Effect of Medial Arch Support on Medial Joint Pain in Osteoarthritis Knee with Flat Foot-A Single Case Study

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Abstract

Background: - Knee osteoarthritis (osteoarthritis) is a prevalent musculoskeletal condition worldwide and is a leading cause of knee pain and disability among elderly people. Of the three knee joint compartments, knee osteoarthritis is most commonly observed in the medial tibio-femoral joint. This is most likely due to the greater loads applied to this compartment (relative to the lateral) during walking.

Objective: - To evaluate the effect of medial arch support on reduction of pain in medial osteoarthritis knee patient with flat foot.

Study Design: - Experimental design, Single case study.

Subject: -Patient was selected on the basis of inclusion and exclusion criteria. The study topic was explained to the patient and written concern was taken. The patient was provided with a medial arch support for a period of two months. The medial arch support was pasted in the patient's footwear and was asked to wear it for a period of minimum 6 hours per day, at least 6 days a week. The medial arch support is made of silicon material with an average thickness of mm.

Results: -The study shows that there is an improvement in pain, symptoms, activities of daily living and quality of life in patients after the 8 week session of medial arch support.

Conclusion: - This case study aimed to evaluate the effects of non-customized prefabricated medial arch supports on medial joint pain in osteoarthritis patient with flat foot. Although a cause-and-effect relationship cannot be inferred from a case study, the outcomes achieved suggests medial arch support may have a substandard impact on the overall disease process in osteoarthritis knee on a long seen patient no immediate changes in the outcomes were evident with their use.

***Keywords*: Flat foot, pain, symptoms, activities of daily living and quality of life.**

I. INTRODUCTION

Osteoarthritis (OA) also known as degenerative arthritis or degenerative joint disease or osteoarthrosis, is a group of mechanical abnormalities involving degradation of joints including articular cartilage and subchondral bone. Osteoarthritis is caused by mechanical stress on the joint, and (unlike rheumatoid arthritis), is not caused by inflammation, although inflammation can result from the physical damage. Symptoms may include joint pain, tenderness, stiffness, locking, and sometimes an effusion. The main cause is limb misalignment, combined with hereditary, developmental, and metabolic factors, which leads to loss of cartilage, sometimes exposing and damaging the underlying bone. Pain makes it difficult to exercise, so muscles may go for atrophy[6].

The worldwide prevalence estimate for symptomatic Osteoarthritis is 9.6% among men and 18% among women. In India, the prevalence of the disease in the adult rural population is estimated to be 5.8%. Osteoarthritis (OA) is the second most common rheumatological problem and is most frequent joint disease with prevalence of 22% to 39% in India. This is the most common cause of locomotor disability in the elderly[16].

Age, sex, obesity, genetic factor, bone density, cigarette smoking,. etc are the risk factors for OA. Nearly a quarter of men and women over 55 years of age report knee pain on most days. At least half of these older adults have radiographic knee osteoarthritis (OA), and many more exhibit signs of cartilage damage. Despite the high prevalence of knee Osteoarthritis, its etiology remains poorly understood..

Research has shown that an increased external knee adduction moment (knee adduction movement, an indirect biomechanical marker of compressive medial knee joint load) significantly increases the risk of medial tibiofemoral osteoarthritis and also structural deterioration over time[4,5]. Of the three knee joint compartments, knee osteoarthritis is most commonly observed in the medial tibiofemoraljoint[1]. This is most likely due to the greater loads applied to this compartment (relative to the lateral) during walking[2,3]. Furthermore, excessive medial knee load is also believed to contribute to the progression of structural disease in people once the disease is established[18].

Goals of managing osteoarthritis include controlling pain, maintaining and improving range of movement and stability of affected joints and limiting functional impairment. Management ranges from pharmacological to non-pharmacological treatments. Pharmacological drugs commonly used are Symptom modifying drugs like Acetaminophen, opiods and, Intraarticular injection[23]. Non Pharmacological treatment ranges from Aerobics , quadriceps strengthening, gait training, active range of motion of hip, knee and ankle, instructions in use of cane, graded elastic band use and pool therapy are modestly effective in reducing pain and disability. Mechanical aids in the form of shock-absorbing footwear with good mediolateral support, adequate arch support and calcaneal cushion are also helpful. Lateral heel wedges may reduce pain related to osteoarthritis of medial Tibiofemoral compartment and applying adhesive tapes to patella can provide relief in Patellofemoral osteoarthritis[2.]

When there is no cure for osteoarthritis, arthroplasty is the only treatment for end-stage disease, it is important to prevent or minimize the rate of structural deterioration in the knee joints of afflicted individuals as much as possible in order to reduce the personal and social burden of disease[6].

During walking, the foot and the knee are linked within a closed kinetic chain, thus foot position and motion may influence load at the knee joint. Accordingly, shoe insoles can potentially increase or decrease knee load depending on their specific design features[6]. It is thus recommended in clinical guidelines that every patient with knee Osteoarthritis receive advice concerning appropriate footwear[7]. Compared to other non-drug interventions for managing knee Osteoarthritis (such as exercise), there is little evidence from randomized controlled trials available to guide clinical practice regarding which shoes and shoe insoles are optimal for people with medial knee osteoarthritis(and conversely, which should be avoided)[17].

However biomechanical evaluations suggest that "minimalist" flexible lightweight footwear may be most suitable, and that high-heeled shoes are best avoided[9,11]. Regarding insoles, most research has focussed on laterally wedged insoles, and although these can reduce medial knee load[6], they have not been shown to have any significant effect on symptoms or joint structure.

Medial arch supports are foot orthoses that provide support to the medial longitudinal arch of the foot, with the aim of realigning skeletal structures and altering lower limb movement patterns during walking. They are readily available in prefabricated non-customized form. Retailers and manufacturers frequently promote medial arch supports as being beneficial for shock absorption and increased foot stability[15]. Importantly, given that patients with medial knee osteoarthritis have a greater prevalence of pronated feet compared to asymptomatic age-matched controls[16], and that recent cross-sectional data has linked the pronated foot type to increased frequency of knee pain and medial Tibiofemoral cartilage damage in older people[17], healthcare clinicians frequently prescribe these orthoses to patients with knee osteoarthritis[1].

Pazitlevinger et al (2010) reported that people with medial compartment knee osteoarthritis exhibit a more pronated foot type compared to controls as indicated by plantar arch index. It is therefore recommended that the assessment of patients with knee osteoarthritis in clinical practice should include simple foot measures. The development of secondary osteoarthritis, for example miner's knee are at risk for osteoarthritis .The relationship between obesity and osteoarthritis is complex and still not fully understood, there is a co relation between a high body mass index and knee osteoarthritis, which may be due to varus deformities in obese person[11] . The arch index is a reliable tool that quantifies foot characteristics based on a static footprint, and as such does not rely on the clinical experience of the examiner[19]. and therefore our study aimed at the potential influence of foot structure and function on the efficacy of foot orthoses in the management of medial compartment knee Osteoarthritis[24].

Reilly et al compared navicular height in sitting and standing in 60 people with hip Osteoarthritis, 60 people with knee Osteoarthritis and 60 controls, and found no differences between the knee Osteoarthritis and control groups. However, there was a significant difference in frontal plane calcaneal angle, indicating a more everted rearfoot in the knee Osteoarthritis group[5]. In a subsequent study, these authors also compared foot posture index (FPI) scores between 20 people with knee Osteoarthritis and 20 controls, and reported a significantly higher median score in those with knee Osteoarthritis (7.0 versus 1.0), indicative of a more pronated foot posture .

Despite the potential importance of understanding foot characteristics of people with medial compartment knee Osteoarthritis, few studies have examined foot posture in this population. So this study is designed to evaluate the effect of medial arch support on reduction of pain in medial osteoarthritis knee patient with flat foot[2]. Though evidence suggesting a biomechanical link between excessively planus foot morphology and potential for mechanical stress on Tibiofemoral and Patellofemoral compartments, we are not aware of any studies that have investigated the relationship of planus foot morphology to the occurrence of frequent knee pain or cartilage damage in older adults. The implications of a detected relation of foot morphology to knee pain and cartilage damage are great, since it would then be conceivable that altering foot posture via appropriate shoes, arch supports, or foot or thoses might serve to reduce the risk of symptomatic Osteoarthritis in targeted knee compartments[21].

II. NEED FOR THE STUDY

Given that the casual relationship between pronated foot posture and knee pain and cartilage damage in people with osteoarthritis is yet to be established, it cannot be assumed that treating pronated foot with medial arch supports will necessarily be beneficial for people with osteoarthritis .Presently there is very little research into the biomechanical effects of medial arch supports in people with osteoarthritis knee. So this study is done to evaluate the effect of medial arch support on reduction of pain in medial osteoarthritis knee patient with flat foot.

III. METHODOLOGY

Study design is experimental design and is a single case study. Study duration is for 8 weeks. Study setting is SRM medical college hospital and research centre, srm university, kattankulathur. Patient with a clinical diagnosis of bilateral medial compartment osteoarthritis of knee joint along with bilateral flat foot walking independently at a moderate pain (4 to 6) on Numeric Pain Rating Scale were included in the study. Patient with Rheumatoid arthritis. Knee joint ligament laxity, valgus /varus deformity or recurvatum of knee, Congenital and rigid flat foot and Medical red flags-traumatic injuries around knee joint, patellar dislocation, Haemarthrosis, meniscal tears were excluded for the study.

IV. CASE DESCRIPTION

Patient History:

A 50 year old female was referred to SRM Pediatric outpatient department of Physiotherapy with a diagnosis of Grade 2 (kellgren and Lawrence scale) Bilateral osteoarthritis of knee. The patient had a history of acquired flat foot and an initial diagnosis of Bilateral osteoarthritis knee approximately 6 years ago which has progressively worsened over the last few years.

The patient reported that being a house wife she is independent with all personal Activities of Daily Living (ADL) and recreational activities but having significant difficulty in performing the work secondary to increased knee pain .The patient had dull ache pain constantly in both the knees during non weight bearing activities that becomes sharp during weight bearing activities, specifically those requiring intermittent squatting .The rate of pain was 6/10 on average in a numerical pain rating scale. On palpation crepitus was felt bilaterally.

Examination:

A standardized history & physical examination was performed .The patient completed the knee injury and osteoarthritis outcome score [KOOS]. Postural assessment revealed bilateral flat foot which was confirmed in flat foot assessment by foot prints and plantar arch index were calculated. Range of motion of knee was measured in supine using a standard goniometer. Finding shows 0^0 to 125^0 of left knee flexion and 0^0-128^0 of right knee flexion. Knee extension was 125^0 to 0^0 for left and 128^0 to 0^0 for right knee. Active range of motion of bilateral hip and ankle were full and pain free.

Manual muscle testing of right hip, ankle & knee gave a result of good strength (5/5). Valgus and varus stress test perfomed at 0 to 30degrees, lachman's test, posterior drawer signs, quadriceps lag test and mcmurray's were negative. Palpation of bilateral knee was unremarkable except medial joint line tenderness (Grade II) were positive .The differential diagnosis examination suggest there is no other pain source other than osteoarthritis & bilateral flat foot contributing to the patient knee pain.

Intervention:

The patient was provided with a pair of prefabricated non-customized medial arch supports inserted and pasted to her daily wear slipper . The medial arch support thickness was found to be universal. The patient were asked to wear the slipper with medial arch support for a period of minimum 6 hours per day, at least 6 days a week.

Procedure

Patient was selected on the basis of inclusion and exclusion criteria. The study topic was explained to the patient and written concern was taken.

The height and weight were measured to calculate Body Mass Index [BMI]. Flatfoot assessment was done by taking the patient foot prints on a paper. The foot was considered as flat if the width of the instep at its widest part is less than 1 cm. Plantar arch index was also calculated fro the foot prints and those with arch index of ≥ 1.15 were considered to be flat feet.

Base line data for pain was graded from Numeric Pain Rating scale and KOOS [knee injury and osteoarthritis outcome score] questionnaire was filled by the patient.

The patient was provided with a medial arch support for a period of two months. The medial arch support was pasted in the patient's footwear and was asked to wear it for a period of minimum 6 hours per day, at least 6 days a week. The medial arch support is made of silicon material.

The patient was asked to note the duration for which the medial arch support was worn each day.

Frequency of follow up: initially pre test grading for NPRS and knee injury and osteoarthritis outcome score (KOOS) was taken. Immediately after one week and at the end of each month post test grading for Numeric Pain Rating scale and KOOS was taken for evaluation.

Outcome Measures:

The outcome measure utilized in this study includes the Numerical Pain Rating Scale (NPRS) and Knee Injury and Osteoarthritis Outcome Score (KOOS). The baseline datas are collected before wearing the slippers, then post datas are collected after 1week and then after 1month for 2 conservative months

Figure 2: Right foot without medial arch support

Figure 3: Left foot without medial arch support

Figure 5: Right foot with medial arch support

Figure 4: Left foot with medial arch support

TABLE 1

PRE TEST AND POST TEST VALUES OF PAIN SYMPTOMS, ACTIVITIES OF DAILY LIVING AND QUALITY OF LIFE WITH KNEE INJURY AND OSTEOARTHRITIS OUTCOME SCORE (KOOS).

NO	VARIABLES	PRE TEST	POST TEST 1	POST TEST 2	POST TEST 3
1	PAIN	47.22	47.22	55.56	61.11
2	SYMPTOMS	67.86	67.86	71.43	75
3	ADL	57.32	57.32	57.32	67.65
4	QOL	56.25	56.25	56.25	62.5

GRAPH 1

PRE TEST AND POST TEST VALUES OF KNEE INJURY AND OSTEOARTHRITIS OUTCOME SCORE (KOOS).

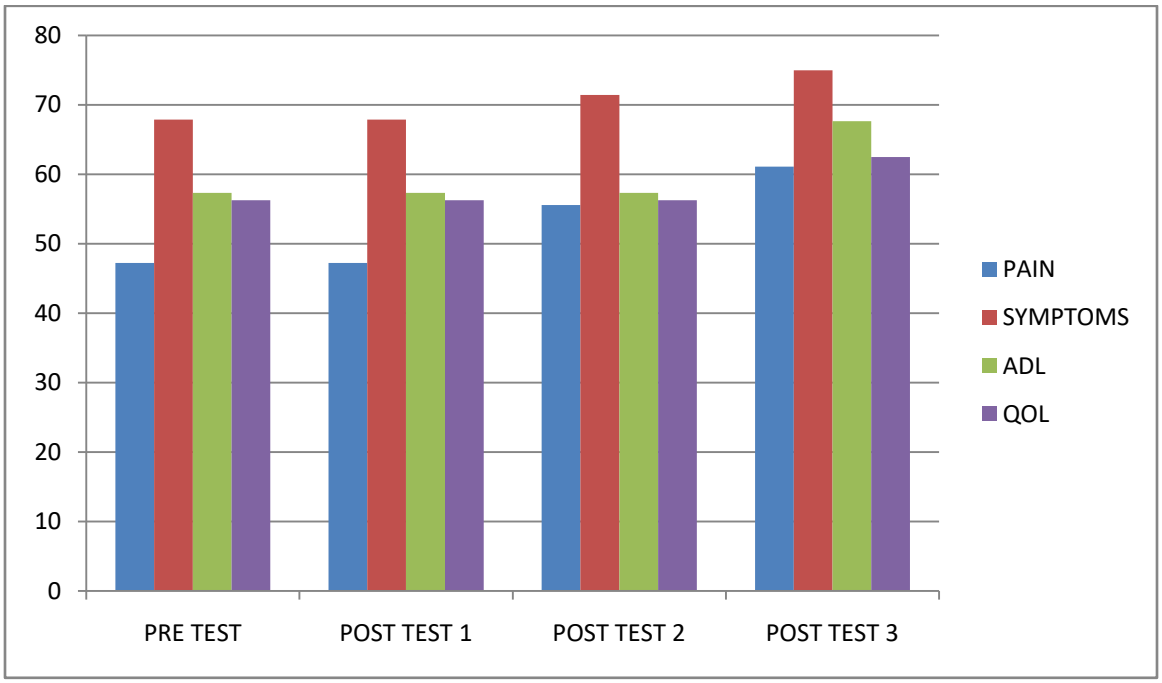


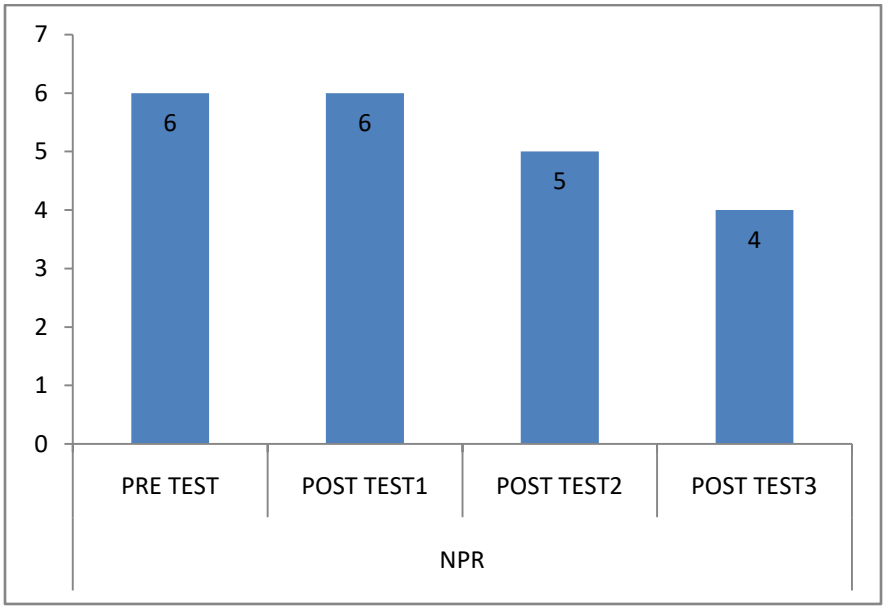
TABLE 2

PRE AND POST TEST VALUES OF NUMERICAL PAIN RATING SCALE.

NUMERICAL PAIN RATING SCALE	PRE TEST	POST TEST 1	POST TEST 2	POST TEST 3
	6	6	5	4

GRAPH 2

PRE TEST AND POST TESTS VALUES OF NUMERICAL PAIN RATING SCALE [NPRS]



V. RESULTS

Table 1 shows the pre and post test values of KOOS. Specifically, the pain sub scale, symptoms sub scale, activity of daily living sub scale and quality of life sub scale were used. There is no difference between the pre-test and first post test values of KOOS which is taken after one week of foot wear modification. But there is a difference between the pre-test and second and third post test values of KOOS which is taken after 1 month and 2 months period of foot wear modification. The post test values for the pain sub scale has increased from 47.22 to 61.11%. the post test values for the symptoms sub scale has increased from 67.86 to 75%. The post test values for ADL sub scale has increased from 57.32% to 67.65%. the post test values for QOL sub scale has increased from 56.25% to 62.5%.

Table 2 shows the pre and post test values of NPRS. There is no difference between the pre-test and first post test values of NPRS which is taken after one week of foot wear modification. But there is a difference between the pre-test and second and third post test values of NPRS which is taken after 1 month and 2 months period of foot wear modification. The post test value of NPRS has decreased from 6 to 4 after wearing the medial arch support for the period of 2 months.

Graph 1 show that there is no significant change in pre test and post test1 values of pain, symptoms, activities of daily living and quality of life. In post test2 values there is a significant change in pain and symptoms but there is no significance in activities of daily living and quality of life. But in post test3 there is a significant change in pain, symptoms, activities of daily living and quality of life.

Graph 2 shows that there is no significance in pain with numerical pain rating scale between pre test and post test 1(at the end of 1st week). But there is a significant decrease in pain with numerical pain rating scale.

VI. DISCUSSION

Physical therapists commonly treat patients who have a diagnosis of knee Osteoarthritis, facilitatory symptom resolution and improving functional activities, including range of motion, muscle strength, flexibility and aerobic endurance. Osteoarthritis rehabilitation is a multimodal approach, a variety of modalities and manual techniques are implemented data to evaluate the effectiveness of medial arch support in reducing the medial joint pain osteoarthritis patients with flat foot. Therefore, the goal of this case report was to assess the outcomes following load-altering intervention (foot orthosis) on pain and physical dysfunction in osteoarthritis patient with flat foot.

This study evaluated the effects of prefabricated medial arch supports on medial joint pain in osteoarthritis patient with flat foot. Supporting our hypothesis the findings from our study revealed a significant changes in both pain and functional scale when medial arch supports were inserted inside the daily foot wear. We also evaluated whether the addition of medial arch supports could immediately change the severity of knee pain experienced during weight activities

This two months case study demonstrated approximately a 40% decrease in knee pain and physical dysfunction following foot wear modifications. The post datas taken at the end of 1st and 2nd month revealed a 2-point decrease on Numerical Pain Rating Scale and 40% increase on Knee Injury and Osteoarthritis Outcome Score measures. These findings are also consistent with the studies of healthy young people reported in the literatures. Franz et al. used a more conventional prefabricated medial arch support that was inserted into standardized athletic shoes, similar to our study protocol. In their study of 22 healthy young people, no significant change in the first peak Knee adduction movement (KAM) during walking was observed. However, they noted a significant increase in the second peak KAM (late stance) during walking by 6%, as well as a significant 4% increase in the peak KAM during running, with medial arch supports. The literature findings of Najira Shakoor et. al (2010) also confined that foot wear may have significant effects on knee loads during walking in subjects with osteoarthritis of the knee.

Our study also observed no immediate decrease in pain or physical dysfunction after wearing the medial arch support. This is revealed when analyzing the pre-test and first post-test taken after 1 week of foot wear modification which is of same values. According to R.R. Hinman et. al no immediate changes in the parameters of the knee load and pain were evident with use of non-customized prefabricated medial arch supports in people with medial knee Osteoarthritis.

The possible explanations for the significant decrease in the pain and physical dysfunction is shifting of the knee joint loading from medial to lateral (neutral) thereby decreasing the (knee adduction force) medial knee loading.

We did not evaluate any changes in the gait parameters as well as on the joint reaction forces which pose a limitation to this study.

Future research should be directed towards evaluating long term follow up of the foot orthos is and its effects on disease progression in osteoarthritis should be considered.

VII. CONCLUSION

This case study aimed to evaluate the effects of non-customized prefabricated medial arch supports on medial joint pain in osteoarthritis patient with flat foot. Although a cause-and-effect relationship cannot be inferred from a case study, the outcomes achieved suggests medial arch support may have a substantial impact on the overall disease process in osteoarthritis knee on a long run and also it is proved that, no immediate changes in the outcomes were evident with their use.

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