Original Article

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Effectiveness of Lateral Wedge Foot Orthosis in the Treatment of Medial Compartmental Osteoarthritis of Knee Joint

Sanjai Kumar[1], Meenu Singh[2], Amit Goel[3]

Abstract

Objectives: To compare the clinical effects of lateral wedge foot orthosis with conventional physiotherapy treatment and only conventional physiotherapy treatment in patient with medial compartmental osteoarthritis knee. Group I conventional group, Group II experimental group. *Subjects:* Thirty (N=30) subjects, age 50-70 years were randomly divide into two groups, Group I conventional group (15 patient) and Group II experimental group (15 patient), who meet the inclusion and exclusion criteria were recruited in the study. *Design:* An experimental design study. All tests of all subjects were conducted in the physiotherapy O.P.D. of Vidya Institute of Creative Teaching, Meerut, at Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut and in the Physiotherapy OPD of Trident College of Education, Meerut. Patient who recruited in the study were assessed on day 1. Then patient were divided randomly into two groups. Group I conventional group (15 patient), Group II experimental group (15 patient). Group I was treated with SWD, US and Exercise. Group II was treated with same as group I and lateral wedge foot orthosis (Height 6.35 mm/ 10 degree, material rubber). Patients were reassessed again at the end of fourth week. Instruction were given to the patient regarding activities which they should not perform like squatting; cross sitting, prolonged standing etc. treatment was for six days a week for four weeks. *Data Analysis:* All analysis were obtained using SPSS windows. Demographic data of subjects including age was descriptively summarized. The dependent variables for statistical analysis were step length, stride length, base of support, cadence and pain while the independent Variable were Conventional Physiotherapy Treatment and Wedge foot orthosis with lateral raise. One way Multivariate analysis of Variance with repeated measures was performed, to analyze the differences in the gait performances among both the groups. The independent t-tests were performed using the difference scores of variables i.e. pre & post intervention. Significance level of 0.05 was used to determine statistical significance. *Results*: The results of my study showed that there is definitely some advantage of using a lateral wedge foot orthosis in addition to conventional mode of treatment in osteoarthritis of knee. Statistically the results are not significantly strong for all parameters i.e. step length, stride length, base of support, cadence and pain, but all measures hint towards a better recovery in the performance of the experimental group (Group II) subjects. *Conclusion*: The results of the study show that biomechanical correction by the use of lateral wedge foot orthosis has an immediate effect which is evident in some of the gait parameters. The changes would be more appreciable if observed for a longer time. The difference in both groups definitely hints towards a better recovery in patients with medial compartmental osteoarthritis of knee when a lateral wedge is used in addition to the conventional physiotherapy treatment. The results of my study supports the hypothesis, within the limitation of this study. The result of this study provides a base for further research as they presents valuable outcomes for practitioners treating the patients with medial compartmental osteoarthritis of knee.

Keywords: CAD (Cadence); BOS (Base of Support); ST (Stride Length); ST (Step Length); GRF (Ground Reaction Force) and VAS (Visual Analogue Scale).

Introduction

Osteoarthritis is a degenerative condition of joint. It is characterized by progressive construction of new bone i.e. osteophyets. It is also known as degenerative arthritis or Osteoarthritis or Hypertonic Arthritis. It is a wear and tear of joint as one age [3].

About 80% of people above the age of 60 will have symptomatic evidence of Osteoarthritis. Male & Female both are affected. However, it is more common in older women i.e. it is seen more commonly in women over the age of 50, particularly in postmenopausal age [9].

It has been said:

"Osteoarthritis is a degenerative wear & tear process in joint that are impaired by congenital defect, vascular insufficiency or previous disease or injury." [14]

Studies suggest that older people are not able to

Author Affiliation: [1]HOD & Professor, Dept. of Physiotherapy, Vidya Institute of Creative Teaching, Meerut, Uttar Pradesh 250002, India. [2]Senior Consultant, Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town, Meerut, Uttar Pradesh 250110, India. [3]Assistant Professor, Dept. of Physiotherapy, Trident College of Education & Research, Meerut, Uttar Pradesh 250103. India.

Corresponding Author: Sanjai Kumar, HOD & Professor, Dept. of Physiotherapy, Vidya Institute of Creative Teaching, Meerut, Uttar Pradesh 250002, India.

E-mail: kumarsanjai880@gmail.com

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continue with exercise for a long time. Therefore emphasis should be given to modify the life style of such people, in order to minimize pain and functional limitation.

- ✓ Advantage of using lateral wedge orthosis -
- ✓ Cost effective
- ✓ Easy to use
- ✓ If patient is habituated then he can continue through his life
- ✓ It can be used as a preventive measures
- ✓ Abnormal gait pattern can be modified by shoe modification and gait training.

In Osteoarthritis, patients generally present with pain on the medial aspect of knee & on radiographic study of many patients, there is decreased medial joint space. Due to this there is altered biomechanics & thus the gait pattern is severely affected. These patients have a shorter step length & stride length broader walking base and a decrease cadence.

This study is on attempt to study the effect of lateral wedge foot orthosis on these parameters of gait which are proposed to be affected by minor biomechanical changes brought by an insole.

At initial contact- due to tight hamstrings and pain in the knee joint, there is excessive knee flexion, knee or 'buckles' instead of extending as the foot contacts the ground [7].

During foot flat and mid stance- weak quadriceps forces the knee to go into hyperextension. Tibia remains at the back of ankle mortise and foot is plantar flexed and supinated [7].

While acceleration and mid swing – because of pain and decreased range of motion of knee, there is limited knee flexion. Due to such change in the gait there is decreased step length, stride length and cadence. Furthermore, the patient also walks with a wide base of support.

When a person stands still on one leg, the ground reaction force (GRF) is equal to the body weight. And when a person is standing on a lateral wedge foot orthosis, the force and length of the hip abductors, obliquity of the pelvis, and curvatures of the spine, all change even though the person is instructed not to change the posture of trunk.

In all cases, with change of the mechanical axis of the lower limb to an upright direction the use of wedge sorolene board caused a decrease in the tensile forces in the lateral collateral ligament and the iliotibial tract and the compression force that affect the medial joint space. The resultant force and tensile force decrease even if the change of the femoro-tibial angle is relatively small [16].

Relevant studies in the past indicated that change in mechanics of the lower extremity with the lateral wedge decreases the pain in osteoarthritis affecting primarily the medial joint space of the knee.

This decreased intensity of pain and change of lower limbs mechanics show some improvement in the gait parameters and this is the fundamental of the this study [17]. The purpose of this study is to find out the if the application of lateral wedge foot othosis as an adjunct to conventional physiotherapy treatment would improve the out come of physiotherapy treatment among osteoarthrities patients, hence it is compared with the outcomes of the conventional physiotherapy treatment.

Aims and Objectives

To evaluate the effectiveness of lateral wedge foot orthosis on pain and gait parameter in medial compartmental osteoarthritis of knee by conventional physiotherapy treatment and by the conventional physiotherapy treatment including lateral wedge foot orthosis.

1. Calculate decrease in pain and improvement in gait parameter by conventional Physiotherapy treatment.
2. Calculate decrease in pain and improvement in get parameter by including lateral wedge foot orthosis.
3. Compare the 1 & 2.

Operational Defination

"Osteoarthritis is a degenerative wear & tear process in joint that are impaired by congenital defect, vascular insufficiency or previous disease or injury" [14].

Hypothesis

Experimental Hypothesis:

HI_1: Conventional Physiotherapy treatment with Lateral wedge foot orthosis is more effective than only conventional treatment in decreasing pain in osteoarthritis of the medial compartment of knee joint.

HI_2: Conventional Physiotherapy treatment with Lateral wedge foot orthosis is more effective than only conventional treatment in improving

Gait parameter in osteoarthritis of the medial compartment of knee joint.

Null hypothesis:

$H0_1$: Conventional Physiotherapy treatment with Lateral wedge foot orthosis is not more effective than only conventional treatment in decreasing pain due in osteoarthritis of the medial compartment of knee joint.

$H0_2$: Conventional Physiotherapy treatment with Lateral wedge foot orthosis is not effective than only conventional treatment in improving Gait parameter in osteoarthritis of the medial compartment of knee joint.

Variables

Dependent Variables

1. Step length
2. Stride length
3. Base of Support
4. Cadence
5. Pain (using V.A.S.)

Independent Variables

1. Conventional Physiotherapy Treatment
2. Wedge foot orthosis with lateral raise

Limitation of Study

The small sample size was one of the major limitations of the study. This study has several limitations. Though patients were advised to use the prescribed footwear with the orthosis regularly, 100% compliance cannot be guaranteed. However, during the time of conventional treatment it was taken care that all patients were using it regularly. A dynamic evaluation of the foot and knee biomechanics in a study like this would have helped to a greater extent, especially instrumentation which could give information on distribution of weight bearing on the foot. Owing to the difficulties involved a longer follow up for a study purpose could not be done. However many patients were called for follow up letter. Also, most the participants belonged to the same community. Thus, results obtained cannot be generalized for all population.

Inclusion Criteria

1. Clinical Feature of osteoarthritis in medial compartment of knee joint.
2. Age group 50 to 70.
3. History of pain from past 1 year.
4. Can be involvement of both knee's (bilateral)
5. Medial compartment has tender point.

Exclusion Criteria

1. Severely affected (grade V), assessed clinically on the bases of X-Ray.
2. Any deformity of knee apart from mild Genu Varum.
3. Regular dose of N.S.A.I. Ds, Calcium supplement, SoS can be taken,
4. Any deformity of foot & Hip.
5. Secondary osteoarthritis
6. Established vascular condition around the knee.
7. Patient having pain primarily due to patellofemoral Osteoarthritis (as confirmed by clinical tests and in some case by radiographical evidence)
8. History of trauma around the knee or any other joint in the lower extremity.

Design: An experimental design study having same subjects. The outcome Pre-test and post-test match subject design.

Instruments and Special Testing Tools: The method required very little equipments which includes-

- A measuring tape
- Chalk powder
- Lateral Wedge Foot Orthosis
- Stop watch
- Short Wave Diathermy
- Ultrasound
- Visual Analogue Scale
- Gait Parameters - Step length, Stride length, Base of support and Cadence

Procedure and Protocol

Thirty (N=30) subjects, age 50-70 years were randomly divide into two groups, Group I conventional group (15 patient) and Group II experimental group (15 patient), who meet the inclusion and exclusion criteria were recruited in the study.

All tests of all subjects were conducted in the physiotherapy O.P.D. of Vidya Institute of Creative Teaching, At Jai Physiotherapy and Dental Clinic, SF-06, Ansal Galleria, Ansal Town,

Meerut and in the Physiotherapy OPD of Trident College of Education, Meerut. Prior to testing, all the subjects were interviewed about their medical history and had explained the research procedure to them. This information was used to characterize the demographics and health status of subjects participating in the study. Pain and functional activity evaluation was done by VAS and gait parameters.

The participants were asked to perform, in randomized order the following activities. VAS was used in order to assess pain. Most widely and commonly used method was given by Bond & Pilowsky (1996), the patient is presented with a strip of paper with a line of 10 cm long is used where zero is considered as no pain and 10 as worst pain felt ever, patient has to mark the line at the point corresponding to the felt intensity of pain and pre and post treatment score was calculated.

Gait Parameters - A path of 10 meters was made with chalk powder on cemented floor, 2 lines were drawn at 2 meter from far end of the 10 m runway. Patients were asked to walk over this runway without shoes minimum of 8 foot prints were taken for measuring the parameters. Footprints for measurement were selected from the middle 6 m runway so that we could get the foot prints of near normal gait pattern avoiding the effects of acceleration and deceleration. The following procedure was used to measure the above parameters. (Fig. 1)

Step length was calculated by measuring the distance between the heel strike of one foot and the heel strike of the other foot.

Stride length was measured as the distance between the heel strike of one foot and the heel strike of the same foot.

Base of support was measured by calculating the distance between the mid-point of heel of one foot to the mid-point of heel of the other foot.

Patient were asked to walk within the distance of 10 m for 1 min. A helper was made to stand on one side of the runway with a stop watch. The number of step taken by the subject were being counted by the examiner in this 1 minute. (Cadence = Number of step / Time).

Patient who recruited in the study were assessed by using the patient assessment chart on day 1. Then patient were divided randomly into two groups. Group I conventional group (15 patient), Group II experimental group (15 patient). Instruction were given to the patient regarding activities which they should not perform like squatting; cross sitting, prolonged standing etc. treatment was for six days a week for four weeks and then assessed again.

Both group received conventional physiotherapy treatment as follows:

Short wave diathermy (SWD) - Cross fire method, for 15 minutes.

Ultra sound (US) - Mode-Continuous, frequency- 1.5 W/cm^2, time- 8 min.

Exercises:

Isometric exercise to Quadriceps and Hamstring muscle. Isotonic exercise to Quadriceps and Hamstring muscle using the Delorm and Watkins method of progressive resisted exercise.

In addition to the above physiotherapy treatment group-II (Experimental group) Patients were prescribed Lateral wedge foot orthosis (Height 6.35 mm/ 10 degree, material rubber) and advise to wear it during all weight bearing activities.

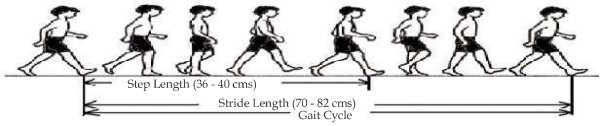


Fig. 1: Outcome measures parameters

Fig. 2: Shoe with Lateral Wedge Foot Orthosis

Data Analysis

To determine the effects of the lateral wedge foot orthosis as an adjunct to conventional physiotherapy treatment in the management of medial compartmental osteoarthritis of the knee. The following dependent variables were analyzed:

- Step Length, Stride Length, Base of Support and Cadence
- Pain Perception

Step length, stride length base of support, cadence

and pain perception for the two groups [Group I (Control Group) n=15], [Group II (Experimental group) n=15] were analyzed using independent t-tests [paired & unpaired]. The independent t-tests were performed using the difference scores of these variables i.e. pre & post intervention. Significance level was set at 0.05.

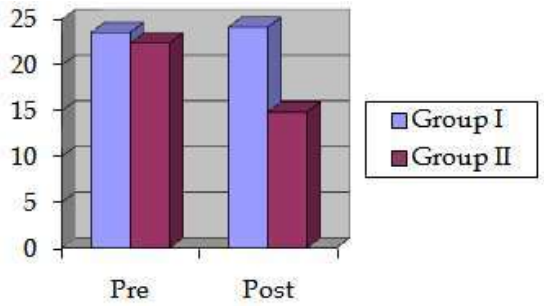
Unrelated T-Test

Table 1: Statistical comparison of Step Length (Pre) of Control and Experimental group

	N	$\overline{X}$	SD	T	P	Inference
Group I	15	23.57	2.82	0.22	< .05	Insignificant
Group II	15	22.4	5.41			

Table 2: Statistical comparison of Step Length (Post) of Control and Experimental group

	N	$\overline{X}$	SD	T	P	Inference
Group I	15	24.15	5.41	7.15	< .05	Significant
Group II	15	14.86	1.45			



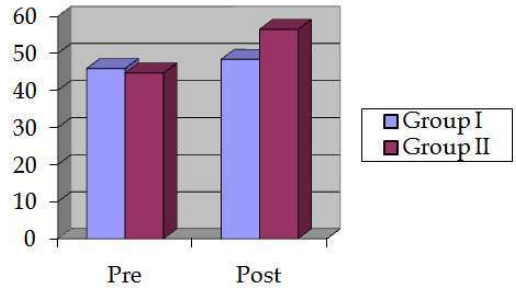
Graph 1: Comparison of Step Length (Pre Pre and Post Post) of Control and Experimental group

Table 3: Statistical comparison of Stride Length (Pre) of Control and Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Group I	15	45.9	5.64	0.22	< .05	Insignificant
Group II	15	44.7	10.82			

Table 4: Statistical comparison of Stride Length (Post) Control and Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Group I	15	48.38	5.65	1.70	< .05	Significant
Group II	15	56.46	9.57			



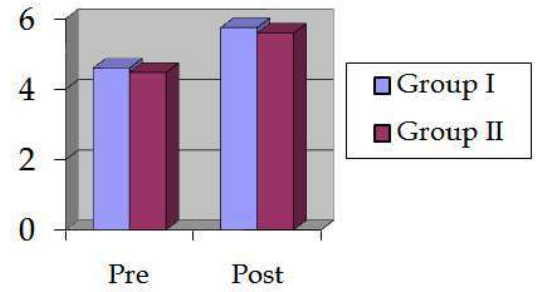
Graph 2: Comparison of Stride Length (Pre Pre and Post Post) of Control and Experimental group

Table 5: Statistical comparison of Base of Support (Pre) of Control and Experimental group

	N	$\overline{x}$	SD	t	P	Inference
Group I	15	4.59	0.54	0.22	< .05	Insignificant
Group II	15	4.47	1.09			

Table 6: Statistical comparison of Base of Support (Post) of Control and Experimental group

	N	$\overline{X}$	SD	T	P	Inference
Group I	15	5.74	0.67	0.24	< .05	Insignificant
Group II	15	5.59	1.35			



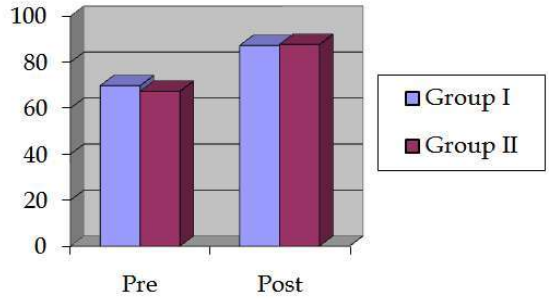
Graph 3: Comparison of Base of Support (Pre Pre and Post Post) of Control and Experimental group

Table 7: Statistical comparison of Cadence (Pre) Control and Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Group I	15	69.8	9.77	0.40	< .05	Insignificant
Group II	15	67.4	7.25			

Table 8: Statistical comparison of Cadence (Post) Control and Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Group I	15	87.3	10.4	0.5	< .05	Insignificant
Group II	15	84.75	9.31			



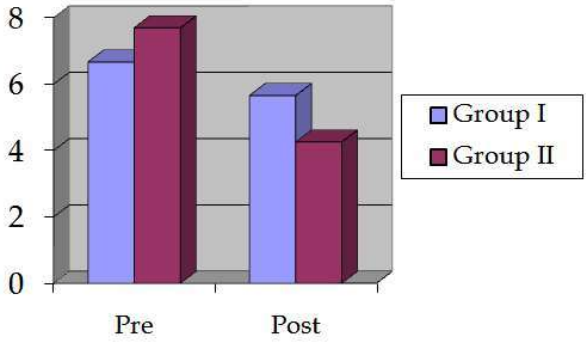
Graph 4: Comparison of Cadence (Pre Pre and Post Post) of Control and Experimental group

Table 9: Statistical comparison of Pain (Pre) of Control and Experimental group

	N	$\overline{X}$	SD	t	p	Inference
Group I	15	6.67	1.29	0.62	< .05	Insignificant
Group II	15	7.70	0.79			

Table 10: Statistical comparison of Pain (Post) of Control and Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Group I	15	5.66	1.34	1.89	< .05	Significant
Group II	15	4.26	1.09			



Graph 5: Comparison of Pain (Pre Pre and Post Post) of Control and Experimental group

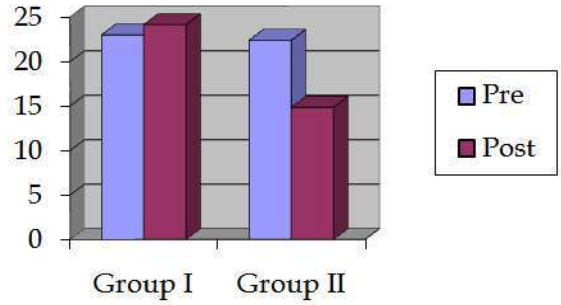
Related T-Test - Pre and Post Gait Parameters in Group I

Table 11: Statistical comparison of Step Length (Pre & Post) of Control group.

	N	$\overline{X}$	SD	T	p	Inference
Pre	15	23.0	2.82	11.56	< .05	Significant
Post	15	24.15	2.66			

Table 12: Statistical comparison of Step Length (Pre & Post) of Experimental group.

	N	$\overline{X}$	SD	t	P	Inference
Pre	15	22.4	5.41	5.24	< .05	Significant
Post	15	14.86	1.45			



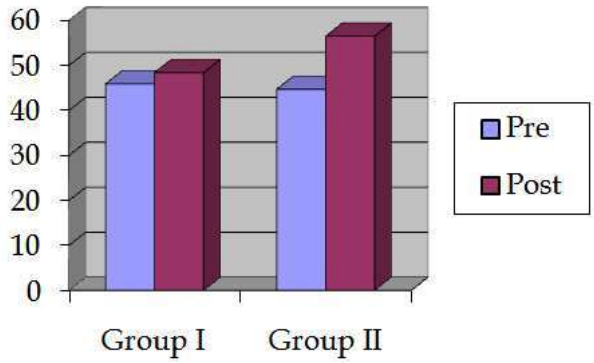
Graph 6: Comparison of Step Length (Pre and Post) of Control and Experimental group

Table 13: Statistical comparison of Stride Length (Pre & Post) of Control group

	N	$\overline{X}$	SD	t	p	Inference
Pre	15	45.9	5.84	13.13	< .05	Significant
Post	15	48.38	5.65			

Table 14: Statistical comparison of Stride Length (Pre & Post) of Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Pre	15	44.7	10.82	7.3	< .05	Significant
Post	15	56.48	9.57			



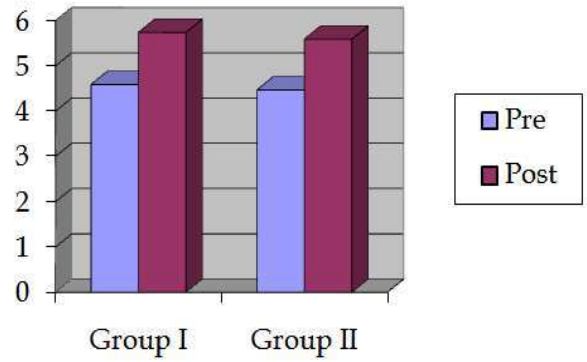
Graph 7: Comparison of Stride Length (Pre and Post) of Control and Experimental group

Table 15: Statistical comparison of Base of Support (Pre & Post) of Control group

	N	$\overline{X}$	SD	t	P	Inference
Pre	15	4.59	0.54	32.75	< .05	Significant
Post	15	5.74	0.67			

Table 16: Statistical comparison of Base of Support (Pre & Post) of Experimental group

	N	$\overline{X}$	SD	t	p	Inference
Pre	15	4.47	1.09	16.48	< .05	Significant
Post	15	5.59	1.35			



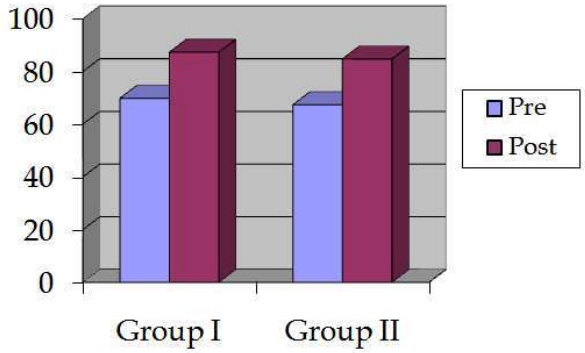
Graph 8: Comparison of Base of Support (Pre and Post) of Control and Experimental group

Table 17: Statistical comparison of Cadence (Pre & Post) of Control group

	N	$\overline{X}$	SD	t	p	Inference
Pre	15	69.8	9.77	14.34	< .05	Significant
Post	15	87.3	10.4			

Table 18: Statistical comparison of Cadence (Pre & Post) of Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Pre	15	67.4	7.25	15.90	< .05	Significant
Post	15	84.75	9.31			



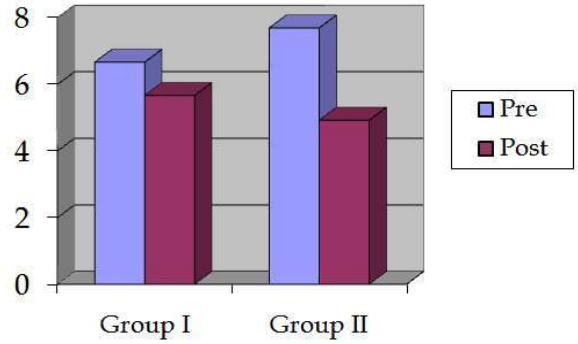
Graph 9: Comparison of Cadence (Pre and Post) of Control and Experimental group

Table 19: Statistical comparison of Pain (Pre & Post) of Control group

	N	$\overline{X}$	SD	t	p	Inference
Pre	15	6.67	1.29	10.24	< .05	Significant
Post	15	5.67	1.34			

Table 20: Statistical comparison of Pain (Pre & Post) of Experimental group

	N	$\overline{X}$	SD	t	P	Inference
Pre	15	7.70	0.79	8.98	< .05	Significant
Post	15	4.93	1.09			



Graph 10: Comparison of Pain (Pre and Post) of Control and Experimental group

Results

The details of 30 subjects are listed as (14 male, 16 females) aged 51-70 (Mean ± SEM: 60 ± 0.95 yrs). The subjects were randomly assigned in two groups. Group I (Control Group) received conventional Physiotherapy treatment in the form of short wave diathermy, ultrasound, isometric & isotonic exercise for Quadriceps & Hamstring. Group II (experimental Group) received Lateral Wedge Foot Orthosis in addition to the conventional Physiotherapy treatment given in Group I. The results of the study are as follows-

Step Length - Graph 1. Illustrates the increase of step length in two groups after the intervention. The increase in group II was found to be statistically significant.

Stride Length - At the start of treatment the groups (Group I and Group II) were comparable in term of stride length. There was a significant change of stride length in group II (Mean±SEM 11.60±3.01) in comparison to the change in Group I (Mean ± SEM: 2.55±0.40) as shows in figure 2. p< 0.05.

Base of Support - As evident there was a better change in group II (Mean±SEM: 0.89±0.20) as compared to group I (Mean±SEM: 1.03±0.16). The change was not found to be statistically significant. P> 0.05.

Cadence - Cadence increased in both groups after the intervention. Group II showed relatively better in cadence (Mean±SEM: 5.33±0.84) in comparison to Group I. (Mean±SEM: 4.40±0.73). The change was statistically insignificant. p> 0.05.

Discussion

This result shows that when osteoarthritis of medial compartment of knee joint was treated

with lateral wedge foot orthosis in addition to conventional physiotherapy treatment it achieved significantly better improvement in reduction of pain & increase in Step length and Stride length than when conventional treatment alone is administered. However, there was no significant improvement in cadence as well as base of support for both groups. The non significant change in base of support can be attributed to the fact that base of support depends on many factors like age, weight and height apart from biomechanical alteration in the lower extremity. However, here also the results showed some encouraging signs and quite likely could have been statistically significant if the study period were relatively longer.

The cadence improved in both groups over time. Statistically the results might not be significant, here again the change in Group II after intervention was appreciable in comparison to Group I. It can be attributed to a variety of reasons especially adaptability which would probably take longer than our study period. It is quite likely that as time passes by cadence in these patients improves due to better adaptability.

These finding suggests to us lateral wedge foot orthosis is an effective additional treatment in reduction of pain & improvement of step length and stride length.

The reason for reduction of pain are unclear although several investigators have advanced reason for reduction of pain including biomechanical correction of the joint resulting in physiological modulation of pain. The possible biomechanical causes which might be attributed to the reduction of pain by using lateral wedge foot orthosis is that it results in normal joint alignment. It also helps in synovial fluid motion which is vehicle for bringing nutrients to the avascular portion of articular cartilage. The lateral wedge foot orthosis technique help to maintain nutrient exchange and thus prevent the painful and degenerative effects of stasis when a joint is swollen or painful.

The improvement of step length and stride length in both the groups indicat that the degenerative disease was resolving and which may have been attributed to the treatment effect from the lateral wedge foot orthosis in experimental group (Group II). Experimental group (Group II) has better step length and stride length as compared to conventional group (Group I). This can be said that the alteration of footwear can result in normal knee joint space alignment between femur and tibia.

Subjective feedback from patients using wedge insole was quite satisfying. Most of the patients felt a decrease in knee pain after a month and noted improvement in walking. Also some patients reported a sense of increased muscle power in the lower limb. These study some patient complained a feeling of fatigue after the use of orthosis initially, but it subsided as they used it for a longer duration. A very minor percentage of patients complained of not being able to adapt to the tilt in the orthosis and found it slightly uncomfortable.

The study could have been much stronger if the dynamic evaluation of the knee and foot after the application of the foot orthosis were also considered. It would be really encouraging to see the biomechanical changes occurring with lateral wedge foot orthosis since such sophisticated instrument like gait analyzers and electrogoniometers were inaccessible, it restricted a lot of valuable information.

Thus the study suggest that foot orthosis in the form of lateral wedge is beneficial along with conventional physiotherapy if the cases are judiciously chosen and a lot of other factors are considered before prescription.

Conclusion

The results of the study shows that the improvement occurred in both the groups over time. The gait parameters of step length, stride length and pain improved significantly more in Group II (Experimental Group) in comparison to Group I (Control Group) Though statistically not significant, all other dependent variables suggest a better recovery in Group II Such results are likely due to the fact that the immediate biomechanical correction due to lateral wedge would have had a greater impact on distance parameters.

Thus it can be concluded by stating that biomechanical correction by the use of lateral wedge foot orthosis though has a beneficial effect which is evident in some of the gait parameters, the changes would be more appreciable if observed for a longer time. The changes in both Groups definitely hint towards a better recovery in patients with medial compartmental osteo-arthritis of the knees when a lateral wedge is used in addition to the conventional physiotherapy treatment.

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