International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Outcome Measurement of Electrical Stimulation on Quadriceps Muscles for Knee Osteoarthritis

Jayanta Nath

[1]Ph.D Scholar, SSUHS, Orthopaedics and Sport Physiotherapist , Assam, India
Industrial Area, P/O Mangaldai, Dist: Darrang, PIN-784125, Assam, India
Physiotherapist at Jugijan Model Hospital (Govt of Assam)

Abstract: ***Introduction: Outcome measurement is very essential part to assess efficacy of treatment intervention. The first objective was to perform a review of all outcome measurement used in manangement of knee OA. Secondly to know if there was any difference of outcome measurement of electrical stimulation on quadriceps muscle based on collected review article. Question: What were the various outcome measurement used for assessment of knee osteoarthritis specially when used electrical stimulation? Design: Review of literature. Participant: reviewer. Adults with osteoarthritis of the knee. Intervention: Electrical stimulation for quadriceps. Outcome measure : VAS, WOMAC, dynamometer,MMT,EMG etc Development: Literature searches were made in these databases: Medline (Ovid), Pedro, SCOPUS, PsycINFO, Web of knowledge, CINAHL (EBSCOHost), SportDicus (EBSCOHost), DOAJ, Cochrane, EMBASE, Academic Search Complete (EBSCOHost), Fuente Académica (EBSCOHost), and MedicLatina (EBSCOHost). A retrospective search of 13 years was used until February 2015. 33 records were selected based on the affinity with the subject of the review and their internal validity according to the PEDro scale. Conclusions: WOMAC, VAS, were most commonly used outcome measurement for OA knee. recommend further research on ES and outcome measurement.There were many outcome measure for knee OA based on literature search .The review evidence suggest that VAS,WOMAC,were useful for assessing quality of management.Out of all outcome measurement tool the WOMAC,PPT, EMG were most valid and reliable tool.***

Keywords: Knee Osteoarthritis, Electrical Stimulation, VAS, WOMAC, Outcome measurement of electrical stimulation, physiotherapy for knee osteoarthritis

1. Introduction

The main aim of this study is to detect the level of evidence and grades of recommendation regarding Physiotherapy management and electrical stimulation on quadriceps muscles and its outcome measurement in patients with knee osteoarthritis. Comparisons between the different methods of intervention in Physiotherapy in knee osteoarthritis on a literature review with a retrospective 13 year search.

1.1 Justification of the Proposed Research Work

Knee osteoarthritis (OA) is a common chronic joint disease and costly public health problem. It leads to pain, loss of function and reduced quality-of-life . About 17% of people aged over 45 years suffer from pain and loss of function due to symptomatic knee osteoarthritis and 40% of people aged over 65 years have symptomatic OA of the knee or hip . The prevalence of osteoarthritis increases with age and generally affects women more frequently than male. Approximately 85% of the population near 65 years of age present radiographic evidences of OA.(Cooper C: The epidemiology of osteoartbritis. In Rheumatology. Edited by Klippel J, Dieppe P. New York: CV Mosby; 1994:7.3.1-4.)

The economic impact of knee OA is substantial and will further increase as the population ages and obesity rates escalate. Individuals with osteoarthritis (OA) of the knee joint commonly display marked weakness of the quadriceps muscles, with strength deficits of 20 to 45% compared with age and gender-matched controls[1] . Persistent quadriceps weakness is clinically important in individual with OA as it is associated with impaired dynamic knee stability [2] and physical function. Moreover, the quadriceps have an important protective function at the knee joint, working eccentrically during the early stance phase of gait to cushion the knee joint and acting to decelerate the limb prior to heel strike, thereby reducing impulsive loading [3]. Weaker quadriceps have been associated with an increased rate of loading at the knee joint [3] and recent longitudinal data have shown that greater baseline quadriceps strength may protect against incident knee pain, patellofemoral cartilage loss [4] and tibiofemoral joint space narrowing.

The role of the quadriceps muscle in mediating risk for knee osteoarthritis (OA) is a common subject of investigation. The quadriceps muscle is a principal contributor to knee joint stability and provides shock absorption for the knee during ambulation. Clinically, weakness of the quadriceps muscle is consistently found in patients with knee OA. Research has shown that higher quadriceps muscle strength is associated with a reduced risk for incident symptomatic knee OA. However, there is limited evidence to suggest that quadriceps muscle plays a significant role in the incidence of radiographic knee OA. In addition, greater quadriceps muscle strength is associated with a lower risk for progression of tibiofemoral joint space narrowing and cartilage loss in women[5].

Knee osteoarthritis (OA) is associated with quadriceps atrophy and weakness, so muscle strengthening is an important point in the rehabilitation process[6]. Since pain and joint stiffness make it often difficult to use conventional strength exercises, neuromuscular electrical stimulation (NMES) may be an alternative approach for these patients. Additionally, NMES training increased the knee extensor torque by 8% and reduced joint pain, stiffness, and functional limitation[6]. In conclusion, OA

patients have decreased strength, muscle thickness, and fascicle length in the knee extensor musculature compared to control subjects. NMES training appears to offset the changes in quadriceps structure and function, as well as improve the health status in patients with knee OA.

1.2 Lacunae in the present knowledge / understanding

In recent years considerable effort has been directed towards investigating the effectiveness of putative disease modifying OA drugs such as glucosamine, chondroitin sulfate, doxycycline and diacerein . There is also interest in the use of pulsed electrical stimulation and electro-magnetic fields as potential OA disease modifying modalities. Laboratory work and animal studies provide theoretical support for the use of electrical stimulation to maintain and repair articular cartilage in the clinical setting. However, there are limited studies examining the effects of pulsed electrical stimulation in humans. Two randomised, placebo-controlled trials have reported using capacitively coupled pulsed electrical stimulation (PES) delivered via skin surface electrodes . In both trials, outcome measures focussing on symptom relief and functional capacity have been the variables of interest.

Physiotherapy is a non-pharmacological intervention for knee osteoarthritis recommended by the American College of Rheumatology and the European League Against Rheumatism. It encompasses numerous treatment modes including exercise, manual techniques, knee taping, and education to impart patient self management strategies. Most studies of physiotherapy for knee osteoarthritis have evaluated individual components, but this does not reflect typical clinical practice. While three randomised controlled trials have investigated a physiotherapy treatment package for knee osteoarthritis[7] ,only one used a placebo comparison group[8]. Two trials reported a beneficial effect of physiotherapy,[7] [8] while one reported no effect.[9] However, results are difficult to compare owing to different osteoarthritis samples and treatments employed.

Outcomes in clinical practice provide the mechanism by which the health care provider (HCP), the patient, the public, and the payer are able to assess the end results of care and its effect upon the health of the patient and society. Measuring results of treatment in clinical setting has been an age long practice, however, the last three decades have witnessed the development of many standardized outcome measures in the health sector and effort has been redirected at integrating outcome assessment into clinical practice.

The measurement of clinical outcomes in the health care delivery system is one of the most efficacious areas within the area of clinical decision making. The methods of outcomes assessment, may help provide tools that HCP can use to learn to focus on important attributes of care that not only meet accountability but patient satisfaction. The development of instruments for the assessment of therapeutic intervention has been an age long practice. A number of well documented reliable and valid measures of functional health and activities of daily living (ADL) status have been developed for osteoarthritis. These include the Arthritis Impact Measurement Scales (AIMS), Knee Osteoarthritis Outcome Score (KOOS), Western Ontario and McMaster University (WOMAC) Osteoarthritis Index, Short Form (SF) 36 Arthritis Specific (SF 36 ASHI), Functional Status Index (FSI), Osteoarthritis Severity Indices of Lequesne (LEQUESNE), Health Assessment Questionnaire, Ibadan Knee/Hip Osteoarthritis Outcome Measure (IKHOAM). According to McKay and Lyons, a standardized outcome measure refers to a published measurement tool, designed for a given population with detailed information on administration, scoring, interpretation and psychometric properties. A review of all published studies that included the use of outcome measures in the assessment of therapeutic interventions in patients with osteoarthritis of the hip and or knee was done through a PubMed search. Search terms used were “osteoarthritis of the knee”, “osteoarthritis of hip”, “rehabilitation”, “outcome assessment” and outcome measures.The date limit was from 1996-2000. These outcome measures were the Knee Osteoarthritis Outcome, Western Ontario and McMaster University Scale, Osteoarthritis Severity Indices of Lequesne, Arthritis Impact Measurement (AIMS) version, Visual Analogue Scale, Functional Status Questionnaire, Stanford Health Assessment Questionnaire and Short Form 36 Arthritis Specific.(REF: A.C. Odole, N.A. Odunaiya and A.O. Akinpelu. Ibadan knee/hip osteoarthritis outcome measure: process of development. Annals of Ibadan Postgraduate Medicine. Vol. 11 No. 2 December, 2013. 71-76)

Neuromuscular electrical stimulation (NMES) entails the use of a low-amplitude electrical pulse to induce involuntary muscle contractions[8]. NMES has been shown to improve QFM strength in healthy individuals and in subjects with various pathological knee conditions, such as after recon-struction of the anterior cruciate ligament9 and after total knee arthroplasty[10]. The advantage of NMES therapy may lie in activation of type 2 muscle fibers at relatively low-contraction intensities. The effect of NMES on the QFM of patients with OA has recently received some attention, indicating its potential as a treatment modality for this population [12-17].

Neuromuscular electrical stimulation (NMES) is the application of electrical current to elicit a muscle contraction and seems to be helpful for strengthening the muscles.Use of NMES for orthopedic and neurologic rehabilitation has grown significantly in recent years and seems to be documented.

Neuromuscular electrical stimulation (NMES) has demonstrated efficacy in improving quadriceps muscle strength (force-generating capacity) and activation following knee replacement and ligamentous reconstruction. Yet, data are lacking to establish the efficacy of NMES in people with evidence of early radiographic osteoarthritis.

2. Methods

Literature search

A literature search was carried out to identify all possible studies that could help to answer the research question. The

following databases were searched for relevant studies: Medline (Ovid), Pedro, SCOPUS, PsycINFO, Web of Knowledge, CINAHL (EBSCOHost), SportDicus (EBSCOHost), DOAJ, Cochrane, EMBASE, Academic Search Complete (EBSCOHost), Fuente Academica (EBSCOHost), and MedicLatina (EBSCOHost). In addition to this, a manual search of the revised reference lists of identified articles and published conference abstracts were done by the reviewer.

Two reviewers carried out several searches in the databases using combinations of key words: Knee osteoarthritis (OA), electrical stimulation of quadriceps, outcome measurement of OA, rehabilitation, Physical therapy osteoarthritis. The searches were limited to English studies reported in between 2003 and February 2015. The randomized and not randomized trials, quasi-experimental trials, case studies and systematic reviews were included.

Inclusion and Exclusion Criteria

Inclusion criteria were constructed using the PICO (population, intervention, control/comparison and outcomes) model. **First, the population** included samples of adult patients who have suffered knee osteoarthritis.

Second, the intervention included electrical stimulation training compared to different intervention methods in physiotherapy for OA knee. **Third, different types** of randomized, non-randomized, cohort, quasi-experimental, systematic reviews and case studies were included.

Finally, the outcomes included were functional outcomes, WOMAC, VAS, EMG ,etc. Studies were excluded if they dealt with other knee problems not related with electrical stimulation.

Assessment of the Methodological Quality

Fifty-one relevant articles were found in the main databases. Thirtythree original studies were examined after subsequent selection based on the title and abstract. After analyzing the primary documents thirty-three were relevant to this review as were three systematic reviews.

The methodological quality of the twelve studies was evaluated using the PEDro scale . Two independent reviewers (Palma- Jiménez, M. & Martín-Valero, R.) completed the assessment list based on PEDro score. This scale (0 to 10) is based on the list developed by Verhagen et al., and assesses the internal validity of randomized controlled trials. A study with a PEDro score of 6 or more is considered level-1 evidence (6–8: good; 9–10: excellent) and a score of 5 or less is considered level-2 evidence (4–5: fair; <4: poor).

3. Review of Evidence

Salaffi F, et al (2003 August)[14] conducted a reliability and validity study of WOMAC Osteoarthritis (OA) Index is a tested questionnaire to assess symptoms and physical functional disability in patients with OA of the knee and the hip. And they conclude that the Italian version of WOMAC is a reliable and valid instrument for evaluating the severity of OA of the knee, with metric properties in agreement with the original, widely used version.(PEDro score: a/10

Petterson SC, et al (2008 Mar) [11]conducted a study to identify determinants of quadriceps weakness among persons with end-stage knee osteoarthritis (OA). Quadriceps strength (MVIC) and volitional muscle activation (CAR) were measured using a burst superimposition test. Muscle composition (lean muscle cross-sectional area (LMCSA) and fat CSA (FCSA)) were quantified using magnetic resonance imaging. Specific strength (MVIC/LMCSA) was computed. They conclude that Both reduced CAR and LMCSA contribute to muscle weakness in persons with knee OA. Similar to healthy elders, the best predictor of strength in the contralateral, nondiseased limb was largely determined by LMCSA, whereas CAR was found to be the primary determinant of strength in the OA limb. Deficits in CAR may undermine the effectiveness of volitional strengthening programs in targeting quadriceps weakness in the OA population.

Palmieri-Smith RM, Thomas AC et al (2010)[13] conducted a study to determine whether NMES is capable of improving quadriceps muscle strength and activation in women with mild and moderate knee osteoarthritis and they conclude that Four weeks of NMES delivered to women with mild and moderate osteoarthritis and mild strength deficits was insufficient to induce gains in quadriceps muscle strength or activation.

Segal NA et al.(Nov 2011)[5] conducted a study to find out the relationship between quadriceps muscle strength and risk for knee OA and concluded that quadriceps muscle plays a significant role in the incidence of radiographic knee OA. In addition, greater quadriceps muscle strength is associated with a lower risk for progression of tibiofemoral joint space narrowing and cartilage loss in women.

Vance CG, et al (July 2012)[12] conducted a study to determine the effects of high-frequency TENS (HF-TENS) and low-frequency TENS (LF-TENS) on several outcome measures (pain at rest, movement-evoked pain, and pain sensitivity) in people with knee osteoarthritis and they conclude that Both HF-TENS and LF-TENS increased PPT in people with knee osteoarthritis; placebo TENS had no significant effect on PPT. Cutaneous pain measures were unaffected by TENS. Subjective pain ratings at rest and during movement were similarly reduced by active TENS and placebo TENS, suggesting a strong placebo component of the effect of TENS.

Vaz MA et al (2013)[10] Conducted a study aimed at (1) identifying the associations of knee OA with quadriceps muscle architecture and strength, and (2) quantifying the effects of a NMES training program on these parameters and conclude that NMES training increased the knee extensor torque by 8% and reduced joint pain, stiffness, and functional limitation.

Palmer S et al (2014)[15] conducted a study to determine the additional effects of TENS for knee osteoarthritis (OA) when combined with a group education and exercise program (knee

group). A total of 224 participants were randomized to 3 arms: TENS and knee group (n = 73), sham TENS and knee group (n = 74), and knee group (n = 77). All patients entered an evidence-based 6-week group education and exercise program (knee group). Active TENS was used as much as needed during the 6-week period. Sham TENS used dummy devices with no electrical output. Results was all outcomes improved over time , but there were no differences between trial arms . They conclude that there were no additional benefits of TENS, failing to support its use as a treatment adjunct within this context.

Anand B et al (2014 june)[16] conducted a study to know the effect of Russian current stimulation on quadriceps muscle strength in patients with primary OA knee. 30 subjects diagnosed with primary OA knee were recruited.Subjects were randomly allocated into 2 groups namely Group A (n=15) who received SWD and exercises and Group B (n=15) who received SWD, exercises and Russian current stimulation for 10 days. Group B showed better improvement in muscle strength and function than group A. The intra group and between group comparison was statistically significant for both the groups. At the conclusion Russian current stimulation is effective in increasing quadriceps muscle strength and secondarily improving the functional ability in subjects with primary OA knee.

Yocheved Laufer et al.(2014 17th july)[17]conducted a study to compare the effects of an exercise program with and without NMES of the QFM on pain, functional performance, and muscle strength immediately posttreatment and 12 weeks after completion of the intervention . 63 participants with knee OA were randomly assigned into two groups receiving 12 biweekly treatments: An exercise-only program or an exercise program combined with NMES. A significantly greater reduction in knee pain was observed immediately after treatment in the NMES group, which was maintained 12 weeks postintervention in both groups. Although at this stage NMES had no additive effect, both groups demonstrated an immediate increase in muscle strength and in functional abilities, with no differences between groups. Although the improvements in gait velocity and in self-report functional ability were maintained at the follow-up session, the noted improvements in muscle strength, time to up and go, and stair negotiation were not maintained.

Ahmed H A et al.(2014 june)[18] conducted a study to compare exercise treatments for hamstring and quadriceps strength in the management of knee osteoarthritis. 40 patients with OA knee, aged 50–65 years were divided into 2 groups. The 1st group received hot packs and performed strengthening exercises for the quadriceps and hamstring, and stretching exercises for the hamstring. The 2nd group received hot packs and performed strengthening exercises for only the quadriceps, and stretching exercise for the hamstring. They Conclude that strengthening of the hamstrings in addition to strengthening of the quadriceps was shown to be beneficial for improving subjective knee pain, ROM and decreasing the limitation of functional performance of patients with knee OA.

Shahnawaz Anwer et al (2014 May)[19],conducted a study to investigate the effects of isometric quadriceps exercise on muscle strength, pain, and function in knee osteoarthritis. The experimental group performed isometric exercises including isometric quadriceps, straight leg raising, and isometric hip adduction exercise 5 days a week for 5 weeks, whereas the control group did not performed any exercise program.The Conclusion was that 5week isometric quadriceps exercise program showed beneficial effects on quadriceps muscle strength, pain, and functional disability in patients with OA of the knee.

Melo MD et al (2014 Sep 26)[20] conducted a study to determine the effects of low-level laser therapy in combination with neuromuscular electrical stimulation on the muscle architecture and functional capacity of elderly patients with knee OA. Participants were randomized into one of the following 3 intervention groups: electrical stimulation group , laser group or combined group (electrical stimulation and low-level laser therapy). After intervention, only the electrical stimulation and combined groups exhibited significant increases in the muscle thickness and pennation angle values. The 3 groups exhibited increased performance on the walk test . The conclusion of the study was NMES reduced the deleterious effects of OA on the quadriceps structure. Low-level laser therapy did not potentiate the effects of electrical stimulation on the evaluated parameters.

Cherian JJ et al (2014 Aug 27) [21] Conducted a study to evaluate the effects of TENS on the following issues in patients who have early-stage OA of the knee: pain reduction; subjective and objective functional improvements; quality-of-life (QOL) measure improvements; and isokinetic strength. In conclusion, the use of TENS for 3 months has shown encouraging results to improve pain, function, and QOL in patients with painful osteoarthritic knees.

Laufer Y et al (2014 Jul 17)[22] conducted a study to compare the effects of an exercise program with and without NMES of the QFM on pain, functional performance, and muscle strength immediately post treatment and 12 weeks after completion of the intervention and they concluded that Supplementing an exercise program with NMES to the QFM increased pain modulation immediately after treatment in patients with knee OA. Maintenance of the positive post treatment effects during a 12-week period was observed only for pain, self-reported functional ability, and walk velocity, with no difference between groups.

Article 1.Van der Esch M et al 2014 Oct [23] conducted a study to determine whether a decrease in muscle strength over 3 years is associated with an increase in activity limitations in persons with early symptomatic knee osteoarthritis (OA) and to examine whether the longitudinal association between muscle strength and activity limitations is moderated by knee joint proprioception and laxity.

The outcome measure like muscle strength, proprioception, and laxity were assessed using specifically designed measurement devices. Self-reported and performance-based activity limitations were measured with

the Western Ontario and McMaster Universities Osteoarthritis Index, the Get Up and Go test, the walk test, and the stair-climb test. They conclude that in patients with early knee OA, decreased muscle strength is associated with an increase in activity limitations. Their results are a step toward understanding the role of muscle weakness in the development of activity limitations in knee OA. Further well-designed experimental studies are indicated to establish the causal role of muscle weakness in activity limitations.

Kade L Paterson et al 13 october 2014 [24]conducted a study to determine i) what types of shoes people are advised to wear for their knee OA and by whom; ii) establish which types of shoes people with knee OA believe are best for managing their knee OA symptoms and (iii) which shoes they wear most often. 204 people with symptomatic knee OA completed an online survey. The survey comprised 14 questions asking what footwear advice people had received for their knee OA and who they received it from, individual beliefs about optimal footwear styles for their knee OA symptoms and the types of footwear usually worn. In summary, most people with knee OA have not received any specific advice about footwear for knee OA. For those that receive advice, footwear that is cushioned or promoted foot stability and/or support is most frequently recommended. People with knee OA typically believe that sturdy/supportive shoes are best for their knee symptoms, and this shoe style was most frequently worn, which is reflective of expert opinion in clinical guidelines. Future research is needed to confirm whether the shoes favoured by expert and patient opinion are indeed optimal for managing symptoms of knee OA or disease progression.

Won Kuel Kim et al 2014 [25]conducted a study to determine the reliability and validity of hand-held dynamometer (HHD) depending on its fixation in measuring isometric knee extensor strength by comparing the results with an isokinetic dynamometer. Twenty-seven healthy female volunteers participated in this study. The subjects were tested in seated and supine position using three measurement methods: isometric knee extension by isokinetic dynamometer, non-fixed HHD, and fixed HHD. During the measurement, the knee joints of subjects were fixed at a 35^0 angle from the extended position. The fixed HHD measurement was conducted with the HHD fixed to distal tibia with a Velcro strap; non-fixed HHD was performed with a hand-held method without Velcro fixation. All the measurements were repeated three times and among them, the maximum values of peak torque were used for the analysis. They conclude that Fixation of HHD during measurement in the supine position increases the reliability and validity in measuring the quadriceps strength.

Dirks ML et al (2014 Oct 8).[26] Conducted a study to investigate the efficacy of twice-daily NMES to alleviate muscle loss in six fully-sedated ICU patients admitted for acute critical illness . One leg was subjected to twice-daily NMES of the quadriceps muscle for a period of 7±1 d while the other leg acted as non-stimulated control (CON). Directly before the first and on the morning after the final NMES session, quadriceps muscle biopsies were collected from both legs to assess muscle fiber-type specific cross-sectional area (CSA). Furthermore, phosphorylation status of key proteins involved in the regulation of muscle protein synthesis was assessed, and mRNA expression of selected genes was measured. In the CON leg, type I and type II muscle fiber CSA decreased by 16±9 and 24±7%, respectively ($P<0.05$). No muscle atrophy was observed in the stimulated leg. NMES increased mTOR phosphorylation by 19% when compared to baseline ($P<0.05$), with no changes in the CON leg. Furthermore, mRNA expression of key genes involved in muscle protein breakdown either declined or remained unchanged , with no differences between legs. In conclusion, NMES represents an effective and feasible interventional strategy to prevent skeletal muscle atrophy in critically ill, comatose patients.

Kodesh E et al (2014 Sep).[27] Conducted a study to determine inter- and intra-tester reliability of strength measurements during maximal electrically induced contractions (MEIC) using a hand-held dynamometer (HHD). Methods: Thirty-seven healthy young female adults, mean age (SD) 23.4 (2.4) years, were tested by two examiners during two sessions, with order of examiners randomized. Biphasic pulses (phase duration-300 µs; pulse frequency-75 Hz) were employed in order to induce contractions of the quadriceps femoris muscle at a maximally tolerated current level. Strength of maximal voluntary isometric contractions (MVIC) and of MEIC was recorded with a HHD utilizing a stabilization belt. Results: Good to excellent inter- and intra-tester reliability were determined with intra-class correlation coefficients ranging between 0.8 and 0.9, and no bias in the Bland-Altman plots. The 95% repeatability ranged between 8.7 and 13.0 kg for the MVIC and MEIC, and between 20.7 and 25.6% for the % MVIC. Conclusion: Results confirm previous findings indicating good to excellent reliability of quadriceps femoris muscle MVIC assessment with a HHD. However, a high 95% repeatability range indicates the HHD is not sufficiently reliable as an indicator of the force level attained during electrically induced contractions. Other methods need to be investigated to assist in determining whether MEIC have reached therapeutic levels.

Maly et al (2014 December)[28] conducted a study to highlight research studies examining rehabilitation for hip and knee OA, as well as the outcome measures used to assess treatment efficacy ,published in 2013.

A systematic search was performed in medline, CIHAHL and Embase databases from January to December 2013.The search was limited to 2013,human studies, and English. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) System was used to evaluate the quality of evidence. First, individual article were related for quality. Second, article were grouped based on outcome: OA disease markers, pain, physical function(self reported ,performance),and health.

Results of 503 titles reviewed, 36 studies were included. The outcome measures related to OA disease markers were organised into subthemes of anthropometric, biomechanics and physiology. The quality of evidence was of moderate,

high and low quality for anthropometric, biomechanical and physiological measures respectively. These studies supported the use of diet for weight loss combined with exercise .Bodies of evidence that showed the efficacy of exercise and passive strategies (thermal/electrical modalities, traction, manual therapy) for reducing pain were of low and moderate quality respectively. The evidence supporting diet and exercise, physiotherapy, and passive strategies to improve physical function was of moderate quality. Evidence supporting exercise to improve psychological factors was of moderate quality.

Conclusion: Exercise combined with diet for weight loss should be the mainstays of rehabilitation for people with knee and hip OA to provide benefit to OA disease markers, pain, physical function, and health.

Vas L et al.(2014 December)[29] conducted a study to report a new technique for pulsed radiofrequency (PRF) of entire nerve supply of the knee as an option in treating osteoarthritis of knee .They targeted both sensory and motor nerves supplying all the structures around knee : joint, muscles, and skin to address the entire nociception and stiffness leading to peripheral and central sensitization in osteoarthritis . 10 patients with pain, stiffness, and loss of function in both knees were treated with ultrasonography (USG) guided PRF of saphenous, tibial, and common peroneal nerves along with subsartorial, peripatellar , and , and popliteal plexuses.USG guided PRF of the femoral nerve was also done to address the innervantion of quadriceps muscle. Assessment of pain (Numerical Rating Scale [NRS], pain DETECT, knee function [WOMAC] were documented pre and post PRF at 3 and 6 months. Knee radiographs (Kellgren-Lawrence[K-L] grading) were done before PRF and one week later . All the patients showed a sustained improvement of NRS, pain DETECT, and WOMAC at 3 and 6 months. The significant improvement of patellar position and tibio-femoral joint space was concordant with the patient's reporting of improvement in stiffness and pain. The sustained pain relief and muscle relaxation enabled the patients to optimize physiotherapy thereby improving endurance training to include the daily activities of life. They conclude that OA knee pain is a product of neuromyopathy and that PRF of the sensory and motor nerves appeared to be safe , effective, and minimally invasive technique. The reduction of pain and stiffness improved the knee function and probably reduced the peripheral and central sensitization.

Dwyer L, Parkin-Smith GF et al (2015 january)[30] conducted a study to examine the methodological integrity, sample size requirements, and short-term preliminary clinical outcomes of manual and manipulative therapy (MMT) in addition to a rehabilitation program for symptomatic knee osteoarthritis (OA).

4. Methods

This was a pilot study of an assessor-blinded, randomized, parallel-group trial in 2 independent university-based outpatient clinics. Participants with knee OA were randomized to 3 groups: 6 MMT sessions alone, training in rehabilitation followed by a home rehabilitation program alone, or MMT plus the same rehabilitation program, respectively. Six MMT treatment sessions (provided by a chiropractic intern under supervision or by an experienced chiropractor) were provided to participants over the 4-week treatment period. The primary outcome was a description of the research methodology and sample size estimation for a confirmatory study. The secondary outcome was the short-term preliminary clinical outcomes. Data were collected at baseline and 5weeks using the Western Ontario and McMasters Osteoarthritis Index questionnaire, goniometry for knee flexion/extension, and the McMaster Overall Therapy Effectiveness inventory. Analysis of variance was used to compare differences between groups.

5. Results

Eighty-three patients were randomly allocated to 1 of the 3 groups (27, 28, and 28, respectively). Despite 5 dropouts, the data from 78 participants were available for analysis with 10% of scores missing. A minimum of 462 patients is required for a confirmatory 3-arm trial including the respective interventions, accounting for cluster effects and a 20% dropout rate. Statistically significant and clinically meaningful changes in scores from baseline to week 5 were found for all groups for the Western Ontario and McMasters Osteoarthritis Index ($P \leq .008$), with a greater change in scores for MMT and MMT plus rehabilitation. Between-group comparison did not reveal statistically significant differences between group scores at week 5 for any of the outcome measures ($P \geq .46$).

6. Conclusions

There were significant changes in scores from baseline to week 5 across all groups, suggesting that all 3 treatment approaches may be of benefit to patients with mild-to-moderate knee OA, justifying a confirmatory trial to compare these interventions.

Mat S, Tan MP, Kamaruzzaman SB et al (2015 Jan).[31] Conducted a systematic review evaluated the effectiveness of physical therapies in improving balance and reducing falls risk among patients with knee OA. A computerised search was performed to identify relevant studies up to November 2013. Two investigators identified eligible studies and extracted data independently. The quality of the included studies was assessed by the PeDro score.They concluded that strength training, Tai Chi and aerobics exercises improved balance and falls risk in older individuals with knee OA, while water-based exercises and light treatment did not significantly improve balance outcomes. Strength training, Tai Chi and aerobics exercises can therefore be recommended as falls prevention strategies for individuals with OA. However, a large randomised controlled study using actual falls outcomes is recommended to determine the appropriate dosage and to measure the potential benefits in falls reduction.

Serrao PR et al.(2015 January)[32] Study indicate that Quadriceps muscle weakness is common in knee

osteoarthritis (OA). Reasons for weakness may include atrophy, reduction in the muscle fibers number, and changes in the muscle activation. It is uncertain when these muscular changes begin to appear. Therefore, the purpose of this study was to determine whether men with early stages of knee OA already had functional and quadriceps muscle morphologic alterations.

DESIGN:
Forty men were divided into two groups: control group (healthy subjects) and OA group (subjects with knee OA). A biopsy of the vastus lateralis muscle was performed for morphometric analysis. Isokinetic evaluation of knee extensor torque, concentric and eccentric (90 and 180 degrees/sec), was performed simultaneously with vastus lateralis electromyographic activity evaluation.

RESULTS:
Significant differences were found in knee extensor torque ($P < 0.05$) and in normalized root mean square ($P < 0.01$) during the eccentric contractions (both velocities), with higher values for the control group. No differences were found during concentric contractions. The OA group presented greater values of the minimum diameter of type 1 fibers and greater proportion and relative cross-sectional area of type 2b fibers ($P < 0.05$).

CONCLUSIONS

Men with early stages of knee OA do not present alterations of concentric strength but had decreased eccentric strength and morphologic quadriceps muscle changes, indicating neuromuscular adaptations.

Duivenvoorden T et al.(2015 january)[33] Told that the results of conservative treatment of knee osteoarthritis (OA) are generally evaluated in epidemiological studies with clinical outcome measures as primary outcomes. Biomechanical evaluation of orthoses shows that there are potentially beneficial biomechanical changes to joint loading; however, evaluation in relation to clinical outcome measures in longitudinal studies is needed.

QUESTIONS/PURPOSES:
They asked (1) is there an immediate effect on gait in patients using a laterally wedged insole or valgus knee brace; (2) is there a late (6 weeks) effect; and (3) is there a difference between subgroups within each group with respect to patient compliance, body mass index, and OA status?

METHODS:
This was a secondary analysis of data from a previous randomized controlled trial of patients with early medial knee OA. A total of 91 patients were enrolled in that trial, and 73 (80%) completed it after 6 months. Of the enrolled patients, 80 (88%) met prespecified inclusion criteria for analysis in the present study. The patients were randomized to an insole or brace. Gait was analyzed with and without wearing the orthosis (insole or brace) at baseline and after 6 weeks. Measurements were taken of the knee adduction moment, ground reaction force, moment arm, walking speed, and toe-out angle. Data were analyzed with regression analyses based on an intention-to-treat principle.

CONCLUSIONS:
Laterally wedged insoles unload the medial compartment only at baseline in patients with varus alignment and by an amount that might not be clinically important. No biomechanical alteration was seen after 6 weeks of wearing the insole. Valgus brace therapy did not result in any biomechanical alteration. Taken together, this study does not show a clinically relevant biomechanical effect of insole and brace therapy in patients with varus medial knee OA.

Oiestad BE et.al.(2015 Feb.)[34] conducted a systematic review and meta-analysis on the association between knee extensor muscle weakness and the risk of developing knee osteoarthritis. A systematic review and meta-analysis was conducted with literature searches in Medline, SPORT Discus, EMBASE, CINAHL, and AMED. Eligible studies had to include participants with no radiographic or symptomatic knee osteoarthritis at baseline; have a follow-up time of a minimum of 2 years, and include a measure of knee extensor muscle strength. Hierarchies for extracting data on knee osteoarthritis and knee extensor muscle strength were defined prior to data extraction. Meta-analysis was applied on the basis of the odds ratios (ORs) of developing symptomatic knee osteoarthritis or radiographic knee osteoarthritis in subjects with knee extensor muscle weakness. ORs for knee osteoarthritis and 95% confidence intervals (CI) were estimated and combined using a random effects model. Twelve studies were eligible for inclusion in the meta-analysis after the initial searches. Five cohort studies with a follow-up time between 2.5 and 14 years, and a total number of 5707 participants (3553 males and 2154 females), were finally included. The meta-analysis showed an overall increased risk of developing symptomatic knee osteoarthritis in participants with knee extensor muscle weakness . This systematic review and meta-analysis showed that knee extensor muscle weakness was associated with an increased risk of developing knee osteoarthritis in both men and women.

Efficacy of different electrical stimulation C.Zeng et al.(February 2015)[35] conducted a study to investigate the efficacy of different electrical stimulation (ES) therapies in pain relief of patients with knee osteoarthritis (OA).

Method
Electronic databases including MEDLINE, Embase and Cochrane Library were searched through for randomized controlled trials (RCTs) comparing any ES therapies with control interventions (sham or blank) or with each other. Bayesian network meta-analysis was used to combine both the direct and indirect evidence on treatment effectiveness.

Results
27 trials and six kinds of ES therapies, including high-frequency transcutaneous electrical nerve stimulation (h-TENS), low-frequency transcutaneous electrical nerve stimulation (l-TENS), neuromuscular electrical stimulation

(NMES), interferential current (IFC), pulsed electrical stimulation (PES), and noninvasive interactive neurostimulation (NIN), were included. IFC is the only significantly effective treatment in terms of both pain intensity and change pain score at last follow-up time point when compared with the control group. Meanwhile, IFC showed the greatest probability of being the best option among the six treatment methods in pain relief. These estimates barely changed in sensitivity analysis. However, the evidence of heterogeneity and the limitation in sample size of some studies could be a potential threat to the validity of results.

Conclusion

IFC seems to be the most promising pain relief treatment for the management of knee OA. However, evidence was limited due to the heterogeneity and small number of included trials. Although the recommendation level of the other ES therapies is either uncertain (h-TENS) or not appropriate (l-TENS, NMES, PES and NIN) for pain relief, it is likely that none of the interventions is dangerous.

Level of evidence

Level Ⅱ, systematic review and network meta-analysis of RCTs.

Knee pain on walking measured by an 11-point NRS

Average knee pain on walking over the past week will be self-reported using an 11-point numeric rating scale (NRS) (0 = no pain, 10 = worst pain possible). This measurement is reliable and valid in OA populations [Bellamy N: Osteoarthritis clinical trials: candidate variables and clinimetric properties. J Rheumatol 1997, 24(4):768–778.]. The minimum clinically important difference to be detected in OA trials has been defined as a change in pain of 1.8 units (out of 10) [Bellamy N, Carette S, Ford P, Kean W, le Riche N, Lussier A, Wells G, Campbell J: Osteoarthritis antirheumatic drug trials. III. Setting the delta for clinical trials- results of a consensus development (Delphi) exercise. J Rheumatol 1992, 19(3):451–457.].

Self-efficacy for pain and function measured by the arthritis self-efficacy scale

Self-efficacy for pain management and its effects on function measured with the Arthritis Self-Efficacy Scale [Lorig K, Chastain RL, Ung E, Shoor S, Holman HR: Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. Arthritis Rheum 1989, 32(1):37–44.], which assess confidence for managing pain (5 questions) and physical function (9 questions) on a 10-point NRS (where 1 = very uncertain and 10 = very certain). Responses are averaged so that higher scores indicate greater self efficacy. This scale is reliable and valid in OA populations [Lorig K, Chastain RL, Ung E, Shoor S, Holman HR: Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis. Arthritis Rheum 1989, 32(1):37–44].

Comparison of effect of electrical stimulation and excercise (Diz Osteoartriti et al)

Objective: Pain is the the main symptom of knee osteoarthritis. Pain causes immobilisation, limitation in the range of motion (ROM) and periarticular muscle spasm through reflex inhibition. Consequently, patients develop weakness and atrophy in the quadriceps muscle. In this study, the effect of isometric exercises and electrical stimulation was compared on patients with knee osteoarthritis.

Materials and Methods: Thirty-eight patients were separated into two groups randomly. In the first group; the combination of paracetamol + infrared + electrical stimulation (20 times, once a day) treatment was applied. In the second group; the combination of paracetamol + infrared + active resistive isometric exercises (20 times, once a day) treatment was applied. The evaluations performed include pre and post-treatment pain, active ROM, thigh circumference measurements, activity time and WOMAC and Lequesne indices. Cross-sections of rectus femoris muscle were measured quantitatively by computerized tomography before and after the treatment. Clinical and radiological findings were evaluated for both groups.

Results: Statistically a significant improvement was observed in all of the parameters for both of the groups ($p<0.05$). The improvement in ROM was found larger in the exercise group in comparative group analysis ($p<0.05$). The diameter of the rectus femoris muscle increased in both of the groups ($p<0.05$). The increase in the diameter of the rectus femoris was higher in the electrical stimulation group ($p<0.05$).

Conclusion: The treatment of electrical stimulation was found to be as efficient as the exercise treatment in cases such as knee osteoarthritis, quadriceps muscle weakness and atrophy prevention. Electrical stimulation treatment could be used alone or in combination with exercise treatment in clinical setting. And, isometric exercises could be undertaken as a home program. Turk J Phys Med Rehab 2008;54:54-8

3a. Discussion

In this review, I systematically reviewed the literature published in the period 2003 to 2015.

Level of evidence: Of the included studies, some studies were randomized controlled trials (RCTs) with Level III evidence. The other studies were non-controlled clinical case series with low levels of evidence .

Patient characteristics: All the participants in the studies were of middle to old age (30-75 years). The majority of study participants were males . Reports on subject characteristics were not mentioned in some included studies. In all the studies, only those with knee osteoarthritis were included.

Treatment characteristics: Only one study clearly explained the type of electrical stimulation used in knee osteoarthritis. Although other studies adopted a similar treatment approach, the biofeedback training for quadriceps were not clearly reported. However, all the participants were instructed to feel maximum tolerable intensity. Therapeutic effectiveness of electrical stimulation: Most studies appear to result in greater pain relief, improve WOMAC score, dynamometer strength following NMES technique .

7. Conclusion

There were many outcome measure for OA. Some used subjective outcome measurement like WOMAC, scale, questionnaire, some used objective measurement. The review evidence suggest that WOMAC,VAS useful for assessing quality of management .The tool (outcome measurement) should be used in clinical practice which have good psychometric property. A valid and reliable tool should be used for electrical stimulation.

8. Limitation of the Review

1) All outcome measurement were not included
2) Level of evidence were not obtained for article or not checked for all.
3) search period was limited
4) The limited number of trials included in this review makes it difficult to draw explicit conclusions.
5) Full text article was not able to find out for some included studies. Only abstract was able to collected for some included studies.

9. Areas of Further Research Work

Longer period of search can be done, level of evidence should be monitored, standard search procedure should advocate.

10. Acknowledgements

The authors would like to thank Dr.Kabul Chandra Saikia(Principal cum chief superintendent GMC&H), Dr.Tulsi Bhattacharyya for valuable advice.

11. Conflicts of Interest

There is no conflict of interest

12. Funding

Self funded

References

[1] Hall MC, Mockett SP, Doherty M. Relative impact of radiographic osteoarthritis and pain on quadriceps strength, proprioception, static postural sway and lower limb function. Ann Rheum Dis. 2006; 65:865-870.
[2] Felson DT, Niu J, McClennan C, Sack B, Aliabadi P, Hunter DJ, Guermazi A, Englund M. Knee buckling: prevalence, risk factors, and associated limitations in function. Ann Intern Med 2007; 147:534-540.
[3] Jefferson RJ, Collins JJ, Whittle MW, Radin EL, O'Connor JJ. The role of the quadriceps in controlling impulsive forces around heel strike. Proc Inst Mech Eng H. 1990; 204:21-28.
[4] Amin S, Baker K, Niu J, Clancy M, Goggins J, Guermazi A, Grigoryan M, Hunter DJ, Felson DT. Quadriceps strength and the risk of cartilage loss and symptom progression in knee osteoarthritis. Arthritis Rheum. 2009 January; 60(1):189-198.
[5] Segal NA, Glass NA. Is quadriceps muscle weakness a risk factor for incident or progressive knee osteoarthritis? Phys Sportsmed. 2011 Nov;39(4):44-50.
[6] Vaz MA, Baroni BM, Geremia JM, Lanferdini FJ, Mayer A, Arampatzis A, Herzog W. Neuromuscular electrical stimulation (NMES) reduces structural and functional losses of quadriceps muscle and improves health status in patients with knee osteoarthritis. J Orthop Res. 2013 Apr;31(4):511-6.
[7] Fransen M, Crosbie J, Edmonds J. Physical therapy is effective for patients with osteoarthritis of the knee: a randomized controlled trial. J Rheumatol. 2001;28:156–64.
[8] Deyle GD, Henderson NE, Matekel RL, Ryder MG, Garber MB, Allison SC. Effectiveness of manual physical therapy and exercise in osteoarthritis of the knee. A randomized controlled trial. Ann Internal Med. 2000;132:173–81.
[9] Quilty B, Tucker M, Campbell R, Dieppe P. Physiotherapy, including quadriceps exercises and patellar taping, for knee osteoarthritis with predominant patello-femoral joint involvement: Randomized controlled trial. J Rheumatol. 2003;30:1311–17.
[10] Vaz MA, Baroni BM, Geremia JM, Lanferdini FJ, Mayer A, Arampatzis A, Herzog W. Neuromuscular electrical stimulation (NMES) reduces structural and functional losses of quadriceps muscle and improves health status in patients with knee osteoarthritis. J Orthop Res. 2013 Apr;31(4):511-6.
[11] Petterson SC, Barrance P, Buchanan T, Binder-Macleod S, Snyder-Mackler L. Mechanisms underlying quadriceps weakness in knee osteoarthritis. Med Sci Sports Exerc. 2008 Mar;40(3):422-7.
[12] Vance CG, Rakel BA, Blodgett NP, DeSantana JM, Amendola A, Zimmerman MB, Walsh DM, Sluka KA. Effects of transcutaneous electrical nerve stimulation on pain, pain sensitivity, and function in people with knee osteoarthritis: a randomized controlled trial. Phys Ther. 2012 Jul;92(7):898-910.
[13] Palmieri-Smith RM, Thomas AC, Karvonen-Gutierrez C, Sowers M. A clinical trial of neuromuscular electrical stimulation in improving quadriceps muscle strength and activation among women with mild and moderate osteoarthritis. Phys Ther. 2010 Oct;90(10):1441-52.
[14] Salaffi F, Leardini G, Canesi B, Mannoni A, Fioravanti A, Caporali R, Lapadula G, Punzi L . Reliability and validity of the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index in Italian patients with osteoarthritis of the knee. Osteoarthritis Cartilage. 2003 Aug;11(8):551-60.
[15] 15.Palmer S, Domaille M, Cramp F, Walsh N, Pollock J, Kirwan J, Johnson MI. Transcutaneous electrical nerve stimulation as an adjunct to education and exercise for knee osteoarthritis: A randomized controlled trial. Arthritis care & research. 2014; 66(9): 387-94
[16] 16.Anand B Heggannavar, Snehal R Dharmayat, Sonal S Nerurkar, Sonali AKamble.Effect of russian current on quadriceps muscle strength in subjects with primary

osteoarthritis of knee: a randomized control trial.Int J Physiother Res. 2014; 2(3):555-60.

[17] 17.Yocheved Laufer, Haim Shtraker, Michal Elboim Gabyzon. The effects of exercise and neuromuscular electrical stimulation in subjects with knee osteoarthritis: a 3-month follow-up study. Clinical Interventions in Aging. 2014(17th july); 9: 1153–1161.

[18] 18.Ahmed H A,Johani, , Shaji John Kachanathu, Ashraf Ramadan Hafez, Abdulaziz Al-Ahaideb, Abdulrahman D Algarni, Abdulmohsen Meshari Alroumi, Aqeel M. Alenazi. Comparative Study of Hamstring and Quadriceps Strengthening Treatments in the Management of Knee Osteoarthritis. J. Phys. Ther. Sci. 2014June; 26(6): 817–820.

[19] 19.Shahnawaz Anwer, Ahmad Alghadir. Effect of Isometric Quadriceps Exercise on Muscle Strength, Pain, and Function in Patients with Knee Osteoarthritis: A Randomized Controlled Study. J. Phys. Ther. Sci.2014 May; 26(5): 745–748.

[20] 20.Melo MD, Pompeo KD, Brodt GA, Baroni BM, da Silva Junior DP, Vaz MA. Effects of neuromuscular electrical stimulation and low-level laser therapy on the muscle architecture and functional capacity in elderly patients with knee osteoarthritis: a randomized controlled trial. Clin Rehabil. 2014 Sep 26.

[21] 21.Cherian JJ, Kapadia BH, Bhave A, McElroy MJ, Cherian C, Harwin SF, Mont MA. Use of Transcutaneous Electrical Nerve Stimulation Device in Early Osteoarthritis of the Knee. Knee Surg. 2014 Aug 27.

[22] 22.Laufer Y, Shtraker H, Elboim Gabyzon M. The effects of exercise and neuromuscular electrical stimulation in subjects with knee osteoarthritis: a 3-month follow-up study. Clin Interv Aging. 2014 Jul 17;9:1153-61.

[23] 23.Van der Esch M, Holla JF, Van der Leeden M, Knol DL, Lems WF, Roorda LD, Dekker J. Decrease of muscle strength is associated with increase of activity limitations in early knee osteoarthritis: 3-year results from the cohort hip and cohort knee study. Arch Phys Med Rehabil. 2014 Oct;95(10):1962-8.

[24] 24.Kade L Paterson, Tim V Wrigley, Kim L Bennell and Rana S Hinman. A survey of footwear advice, beliefs and wear habits in people with knee osteoarthritis. Journal of Foot and Ankle Research . 23 October 2014; 7:43

[25] 25.Won Kuel Kim, MD, Don-Kyu Kim, MD, Kyung Mook Seo, MD, Si Hyun Kang, MD. Reliability and Validity of Isometric Knee Extensor Strength Test With Hand-Held Dynamometer Depending on Its Fixation: A Pilot Study. Ann Rehabil Med 2014;38(1):84-93.

[26] 26.Dirks ML, Hansen D, Van Assche A, Dendale P, Van Loon LJ. Neuromuscular electrical stimulation prevents muscle wasting in critically ill, comatose patients. Clin Sci (Lond). 2014 Oct 8.

[27] 27.Kodesh E, Laufer Y. The reliability of hand-held dynamometry for strength assessment during electrically induced muscle contractions. Physiother Theory Pract. 2014 Sep; 15:1-6.

[28] 28.Maly MR,Robbins SM.Osteoarthritis year in review 2014 : rehabilitation and outcomes.Osteoarthritis cartilage.2014 Dec;22(12):1958-1988.

[29] 29.Vas L, Pai R, Khandagale N, Pattnaik M. Pulsed radiofrequency of the composite nerve supply to knee joint as a new technique for relieving osteoarthritic pain: a preliminary report.Pain physician.2014 December;17(6):493-506.

[30] 30.Dwyer L, Parkin-Smith GF, Brantingham JW, Korporaal C, Cassa TK, Globe G, Bonnefin D, Tong V. Manual and manipulative therapy in addition to rehabilitation for osteoarthritis of the knee: assessor-blind randomized pilot trial. J Manipulative Physiol Ther. 2015 Jan;38(1):1-21.

[31] 31.Mat S, Tan MP, Kamaruzzaman SB, Ng CT. Physical therapies for improving balance and reducing falls risk in osteoarthritis of the knee: a systematic review. Age Ageing. 2015 Jan;44(1):16-24.

[32] 32.Serrao PR, Vasilceac FA, Gramani-Say K, Lessi GC, Oliveira AB, Reiff RB, Mattiello-Sverzut AC, Mattiello SM. Men with early degrees of knee osteoarthritis present functional and morphological impairments of the quadriceps femoris muscle. Am J Phys Med Rehabil. 2015 Jan;94(1):70-81.

[33] 33.Duivenvoorden T, van Raaij TM, Horemans HL, Brouwer RW, Bos PK, Bierma-Zeinstra SM, Verhaar JA, Reijman M. Do laterally wedged insoles or valgus braces unload the medial compartment of the knee in patients withosteoarthritis? Clin Orthop Relat Res. 2015 Jan;473(1):265-274.

[34] 34.Oiestad BE, Juhl CB, Eitzen , Thorlund JB . Knee extensor muscle weakness is a risk factor for development of knee osteoarthritis. A systematic review and meta-analysis. Osteoarthritis Cartilage. 2015 Feb;23(2):171-177.

[35] 35.C.Zeng, H.li, T.Yang, Z.h.Deng, Y. Yang, Y. Zhang, G.h. Lei. Electrical stimulation for pain relief in knee osteoarthritis: systematic review and network meta-analysis. Osteoarthritis and Cartilage .Volume 23, Issue 2, February 2015, Pages 189–202.

Author Profile

Jayanta Nath is currently working as a physiotherapist at Jugijan Model Hospital (Govt Of Assam). He did BPT from Srinivas college of physiotherapy and research Mangalore and MPT in the specialization of orthopaedics and sport physiotherapy from Rajiv Gandhi University Of Health Sciences Bangalore in 2012. Presently he is pursuing Ph.D in the same field. He has 3 International Publications. His interested areas of research are, Musculoskeletal and sport physiotherapy, manual therapy.