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EFFECT OF INSTRUMENT-ASSISTED SOFT TISSUE MOBILIZATION (IASTM) ON PAIN, KNEE FUNCTION AND QUADRICEPS FLEXIBILITY IN SUBJECTS WITH KNEE OSTEOARTHRITIS- A PILOT STUDY

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ABSTRACT

Background: Osteoarthritis (OA) is a degenerative joint disorder characterized by cartilage deterioration and its effects on surrounding tissues. It includes a group of symptoms like stiffness, crackles, swelling and tenderness. It causes restricted range of motion, knee function and quadriceps flexibility. IASTM (instrument-assisted soft tissue mobilisation) is a non-invasive technique that utilises specialised tools to manipulate soft tissues through targeted compression strokes. Instrument-assisted soft tissue mobilization (IASTM) is a therapeutic technique that uses specially designed tools to manipulate soft tissues, helping to alleviate discomfort and enhance mobility. This study aims to determine the effect of instrument-assisted soft tissue mobilisation on pain, knee function, and quadriceps flexibility. **Methodology:** This pretest-posttest experimental study was conducted in and around the community. A total of 82 samples were screened; only 40 participants were selected according to inclusion and exclusion criteria. The pre-treatment outcome measures were taken. The participants were assigned to group A and group B. Group A is the experimental group and group B is the control group. Group A received IASTM with hot pack, quadriceps stretching, and strengthening, and Group B received quadriceps stretching, strengthening, hot pack only. Treatment was given to both groups for 6 weeks,3 sessions per week, with 30 minutes duration of each session. The post-treatment outcome measures were taken after 6 weeks. The pretest-posttest values were statistically analysed using SPSS software (SPSS.25). The significance level was kept as $p<0.05$. Wilcoxon signed-rank test was used for the intra- group comparison of pretest and posttest results. Mann-Whitney U test was used for the inter-group comparison. **Result:** Significant differences ($p<0.001$) were found in quadriceps flexibility and pain between group A and group B. There was a significant improvement in quadriceps flexibility and a reduction in pain within each group. There was no statistically significant improvement ($p>0.05$) between the groups regarding knee function. **Conclusion:** The study concluded that IASTM has significant effects on quadriceps flexibility and in reducing pain in subjects with knee osteoarthritis.

KEYWORDS: IASTM, Knee function, Quadriceps Flexibility, Osteoarthritis, Pain.

1. INTRODUCTION

1.1 BACKGROUND OF STUDY

Osteoarthritis (OA) is a degenerative joint disorder characterised by cartilage deterioration and its effects on surrounding tissues.[1] Knee osteoarthritis (KOA) predominantly affects older adults and is a major cause of disability worldwide.[2] Knee osteoarthritis is a significant public health concern, ranking as the fourth most common disabling condition. Several risk factors contribute to the development of knee OA, including ageing, congenital or acquired deformities, previous trauma, and female gender.[1] Research by Bayram et al. suggests that increased tension in the quadriceps, hamstrings, and iliotibial (IT) band can exacerbate pain and mobility limitations in individuals with osteoarthritis (OA).[4] Globally, an estimated 528 million individuals experience OA, with 73% of cases occurring in those over the age of 55 and 60% affecting females. The knee joint is the most commonly impacted, accounting for around 365 million cases, followed by the hip and hand.[2]

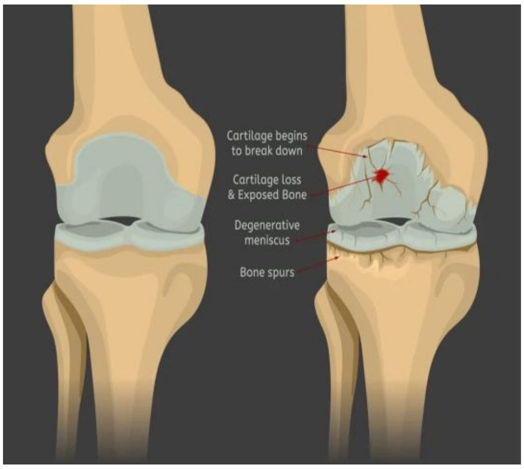


Fig 1: Osteoarthritis Publication-Pilot.

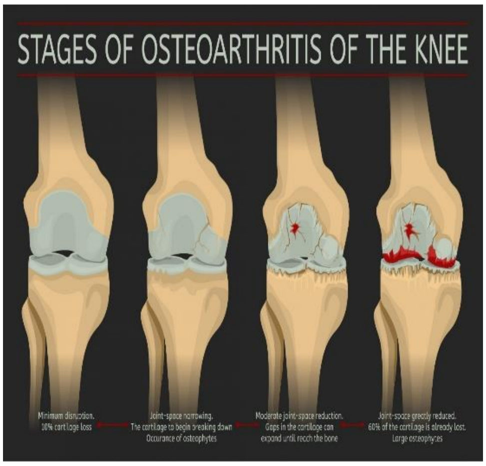


Fig 2: Stages of osteoarthritis of knee.

The hamstrings and quadriceps are two primary muscle groups essential for efficient movement and smooth knee joint function.[3] The quadriceps play a crucial role in shock absorption and maintaining knee stability during walking and running. Reduced flexibility in the quadriceps can be a contributing factor to anterior knee pain, including conditions such as patellofemoral pain syndrome and patellar tendinopathy.[4] Tight quadriceps may also increase stress on the knee joint during physical activities. Additionally, joint mobility is influenced not only by skeletal muscles but also by noncontractile structures, such as the skin, tendons, and joint capsule. These components are vital in determining overall flexibility and movement capability.[5] A study examining quadriceps tendon stiffness in individuals with knee osteoarthritis (OA) found that passive stiffness in the quadriceps tendon was negatively associated with the maximum knee flexion angle. Researchers speculated that increased soft tissue stiffness could contribute to functional limitations in affected patients. Individuals with knee osteoarthritis (OA) frequently undergo abnormal modifications in the muscles surrounding the knee joint. These changes can impact mobility, strength, and overall function, often leading to altered movement patterns and discomfort.[6]

Knee osteoarthritis can be managed through various conventional methods, including medical treatments, surgical interventions, and rehabilitative approaches. Physiotherapy plays a key role in this process, incorporating techniques such as therapeutic exercises, manual therapy, and the use of specific modalities to alleviate symptoms and improve function.[5] There are various methods to enhance range of motion (ROM), including platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) injections, biofeedback techniques, medication, physiotherapy, and surgical interventions. Each approach offers unique benefits, depending on an individual's condition and needs.[6]

A potential therapeutic approach is Instrument-Assisted Soft Tissue Mobilization (IASTM), a non-invasive technique utilising specialised tools to manipulate soft tissues through targeted compression strokes. Instrument-assisted soft tissue mobilization (IASTM) is a therapeutic technique that uses specially designed tools to manipulate soft tissues, helping to alleviate discomfort and enhance mobility.[7] By applying controlled pressure with these instruments, practitioners aim to break down restrictions in muscle and fascia, promoting better circulation and tissue healing. This approach is often used in rehabilitation to improve flexibility, reduce pain, and support overall recovery.[8] Marshall PW et al.'s research suggests that Instrument-Assisted Soft Tissue Mobilization (IASTM) may be more effective than other techniques in improving quadriceps strength, balance, knee flexibility, and pain tolerance.[9] These findings highlight its potential as an advanced method for knee health, possibly leading to stronger muscles, enhanced coordination, greater joint mobility, and reduced discomfort. Given these promising results, further research is warranted to explore its therapeutic applications. IASTM appears to work by targeting myofascial restrictions, modulating pain signals, and improving tissue elasticity.[5] Additionally, it may help identify areas of adhesion, stimulate inflammation beneficial for healing, increase muscle blood flow, reduce tissue viscosity, and facilitate collagen repair, contributing to enhanced recovery and mobility. This method employs a specialized tool to create controlled micro-trauma in the targeted area. This process stimulates an inflammatory response, accelerating tissue repair and enhancing flexibility while supporting cartilage restoration (Fousekis et al., 2020).[10] The therapeutic effects of this approach appear to include decreasing tissue adhesion, enhancing the number of fibroblasts, and stimulating collagen synthesis (Kiran et al., 2022; Cheatham, Baker & Kreiswirth, 2019).[11]

Instrument-assisted soft tissue mobilization (IASTM) offers a mechanical advantage for practitioners by utilising specialised tools with carefully designed surfaces.[12] These instruments help reduce the physical effort required by the practitioner while effectively increasing the force applied to the targeted tissues. This allows for deeper penetration and more precise treatment. One of the key benefits of IASTM is its ability to yield positive results in a significantly shorter time compared to other soft tissue mobilization techniques, making it a highly efficient approach for pain relief and improving mobility.[13]

GRASTON TECHNIQUE

The Graston Technique is a widely used form of Instrument-Assisted Soft Tissue Mobilization (IASTM). It involves six uniquely shaped stainless steel tools designed to identify and break down scar tissue, adhesions, and fascial restrictions, promoting better mobility and tissue recovery.

The Graston Technique was introduced and developed by David Graston in 1994. As a competitive water skier, he sustained a knee injury in 1987 but found that traditional physical therapy did not fully address his recovery needs.[14] Motivated by his own rehabilitation challenges, Graston began experimenting with different tool designs to replicate the manual techniques used by therapists. His innovation led to the development of specialised instruments that have since become widely used in soft tissue therapy. David Graston collaborated with Ball Memorial Hospital and Ball State University to refine the manipulation of soft tissue techniques. Through extensive experimentation and collaboration with therapy professionals, he and his team developed the Graston Technique—an advanced method of Instrument-Assisted Soft Tissue Mobilization (IASTM). This innovative approach, established in Indianapolis, USA, continues to be widely used in therapeutic settings to improve mobility and recovery.

The Graston Technique utilises six stainless steel instruments, each uniquely shaped and sized to suit different areas of the body. These tools feature bevelled edges with convex and concave surfaces, allowing for varied force application during treatment. A single bevelled edge is formed by angling both sides into a V-shape. Smaller tools are designed for more delicate anatomical structures, applying lighter pressure, while convex surfaces generate greater force for deeper tissue work. Conversely, concave surfaces evenly distribute force for a gentler approach. The principles behind the Graston Technique are rooted in deep friction and cross-friction massage methods, originally introduced by Cyriax.[15]

Each instrument utilised in the Graston technique is composed of specific stainless steel variants, namely GT1, GT2, GT3, GT4, GT5, and GT6. Each of these instruments is designated for use on different body parts, tailored to the anatomical structures present.

The GT1 instrument is the longest among the tools, featuring a single bevel surface. It is primarily employed for larger areas of the body, including the back muscles, hamstrings, quadriceps, and gluteal muscles.
The GT2 instrument is characterized by two circular shapes on either side; one side has a single bevel while the other possesses a double bevel. This instrument is predominantly used on medium rounded surfaces, such as the patellar tendon, forearm, and wrist.
The GT3 instrument features a single bevel on one side and is suitable for smaller areas of the body. It is typically utilised after identifying tight spots in these smaller regions.
The GT4 instrument features a half-ovular shape. Its circular side is designated for treatments. It possesses a single bevel and is primarily utilised for addressing medium-sized areas of the body.
The GT5 is characterised by a concave shape with a single bevel. It boasts a wide flat surface and is also effective for treating circular-shaped areas of the body.
The GT6 instrument is smaller than the other tools. It has double bevel edges and is mainly employed for treating fingers, toes, and hands.

1.2 NEED OF THE STUDY
Many of the studies were primarily focused on enhancing hamstring flexibility to alleviate knee pain, with limited studies exploring the impact of quadriceps flexibility on knee osteoarthritis (KOA) patients. However, quadriceps inflexibility not only increases the risk of developing knee OA but also exacerbates pain and restricts joint mobility. Instrument-Assisted Soft Tissue Mobilization (IASTM) offers a user-friendly approach, reducing the strain of the therapist and enabling deeper tissue penetration with minimal compressive force. While studies have demonstrated IASTM's effectiveness in improving hamstring flexibility and pain management in knee OA patients, its impact on quadriceps muscle flexibility remains understudied. This knowledge gap highlights the need for research on IASTM's effects on the quadriceps muscle to find the effect on knee OA patients. Quadriceps muscle tightness is primarily a big challenge for these patients for their pain, flexibility and functional activity. Here, the researcher plans to explore IASTM'S application in this area to enhance pain management and range of motion, promoting more effective treatment strategies.

METHODOLOGY
STUDY DESIGN
Experimental study.

STUDY SETTING
Community & Physiotherapy OPD.

STUDY DURATION
Total study duration: 1 year from the inception of the idea

Intervention period: 6 weeks

Frequency : 3 sessions per week

SAMPLING
Sampling method

Convenient sampling

ETHICS COMMITTEE APPROVAL.
The Ethical Approval as follows-MTH/MPT/EC/2444/24 Dated-13.07.2024

SELECTION CRITERIA
Inclusion criteria

- Age between 45 to 65 years
- Gender: both males and females
- Subjects with knee osteoarthritis: Kellgren and Lawrence classification grade1 and 2 only
- Subjects with a modified Thomas test positive.

Exclusion criteria

- Subjects who are not willing to participate
- Subjects having injuries/Surgeries in the past 6 months on the lower limb
- Recent hip or knee fractures.
- Recent hip or knee deformities.
- Any other neurological or musculoskeletal conditions.
- Patients having anterior knee pain.

METHODS OF DATA COLLECTION
OUTCOME MEASURES
1. Pain

Pain is measured using NPRS, which is validated and widely used. The NPRS is a self-assessment questionnaire of pain, which is a whole number from 0-10 integers. The score ranges from zero, indicating no pain; as the number increases, there is an increase in pain. The score of ten indicates the worst possible pain.

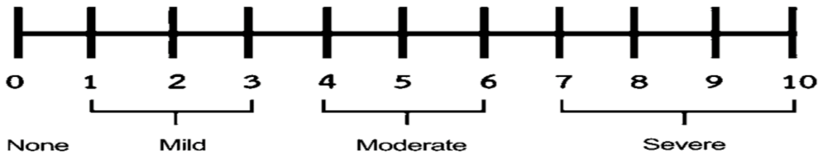


Fig 5: Numerical pain rating scale.

2. Knee injury and osteoarthritis outcome score

Knee function is measured using KOOS, which is widely used and validated. The KOOS is a patient-reported outcome measure of knee function that holds five subscales. Pain includes nine items, other symptoms include seven items, Activities of daily living includes seventeen items, sports and recreation function includes five items, and knee- related quality of life includes four items. Each subscale is scored separately, from zero indicating (extreme knee problems) to one hundred indicating (no knee problems).

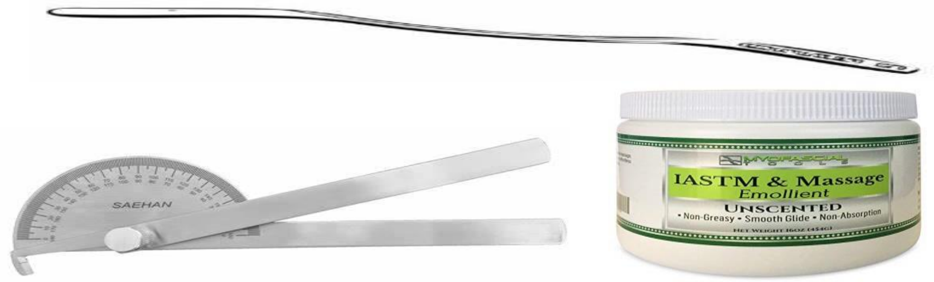
3. Range of Motion

Range of motion [ROM] is assessed by the therapist using a goniometer. Position the patient in prone with the joint in neutral alignment. Place the goniometer's axis of rotation on the joint's axis of rotation. Align the fixed arm of the goniometer with the proximal segment (closer to the trunk) and align the movable arm with the distal segment (farther from the trunk). Ask the patient to actively move the joint through its range of motion (e.g., flexion, extension). Take note of the angle measurement on the goniometer as the patient moves the joint. Record the angle measurement when the patient reaches the end-point of their active range.

Fig 6: Knee flexion range of motion.

MATERIALS REQUIRED

- Graston GI Tool
- Goniometer (universal goniometer)
- The knee injury and osteoarthritis outcome score (KOOS)
- Numerical pain rating scale (NPRS)
- Emollient Gel
- Pen
- paper



PROCEDURE

SAMPLING PROCEDURE

After the ethical committee approval for data collection, subjects were taken according to inclusion and exclusion criteria. Although a total of 82 samples were screened, only 40 participants were selected according to inclusion and exclusion criteria. The procedure of the study was briefed to the participants, and they were encouraged to clear any queries regarding the study. Informed consents were taken from all the participants. The participants were asked to complete a structured questionnaire including demographic information (name, age, gender, BMI), knee injury and osteoarthritis outcome score, and numerical pain rating scale. The pre-treatment values of knee injury and osteoarthritis outcome score, numerical pain rating scale, and knee flexion range of motion were taken before the treatment. The participants were assigned to group A and group B. Group A is the experimental group and group B is the control group. Group A received IASTM with hot pack, quadriceps stretching, and strengthening, and Group B received quadriceps stretching, strengthening, hot pack only. Treatment was given to both groups for 6 weeks,3 sessions per week, with 30 minutes duration of each session. The post-treatment values of knee injury and osteoarthritis outcome score, numerical pain rating scale, and knee flexion range of motion were taken after 6 weeks.

INTERVENTION

EXPERIMENTAL GROUP

Group A received a comprehensive treatment that combined Instrument-Assisted Soft Tissue Mobilization (IASTM) with traditional physiotherapy techniques. The treatment was commenced with hot pack application to the quadriceps muscle and knee joint for 5 minutes to promote relaxation and warmth. Seated comfortably with back support, patients underwent IASTM using the Graston G1 tool, which was lubricated and disinfected beforehand to ensure smooth application. Gentle stroking techniques were applied along the quadriceps muscle 30 times, spanning from origin to insertion. Subsequently, the patient was subjected to perform quadriceps strengthening exercises and stretching exercises. Quadriceps strengthening exercise comprises of five sets of 10 repetitions, where the patient applies pressure to a towel roll placed under the knee for 10 seconds each time. Stretching exercise comprises of quadriceps stretching, where the patient was positioned in side-lying, bends the knee of the leg on top, and the therapist grasps the knee and ankle and pulls the knee back into hip extension.

CONTROL GROUP

Group B received only conventional physiotherapy like quadriceps stretching, strengthening, and hot pack. The treatment was commenced with hot pack application to the quadriceps muscle and knee joint for 5 minutes to promote relaxation and warmth.

Quadriceps strengthening exercise comprises five sets of 10 repetitions, where the patient was applying pressure to a towel roll placed under the knee for 10 seconds each time. Stretching exercise comprises of quadriceps stretching, where the patient was positioned in side-lying, bent the knee of the leg on top, and the therapist grasped the knee and ankle and pulled the knee back into hip extension.

DATA ANALYSIS

The statistical analysis of the results was performed using the SPSS Software (SPSS.25). Normal distribution of the data was verified with the Shapiro-Wilk test. Due to non-normally distributed data, non-parametric tests were used for the calculation of the results. Wilcoxon signed rank test was used for the intragroup comparison of pre- test and post-test values. Mann-Whitney U test was used for the inter-group comparison. The significance level was kept as $p \leq 0.05$. 28.

RESULTS

The principal reported results are summarized below. Values are transcribed/reformatted from the dissertation's statistical tables rather than newly calculated from raw participant-level data.

TABLE-1

Outcome/comparison	Experimental	Control	Between-group result
KOOS: pre-test mean ± SD	88.00 ± 3.22	89.85 ± 4.97	t=1.31, p>0.05
KOOS: post-test mean ± SD	88.41 ± 3.14	90.40 ± 4.93	t=1.43, p>0.05
KOOS: within-group change	+0.41	+0.55	Both reported p<0.05
Knee ROM: pre-test mean ± SD	94.70 ± 4.74	91.90 ± 4.58	Reported t=1.59, p>0.05
Knee ROM: post-test mean ± SD	102.88 ± 4.15	94.95 ± 4.69	Reported t=4.09, p<0.001
NPRS: pre-test mean	5.58	5.20	U=120; p>0.05
NPRS: post-test mean	3.35	4.80	Reported p<0.001

Table 1.
Summary of reported descriptive and inferential statistics. SD = standard deviation; KOOS = Knee Injury and Osteoarthritis Outcome Score; ROM = range of motion; NPRS = Numerical Pain Rating Scale.

Within-group pain analysis showed a significant reduction in the experimental group (Wilcoxon z=3.703, $p<0.001$) and in the control group (z=2.828, $p<0.01$). The dissertation reports a significant post-test difference in NPRS between groups.

For KOOS, both groups demonstrated statistically significant pre–post improvement in the dissertation's within-group tables, but the between-group post-test comparison was not significant ($p>0.05$).

The reported ROM findings favoured the IASTM group. The experimental group increased from a mean of 94.70° to 102.88°, whereas the control group increased from 91.90° to 94.95°. The dissertation reports a significant post-test between-group difference (t=4.09, $p<0.001$.

The reported ROM findings favoured the IASTM group. The experimental group increased from a mean of 94.70° to 102.88°, whereas the control group increased from 91.90° to 94.95°. The dissertation reports a significant post-test between-group difference (t=4.09, $p<0.001$).

Table 2.

TABLE-2					
Variable	**Group**	**Pre-test**	**Post-test**	**Test statistic**	**p-value**
NPRS	Experimental	5.58 ± 0.50	3.35 ± 0.70	Wilcoxon z=3.703	<0.001
NPRS	Control	5.20 ± 0.83	4.80 ± 0.89	Wilcoxon z=2.828	<0.01
KOOS	Experimental	88.00 ± 3.22	88.41 ± 3.14	t=2.74	<0.05
KOOS	Control	89.85 ± 4.97	90.40 ± 4.93	t=2.97	<0.05
ROM (°)	Experimental	94.70 ± 4.74	102.88 ± 4.15	t=5.39	<0.001
ROM (°)	Control	91.90 ± 4.58	94.95 ± 4.69	t=1.82	reported p>0.05

Within-group statistics reported in the dissertation. Values are presented as reported; the source contains some internal inconsistencies in sample sizes and selected descriptive values, which should be checked against the original SPSS output before journal submission.

DISCUSSION

The present study was designed to determine whether IASTM applied to the quadriceps provides additional benefit when combined with conventional physiotherapy for knee osteoarthritis. The main findings support an effect on pain and knee mobility, while the evidence for additional improvement in KOOS-based knee function is less convincing.

Pain. The experimental group showed a larger reduction in NPRS than the control group. This finding is consistent with the dissertation's interpretation that IASTM may influence pain through soft-tissue and neuromodulatory mechanisms. The source discussion proposes that improved tissue mobility, reduced soft-tissue restriction and altered sensory input may contribute to analgesia. The dissertation also notes consistency with previous IASTM research, including Anjum et al.

Range of motion and quadriceps flexibility. ROM improved substantially in the experimental group, and the reported between-group comparison favored the IASTM intervention. A plausible interpretation is that treatment of soft-tissue restrictions around the quadriceps may reduce resistance to knee movement. The dissertation cites literature indicating increased quadriceps stiffness in knee OA and evidence that IASTM can improve ROM in some musculoskeletal populations.

Knee function. Although KOOS scores increased within both groups, the post-test difference between groups was not statistically significant. This suggests that adding IASTM did not demonstrate a clear incremental effect on patient-reported knee function over the 6 weeks. The source discussion similarly.

attributes this finding partly to the fact that IASTM primarily targets soft tissue rather than all components of joint mechanics.

Clinical interpretation. Taken together, the findings suggest that IASTM may be a useful adjunct rather than a replacement for conventional physiotherapy. The combination used in the experimental group included hot pack application, quadriceps stretching and strengthening in addition to IASTM. Therefore, the study supports the value of the combined rehabilitation package; it does not establish IASTM as an independent treatment because the control group received active conventional treatment.

The findings are broadly compatible with the literature summarized in the dissertation. Anjum et al. reported beneficial effects of IASTM for flexibility and pain in knee osteoarthritis, while a 2024 meta-analysis cited in the dissertation reported that IASTM can improve ROM in degrees in several populations, although certainty of evidence was low to very low for some comparisons. The dissertation also cites systematic-review evidence suggesting possible benefits for pain and function in musculoskeletal disorders, while emphasising uncertainty in the evidence base.

The lack of a significant between-group KOOS result is clinically important. Pain and ROM can improve over a short period without producing a detectable difference in broader self-reported function. KOOS incorporates several domains, including pain, symptoms, activities of daily living, sports/recreation and knee-related quality of life. A 6-week intervention and a relatively small sample may therefore be insufficient to demonstrate changes across all functional domains.

CONCLUSION

This study was conducted to know the effect of instrument-assisted soft tissue mobilization (IASTM) on patients with knee osteoarthritis. This was a novel idea on the application of IASTM on the quadriceps muscle to find the effect in Osteoarthritic patients.

The study variables were as follows: pain, Quadriceps flexibility and Knee function.

The result of the study showed that there is a significant improvement in pain and quadriceps flexibility after the application of IASTM for 6 weeks; however, knee function was not significantly improved.

In case of pain & quadriceps flexibility, statistical improvement was evident when comparing the post-intervention reading with the pre-intervention reading of both the experimental group and control group. But greater significance was seen in case of the experimental group only on pain and range of motion compared to control group.

Instrument-Assisted Soft Tissue Mobilisation (IASTM) is effective in improving **Knee range of motion and reducing pain**. This suggests that application of IASTM may be a valuable tool in grade 1& 2 knee osteoarthritic patients along with conventional Physiotherapy treatment. The need of Promote community education on the appropriate use of IASTM is crucial to ensure its responsible and impactful integration within rehabilitation programs.

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