

Gait Analysis and Falls between Persons with Knee Osteoarthritis and Non-Knee Osteoarthritis

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Keywords: Gait Analysis, Falls, Non-Obesity, Knee Osteoarthritis.

Abstract: Persons with knee osteoarthritis have a twenty-five percent higher risk of falling. It is important to evaluate the change of the walking pattern that leads to inadequate balance. This is a preliminary study with a cross-sectional design in 20 subjects men and women aged 50-70 years old. By consecutive sampling, the subjects were divided into 2 groups, non-obesity knee osteoarthritis (NOKO) group, and non obesity non osteoarthritis (NONO) group. TUG test and temporospatial gait analysis without EMG reading were done on each subject. An independent T-test is used to determine the difference of the two groups. NOKO group has differences in temporospatial gait parameters and TUG time, than NONO group. NOKO group have prolonged TUG, smaller step length, smaller stride length and more steps per minute than NONO group, but not statistically significant ($p > 0.05$). There were differences in Gait Patterns and Fall Risk between Non Obesity Knee OA and Non Obesity Non Knee OA patients.

1 INTRODUCTION

Falls can lead to major health problems. Around 30-40% of people have a history of falling. One of the many factors for falling risk is Osteoarthritis (OA). In Indonesia, the prevalence of OA reached 74,48% from all rheumatic cases in 2004, where 69% is a woman and 87% are knee OA cases (IRA, 2014).

Osteoarthritis (OA), known as joint degenerative disease, is typical of biochemical and morphological changes in synovial membranes, joint cartilages, and bones. The knee is a weight-bearing joint, that is why the knee is the most commonly affected by OA. The etiology of OA is multifactorial and a combination of local and systemic factors. Old age, overweight to obesity, knee injury, overuse of joints, bone density, muscle weakness, and joint laxity plays an important role in knee OA (Losina, 201).

Around 50% of 65 years of people and over give radiological features according to osteoarthritis, where 10% of men and 18% of women show clinical symptoms of OA, and about 10% experience disabilities because of their OA, and older the possibility to get OA is higher. (Losina et al., 2011).

The knee OA population has a 25% higher risk of falling. Several factors such as balance deficit and weakness of the lower limb muscles which ultimately cause changes in walking patterns can contribute to the risk of falling in knee OA (Pater ML et al., 2019). That is why the purpose of this study is to observe changes in walking patterns and see if there is a balance disturbance that can be seen through step length, stride length, step width, number of steps in certain time and track, and walking speed. So that medical staff can determine the abnormalities of the walking pattern and help them to correct it to reduce the risk of falling on knee OA patients.

2 METHODS

2.1 Ethical statement

This study was approved by the Medical Ethics Committee of the faculty of medicine, University of Indonesia (19-08-0953/Aug 2019). All participants read and signed a written consent form.

2.2 Participants

This study uses a cross-sectional design approach. Around 20 patients (male and female) were participated and evaluated. Selected patients were those who meet the following criteria; age between 50 to 70, Normoweight BMI (< 23 kg/m², WHO for Asia Pacific BMI Classification), knee OA (grade 1-3) and non-knee OA without other lower limb abnormality or problem, able to walk as far as 10 m.

2.3 Measurements

Balance and risk of falls were assessed with Time Up and Go (TUG) and gait analysis through the walking test. The first test requires the patients to sit on a chair and when instructed start to stand, walk forward along the 3 m track, turn at the end of the track, walk back to the chair, and finally sit on the chair again, while the examiner measures the time needed to complete the task using a stopwatch (Barry E et al., 2014).

The second test consisted of patients walking along a 10-meter long pathway of cloth on a flat floor. Patients were asked to sit in a chair, immerse their feet in blue ink, and were instructed to stand up and start walking along the pathway at their normal speed while the examiner calculated their walking time using a stopwatch. Meanwhile step width, step length, and stride length can be obtained by measuring the distance on the footprints using a ruler and number of steps by counting the number of steps in the first minute (Xiangping Li et al., 2012).

2.4 Statistical Analysis

All the data that have been obtained are processed, presented, and then analyzed using the SPSS program and performed using the independent t-test. The SPSS Statistics version 21 was used for all statistical analyses. A P-value ≤ 0.05 was considered significant. Besides, descriptive analysis was used to assess the mean and standard deviation (SD) of all variables.

3 RESULTS

Table 1 illustrates the means of characteristics of subjects used in this study. Among 20 people who have participated in this study, there were 3 (30%) men and 7 (70%) woman from non obesity non osteoarthritis (NONO) group, and 2 (20%) men and

8 (80%) woman from non obesity knee osteoarthritis (NOKO) group. The mean age from all the participants in both groups was 58 and 64 years old. The mean score for BMI was 20.71kg/m² and 21.87kg/m². From table 1, it can be concluded that the subject dominantly female, with non obesity knee osteoarthritis (NOKO) group, KL mostly grades 2 and 3.

Meanwhile, Table 2 illustrates the mean values of the Gait features on non obesity non osteoarthritis (NONO) group and non obesity knee osteoarthritis (NOKO) group subjects and the result of Independent t-test. The TUG test results of non-obesity non osteoarthritis (NONO) group mean scores were 10.026 seconds and non obesity knee osteoarthritis (NOKO) group were longer 11.98 seconds.

There were some differences in the mean score between the two groups. For step width in non obesity non osteoarthritis (NONO) group was 16.1cm and non obesity knee osteoarthritis (NOKO) group was 14.7cm. Step length in non obesity non osteoarthritis (NONO) group was 49.9cm and non obesity knee osteoarthritis (NOKO) group was 45cm, stride length in non obesity non osteoarthritis (NONO) was group 104.5cm and non obesity knee osteoarthritis (NOKO) group was 93.95cm, cadence 73x/min in non obesity non osteoarthritis (NONO) group and 77.7x/min for non obesity knee osteoarthritis (NOKO) group, and walking speed for non obesity non osteoarthritis (NONO) group was 0.63m/s and 0.61m/s for non obesity knee osteoarthritis (NOKO) group.

Table 1: Characteristics of subjects.

Variable	Groups	
	Non-knee OA N=10	Knee-OA N=10
Gender Man	30%	20%
Gender Woman	70%	80%
Age (years)	58.30 ± (7.33)	64.30 ± (5.25)
Weight (kg)	50.15 ± (6.37)	53.80 ± (4.04)
Height (m)	1.55 ± (0.07)	1.56 ± (0.05)
BMI (kg/m ²)	20.71 ± (2.36)	21.87 ± (1.06)

Based on the data shown in table 2, there were differences between non obesity knee osteoarthritis (NOKO) group and non obesity non osteoarthritis (NONO) group. It can be seen that non obesity knee osteoarthritis (NOKO) group have prolonged TUG, smaller step length, smaller stride length, and more steps per minute (cadence) than non obesity non

osteoarthritis (NONO) group, although not statistically significant ($p > 0.05$).

Table 2: Gait features and Independent t-test result in Non-knee OA and knee OA patients.

Variable Gait features	Groups		p-value
	Non-knee OA N=10	Knee-OA N=10	
TUG (second)	10.026 ± 2.12	11.98 ± 2.23	0.545
Width (cm)	16.1 ± 3.85	14.7 ± 3.32	0.396
Step Length (cm)	49.9 ± 8.97	45 ± 11.74	0.308
Stride Length (cm)	104.5 ± 12.03	93.95 ± 19.85	0.168
Cadence (x/minutes)	73 ± 19.22	77.7 ± 13.66	0.536
Walking Speed (m/s)	0.636 ± 0.19	0.613 ± 0.15	0.773

4 DISCUSSIONS

This study is preliminary. And according to our knowledge, there are still very few studies discuss this topic. The results in this study show that there was a difference in Gait Patterns and Fall Risk in Non-Obese Knee OA and Non-obese non Knee OA patients, although not statistically significant. This is not in line with Khalaj N et al. (2014) study, where total of 60 subjects participated in the study (20 male, 40 female) with the age of participants ranged from 50 to 69 years showed that there is a significant difference between three groups (healthy, mild knee OA, and moderate knee OA) in all the test. In general, the findings of Khalaj study supported that individuals with bilateral knee OA had impaired balanced compared to healthy controls, and this impairment was more pronounced in moderate knee OA patients (Khalaj N et al. 2014).

One of the explanatory factors for the variation of gait patterns in individuals with knee OA is the severity of knee pain. Pain associated with osteoarthritis of the knees increased the propensity to trip on an obstacle, and the greater the pain is associated with greater risk of falls. However, one study illustrated that knee pain is associated with poor balance in individuals with muscle weakness (Khalaj N et al. 2014). This can be measured through TUG test, where the subjects on the knee-OA group will take a longer time to complete the task compared to the non-OA group.

The differences in the result are because the subjects in this study were non-obese, which means there was no burden on the knees which plays the role of weight-bearing joints. So it will not be that hard to support the weight of the body and results.

There is a weakness or limitation on this study, it is the lack of subjects, when all the subject needed were 20 in each group subject which is 40 subjects in total, however, this study can only collect 20 subjects in total (10 each), so that the results are not as expected. The low participation in this study is influenced by many things including the difficulty of finding participants who met all inclusion criteria. Another disadvantage of this study is the use of calico cloth in the 10 m pathway test which is less sensitive in assessing walking parameters when compared to the gait analyzer.

5 CONCLUSIONS

The purpose of this study is to see gait patterns in patients to reduce the high risk of falling. Improving the postural stability of older adults with knee OA has become an important challenge for the medical practitioner. Establishing these data have implications in planning rehabilitation programs and will enable the practitioner to customize their rehabilitation strategies.

The results in this study show that there was a difference in Gait Patterns and Fall Risk between two groups with every 10 subjects, although not statistically significant. Therefore further study with more subjects needed to determine the difference in gait patterns and the risk of falling in the subjects.

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