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Relation of Side Step Length with Dynamic Balance in Patients with Bilateral Knee Osteoarthritis

Adiba Javed¹, Muhammad Suleman Tahir², Sarwat Mehmood³, Zain Ali^{4*}

¹Al Fazal Hospital, Lahore, Pakistan ²Anam Rehab and Physio Lab, Faisalabad, Pakistan ³Faisal Hospital, Faisalabad, Pakistan ^{4*}Department of Rehabilitation Sciences, The University of Faisalabad, Faisalabad, Pakistan

KEYWORDS

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Dynamic gate index
Knee osteoarthritis
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DECLARATIONS

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CORRESPONDING AUTHOR

Zain Ali
Department of
Rehabilitation Sciences, The
University of Faisalabad,
Faisalabad, Pakistan
zainalibal47@gmail.com

ABSTRACT

Background: Knee osteoarthritis is a prevalent, multifactorial joint disease that progresses over time and is marked by functional impairment and persistent discomfort. **Objective:** To find out the relation of side step length with dynamic balance in patients with bilateral knee osteoarthritis. **Methodology:** A cross-sectional study was conducted on 200 participants with bilateral knee osteoarthritis. The study settings were Allied Hospital, Reactive Rehabilitation Clinic, and Pro-health Rehab and Medical Centre. The participants of both genders with an age between 40-65 years, who can walk 10 meters unassisted, and diagnosed with bilateral knee osteoarthritis, were included in the study. Participants with a history of any neurological disorders that would affect balance, any history of joint replacement in lower limbs, which could affect balance, and visual field defects were excluded from the study. Data was collected using a Berg balance scale, side step length test, and dynamic gate index from willing individuals after gaining consent from participants. Data was analysed by using descriptive statistics, and the chi-square test was applied. Permission from the ethical committee of the university was obtained before the commencement of the study. **Results:** Results reveal that dynamic balance and side step length were related to the age and gender of the patient. Most of the elderly patients with an age above 55 years had mild impairment with poor side step length. The majority of the females were facing mild impairment with fair side step length. A moderate association was found between the Berg balance scale, the dynamic gait index, and side step length. The majority of subjects had poor side-step length without any balance disturbance. Subjects with mild impairment with the gait index had poor side step length. **Conclusion:** This highlights a positive correlation between side-step length, Berg balance scale, and dynamic gait index in individuals with bilateral knee osteoarthritis. Most participants exhibited mild balance impairments and reduced side step length, supporting findings from previous research. It emphasises the need for clinicians to assess dynamic balance and step length in these patients. Further studies with larger samples and longer durations are recommended to validate and expand upon these findings.

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INTRODUCTION

Knee osteoarthritis, often referred to as degenerative joint disease, typically develops due to the progressive wear and deterioration of articular cartilage over time. It exists in two distinct forms and is most commonly observed in older adults.¹ Primary osteoarthritis leads to articular cartilage degeneration without any identifiable underlying cause.² In contrast, secondary osteoarthritis arises either from abnormalities in the articular cartilage itself, such as those seen in rheumatoid arthritis (RA), or from abnormal joint loading patterns, as observed in post-traumatic cases.

Osteoarthritis (OA) is the most widespread joint disorder globally, with the knee being the joint most commonly impacted. The condition primarily affects individuals over the age of 45. While OA can lead to pain and reduced joint function, not every person with radiographic signs of knee OA will exhibit symptoms. One particular study found that only 15% of individuals with radiographic knee OA reported clinical symptoms. Approximately 6% of the adult population is affected by OA, with women more commonly impacted than men.³ Asymptomatic knee osteoarthritis is seen in about 13% of women and 10% of men aged 60 years and older, and this prevalence rises to 40% in those over 70 years of age. With increasing life expectancy and rising obesity rates, the prevalence of OA is expected to grow further. Knee OA is classified as either primary or secondary, depending on the underlying cause.⁴

When cartilage begins to degrade, the underlying bone surfaces start to exhibit changes. This process often leads to the formation of bony projections known as osteophytes or spurs. As the disease advances, it is common for muscle wasting and ligament weakening to occur. Typical symptoms of knee OA include pain during movement—especially in the morning—joint stiffness, limited range of motion, discomfort after prolonged periods of sitting or lying down, tenderness upon joint line palpation, and joint swelling.⁵

Blood tests can be used to identify the type of arthritis as a diagnostic tool. A simple X-ray is used to investigate cartilage degradation, joint space narrowing, the development of bone spurs, and to rule out other possible reasons for discomfort in the concerned joint. In order to gain visual information on the harm caused to the joint by OA,

a camera is implanted during an arthroscopy procedure.⁶ The medical professional's office can perform the arthrocentesis technique. Joint fluid samples are drawn using a sterile needle, and these samples are later tested for the presence of cartilage fragments, infections, or gout. An improved view of cartilage and other tissues is provided by MRI to help identify early anomalies that are indicative of osteoarthritis. X-rays find joint enlargement, osteophyte development, scleroderma subchondralis, Subchondral tumours, and early OA symptoms include a slight narrowing of the joint space. The joint line may disappear in cases of severe OA.⁷

Treatment for knee OA can be divided into two main categories: conservative and surgical. Among conservative approaches, physiotherapy-based exercise therapy is considered the primary intervention for managing knee OA. Physiotherapy generally includes patient education, therapeutic exercises, modification of daily activities, weight loss guidance, and the use of knee supports or braces.⁸ For individuals with symptomatic knee OA, the initial recommended treatments are patient education and physical therapy. Studies have shown that the most effective results are achieved when supervised physiotherapy sessions are complemented with a structured home-based exercise program. However, the benefits gained from exercise tend to diminish within six months if the routine is discontinued.⁹

Weight reduction proves advantageous at every stage of knee OA, especially in patients presenting with symptoms and a body mass index (BMI) of 25 or higher. The most effective weight management strategy involves dietary regulation along with participation in low-impact aerobic activities. In some cases, knee bracing may also be used in OA management. Such braces help redistribute mechanical loads away from the affected joint compartment. This technique can be particularly helpful in patients exhibiting varus or valgus knee deformities.¹⁰

Pharmacological management is one of the numerous interventions that are not dependent on physiotherapy. Acetaminophen medications that are non-steroidal anti-inflammatory drugs (NSAIDs), COX-2 blockers, Chondroitin sulphate and glucosamine, injections of corticosteroids, and Acid hyaluronic (HA).¹¹ For patients with symptomatic OA, drug therapy in conjunction with physical therapy should be the initial line of

treatment. There are many different NSAIDs available; however, due to their negative effects, care should be taken while prescribing NSAIDs ¹²

Surgical intervention may be considered when osteoarthritis-related knee pain cannot be adequately controlled through medical management and significantly disrupts daily life. Surgery is generally reserved for individuals with advanced stages of osteoarthritis. Various techniques, including minimally invasive joint replacement procedures, are available. Although surgery carries certain risks, it can be highly effective in relieving pain and restoring a degree of joint function in appropriately selected patients.¹³ Currently, there is a growing focus on the early detection, prevention, and management of the disease. Understanding the prevalence, incidence, and modifiable risk factors associated with knee osteoarthritis is essential for developing successful preventive strategies.¹⁴ The purpose of the study was to find out the relationship between the side step length and dynamic balance in patients with bilateral knee osteoarthritis.

METHODOLOGY

A cross-sectional study was conducted on 200 participants with bilateral knee osteoarthritis. The sample size was calculated by confidence level = 95% and 5% margin of error (Raosoft, 2016). The study settings were Allied Hospital, Reactive Rehabilitation Clinic, and Pro-health Rehab and Medical Centre. The sampling strategy used was non-probability convenience sampling. The duration of the study was 4 months. The participants of both genders with an age between 40-65 years, who can walk 10 meters unassisted, are willing to participate, and diagnosed with bilateral knee osteoarthritis, were included in the study.

Participants with a history of any neurological disorders that would affect balance, any history of joint replacement in lower limbs, which could affect balance, and Visual field defects were excluded from the study. Data was collected using a Berg Balance Scale, Side Step Length test, and Dynamic Gate Index from willing individuals after gaining consent from participants. Data was analysed by using SPSS version 27.0 by using descriptive statistics and the chi-square test were applied. Permission from the ethical committee of the university was obtained before the commencement of the study. Written informed

consent was taken from all the participants, and the data will remain confidential.

RESULTS

Descriptive statistics among 200 bilateral knee OA patients showed, 17 (17.9%) were male and 78 (82.1%) were female. The majority of participants, 8 (8.4%), were in the 45 to 50 years' age group, while 19 (20%) were in the 51 to 56 years' age group and 28 (29.5%), were in the 57 to 62 years' age group, while 40 (42.1%), were in the 63 to 68 years' age group. The mean±S.D of Berg Balance Scale, dynamic gate index & side step length was 3.185±0.959, 1.968±0.89, and 2.736±1.496, respectively. Out of the 200 participants, 4 participants (4.2%) had zero severe balance disturbance, 3 participants (3.2%) had 0-14 severe balance disturbance, 3 participants (3.2%) had 15-28 mild balance disturbance, 46 participants (48.4%) had 29-42 No balance disturbance and 39 participants (41.1%) had 42-56 good functional balance. This indicates that the majority of the subjects (48.4%) were not facing any balance disturbance.

The frequency distribution of the dynamic gait index revealed that 6 participants (6.3%) had severe impairment, 17 participants (17.9%) had moderate impairment, 50 participants (52.6%) had mild impairment, 18 participants (18.9%) had a normal index, and 4 participants (4.2%) had 4.00 index. This indicates that the majority of the subjects (52.6%) had mild impairment. Among the participants, 28 participants (29.5%) had poor side step length, 21 participants (22.1%) had fair side step length, 10 participants (10.5%) had average length, 20 participants (21.1%) had good side step length and 16 participants (16.8%) had high side step length which indicates that most of the involved participants suffer from poor side step length. A statistically significant association was

Table 1: Participants' demographics

Variables		Frequency (%)
Gender	Male	17(17.9%)
	Female	78(82.1%)
Age (years)	45-50	8(8.4%)
	51-56	19(20%)
	57-62	28(29.5%)
	63-68	40(42.1%)

observed between the Berg balance scale and other parameters, with p-values as follows: gender ($p=0.000$), age ($p=0.004$), indicating that is relation exists between gender and balance disturbance, age and balance disturbance respectively. A statistically significant association was observed between the Dynamic Gait Index and other parameters, with p-values as follows: gender ($p=0.284$), age ($p=0.004$), indicating that there is no relation between gender and impairment, while there is a correlation between age and impairment. A statistically significant association was observed between Side Step Length and other parameters, with p-values as follows: gender ($p=0.038$), age ($p=0.00$), indicating that is relation exists between gender and side step length, age and side step length respectively.

By the correlation between the Berg balance scale and side step length, participants with no disturbance of balance had poor side step length, while 12 participants with no disturbance of balance had high side step length. About 10 subjects with good balance had poor and good side step lengths, respectively. A statistically significant association showed that there is a relation between the Berg Balance Scale and the side step length of patients with knee osteoarthritis ($p=0.004$).

Following the correlation between dynamic gait index and side step length, 15, 10, and 13 participants with mild impairment had poor, fair, and high side step length, respectively. 5, 6, and 5 participants with normal gait index had poor, fair, and average side step length, respectively. The majority of the participants with mild impairment had poor side-step length. A statistically significant association showed that there is a correlation between the dynamic gait index and side step length of patients with knee osteoarthritis; $p=0.009$.

DISCUSSION

This cross-sectional study was designed to evaluate the connection between the dynamic gait index and side step length among patients with bilateral knee osteoarthritis. Patients were randomly recruited from Allied Hospital, Re+active Rehabilitation Clinic, and Pro Health Rehab and Medical Centre. The trial was carried out within 6 months of duration. A total of 95 subjects participated in this trial. Berg balance scale, side step length, and dynamic gait index were outcome measures used to calculate data from the participants. Results of this suggested that there is a relationship between the Berg balance scale and

Table 2: Statistics of Berg balance scale, dynamic gait index & side step length

Variable	Mean±S.D	Categories	Frequency (%)
Berg Balance Scale	3.18±0.95	0	4.2%
		0-14	3.2%
		15-28	3.2%
		29-42	48.4%
		42-56	41.1%
Dynamic Gait Index	1.96±0.89	Severe impairment	6.3%
		Moderate impairment	17.9%
		Mild impairment	52.6%
		Normal	18.9%
		4.00	4.2%
Side Step Length	2.73±1.49	<37 (Poor)	29.5%
		38-41 (Fair)	22.1%
		42-45 (Average)	10.5%
		46-49 (Good)	21.1%
		>50 (High)	16.8%

Table 3: Correlation of side step length with Berg balance scale and dynamic gait index

Variable 1	Variable 2	Pearson Chi-Square	p-value
Side Step Length	Berg Balance Scale	35.376a	0.004
	Dynamic Gait Index	32.216a	0.009

side-step length among patients enduring knee osteoarthritis. To evaluate dynamic balance in stroke survivors, a cross-sectional trial was conducted by Arju, Joshua.¹⁵ The main aim of the study was to find the connection between side step length and the Berg Balance Scale. A total of thirty patients were enrolled in this trial who were capable of walking. By the use of Spearman's rank correlation coefficient, a positive link was found between side step length and the Berg Balance Scale. The present trial was also drafted to explore the association between the Berg Balance Scale and side step length in patients with bilateral knee osteoarthritis. Outcomes demonstrate that there is a constructive linkage between balance disturbance and side-step length.

To assess dynamic balance in post-stroke hemiparetic patients, Vistamehr¹⁶ conducted a study that aimed to identify the link between the Berg Balance Scale, the Dynamic Gait Index, the margin of stability, and peak-to-peak range of angular momentum. 19 individuals recuperated from stroke were included in this study. Outcomes of this study reveal that there is poor control of balance in post-stroke hemiparetic patients. A moderate association was found between outcome measures. Current trial suggests that a positive linkage was found between balance disturbance and side step length in bilateral knee osteoarthritis patients.

Khalaj¹⁷ conducted a research study to find the balance and probability of falls in individuals suffering from lenient and moderate knee osteoarthritis. 60 subjects ranging between 50 and 70 years of age volunteered to participate in this study. These subjects were equally allocated into three groups. Group 1 includes participants without bilateral knee osteoarthritis, group 2 includes participants with mild knee osteoarthritis, and participants with moderate knee osteoarthritis were included in group 3. Bioindex

Stability System was used to assess static and dynamic balance and risk of fall, while the Time Up and Go test was also utilised for assessment of balance. Results of this study indicated that balance was impaired and the probability of falls was enhanced among patients suffering from bilateral knee osteoarthritis, especially those with moderate osteoarthritis. The current study proves that most of the patients enduring bilateral knee osteoarthritis had no disturbance of balance but were facing mild impairments. However, the majority of the individuals had poor side-step length.

This study manifests that patients suffering from bilateral knee osteoarthritis had poor side step length and mild impairment. There was a positive correlation between the Berg Balance Scale, side step length, and the dynamic gait index. Evidence from the literature also supports these findings. There are certain limitations to this experiment, even though it assesses the relationship between side-step length and dynamic balance in individuals with osteoarthritis in the knee. First, the survey had a limited sample size. Second, the study's duration was brief. With a larger sample size and a longer survey period, more research on this subject can be conducted. It is advised that medical practitioners rule out side-step length and balance issues in patients with osteoarthritis in the knee.

CONCLUSION

This study highlights a positive correlation between side-step length, the Berg balance scale, and the dynamic gait index in individuals with bilateral knee osteoarthritis. Most participants exhibited mild balance impairments and reduced side step length, supporting findings from previous research. The results emphasise the need for clinicians to assess dynamic balance and step length in knee osteoarthritis patients. Further studies with larger samples and longer durations are recommended to validate and expand upon these findings.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of Data and Materials: Data will be made available upon request. The corresponding

author will submit all dataset files.

Competing interests: None

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