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Original Research Article

QUANTITATIVE GAIT ANALYSIS IN PATIENTS WITH KNEE OSTEOARTHRITIS

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ABSTRACT

Background: Knee osteoarthritis is one of the most prevalent conditions. According to world health organization the knee osteoarthritis is the fourth most important cause of disability in women and eight most important causes in men. Various methods have been used like high speed cinematography, force platform etc but no study was done by using pen marking analysis to compare the gait parameters of osteoarthritis patients and healthy individuals.

Purpose of study: To compare gait parameter that is step length, step width, stride length, walking velocity and cadence of osteoarthritis patients and healthy individuals.

Materials and Methods: This experimental cross sectional study conducted at Guru Jambheshawar University of Science and Technology, Hisar. 30 subjects were taken as per selection criteria which included both male and female between the ages of 40 to 65 years. They were divided into two groups that is group A has osteoarthritis patients (n = 15) and group B has normal healthy subjects (n = 15). Step length, Step width, Stride length, Walking velocity and Cadence were taken as outcome measurement parameters.

Results: Comparison was made between the gait parameters within group and between the groups by using t-test for statistical analysis. Result shows statistically significant difference in gait parameters between the patient group and healthy individuals. Patient group have lower step length (34%), stride length (33%), walking velocity (48%) and cadence (31%) and greater step width (44%) then the control group. Females with knee osteoarthritis have lower values for step length, stride length, walking velocity and cadence and greater step width then control group females. Males with knee osteoarthritis have lower values for step length, walking velocity and cadence than the control group males.

Conclusion: Knee osteoarthritis shows significant difference in the gait parameters between the osteoarthritis patients and healthy individuals and between the genders.

KEY WORDS: Gait analysis, Gait parameters, Knee osteoarthritis.

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INTRODUCTION

Osteoarthritis (OA) is one of the most common chronic diseases which affect patients and has great reduction in the individual's quality of life [1]. It is a

common, degenerative joint disease characterized by progressive destruction of cartilage that can affect several joints, especially weight-bearing joints such as the knee. Osteoarthritis is the most prevalent form of arthritis in the elderly. The main clinical manifestations of knee OA are pain and stiffness leading to reduced joint mobility and progressive gait dysfunction. A recent World Health Organization report on the global burden of disease indicates that knee OA is likely to become the fourth most important cause of disability in women, and the eighth most important cause in men [2,3].

Patients suffering from osteoarthritis often complain of pain on movement, typically occurring when movement is initiated or when the patient begins to walk. The pain is often described as a dull ache. As osteoarthritis progresses, the pain becomes continuous, and the function of the joint is severely impaired. Likelihood of developing osteoarthritis increases with age. It is estimated that 10% of men and 21% of women of age 60 have osteoarthritis in the knee joint. Studies have shown that knee osteoarthritis in men aged 60 to 64 is more commonly found in the right knee (23%) than in the left knee (16.3%), while its distribution seems to be more evenly balanced in women (right knee, 24.2%; left knee, 24.7%) [1-7].

Gait adapted by the patient according to pain, deformity or laxity in the joints of the lower extremities. Mainly antalgic gait is often adapted the patients with knee osteoarthritis. Gait adaptation is mainly related to the severity of the disease, pain, muscle weakness, or limitations in a passive range of motion. Adaptations which are protecting the knee joint also affect the motion of the lower back and other joints of the lower extremities. The analysis of the biomechanical parameters of lower extremities in patients with knee osteoarthritis is done by gait measurement [5-7]. As the disease progresses it effects the patients gait. Patients with knee osteoarthritis seem to develop their own gait pattern and try to unload the affected structures during gait. More over patients with less severe knee osteoarthritis develop a gait pattern that differs from patients with severe osteoarthritis and control group of patients. When a person is walking the body should bear weight, provide support for locomotion and maintain equilibrium to achieve that gait and the body alignment should set accordingly. As the mobility is important to the independence of the patient they strive to retain this ability even in the presence of severe impairment. There is a clear link between human gait characteristics and osteoarthritis [8-13].

MATERIAL AND METHODS

Instrumentation Included for this study were Stopwatch, Two markers, Acetone, Tape, Walkway – 16 m (53 ft), Plicometer, Goniometer, Calculator, Scale, Scissor.

Inclusion criteria:

1. Age: 40 - 65 Years
2. Osteoarthritis of unilateral/bilateral knee joints

Exclusion criteria:

1. Any gait pathologies
2. Use of ambulatory aids
3. Receiving any physical therapy
4. Any knee deformity
5. Any knee surgeries
6. Arthroplasty of lower limb
7. Knee pain derived from hip or back
8. Knee pain associated with hip or ankle
9. History of acute injury to the knee with in previous six months
10. Tumour, meniscal, ligament or cruciate abnormalities
11. Use of pain killers
12. Fibromyalgia or inflammatory arthritis
13. Connective tissue disease
14. Steroidal medication
15. Central or peripheral neuropathy
16. Intraarticular injection in past two months

Procedure: Thirty participants were included for the study after fulfilling the inclusion criteria. By the time patients enrolled in the study, they had unilateral/bilateral knee pain that fulfilled the American College of Rheumatology criteria of knee OA. Patients were diagnosed with knee osteoarthritis on the basis of clinical history, radiographic changes and physical examination of the patient by an orthopaedic surgeon.

Table 1: shows comparison between control group and patient group.

GROUP	SL	SW	STL	WV	C
CONTROL	70.97±2.49	10.44±0.90	137.02±2.60	48.11±2.81	102.76±3.53
PATIENT	46.55±1.96	18.68±1.80	90.7±6.66	24.96±1.54	70.85±9.33
T VALUE	7.60**	5.83**	6.47**	9.13**	5.07**

Table 2: Shows comparison between females of control and patient group.

FEMALES	SL	SW	STL	WV	C
CONTROL	69.56±5.06	10.28±1.03	131.85±4.25	46.57±3.66	101.52±5.70
PATIENT	44.84±2.10	20.14±0.96	86.99±7.64	25.73±1.90	74.36±4.97
T VALUE	4.50**	6.95**	5.12**	5.04**	3.58**

Table 3: Shows comparison between males of control and patient group.

MALES	SL	SW	STL	WV	C
CONTROL	72.2±1.92	10.57±1.49	141.57±2.37	49.46±2.13	103.85±4.69
PATIENT	51.24±4.40	14.66±2.16	100.91±13.95	22.87±2.41	61.22±7.69
T VALUE	4.67**	1.55 (NS)	2.87 (NS)	8.09**	4.72**

Subjects were divided into two groups that is group A has osteoarthritis patients (n=15) and group B has normal healthy subjects (n=15).

The markers were taped to the back of the subject's shoes so that the marker's tip just reaches the floor when the subject is standing. Before the procedure, the subject took few steps at the side of the walkway to ensure that the markers were correctly positioned to indicate heel contact. The subjects were instructed to walk at his usual walking speed from one end of the 16-m walkway to the other end in a single direction and not to return back in the walkway. By using a stopwatch, records the time taken for the patient to walk the center 6 m distance. Number of steps were counted and recorded. After the participant had walked step length, step width and stride length was measured using the pen marks. Measurements within the 6-m area were then made from each heel contact pen mark. A mean value was obtained from three measurement of each step length, step width and stride length.

Data Analysis: Thirty subjects were taken. They were divided into two groups that is patient group and healthy individual group. Both group consisted of 15 subjects each. Patient group consisted of 9 females and 6 males and healthy group consisted of 6 female and 9 male subjects. Mean age of subjects in patient group 52.4±6.87 years and healthy group was 47.2±6.30.

RESULTS

Results showed statistically significant differences in the step length, step width, stride length, walking velocity and cadence for both patient group and healthy individuals group.

DISCUSSION

Osteoarthritis of the knee joint, commonest among all the joints (Mahajan, Verma and Tandon 2005) is likely to become the fourth most important global cause of disability in women and eighth most important in men [19].Complete gait assessment requires highly specialized training and equipment (such as high-speed cinematography, force platforms, electromyographic recording) [20,21]. Pen marking analyses are presented as a clinically accessible, low-investment alternative method to measure selected kinematic variables of spatial (step length, stride length, step width) and temporal (cadence and velocity) patterns of foot placement [16]. Assessment of gait changes will be helpful in the predicting occurrence of compensatory mechanisms during the course of diseases [19]. Quantitative analysis of gait parameters that is step length, step width, stride length, walking velocity and cadence has been done to focus on the effect of knee osteoarthritis on the gait of the patient. Quantitative gait analysis is widely used by researcher. There is little evidence available comparing the step length, step width, stride length, walking velocity and cadence between the osteoarthritis patients and healthy individuals.

The aim of present study is to determine the difference between the step length, step width, stride length, walking velocity and cadence between the OA patients and healthy individuals. Result shows the significant difference of the step length, step width, stride

length, walking velocity and cadence between the OA patients and healthy individuals. The result of present study support the hypotheses that step length, stride length, walking velocity and cadence are decreased and step width is increased in OA population then the healthy population [15]. These result also confirm the pattern found in osteoarthritis males and females [1]. Judith falconer in 1991 also found that step length and cadence is decreased in OA population [4].

Previous research on gait analysis of osteoarthritis population provided inconsistent evidence. Study done by Marlene Fransen 1997 particularly relevant to the patients with osteoarthritis involving the lower limbs support the hypothesis that there is decreases in walking speed and stride length [9]. This study demonstrated that quantitative gait analysis and a composite self-reported physical function score provided reliable baseline measurements for persons with osteoarthritis of the knee. Zolta´ n Bejek in 2006 also indicate the same result in his study that there is changes in gait parameters occur in patients with unilateral osteoarthritis of the knee joint compared to the gait pattern of healthy control subjects [6]. Ronen Debi in 2009 also given the same result about the difference in spatio-temporal factors between the genders due to the gait strategies adopted by males and females in order to reduce pain and cope with the loads on their affected joints of OA [14]. Individuals with knee OA have been shown to walk with slower velocities, slower cadence, smaller stride lengths and greater stance durations [22].

Avi Elbaz I 2014 also said that the patients with knee OA demonstrate deterioration in spatio-temporal gait parameters including slower walking velocity, shorter step length and shorter single-limb support (SLS) compared to healthy controls. In the study done by Amanpreet Kaur in 2014 stated that the step length, stride length, normalized stride length, step width and toe out angle in patients with knee osteoarthritis changed significantly compared to those of the healthy Subjects [19]. According to Andriacchi et al. (1982), reduced walking speed and stride length were part of the adaptive mechanism to reduce pain by decreasing knee moments. These adaptive changes occurred relatively early in the course of the disease. According to Prodromos et al. (1985), a shorter than normal stride length suggest an unloading mechanism during gait which appears to be beneficial in patients with medial OA of the knee joint which could be a protective mechanism against further progression of the disease by resisting the external adductor moment [17-19].

This could be the possible reason for above results that during the pathological process of osteoarthritis, degenerative changes occur in the knee joint, causing knee joint laxity, reduced muscle activation. It becomes difficult to compensate body weight during the gait cycle; Body tends to keep the next step to overcome the difficulty as a result reducing the step length. Reduce step length cause reduction in walking velocity and cadence. Knee joint degeneration was compensated by the pelvis and other joints in the lower limb. Reduced motion of the knee joint leads to an increased pelvic motion which affects the natural mobility of the lumbar spine and cause pain in the lumbar region of the spine because of their kinematic interaction [7,9]. Further research on broad task, more number of subjects and criteria domains is needed. Research is needed on other parameters of gait that is angle of toe out, double support time and single support time.

CONCLUSION

The gait parameters such as step length, walking velocity, stride length and cadence are decreased in knee OA patients as compared the healthy individuals. Step width is increased in knee OA patients then the healthy individuals. Moreover there is no difference in stride length and step width among male between the healthy and patient group.

ABBREVIATION

SL - Step Length
SW - Step Width
STL - Stride Length
WV - Walking Velocity
C - Cadence
****** - Significant at 1% level ($P < 0.01$),
***** - Significant at 5% level ($P < 0.05$)

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