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Pain Deterioration Within 1 Year Predicts Future Decline of Walking Ability: A 7-Year Prospective Observational Study of Elderly Female Patients With Knee Osteoarthritis Living in a Rural District

Naoki Yamaguchi, MD[1], Tsuneari Takahashi, MD, PhD[2], Takashi Ueno, MD[3], Shuhei Hiyama, MD[1], Masaya Ogawa, MD[4], Tomohiro Matsumura, MD[2], Hideyuki Sasanuma, MD, PhD[5], and Katsushi Takeshita, MD, PhD[2]

Abstract

Introduction: Knee osteoarthritis (KOA) is commonly a main cause of locomotive syndrome. Consequently, appropriate timing of intervention is clinically important. **Materials and Method:** Fifty female patients of a primary care clinic in a rural district fulfilled the criteria for KOA and were recruited and underwent knee medical checkups. They initially underwent physical examination bilaterally of knees by an orthopedic surgeon, radiological evaluation, and they answered the outcome of Japanese Knee Osteoarthritis Measurement (JKOM). They were asked to answer JKOM 1 and 7 years after the initial checkup. Fourteen patients were lost to follow-up due to death or moving to a nursing home. Thirty-six patients were finally included and divided into 2 age-matched groups according to walking ability at the 7-year follow-up: group A, walking ability did not decline (n = 24), and group B, walking ability did decline (n = 12). The walking ability was measured as per ordinal classification as: 5 (walking without any aid), 4 (walking with a crutch), 3 (walking using walker), 2 (walking only possible in parallel bars), and 1 (wheelchair). We completed between-group comparisons of each of the 3 subsections of the JKOM (pain, limitation in mobility related to daily activity, and restriction of participation in social life and health perception), during each period. **Results:** There were significant differences in JKOM pain score (12.9 vs 18.3, $P = .0058$) and total score (41.3 vs 55.8, $P = .0093$) between the groups at 1-year follow-up, even though base scores did not differ. **Discussion:** Clinicians should pay attention to changes in perceived knee pain and should not continue prolonged conservative therapy in patients exhibiting rapid deterioration. **Conclusion:** Female patients with KOA whose pain deteriorated within 1 year may require early intervention to prevent future decline in walking ability.

Keywords

Kellgren-Lawrence, knee osteoarthritis, Japanese knee osteoarthritis measurement, activities of daily living, locomotive syndrome

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Introduction

Musculoskeletal disorders such as osteoporosis (OP) and osteoarthritis (OA) deteriorate mobility of the aged population. As the population in Japan ages, fractures due to OP or OA are top ranked as reasons related to disability.[1] In addition, sarcopenia is associated with increased risk of falling, and elderly individuals will frequently exhibit fall-induced fractures.[2] The Japanese Orthopedic Association described "locomotive syndrome," (LS) as decreased walking ability due to musculoskeletal disorders and/or sarcopenia and suggested the

[1] Department of Orthopedic Surgery, Haga Red Cross Hospital, Moka, Japan
[2] Department of Orthopedic Surgery, Jichi Medical University, Shimotsuke, Japan
[3] Department of Gastroenterology, Jichi Medical University, Shimotsuke, Japan
[4] The Center for Graduate Medical Education, Shimane Prefectural Central Hospital, Izumo, Japan
[5] Department of Sports and Health Medicine, Tochigi Medical Center Shimotsuga, Tochigi, Japan

Corresponding Author:
Tsuneari Takahashi, Department of Orthopedic Surgery, Jichi Medical University, 3311-1 Yakushiji, Shimotsuke, Tochigi, Japan.
Email: tsuneari9@jichi.ac.jp

importance of elderly individuals maintaining walking ability in order to maintain a healthy life expectancy.[3]

Knee osteoarthritis (KOA) is the most common musculoskeletal disease, affecting approximately 4% of the world's population,[4] and it is estimated that there are more than 25 000 000 patients with radiographic KOA who are older than 40 years of age in Japan.[5] Care and prevention of KOA helps prevent LS.[6] However, little is known about the natural course of KOA in Japan since the gold standard treatment for KOA is knee replacement (KR) after failed initial conservative treatment. Kawata et al identified over 180 000 cases of KR from a patient database in Japan between 2007 and 2015,[7] even though there are still concerns regarding the cost-effectiveness of KR for KOA.[8-10] In addition, it is estimated that up to 20% of patients with KR have suboptimal outcomes.[11,12] So, careful patient selection is necessary to optimize the clinical and economical aspects of KR for patients with KOA.[8]

Thorstensson et al found that onset of knee pain could predict future development of KOA.[13] Hernborg et al described that early onset of KOA is unfavorable and is associated with development of pain that worsens over the years.[14] However, following an exhaustive literature search, we found no studies of how progressive pain, in patients with KOA, affects the prognosis of walking ability within short-term periods if patients do not undergo any surgical interventions. This question requires clarification because large health gains are potentially realizable from public health and policy measures aimed at decreasing progression, pain, and disability associated with KOA.[15] It is economically important, as well as important for preserving the mobility of patients without unnecessary interventions, for these unanswered questions to be clarified.

Therefore, we have conducted the prospective observational study of patients with KOA who live in rural districts where there are no orthopedic surgeons. In these settings, most patients are followed by primary care clinics, usually operated by family physicians. The hypothesis of our study was that short-term pain deterioration can predict decline of walking ability after longer term follow-up.

Materials and Methods

Knee medical checkups were performed for patients of a primary care clinic in a rural district in 2008. The population of the district was 250 and approximately 72% of the population was older than 65 years of age. The clinic was usually operated by a family physician. One hundred patients regularly visited once every 2 weeks. They initially underwent physical examinations of both knees by an orthopedic surgeon, radiological evaluation including Kellgren-Lawrence (KL) grading, and completed the Japanese Knee Osteoarthritis Measurement (JKOM) questionnaire.[16] Importantly, a central activity of daily living (ADL) of Japanese people involves crouching, using deep knee flexion. This activity is highly affected by the symptoms of KOA. Japanese Knee Osteoarthritis Measurement is a self-administered questionnaire and consists of 25 items (each item is scored 1 to 5 points, with 25 the best possible score and 125 the worst possible score). Specifically, the questionnaire assesses: (1) pain level during walking, standing, or climbing stairs; (2) physical ADL functions; and (3) social functions, including social participation. It has been validated for use on patients with KOA using the Short Form-36 and the Western Ontario and McMaster Universities Osteoarthritis Index.[17] The diagnosis of KOA was based on a radiological evaluation. Cases with KL grade >2 were diagnosed with KOA.[18]

Inclusion criteria were patients >65 years old at the time of initial knee medical checkup; diagnosis of KOA by radiological evaluation; and patients who could walk unaided, or with 1 hand cane. Exclusion criteria were patients who had already undergone KR at the time of initial knee medical checkup; patients who complained of knee pain without radiological evidence of KOA; and patients who could not walk without aid, except for 1 hand cane.

Fifty female patients who regularly visited this clinic fulfilled the criteria of KOA and were recruited for this study. There were initially no patients with neurological or proprioceptive disorders confirmed by their family physician. They started receiving medication such as oral analgesics and/or intra-articular hyaluronic injections after diagnosis. They were asked to complete the JKOM 1 year from the initial checkup. Fourteen out of 50 patients were lost to follow-up due to death (7 patients), or moving to nursing home (1 patient), and the rest for reasons unknown (6 patients). So finally, 36 patients were included in the study. We had confirmed that none of 36 patients developed any additional disease contacting with family physician in that clinic during the study periods. The patients were divided into 2 groups according to walking ability at the time of the 7-year follow-up: group A, walking ability did not decline from baseline ($n = 24$, averaged age: 76.8 ± 6.8 years), and group B, walking ability declined from baseline ($n = 12$, averaged age: 78.6 ± 6.6 years; Figure 1). Walking ability was stratified according to a 5-point scale: 5 points, walking without any aid; 4 points, walking with cane; 3 points, walking in parallel bars; 2 points, walking with a walker; and 1 point, wheelchair. The groups did not differ concerning age, weight, and body mass index. On the other hand, there was significant difference between the groups concerning height at the time of 7-year follow-up (Table 1).

Statistical Analysis

Data are presented as the mean and standard deviation. Student *t* test was used to compare the numerical data. Fisher exact test was used to compare the distribution of radiological grade of KOA. All statistical analyses were performed using EZR software (http://www.jichi.ac.jp/saitama-sct/SaitamaHP.files/statmed.html).[19] A priori sample size calculation for primary outcome was performed and the significance level was set at $P < .05$. The power analysis for an α error of 0.05, and an effect size of 0.8 was calculated (using G_Power 3.1, Franz Paul, Kiel, Germany). A power analysis calculated a β error of 0.4 (ie, the power was 0.6) with 24 patients in group A and 12

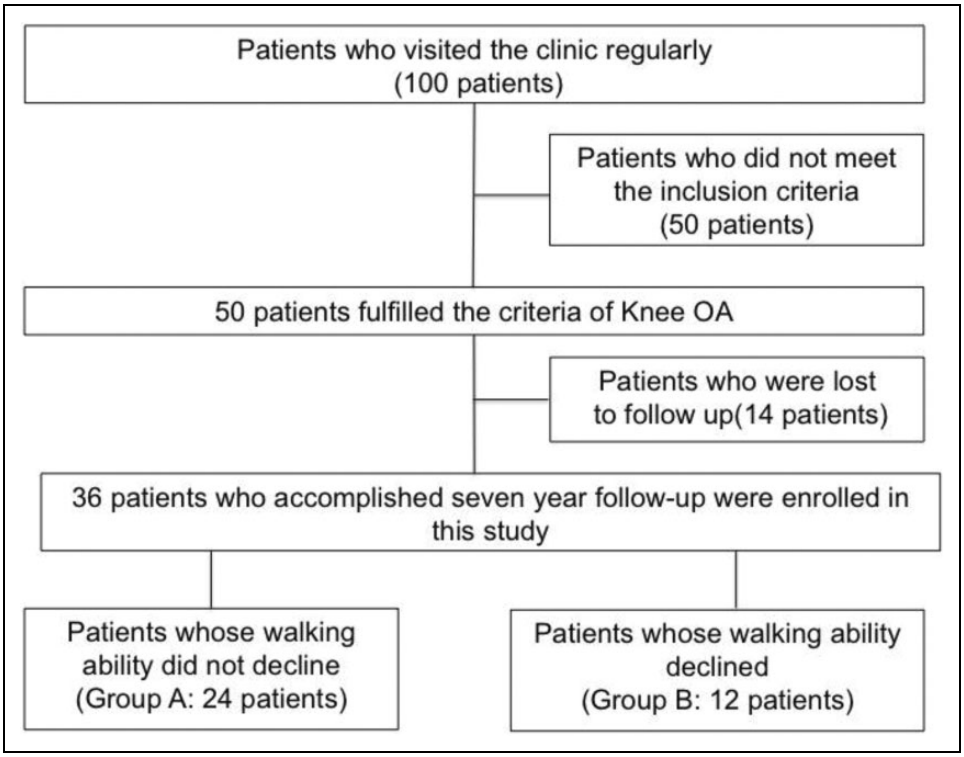

Figure 1. Patient enrollment.

Table 1. Patient Demographics Between the Groups.[a]

	Group A	Group B	*P* Value
Age	76.8 (6.9)	78.6 (6.6)	.42
Height	148.6 (6.0)	144.0 (6.2)	.046
Weight	52.0 (8.6)	53.5 (13.7)	.75
BMI	23.5 (3.1)	25.4 (7.2)	.27

Abbreviation: BMI, body mass index.
[a]Data are expressed as average (standard deviation).

Table 2. Differences Between the Groups With Regard to Radiological Evaluation of KOA.

	KL Grade 2	KL Grade 3	KL Grade 4	*P* Value
Group A	20	4	0	.35
Group B	8	3	1	

Abbreviations: KL, Kellgren-Lawrence; KOA, knee osteoarthritis.

patients in group B. Walking ability at 1- and 7-year follow-up and points for each of the 3 subsections of the JKOM at 1-year follow-up were compared between the groups.

Results

Radiological Evaluation of the Knee

There were no significant differences between the groups with regard to KL grade ($P = .35$; Table 2).

Table 3. Differences Between the Groups Concerning Baseline JKOM Scores.[a]

	Group A	Group B	*P* Value
Pain	11.9 (3.3)	12.4 (4.2)	.73
Physical function	14.6 (3.6)	19.2 (8.3)	.051
Social function	11.3 (1.9)	13.9 (5.8)	.092
JKOM	37.8 (7.7)	45.5 (15.9)	.092

Abbreviation: JKOM, Japanese knee osteoarthritis measurement.
[a]Data are expressed as average (standard deviation).

Baseline JKOM Scores

There were no significant differences between the groups concerning baseline JKOM pain scores (11.9 $\pm$ 3.3 vs 12.4 $\pm$ 4.2, $P = .73$), JKOM physical function scores (14.6 $\pm$ 3.6 vs 19.2 $\pm$ 8.3, $P = .051$), JKOM social function scores (11.3 $\pm$ 1.9 vs 13.9 $\pm$ 5.8, $P = .092$), and JKOM total scores (37.8 $\pm$ 7.7 vs 45.5 $\pm$ 15.9, $P = .092$; Table 3).

Japanese Knee Osteoarthritis Measurement Scores at the Time of 1-Year Follow-Up

There were significant differences between the groups with regard to JKOM pain scores (12.9 $\pm$ 4.3 vs 18.3 $\pm$ 6.7, $P = .0058$), JKOM physical function scores (15.5 $\pm$ 5.0 vs 21.6 $\pm$ 8.1, $P = .0082$), and JKOM total scores (41.3 $\pm$ 12.7 vs 55.8 $\pm$ 18.4, $P = .0093$) at the time of 1-year follow-up. On the other hand, there was no significant difference between the

Table 4. Differences Between the Groups Concerning JKOM Scores at the Time of 1-Year Follow-Up.[a]

	Group A	Group B	*P* Value
Pain	12.9 (4.3)	18.3 (6.7)	.0058
Physical function	15.5 (5.0)	21.6 (8.1)	.0082
Social function	13.0 (3.9)	15.8 (5.3)	.073
JKOM total score	41.3 (12.7)	55.8 (18.4)	.0093

Abbreviation: JKOM, Japanese knee osteoarthritis measurement.
[a]Data are expressed as average (standard deviation).

Table 5. Change of Each Score of JKOM During 1-Year Follow-Up.[a]

Pain	Baseline	1-Year F/U	*P* Value
Group A	11.9 (3.3)	12.9 (4.3)	.13
Group B	12.4 (4.2)	18.3 (6.7)	.010
Physical	Baseline	1-Year F/U	*P* Value
Group A	14.6 (3.6)	15.5 (5.0)	.33
Group B	19.2 (8.3)	21.6 (8.1)	.25
Social	Baseline	1-Year F/U	*P* Value
Group A	11.3 (1.9)	13.0 (3.9)	.026
Group B	13.9 (5.8)	15.8 (5.3)	.14
JKOM	Baseline	1-Year F/U	*P* Value
Group A	37.8 (7.7)	41.3 (12.7)	.072
Group B	45.5 (15.9)	55.8 (18.4)	.053

Abbreviation: F/U, follow-up; JKOM, Japanese knee osteoarthritis measurement.
[a]Data are expressed as average (standard deviation).

groups concerning JKOM social function scores (13.0 $\pm$ 3.9 vs 15.8 $\pm$ 5.3, $P = .073$; Table 4).

Change of Each Score During 1-Year Follow-Up

Averaged scores of all 3 parameters and JKOM total scores in 2 groups declined by the time of 1-year follow-up (Table 5). However, only JKOM pain score in group B and JKOM social function score in group A exhibited significant declines.

Walking Ability of the Patients at Baseline, 1-Year, and 7-Year Follow-Up

Decline in walking ability was not observed in all patients of groups A and B at the time of 1-year follow-up. Looking at the patients in group A, 95.8% (23/24) could walk unaided at the time of initial checkup and walking ability did not decline during the 7-year follow-up. On the other hand, 91.7% (11/12) of the patients in Group B could walk unaided at the time of initial checkup, but walking ability declined during the 7-year follow-up. However, only 58.3% (7/12) of the patients could walk with a one-handed cane and, for the rest of the patients, walking ability declined to 2 points (3 patients) and 1 point (2 patients).

Discussion

The main findings of this study were: (1) patients whose knee pain deteriorated within 1 year also reported whose physical function score of JKOM at the time of 1-year follow-up; (2) deterioration of pain score, compared with baseline, was observed in patients whose walking ability deteriorated by the time of 7-year follow-up; and (3) over 40% of the patients whose knee pain deteriorated by the 1-year follow-up were unable to walk by the 7-year follow-up.

There are currently only a few reports about the natural course of KOA. Thorstensson et al described that 90% of the patients with clinical KOA and 78% without clinical KOA developed tibiofemoral OA over a 12-year follow-up period.[13] Felson et al noted that bone marrow edema was a risk factor for deterioration in patients with KOA.[20] However, the above studies did not focus on clinical findings, but rather on radiological evaluations. There are no studies of how short-term changes in pain perception affect walking ability after longer follow-up. This might be because the majority of patients with painful KOA tend to have elective orthopedic surgery.[21] In our study, over 40% of the patients whose knee pain worsened within 1-year follow-up were unable to walk by the 7-year follow-up, even though they had not developed any other additional diseases. The average pain score on the JKOM for group B was 18.3 and pain deterioration in group B was nearly 5 points. This change means many patients went from best to worst score on one question as the pain score in the JKOM varies from 8 (best) to 40 (worst). Wright et al found that the density of orthopedic surgeons and referring physicians was the dominant factor that affected care for patients with KOA.[22] So general physicians in areas where the density of orthopedic and referring physicians is low should pay careful attention to their patients' perceived pain levels and refer rapidly deteriorating patients to orthopedic surgeons for further management. However, in developing countries, it can be difficult for patients or general physicians to locate a specialist, particularly orthopedic surgeons.[23] Consequently, orthopedic surgeons and referring physicians should also inform patients and general physicians of the importance of early interventions such as physiotherapy or elective surgery if needed for the patients with KOA who complain of worsening pain within the short term and the efficacy of early intervention to prevent declination of ADL is our future interest.

There were several limitations to this study. Firstly, only female patients fulfilled the inclusion criteria because there were few male patients. The prevalence of KOA is reported to be much higher in female than in male populations. As a result, our findings should not be directly interpreted for male patients. Secondly, the number of patients included was low. However, in this district, there were an estimated 180 individuals over 65 years of age, and over half of the aged population (100/180) underwent screening by the orthopedic surgeon. Thirdly, power of this study was low according to small number of patients; there was a certain possibility of false-negative results. Fourthly, radiological evaluation of KOA was only

performed at the time of initial checkup. Fifthly, there was significant difference in patients' heights at the time of the 7-year follow-up. Height loss in the aged population might be caused by progression of spinal OP, which may affect walking ability.[24] On the other hand, however, the study by Paradowski et al describes that weight, not height, is more likely to affect knee function and pain.[25] So, further studies are needed to determine whether change of posture due to height loss affects perceived knee pain in patients with KOA.

Beyond these limitations, this prospective observational study clarified the natural course of patients with KOA whose pain worsened within the short term. Early intervention to prevent decline of walking ability may be beneficial for those patients, so clinicians should pay attention to changes in perceived knee pain and should not continue prolonged conservative therapy in patients exhibiting rapid deterioration.

Conclusion

Patients with KOA whose pain deteriorated within 1 year may need early intervention to prevent future declines in walking ability.

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Declaration of Conflicting Interests

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ORCID iD

Tsuneari Takahashi, MD, PhD http://orcid.org/0000-0002-4198-6684

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