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Research Article

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Case Studies Showing Effectiveness of Dry Needlng in Radiographic Improvement of Joint Space Width in Osteoarthritic Knees

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Introduction

Osteoarthritis (OA) is a chronic degenerative disease with multifactorial etiology characterized by biochemical and morphological alterations of loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis, and reduced joint range of motion [1]. Conventional radiography has been, and continues to be, the primary imaging modality used in the evaluation of OA, both in terms of diagnosis and monitoring of disease progression. In the knee joint, osteoarthritic features visible on radiographs include joint space narrowing, osteophytosis, subchondral osteosclerosis, and subchondral cysts. The measurement of the separation between the distal femur and the proximal tibia, joint space width (JSW), has become the standard tool for the assessment of knee OA progression and is used as a major criterion in the diagnosis of OA from radiographs and monitoring progression of the disease [2,3].

Short- and Long-term goals in Knee OA Physiotherapy focus on reducing pain, minimizing inflammation and swelling, improving joint proprioception and enhancing functional activity/ quality of life [4]. Exercise therapy is recognized as a first-line treatment strategy in the guidelines for the diagnosis and treatment of knee OA worldwide [5]. Evidence-based guidelines for knee OA management recommend interventions including closed kinetic chain exercises (CKCEs), Dry Needling, open kinetic chain exercises (OKCEs), aerobic exercises, strength training, electrotherapeutic modalities and weight management [4].

Dry needling (DN) is an intervention that uses a fine filiform needle to stimulate myofascial trigger points for the treatment of musculoskeletal disorders. The primary goal of DN is to improve the function of the muscle. It has been observed that performing the DN technique combined with stretching exercises in subjects with knee OA leads to significant improvements in terms of pain, functionality, and range of motion [6].

Reepa A. Ughreja, et al conducted a systematic review study on knee osteoarthritis using dry needling as treatment in conjunction with other therapies and they found that both the short-term and long-term effects of periosteum needling revealed improvements in knee OA pain and function [7]. Similarly, Jimenez-del-Barrio et al. conducted another systematic review study on the short-, medium-, and long-term effects of dry needling with similar effects [8]. There is however no evidence on the use of Dry Needling to improve Joint Space Width around the Knee, as seen radiographically. The aim of this study was to determine the effectiveness of Dry Needling in affecting the changes in Joint Space width as seen on Radiographic images of the OA Knee.

Knee joint alterations that commonly take place in Osteoarthritic knees, include:

- Joint Space narrowing (at medial or lateral joint space of knee)
- Lateral shift of the Tibia
- Patellofemoral joint space narrowing

These Biomechanical alterations in OA Knee Joint mechanics are what we focused on in the below mentioned case studies, leading us to question whether these alterations were part of a bigger picture pre-existing alterations in strength, coordination and timings of muscular contraction of the muscles of the spine, hip, knee and foot.

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Figure 1: Joint Space Narrowing Commonly Seen in Knee Oa

Figure 2: Lateral Shift of the Tibia Commonly Seen in Knee Oa, Possibly Leading to Knee Valgus

Figure 3: Patellofemoral Joint Space Narrowing Commonly Seen in Knee OA

Methods and Materials

Eligibility Criteria

- **Inclusion Criteria**

Age: 50 years and above
Gender: Both Male and Female
Bilateral Tibiofemoral Knee Osteoarthritis
Knee Osteoarthritis that fell into the Ahlback Scale I of OA Radiological grading

- **Exclusion Criteria**

Any Post Surgical Knee cases (TKR, ACL or Meniscus repairs)
Cancer, Inflammatory Arthritis, and Infectious diseases
Neurological Conditions like Stroke, Parkinson's, etc.
Mental disorders

Outcome Measurements

- **Joint Space Width (JSW) on Radiographs:** JSW can be assessed by measurement of the interbone distance at its narrowest point (minimum JSW) as a mean width or as joint space surface area (JSA), using a graduated eyepiece and / or image analysis systems. The assessment of radiographic progression of knee OA has generally been based on measurement of JSW in the femorotibial compartment in standing anteroposterior (AP) radiographs of the extended knee. Measurement of femorotibial compartment JSW is influenced by a number of variables, including the degree of weight bearing, alignment of the medial tibial plateau with the central x-ray beam rotation of the knee, and the degree of knee flexion. However, for the sake of this paper, we have only reported the visual changes in the Knee Joint Space Width on Radiographs. Subsequent papers that will be published in series, will account for the changes in Knee Joint Space Width, before and after Dry Needling treatment [9].

In this study, Radiographs were taken in were taken in the AP view, in Unilateral standing (with hand held support). Specifications of the Radiograph machine were:
Meditronix Diagnox – 4032 RF with 300 mA, high frequency with exposure of 55 kV, 0.8 mAs for imaging.

- **Alback Scale:** The Ahlback Radiographic scale for grading Tibiofemoral joint Osteoarthritis is based on the presence of joint space narrowing. and has a moderately strong correlation with the actual degree of Osteoarthritis. Participants of this study all fell in Grade I of the Ahlback Grading scale.

Table 1: Ahlback Ordinal Grading Scale for evaluation of Knee Tibiofemoral OA

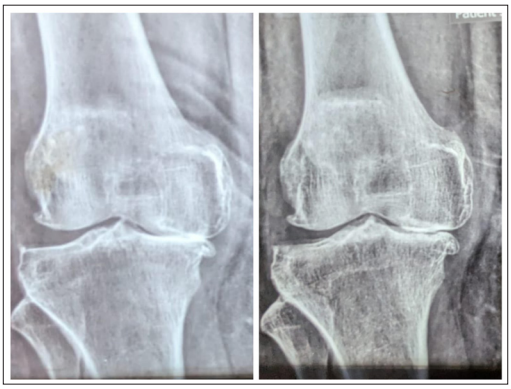
Grades	Description of those grades
0	No Radiographic features of OA are present
1	Joint space narrowing (less than 3 mm)
2	Joint space obliteration
3	Minor bone attrition (0-5 mm)
4	Moderate bone attrition (5-10 mm)

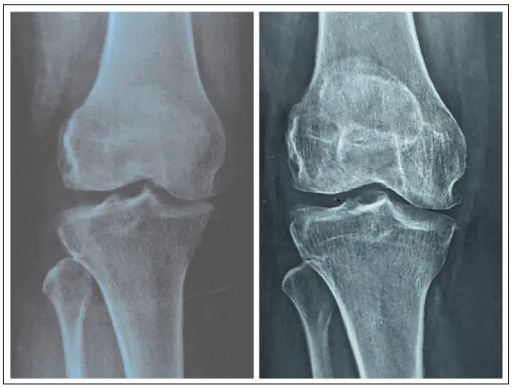
Method

- The process of Dry Needling was explained to patients and their verbal consent was obtained. The therapist doing the Dry Needling also explained what to expect during (twitches) and after (post Dry Needling soreness) the procedure of Dry Needling. The participants wore comfortable clothes all throughout the procedure, such that the body part to be needled had to be completely exposed.
- Dry Needling to the following muscles was done by the licensed therapist, in a hygienic setting, with the patients in supine/ prone/ or side lying positions. Disposable gloves were used to keep the Acupuncture needle (with guide tube) free from contamination. The site for Dry Needling was scrubbed with Isopropyl Alcohol before a stainless-steel needle of 0.30 mm thickness and 75 mm length was inserted into the following muscles to obtain twitches from Trigger point Dry Needling.
- The following muscles were needled three times a week for 30 minute sessions, for 6 weeks on both legs: Gluteus Maximus, Gluteus Medius, Gluteus Minimus, Tensor Fascia Latae, Piriformis, Gemelli Superior, Gemelli Inferior, Obturator Internus, Obturator Externus, Quadratus Femoris, Vastus Lateralis, Vastus Intermedius, Vastus Medialis, Rectus Femoris, Tibialis Anterior, Peroneus Longus, Peroneus Brevis, Medial Gastrocnemius, Lateral Gastrocnemius and Soleus.

Case Studies

- A 54-year-old male came with a complaint of Bilateral knee pain while climbing up and down the stairs, with difficulty in weight bearing on the same side; Bilateral knee pain on the patellar aspect with discomfort for 2-3 years [10]. There was pain in the posterior aspect of both knees with swelling in the infrapatellar aspect of the knees. He had difficulty walking normally after prolonged sitting. (Fig 4).
- A 73-year-old female complained of bilateral knee pain (Right > left) with difficulty walking, visible bowing of both legs on Radiograph and difficulty from sit to stand. (Fig 6).
- A 57-year-old female complained of knee pain (Right > Left) for 15 years and difficulty straightening both the knees. The pain aggravated when walking for 5 minutes, standing, and getting down the stairs. (Fig 5).
- A 53-year-old female reports bilateral knee pain (Right > left) for 4 to 5 years. The pain aggravated when climbing up and down the stairs and doing household chores, and relieved after taking medications. (Fig 7).





Figures 4-7: Before and After Radiographs of Knee Tibiofemoral Joint Space Width Changes and Patellofemoral Joint Space Width Changes, as Visually Observed on Ap View Unilateral Standing Radiographs

Results and Discussion

In our case studies, we started with the presumption that Knee joint space width narrowing was a result of Femur rotational and/ or medial/lateral shifts at the knee, in addition to Tibia rotational and/or medial/ lateral shifts at the knee joint [11]. This in turn led us to believe that muscle co-ordination patterns, muscle strength and muscle contraction were possibly responsible for the Biomechanical alteration of the knee joint, which ultimately resulted in poor loading patterns at the knee. These poor loading patterns at the knee, consequently caused breakdown of the cartilage, erosion of the bone and resulted in generation of Osteophytes as a part of the repair process by the body. Faulty Femoral rotations, due to poor muscle contraction/ timing/ coordination/ strength were suggested to have caused changes in the positioning of the Patella. Correction of Muscular Trigger points in the Hip, Thigh and Leg muscles of one of the case studies, led to improvement in the joint space of the patella in that patient.

Correcting biomechanical alterations at the Knee was therefore considered as the baseline to improve Joint Space width at the knee. Detailed discussions on these Biomechanical Alterations, how they were approached and the reasoning behind choosing the muscles to needle based on these altered Biomechanics-will be shared in future research papers.

Six weeks of Acupuncture to the Gluteal and Lower extremity muscles helped relieve pain, improved joint movement and improved Knee joint space width as seen visually on the Radiographs given below. Pain scores though not mentioned as part of this study due to the exclusive focus on Radiological Joint space width, improved remarkably; with all patients going from a VAS Pain Score of 10 to 0, during activities of daily living.

Joint Space width improved visibly in all the four case studies as is seen in the Radiographs given below. These visible changes in Knee Joint Space width correlated with improvements in pain levels, improvements in joint ranges of movement and with improvements in activities of daily living-though all of these parameters will be discussed in detail, in subsequent studies and research publications ahead.

Dry Needling is known to improve muscle strength, muscle coordination and muscle contraction (*Travell and Simmons, 3rd Edition, 2019*). Trigger point Dry Needling deactivates them, allowing the muscle to return to normal resting state where it can function more effectively. Dysfunctional muscle patterns are reset through Dry Needing which helps improve communication between muscles and nerves. This neuromuscular re-education helps muscles contract more efficiently. By balancing the activation between different muscles in the lower limb, Dry Needling can improve overall muscle coordination, which is particularly beneficial for improving biomechanical movement patterns of joints. Dry Needling is also known to increase local blood circulation, delivering essential oxygen and nutrients while flushing out metabolic waste products thus supporting musculoskeletal health.

We believe that it is the improvements in these muscle parameters (strength, coordination and contraction) that have consequently helped improve Knee Joint space width in the case studies discussed above. Continuing ongoing research at our facility is directed towards quantifying the changes in knee joint space width after Dry Needling procedure and is also directed towards assessing improvements in joint cartilage health post increases in knee joint space width, by using Magnetic resonance imaging techniques.

Note to Readers: This experimental study was done as a pilot, to check if it was clinically possible to change Knee Joint Space width with Dry Needling. In light of the results obtained, we now have an opportunity to measure Post Dry Needling Knee Joint Space width changes in Osteoarthritic knees, Check for MRI based Knee Cartilage changes after such Knee Joint Space Width improvements and possibly reverse changes occurring in Knee Osteoarthritis over continued treatment sessions of Dry Needling.

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