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Association of Varus Thrust With Pain and Stiffness and Activities of Daily Living in Patients With Medial Knee Osteoarthritis

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Background. Increasing evidence highlights potential associations between varus thrust and health domains associated with knee osteoarthritis (OA).

Objective. The aim of this study was to investigate the association between varus thrust and 2 subcategories—"pain and stiffness" and "activities of daily living (ADL)"—of the Japanese Knee Osteoarthritis Measure (JKOM).

Design. This was a cross-sectional study.

Methods. In total, 296 outpatients with knee OA visiting orthopedic clinics were enrolled. The inclusion criteria were age ≥ 50 years, medial knee OA and Kellgren-Lawrence (K/L) grade ≥ 1 in one or both knees, and the ability to walk independently. Standard posterior-anterior knee radiographs were measured for varus alignment. Participants were video recorded while walking and were evaluated for the presence or absence of varus thrust. Pain and stiffness of the knee joint and ADL were evaluated using the JKOM. Multivariate regressions (outcomes: pain and stiffness and ADL; predictor variable: varus thrust) were performed.

Results. Varus thrust was present in 46 (16.2%) of 284 patients. Multivariate regression analyses demonstrated that varus thrust is independently associated with pain and stiffness, adjusted for age, sex, body mass index, K/L grade, and varus alignment ($\beta = .17$, $P = .005$). However, the association between varus thrust and ADL was not significant ($\beta = .11$, $P = .058$). Based on sensitivity analyses, including participants of K/L grade 1 had little influence on this analysis.

Limitations. Only 16.2% of participants had a varus thrust. Moreover, a cause-effect relationship between varus thrust and pain and stiffness remains unknown due to the cross-sectional design of this study.

Conclusions. Varus thrust was associated with pain and stiffness in patients with medial knee OA. However, the association between varus thrust and ADL did not reach significance.

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Knee osteoarthritis (OA) is the most common joint disease and an important cause of pain and disability among older adults.^{1,2} In a 2009 study by Yoshimura et al,³ the estimated number of Japanese patients with knee OA was approximately 25 million people aged ≥ 40 years, and the prevalence of knee OA in men and women was 42.0% and 61.5%, respectively. Knee OA is a progressive disease that requires surgery at the late stages. Therefore, appropriate evaluation and treatment to prevent the progression of disease are required during conservative therapy.

To date, radiographic data have been used for diagnosing radiographic knee OA and judging the stage of the disease by using the Kellgren-Lawrence (K/L) grade as a static evaluation procedure.⁴ However, the structural changes in radiographic data do not sufficiently explain the symptoms and associated health problems experienced by patients with knee OA.⁵ Therefore, information from other factors is needed. Biomechanical assessments such as varus thrust may be essential in the diagnostic process for knee OA. Varus thrust has been linked to increased risk of disease progression in people with knee OA⁶ and thus is a feature that warrants evaluation in clinical settings.

Varus thrust is an abnormality of knee motion in the frontal plane and an easy-to-assess measure of dynamic alignment. It has been defined as the first appearance of varus or an abrupt worsening of an existing varus while the limb is weight bearing during gait, with a return of the limb to less varus alignment during the swing phase or the non-weight-bearing phase of gait.⁶ Lo et al⁷ showed that 25 (30.5%) of 82 participants had a varus thrust, and they reported a significant association between varus thrust and knee pain

in the weight-bearing condition. Furthermore, Sharma and colleagues^{8,9} reported that varus laxity of the knee joint was associated with decreased physical function in patients with knee OA. The varus laxity is a biomechanical parameter that may be indicative of varus thrust. Therefore, varus thrust may cause difficulties in carrying out the physical activities of daily living (ADL).

Chang et al¹⁰ showed that varus thrust was present in 67 (16.7%) of 401 knees, and they reported that the association between varus thrust and the physical function subscale of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) did not reach significance. However, van der Esch et al¹¹ reported that in patients with high varus-valgus range of motion (VV-ROM) assessed by optoelectronic recording and 3-dimensional motion analysis during gait evaluation, muscle weakness was associated with a reduction in physical function. Thus, reports about the association between varus thrust and the health domains have been increasing in recent years.

Knee pain and physical function are 2 important health domains that are affected by knee OA. These domains may be evaluated by using 2 subcategories—"pain and stiffness" and "ADL"—of the Japanese Knee Osteoarthritis Measure (JKOM) (Appendix). The JKOM was proved to have sufficient reliability and validity by means of statistical evaluation and comparisons with the WOMAC,¹² and it is one of the most frequently used measures for the management of knee OA in Japanese clinical practice.

Therefore, the purpose of this study was to investigate whether varus thrust is associated with 2 subcategories—"pain and stiffness" and "ADL"—of the JKOM.

Method

Participants

This study had a cross-sectional design. The participants were 296 outpatients with knee OA diagnosed by their treating physician in community orthopedic clinics in Hiroshima and Kyoto, Japan. For recruitment, we distributed an advertisement requesting patients, who were visiting the community orthopedic clinics for conservative treatment, to be measured within a 3-day window from February 6 to 8, 2014. The inclusion criteria were age ≥ 50 years, medial tibiofemoral knee OA and K/L grade ≥ 1 in one or both knees, and the ability to walk independently. Because a recent study showed that there is structural damage in the medial compartment of the knee in patients with early-stage OA, including stage 1, we included K/L grade ≥ 1 in the present study.¹³ The exclusion criteria were lateral knee OA and a history of the surgical operation in the knees, periarticular fracture, and neurological problems such as hemiplegia. When a symptom was found to be bilateral, the affected side was defined as having the more severe disease. Written informed consent was obtained from each participant in accordance with the guidelines of the Kyoto University Graduate School of Medicine and the Declaration of Human Rights, Helsinki, 1995.

Measurements

Demographic data. Data on age, sex, and height were self-reported by the participants. Weight was measured on a scale, with the participants wearing their street clothes and without their shoes. Body mass index (BMI) was calculated by dividing the weight by the square of height.

Radiography. Radiographs of the affected side were taken by using a posterior-anterior (PA) view (from a knee radiograph), with weight bear-

ing and foot map positioning. The cassette holder was lowered so that the center of the film was at the level of the participant's tibiofemoral joint line. Fluoroscopic guidance with a horizontal PA x-ray beam was used to properly visualize the joint space. Radiographs taken within 3 months were used. If no radiographs were taken within 3 months or there was an acute exacerbation such as arthritis within 3 months, participants were subjected to radiography at the time of our measurement. Radiographs were scored on the basis of the K/L grade, and the scores were used to evaluate the participants' knee OA severity. In this evaluation method, the scores were as follows: 0=normal; 1=possible osteophytes; 2=definite osteophytes, possible joint space narrowing; 3=moderate osteophytes, definite narrowing, some sclerosis, possible attrition; and 4=large osteophytes, marked narrowing, severe sclerosis, and definite attrition.¹⁴ To assess intrarater reliability, 100 radiographs that were randomly selected were scored again by an experienced reader (T.A.) after 1 month. As a result, the intrarater reliability for the K/L grade was high, with a kappa coefficient of .90. The reader was blinded to the other health domains at the time of measurement in this study.

We used radiographs taken in the weight-bearing position to evaluate the affected side for the presence or absence of varus alignment. The static alignment was measured, using a validated method,¹⁵ by one trained reader (H.I.). The anatomical axis angle (AAA) was defined as the internal angle formed by the intersection of 2 lines originating from points bisecting the femur and tibia and converging at the center of the tibial spine tips.¹⁶ To better reflect mechanical alignment, subtraction of a 4-degree correction factor was performed; knees with AAA <182 degrees were defined as having varus

alignment (intraclass correlation coefficient=.98).

Varus thrust assessments. By using a standard digital video camera (HDR-CX550V, Sony Corp, Sony Marketing Inc, Tokyo, Japan), participants were recorded while walking barefoot, 10 m away from and toward a stationary camera, at a self-selected speed without any walking aid. Their trousers were rolled up so that the movement of the knee during gait could be definitively observed. Two physical therapists (N.F. and H.I.) who were blinded to the knee disease status evaluated the varus thrust after training by viewing the gait videos on separate reading sessions. The videos were evaluated for the presence or absence of varus thrust. The presence or absence of varus thrust was evaluated on the affected side. We set the number of times that physical therapists could observe a video to a maximum of 5 times.

The judgment of the presence of varus thrust followed the method of a previous study,⁷ and our criteria were as follows: (1) movement of knee joint on the frontal plane; (2) motion from initial contact to mid-stance of the stance phase; (3) lateral movement of the tibial tuberosity relative to hip and ankle joint, independent from hip external rotation plus knee flexion, with a resultant increase in varus alignment; and (4) return to a more neutral position at the unloading. The physical therapists observed a video with the criteria in mind and judged varus thrust was present when there was a dynamic worsening or an abrupt onset of varus alignment as the limb accepted weight, with a return to less varus alignment during lift-off and the swing phase of the gait.⁷ Any disagreements were solved by a consensus between the 2 evaluators. To assess intrarater reliability, the gait videos were re-evaluated after 1

month; intrarater reliability was excellent (kappa=.92 [N.F.], and kappa=.81 [H.I.]). Furthermore, the interrater reliability between the 2 examiners was good (kappa=.73).

Two subcategories—"pain and stiffness" and "ADL"—of the JKOM. The JKOM was used to assess the pain and stiffness and ADL measures. The JKOM is a self-administered, disease-specific questionnaire of pain and stiffness (0–32 points) and ADL (0–40 points) for patients with knee OA. Each question is graded on a scale of 0 to 4 (a score of 0 indicates no pain or difficulty, scores of 1–3 indicate that patients experience some pain or difficulty, and a score of 4 indicates very severe pain or difficulty). Higher scores of the subcategories indicate worse function. This evaluation modality is considered to have sufficient reliability and validity for studies on the clinical outcomes of Japanese patients with knee OA.¹² It can be completed in about 10 minutes.

Data Analysis

The participants were divided into 2 groups: with or without varus thrust. The characteristics of the participants were summarized by using means and standard deviations for continuous variables and counts and percentages for dichotomous or categorical variables. We statistically analyzed the differences between the 2 groups using the unpaired *t* test for continuous variables and the chi-square test for dichotomous or categorical variables. Furthermore, we calculated the means and standard deviations for total pain and stiffness and ADL points of the JKOM in the 2 groups. Multivariate regressions were performed to investigate whether varus thrust was independently associated with pain and stiffness and ADL adjusted for age, sex, BMI, K/L grade, and varus alignment. We considered K/L grade as a cate-

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gorical value and varus alignment as a dichotomized value. We also performed a sensitivity analysis to justify the inclusion of participants with K/L grade 1. All statistical analyses were performed with IBM SPSS version 20.0 software (IBM Corp, Armonk, New York). The level of statistical significance was set at $P < .05$ for all analyses.

According to a report by Lo and colleagues,⁷ the mean WOMAC pain score was 6.28 points (SD=4.14) in patients with varus thrust and 3.88 points (SD=3.38) in those without varus thrust. Therefore, the effect size was calculated to be 0.58. A sample size of 90 is necessary when assuming that $\alpha = .05$ and $\beta = .20$. Furthermore, a sample size of at least 100 participants is necessary when assuming that 10% of patients will fall within the exclusion criteria.

Results

Characteristics of Participants

In this study, 296 participants, 12 (4.0%) of whom were excluded because of a missing value in the JKOM, were evaluated. Among the 284 participants, 46 (16.2%) had a varus thrust. The comparison of characteristics between participants with varus thrust and those without varus thrust is shown in Table 1. The weight and BMI of participants with varus thrust were significantly higher than those of participants without varus thrust ($P = .01$ and $P = .005$, respectively). In K/L grade, the significant difference was recognized by using a 2×4 chi-square test ($P < .001$). The ratio with varus alignment in participants with varus thrust was 56.5%, whereas that of participants without varus thrust was 18.4% ($P < .001$). No significant differences in age, sex, and height were observed between the 2 groups.

Table 1.

Comparison of Characteristics Between Participants With and Without Varus Thrust^a

Variable	With Varus Thrust (n=46)	Without Varus Thrust (n=238)	P
Demographic data			
Age (y), $\bar{X}$ (SD)	73.4 (7.1)	72.4 (7.0)	.40
Sex (male/female), n	9/37	51/187	.48
Height (cm), $\bar{X}$ (SD)	153.8 (6.4)	154.2 (7.2)	.73
Weight (kg), $\bar{X}$ (SD)	60.7 (9.9)	56.7 (9.9)	.01*
BMI (kg/m ²), $\bar{X}$ (SD)	25.6 (3.3)	23.7 (4.0)	.005**
K/L grade, n (%)			<.001**
1	11 (11.0)	89 (89.0)	
2	12 (10.3)	105 (89.7)	
3	13 (29.5)	31 (70.5)	
4	10 (41.7)	14 (58.3)	
Varus alignment, ^b n (%)	26 (56.5)	44 (18.4)	<.001**

^a BMI=body mass index, K/L grade=Kellgren-Lawrence grade. *P values <.05 were considered to be statistically significant; **P values <.01 were considered to be statistically significant.

^b Varus alignment was defined as an anatomical axis angle of <182°.

Comparison of Pain and Stiffness and ADL Between Patients With and Without Varus Thrust

The results of the comparison between the groups according to pain and stiffness and ADL subcategories of the JKOM are shown in Table 2. Significant differences were recognized in pain and stiffness and ADL ($P < .001$ and $P = .002$, respectively).

Association of Varus Thrust With Pain and Stiffness and ADL

The results of multivariate regression analyses are shown in Table 3. Varus thrust was independently associated with pain and stiffness adjusted for age, sex, BMI, K/L grade, and varus

alignment ($\beta = .17$, $P = .005$). The association between varus thrust and ADL did not reach significance ($\beta = .11$, $P = .058$).

Sensitivity Analysis of Excluding Patients With K/L Grade 1 From the Sample

To justify the choice of patients with K/L grade 1 as the study sample, we performed a sensitivity analysis by modifying the cutoff used for the definition of K/L grade 2. Varus thrust was significantly associated with pain and stiffness independently when the cutoff was K/L grade 2 ($\beta = 0.16$, $P = .037$). Furthermore, varus thrust was not associated with ADL ($\beta = .07$, $P = .356$).

Table 2.

Comparison of Scores for 2 Subcategories of the Japanese Knee Osteoarthritis Measure Between Participants With and Without Varus Thrust^a

Variable	With Varus Thrust (n=46)	Without Varus Thrust (n=238)	P
Pain and stiffness (points)	11.6 (7.3)	7.0 (5.8)	<.001*
Activities of daily living (points)	10.0 (8.0)	5.9 (6.1)	.002*

^a Data are shown as mean (SD). The possible range of the pain and stiffness score is 0–32 and that of the activities of daily living score is 0–40, with higher scores indicating worse function. *P values <.01 were considered to be statistically significant.

Table 3.

Multiple Regression Analysis: Association Between Varus Thrust and Subcategories of Pain and Stiffness and Activities of Daily Living of the Japanese Knee Osteoarthritis Measure^a

Predictor Variable	Pain and Stiffness				Activities of Daily Living			
	B ^b	95% CI	β^c	P	B ^b	95% CI	β^c	P
Varus thrust	2.86	0.89, 4.82	.17	.005**	1.93	−0.07, 3.94	.11	.058
Age	0.07	−0.03, 0.18	.08	.174	0.27	0.17, 0.37	.29	<.001**
Sex	−1.15	−2.80, 0.50	−.08	.172	−0.003	−1.65, 1.64	.001	.997
BMI	0.32	0.14, 0.50	.19	.001**	0.44	0.26, 0.62	.26	<.001**
K/L grade	1.14	0.27, 2.02	.17	.011*	0.99	0.11, 1.86	.14	.027*
Varus alignment	1.93	0.08, 3.78	.13	.041*	1.76	−0.09, 3.61	.12	.062

^a CI=confidence interval, BMI=body mass index, K/L grade=Kellgren-Lawrence grade. *P values <.05 were considered to be statistically significant; **P values <.01 were considered to be statistically significant.

^b Unstandardized coefficients.

^c Standardized coefficients adjusted for age, sex, BMI, K/L grade, and varus alignment.

Discussion

This cross-sectional study provides a meaningful finding for clinical practice. Varus thrust, which is a dynamic biomechanical evaluation measure, was independently associated with pain and stiffness adjusted for the K/L grade and varus alignment, which is a static evaluation. However, the association between varus thrust and ADL did not reach significance.

Varus thrust was present in 46 (16.2%) of the 284 participants in our study. This is the first study to show the prevalence of varus thrust in Japanese patients. Chang and colleagues reported a prevalence of varus thrust of 16.7% (67 of 401 knees) in 2004¹⁰ and of 36.7% (743 of 2,026 cases of radiographic knee OA) in 2010.¹⁷ Furthermore, Lo et al⁷ reported a prevalence of varus thrust of 30.5% (25 of 82 cases of symptomatic radiographic knee OA). It is not clear why we observed a much lower prevalence of varus thrust compared with other published literature.

Possible reasons for the difference in the prevalence of varus thrust include the markedly different participant characteristics across the studies. Compared with previous

studies, our study included more female participants (78.9% versus 60.0% in the study by Lo et al⁷ and 57.5% in the 2010 study by Chang et al¹⁷) and the average BMI was low (24.0 kg/m² versus 30.2 kg/m² in the study by Lo et al⁷ and 29.4 kg/m² in the 2010 study by Chang et al¹⁷). According to Chang et al,¹⁷ participants with a high BMI are more likely to show varus thrust, and the odds ratio for varus thrust in women is 0.66. Therefore, sex and BMI could have been important contributors to the relatively low prevalence of varus thrust in the present study. However, because there are no major differences in the inclusion criteria between our study and previous studies (Lo et al⁷ and Chang and colleagues^{10,17}), we did not consider our inclusion criteria to have any influence on the comparatively low prevalence of varus thrust in our study.

We examined the association between varus thrust and pain and stiffness adjusted for the K/L grade and varus alignment, which is a static evaluation, and a significant association was recognized between them. Furthermore, from the sensitivity analysis, varus thrust was found to be significantly associated with pain and stiffness, independently, when

the cutoff was K/L grade 2. Therefore, we propose that varus thrust is reasonable and useful as dynamic biomechanical evaluation in terms of pain and stiffness. In theory, varus thrust can lead to acute elevation of the medial compartment load during the stance phase of gait.⁷ This theory is consistent with the results of a previous study showing that knees with varus thrust had a greater external adduction moment,¹⁸ a major determinant of medial compartment mechanical load during gait, compared with knees without varus thrust.^{10,19} The knee adduction moment is a measure of joint loading and is used extensively as a proxy for medial compartment loading in the knee with evidence of high validity and reliability.^{20,21} Robbins et al²² reported that increased knee loading magnitude was associated with increased knee pain. Although the present study investigated presence or absence of knee pain in association with varus thrust and did not examine increase in pain as the study by Robbins et al²² did, these previous studies suggest the possibility that elevation of medial compartment loading due to varus thrust causes knee pain.

We also investigated the association between varus thrust and ADL. As a

result, the ADL scores in patients with varus thrust were significantly higher in univariate analysis; however, the association between varus thrust and ADL did not reach significance in multivariate analysis ($P=.058$). Chang et al¹⁰ investigated whether varus thrust is associated with the WOMAC physical function scale; they found no significant association between them. Van der Esch et al¹¹ investigated whether VV-ROM during gait is associated with the WOMAC physical function scale. In univariate analysis, a significant correlation was accepted between VV-ROM during gait and WOMAC physical function, but no association was recognized in multivariate analysis. Our result concurs with the results of previous studies^{10,11} in that no association between varus thrust and observed physical function (unpublished data) was recognized. However, when varus thrust is accompanied by muscle weakness of the lower limbs, a significant association with a reduction in physical function has been reported.¹¹ Therefore, varus thrust intervenes in other factor such as muscle weakness and may be related to poor ADL function.

Our study demonstrated that there is a significant association between varus thrust and pain and stiffness in patients with medial knee OA and that this finding has a potential clinical implication for the treatment of patients with medial knee OA. Several intervention studies to date have reported that gait retraining^{23,24} or bracing^{25,26} intervention can reduce knee adduction moment. These strategies may be useful and warrant future research, as it is currently unknown if they can reduce the prevalence of varus thrust. Furthermore, because varus thrust is a risk factor for the progression of knee OA, these approaches may prevent the progression of knee OA in patients with varus thrust. Varus thrust is a simple dynamic evaluation measure in the

clinical setting, and because it does not require measurement with 3-dimensional movement analysis instruments, it has high versatility. Further investigations, including prospective and intervention studies, are needed to clarify the influence of and the therapeutic measures for varus thrust.

We believe that the generalizability of our results is high because we showed the reliability and validity of the JKOM. In addition, although the BMI was markedly different from that in other populations, we supposed that the influence is small because we used BMI in multivariate analysis as an adjustment variable. Furthermore, although Chang et al¹⁷ reported that race influences the presence or absence of varus thrust, a significant association between varus thrust and knee pain was shown in other populations.^{7,10} However, additional study is necessary to confirm the generalizability of our results.

Two limitations of this study warrant mention. First, with regard to the judgment of varus thrust, not all evaluators may completely concur on the criteria for the classification of varus thrust. The evaluators, who were blinded to the knee disease status, judged the presence or absence of varus thrust to examine the inter-rater reliability in our study. The kappa coefficient of the evaluators' judgment was .73, showing that a substantial reliability of varus thrust was achieved.²⁷ Second, because this study was cross-sectional in nature, a cause-effect relationship between varus thrust and pain and stiffness remains unknown.

In this study, we investigated the association of varus thrust with pain and stiffness and ADL in patients with medial knee OA. We found a significant association between varus thrust and pain and stiffness.

However, the association between varus thrust and ADL did not reach significance.

Mr Fukutani, Dr Aoyama, Mr Iijima, Mr Fukumoto, Mr Uritani, Dr Kaneda, and Professor Matsuda provided concept/idea/research design. Mr Fukutani, Mr Iijima, Dr Aoyama, and Dr Tsuboyama provided writing. Dr Kaneda and Dr Ota provided data collection. Mr Fukutani, Dr Aoyama, Mr Iijima, and Professor Matsuda provided data analysis. Mr Fukutani, Dr Aoyama, Mr Iijima, Dr Kaneda, Dr Ota, and Professor Matsuda provided project management. Dr Aoyama provided fund procurement and administrative support. Dr Kaneda and Dr Ota provided participants and facilities/equipment. Mr Fukutani, Dr Kaneda, Dr Ota, and Dr Aoyama provided institutional liaisons. Dr Aoyama, Mr Iijima, Mr Fukumoto, Mr Uritani, and Dr Tsuboyama provided consultation (including review of manuscript before submission). The authors thank Ms Yuko Yamamoto and Mr Masakazu Hiraoka (Nozomi Orthopaedic Clinic, Hiroshima, Japan) for their assistance in data collection and all study participants for their contribution to this study.

The study protocol was approved by the Ethical Committee of Kyoto University Graduate School of Medicine.

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Appendix.

Continued

8. Do you have pain in your knees when standing?

Not at all

☐

Slight

☐

Moderate

☐

Quite

☐

Extreme

☐**III. Condition in Daily Life**

Here are a couple of questions regarding your ability to perform daily routines during the last few days. Choose one answer and mark × in the box next to it.

9. How difficult is ascending or descending stairs?

Not at all

☐

A little

☐

Moderately

☐

Quite

☐

Extremely

☐

10. How difficult is bending to the floor or standing up?

Not at all

☐

A little

☐

Moderately

☐

Quite

☐

Extremely

☐

11. How difficult is standing up from sitting on a Western style toilet?

Not at all

☐

A little

☐

Moderately

☐

Quite

☐

Extremely

☐

12. How difficult is wearing pants, skirts, and underwear?

Not at all

☐

A little

☐

Moderately

☐

Quite

☐

Extremely

☐

13. How difficult is putting on socks?

Not at all

☐

A little

☐

Moderately

☐

Quite

☐

Extremely

☐

14. How long can you walk on a flat surface without taking a rest?

More than
30 minutes☐About 15
minutes☐Around
my house☐Only in my
house☐Can hardly
walk☐

15. Have you been using a walking stick (cane) recently?

Not at all

☐

Hardly

☐

Sometimes

☐

Often

☐

Always

☐

16. How difficult is shopping for daily necessities?

Not at all

☐

A little

☐

Moderately

☐

Quite

☐

Extremely

☐

(Continued)

Thrust Is Associated With Pain and Stiffness

Appendix.

Continued

17. How difficult is doing light housework (cleaning the dinning room after eating, etc)?

Not at all	A little	Moderately	Quite	Extremely
☐	☐	☐	☐	☐

18. How difficult is doing heavy housework (using the vacuum cleaner, etc)?

Not at all	A little	Moderately	Quite	Extremely
☐	☐	☐	☐	☐

IV. General Activities

Here are a couple of questions regarding your general activities during the last one month. Choose one answer and mark × in the box next to it.

19. Have you gone to an event or to a department store during the last one month?

More than 2-3 times a week	About once a week	About twice every 2 weeks	Once a month	Not at all
☐	☐	☐	☐	☐

20. Were things that you usually do (some kind of lesson, meeting friends, etc) difficult because of knee pain during the last one month?

Not at all	A little	Moderately	Quite	Extremely
☐	☐	☐	☐	☐

21. Did you limit doing things you usually do because of knee pain during the last one month?

Not at all	A little	Moderately	Quite	Didn't do them (things you do usually) at all
☐	☐	☐	☐	☐

22. Did you despair of going outside somewhere close because of knee pain during the last one month?

Not at all	Hardly	Sometimes	Often	Didn't go outside (close)
☐	☐	☐	☐	☐

23. Did you despair of going outside somewhere far because of knee pain during the last one month?

Not at all	Hardly	Sometimes	Often	Didn't go outside (far)
☐	☐	☐	☐	☐

(Continued)

Appendix.

Continued

V. Health Conditions

Here are a couple of questions regarding your health during the last one month. Choose one answer and mark × in the box next to it.

24. Do you think your health during the last one month is average?

I really I
think so

☐

I think so

☐

I don't know

☐

I don't think so

☐

I don't think so
at all

☐

25. Do you think that knee pain has been affecting your health badly during the last one month?

It isn't
affecting it
at all

☐

It is affecting it
a little

☐

It is affecting
it moderately

☐

It is affecting it
significantly

☐

It is affecting
it greatly

☐

^a Reprinted with permission from: Working Group on the Development of Knee Osteoarthritis QOL Measure. Development of new disease-specific QOL measure for patients with knee osteoarthritis: Japanese Knee Osteoarthritis Measure (JKOM). *J Jpn Orthop Assoc.* 2006;80:307–315.

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Association of Varus Thrust With Pain and Stiffness and Activities of Daily Living in Patients With Medial Knee Osteoarthritis

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