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Research paper

Effect of Matrix Rhythm Therapy Along with Wall Squats and Conventional Therapy in Individuals with Osteoarthritis of Knee: A Randomized Controlled Trial

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Abstract

Background: Knee osteoarthritis (OA) is a progressive degenerative condition that causes pain, restricted mobility, and reduced quality of life. Standard physiotherapy may not always address both tissue-level dysfunction and biomechanical deficits. Matrix Rhythm Therapy (MRT) is a novel modality that uses low-frequency mechanical vibrations to improve microcirculation, tissue relaxation, and oxygen delivery. This study evaluated the combined effects of MRT, wall squats, and conventional exercises in patients with unilateral knee OA.
Methods: An interventional study was conducted at Dr. D.Y. Patil College of Physiotherapy OPD. Thirty participants aged 45–65 years, diagnosed with unilateral knee OA (NPRS 5–8), were randomly allocated into two groups (n=15 each). Group 1 received MRT with wall squats and conven-tional exercises; Group 2 received MRT with conventional exercises only. Interventions were administered for 10 sessions over two weeks. Outcomes measured pre- and post-intervention included pain (Numerical Pain Rating Scale, NPRS), knee range of motion (ROM), and functional performance (Knee injury and Osteoarthritis Outcome Score, KOOS).
Results: Within-group analysis showed significant improvements in pain, knee flexion ROM, and KOOS scores in both groups ($p<0.05$), with no significant change in knee extension ROM. Between-group comparison indicated Group 1 achieved significantly greater pain reduction ($p=0.025$) and showed a trend toward greater improvement in knee flexion ROM and KOOS scores, though differences were not statistically significant.
Conclusion: The integration of MRT, wall squats, and conventional exercises is effective in reducing pain and improving functional per-formance in knee OA, offering a holistic, non-invasive rehabilitation approach.

Keywords: *Knee Osteoarthritis; Matrix Rhythm Therapy; Physiotherapy; Rehabilitation.*

1. Introduction

Osteoarthritis (OA) is a progressive joint disorder most common in older adults, often targeting major weight-bearing joints like the knees and hips. Among these, knee OA is particularly widespread, especially in younger obese women. Contributing factors include mechanical stress and biochemical changes, and its occurrence is expected to rise with increasing life expectancy and body weight. Common symptoms are persistent knee pain, restricted mobility, swelling, and morning stiffness. Physical stress and joint deformities, such as genu varum or valgum, can worsen the condition. Management ranges from lifestyle changes and physiotherapy to medications like NSAIDs, with joint replacement as a last resort (1).
Matrix Rhythm Therapy (MRT) is a relatively new physiotherapy technique designed to reduce pain, improve blood flow, enhance micro-circulation, promote relaxation, and support better oxygen delivery to tissues. Healthy cells move rhythmically within connective tissue (the “matrix”), but injury or illness can disrupt this rhythm, slowing metabolism and impairing waste removal. MRT works to restore normal cell activity, support lymphatic drainage, and ease muscle tension, thereby improving overall tissue health.
The bodyweight wall squat is a safe, functional lower-limb exercise often used early in rehabilitation. The wall provides stability, reducing balance demands and making it suitable for patients transitioning from partial to full weight-bearing. Variations include the long wall squat (feet placed so the shins are vertical) and the short wall squat (closer foot position, causing knees to pass the toes), each altering joint loading patterns (2–4).

Conventional exercises, such as machine-based or isolated joint movements, are valuable for strengthening specific muscle groups, particularly when protecting an injured joint. For example, hamstring curls, calf raises, or static leg extensions can maintain strength while avoiding aggravation of the injured area (5).

This study aims to examine the combined effect of MRT, wall squats, and conventional exercise in knee OA management, with the goal of relieving pain, enhancing circulation, promoting relaxation, and improving functional performance.

Knee osteoarthritis (OA) affects millions globally, particularly adults aged 45–65, and is a leading cause of pain, mobility loss, and reduced quality of life. Standard treatments, including medication and routine physiotherapy, may not always address symptoms effectively or correct underlying biomechanical issues(6–8) .

Matrix Rhythm Therapy (MRT) aims to ease pain, relax muscles, enhance joint mobility, and improve knee function through low-frequency mechanical vibrations applied to the affected area. This stimulates surrounding tissues, boosts circulation, and helps restore natural movement patterns. When combined with targeted exercises such as wall squats and conventional strengthening routines, MRT may form part of a more comprehensive rehabilitation strategy (9,10).

Research on integrating MRT with wall squats and conventional exercises in knee OA is scarce. This study seeks to fill that gap, exploring whether such a combined approach can reduce pain, improve function, and enhance quality of life in affected individuals.

2. Methodology

This interventional study was carried out at the Outpatient Department of Dr. D.Y. Patil College of Physiotherapy. The target population included patients referred to the physiotherapy OPD with a confirmed diagnosis of unilateral knee osteoarthritis (OA). A total of 30 participants were selected through random sampling, with 15 individuals assigned to each of two intervention groups. Eligible participants were males and females aged 45–65 years, presenting with unilateral knee OA and a Numerical Pain Rating Scale (NPRS) score between 5 and 8. Patients with a history of knee replacement, lower limb fractures, recent surgeries (within six months), or joint implants were excluded from the study.

The required materials included a consent form, demographic data sheet, goniometer, and Matrix Rhythm Therapy (MRT) equipment. Outcome measures were pain intensity using the NPRS, knee range of motion (ROM) measured by a goniometer, and functional disability assessed with the Knee Injury and Osteoarthritis Outcome Score (KOOS) scale. Assessments were performed before the first treatment session and after the tenth session. The process of the study is mentioned in figure 1 below

In Group 1, participants received MRT in combination with wall squats and conventional exercises for 10 sessions over two weeks. MRT was administered in the supine position using a frequency of 8–10 Hz for 20 minutes per session. Following MRT, exercises were performed in a high-sitting position and included static hamstring, quadriceps, and adductor contractions, as well as dynamic quadriceps strengthening using a yellow theraband, followed by wall squats with support (10 repetitions). Figure 3 Showing patient performing wall squats, figure 4 showing patient performing dynamic quads

In Group 2, participants received MRT combined only with conventional exercises over the same duration and frequency as Group 1. MRT parameters were identical, and exercises included static hamstring, quadriceps, and adductor contractions, along with dynamic quadriceps strengthening using a yellow theraband. Figure 2,

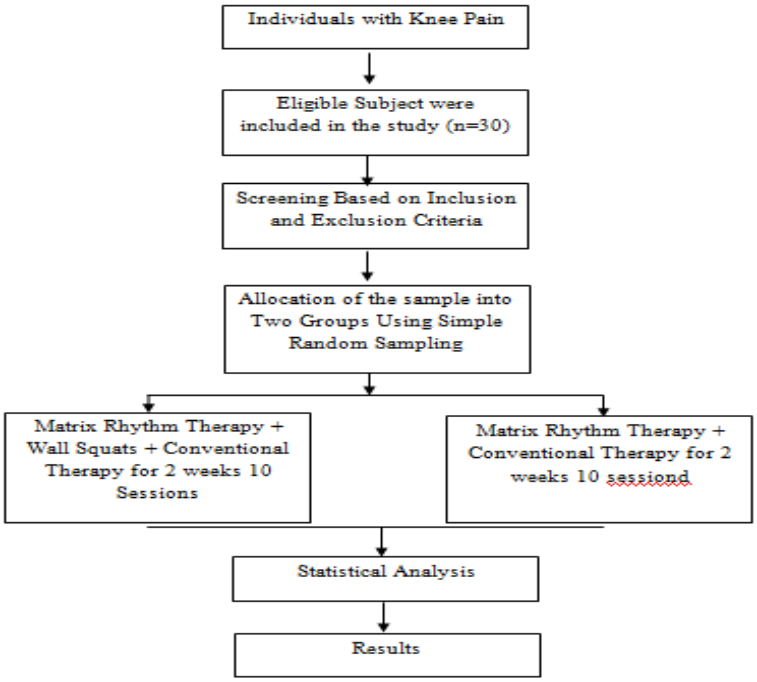


Fig. 1: Flowchart of the Study.

Fig. 2: Showing Application of Matrix Rhythm Therapy.

Fig. 3: Patient Performing Wall Squats.

Fig. 4: Showing Patient Performing Dynamic Quadriceps Exercises.

3. Statistical analysis

Table 1: Mean age distribution in Group 1

Descriptive Statistics	N Statistic	Mean Statistic	Std. Deviation Statistic
Age_Group1	15	52.13	4.809
ValidN	15		

Table 2: Showing Mean of Gender of the Samples of Group 1

Gender_Group1		Frequency	Percent	Valid Percent	Cumulative percent
Valid	Female	7	46.7	46.7	46.7
	Male	8	53.3	53.3	100.0
	Total	15	100.0	100.0	

Table 3: Mean of Outcome Measures of Group 1

Outcome Measures	N Statistic	Mean Statistic	Std. Deviation Statistic
NPRS Pre_Group1	15	5.93	.961
NPRS Post_Group1	15	3.53	1.125
ROM(KNEEFLEX)pre_Group1	15	98.00	13.862
ROM(KNEEFLEX)post_Group1	15	108.20	13.278
ROM(KNEE EXT) pre_Group1	15	5.27	7.905
ROM(KNEEEXT) post_Group1	15	3.93	6.670
KOOS (0-100)PRE_Group1	15	52.67	6.630
KOOS (0-100)POST_Group1	15	55.67	7.178
ValidN	15		

Table 1 showing the mean of the age of the samples in group 1, table 2 showing mean of the genders in group 1, Table 3: Showing comparison of the outcome measures such as range of motion (ROM, NPRS) of group 1

The Wilcoxon Signed Ranks Test Results for Group1 indicate the following:

NPRS (Pre vs. Post Group1): A significant reduction in pain is observed, with all 15 positive ranks showing lower NPRS scores post-intervention (Z=−3.482Z = -3.482Z=−3.482, p<0.001p < 0.001p<0.001).

ROM (Knee Flexion, Pre vs. PostGroup1): A significant improvement in knee flexion range of motion is observed, with 14 positive ranks showing increased post-intervention ROM (Z=−3.376, Z=-3.376, Z=−3.376, p = 0.001, p = 0.001, p=0.001).

ROM (Knee Extension, Pre vs. Post Group1): No significant change in knee extension range of motion isobserved, with 3 negative, 1 positive, and 11 tied ranks (Z = − 1.461, Z = -1.461, Z = − 1.461,p = 0.144, p = 0.144, p = 0.144).

KOOS (Pre vs. Post Group 1): A significant improvement in functional outcomes is observed, with 14 positive ranks showing higher KOOS scores post-intervention (Z=−3.311, Z=-3.311, Z=−3.31, p = 0.001, p =0.001, p = 0.001).

Tabular representation of gender distribution is mentioned in table 1, table 2 showing gender distributions in group A and table 3 shows comparison of outcome measures

In summary, in Group 1, significant improvements are seen in pain reduction (NPRS), knee flexion ROM, and functional outcomes (KOOS), but no significant change is noted in knee extension ROM.

Table 4: Mean of Age of Samples in Group 2

Descriptive Statistics	N Statistic	Mean Statistic	Std. Deviation Statistic
Age_Group2	15	57.80	7.655
ValidN	15		

Table 5: Showing Age Distribution of Group 2

Gender_Group2		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	11	73.3	73.3	73.3
	Male	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

Table 6: Showing Gender Distribution of Group 2

Outcome Measures	N Statistic	Mean Statistic	Std. Deviation Statistic
NPRS Pre_Group2	15	6.53	.915
NPRS Post_Group2	15	4.80	1.146
ROM (KNEE FLEX) pre_Group2	15	96.53	14.817
ROM (KNEE FLEX) post_Group2	15	102.73	15.595
ROM(KNEE EXT) pre_Group2	15	4.73	7.741
ROM(KNEEEXT) post_Group2	15	4.60	7.337
KOOS (0-100)PRE_Group2	15	53.93	6.819
KOOS (0-100)POST_Group2	15	55.67	7.178
ValidN	15		

Table 6: Showing comparison of outcome measures of group B

The Wilcoxon Signed Ranks Test results indicate the following improvements:

Table 4 showing age distribution in group 2, table 5 showing gender distribution in group B and table 6 shoeing outcome measures comparison of group B

NPRS (Pre vs. Post Group 2): A significant reduction in pain is observed, as all 14 positive ranks indicate lower NPRS scores post-intervention (Z= − 3.376, Z = -3.376, Z = − 3.376, p = 0.001, p = 0.001, p = 0.001).

ROM (Knee Flexion, Pre vs. Post Group 2): A significant improvement in knee flexion range of motion is observed, with all 15 positive ranks showing increased post-intervention ROM (Z = − 3.416, Z = - 3.416, Z=−3.416, p = 0.001, p = 0.001, p = 0.001).

ROM (Knee Extension, Pre vs. Post Group 2): No significant change in knee extension range of motion is observed, with 5 negative, 1 positive, and 9 tied ranks (Z=−0.957, Z = -0.957, Z=−0.957, p = 0.339, p = 0.339, p = 0.339).

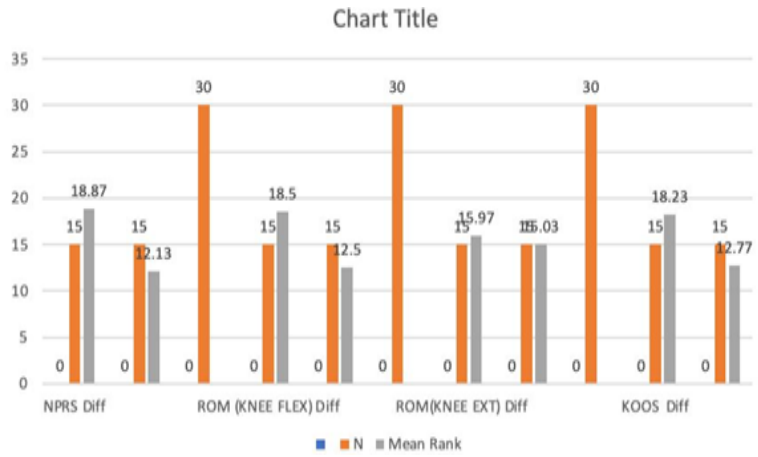
KOOS (Pre vs. Post Group 2): A significant improvement in functional outcomes is observed, as all 14 positive ranks show higher KOOS scores post-intervention (Z = − 3.352, Z = -3.352, Z = − 3.352, p = 0.001, p = 0.001, p=0.001).

In summary, Group 2, the intervention significantly reduced pain (NPRS), improved knee flexion ROM, and enhanced functional outcomes (KOOS), but did not significantly affect knee extension ROM.

Between Group Results: Mann-Whitney Test

Table 7: Showing between Group comparison of the Outcome Measures

Group		N	Mean Rank	Sumo franks
NPRS DiffGroup1		15	18.87	283.00
Group2		15	12.13	182.00
Total		30		
ROM(KNEE FLEX)Diff	Group1	15	18.50	277.50
Group2		15	12.50	187.50
Total		30		
ROM(KNEEEXT) Diff	Group1	15	15.97	239.50
Group2		15	15.03	225.50
Total		30		
KOOS Diff	Group1	15	18.23	273.50
Group2		15	12.77	191.50
Total		30		



Graph 1: Between Group Comparison of GroupA and Group B.

Table 7 showing comparison of the outcome measures of group 1 & 2, The Mann-Whitney U Test results indicate differences in the changes (differences between pre-and post- intervention scores) between Group 1 and Group 2 for the following measures: the graphical representation of the outcome measure in mentioned in graph 1.

NPRS Difference:

Group: 1 showed significantly greater reductions in pain compared to Group 2 (U=62.000, U =62.000, U = 62.000, Z = − 2.240, Z = -2.240, Z = − 2.240, p = 0.025, p = 0.025, p = 0.025). The mean rank for Group 1 (18.87) is higher than for Group 2 (12.13), indicating that Group1had better improvements in NPRS.

ROM (Knee Flexion) Difference:

There is no statistically significant difference between the groups (U=67.500U = 67.500U=67.500, Z=−1.896, Z = -1.896, Z = −1.896, p = 0.058, p = 0.058, p = 0.058). However, Group 1 shows a trend towards greater improvement (mean rank=18.50) in range of flexion compared to Group 2 (mean rank = 12.50).

ROM (Knee Extension) Difference:

No significant difference is observed between the groups (U = 105.500, U = 105.500 U = 105.500, Z = −0.346, Z= -0.346, Z=−0.346, p=0.729, p = 0.729, p = 0.729). The mean ranks are similar for Group 2 (15.03) and Group 1(15.97), indicating comparable improvements.

KOOS Difference:

There is no statistically significant difference in functional outcomes between the groups (U=71.500, U = 71.500, U=71.500, Z = −1.755, Z = -1.755, Z = −1.755, p = 0.079. p = 0.079. p = 0.079).However, Group1 (mean rank =18.23) tends to have greater improvements compared to Group 2 (mean rank =12.77).

Group 1 demonstrated significantly greater improvements in pain reduction (NPRS) compared to Group 2. While no statistically significant differences were observed for knee flexion ROM, knee extension ROM, or KOOS, Group 1 showed a trend toward greater improvement in knee flexion ROM and KOOS

4. Results

Group 1 showed significantly greater reductions in Pain compared to Group 2 (U = 62.000, U = 62.000, U = 62.000, Z = − 2.240, Z = -2.240, Z = − 2.240, p = 0.025, p = 0.025, p = 0.025).The mean rank for Group 1 (18.87) is higher than for Group 2 (12.13), indicating that Group1 had larger improvements in NPRS.

ROM (Knee Flexion) Difference:

There is no statistically significant difference between the groups (U = 67.500, U = 67.500, U = 67.500, Z = − 1.896, Z = -1.896, Z = −1.896, p = 0.058. p = 0.058, p = 0.058). However, Group 1 shows a trend toward greater improvement (mean rank = 18.50) compared to Group 2 (mean rank = 12.50).

ROM (Knee Extension) Difference:

No significant difference is observed between the groups (U = 105.500, U = 105.500, U = 105.500,Z = −0.346, Z = - 0.346, Z = − 0.346, p = 0.729, p = 0.729, p = 0.729).The mean ranks are similar for Group 2 (15.03) and Group 1(15.97), indicating comparable improvements.

KOOS Difference:

There is no statistically significant difference in functional outcomes between the groups (U=71.500U = 71.500U=71.500, Z= −1.755, Z= -1.755, Z= −1.755, p = 0.079, p = 0.079, p = 0.079). However, Group 1 (mean rank =18.23) tends to have greater improvements compared to Group 2 (mean rank =12.77). Group 1 demonstrated significantly greater improvements in pain reduction (NPRS) compared to Group

2. While no statistically significant differences were observed for knee flexion ROM, knee extension ROM, or KOOS, Group 1 showed a trend toward greater improvement in knee flexion ROM and KOOS. Table. Graph 1 showing comparison of outcome measures

5. Discussion

The aim of the study was to focus on the effect of Matrix Rhythm Therapy combined with wall squats and conventional exercises on pain reduction, joint mobility, muscle strength, and functional performance in individuals with knee osteoarthritis (OA). Specifically, the study sought to assess the impact of MRT on pain relief and tissue stiffness in knee OA. Investigate the role of wall squats in enhancing muscle strength and joint stability. Compare the individual and combined effects of MRT , wall squats, and conventional exercises on range of motion (ROM), pain (NPRS), and overall functional outcomes (KOOS).It was an experimental study where 30 participants having knee osteoarthritis having entry criteria of age group 45 years to 65 years old males and females having Unilateral knee Osteoarthritis with NPRS between 5 to 8were recruited and randomly allocated into 2 groups. Group A Matrix Rhythm Therapy, Wall Squats and Conventional Exercises. Group B Matrix Rhythm Therapy combined with Conventional Exercises. Treatment was given for 10 sessions in 2 weeks, Pre-treatment assessment was done on 1st day and post – treatment assessment was done on 10th Day. Matrix Rhythm Therapy prepares tissues by reducing stiffness and pain, making exercises more effective and feasible. Whereas, Wall Squats and Conventional Exercises build strength, improve mobility, and enhance functional capacity over time, complementing the immediate benefits of MRT. This topic was chosen due to various purposes one of them is Prevalence and Impact of OA Knee. OA is one of the most common degenerative joint diseases affecting millions of population worldwide significantly affecting the quality of life, particularly in older adults. Its progressive nature leads to chronic pain, stiffness, and functional limitations, making it a major public health concern. Exploring effective, non-invasive treatments for knee OA is essential to address this widespread issue. Conventional exercise therapy is widely recommended for OA but often yields limited results when used alone. Therefore, combining therapies, such as matrix rhythm therapy, wall squats and Conventional exercises offers the potential for enhanced outcomes by addressing both tissue-level dysfunctions and biomechanical deficits. In evaluating the effect of this study various outcomes such as NPRS, Range Of Motion, and KOOS were chosen as assessment tools due to their relevance, comprehensiveness, and established validity in measuring. Clinical outcomes in OA patients. NPRS was used for pain assessment because Pain is one of the most debilitating symptoms of knee OA and a primary outcome to evaluate treatment effectiveness. NPRS is simple, quick, and patient-friendly, making it suitable for routine clinical use. It allows patients to subjectively rate their pain on a scale from 0 (no pain) to 10 (worst pain imaginable), providing a direct measure of perceived pain intensity. NPRS is widely validated as a reliable and responsive tool for assessing pain in musculoskeletal conditions, including OA. ROM reflects the flexibility and mobility of the knee joint, which are often impaired in OA due to stiffness and pain. It is an objective measure to evaluate functional improvement in the joint. Improved ROM indicates reduced stiffness and enhanced joint functionality, which are key goals of OA management. ROM measurement using tools like goniometers is a validated and reliable method for assessing joint mobility. It provides objective data that complements subjective measures like NPRS and KOOS. ROM assessments are widely used in physiotherapy and rehabilitation research to track functional recovery. KOOS is a comprehensive, disease-specific questionnaire designed to assess multiple dimensions of knee health: pain, symptoms, activities of daily living (ADL), sports/recreation, and quality of life (QOL).It captures the broader impact of knee OA on a patient's functional abilities and well-being, making it a holistic outcome measure. KOOS is a validated and reliable tool, extensively used in clinical research for knee - related conditions, including OA. It demonstrates high internal consistency, test-retest reliability, and construct validity. Its subscales provide detailed insights into specific aspects of knee health, ensuring a comprehensive assessment of outcomes. NPRS, ROM, and KOOS were selected for their ability to provide comprehensive and valid assessments of the effects of MaRhyThe, wall squats, and conventional exercises in knee OA. Together, they capture critical aspects of patient outcomes—pain relief, joint mobility, and functional performance—ensuring a robust evaluation of the interventions' efficacy.

Matrix rhythm therapy (MRT) is a technique employed in health centers today to cure abnormalities since it preserves the body's various physiological functions, adopting a cell-based, goal-oriented approach occurring at the cellular level .The development of MRT is an external and dynamic method that permits cellular movement of tissues and activates matrix fluid using vibrations at an intensity of 8-12 Hz(11).

The application of wall squats in the cases of osteoarthritis of knee leads to compressive forces on the bone which stimulate the osteoblastic activity of the bone causing increased synthesis of bone making the bone more strong. This compression induced on knee joint stimulates the proprioception of the joint leading to improved balance and joint position sense and reduction in the intensity of pain. Along with this application of matrix rhythm therapy has a oscillating frequency of 8 – 12 Hz which mimics the normal physiological vibration frequency of the body and cells when to correct the vibration of the cell who are out of the normal range of vibration (8-12MHz) promoting healing of the bone and strengthening the bone by increasing the density(12–14).

A study done by Shrivastava S. says that MRT helps to reduce swelling and pain, improve joint motility, increase tissue elasticity, and aid in the restoration of functions. According to the research of Dr. U. G. Randoll, our cells oscillate rhythmically between 8-12 HZ provided they are healthy. During the state of swelling, Inflammation, stiffness, tightness, spasticity the cells do not get space to oscillate. This restricts the flow of fresh oxygen at the site of congestion. Mitochondria also called power house of body present in the cells do not get enough oxygen to produce energy his leads to further contraction of tissue and muscle, resulting in restriction of movement and pain (15). Matrix Rhythm Therapy provides oscillations between physiological frequencies of 8-12 Hz. This frequency synchronizes with the body to re-establish the disturbed rhythm at cellular level. The therapy improves the oxygen supply by improving the microcirculation thereby improving the energy production. The immediate effect can be seen as relaxation of tissue, muscle, and fascia. This relaxation remains longer and maintained as the metabolic process at cellular level are regulated and oxygen supply to cells is improved One can experience the reduction of pain during the session itself. Once the pain is reduced and soft tissues are relaxed the situation comes under control that can be further maintained by routine exercises. The therapy is applicable for non healing wounds, arthritis, osteoporosis, vascular insufficiencies, spasticity, migraine, vertigo, and many conditions related to circulation, ligaments, in tendons, nerves, bone degeneration, stiffness, neuropathy, pain and swelling

Comparison between the results demonstrated by both the groups Group 1 - Matrix Rhythm Therapy, Wall Squats and Conventional Exercises, Group 2 -Matrix Rhythm Therapy combined with Conventional Exercises, both groups demonstrated comparable improvements in key outcome measures, including pain reduction, range of motion (ROM), and functional performance (as assessed by KOOS). While the combination of matrix rhythm therapy, wall squats, and conventional exercises showed slight advantages in certain domains, the overall results were statistically similar between the groups. This suggests that group 1 is effective in managing the symptoms of knee osteoarthritis, albeit through potentially different mechanisms.

The positive findings demonstrate that combining matrix rhythm therapy, wall squats, and conventional exercises is highly effective in managing knee OA. This integrative approach provides significant pain relief, enhances joint mobility, strengthens muscles, and improves overall functional performance and quality of life, making it a valuable treatment strategy for patients with knee osteoarthritis(16) . The study involves conventional group along with wall squats whereas in future addition of a group with only conventional exercises and no wall squats and comparing that with an experimental group where combination of matrix rhythm therapy along with conventional therapy in given this stud will provide indepth and unbiased comparison between the interventions. Due to time constraints we have included sample size (n) = 30 future studies can be conducted with larger sample sizes. In our study we have included individuals suffering from unilateral a long term study with inclusion of bilateral osteoarthritis of the knee can be conducted in order to make the study more applicable to wider population.

6. Conclusion

The study concludes that group 1 is effective in treatment of knee OA in patient by alleviating pain, improvement in ROM, and improving functional activities. There are significant differences between both the groups across the specific measures. This suggests that the treatments applied to both groups hadsignificant effective outcomes with substantial statistically significant differences in their effects on pain, knee flexion, and overall knee health and functionality except in knee extension.

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