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Added effect of proximal fibular glide in subjects with knee osteoarthritis

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ABSTRACT

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Background and Aim

Knee osteoarthritis (OA) produces significant changes in health-related quality of life, physical, mental and social components of health. Aim of the study is to find the effectiveness of tibio-fibular glide along with conventional treatment for reducing pain and improving the functional ability in the Subjects with Knee Osteoarthritis.

Methods and Results

30 Subjects with Knee Osteoarthritis were selected with purposive sampling method and randomly divided into two groups of 15 subjects in each Group. Group A received tibio-fibular glide along with conventional treatment while Group B received only conventional therapy, pain and functional ability was measured using NRS and WOMAC scale respectively.

Results

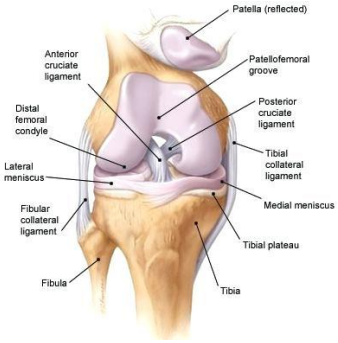
The subjects who received tibio-fibular glide along with conventional therapy both their NRS and WOMAC improved significantly ($p<0.0001$) as compared to those who received the conventional therapy alone.

Conclusion

The study demonstrated tibio-fibular glide when combined with conventional physiotherapy, improved pain and functional ability in patients with Knee Osteoarthritis.

Keywords: Knee Osteoarthritis, Proximal tibio-fibular glide.

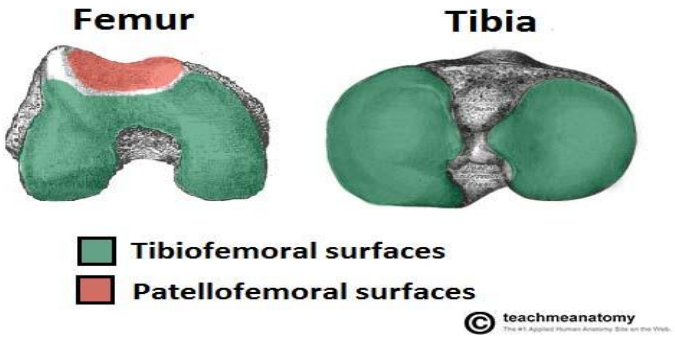
INTRODUCTION



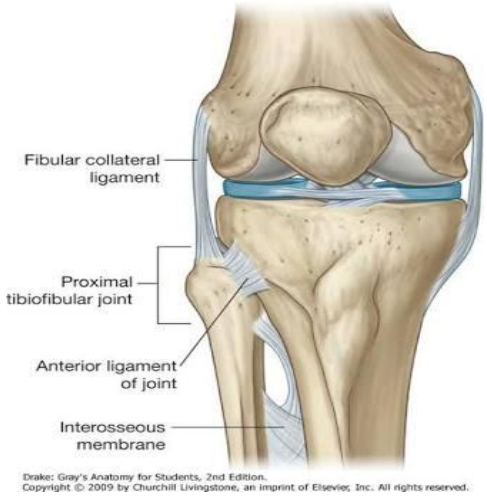
ANATOMY OF KNEE JOINT

The knee joint is the largest and most complex joint of the body. The complexity is the result of fusion of three joints in one. It is formed by fusion of lateral tibio-femoral, medial tibio-femoral and patello-femoral joints.The knee joint allows for flexion and extension (and a small degree of medial and lateral rotation) [1]

The knee joint consists of two articulations [2]



- **Tibio-femoral-** The medial and lateral condyles of the femur articulating with the tibia.
- **Patello-femoral-** The anterior and distal part of the femur articulating with the patella.
- The tibio-femoral joint is the weight-bearing joint of the knee.



- The proximal tibio-fibular joint is a plane synovial joint formed by the articulation of the head of fibula with the postero-lateral aspect of the tibia.
- Each proximal tibio-fibular joint is surrounded by a joint capsule that is reinforced by anterior and posterior tibio-fibular ligaments.
- Motion at the proximal tibio-fibular joint is variable but consistently small; it has been described as superior and inferior sliding of the fibula and as fibular rotations. [3]

KNEE OSTEOARTHRITIS

- Osteoarthritis is primarily confined to one or more synovial joints and its surrounding soft tissues. Pathological feature defined OA: the progressive destruction of articular cartilage and formation of bone at the margins of the joint.
- OA is now recognized as a disease involving the entire joint including the periarticular musculature.
- Osteoarthritis is the most common form of arthritis and extremely prevalent among individuals over 40 years of age. [4]
- Prevalence of osteoarthritis among the age 40-65 range from 17%-66.6% in Indian population with 11% of all women over the age of 60 years. [5]

CLASSIFICATION OF OA KNEE

For the grading of osteoarthritis in the knee, the **International Knee Documentation Committee (IKDC) system [6]** is regarded to have the most favorable combination inter-observer precision and correlation to knee arthroscopy findings.

GRADE	FINDINGS
A	No joint space narrowing, defined in this system as at least 4 mm joint space.
B	At least 4 mm joint space, but small osteophytes, slight sclerosis, or femoral condyle flattening
C	2-4 mm joint space.
D	<2 mm joint space.

Changes in osteoarthritic knee

- The first change observed is an increased in the water content and depletion of the proteoglycans from the cartilage matrix.
- Repeated weight bearing on such a cartilage leads to its fibrillation. The cartilage gets abraded by the grinding mechanism at work at the points of contact between the opposing articular surfaces, until eventually the underlying bone is exposed.
- Further the subcondral bone becomes hard and glossy (eburnated).
- Meanwhile, the bone at the margins of the joint hypertrophies to form a rim of projecting spurs known as osteophytes.
- A similar mechanism results in the formation of subchondral cysts and sclerosis.
- The loose flakes of cartilage incite synovial inflammation and thickening of the capsule, leading to deformity and stiffness of the joint. [7]

Signs and symptoms

- PAIN is the earliest symptom, it occurs intermittently in the beginning, but becomes constant over months or years.
- A coarse CREPITUS may be complained by some patients.
- SWELLING of the joint is usually a late feature, and is due to the effusion caused by inflammation of the synovial tissues.
- STIFFNESS is initially due to pain and muscle spasm; but later, capsular contracture and incongruity of the joint surface contribute to it.
- Other symptoms are, a feeling of 'INSTABILITY' of the joint, and 'LOCKING' resulting from loose bodies and frayed menisci. [7]

EFFECT OF JOINT MOBILIZATION

Neurophysiological effects

- Small amplitude oscillatory and distraction movement are used to stimulate the mechanoreceptors that may inhibit the transmission of nociceptive stimuli at the spinal cord or brain stem levels

Mechanical effects

- Small-amplitude distraction or gliding movements of the joint are used to cause synovial fluid motion, which is the vehicle for bringing nutrients to the avascular portions of the articular cartilage. Gentle joint play techniques help maintain nutrient exchange and, thus prevent the painful and degenerating effects of stasis when a joint is swollen or painful and cannot move through the ROM. [8]
- Tibio-fibular hypomobility and being an adjacent structure may contribute to lateral knee pain.
- Clinicians and anatomists have ignored the superior tibio-fibular joint too long. As Dr. Arthur Helfet states [9]: "The superior tibio-fibular joint has suffered clinical and literary neglect." Although pathology of this joint is relatively uncommon, it must be considered as a differential diagnosis. [9]
- Jacob Scott et al in his study '**The effect of tibiofemoral loading on proximal tibiofibular joint motion.'** on four human cadaveric knee specimens has proven that translational motion of 1–3 mm was observed during torques and forces that correspond to physiologic motions such as gait and stair climbing.[10]
- Many joint mobilization techniques are tried specific knee joint, but the adjacent proximal tibio-fibular joint is been minimally explored.
- Hence the project aims to evaluate whether joint mobilization at proximal tibio-fibular joint along with conventional treatment help to reduce pain and improve functional ability.
- According to Kaltenborn the mechanical reason for decreased movement is often because the normal proportion of rolling and gliding is missing in the joint.
- Decreased gliding component which contributes most to joint hypomobility. [11]
- Kaltenborn grade 1 glide/ distraction is used with all gliding motions and used for relief of pain.
- Gentle grade 2 is useful to inhibit pain and to maintain joint play.
- Grade 3 is used to stretch the joint structures and thus increase joint play.
- Proximal tibio-fibular glide will help to increase movement of the fibular head and reduce stiffness. [8]

MATERIALS AND METHODS

Materials: Included

- Pen
- Pencil
- Evaluation form
- The Western Ontario and McMaster Universities Osteoarthritis Index
- (WOMAC) scale [12]
- Numerical Pain Rating (NPR) scale
- Plinth
- Towel roll
- Mobilization belt
- TENS machine

METHODOLOGY

30 Subjects with Knee Osteoarthritis within the age group of 40-70 were recruited in the study, diagnosed by Orthopedic surgeon. They were randomly divided into two groups Group A (N=15) and Group B (N=15). Consent was signed before the treatment and was assessed using WOMAC scale and NRS.

Inclusion criteria

Sub-acute or chronic OA (osteoarthritis) grade A and B according to the **International Knee Documentation Committee (IKDC) system.**

Exclusion criteria

- No any history of fracture or any trauma to knee joint.
- No history of surgery around the knee joint.
- Any other referred pain to hip or knee joint.
- Ligamentous or meniscal injuries.
- Autoimmune disease- Rheumatiod arthritis, systemic lupus erythematous, reactive arthritis.
- Malignancy

- Infection- septic arthritis, osteomyelitis, tuberculous arthritis

EXPERIMENTAL GROUP: (GROUP A)

- This group received whole conventional treatment along with proximal tibio-fibular joint mobilization.
- Procedure for Joint Mobilization: Non-thrust sustained joint play technique, for 1 week (6 sessions)
- Grade II: (tighten) Enough distraction or glide applied to tighten the tissues around the joint. Kaltenborn called this 'taking up the slack' [8]
- Grade III : (stretch) A distraction or a glide is applied with an amplitude large enough to place stretch on the joint capsule and the surrounding periarticular structures. [8]
- Grade III glide was used to stretch the joint structure and to improve joint play. For restricted joints, applied for minimum of a 6 second stretch force followed by partial release (to grade I or II) then slow, intermittent stretches were repeated at 3 to 4 of second interval.
- Proximal Tibio-fibular Articulation: Anterior (Ventral) Glide [8]
- Patient Position
- Side-lying, with the trunk and hips rotated partially toward prone.
- The top leg is flexed forward so the knee and lower leg are resting on the table or supported on a pillow

- Therapist Position and Hand Placement
- Stand behind the patient, placing one hand under the tibia to stabilize it.
- Place the base of other hand posterior to the head of the fibula, wrapping fingers anteriorly.
- Mobilizing Force
- The force comes from the heel of the hand against the posterior aspect of the fibular head, in an anterior-lateral direction.
- Duration
- 5- 7 seconds hold was given with 3-5 repsAt the end of the treatment, that is, on 6th day, patients were reassessed by WOMAC and NRS scale to note the changes in pain and functional ability.

CONTROL GROUP (GROUP B) [13]

Received conventional treatment includin

Educating the Subject about his conditions (do's and don'ts, reduce degree of compressive forces)

TENS Conventional 2 channels TENS with frequency of 50-100 Hz was given for 10 minutes for 6 days from day one.

Exercise: The exercise programme consisted of isometric, isotonic exercises and stretching which were taught to the patients.

1. Isometric quadriceps exercise.
2. High sitting knee extension
3. Isometric quadriceps with plantar and Dorsi-flexion
4. Straight leg rising
5. Hip abduction
6. The stretching exercise was performed actively and included the following muscles and in order: the calf, quadriceps, and the hamstring muscles.

The patients were instructed to perform these exercises twice/day for 6 days.

STUDY RESULTS

Study represents data with respect to NRS and WOMAC scale of the control and experimental groups. Descriptive statistics including p-value mean were calculated.

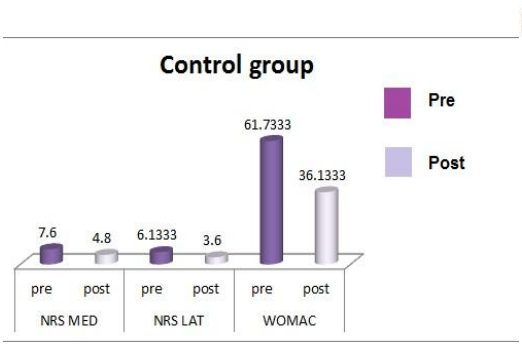
Intra group (within) comparison was done using WILCOXON signed-rank test. Table 1 showed pre post mean of NRS medial, NRS lateral WOMAC and P value in both groups improved after the treatments and improvement was highly significant in both the groups.

Table 1: Inter-group analysis

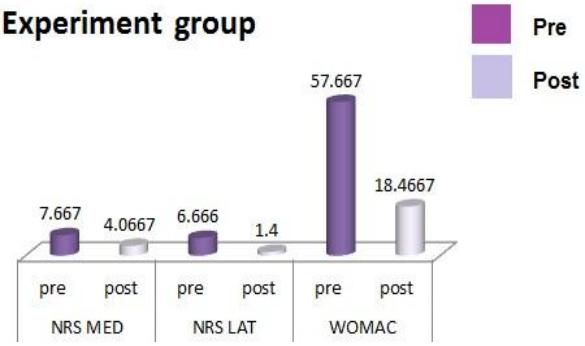
	GROUP A(EXPERIMENTAL)			GROUP B(CONTROL)		
	MEAN		**P VALUE**	**MEAN**		**P VALUE**
	PRE	POST		PRE	POST	
NRS MEDIAL	7.666	3.667	<0.0001	7.6	4.8	<0.0001
NRS LATERAL	6.66	1.4	<0.0001	6.133	3.6	<0.0001
WOMAC	57.66667	18.46667	<0.0001	61.733	36.133	<0.0001

Graphical representation of Pre-Post Mean NRS and WOMAC

Graph 1



Graph 2



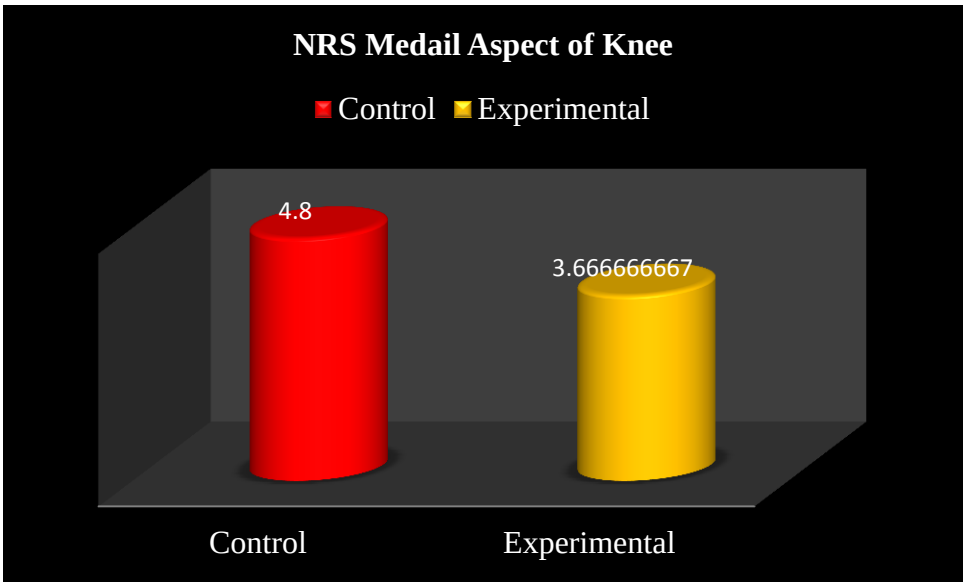
Inter group (between) comparison was done using Mann-Whitney *U* test

Table 2 showed post mean NRS medial, NRS lateral, WOMAC and P value

Table 2: Intra-group analysis of P value

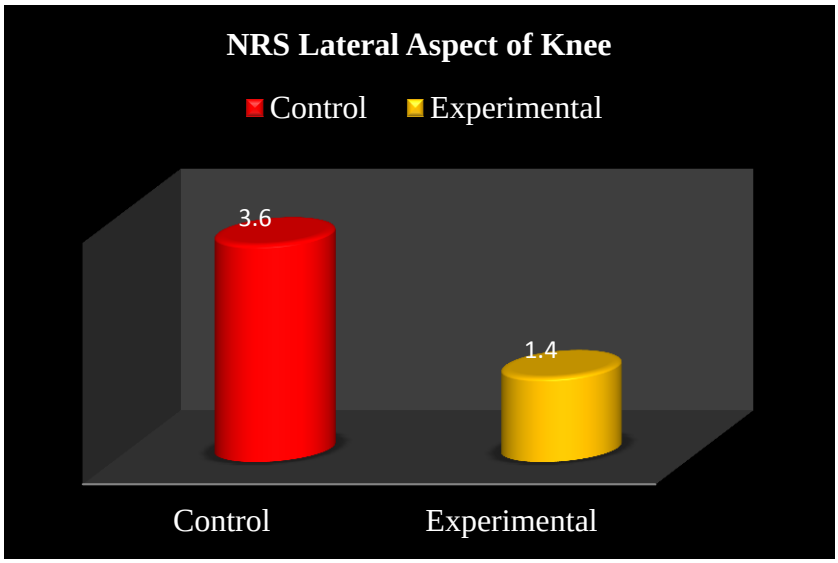
	GROUPS	MEAN	P VALUE	SIGNIFICANCE
NRS MEDIAL	EXPER.	3.5994	0.3075	Not significant
	CONTROL	2.8		
NRS LATERAL	EXPER.	5.26	0.0002	Extremely significant
	CONTROL	2.533		
WOMAC	EXPER.	39.2	<0.0001	Extremely significant
	CONTROL	25.6		

Comparing the mean medial NRS score between the groups did not showed any significant difference (p=0.3075). NRS of Medial aspect showed clinical significance but not statistical.



Graph 3: Graphical representation-NRS medial aspect of Knee

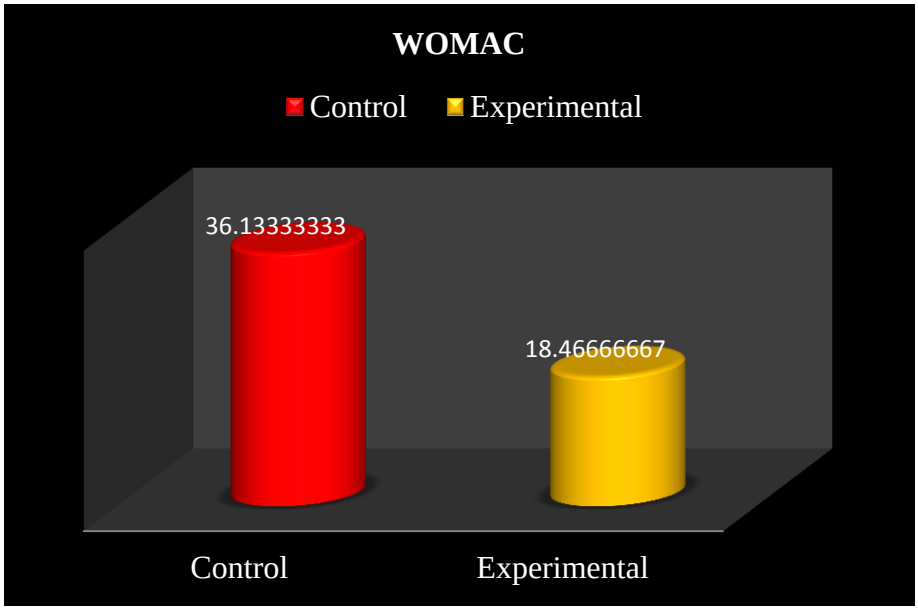
However comparing the mean lateral NRS score between the group A and group B showed extreme significance. (p=0.0002)



Graph 4: Graphical representation NRS lateral aspect of knee

The WOMAC score in both group A and group B improved significantly but the P value of Experiment group was extremely significant (p<0.0001)

In other words, both the treatments are effective for improving the WOMAC in Subjects with OA knee but added tibio-fibular joint mobilization is more effective.



Graph 5: Graphical representation of WOMAC score

DISCUSSION

Osteoarthritis is the most common form of arthritis and extremely prevalent among individuals over 40 years of age. [4]

Previous study published by Helfet [9] has describes the importance of the superior tibio-fibular joint in lower extremity function. Flexion and extension of the knee occur with some amount of tibial rotation. Ankle flexion and extension is not an isolated motions but rather require a component of tibial rotation as well. During weight-bearing, rotation of the tibia is quite restricted. To accommodate internal and external rotatory movements of the tibia, the superior tibio-fibular joint provides a compensatory motion.

Movements at superior tibio-fibular joint occur in the relationship between the tibia and fibula: 1) anterior-posterior, 2) superior and inferior, and *3)* rotation. Motions occur simultaneously and are dependent upon knee position as well as foot position. Ogden determined the following primary functions of the superior tibio-fibular joint: *1)* the dissipation of torsional stresses applied at the ankle joint, *2)* the dissipation of lateral tibial bending movements, and *3)* tensile rather than compressive weight bearing.[9]

In my following study proximal tibio-fibular joint mobilization was done to reduce pain and improve functional ability.

The current study shows considerable difference in the NRS and WOMAC score. Subjects those who received fibular glide and conventional therapy both their WOMAC and pain of Lateral compartment reduced significantly (p 0.0002) as compared to those who received the conventional therapy alone.

The results for Mann-Whitney *U* test for WOMAC was <0.0001 which is extremely significant.

Joint mobilization helps by

1. 1 Pain reduction
2. 2 Improved Joint Mobility
3. 3 Reduction of Hyperalgesia

Results agree with previously published studies on the subject indicating the ability of Joint mobilization to reduce pain and improve physical function.

Physiological effects

Jeff G.et al stated joint mobilization techniques render to restore the accessory motions. Joint mobilization helped in mitigating capsular restrictions and breaking adhesions, distracting impacted tissue, and providing movement and lubrication for normal articular cartilage. Pain reduction and decreased muscle tension was because of the stimulation of fast-conducting fibers (type A-β and A-α fibers) to block small pain fibers (type C afferent fibers) and through the activation

of dynamic mechanoreceptors which produced reflexive relaxation. Thus joint mobilization is indicated for the treatment of capsular restrictions. [14]

Pain reduction

Pain reduction following joint mobilization has been established in previous studies. Sambajon et al. in 2003 conducted an in vitro animal study in which he found a 70% reduction in levels of cellular prostaglandin (PG) E^2, (a strong inflammatory mediators causing hyperalgesia in arthritic joints), within 24 hours of mobilization. Skyba et al. (2003) suggested that analgesic effect following knee joint mobilization was primarily due to enhancement of the descending pain inhibitory pathway in the spinal cord, which utilized serotonergic (5-HT1A) and noradrenergic receptors (alpha-2). [15]

Improved joint mobility

Joint mobilization increase excursion by breaking these collagen cross-links, which form as a result of the decrease in GAG. In the traumatized joint, the proliferation of intra-articular fibro-fatty deposits will also restrict motion. Another mechanism by which joint mobilization may aid in restoring motion is by decreasing edema. The intermittent compression and distraction of the joint will redistribute fluid into the soft tissue and allow for easier movement. [16]

Reduction of hyperalgesia

Sluka KA et al (2006) Measured mechanical hyperalgesia by examining the mechanical withdrawal threshold of the rat's paw before and after induction of inflammation with 3% carrageenan (gastrocnemius muscle) or 3% kaolin/carrageenan (knee joint), and for 1 hour after knee joint mobilization. A bilateral decrease in mechanical withdrawal thresholds occurred 1, 2, and 4 weeks after inflammation of the knee joint or muscle. Therefore, joint mobilization reduces hyperalgesia induced by chronic inflammation of muscle and joint. [17]

Previous study of Aftab Ahmad has proven that manual joint mobilization improves the effectiveness of the treatment program in treating symptoms of knee OA and improves function in elderly people with knee OA. [18]

In the present study, when the mean scores of Western Ontario McMaster University Osteoarthritis Disability Index was analyzed intra group, it was found statistically significant in both the groups and has shown reduced WOMAC scores which represents an improvement in the pain, and function activities whereas.

Further studying the WOMAC scale also showed that components such as pain at rest, morning stiffness reduced significantly, physical activities like ascending stairs, walking, putting on and taking off socks were at more ease for Group A whereas activities: getting on/off the toilet seat still remained difficult.

Group A had shown statistically significant changes in pain and functional activities than Group B owing to the increased joint mobility in the proximal tibiofibular joint. This indicated that fibular glide has an added effect to the conventional treatment.

This study can be performed with long duration with greater sample size to access the effect of glide on ankle and knee ROM.

ROM of knee and ankle can be included as an outcome measure for similar study.

CONCLUSION

The study concludes fibular glide is effective in decreasing pain improving physical function of the subjects with knee osteoarthritis.

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