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Effect of Lateral Wedge in Reduction of Knee Pain and Improvement of Gait Parameter in Subject with Knee Osteoarthritis: in Context with Indian Population

Rajeev Kumar[1], Anjani K. Sinha[2], Ranjeet Kumar[3], Akshay Kumar[4], Ranjay Kumar Choudhary[5], Rashmi A Saibannavar[6]

[1]Department of Physical Therapy, College of Applied Medical Sciences, Majmaah University, Al-Majmaah, 11952, Saudi Arabia
[2]Junior Manager, Artificial Limbs Manufacturing Corporation of India, Kanpur, India
[3]Prosthetist and Orthotist, Composite Regional Centre, Davangere, Karnataka
[4]Department of Prosthetics & Orthotics, Composite Regional Centre for Skill Development Rehabilitation and Empowerment of Persons with Disabilities, Kozhikode, India
[5]Department of Medical Laboratories, College of Applied Medical Sciences, Majmaah University, Al-Majmaah, 11952, Saudi Arabia
[6]Department of Physical Therapy, College of Applied Medical Sciences, Majmaah University, Al-Majmaah, 11952, Saudi Arabia

Corresponding Author: Rajeev Kumar

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ABSTRACT

Knee osteoarthritis is a chronic joint disorder predominantly affecting older individuals. Factors like Varus malalignment that alter load distribution may cause the ground reaction force vector to press more medially to the knee joint center, resulting a higher knee adduction moment that aggravates pain and diminishes mobility.

Intervention such as lateral wedge sole aim to reduce pain and increase activity level in medial compartment knee osteoarthritis. Biomechanical forces created by lateral wedge that alter the load distribution on knee used to reduce adduction moment of osteoarthritis knee. To access and quantify the effectiveness of lateral wedge sole using valid and reliable tool visual analogue scale and 10-meter paper walks way test. Lateral wedge sole (6.35mm with 10° inclinations from lateral border) affix with shoes, pre-test intervention score measured on 1st day, 7 days' adaptation period recommended. Post-test intervention score repeated on same measures.

There was no significant difference found in gait parameter between pre-test and post-test intervention score. But significant difference found in pre-test and post-test intervention score in visual analogue score. No such improvement found in gait parameter score, but it shows significant relief in knee pain in medial compartment knee osteoarthritis after use of lateral wedge sole.

Key Words: Osteoarthritis, Gait-parameter, Lateral Wedge, Pain.

INTRODUCTION

Osteoarthritis (OA) known as osteoarthritis or degenerative joint disease (DJD), is a progressive disorder of the joints caused by gradual loss of cartilage formation of bony spurs and cysts at the margins of the joints[1].

The knee joint is most vulnerable lower limb site for OA, the disease diminishes the mobility. Many risk factors and their association with knee OA have

been reported some of which include aging, gender, obesity, joint injury, occupation, malalignment and muscles strength [2].

According to WHO technical report series-919 BHIGWAN COPCORD. Prevalence of knee Osteoarthritis in 100000 per Indian population. Total 4644 males and 6587 females found between age of 45-59 years, 15385 males and 14371 females found between age of 60- 69 years[3]. Currently Pal and Singh et al[4] found the prevalence of primary knee osteoarthritis is 28.7% in 1.252 billion Indian populations.

Factors such as Varus malalignment that alter load distribution may cause the ground reaction force vector to press more medially to the knee joint center, results higher the knee adduction moment. Higher the knee adduction moment is associated with severe knee pain and greater radiographic severity[5,6,7].

Lateral wedge soles and shoes considered as first-line approach to disease management. Either to reduce pain and increase activity level of osteoarthritis knee, biomechanical technique used as to reduce adduction moment of osteoarthritis knee[6,7,8,20,21,22,24].

Sasaki and Yasuda[8,23] first described potential use of lateral wedge insole in knee osteoarthritis treatment; they showed that how spatial position of lower limb shift laterally if a person will stand on 5^0 inclined board. Based on these changes they stated that loading through the medial knee joint would be reduced. Kakihana et al[21,22] revealed that use of 6° inclination in lateral wedge is not effective to reduce external knee Varus moment. In different study by Kerrigan DC et al.[9] suggested that lateral wedge insole of either 5° (3.175 mm thickness) or 10° (6.35mm thickness) applicable to reduces the knee Varus moment in subject with medial knee osteoarthritis.

Wolfe and Brueckman et al.[10,11,12] summaries in their study. 82% patients got improvement in pain with medial knee osteoarthritis using lateral heel wedge. while Keating et al [10,23] reported that 61% of medial compartment knee osteoarthritis patient got improvement in knee pain scores with lateral heel wedge. Kim Bennell et al[13] in 12 months follow up assessment found greater improvement in knee pain relief, good physical function and health related quality of life [13].

Mokhtar Arazpour et al[16] identify the effectiveness of gait parameter and pain using lateral wedge insoles comparison with knee unloader orthoses. Both type of orthosis shows improvement in knee pain, range of motion, increase walking speed and step length in conjunction with reduction in adduction moment. During review of previous study by Maryam Maleki, Mokhtar Arazpour et al[17] found improvement in Kinetic and kinematic parameters, temporospatial parameters related decrease in knee pain, improve range of motion, walking speed and step length and reduction in adduction moment of knee with medial compartment knee osteoarthritis.

Many studied had been done on effect of lateral wedge on improvement of Varus alignment, pain reduction, comfort, knee joint torque for subject with medial compartment knee osteoarthritis. But the literature for its effect on gait parameter and way of gait analysis in disease knee [25] (step length. Stride length, cadence, and velocity is not enough specified in Indian Population due to their race and geographical differences.

So, the aim of present study is to quantify the effect of lateral wedge sole in improvement of gait parameter and reduction of knee pain in subject with medial compartment knee osteoarthritis in context with Indian population.

METHOD

Selection and Description of Participants

A sample of 30 subjects, including 16 females and 15 males having osteoarthritis were recruited from Indian Spinal Injury Center, Vasant Kunj, new Delhi, Akshyaprathisthan, New Delhi, Kiwani Artificial Limb Center, New Delhi. The study was approved by Research

Committee of ISIC Institute of Rehabilitation Sciences, New Delhi, India (Ref:ISIC/IRS/MPO/RP/2010-11/930).

The inclusion criteria for subject with medial compartment knee osteoarthritis was (1) subject age 55- 65 yrs. (2) male and female subject. (3) knee pain from at least (duration <6 months). (4) subject with diagnosis of painful medial compartment of knee. (5) criteria for diagnosis of OA of knee as per American rheumatism association classification. (6) currently subject has not using wedge insole or custom orthosis in shoes. (7) Subject using flat bottom heel (8) Grade 2,3 on Kellgren Lawrence radiographic grading scale of OA[18], (9) Subject should be able to walk independently without any assistive devices.

Exclusion Criteria for subject with medial compartment knee osteoarthritis was (1) History of major trauma and surgery to lower limb. (2) Patient using steroid injection and oral. (3) Knee with flexion contracture more than 50^0. (4) VAS Score more than 7, Cristiana Kahl et al[19]. (5) Any congenital deformity in lower limb. (6) Foot and ankle problem precluding the use of insole. (7) History of cardiovascular and neurological disorders.

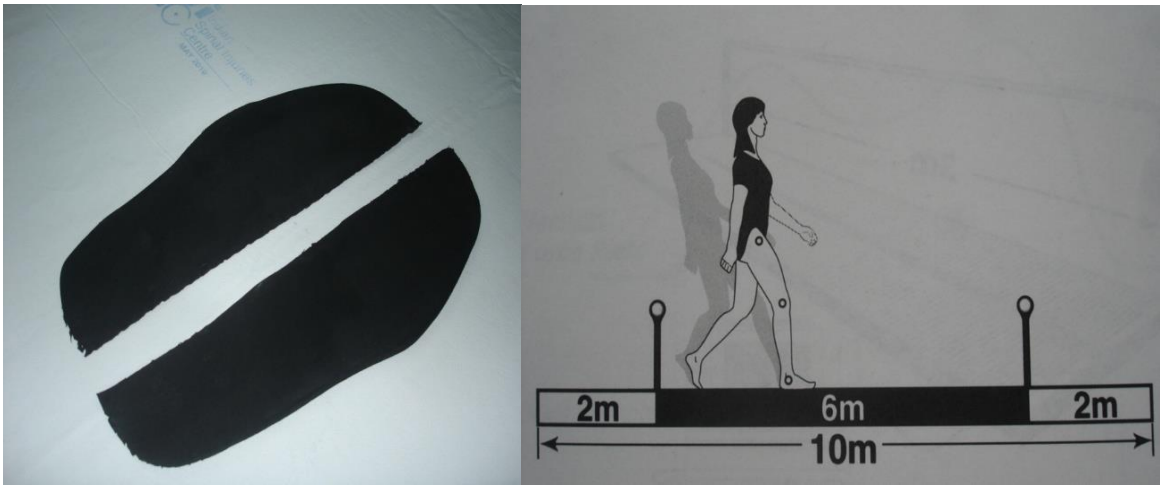

Fig 2. Lateral wedge sole and 10-meter paper walks way test

Tools and Equipment's

(1) Lateral Wedge insole (EVA) 6.35mm thickness with 10^0 inclinations (2) 10-meter paper walks way. (3) Measurement tape. (4) Stop watch. (5) Goniometer. (6) Score sheet. (7) Visual analog scale. (8) Weighing machine. (9) Ink. (10) Cotton stockinet.

Procedure

Subject with knee osteoarthritis who were referred from to rehabilitation department of different organization were screened. History of Subject was taken. The Subject with diagnosed medial compartment of knee osteoarthritis was assessed for inclusion and exclusion criteria. Detailed explanation of procedure has been given to the subjects. Informed consent has been taken by the subject and their relatives (witness).

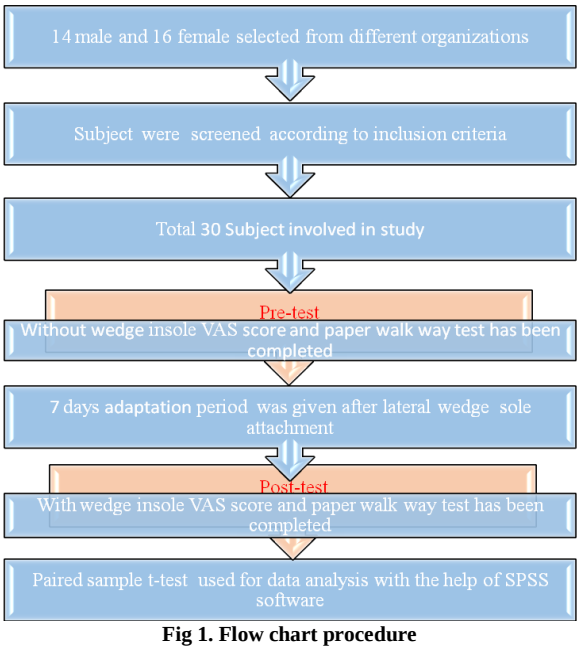

Fig 1. Flow chart procedure

In Pretest score for Visual Analogue Score (VAS) of all the subjects had been

recorded. The pretest score for gait parameter had been recorded on 10-meter paper walk way[25]. 10-meter length of absorbent paper was spread on a flat, smooth, non-slippery and obstacle-free surface in a corridor; two parallel lines drawn by marking pensile start at measured distance line (at 2 meter) and finish line (at 8 meter) on paper walk way. A demonstration of how to walk on the paper walk way was given. Subjects were asked to wear cotton stockinet without wedge sole shoes in their feet. Ink is applied over flat bottom of the shoe. Then they walk over 10-meter paper way with self-selected speed in normal walking pattern, which left behind their foot prints. Stop watch started instant the first foot cross the start line and stopped after cross the finish line. Reading was taken only in the middle 6-meter of the walk way to record the most stable phase of each walk and reduce the effect of acceleration and deceleration. Walking time is recorded by digital stopwatch.

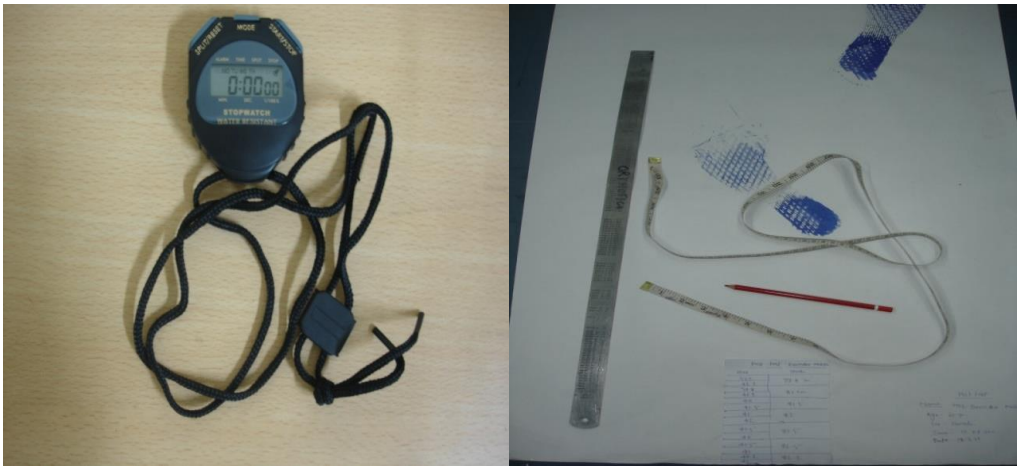

Fig 3. Instrument and Foot Impression

Lateral wedge sole (EVA material having 6.35mm thickness with 10^0 inclinations from lateral border) affix with the flat bottom shoes, while 7 days' adaptation period was given to know the effect of lateral wedge. Subject has advised to Wear 3 to 6 hrs. affix sole with shoes[9,13,14].

The Post-test score for Visual Analogue Score (VAS) recorded on 8th day. The post test score for gait parameter (step length, stride length, cadence and velocity) were recorded in the same way with lateral wedge sole.

Data Analysis

The data was managed on excel spread sheet and analyzed using the SPSS software PASW (Version 18.0). Descriptive statistics (Mean, and Standard Deviation) were computed for each study variable. The outcome variables used for analysis were Step Length, Stride length, velocity, cadence and Visual Analogue Score.

Table A; Result: Paired samples t-test between PSL and SSL; PTSL and STSL; PCAD and SCAD; PVEL and SVEL; PVAS and SVAS

		Mean SD	t-value	p- value
STEP LENGTH	PSL SSL	43.64±6.56 43.62±6.79	0.019	0.985
STRIDE LENGTH	PTSL STSL	87.40±12.92 87.96±13.77	0.265	0.793
CADANCE	PCAD SCAD	75.57±9.31 76.55±14.33	0.393	0.697
VELOCITY	PVEL SVEL	0.599±0.086 0.599±0.088	0.016	0.987
VISUAL ANALOGUE SCORE	PVAS SVAS	5.66±1.24 4.46±1.07	8.635**	0.000
**significant at 0.05 level*				

PSL: Pre-test step length; SSL: Post-test Step length; PTSL: Pre-test stride length; STSL: Post-test Stride length; PCAD: Pre-test cadence; SCAD: Post-test cadence; PVEL: Pre-test velocity; SVEL: Post-test velocity; PVAS: Pre-test Visual analogue score; SVAS: Post-test visual analogue score

Hypothesis was tested at Significant Level of P<0.05.

RESULT

The sample consisted of 30 individuals with osteoarthritis as 14 Males with mean age (years) 57.93±3.149. While 16 females were 60.06±3.149. The mean height (cm) of the male was 167.10±4.585 and of female was 158.91±7.476. The weights (kg) of male subject range from 70.64±12.935 and of females were lies between 66.31±12.690.

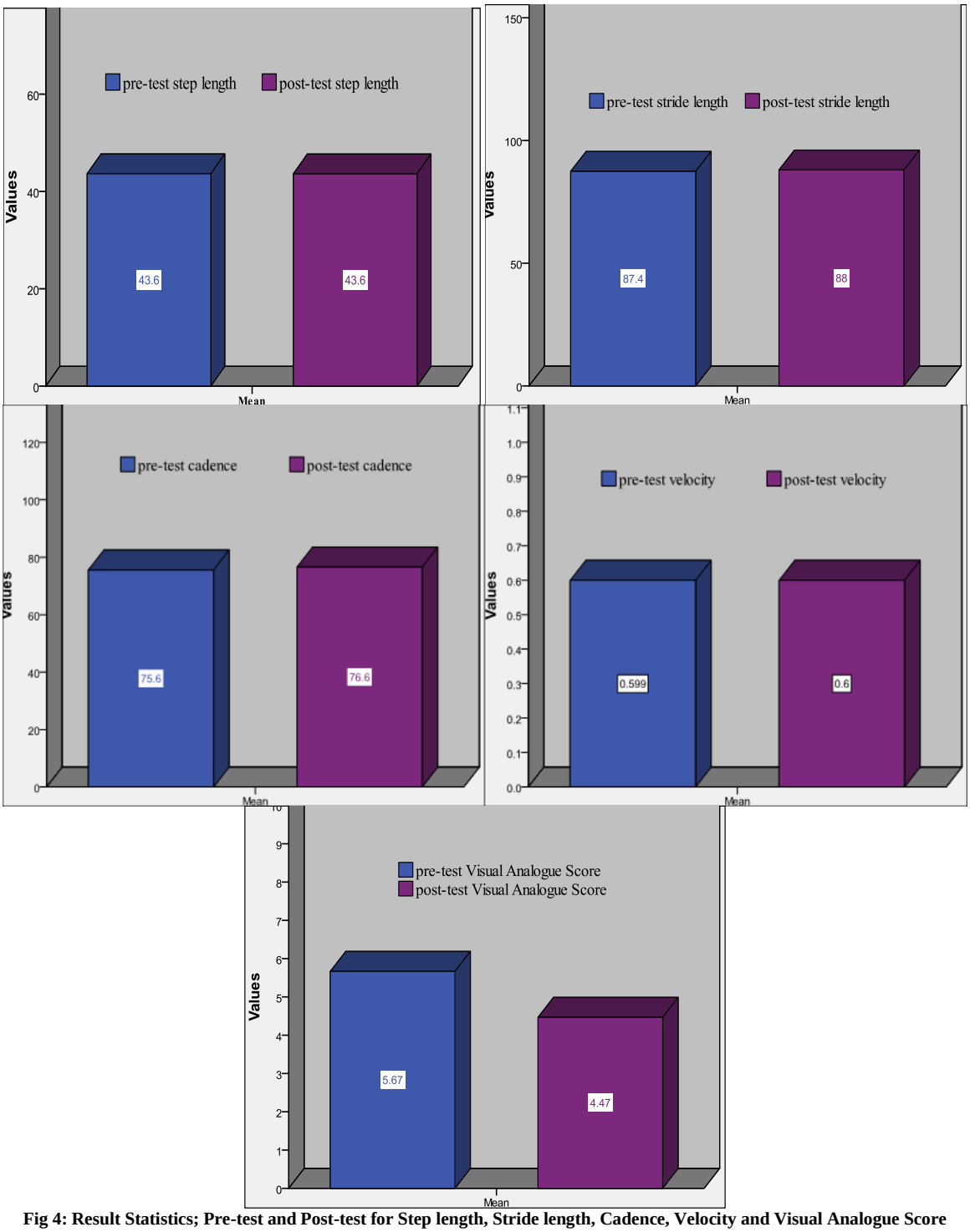

Fig 4: Result Statistics; Pre-test and Post-test for Step length, Stride length, Cadence, Velocity and Visual Analogue Score

Gait Parameter

The comparison of pre-test score for step length (43.64±6.56) and the post-test

score step length was (43.62±6.79) recorded no significant difference (P-value =0.985, t-value = 0.019) indicating no such effect of lateral wedge on step length improvement for subject with medial compartment knee osteoarthritis.

The comparison of pre-test score for stride length (87.40±12.92) and post-test score for stride length (87.96±13.77) shows no significant difference (P-value = 0.793, t-value = 0.265) Showing no marked effect of lateral wedge on improvement of stride length.

The comparison of pre-test score for cadence (75.57±9.31) and post-test score of cadence (76.55±14.33) shows no significant difference (P-value = 0.697, t-value = 0.393) showing the lateral wedge has no effect on increasing cadence for subject with medial compartment of knee osteoarthritis.

The comparison of pre-test score for velocity (0.599±0.086) and post -test score for velocity (0.599±0.088) shows no significant difference (P-value = 0.987, t-value = 0.016). this shows that lateral wedge has no effect on increasing velocity for subject with medial compartment knee osteoarthritis.

Knee Pain

The comparison of pre-test Visual Analogue Score (5.66±1.24) and the Post-test Visual Analogue Score was (4.46±1.07) shows significant difference (P-value = 0.000, t-value = 8.635) indicating that lateral wedge is effective in reduction in subject with medial compartment knee osteoarthritis.

DISCUSSION

The primary aim of study was to evaluate gait parameter and pain score in medial compartment of knee osteoarthritis. The earlier studies also supported potential use of laterally wedge sole in the shoe to treat medial compartment knee osteoarthritis. In gait parameter Step length, stride length, cadence, velocity and visual score were used as key criteria for evaluation. Assumption has made that lateral wedge sole will keep knee in statically aligned, in more upright position, by shifting the calcaneus in valgus position relative to the tibia. Such an alteration will helpful to reduce excessive load on medial joint surface and migration of knee pain. Gait analysis was carried out to compare the performance of gait parameter without lateral wedge sole in pretest and with lateral wedge sole in post- test.

Normative step length, stride length, cadence and velocity will vary in individuals due to their pathological condition. These individuals tend to walk slower in steps, stride, cadence and velocity than normal.

All participants have attended average of 43.64±6.56 step length acquired during pre-test score and 43.62±6.79 (p-value= 0.985, t-value = 0.019) step length in post -test score. The comparison of result shows that subjects were not get benefited using lateral wedge sole as far as step length is concerned.

The comparison of score for average stride length in pre-test score was 87.40±12.92 and post-test 87.96±13.77 (p-value= 0.793, t-value = 0.265) shows no significant difference. Zhang Min et al.[27] in their earlier study also find stride length is not affected in comparison of normal walk in subject with osteoarthritis.

The comparison of pre-test score for cadence was (75.57±9.31) and post-test score was 76.55±14.33 (P-value = 0.697, t-value = 0.393) showing the lateral wedge has no such effect on increasing cadence for subject with medial compartment of knee osteoarthritis. Study by Kerrigan DC et al.[9]also got no such deviation in stride length, cadence and velocity when they use lateral wedge thickness of 6.35mm mearly10^0 inclination. These results might be due to only 7 days adaptation period, which is small to advice the effect of lateral wedge sole on these gait measures.

The fact reported in different literature extensively as waking speed for healthy individuals lies in range of 1.2 to 1.3 m/sec.[26]. Here count of time completed in

given direction with self-selected speed over paper walkway within 6-meter distance, calculated velocity marked in sheet. The comparison of pre-test score for velocity was 0.599±0.086 and post -test score for velocity was 0.599±0.088 (P-value = 0.987, t-value = 0.016). Result shows that lateral wedge has no such effect on increasing velocity for subject with medial compartment knee osteoarthritis

The visual analogue score for knee pain pre-test score was 5.66±1.24 and post-test score was 4.46±1.07 score shows significant difference (p-value = 0.000, t-value = 8.635) indicating marked reduction of knee pain after using lateral wedge sole, which is also supported by earlier studies [9,10,12,13,16,21,22].

Gait parameter is not affected may be due to adaptation period was kept 7days before post-test, either use of 6.35mm thick insole, that will be uncomfortable in paper walk way test[9].

Clinical Implication

The finding of study suggested that Lateral wedge is effective in improving knee pain in large population of medial compartment knee Osteoarthritis. But the effect of lateral wedge sole on improvement of gait parameter is not supported by the present study. Thus, the study suggests that lateral wedge can prescribed for reduction of knee pain, might increase the potential functional capacity and reduce disability in long term use.

CONCLUSION

A Lateral wedge insole was tested over medial osteoarthritis knee joint. Multiple studies also supported that lateral wedge can improve knee pain, but we did not find out significant improvement in step length, stride length, cadence, and velocity in subject with medial osteoarthritis. Improvement in gait parameter is not appeared, may be due to limited adaptation time and thickness of insole for lateral wedge sole. This study can motivate the user for use of lateral wedge as far as concerned with relief in osteoarthritis knee pain.

Thus, it can be concluded that lateral wedge sole must be useful in a regular prescription in clinical practice as it increases subject functional capacity by reducing pain and disability. Future work would include conducting studies on increase adaptation period and reduce thickness of insole, that may improve gait parameter in subject with medial compartment osteoarthritis.

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Declaration of Conflicting Interests

There is no Conflict of interest.

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Ethical Approval: Approved

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