Validation of the Korean Version of the Oxford Knee Score in Patients Undergoing Total Knee Arthroplasty

Il Soo Eun MD, Ok Gul Kim MD, Chang Kyu Kim MD,
Hong Seok Lee MD, Jung Sub Lee MD, PhD

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Abstract

Background Although translated versions of the Oxford Knee Score (OKS) in several languages are available, the absence of a Korean version precludes comparing data from Korea with that from other countries using the OKS.

Questions/purposes We therefore evaluated the reliability and validity of the adapted Korean version of the OKS.

Methods We first translated the English version of the OKS into Korean, then back into English, then held expert committee discussions to finalize the Korean version. We then mailed the Korean version of the VAS for pain, OKS, and the previously validated SF-36 to 142 patients who underwent TKAs for knee osteoarthritis. Factor analysis and reliability assessment using the kappa statistic of

agreement for each item, the intraclass correlation coefficient, and Cronbach's alpha were conducted. To determine the subscales of the OKS, we used the factor analysis. We also evaluated concurrent and construct validity by comparing the responses to the OKS with the results of the VAS and SF-36 using Pearson's correlation coefficient.

Results All items had a kappa statistic of agreement greater than 0.6. The OKS showed test and retest reliability as follows: OKS, 0.848; Factor 1, 0.867; and Factor 2, 0.819. Internal consistency of Cronbach's alpha was as follows: OKS, 0.932; Factor 1, 0.907; Factor 2, 0.867. The OKS correlated ($r = 0.692$) with the VAS. The Korean version of the OKS correlated with the SF-36 total and individual domain (physical functioning, role physical, bodily pain) scores.

Conclusions The adapted Korean version of the OKS was translated and showed acceptable measurement properties. The data suggest it is suitable for assessing outcomes in Korean-speaking patients having TKAs.

Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request.

Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at Busan Medical Center and Pusan National University School of Medicine, Busan, South Korea.

I. S. Eun · O. G. Kim · C. K. Kim
Department of Orthopaedic Surgery,
Busan Medical Center, Busan, South Korea

H. S. Lee · J. S. Lee (✉)
Department of Orthopaedic Surgery, Medical
Research Institute, Pusan National University
School of Medicine, Busan, South Korea
e-mail: jungsublee@pusan.ac.kr

Introduction

Knee osteoarthritis (OA), one of the most common forms of OA, is characterized by pain and physical disability that can have a considerable impact on function and health-related quality of life [9, 10, 14]. Assessment of physical function and pain is essential to identify the course of disease and determine treatment effects in patients with musculoskeletal diseases. Numerous instruments have been developed to measure functional disability and pain, ranging from physical assessments by trained assessors to self-reported questionnaires [11, 12]. Among these instruments, the Oxford Knee Score (OKS) is a 12-item

questionnaire developed specifically for use in TKA and has shown good validity, reliability, and sensitivity to change in studies in different languages, including Thai, British, Swedish, Portuguese, Dutch, German, Italian, Japanese, and Chinese [2–4, 6, 8, 13, 15–17]. It is well established that a scale or questionnaire cannot be transposed directly from one social environment to another without being revalidated in terms of its ability to take into account culture-specific conditions [1]. The OKS had not been validated in Korean.

We therefore translated a culturally adapted version of the OKS into the Korean language and validated this adapted version of the OKS in Korean patients who had TKAs. Specifically we determined whether the Korean version would show similar reliability and validity with previous studies [2–4, 6, 8, 13, 15–17].

Patients and Methods

This study was approved by the Clinical Research Ethics Committee of our university and hospital. The cross-cultural adaptation of the OKS was performed according to the guidelines for cross-cultural adaptation of self-completed measures [1]. The procedure involved three stages, namely, forward translation, back translation, and a committee discussion. In addition, a pilot study was performed to test whether the prefinal version could be correctly understood. The final version was achieved and tested for its validity and reliability with the Korean version of the SF-36 (Rand/Health Institute methods) [7]. Two fluent Korean translators completed the forward translation. The first translator (ISE) is an orthopaedic surgeon and the other is a professional uninformed translator (SSL). The original version and two translators' versions were compared by the two translators and a second orthopaedic surgeon (HSL). The back translation was independently completed by two bilingual mother-tongue translators (JGG, SC). All translation versions, and the original, were discussed by the four translators (ISE, SSL, JGG, SC) and an expert committee comprised of three bilingual experts (HSL, JSL, SHP), two orthopaedic surgeons (OGK, CKK), and a Korean translation expert (TSG). A committee meeting was held with all persons involved in the translation process to resolve any problems and discrepancies and to establish the prefinal version of OKS. The pretesting of the prefinal version was performed by Korean-speaking patients with knee OA, who were receiving one or more therapeutic treatments at another arthroplasty center, for accuracy of wording and ease of understanding of the questionnaire. These 30 patients included 28 women and two men with a mean age of 69.3 years (range, 49–85 years). The majority of the 30 subjects understood the

questionnaire well. However, 12 patients (40%) questioned the meaning of Item 5 ("After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee?"). The committee meeting decided to modify this to "How painful has it been for you to stand up from a chair because of your knee?" in the final Korean version of OKS. The final Korean version of the OKS was determined by the expert committee (Appendix 1).

We mailed the VAS for pain, Korean version of the OKS, and the SF-36 to 142 patients who underwent TKAs for knee OA in one arthroplasty center between March 2009 and December 2009 and had a minimum followup of 2 years. During that time we performed a total of 176 THAs for OA. The first mailing contained a consent form, a description of the study, the VAS for pain, Korean versions of the OKS and SF-36, and an addressed and stamped return envelope. The VAS measure of pain is a 0- to 100-point scale with 100 being the worst score. OKS scores range from 12 to 60 and the higher the score, the more pain and disability. One hundred seven of the 142 patients (75%) who had TKAs responded to the first set of questionnaires; 85 were women and 22 were men. Eighty-four of the first-time respondents (59% of the total 142 patients) returned their second survey; 68 were women and 16 were men (Table 1). All patients completed all questionnaires and there were no missing responses. The average age of the 84 patients was 66.8 years (range, 47–83 years) at the time of the survey. The average time between the first and second mailings was 14 days (range, 9–21 days).

We measured test and retest reliability by comparing responses to the first and second measurements of the OKS. Because clinical status is unlikely to change considerably during this time in patients with chronic pain in the absence of specific intervention, reliability of functional status questionnaires may be assessed using an interval of 1 to 2 weeks between measurements, and thus we decided to use this in our study. The kappa statistic of agreement for each item and the intraclass correlation coefficient (ICC 2,1) were used to measure reliability. The overall scores are assumed to be continuous and thus an ICC is used to analyze reliability where a value of 1.0 represents complete agreement, whereas for individual (categorical) questions, the reliability is assessed using kappa where we presumed a value greater than 0.70 reflected excellent agreement. Cronbach's alpha was used to measure internal consistency. To determine subscales of the OKS, we analyzed the structure of the OKS by means of a factor analysis and identified subscales. Dimensionality was assessed through exploratory principal component factor analysis with the varimax rotation method. The retained factors in each scale had eigenvalues greater than 1. Correlations of the OKS score and its constituent items with 0.4 or more were considered acceptable [5]. The concurrent validity of the translated OKS was examined by analyzing the strength of

Table 1. Demographic characteristics of the study population

Characteristic	First assessment	Second assessment
Gender (number)		
Female	85	68
Male	22	16
Education (number)		
Elementary school	58	44
Middle school	29	23
High school	16	13
University	4	4
Profession (number)		
White collar	5	4
Blue collar	20	14
Intermediate level	16	13
Retired	12	10
Housewife	24	18
Unemployed	30	25
Time from surgery to first survey (months)	27.7 (range, 24–31)	
Time between first and second surveys (days)		14.0 (range, 9–21)
TKA (number)		
Unilateral/bilateral	76/31	60/24
OKS (median/mean $\pm$ SD)	40/39.1 $\pm$ 10.6	40/41.0 $\pm$ 13.1
SF-36 (median/mean $\pm$ SD)	51.0/50.4 $\pm$ 18.7	49.0/48.6 $\pm$ 19.1
VAS (median/mean $\pm$ SD)	30/36 $\pm$ 24	30/33 $\pm$ 29

OKS = Oxford Knee Score

the correlation between its score and the results of the VAS for pain. The construct validity was examined by means of convergent validity and divergent validity. To examine convergent validity, we hypothesized that the correlation coefficients describing the relationship between the Factor 1 score of the OKS and pain-related domain scores of the SF-36 and between the Factor 2 score of the OKS and function-related domain scores would be moderate to high ($r = 0.50$ – 0.80). To examine divergent validity, we expected that the correlations between the Factor 1 score and function-related domain scores and between the Factor 2 score and pain-related domain scores would be lower ($r < 0.50$). Concurrent and construct validity were examined by analyzing the responses to the OKS with the results of the VAS and the responses to the SF-36 using Pearson's correlation coefficient. We also examined the distribution of floor and ceiling effects of the Korean OKS by analyzing the proportion of individuals obtaining the lowest and highest scores, respectively. The statistical analysis was performed using SPSS® Version 16.0 software (SPSS Inc, Chicago, IL, USA).

Results

The mean OKS scores of the first and second assessments were 39.1 ± 10.6 and 41.0 ± 13.1 , respectively. The mean difference of the OKS scores between the first and second assessments was 4.9 ± 3.4 . Factor analysis of the Korean OKS revealed a two-factor structure (Table 2). The first

Table 2. Factor analysis

OKS questions	Factor 1	Factor 2
How would you describe the pain you usually have from your knee?	0.871	
After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee?	0.847	
Have you been limping when walking, because of your knee?	0.767	
How much has pain from your knee interfered with your usual work (including housework)?	0.716	
Have you felt that your knee might suddenly 'give way' or let you down?	0.573	
Have you had any trouble getting in and out of a car or using public transport because of your knee?	0.558	
Have you been troubled by pain from your knee in bed at night?	0.552	
Could you do the household shopping on your own?		0.790
Could you walk down one flight of stairs?		0.788
For how long have you been able to walk before pain from your knee becomes severe?		0.707
Could you kneel down and get up again afterwards?		0.682
Have you had any trouble with washing and drying yourself (all over) because of your knee?		0.588

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Table 3. Test and retest reproducibility determined by ICC ($n = 84$)

Questionnaire	ICC (95% CI)
OKS	0.848 (0.818–0.874)
OKS Factor 1	0.867 (0.831–0.898)
OKS Factor 2	0.819 (0.764–0.863)

OKS = Oxford Knee Score; ICC = intraclass correlation coefficient.

Table 4. Internal consistency as determined by Cronbach's alpha ($n = 107$)

Questionnaire	Cronbach's alpha
OKS (12 items)	0.932
OKS Factor 1 (Questions 1, 5, 6, 9, 10, 3, 8)	0.907
OKS Factor 2 (Questions 11, 12, 4, 7, 2)	0.867

OKS = Oxford Knee Score.

factor represents knee pain (Questions 1, 3, 5, 6, 8, 9, 10); the second factor represents knee dysfunction related to activities (Questions 2, 4, 7, 11, 12).

All questions in the OKS had a kappa statistic of agreement greater than 0.6 and ranged from 0.61 to 0.87. The ICC of the test and retest reliabilities were 0.848 for the 12 questions in the OKS, 0.867 for Factor 1, and 0.819 for Factor 2 (Table 3). In addition, internal consistency calculated by Cronbach's alpha was greater than 0.8 (Table 4).

We found positive correlations between the OKS and the VAS (12 questions of the OKS, $r = 0.692$, $p < 0.001$; Factor 1, $r = 0.708$; $p < 0.001$; Factor 2, $r = 0.566$, $p < 0.001$). When we evaluated construct validity using the relationship between the OKS and SF-36 scores, we obtained an r value of -0.74 . We observed convergent validity for the Korean OKS based on correlations (range, 0.5–0.8) between factor scores of the OKS and three domain scores (physical functioning, role physical, bodily pain). The strongest correlations were observed between the Factor 1 score of the OKS and the bodily pain score of the SF-36 ($r = -0.698$) and the Factor 2 score and the physical functioning score ($r = -0.715$). The correlation coefficients between factor scores of the OKS and other domain scores were relatively weak ($r < 0.5$), indicating adequate divergent validity. We found no ceiling effects for the Korean OKS. The worst score was 59 points in one patient and the best was 12 points in two patients.

Discussion

The objectives of this study were to produce a Korean version of OKS by translation and adaptation. Therefore, we translated a

culturally adapted version of the OKS into the Korean language and validated this adapted version of the OKS in Korean patients who had TKAs. In addition, we determined whether the Korean version would show similar reliability and validity with the previous study [2–4, 6, 8, 13, 15–17].

Before interpreting our results, several limitations must be considered. First, our subjects were patients who underwent TKAs at only one arthroplasty center. Although access to the hospital is open to every patient and our patients are a mixture of urban and rural inhabitants, the current study cohort might not represent all people of our country because study samples were enrolled only from the southeastern area of country. Second, the time between the test and retest was relatively short, which might have positively biased our reliability results because the patients would not have had time to forget their answers on the earlier questionnaire. Finally, this validation was performed with patients who underwent TKAs for knee OA. Further investigation of the Korean OKS with patients after TKA is warranted to concomitantly assess the responsiveness of this measure.

The Korean version of the OKS was easily understood by the patients and administered. Our results show the Korean version of the OKS is a reliable and valid instrument for measuring outcome in Korean patients with TKAs, and its reliability levels were similar to those of the Chinese [17], Dutch [8], German [13], Japanese [16], Italian [15], and Swedish versions [4].

Although the Chinese version had a three-factor structure [17], we found a two-factor structure for the OKS. A two-factor structure also was identified by Xie et al. [18]. Many published studies [2, 4, 6, 8, 13, 15, 16] did not perform a factor analysis. Regarding internal consistency, Dawson et al. [3] reported 0.87 of internal consistency for the English version. The Cronbach's alpha values obtained from our study were 0.932 for the OKS, 0.907 for Factor 1, and 0.867 for Factor 2 and were similar to those reported in other studies [3, 4, 6, 8, 13, 15, 16, 18]. These results indicate this translated version is reliable and has a low standard error at measuring.

The reproducibility of each of the 12 items showed kappa statistics of agreement greater than 0.6. Although numerous OKS validation studies have been published [2–4, 6, 8, 13, 15–17], the average reproducibility of each OKS item was not reported. If the first and second questionnaires were assessed by the patients during clinic visits, it could decrease the average reproducibility of the questionnaire. The results can be explained by some patients probably having to wait much longer than others for the consultation before being seen by the interviewer. To avoid this bias, we mailed the VAS for pain, Korean version of the OKS, and SF-36 to 142 patients who underwent TKAs for knee OA. An ICC of 0.848 for the Korean version of

the OKS is in accordance with other translated versions with ICCs ranging from 0.85 to 0.97 [4, 6, 8, 13, 15, 16].

Our data show the OKS could be translated into Korean without losing the psychometric properties of the original OKS version. Accordingly, the Korean version of the OKS appears to be a reliable and valid instrument for self-assessment of pain and function in patients who had TKAs. Therefore, we suggest this Korean version of the OKS can be used for future clinical studies in Korea.

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Appendix 1: Korean version of the Oxford Knee Score (옥스포드 슬관절 점수)

지난 4주 동안...

1. 무릎이 얼마나 아팠습니까?
☐ 전혀 아프지 않았다
☐ 아주 조금 아팠다
☐ 조금 아팠다
☐ 꽤 아팠다
☐ 아주 심하게 아팠다
2. 무릎 통증 때문에 혼자서 씻고 닦는데 얼마나 힘들었습니까?
☐ 전혀 힘들지 않았다
☐ 아주 조금 힘들었다
☐ 제법 힘들었다
☐ 매우 힘들었다
☐ 불가능했다
3. 무릎 통증 때문에 승용차를 타고 내리거나 대중교통을 이용하는데 얼마나 힘들었습니까?
☐ 전혀 힘들지 않았다
☐ 아주 조금 힘들었다
☐ 제법 힘들었다
☐ 매우 힘들었다
☐ 불가능했다
4. 무릎 통증이 심해지기 전에 얼마 동안 걸을 수 있었습니까? (지팡이 사용과 관계 없이)
☐ 30분 이상
☐ 16-30분
☐ 5-15분
☐ 집 주변만
☐ 전혀 걸을 수 없었다
5. 의자에서 일어날 때 무릎이 얼마나 아팠습니까?
☐ 전혀 아프지 않았다
☐ 조금 아팠다
☐ 제법 아팠다

- ☐ 많이 아팠다
☐ 견딜 수 없을 정도로 아팠다
6. 무릎 통증 때문에 절뚝거리며 걸은 적이 있었습니까?
☐ 전혀 없었다
☐ 가끔 있었다
☐ 자주 있었다
☐ 대부분 있었다
☐ 항상 있었다
 7. 무릎을 꿇고 앉았다가 다시 일어나는 일을 할 수 있었습니까?
☐ 아주 쉽게 할 수 있었다
☐ 조금 힘들게 할 수 있었다
☐ 다소 힘들게 할 수 있었다
☐ 매우 힘들게 할 수 있었다
☐ 불가능했다
 8. 무릎 통증 때문에 밤에 잠을 설친 적이 있었습니까?
☐ 없었다
☐ 하루 이틀 정도
☐ 며칠 정도
☐ 거의 대부분
☐ 매일
 9. 무릎 통증이 일상 생활(집안일 등을 포함해서)에 얼마나 지장을 주었습니까?
☐ 전혀 없었다
☐ 약간 있었다
☐ 제법 있었다
☐ 많이 있었다
☐ 일상 생활을 전혀 할 수 없었다
 10. 무릎이 갑자기 휘청거리거나 주저앉을 것 같다고 느낀 적이 있었습니까?
☐ 전혀 없었다
☐ 가끔 있었다
☐ 자주 있었다
☐ 대부분 있었다
☐ 항상 있었다
 11. 혼자서 시장에 갈 수 있었습니까?
☐ 아주 쉽게 갈 수 있었다
☐ 조금 힘들게 갈 수 있었다
☐ 다소 힘들게 갈 수 있었다
☐ 매우 힘들게 갈 수 있었다
☐ 불가능했다
 12. 계단 한 층을 걸어서 내려갈 수 있었습니까?
☐ 아주 쉽게 내려갈 수 있었다
☐ 조금 힘들게 내려갈 수 있었다
☐ 다소 힘들게 내려갈 수 있었다
☐ 매우 힘들게 내려갈 수 있었다
☐ 불가능했다

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