EFFECT ON KNEE PAIN AND STRIDE CHARACTERISTICS IN PERSONS WITH MEDIAL COMPARTMENT KNEE OSTEOARTHRITIS: A COMPARATIVE STUDY BETWEEN SINGLE BAR UNIAXIAL VALGUS KNEE ORTHOSIS AND LATERAL WEDGE INSOLE

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Abstract

Background: Osteoarthritis can be defined as a degenerative disease characterized by biomechanical and architectural deterioration of the articular cartilage. After the age of 60 years, more than 80% of the people have the radiological sign of Osteoarthritis (OA) in the knee and approximately 20% of the people suffer from pain and movement limitations. Currently used pharmacologic treatments including non-steroidal anti- inflammatory drugs, which do not slow or reverse the degenerative process in OA. So orthotic intervention received a great deal of attention from the health care providers as a potential treatment of OA.

Objectives: To determine the significant differences between single bar uniaxial valgus knee orthosis and lateral wedge insole in improving stride characteristics (step length, stride length, cadence and velocity) and in reducing knee pain in subjects with medial compartment knee osteoarthritis.

Methods: 30 subjects of OA patients were randomly selected and divided into two groups. The first group was provided with single bar uniaxial valgus knee orthosis and second group with lateral wedge insole for an adaptation period of seven days to analyze VAS and stride characteristics (10 meter paper walkway)

Results: The post- test value on gait parameters for step length of Group-1 (41.50±4.83) and Group-2 (40.70±5.80) recorded with (p-value=0.683 and t-value=0.412), for stride length of Group-1 (84.20±10.17) and Group-2 (81.40±11.53) recorded with (p-value=0.485 and t-value= 0.707), for the cadence of Group-1 (58.28 ± 10.03) and Group-2 (65.65 ± 11.48) recorded with (p-

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value=0.072 and t-value=-1.872) showed no such differences between single bar uniaxial valgus knee orthosis and lateral wedge insole on medial compartment knee osteoarthritis. Only significant difference was seen for speed and knee pain. Speed of Group-1 (0.468 ± 0.062) and Group-2 (0.540±0.106) recorded with (p-value=0.032 and t-value= -2.256) shows that the single bar uniaxial valgus knee orthosis subjects show less speed than the lateral wedge

insole. VAS for knee pain for Group-1 (3.133 ± 0.915) and Group-2 (4.333 ± 1.175) recorded with (p-value=0.04 and t-value= -3.120) indicating that the Uniaxial Valgus knee Orthosis is more effective than lateral wedge insole.

Conclusion: On the basis of proceeding data, the study suggests that the speed with the Uniaxial Valgus knee Orthosis is lesser than the lateral wedge insole but it has significant improvement in reducing pain in persons with medial compartment knee osteoarthritis.

Keywords: osteoarthritis, lateral wedge insole, single bar uniaxial valgus knee orthosis.

INTRODUCTION

OA is characterized by an irregular distribution of loaded cartilage more frequently in areas of increased load, sclerosis of subchondral bone, subchondral cysts, marginal Osteophytes, increased metaphysical blood flow and variable synovial inflammation. It is the most common joint disorder, accounting for a large proportion of disability in adults. The world health organization estimates that 10% of the world's population over 60 years of age suffers from clinically significant osteoarthritis, making it one of the most common health problems and 70 million Indians are its victims, out of which nearly 80% of them are above 75 years. Knee OA is more common among women than men. The prevalence of radiological knee OA was 12% and the prevalence of symptomatic knee OA was 6% in women aged 45-64 years in the Chingford study. Although, it is observed that the symptoms occur earlier in women. Knee Osteoarthritis, occurs symptomatically in approximately 6% of adults who are 30 years of age and older and in 11% of adults who are 65 years of age and older. It accounts for more mobility disability in the elderly than any other disease. It was estimated that approximately 10% of the world's population who are 60 years or older have symptomatic problems that can be attributed to osteoarthritis.

Patient with knee OA usually presents with major involvement in only one compartment, with the medial compartment involved nearly 10 times more often than the lateral compartment.[1] Osteoarthritis typically affect joints in a no uniform manner, during walking, the normal forces acting on the leg produce a varus torque, this varus torque is directly associated with the compressive force across the medial aspect of the knee, which is nearly 2½ times the force

through the lateral aspect of the knee. The effect of wearing a laterally wedged insole to reduce symptoms in osteoarthritis patients with a varus deformity of the knee was first reported in 1987. Wolfe and Brueckmann reported that wearing a laterally wedged insole reduced the load in the medial compartment of the knee, which was effective for the treatment of knee pain in patients with osteoarthritis (OA). Crenshaw and Kerrigan and colleagues reported that wearing a laterally wedged insole reduces the knee joint varus torque moment, suggesting an effective mechanism for knee pain reduction in patients with OA. However, Crenshaw et al found that wearing a laterally wedge insole reduced the knee joint varus moment during gait in healthy subjects which suggested an effective

mechanism for the treatment of patients with knee osteoarthritis, however, they did not show the evidence resulting in the knee joint varus moment with the lateral wedge insole. Wolfe and Brueckman reported that 82% of their patients with medial knee osteoarthritis had at least some lessening of pain with a lateral heel wedge, and Keating et al. reported that 61% of knees with medial osteoarthritis had improved pain scores with a lateral heel wedge.

Braces are mainly prescribed to modify the mechanical stress placed on the symptomatic joint compartment by correcting joint instability and alignment with the help of three point pressure system. Lindenfeld et al. evaluated the effects of the unloader braces on the gait of patients who had varus gonarthrosis and found that the adduction moment at the knee was altered when the brace was worn. This alteration may decrease the load transmitted through the medial compartment, resulting in less pain. For correction of medial compartment osteoarthritic knee, previous studies have been done on effect of knee bracing for medial compartment osteoarthritis and effect of lateral wedge insole on knee varus torque in patient with knee osteoarthritis. But the comparison between the single bar uniaxial valgus knee orthosis and the lateral wedge insole is still a matter of concern due to little evidence. For that our aim is to determine the significant difference between single bar uniaxial valgus knee orthosis and lateral wedge insole or which one is significantly better for an overloaded medial compartment of the knee and shift some body weight to the lateral compartment.

METHODOLOGY

A sample of 30 subjects including 19 female and 11 male with medial compartment knee osteoarthritis were recruited from Indian Spinal Injury Centre and Akshay Pratishthan, Vasant Kunj, New Delhi. Subjects who were diagnosed as per American rheumatism association criteria, were using flat bottom outer sole. Subjects with the age group of 50-65 years, who were able to walk at least 6 minutes without any assistive device. Subjects having Grade 2 or 3 on Kellgren

Lawrence radiographic grading scale of OA and who had a predominance of pain/tenderness over the medial region of the knee were included in the study.

The participants having congenital deformity in lower limb, who were already using a wedge or other custom made orthosis, who had foot and ankle problem excluding the use of insole. Subjects with VAS Score more than 7 and Kellgren-Lawrence Grade 4. Subject having rheumatoid arthritis and other systematic inflammatory arthritis, who had a history of major trauma and surgery to lower limb. Subject with any fixed knee ~~deformity~~, who had a history of cardiovascular and neurological disorders and cognitive function were excluded from the study. The detailed information was given to the subjects about the procedure. Subjects consenting to participate in the study were told to sign the consent form. The subject was divided into two groups, group-1 and group-2. After that the subjects of group-1 was provided with single bar uniaxial valgus knee orthosis (Fig:1) and subjects of group-2 with lateral wedge insole (Fig:2) . After seven days of adaptation period, the post test score for VAS recorded and stride

characteristics for all the subjects had been recorded on 10 meter paper walk way. The 10 meter length of absorbent paper was spread on a flat, smooth, non-slippery and obstacle free surface. Two parallel lines were drawn at 2 meter length from both ends of 10 meter paper walk way. Detailed process was demonstrated to all subjects. During this process, the subject had to sit on a chair, wear the stockinet on both shoes, apply ink on the outer sole over the stockinet, and then the subject had to stand and walk on paper with his own speed. The subject was instructed that on the word “Go” he/she should walk on the paper walkway. When the subject crossed the initial line of acceleration, immediately the stop watch was started to get the time & when the subject touched the line of deceleration the stop watch was stopped. The stride data was calculated within the 6 meter.

DATA ANALYSIS

The data was managed on an excel spreadsheet and was analyzed using the SPSS software PASW (Version 17.0). Descriptive statistics (Mean and Standard Deviation) were computed for each study variable. The outcome variable used for analysis were Step Length, Stride Length, Velocity, Cadence and Visual analogue Score after the seven days of adaptation period. Independent t-test was used for comparing improvements in Stride Characteristics (Step length, stride length, cadence and velocity) and Visual Analogue Score. Hypothesis was tested at a significant level of $P<0.05$.

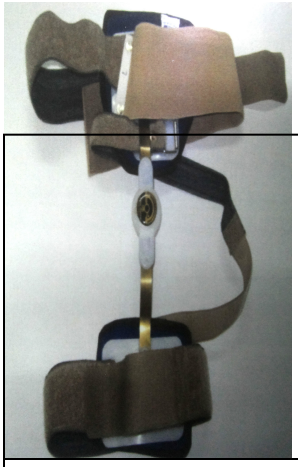


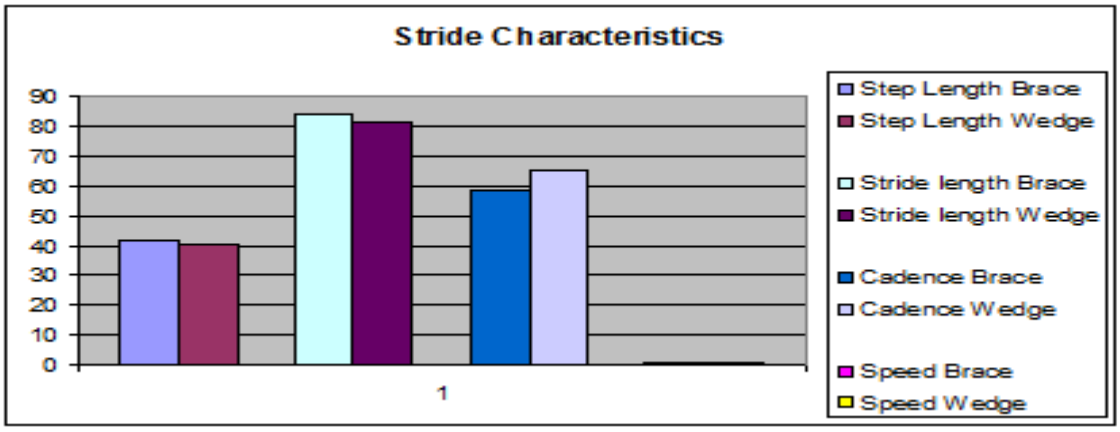
Fig: uniaxial Knee Orthosis

RESULTS

30 subjects were included in this study in which 19 were female and 11 were male subjects. The sample of 30 individuals with medial compartment knee osteoarthritis divided into two groups. Group-1 consisted of 6 male and 9 female with 61.33 ± 4.04 years and Group-2 consisted of 5 male and 10 female with 59.93±3.82 years. The mean height (cm) of Group-1 was 166.73±5.14 and Group-2 was 165.00± 2.77. The mean weight (Kg) of Group-1 was 70.00 ± 4.50 and Group-2 was 70.86±5.86. An independent t-test was used to compare the post test score for Visual Analogue Scale and gait parameter of the 30 subjects.

Stride characteristics

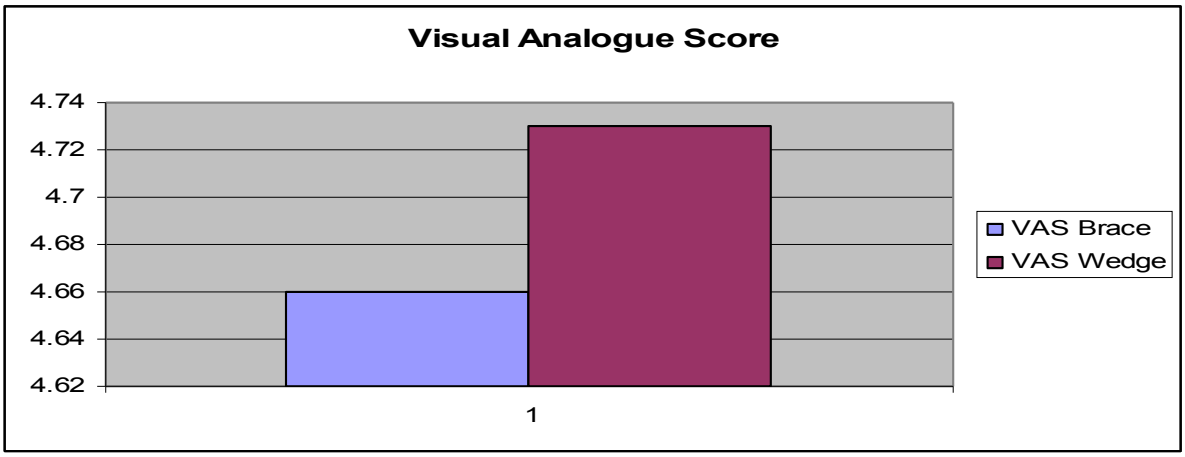
The comparison of post-test score for step length of Group-1 (41.50±4.83) and Group-2 (40.70±5.80) subjects recorded with (p-value=0.683 and t-value=0.412) indicated no such differences in single bar uniaxial valgus knee orthosis and lateral wedge insole on medial compartment knee osteoarthritis(Fig-3)



The comparison of post-test score for stride length of Group-1 subjects (84.20±10.17) and stride length of Group-2 subjects (81.40±11.53) recorded with (p-value=0.485 and t-value= 0.707) indicated no such differences between single bar uniaxial valgus knee orthosis and lateral wedge insole on medial compartment knee osteoarthritis. The comparison between of post-test score for the cadence of Group-1 subjects (58.28 ± 10.03) and cadence of Group-2 subjects (65.65 ± 11.48) recorded with (p-value=0.072 and t-value=-1.872) indicated no such differences between single bar uniaxial valgus knee orthosis and lateral wedge insole on medial compartment knee osteoarthritis (Fig-3). The comparison of post-test score for speed of Group-1 subjects (0.468 ± 0.062) and speed of Group-2 subjects (0.540±0.106) recorded with (p-value=0.032 and t-value = -2.256) indicated significant differences with the single bar uniaxial valgus knee orthosis subjects show less speed than the lateral wedge insole on medial compartment knee osteoarthritis(Fig-3)

Knee Pain

The comparison of post test Visual analogue Score for Group-1 (3.133 ± 0.915) and the post test score for Visual analogue Score for Group-2 (4.333 ± 1.175) shows a significant difference with (p-value=0.04 and t-value= -3.120) indicating that the Uniaxial Valgus knee Orthosis is more effective than lateral wedge insole in improving knee pain in medial compartment knee osteoarthritis (Fig-4)



DISCUSSION

Most previous studies of valgus bracing and lateral wedge insole have concentrated on the clinical effect of orthosis on patient with medial compartment knee osteoarthritis. This study examines the significant differences between single bar uniaxial valgus knee orthosis and lateral wedge insole in person with medial compartment knee osteoarthritis. In this study there are no statistical significant differences in stride characteristics such as step length with t-value=0.412 and p-value=0.683, stride length with t-value=0.707 and p-value=0.485, and cadence with t-value= -1.872 and p-value=0.072 in patients with medial compartment knee osteoarthritis. Jawad and Goodwill reported in pain reduction in OA or RA patient fitted with valgus brace, but no specific information regarding the extent of arthritic changes or mechanical data was provided in their reports. Pain reducing ratio while using brace was 78%. Sasaki and Yasuda[1] in their study using a wedged insole, reported 70% improvement in turns of 40% in advanced OA stage. The Smith[21] study, in which individually designed braces were used, reported that 75% of its user exhibited an overall pain reduction. Horlick and Loomer tested the efficacy of Generation II orthosis, valgus bracing in patients with medial compartment OA of the knee. They recorded an 82% success rate for pain relief with braces in valgus. The reason for pain reduction was not analyzed.

Speed show differences with t-value= -2.256 and p-value=0.032 between single bar uniaxial valgus knee orthoses and lateral wedge insole while stride length, step length and cadence shows no any significant differences. This result shows speed decrease in group-1 (with brace) than group-2 (with insole). This could be due to the strapping of thigh muscles, prevent flexion, extension and knee range of motion in the sagittal plane. Davidson et al also supports this result. While the lateral wedge insole had no such restriction. This result was also supported by the result of Ricchards, J.D., Sanchez-Ballester, J., Jones, R.K, Darke, N Y& Livingstone, B.N. on, "A comparison of knee braces during walking for the treatment of osteoarthritis of the medial compartment of the knee" , reducing pain with the VAS score having t-value= -3.120 and p-value=0.004. This result showed that the uniaxial valgus knee orthosis is more effective than the lateral wedge insole. This view is supported by Kirkley et al and Lindenfeld et al. This could be due to the corrective force applied by the elastic strap of brace in coronal plane which is more effective and this in turns not only help in reducing symptoms, but also shifting the weight-bearing load. While straping the anatomical knee joint with uniaxial brace provides a significant decrease in the varus moment during stance, which can contribute to reduction in pain. This view is also supported by Self et al. "While bracing the knee joint, the center axis of pressure shifts and reduce pain", this view is supported by Pollo et al. The findings of the study suggests that the single bar uniaxial valgus knee orthosis is more effective than lateral wedge insole in comparison with pain reduction while the lateral wedge insole is better than the single bar uniaxial valgus knee orthosis in comparison with speed for patient with medial compartment knee osteoarthritis, but the significant differences in gait parameter such as step length, stride length and cadence is not supported by the present study. Thus, the study suggests that the single bar uniaxial valgus knee orthosis prescribed for maximum reduction of pain and lateral wedge insole for maintaining speed of patient with medial compartment knee osteoarthritis. The reduction of knee pain might increase the potential functional capacity, reduce disability and increase the quality of life of patient with medial compartment knee osteoarthritis. The study period was of very short duration and a small sample size. The future research is required to analyze the restriction of movement produced by the single bar uniaxial valgus knee orthosis and significant differences on gait parameter which is not supported by the present study.

CONCLUSION

This study supports hypothesis partially in which speed of Group-1 (Single bar uniaxial valgus knee orthosis) shows significant differences from Group-2 (Lateral wedge insole) but step length, stride length and cadence does not support the hypothesis. So the lateral wedge insole is better than single bar uniaxial valgus knee orthosis while comparing speed. In the second case, the study supports the hypothesis and shows significant differences between single bar uniaxial

valgus knee orthosis and lateral wedge insole in which single bar uniaxial valgus knee orthosis is better than a lateral wedge insole in reducing pain.

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