The Median IPAQ score is 1399.5 and 940.5 in diabetic and control groups respectively. There is no significant difference in IPAQ score (p=0.120) and IPAQ sitting hours (p=0.099) between diabetic and control groups

Results

Both groups are matched with respect to Age, BMI and Gender. The diabetic group walked 68.4 meters less during the 6MWT as compared to healthy Controls which was statistically significant (p=0.000). There was no difference in Physical activity levels (median IPAQ score, p=0.12) and sitting hours (IPAQ sitting hours, p=0.099) in both groups.

Discussion

The Aim of this study was to compare physical activity level and functional capacity in patients with type 2 DM and healthy controls. The study shows that patients with T2DM demonstrated significantly lower functional capacity than healthy controls (p=0.000). However, there is no significant difference in physical activity levels in both the groups (IPAQ score, p=0.12).

In this study, the diabetic group walked 68.4 meters less during the 6MWT as compared to healthy controls. A difference of 30 meters or more is considered clinically significant [19]. This suggests patients with T2DM have lower functional capacity than their age, gender and BMI matched healthy controls.

Some studies demonstrated an inverse relation between 6MWD and BMI in T2DM patients and also suggest that

Female diabetic patients had lower functional capacity as compared to male patients [11, 12]. In this study, despite of matching the BMI, diabetic subjects had a lower functional capacity as compared to healthy controls. Factors probably contributing to reduced exercise capacity in diabetics could be impaired glucose metabolism, reduced cardiac function and effect on respiratory systems.

Hyperglycemia affects cardiac function. It contributes to increased left ventricular mass [20]. This is due to factors like cardiomyocyte hypertrophy, collagen buildup, and protein glycation [20]. Glycation forms advanced glycation end products (AGEs) which can accumulate in tissues and cause left ventricle mass increment [20, 21]. This enhances myocardial oxidative stress. Additionally, hyperglycemia stiffens arteries, further straining the heart [20]. The compliance of the aorta plays an important role in modulating coronary blood flow. The vascular load and wall stress stimulates Left ventricular hypertrophy and remodeling that further affects myocardial work capacity and therefore, may result in reduced functional capacity [11]. In a study, A. Barmeyer et al (2009) stated that diastolic dysfunction is associated with a reduced exercise capacity. In diastolic dysfunction, the mechanical properties of the left ventricle are altered causing slowed diastolic filling which result in poor increase of cardiac output at exercise and can limit exercise capacity [22].

Poor glycemic control causes increased stiffness of pulmonary vessels, thickening of alveoli walls and basal membrane of capillaries and endothelium. This impairs diffusion of gases and decreases parenchymal elasticity [23]. These factors may influence the functional capacity. The huge vascular and capacitive reserve may compensate for partial loss of pulmonary parenchyma and make the complication clinically silent [23]. However, stress on the respiratory system such as during exercise, this effect may be elicited.

This study showed a reduced exercise capacity in diabetic group than the control group which could be attributed to the above-mentioned determinants of the disease process. There was no significant difference in median IPAQ scores i.e. Physical activity levels (p=0.12). The counseling provided by the endocrinologist for having a more active lifestyle as well as the diabetics being more conscious regarding their health may be the possible causes for diabetic group to be relatively more active than the control group. The control group was majorly from the office going staff of a tertiary hospital that have a sitting desk job and thus are relatively less active than the diabetic group. Therefore, no significant difference in physical activity level was observed between the diabetic group and the control group.

Decreased level of physical activity is inversely associated with increased sitting time [24]. This study shows that the mean sitting time in diabetic group was 4.8 hours per day and in control group was 5.7 hours per day. The American Diabetes Association has recommended that diabetes patients should be encouraged to decrease their sedentary time and to not sit for more than 90 minutes [25]. The study demonstrates that there was no significant difference in physical activity levels in T2DM patients as compared to their matched healthy controls. It also shows that T2DM patients are equally active yet their functional capacity is reduced due to the disease process suggesting that the disease process is having a negative impact on the functional capacity of individuals.

Conclusion

The study demonstrates T2DM patients have reduced functional capacity as compared to control group. A difference of 68.4 meters in 6MWD was observed with no difference in physical activity levels between patients with T2DM and Age, Gender and BMI matched healthy individuals in the control group.

Limitations

- Small sample size
- Participants had different job profiles which may cause variations in physical activity levels.

Clinical Implications

This study creates awareness about the importance of early exercise prescription and physical fitness for improving glycemic control and functional capacity in patients with type 2 diabetes.

Funding Sources: The study does not have financial support from any sources.

Ethical Clearance/Statement of Ethics The study has been approved by the Ethics Committee for Academic Research Projects (ECARP) PG Academic Committee, T.N.M.C, Mumbai, Maharashtra, India. (Date-13.02.2020, Protocol no.- ECARP/2020/32)

Conflicts of interest statement : There are no conflicts of interest

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Original Article

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A Study on The Effectiveness of Body Weight Supported Treadmill Training along with Conventional Physiotherapy for Osteoarthritis in Improving Knee Joint Function.

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Abstract

Background: Osteoarthritis is one of the most prevalent and chronic disabling joint disease of knee joint. It may due to aging, obesity, sedentary lifestyle, overuse, malalignment, and abnormal loading of the jointcauses pain and difficulty in walking. Hence, there is a need to study Body Weight Supported Treadmill Training along with conventional physiotherapy for osteoarthritis to restore normal gait patterns by increasing the joint space.

Method: This study was a quasi-experimental study of pre and post type carried out in Adhiparasakthi Medical sciences and Research Institute. Melmaruvathur. 60 subjects with knee osteoarthritis were chosen for the study of age above 45 years, according to inclusion criteria. They were equally divided into two groups. Group 1, 30 subjects were given with Body weight supported treadmill training withconventional physiotherapy. Group 2 , 30 subjects were given with conventional physiotherapy alone. Treatments were given for 6 sessions for 2 weeks .Both the groups were measured with pre and post-test for pain, range of motion, and walking speed using a Numerical pain rating scale, goniometer, and pedometer respectively.

Result: At the end of the treatment program, there is a significant relief of pain, increased knee joint range of motion, and walking speed in patients treated with Body weight-supported treadmill training along with conventional physiotherapy.

Conclusion:From this study, it was concluded that the Body weight supported treadmill training along with conventional physiotherapy reduces pain, and increases knee joint range of motion and walking speed among patients with knee osteoarthritis.

Keywords: Osteoarthritis, Range of motion, walking speed ,Numerical pain rating scale, goniometer, pedometer .

Introduction

Osteoarthritis is one of the most prevalent and chronic disabling joint disease.Worldwidely, Osteoarthritis affects more than 250 million people above the age of 45 years. In India 22 to 39% of middle-age peoples are affected. Females are most commonly affected than males due to menopause, hormonal changes, ageing, obesity, sedentary life-style, over use, malalignment and abnormal loading of the joint.[1]World Health Organisation reports it as the fourth and eighth most common cause of disability in women and men respectively.

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Knee pain and difficulty in walking are the major complaints of osteoarthritis patientleading to disability.[2]

In knee Osteoarthritis, the medial compartment is more frequently affected than the lateral compartment due to the higher transfer of loads through the medial compartment.[3] Body weight is the super most common risk factor associated with the onset and progression of knee osteoarthritis.[4]Body Weight supported Treadmill TrainingImproving speed of walking Improve endurance, Improve balance, and functional walking.[5]Hence, there is need for studying Body Weight supported Treadmill Training for osteoarthritis to restore their normal gait pattern by increasing the joint space.

Disease progression is commonly associated with gradual and debilitating joint pain and stiffness, which leads to an overall de-conditioning of the musculoskeletal system and manifests as, a loss of thigh muscle strength about the knee [6] diminished knee joint function [7]increased body weight or Body mass index[8]Each of these changes makes it difficult to distance walking, stair climbing, stooping, kneeling, carrying weights, and performing heavy household activities which may result in a reduced quality of life.[7]So the aim of the study is to evaluate the effectiveness of body weight supported treadmill training along with conventional physiotherapy for osteoarthritis to improve function of the knee joint**.**

Biomechanics Of Knee Joint

The knee is the largest and most complex joint of the body. The complexity is the results of fusion of three joints in one. It is formed by fusion of the lateral tibiofemoral, medial tibiofemoral and patellofemoral joints.[9]The tibiofemoral joint is a double condyloid joint with three degrees of freedom of angular motion.Flexion and extension occur in the transverse plane around the coronal axis through the epicondyles of the distal femur.The medial and lateral rotation occurs in the transverse plane about a longitudinal axis through the lateral side of the medial tibialcondyle. Abduction and adduction occur in the frontal plane around an anteroposterior axis.[10]

Weight Bearing Forces:

a. In a bilateral stance, the weight-bearing stresses on the knee joint are therefore equally distributed between the medial and lateral condyles.
b. However, once a unilateral stance is adopted or dynamic forces are applied to the Joint, compartmental loading is altered.
c. In the case of a unilateral stance, the weight-bearing line shifts towards the medial compartment to account for the smaller base of support below the center of mass, this shift increases the compressive forces on the medial compartment.
d. If the forces from the floor extend medial to the knee joint center, then an adduction movement is created around the knee joint, which acts to rotate the knee into a relatively greater varus (Adduction).
e. Thus the magnitude of the knee adduction moment can be used as a surrogate measure for medial compartment loading during gait and other activities of daily living. Abnormally high knee adduction moment is associated with the development of knee OA.
f. The association between knee malalignment and the progression of knee osteoarthritis has implications for patients who present with abnormal anatomical alignment.

Body Weight Supported Treadmill Training:

GOALS: To practice walking and standing, To work on walking quality and speed,To train fitness and health.

Body weight-supported treadmill training is considered one of the newest evidence-based clinical approaches to improve ambulation in patients with lower limb disability.Body weight-supported treadmill training is a therapy modality in which part of a person's body weight is supported while walking on a treadmill.It is usually done using an overhead suspension system attached to a harness thatpartially or completely supports part of a person's body weight over a treadmill.While supported, the person walks with or without assistance from health providers on a treadmill.

During Body weight-supported treadmill the patient is partially suspended in a harness, which reduces the joint loading by increasing the joint space and improving the functional ability of the knee joint.Body weight-supported treadmill training will directly increase the demand placed on the postural control mechanics of your body. Thus BWSTT helps to prepare your body to achieve the right alignment and posture to walk.[11]The advantages of BWSTT are the convenience of walking, lesser risk of falling while using a harness, better walking speed, and the amount of load that can adjusted according to thepatient's potential.[12]

EQUIPMENT HAVE : A harness,Groin and abdominal straps and padding, An overhead suspension system, A treadmill with adjustable speeds, A ramp up to the treadmill, Additional tubing or strapping, Parallel bars , Braces and orthoses.

PEDOMETER APP: Pedometer App is one of the smartphone App that records the number of steps you have walked and displays along with number of calories you have burned,distance,walking time and speed per hour[13]

Ask the patient to turn on the start icon of the pedometer App, patient either hold the mobile phone in hand or keep in pocket while walking.After 10 minutes turn off the App and see the steps walked.The best advantages of this App is ,easy to use.

Methodology

Study design :Quasi experimental study
Sampling technique:Convenient sampling
Study population:Osteoarthritispatient
Sample size :n= 60

Sample size was calculated using previous research standard deviation and variance by the software G power3.1.9.4and calculated.Sample size -44 osteoarthritis patient ,each group had 22 members(Jason peeler,phd,CATCO et al, june 12,2018,wolterkluwer Health).

Participant selection: 60 samples are selected based on criteria and they are equally divided into two groups without any gender ,age bias.Before treatment,informed consent were getting from all subjects. Treatment were given for both groups . three sessions per week, totally 6 sessions for 2 weeks.

Inclusion Criteria:1. Age over 45 year ,2.Both female and male 3.BMI>25KG/m.sq 4.Mild to moderate knee osteoarthritis,kellegren and Lawrence scale(Grade 2 and 3)5. Walk independently, 6. Chronic knee pain.

Exclusion Criteria:1.Total knee replacement patient. 2.Any previous surgeries on lower limb. 3.Fracture around the knee joint.4.Cardiovascular disease. 5. Renal condition patients. 6.Malignancy or tumor around the knee joint.7.Intrarticular steroid injection to the knee joint. 8.Inflammatory arthritis.9. Meniscal and ligament injury.

Variables of the Study

DEPENDENT VARIABLE: Pain**,**Decreased knee joint range of motion, walking speed.

INDEPENDENT VARIABLE: Wax therapy, Body weight supported treadmill training, Conventional physiotherapy-(stretching and isometric strengthening exercises).

OUTCOME MEASUREMENT SCALE: Numerical pain rating scale, Goniometer, pedometer

MATERIALS USED: Body weight supported treadmill, wax therapy, Low couch**,**Pillows**,** Goniometer, Assessment chart, Numerical pain rating scale pedometer app.

Experimental group:(Group 1)

30 subjects were treated with body weight supported treadmill training along with conventional physiotherapy.Body weight supported treadmill training(20 mins)

Wax therapy(10 mins),Exercises(15 mins). (Based on manual muscle length examination strengthening and stretching exercise are advised to the patient).

Figure 1 Body weight supported treadmill training

Control group: (Group 2)

30 subjects were treated with conventional physiotherapy alone.Wax therapy(10 mins),Exercises(15 mins). (Based on manual muscle length examination strengthening and stretching exercise are advised to the patient.

Data Analysis

Table 1 Paired Samples StatisticsNumerical Pain Rating –Experimental Group-1

Numerical Pain Rating –Experimental Group-1		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	8.1000	30	1.24152	.22667
	Posttest	3.9333	30	1.11211	.20304

Table 2 Paired Samples TestNumerical Pain Rating –Experimental Group-1

Numerical Pain Rating –Experimental Group-1 Mean		Paired Differences					t	Df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pretest–Posttest	4.1666	1.36668	.24952	3.65634	4.67699	16.699	29	.000

Table 3 Paired Samples StatisticsNumerical Pain Rating –Control Group-2

Numerical Pain Rating –Control Group-2		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	8.0333	30	1.21721	.22223
	Posttest	5.6333	30	1.06620	.19466

Table 4 Paired Samples TestNumerical Pain Rating –Control Group-2

Numerical Pain Rating –Control Group-2 Mean		Paired Differences					t	Df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pretest–Posttest	2.4000	.72397	.13218	2.12966	2.67034	18.157	29	.000

Table 5 Paired sample statistics Goniometer Experimental Group-1

Goniometer Experimental Group-1		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	74.6667	30	10.67815	1.94956
	Posttest	97.3667	30	9.75734	1.78144

Table 6 Paired sample test Goniometer Experimental Group-1

Goniometer Experimental Group-1 Mean		Paired Differences					t	Df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pretest–Posttest	-22.700	7.14939	1.30529	-25.36963	-20.03037	-17.39	29	.000

Table 7 Paired sampe statistics Goniometer Control Group-2

Goniometer Control Group-2		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	74.9333	30	10.78611	1.96927
	Posttest	85.0667	30	12.14548	2.21745

Table 8 Paired sample test Goniometer Control Group-2

Goniometer Control Group-2 Mean		Paired Differences					t	df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pretest–Posttest	-10.133	4.32103	.78891	-11.74683	-8.51984	-12.84	29	.000

Table 9 Paired sample statistics Pedometer Experimental Group-1

Pedometer Experimental Group-1		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	687.8000	30	108.64285	19.83538
	Posttest	738.9667	30	110.25690	20.13006

Table 10 Paired sample test Pedometer Experimental Group-1

Pedometer Experimental Group-1 Mean		Paired Differences					t	df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pretest - Posttest	-51.166	11.28955	2.06118	-55.38226	-46.95108	-24.82	29	.000

Table 11 Paired sample statisticsPedometer Control Group-2

Pedometer Control Group-2		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	681.1667	30	124.84448	22.79338
	Posttest	702.3000	30	124.73009	22.77250

Table 12 Paired Samples Test Pedometer Control Group-2

Pedometer Control Group-2 Mean		Paired Differences					t	df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pretest - Posttest	-21.133	6.19083	1.13029	-23.44503	-18.82164	-18.69	29	.000

Result

By the statistical analysis of the data of group A and group B ,the scores of group A who received **Body weight supported treadmill training along with conventional physiotherapy,** thep value is 0.00 in Numerical pain rating scale, goniometer and pedometer measurement.Hence the technique has highly significant among the osteoarthritis patient.

Discussion

Body weight-supported treadmill training (BWSTT) has emerged as a promising rehabilitation method for individuals suffering from knee osteoarthritis.BWSTT involves the partial unloading of body weight during treadmill walking, offers a low-impact exercise option that can help reduce pain, improve function, and enhance the overall quality of

life in individuals with knee OA.Knee OA is characterized by the degeneration of joint cartilage and changes in the subchondral bone, leading to pain, stiffness, and reduced mobility. Conventional exercise is essential in managing knee OA, but the pain associated with weight-bearing activities often limits participation. BWSTT mitigates this issue by reducing the load on the knee joint during ambulation, allowing patients to engage in aerobic and strengthening exercises with less discomfort.Lim et al 2015 had emphasized that reduced load on the knee joint during BWSTT can decrease joint stress, which is beneficial in slowing the progression of OA.the repetitive nature of treadmill walking under supported conditions can improve gait mechanics, muscle strength, and cardiovascular fitness without exacerbating joint symptoms. These improvements may contribute to better joint stability and reduced pain over time.[14]When compared to other non-pharmacological interventions for knee OA, such as aquatic therapy or cycling, aerobic exercise.BWSTT offers a unique combination of reduced joint loading and functional weight-bearing exercise. While aquatic therapy provides similar joint unloading, it does not replicate the specific biomechanical patterns of walking, which are crucial for everyday function. Cycling, although beneficial for cardiovascular fitness, does not engage the lower extremity in a weight-bearing manner, which is essential for improving gait and leg strength. Aerobic exercises have beneficial in weight andpain reduction but not play a role in enhancing balance and gait.BWSTTdirectiy increase the demand placed on postural control mechanics of body to achieve the postural alignment and balance of body.

BWSTT can also complement traditional therapeutic exercises by allowing patients to progress to more challenging activities as their pain and functional status improve. As patients become more comfortable with weight-bearing, the amount of body weight support can be gradually reduced, facilitating a smoother transition to full-weight-bearing activities.[15]

One unique aspect of our study was individualised adjustementof body weight support based on real timefeedback and patient tolerance.while many other studies implement a fixed percentage of weight support, we allowed flexibility in adjusting the weight bearing load throughtout the intervention.this adaptive approach may be contributed to the improved functional outcomes.

Customizable BWSTT yields superior, sustained improvements in gait and pain relief compared to standard ,fixed approaches.

Limitations and Future Directions

Despite its benefits, BWSTT is not without limitations. Access to specialized equipment and the need for professional supervision may limit its widespread availability. Additionally, the long-term effects of BWSTT on the progression of knee OA remain unclear, and more research is needed to determine the optimal duration and frequency of training. Short duration of treatment and lack of long term follow up to determine long term effectiveness of treatement were also other potential limitation of this study.

Future research should focus on comparing BWSTT with other exercise modalities, exploring its cost-effectiveness, and investigating its long-term impact on disease progression and quality of life in patients with knee OA. Additionally, studies should explore the potential benefits of combining BWSTT with other therapeutic modalities, such as resistance training or manual therapy, to maximize patient outcomes.Body weight-supported treadmill training presents a valuable therapeutic option for individuals with knee osteoarthritis, offering a way to engage in low-impact exercise while minimizing pain and joint stress. It can improve pain, mobility, and overall function, particularly in patients for whom traditional weight-bearing exercises are challenging. As evidence continues to emerge, BWSTT may become a standard component of knee OA rehabilitation, helping to improve the quality of life for many individuals affected by this chronic condition.

CONCLUSION: This study concluded that , the Group 1 received **Body weight supported treadmill training along with conventional physiotherapy** is much more effective in reducing pain,increasing knee joint range of motion and walking speed among osteoarthritis patient than Group 2 received conventional physiotherapy alone

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Original Article

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A Study to Compare the Effectiveness of Alternate Nostril Breathing Exercise Versus Bee Breathing Exercise on Respiratory Components in Air-conditioner Users

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Abstract

Background: Modern lifestyles among people particularly in urban areas are having a risk of developing airway problems and alteration pulmonary functions due to the intensive use of air conditioners.

Purpose of the study: The present study is to compare the effect of alternate nostril breathing exercise and bee breathing exercise on Peak expiratory flow rate(PEFR), chest expansion and respiratory rate in air conditioner users.

Methods: This study included 50 subjects with age of 20-50 years, those who were working in air-conditioned environment for 8-10hrs/day. Patients were selected based upon who fulfilled the inclusion criteria. The purpose of the study was explained to all subjects and the subjects were randomly assigned into either Group A (Alternate nostril breathing exercise) or Group B (Bee breathing exercise). The subjects in both groups practiced exercises of about 6 sessions/weeks for 4 weeks. The parameters assessed are Peak expiratory flow rate, chest expansion, respiratory rate was measured before and after 4 weeks of breathing exercise sessions.

Results: Going by the statistical analysis results, the mean improvement in PEFR (A=34$\pm$12.91&B=32.8$\pm$11), chest expansion (A=0.32$\pm$0.09 &B=0.28$\pm$0.08) and reduction in respiratory rate (A=3.76$\pm$1.20&B=3.52$\pm$0.96) of group A is very closer to group B.

Conclusion: We conclude that both the treatments are equally effective in improving PEFR and Chest Expansion and reducing Respiratory Rate in air conditioner users.

Keywords: Air conditioner users, Peak expiratory flow rate, Chest expansion, Respiratory rate, Alternate nostril breathing exercise, Bee breathing exercise.

Note: This study's abstract was presented at a national-level conference paper presentation and subsequently published in the conference proceedings. The corresponding link is provided below: https://ijpbs.net/admin/upload/con_28.pdf.

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Background

Devices like Air-conditioners (AC) which cool the room air by process of condensation of water vapor were reducing the humidity of air.[1]AC makes the living environment more comfortable byadjusting the room temperature based on the seasonal weather changes, but it is considered one of the destructiveprocesses to the environment also harmful to human's health.[2] Among various workplaces AC use has become unavoidable in thiscomputerized twenty first century particularly in urban areas which leads to altered pulmonary function by cold dry air inhalation for longer duration because of intensive use of air conditioners. [3,4] The respiratory tract of the subjects who are exposed to air conditioners leads to hyper-responsiveness and decreased airway patency.[4]Peak expiratory flow rate is the maximum velocity in liters per minute with which air is forced out of the lungs measured by mini wright peak flow meter. [3]Chest expansion measurements provide information regarding a patient's baseline respiratory status. Bronchoconstriction leads to decreased air entry and decreased chest expansion. [4]Inhalation of cold dry air resulting in bronchospasm as a protective mechanism which leads to reduced air flow into airways and lungs. Cold dry air challenge test among asthmatic patients resulted in bronchoconstriction, and increased airway resistance. [5] The respiratory rate is the number of breaths that a person takes each minute. Stimulation of irritant receptors produces reflex tachypnoea and bronchoconstriction leads to increased airway resistance which leads to increased respiratory rate.[3] Breathing exerciseprovides connection between body and mind and breathing techniques that produce different physiological responses in healthy individuals. [6]Alternate nostril breathing exercise has various effects on respiratory system such as decreases the work of breathing, strengthens and trains the diaphragm, improves gas exchange and oxygenation. It also has been known to alter cardiorespiratory and autonomic parameters. [7]Bee breathing is a technique in which the subject should inhale through both nostrils and while exhaling produce humming sound of a bee. Epidemiological studies found thatincreased prevalence of respiratory symptoms among AC users because ofmild airflow obstruction.[2]We suggest frequent monitoring of PEFR, chest expansion, respiratory rate of the workers who work in AC environment. This will ensure early detection of any underlying respiratory dysfunction, its treatment and prevention of complications arising later in life. Considering the problem present study was planned to make the employees working in Air-conditioned environment to aware more about the risk of prolonged inhalation of cold dry air and to implement the effective exercises to improve peak expiratory flow rate and chest expansion and reducing respiratory rate by different breathing exercise.[8]To compare the effectiveness of Alternate nostril breathing exercises versus Bee breathing exercises on respiratory components in young healthy, non-smoking workers exposed to an air-conditioned work environment by different breathing exercise.

Methods

This Experimental study design was conducted in COGNET HRO PRIVATE LIMITED, Chennai. For data collection 55 subjects with age of 20-50 years in both the sex, those who were working in air-conditioned environment were selected by simple random sampling method based upon who fulfilled the inclusion criteriasuch as Healthy males and females those who are free from diseases, Using air conditioner for 6 – 12 hours a day for more than 6 months by simple random sampling and on that 5 subjects were excluded as they were not willing to participate in this study.The subjects were excluded from the study with a history of smoking and alcoholic, using air conditioner on irregular basis, history of chronic respiratory disease, any chest injury, systemic illness which directly or indirectly affects the respiratory system, extremes of weight and height (BMI more than 30) and pregnant women.While the population in this study is clearly defined (air-conditioner users), the generalizability of the findings to other populations, such as individuals in different climates or those with underlying health conditions, was not evaluated. Power analysis for sample size calculation was done by Power Analysis & Sample Size (PASS) software. The purpose of the study was explained to all subjects and Informed consent was obtained. The subjects were randomly assigned into either Group A n = 25; 13 female, 12 male (Alternate nostril breathing exercise) or Group B n = 25; 12 female, 13 male (Bee breathing exercise). Both the group performs 15 minutes per session, 6 sessions per week for 4 weeks. There is no control group. The parameters used in this study were Peak expiratory flow rate (PEFR), Chest expansion at 3 levels, Respiratory rate.All the subjects underwent pretest measurements prior to treatment and posttest measurements at the end of the last session of treatment i.e. after 4 weeks.The participants and investigators were blinded in this study. The Mini-Wright Peak Flow Meter is used to measure PEFR which is one of the reliable measurement tools.Chest expansion measurements involvegirth of the chest in full expiration and inspiration should be recorded to determine the range of expansion at axillary level, nipple level and xiphoid process level using ainch tape.The respiratory rate is the number of breaths taken per minute by an individual. In group A participants performed the alternate nostril breathing exercise while seated comfortably on the floor with their backs straight. They positioned their right hand by opening it, folding down the index and middle fingers, and used the thumb to close the right nostril. The left nostril was closed using the ring and little fingers. The exercise involved inhaling through the left nostril, then closing it and exhaling through the right nostril. This was followed by inhaling through the right nostril, closing it, and exhaling through the left nostril. This cycle was repeated five times. Subsequently, participants lowered their hands and breathed through both nostrils for five breaths. The entire breathing exercise was performed for a duration of 15 minutes.

Bee breathing exercise performed by Sitting comfortably with back, neck and head in a straight line. Hand placement was placing both index fingers on cartilage of ears.The subjects must inhale through nose to the count of 5, then exhale to the count of 10, producing a humming sound through nostrils by fully concentrating on this sound. The subject can feel the sound vibration over the head. This sound is like the humming sound of the bee. Repeat the process 6 to 7 times, making the buzzing bee noise louder as progress, without straining.

Results and Discussion

In this study, two hypothetical tests have been conducted to test our hypothesis and those tests are Paired Samples t-test, and Independent Samples t-test. These two tests are performed at 5% level of significance. That is, $\alpha = 5\%$ or 0.05.

The twenty first century was highly computerized with the use of air-conditioners at workplaces particularly in the field of Information Technology sector which have been unavoidable. Even though the working environment with AC was pleasant it leads to various adverse effects to the person being exposed. (Savina O George 2012). The most common adverse effect would be affecting the respiratory system where bronchospasm exists as aresponse to nasal inhalation of cold and dry air that indirectly reduce the air flow rate into airways and limits the penetration of insufficiently conditioned inspired air into the lungs (Pierre fontanari et al 1996).A Study on effect of AC environment on pulmonary function tests in female employees by R. Babitha, R. Rangarajan, Basavarajaiah. M.G revealed that there is a significant decrease in PEFR, Chest expansion and significant increase in respiratory rate. The decrease in PEFR in the subjects exposed to AC could be due to Hyper-responsiveness of airways by inhalation of Cold dry air and leads to dehydration injury and airway epithelial disruption, which leads to removal of protective mucosal barrier, bronchoconstriction that thereby increases airway resistance, decreases dynamic compliance which results in decreased PEFR.Increased respiratory rate in the subjects exposed to AC due to stimulation of irritant receptors produces reflex tachypnoea and bronchoconstriction which again increases airway resistance which leads to increased RR.

Table.1 Descriptive statistics for Age and BMI in Group A and B

	A Age	*B_Age*	*A_BMI (Kg/m2)*	*B_BMI (Kg/m2)*
Mean	**25.88**	**25.64**	**23.48**	**23.28**
Standard Deviation	**6.10**	**3.49**	**3.82**	**3.12**
Sample Variance	37.19	12.16	14.59	9.71
Kurtosis	10.90	0.71	-0.98	2.03
Skewness	3.17	1.12	-0.49	-1.05
Range	29	13	13	14

Table.2 Gender distribution among both the groups

	Group A		**Group B**	
Gender	**Count**	**%**	**Count**	**%**
Male	12	48%	13	52%
Female	13	52%	12	48%
Total	**25**	**100%**	**25**	**100%**

The above descriptive statistics clearly indicate that the subjects from both the treatment groups are homogenous in terms of Age and BMI. Also, the gender distribution is appears to be approximately equal across the two treatment groups.

In present study we compared the pre and post-test means of PEFR, Chest expansion and respiratory rate in group (A) Alternate nostril breathing exercise the results reveals that the mean of pre-test score is 378.80 (SD

=87.86), 2.46 (SD =0.32), 21.28/min (SD = 1.40/min),and mean of post test score is 412.80 (SD = 88.62), 2.79 cm(SD = 0.30 cm), 17.52/min (SD = 1.05/min) and t value is 13.17, 18.42, -15.67 were p-value is 0.000<0.05 from the above table p value shows the significant difference between pre and post-test means of PEFR, Chest expansion, respiratory rate in group (A) Alternate nostril breathing exercise respectively.

Table.3 Intra-Group Analysis (Within Group Analysis)

Parameters	GROUP A					GROUP B				
	Pre-test (mean+SD)	Post-test (mean+SD)	df	't' score	'p' value	Pre-test (mean+SD)	Post-test (mean+SD)	df	't' score	'p' value
Peak Expiratory Flow Rate	378.80+87.86	412.80+88.62	24	13.17	0.000	360.40+86.43	393.20+79.83	24	14.90	0.000
Chest Expansion	2.46+0.32	2.79+0.30	24	18.42	0.000	2.52+0.30	2.80+0.29	24	17.14	0.000
Respiratory Rate	21.28+1.40	17.52+1.05	24	-15.66	0.000	21.28+1.43	17.76+1.20	24	-18.28	0.000

This result suggests that group A and group B significantly improve peak expiratory flow rate, chest expansion and reducing the respiratory rate in air conditioner users.

A various Studies explained about the effect of " Alternate nostril breathing exercise" by Upadhyay Dhungel K et al 2008; Sivapriya et al 2010; Srivastava RD et al 2005 on respiratory parameters revealed that alternate nostril breathing exercise increases PEFR, Chest expansion and reduces respiratory rate because stimulation of pulmonary stretch receptors by inflation of the lung and relaxes smooth muscles of larynx and trachea-bronchial tree, probably this modulates the airways caliber and reduces airway resistance.Increase in PEFR due to following changes in respiratory dynamic as wellincreased respiratory muscle strength.Efficient use of diaphragmatic and abdominal muscles, thereby emptying and filling the respiratory apparatus more effectively and completely. It also improves thoracic-pulmonary compliances and bronchodilation.Increase in chest expansion following the phase of inspiration the lungs are expanded considerably and the walls of alveoli are stretched maximum. After a particular degree of stretching, the stretch receptors situated in the alveolar walls are stimulated. In normal breathing, at the stage or even before this, the inhibitory impulses would have been sent to the inspiration center and the phase of exhalation would have been started in a reflex. The decline in RR can be explained by influence of a probable hypocapnia on medullary respiratory center and persistent voluntary effort of breathing, producing inhibition of rhythmic spontaneous breathing by a phenomenon to over drive suppression. Reduced sympathetic activity is mainly responsible for decrease in RR. It produces state of restful alertness which decreases the anxiety and help to reduce respiratory rate.According to Raghavendra et al., yogic breathing involves the isometric contraction and expansion of abdominal and intercostal muscles, which may also enhance the strength of the intercostal muscles, leading to increased forced vital capacity (FVC) and forced expiratory volume in one second (FEV1). The increase in peak expiratory flow rate (PEFR) is attributed to greater involvement of lung alveoli during breathing exercises, which were previously inactive. Joshi et al and Ankad et alsuggest that the rise in PEFR may be due to the increased release of lung surfactant and prostaglandins, which reflexively relax the smooth muscles of the larynx and tracheobronchial tree. This relaxation modulates airway caliber and reduces airway resistance, identified as the causal factors for the increase in PEFR in their study. According to Karmur et al., Dhungel et al., and Shrivastava et al., the increase in thoracopulmonary compliance and bronchodilation achieved through breathing exercises may be responsible for the observed rise in peak expiratory flow rate (PEFR).[7, 41]

In present study when we compare the pre and post-test means of PEFR, Chest expansion and respiratory rate in group (B) Bee breathing exercise the results reveals that the mean of pre-test score is 360.40 (SD = 86.43), 2.52 cm (SD =0.30 cm), 21.28/min (SD =1.43/min), and mean of post test score is 393.20 (SD = 79.83), 2.80 cm (SD = 0.29 cm),17.76/min(SD = 1.20/min) and t value is 14.91, 17.15 , -18.28, p-value is 0.000<0.05 from the above table p value shows the significant difference between pre and post-test means of PEFR, chest expansion, respiratory rate in group (B) Bee nostril breathing exerciserespectively.

A various Studies explained about the effect of "Bee breathing exercise" by Ankad RB et al 2001; Patil YR et al 2012; Saxena T et al 2009; Mooventhan et al 2014; Bora G et al 2013; Soni R et al 2012 on respiratory parameters revealed that bee breathing exercise increases PEFR, Chest expansion and reduces respiratory rate because Bee breathing is an art of prolongation and control of breath, which helps to bring the conscious awareness in breathing and to reshape breathing habits and patterns. The persistent conditioning of breathing pattern increases the pulmonary function in healthy individuals. Bee breathing exercise is used as expiratory exercise for bronchial asthma.[13]During this breathing lung inflates to the maximum which stimulates pulmonary stretch receptors.The increased PEFR may attribute to voluntary prolongation of inspiration and expiration during breathing exercise stretched the respiratory muscles to their full extent and the respiratory apparatus was able to work to their maximal capacity, the use of diaphragmatic and abdominal muscles more effectively during bee breathing. Improvement of respiratory muscle function helps to reduce the relative load on the muscles and increases sustained ventilator capacity.By practicing bee breathing exercise the stretch receptors reflex decreases the trachea-bronchial smooth muscle tone, which in turn decreases air resistance and increase airway caliber, which causes improvement in lung function and reduces Respiratory rate.[6]

Bhramari Pranayama, also known as bee breathing, this practice has been shown to:

1. **Increase lung capacity**: By regulating the breath and encouraging deep inhalations and controlled exhalations, Bhramari pranayama helps expand the lung capacity and the air spaces in the lungs.
2. **Strengthen respiratory muscles**: The controlled breathing in pranayama strengthens the diaphragm and the intercostal muscles, improving overall respiratory efficiency.
3. **Improve lung elasticity**: Regular practice helps maintain or even enhance the elasticity of the lung tissue, which is essential for efficient gas exchange.
4. **Enhance pulmonary function**: Studies suggest that pranayama, including Bhramari, can lead to better ventilatory function by improving parameters like vital capacity, peak expiratory flow rate, and forced expiratory volume.

Table.3 Inter-Group Analysis

Parameters	Group A	Group B	Inter-group Analysis		
	Post-test (mean+SD)	Post-test (mean+SD)	df	't' score	'p' value
Peak Expiratory Flow Rate	34.00+12.91	393.20+79.83	48	0.3538	0.3625
Chest Expansion	0.32+0.09	0.28+0.09	48	1.8333	0.0730
Respiratory Rate	-3.76+1.20	-3.52+0.96	48	-0.7800	0.4392

The inter-group analysis shows that there is no significant difference between the two treatment groups in terms of all the three measures (i.e., PEFR, Chest Expansion and Respiratory Rate).

The result of this study concludes that both Group A and Group B were statistically found to have significant increase in PEFR, chest expansion and decrease in respiratory rate.Considering PEFR, chest expansion, respiratory rate measurement as a risk factor among subjects in increased intensive use of AC in workingplace, may help to reduce respiratory dysfunction and enhance the quality of life in young adults working in air-conditioned environment.

Conclusion

This study shows that both the treatment groups (A & B) are individually effective in improving PEFR and Chest Expansion and reducing Respiratory Rate in air conditioner users, which was shown by the Intra-Group Analysis. However, the inter-group analysis shows that there is no significant difference between the two treatment groups in terms of all the three measures (i.e., PEFR, Chest Expansion and Respiratory Rate). Hence, we conclude that both the treatments are equally effective in improving PEFR and Chest Expansion and reducing Respiratory Rate in air conditioner users. This study's abstract was presented at a national-level conference paper presentation and subsequently published in the conference proceedings. The corresponding link is provided below: https://ijpbs.net/admin/upload/con_28.pdf.

Recommendations

- To enhance the reliability of the findings, future research should strive to include a larger sample size.

- Future studies should incorporate a control group, either receiving no intervention or a placebo intervention, to ensure that the observed effects are attributable to the breathing exercises rather than external factors.
- Prolonging the follow-up period would assist in evaluating the long-term sustainability of improvements in PEFR, chest expansion, and respiratory rate.

Competing interests

The author(s) declare that they have no competing interests

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Original Article

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Students Opinion on guest lectures series during orientation program – An Overview

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Abstract

Background: The Orientation Program (OP) is an integral part of any professional course. A well thought guest lectures with key highlights on essential topics can be a pivoting point to address students concerns before beginning a professional course.

Objective: This study was to obtain input from first-year physiotherapy students regarding guest lecture series which were part of current orientation program**.**

Methods: Eighty-one students volunteered for the feedback analysis. We used a structured google feedback form with closed-ended questions focusing on cognitive, social and personality, and mental and physical health domains of psychology to evaluate the students opinion on various lectures.

Results: Most of the students expressed satisfaction, with positive feedback ranging from 56 to 83%. for every lecture and orientation session as a whole. A small percentage of students, ranging from 1 to 6%, disagreed or expressed dissatisfaction with the lectures. The overall response of students to the orientation program and guest lectures was positive.

Conclusions: The overall feedback towards all the guest lecture was positive,and merely small percentage of students disagreed. The study concludes that guest lectures should be added to such OP

Key words: Orientation, feedback analysis, Personality, Communication

Introduction

The Oxford Dictionary defines orientation as a person's basic attitude, finding directions, belief or feelings in relation to a particular subject or issue.[1]Every academic institution regularly implements orientation sessions for incoming undergraduate or postgraduate students. The primary goal of these programs is to familiarize students with the campus, college, and other relevant departments as well as with the rules and regulations of the organization. [2]

When students from diverse background enroll in professional programs such as medicine, physical therapy, or dentistry at a young age (18 to 19), there are many psychological aspects associated with it.Such as anxiety about un-

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familiar places, people, bullying, language barriers, added work responsibilities towards college as well as expectations from family and the course itself [2]. With everything taken into consideration, students have many questions. Orientation programs play a crucial role in breaking down barriers by helping students feel comfortable in unfamiliar surroundings and in fostering communication between students and staff. It also offers a safe space where new experiences can be discussed and shared with classmates or parents who may be experiencing similar emotions.[3] Research conducted by Mac Eachern MJ further states that orientation sessions are essential for incoming students in every field of study to assist them in acclimating to a new setting.[4] Throughout the orientation program, parents and students can attend educational lectures that are specifically tailored to address any issues they may have. Through their facilitation of a successful start to any course and its consequences, they help students feel less pressured and apprehensive.[5]According to one study, orientation is ranked as the eighth most important thing for any student to do upon starting college, and it affects both attendance and performance.[6] Typically, these training sessions include a thorough orientation to the entire campus, which includes all of the amenities, such as food courts, general stores for essentials, college, libraries, and teaching hospitals.

Guest lectures are an integral part of any orientation program. The literature suggests that guest lectures have a positive impact on students' learning and retention of knowledge.[17, 19]In the current orientation program, guest lectures were incorporated, and an effort was made to check the opinion of the students towards these guest lecture[7].

Many studies have evaluated impact orientation programs, which have been shown and proven to neutralize potential negative stress-induced disorders[8], and deterioration of academic performance once enormous subject wise teaching-learning (TL) [9] rolls on to eventually integrate into healthcare delivery systems in the course of psychosomatic, socioeconomic, emotional and family issues. However, there is a dearth of literature on the point of view of students toward planned lectures and the effectiveness of such lectures; hence, the current study is planned.

The purpose of this study was to obtain input from first-year physiotherapy students regarding guest lecture series which were part of current orientation program.

Materials and Methods

We conducted this review at the beginning and the end of the orientation program for a fresh batch of Physiotherapy undergraduate students from Belagavi, North Karnataka. The orientation program promoted by the UGC to address the changes and create awareness in 81 students over a period of 4 days. According to the schedule, we exposed the students to guest lecture series on personality development, communication skills, stress management and corona and self-care to boost their self-esteem and give them a better perspective as they began their new lives.

Data collection tool: We formulated a structured google form. The questionnaire had 3 domains: first, demographic data; second, college norms such as infrastructure, library, anti-ragging, mentorship and essential skills; and third, feedback on guest lectures. The questionnaire focused on the cognitive, social and personality, and mental & physical health domains of psychology.

Procedure: We approached first- year students and did not compel them to provide "overall impression" or "positive impact" feedback on the orientation program as a whole or in specific domains. As we administered the questionnaire, we informed the students that their honest input would benefit the orientation program in the future

Inclusion criteria: All first-year students who participated in the physiotherapy orientation program consented to be enrolled in the study

Results: A total of 81 students participated in the orientation program and in this study.

The mean age of the 81 respondents (37 men and 44 women) was 18.69 ± 0.32 years. The combined responses for the various guest lectures offered during the orientation program (OP) are presented in Table 1. The majority of the students expressed satisfaction, with positive feedback ranging from 56 to 83% (n=45 to 67) for every lecture and orientation session as a whole. A small percentage of students, ranging from 1 to 6%, (n= 1 to 5) disagreed or expressed dissatisfaction with the lectures. The overall response of students to the orientation program and guest lectures was positive.

Table 1: Collective response to various guest lectures offered during orientation programs

Feedback by students regarding different guest lectures and overall orientation program				
Sr. No	Lectures	Positive feedback	Average feedback	Negative feedback
1	personality development	66%	31.6%	2.4%
2	communication skills	58%	39.5%	2.5%
3	lecture on corona and self-care	63%	36%	1%
4	stress management	56%	41.6%	2.4%
5	bedside manners in hospital	76%	20%	4%
6	Essential skills for college students	70%	25.8%	4.2%
7	Orientation to Physiotherapy College	67%	32.6%	0.4%
8	Orientation program overall	82.7%	17.3%	0%

Discussion

We conducted the current review to check the overall opinion of students towards the guest lecture individually. Eighty-one students participated in the study regarding the studentsopinion on guest lectures series during orientation program. The majority of students agreed that the orientation program was helpful, and only a small percentage of students said it was somewhat helpful.

Students join university degree courses with little knowledge of their professionalism and careers. Many students who have different states and backgrounds find it difficult to adjust to new environments and places. A well-planned orientation (induction) program can help them with all their concerns[4, 19.]

The induction program included orientation to colleges, campus, rules & regulations, mentorship, anti-ragging, and guest lectures on personality development, communication skills, corona and self-care, stress management, bedside manners and psychological counseling.

Guest lectures are an integral part of the learning process, and when performed by eminent speakers, they have a great impact on students overall experience. Castello (2012)[10] suggested that inviting a guest speaker is one potential method for boosting interaction and engagement among students, as lecture-based classrooms lack these elements. According to Kamoun and Selim (2007) and Alebaikan RA[11,18], bringing in a guest speaker can help students learn about best practices and life lessons.

Importance of personality development lectures: A study by Dr. Howard Gardner,a developmental psychologist,discusses multiple intelligences that go beyond grades to encompass a student's total development.[12] Additionally, Swami Vivekananda stressed the value of personality development and the role that teachers have in forming students. A personality development lecture at an orientation program might be a great way for them to start a new chapter in their professional lives. The opinions of the present orientation align with Kumar P's research, which states that a students total growth is dependent on his or her personality development [13].

Lecture on communication skills:Since university students come from a variety of backgrounds, cultures, and educational backgrounds communication can be difficult at times but is a crucial component that must be addressed. It matters a great deal in university courses how you present yourself in terms of communication abilities. Dr. Parmar-Shubhda's study on the value of communication skills for college students highlights the necessity of giving them careful thought. The current orientation program included a lecture on the same topic to help students understand the need for communication skills, and the majority of students agreed that the lecture indeed helped them[14.]

Lecture on COVID-19 and self-care: In response to heightened concerns amidst the pandemic, an orientation program for students entering medical education emphasized the critical need for precautionary measures. Acknowledging the heightened vulnerability of students to potential exposure, a lecture was delivered to promote student preparedness. The lecture underscored the importance of adopting stringent safety protocols and provided knowledge on effective self-care practices. By equipping students with essential information, the program aimed to foster a culture of vigilance and responsibility, mitigating risks within the academic environment. Such proactive measures serve to safeguard student well-being and contribute to a safer educational experience amid uncertain times.[15,20]

Lecture on stress management: Hena et al. highlighted the significance of stress management among university students and its impact on their quality of life. In alignment with this, the recent orientation program featured a guest lecture focusing on stress management. Recognizing the multitude of stressors encountered by students transitioning to university life, such as relocation, academic demands, and familial separation, the lecture aimed to equip them with coping strategies. Feedback from students indicated the efficacy of the lecture in providing valuable insights and support. By proactively addressing these challenges, the program endeavors to enhance student well-being and facilitate successful adaptation to their new academic environment.[8]

Lecture on bedside manners in hospitals: In hospital settings, bedside manners constitute a vital aspect of medical education, profoundly impacting patient care. The manner in which students conduct themselves and establish rapport with patients during examinations is paramount to their training. As a crucial element, incoming student cohorts must receive orientation regarding proper conduct in such settings. Zerwa Farooq emphasizes the significance of this aspect and explores the faculty's role in instilling these principles in students. This underscores the necessity for students to adhere to basic guidelines on interacting with patients, ensuring their comfort and fostering a conducive environment for effective medical practice[16].

Essential skills:Essential skills are important for shaping a student from being a mere human to being a professional. Various patients are treated not only in terms of the treatment provided to the patient but also to counsel them and provide comfort and reassurance. Essential skills also help them develop attitudes to handle critical situations in their personal and professional life.[17]

Orientation to colleges and campuses: Introducing new students to campuses and colleges aids in familiarizing them with both teaching and nonteaching staff, facilitating their academic and administrative tasks. Orientation to the college's infrastructure familiarizes students with the environment and classrooms, which is particularly beneficial for interdisciplinary courses. It also enables them to grasp

the array of facilities and amenities available on campus. Moreover, it acquaints them with emergency procedures, including entry and exit points, ensuring their preparedness in times of calamity.[4]

Overall orientation program: An induction program was implemented to help the students adjust to the new environment (college campus) and become comfortable with faculty and other students. Overall, the induction program was very effective in terms of impacting their personality, providing skills for communication, and inculcating good bedside manners in hospitals, which could be reflected in patient–doctor relations in the near future.

Conclusion

The present study reviewed the student's opinion (first-year BPT students) on series of guest lectures which were a part of 4-day OP. The overall feedback towards all the guest lecture was positive and merely small percentage of students disagreed. The study concludes that guest lectures should be added to such OP

Limitation: The interview method of analysis would emphasize on individual students opinion on orientation program

Future scope: Impact analysis and/or interventional studies on pre and post analysis can be taken up.

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