

The Degree of Radiographic Abnormalities and Postural Instability in Patients with Knee Osteoarthritis

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ABSTRACT

Aim: to determine the degree of radiographic abnormalities based on Kellgren-Lawrence criteria, to determine posturography features in patients with knee OA.

Methods: ninety nine subjects were recruited by consecutive sampling at the outpatient clinic of Internal Medicine in Cipto Mangunkusumo Hospital. History taking and physical examination including rheumatology examination were conducted, followed by knee radiographic examination in weight bearing and 30 degree skyline position. A cross sectional design was performed to evaluate the variable results for degree of radiologic abnormalities and posturography results.

Results: the subjects were 79.8% women and 20.2% men, mostly > 60 year-old (78.8%), with low education 76.8%, BMI > 23 74.7%, mean value of active VAS was 5.4, mean value of passive VAS 2.8. Mild radiographic abnormality was found in 77.8% subjects, and the others were severe, i.e. 22.2%. There were increase in length of postural sway, increase of postural sway velocity, and increase in area of postural sway in patients with knee OA compared with normal subjects with 40-60 years old.

Conclusion: there is an increase in nearly all variables of posturography in patients with knee OA.

Key words: knee OA, Kellgren-Lawrence criteria, posturography.

INTRODUCTION

Knee osteoarthritis (knee OA) is the most prevalent musculoskeletal disorder in the community, affecting 30-40% of the population by the age of 65 years.¹ One of four patients over 55 years old has complained of knee pain, and at the age of 65 years old, 30% men and 40% women have abnormalities of knee radiograph.² Approximately 56.7% patients at the outpatient clinic of Rheumatology Department, in Cipto Mangunkusumo Hospital have been diagnosed with one of OA variants.³

In patients with knee OA, there are some changes, not only in intracapsular tissue but also in periarticular tissues such as ligaments, joint capsule, tendon, and muscles. Individuals with knee OA have also known to have proprioceptive impairment compared to normal individual at similar age, and based on histological features of ligament tissue, there is a significant decline of mechanoreceptor. Knee OA is also associated with a 50-60% reduction in quadriceps strength, which is probably caused by disuse atrophy and arthrogenic inhibition.⁴

As the proprioceptive impairment has been revealed in patients with knee OA, it is highly assumed that postural control abnormalities may also occur along with all of the consequences. Postural control is an important function of all posture and situation, either static or dynamic. One of the evaluations that may assume any postural control abnormalities is posturography. Posturography is an instrument that can evaluate individual postural balance, either quantitative or qualitative. The evaluation is performed based on postural sway pattern and a shift of gravitational centre of the body on its base support.

The studies at present could only reveal that there is balance impairment in knee OA, but have not found the reason. Previous data are conflicting and has not explained all of the phenomena. Moreover, there have not been any study in Indonesia that particularly evaluates the posturography parameters in patients with knee OA.

By revealing the impact of knee OA on postural control, we will gain further knowledge on the underlying mechanism of disability and impairment; therefore, it will provide a more comprehensive, holistic, multidisciplinary, accurate and effective treatment. Clinicians are expected to have special vigilance with such problems; therefore, disability and impairment can be early anticipated. In the future, the treatment for patients with OA will not be limited on the drug prescription but also a prescription containing balance exercise, physical exercise, etc. that certainly will be adjusted to the patient's need.

METHODS

A cross-sectional study design was applied in this study to recognize the degree of radiographic abnormalities and postural instability (posturography parameters) in knee OA. The study was conducted at Division of Rheumatology, Department of Internal Medicine, Faculty of Medicine, Cipto Mangunkusumo Hospital. Sampling was conducted since May 2006 to December 2006. The study samples were determined by non probability sampling through consecutive sampling techniques.

The Inclusion Criteria

The inclusion criteria were: the willing to participate in the study after having an explanation on study protocol, patients with knee OA in keeping with ACR criteria (American College of Rheumatology), and who were able to be evaluated by posturography.

The Exclusion Criteria

The exclusion criteria were: history of recurrent fall in a faint, history of vertigo, Parkinson and parkinsonism, stroke, hearing loss accompanied with disequilibrium, uncorrected vision disorder, other conditions that may impair the body balance, patients with extremity abnormalities so that they can not be evaluated by posturography.

The main objective of this study was to observe the degree of radiographic abnormalities and the result of posturography in patients with knee OA; therefore, the following formula was applied:

$$n = (z\alpha)^2 \frac{PQ}{d^2}$$

Notes: $z\alpha = 1.96$; $P = 0.5$; $d = 0.1$

Based on the abovementioned formula, the sample needed would be 96.

Furthermore, the collected data were analyzed statistically by using SPSS version 12; while the hypothesis test was adjusted to the data characteristics.

RESULTS

The study subjects who were willing to participate in the study were at age 43-82 years and the mean age was 64.8 years. The age group of more than 60 years was predominant, i.e. 78.7%. Female was more frequent (79.8%), as is always mentioned in the literatures that overall there were more females who suffered from knee OA. The subject's education level still indicated the characteristic of developing countries, i.e. most subjects were of elementary to high school education (76.8%).

BMI that indicated the body weight of subjects was also in accordance with the nature of knee OA, i.e. frequently occurred in patients who were overweight. There were 74.7% study subjects who were overweight ($BMI \geq 23$).

The active VAS was obvious in the groups with moderate to severe pain (82.8%); while the passive VAS was pooled in the mild to moderate pain group (97%).

The study results on the degree of radiographic abnormalities based on Kellgren-Lawrence criteria indicated that most subjects (77.8%) had mild degree (grade 1 and 2); while others (22.2%) had severe stage of radiographic abnormalities (grade 3 and 4).

All variables of the posturography parameters demonstrated that when all of the equilibrium system (vestibular, visual, and proprioceptive) was regarded functional then the variables value (length of postural sway, postural sway velocity, area of postural sway) had become the best (smaller value) than when only vestibular and proprioceptive system regarded as functional (closed eyes); or compared to when only vestibular and visual system regarded as functional (with rubber); as well as when only vestibular system regarded as functional (eye closed and using rubber).

Based on the above table, we found no statistically significant difference in BMI between the group with mild radiographic grade and the severe one. Moreover, there was no significant difference in age variables among the group of Kellgren-Lawrence 1 and 2 with group 3 and 4.

DISCUSSION

There were a lot more female subjects compared to male in this study (79.8% vs. 20.2%), and mostly were at age more than 60 years (78.7%). Before

Table 1. Subject characteristics

Characteristics	N	%
Sex		
- Male	20	20.2
- female	79	79.8
Age group		
- < 60 years	21	21.1
- 60 – 69 years	44	44.4
- ≥ 70 years	34	34.3
Education		
- Elementary-high school	76	76.8
- University	23	23.2
BMI		
- < 23	25	25.3
- ≥ 23	74	74.7
Active VAS		
- Mild	17	17.2
- Moderate	64	64.6
- Severe	18	18.2
Passive VAS		
- Mild	70	70.7
- Moderate	26	26.3
- Severe	3	3.0
Kellgren-Lawrence Criteria		
- Mild	77	77.8
- Severe	22	22.2

Notes: VAS=visual analogue scal, BMI=body mass index

Table 2. Variable mean value and standard deviation

Variables	Mean	SD	95% CI		Median
			Low	High	
Age	64.8	8.9	63.1	66.6	65.0
BMI	24.8	3.2	24.1	25.4	24.0
Active VAS	5.4	2.1	4.9	5.8	5.0
Passive VAS	2.8	1.8	2.5	3.2	2.0
LEOTR	112.9	44.8	104.1	121.8	100.7
LECTR	167.4	89.0	149.8	184.9	146.2
LEOR	149.0	69.9	135.3	162.8	128.8
LECR	232.1	121.4	208.2	256.1	197.5
LTEOTR	1.9	0.7	1.7	2.0	1.7
LTECTR	2.8	1.5	2.5	3.1	2.4
LTEOR	2.5	1.1	2.3	2.7	2.2
LTECR	3.9	2.0	3.5	4.3	3.3
ENVEOTR	5.1	2.8	4.6	5.6	4.3
ENVECTR	7.8	5.9	6.7	9.0	6.1
ENVEOR	7.4	3.7	6.7	8.1	6.5
ENVECR	14.8	10.8	12.7	17.0	11.3
RQTR	1.5	0.4	1.4	1.5	1.4
RQR	1.5	0.4	1.5	1.6	1.5

LEOTR: length eye open without rubber, LECTR: length eye close without rubber, LEOR: length eye open with rubber, LECR: length eye close with rubber, LTEOTR: length/time eye open without rubber, LTECTR: length/time eye close without rubber, LTEOR: length/time eye open with rubber, LTECR: length/time eye close with rubber, ENVEOTR: envelope eye open without rubber, ENVECTR: envelope eye close without rubber, ENVEOR: envelope eye open with rubber, ENVECR: envelope eye close with rubber, RQTR: romberg quotation without rubber, RQR: romberg quotation with rubber

Table 3. Correlation between the Kellgren-Lawrence criteria and variables of age and BMI

Variables	Kellgren-Lawrence criteria				P
	Mild (n=77)		Severe (n=22)		
	Mean	SD	Mean	SD	
Age	64.44	9.27	66.23	7.28	0.408
BMI	24.39	2.89	26.09	3.97	0.028

Notes: student t-test

reaching the age of 50 years, the prevalence of knee OA was higher in male; while at the age over 50 years, it was more frequent in female subjects. The literatures have mentioned that old-female, particularly who has experienced menopause stage, has a higher risk of knee OA.⁵ The biochemical effect of sex hormone on cartilages has been considered to have an important role on the occurrence of OA. However, there are different results for each study, and the role of sex hormone was varied on the menopause status and OA grading.⁵

The BMI evaluation has indicated that most subjects were overweight according to the Perkeni criteria (74.7%), which is appropriate to the theory, i.e. overweight is one of risk factors in knee OA. A study by David Felson et al found that reduced BMI more than 2 points for over ten years prior to current examination will decrease the risk of OA as much as 50%.⁶

A study by Thumbor et al found that the patients with knee OA who had good education level apparently had better functional scores and pain scores. Most subjects in the present study have low education level (76.8%); however, we still can not draw any distinct conclusion that the pain score will be higher in patients who have lower education level.

The VAS (visual analogue scale) applied in this study demonstrated that knee OA pain was more severe during activity (82.8% of moderate and severe pain). Hinman et al found that the mean of pain score during activity was 5.0 compared to 3.0 during rest. In the present study, the mean VAS active was 5.4; while VAS passive was 2.8. Studies by Hinman et al¹ and Bennell⁷ found that there was no correlation between the quality of pain and balance deficit; while Hassan et al found that pain is an important predictor for posturography result.⁸ However, another study conducted by Hassan also found that reduced pain in OA has no impact on improvement of balance status.

The Kellgren-Lawrence criteria, which was applied in the present study to determine the degree of joint damage, have shown that most subjects had mild degree (grade 1 and 2), i.e. 77.8%; while the study by Hinman et al demonstrated that grade 3 and 4 were more

dominant, i.e. 82%.¹ A study by Setiyohadi also indicated that grade 1 and 2 were also dominant in the study subjects (99.12%). There are several differences in subject characteristics between the present study and the study by Hinman et al, i.e. mean age of study subjects in Hinman study was 68.1 years; while in the present study, it was 64.8 years. There are also differences in BMI, i.e. 28.6 kg/m² in the study by Hinman et al and 24.8 kg/m² in the present study.

Although we were not specifically evaluating the correlation between the degree of radiographic abnormalities and the pain score; we found different result compared to other studies. The study by Hinman et al, demonstrated similar result in the mean value of active and passive VAS to the present study (5 and 3 in the study by Hinman et al vs. 5.4 and 2.8 in the present study). However, there was more frequent severe joint damage (grade 3 and 4) compared to the present study (82% vs. 22.2%). The literatures have mentioned that the proportional relationship between the severity of radiographic abnormalities and pain symptoms does not always occur. There are only approximately 40-80% patients who have positive radiographic abnormalities that also have symptoms.⁹ Of all available radiographic variables, osteophytes is the variable which has the best correlation to the pain; while Kellgren-Lawrence criteria also depend on osteophytes finding for the classification.

Until now, no recommended value for it available for posterography results in patients with knee OA. Basically, in balance disorder, there will be increased postural sway length (*length*), increased postural sway velocity (*length/time*), and widened postural sway area (*envelope area*).

In general, we found increased mean value of postural sway length, as well as postural sway velocity and postural sway area in the subjects of this study compared to posturography value for subjects at the age of 40-60 years. However, no final conclusion can be withdrawn, whether there has been balance disorder in the subjects of this since the mean age of study subjects are 64.8 years, while the recommended value are for age 40-60 years.

In length variables (postural sway length) we found the mean LECR>LECTR>LEOR>LEOTR. Similar pattern was also found for length per time and envelope area variables, i.e. LTECR > LTECTR > LTEOR > LTEOTR and the mean ENVECR was higher than ENVECTR > ENVEOR > ENVEOTR. Of the three posturography variables, we found similar pattern, i.e. posturography results for each variables during the eyes closed with rubber were worse than during the eye closed

without rubber; it was worse than during the eye opened with and without rubber (ECR>ECTR>EOR>EOTR). Based on the abovementioned result, we learned that to maintain postural balance, visual system has more important role compared to proprioceptive with the assumption that the vestibular functions are mutually normal. Unlike the posturography result for adult male at the age of 40-60 years, there was greater value in envelope area variables during the eye opened with rubber compared to the eye closed without rubber. (ENVEOR>ENVECTR).

A study by Hassan et al found that there was increased postural sway in patients with knee OA during the eye closed and opened with rubber.¹⁰ While Hurley et al have not demonstrated any increased in postural sway; although they found that it was more unstable in the groups with OA.¹¹

The present study has not evaluated the proprioceptive acuity, whereas posturography has intense correlation with proprioceptive problem. Therefore, there is still a question whether joint destruction will disturb the proprioceptive. If the joint damage does correlated to proprioceptive disorder, what are the factors of such joint destruction that will have direct correlation to proprioceptive disorder. Hence, it will be better if we also conduct a study that evaluate factors on joint destruction that correlate to proprioceptive disorder.

Since there has not been any normal value of posturography in population with OA, it will be better if the study design is a case-control study.¹²

CONCLUSION

This study found that there was a greater degree of radiographic abnormalities of knee OA by the Kellgren-Lawrence criteria which were mild grade compared to severe grade (77.8% vs. 22.2%). Based on posturography results there are increased postural sway length, postural sway velocity as well as postural sway area in patients with knee OA compared to normal people at the age of 40-60 years.

Patients with unstable OA should be referred to participate in balance exercises. Further studies are necessary in order to find the range of normal values for posturography results in the general population and particularly, patients with knee OA or studies with the appropriate normal control (case-control study). Moreover, further studies are also necessary to recognize whether knee OA will independently cause balance disorder, as well as to recognize what determinant factors of knee OA that may cause balance disorder. Likewise, how far such a balance disorder will affect functional impairment in patients.

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