Progress towards understanding anterior knee pain after total knee arthroplasty

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Chapter 5

Dutch Translation of the Kujala Anterior Knee Pain Scale and Validation in Patients after Knee Arthroplasty


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Chapter 5

Abstract

Purpose
To translate and validate the Kujala Anterior Knee Pain Scale (AKPS) in patients who have undergone Total Knee Arthroplasty (TKA) or Unicompartmental Knee Arthroplasty (UKA) and evaluate the internal consistency, construct validity and ceiling or floor effect.

Methods
After standard forward and backward translation was performed, 302 patients who have received a TKA or UKA filled out the AKPS together with Hospital for Special Surgery (HSS) patella score, Visual Analogue Score (VAS) for pain, the Oxford 12-item knee questionnaire and the SF-36 at follow-up. The internal consistency was tested using Cronbach’s alpha coefficient. The construct validity was assessed using Spearman’s rank correlation (R) to test for correlations between the AKPS and VAS HSS, HSS patella score, VAS month, Oxford 12-item knee questionnaire and SF-36 subscales. Ceiling or floor effects are given in percentage of patients giving a maximum or minimum score.

Results
The internal reliability of the AKPS is acceptable with a Cronbach’s alpha of 0.81 in patients after TKA or UKA. A high correlation was found between the AKPS and the Oxford 12-item questionnaire (R = 0.81). Moderate correlations were found with the VAS month (R = 0.63), HSS patella score (R = 0.51) and SF-36 subscales physical functioning (R = 0.59), role-physical (R = 0.59), bodily pain (R = 0.57). Other correlations were poor, therefore indicating a good convergent and divergent validity. Ceiling effects were observed for the HSS patella score (31%), VAS HSS (51%), VAS pain (19%), SF36-RP (46%), SF36-RE (80%), SF36-BP (24%). No ceiling or floor effect was found for the AKPS, Oxford 12-item knee questionnaire, and the other SF36 domains.
Conclusions
The AKPS appears to be reliable and valid in patients after knee arthroplasty, with no ceiling and floor effects, and can be used to assess anterior knee pain in patients who underwent joint replacement surgery.

Level of Evidence
Diagnostic study, level I
Chapter 5

Introduction

Total Knee Arthroplasty (TKA) and Unicompartmental Knee Arthroplasty (UKA) are highly effective for treating patients with complaints caused by rheumatoid arthritis or osteoarthritis of the knee [9]. However successfully, approximately 10 percent of the patients experience Anterior Knee Pain (AKP), also reported as patellofemoral pain (PFP), after TKA[1,6,14,28]. In patients following UKA, it has been reported that up to 48% of patients had some form of AKP at two years after surgery [25]. This pain hinders patients in their everyday lives, especially with walking stairs, standing up from a chair or cycling.

A reliable and valid questionnaire is lacking and needed to adequately assess the problem of AKP in patients following knee arthroplasty. Currently used questionnaires do not adequately assess AKP in patients following TKA or UKA. Even with good to excellent scores on widely used questionnaires, these patients can still suffer from AKP. This results in an under-reporting of AKP in arthroplasty patients. The Kujala Anterior Knee Pain Scale (AKPS), also called the Anterior Knee Pain scale, is a validated tool to evaluate PFP or AKP [11,23]. It was reported first in English and has been translated and validated in Finnish [23], Persian [26], Chinese [10] and Turkish [24]. It has not yet been validated in patients after joint replacement surgery of the knee and a validated Dutch patient reported outcome measure (PROM) for AKP is lacking.

The number of patients with AKP following surgery is likely to increase in coincidence with an expected rise of TKA’s being performed [9]. Currently, each year about 20,000 TKA are performed in the Netherlands, but the estimation is that this number will increase to 60,000 a year in 2030 [22]. This is expected to result in an increase in patients with AKP at following TKA or UKA. If the AKPS would be validated for TKA and UKA patients, AKP could be more adequately diagnosed and followed. It can be used by orthopaedic surgeons and physical therapists to assess the amount of complaints from AKP perceived by the patient and to evaluate treatment strategies. Greater attention to and understanding of AKP will aid in developing new strategies for significant pain relief and overall patient satisfaction after TKA or UKA.

The purpose of this study was therefore to translate and validate the AKPS in patients who have undergone TKA or UKA and evaluate the internal consistency, construct validity and ceiling or floor effects.
Material and methods

It was deemed that the Medical Research Involving Human Subjects Act (WMO) does not apply to the study due to the fact that only questionnaires were used and official approval was not required. To validate the AKPS in patients who have undergone TKA or UKA in the Netherlands, the questionnaire first needed to be translated in Dutch.

Translation process
The procedures recommended by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) and other cross-cultural adaptation and translation studies were followed [4]. First, forward translation from English to Dutch was performed by three independent people, a PhD-student, an orthopaedic resident and an orthopaedic surgeon. These translations were then combined in a consensus meeting with a fourth person acting as referee in case of a difference of opinion. After the translation to Dutch, the questionnaire was re-translated into English by a native-speaking English person blinded for the original English version of the AKPS. Two research fellows in the field of Orthopaedics checked the translation for equality to the original English AKPS. No inconsistencies were found. Before the actual study commenced a pilot study was performed in a small group of 15 patients to evaluate the questionnaire. There were no problems, and the Dutch AKPS was deemed ready for the validation process.

Patients
Following the translation process a multicenter study was set up. The AKPS (appendix 1) was given to patients at follow-up evaluation in the hospital after having undergone TKA or UKA in one of four participating hospitals. Next to the AKPS, patients also received and filled out the Hospital for Special Surgery (HSS) patella score [19], visual analogue score (VAS) for pain in the last month [11], the Oxford 12-item knee questionnaire [12,17] and the SF-36 at follow-up [32]. Re-evaluation was done by a nurse practitioner or a doctor working in the orthopedic department, and the patient filled out the questionnaires. The VAS is a continuous score from 0 to 100 that is used to determine the level of pain [11]. The Oxford 12 is a knee-specific questionnaire; every item has a
score from 1 to 5 (from less to most difficult or serious) and a total score with a range from 12 to 60 \cite{12,17}. The AKPS, also known as the anterior knee pain score, is a 13-item questionnaire including different items on pain related to function and activities \cite{11,23}. The score has a range from 0 to 100, and higher scores indicate less disability. The Hospital for Special Surgeries patella (HSS patella) score is a knee-specific questionnaire, which contains subjective and objective questions relating to anterior knee pain \cite{19}. The score has a range from 0 to 100, and higher scores indicate best-case scenario. The SF-36 is a general health-related quality of life instrument \cite{32}. Thirty-six questions reflect eight dimensions of functioning: Physical Functioning (PF), Role limitation resulting from Physical problems (RP), Role limitation resulting from Emotional problems (RE), Social Functioning (SF), Mental Health (MH), energy Vitality (VT), Bodily Pain (BP), and General Health perception (GH). The score has a range from 0 to 100 per dimension. Higher scores indicate a better quality of life. This score also contributes to determining patient satisfaction.

**Statistical analysis**

As measure of reliability, the internal consistency was evaluated, since the patients had a single assessment. The internal consistency is the degree to which items of (sub)scales are intercorrelated and was assessed by calculation of Cronbach’s alpha coefficient \cite{30}. A Cronbach’s alpha coefficient of 0.7 or higher is considered satisfactory \cite{5}.

In the absence of a gold standard, construct validity was assessed using Spearman’s rank correlation coefficient (R). The correlation value was considered to be very strong if it was between 0.9 and 1.0, strong if it was between 0.7 and 0.9, moderate if it was within 0.5–0.7, and weak if it was below 0.5 \cite{10,18}. As it is hypothesized that the AKPS measures a different but related construct that are measured by the currently available questionnaires, and therefore is an addition to the current set of questionnaires, the correlations are not expected to be very high. For determination of the construct validity, convergent and divergent validity were evaluated. Convergent validity was tested by hypothesising strong and moderate correlations between the AKPS and (items of) questionnaires that measure similar constructs like the VAS HSS, HSS patella score, VAS month, Oxford 12-item questionnaire and the physical domains of the SF36 (PF, RP, BP). Divergent validity was tested by hypothesizing weak correlations between the AKPS and (items of) questionnaires that are
expected to measure different constructs like the mental domains of the SF36 (VT, RE, SF, MH and GH).

The presence of ceiling and floor effects was evaluated using the percentages of patients having the maximum or minimum score. In defining what a floor/ceiling effect is, we used the gold standard, being the COSMIN criteria. According to these quality criteria and the definitions by Terwee et al, less than 15% of patients having a minimum or maximum score means there are no floor or ceiling effects [30].

Results

Three hundred and six patients filled out the set of questionnaires at an average of 13.2 months after TKA or UKA (SD = 6.8). The descriptives of the scores are presented in table 1.

The internal consistency of the AKPS was good with a Cronbach’s alpha of 0.81 in patients with a TKA as well as UKA. A strong correlation was found between the AKPS and the Oxford 12-item questionnaire (R = 0.84). The criteria set for convergent validity was met with moderate correlations for HSS patella score (R = 0.51), VAS month (R = 0.63) and SF-36 subscales Physical Functioning (R = 0.59), Role-Physical (R = 0.54), Bodily Pain (R = 0.57) however not for the VAS HSS (R = 0.45). The criteria set for divergent validity was met with other correlations being poor (table 2).

Floor effects were only present for the SF36-RP, and ceiling effects were observed for the HSS patella score, VAS HSS, VAS pain, SF36-RP, SF36-RE, and SF-36-BP. The AKPS score did not show a floor or ceiling effect (table 1 and figure 1).

The Kujala questionnaire had a total of 6 not answered questions in a total of 306 questionnaires (3,978 items), resulting in 0.15% unanswered questions.
Table 1. Descriptives of the scores (PF=Physical Functioning, RP=Role limitation resulting from Physical problems, RE= Role limitation resulting from Emotional problems, SF=Social Functioning, MH=Mental Health, VT=energy Vitality, BP= Bodily Pain, GH=General Health perception). Floor and ceiling effects are present if % floor or % ceiling >15% (bold).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean (SD)</th>
<th>Median (min-max)</th>
<th>% Floor</th>
<th>% Ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kujala score</td>
<td>68.3 (18.9)</td>
<td>69.0 (15-100)</td>
<td>0 %</td>
<td>4 %</td>
</tr>
<tr>
<td>VAS month</td>
<td>20.1 (23.8)</td>
<td>10 (0-95)</td>
<td>0 %</td>
<td>19 %</td>
</tr>
<tr>
<td>Oxford 12-item questionnaire</td>
<td>22.0 (9.0)</td>
<td>20 (12-54)</td>
<td>0 %</td>
<td>10 %</td>
</tr>
<tr>
<td>HSS patella</td>
<td>83.5 (20.3)</td>
<td>95 (15-100)</td>
<td>0 %</td>
<td>31 %</td>
</tr>
<tr>
<td>VAS HSS</td>
<td>41.7 (11.5)</td>
<td>50 (10-50)</td>
<td>0 %</td>
<td>51 %</td>
</tr>
<tr>
<td>SF36 PF</td>
<td>64.0 (24.1)</td>
<td>67.5 (5-100)</td>
<td>0 %</td>
<td>3 %</td>
</tr>
<tr>
<td>SF36 RP</td>
<td>60.0 (41.8)</td>
<td>75 (0-100)</td>
<td>22 %</td>
<td>46 %</td>
</tr>
<tr>
<td>SF36 RE</td>
<td>85.4 (32.0)</td>
<td>100 (0-100)</td>
<td>9 %</td>
<td>80 %</td>
</tr>
<tr>
<td>SF36 SF</td>
<td>73.6 (19.9)</td>
<td>77.8 (0-88.9)</td>
<td>1 %</td>
<td>0 %</td>
</tr>
<tr>
<td>SF36 MH</td>
<td>81.0 (16.7)</td>
<td>84 (0-100)</td>
<td>1 %</td>
<td>13 %</td>
</tr>
<tr>
<td>SF36 VT</td>
<td>68.0 (16.7)</td>
<td>84 (0-100)</td>
<td>0 %</td>
<td>6 %</td>
</tr>
<tr>
<td>SF36 BP</td>
<td>72.3 (23.6)</td>
<td>77.8 (0-100)</td>
<td>1 %</td>
<td>24 %</td>
</tr>
<tr>
<td>SF36 GH</td>
<td>70.14 (21.7)</td>
<td>75.0 (5-100)</td>
<td>0 %</td>
<td>6 %</td>
</tr>
</tbody>
</table>

Table 2. Spearman correlation between the Kujala and the other scoring systems (PF=Physical Functioning, RP=Role limitation resulting from Physical problems, RE= Role limitation resulting from Emotional problems, SF=Social Functioning, MH=Mental Health, VT=energy Vitality, BP= Bodily Pain, GH=General Health perception). All correlation coefficients are statistically significant (p<0.01).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Spearman's correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS month</td>
<td>0.63</td>
</tr>
<tr>
<td>Oxford 12-item questionnaire</td>
<td>0.84</td>
</tr>
<tr>
<td>HSS patella</td>
<td>0.51</td>
</tr>
<tr>
<td>VAS HSS</td>
<td>0.45</td>
</tr>
<tr>
<td>SF36 PF</td>
<td>0.59</td>
</tr>
<tr>
<td>SF36 RP</td>
<td>0.54</td>
</tr>
<tr>
<td>SF36 RE</td>
<td>0.22</td>
</tr>
<tr>
<td>SF36 SF</td>
<td>0.37</td>
</tr>
<tr>
<td>SF36 MH</td>
<td>0.27</td>
</tr>
<tr>
<td>SF36 VT</td>
<td>0.46</td>
</tr>
<tr>
<td>SF36 BP</td>
<td>0.57</td>
</tr>
<tr>
<td>SF36 GH</td>
<td>0.33</td>
</tr>
</tbody>
</table>
Table 3. Overview of different validity and reliability tests that have been reported in the different language validations of the Kujala. <sup>a</sup>Crohnbach's alpha, <sup>b</sup>Test-retest reliability

<table>
<thead>
<tr>
<th>Test category</th>
<th>This study (Dutch version)</th>
<th>Original Kujala</th>
<th>Turkish</th>
<th>Persian</th>
<th>Chinese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Validity (correlations to similar constructs)</td>
<td>+</td>
<td>+</td>
<td>Not tested</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Content Validity (floor/ceiling effects)</td>
<td>+</td>
<td>+</td>
<td>Not tested</td>
<td>+</td>
<td>Not tested</td>
</tr>
<tr>
<td>Convergent and divergent validity (hypothesis of higher correlations to similar and lower correlations to different constructs)</td>
<td>+</td>
<td>Not tested</td>
<td>Not tested</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Reliability</td>
<td>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not tested</td>
<td>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Discussion

The most important finding of the present study was that the AKPS demonstrated a good internal reliability and good construct validity and that ceiling or floor effect of the AKPS were not observed in patients with AKP following TKA or UKA. Furthermore, this is the first study to translate the AKPS...
to Dutch and validate it for use in patients following TKA or UKA. An overview of several validity and reliability tests that have been reported in previous literature is shown in table 3.

Low floor and ceiling percentages are found in instruments with good content validity [15]. Most of the questionnaires, or subscales of questionnaires, focusing on pain had a ceiling effect. In particular, the HSS patella score had a large ceiling effect. The objective part of the score consist of 35 of the 100 points, the VAS of 50 points, and the remaining 15 points result from a single question on functional limitations. The VAS is leading in this; if the VAS is maximal, it is almost impossible to score less than maximum on the other 50 points, basically because they are dichotomous questions, answered yes or no. The VAS is specific for anterior knee pain, so if none is present there is no further differentiation possible in the score; therefore ceiling effect occurs. Based on this ceiling effect, the score is less suitable for patient groups following joint replacement surgery.

Only the correlation of the AKPS with the VAS HSS did not meet the criteria for convergent validity of moderate or high correlations (R > 0.5). This is probably due to the nonparametric distribution (ceiling effect) of the VAS HSS. Performing the analysis when leaving out scores with a maximum score on the VAS HSS, the spearman rho is 0.63 instead of 0.45 for the correlation with the AKPS. Very high correlations for convergent validity were not expected, as the hypothesis is that the AKPS measures complaints that are not evaluated with the other questionnaires. In other words, there should be some correlation between the questionnaires, as they all measure complaints of the knee, but the strength of the correlations can be somewhat different as they measure different aspects.

The AKPS was originally designed for the evaluation of isolated patellofemoral pathologies [23]. If a patient has general complaints of functioning of the knee but no specific complaints of isolated anterior knee pain, the correlation might not be high but some correlation will be present due to a relation between the questions being asked. Hence the threshold for convergent validity is set to moderate to high but is not expected to be very high. The results found support the hypothesis that the dimensions are related but the questionnaire does not measure the exact same thing. It is therefore advised to administer the questionnaire in combination with a more general questionnaire to generate more information about the status of the knee.

Based on literature, a Cronbach's alpha coefficient of higher than 0.7 is acceptable for satisfactory internal consistency [5]. The Cronbach's alpha coefficient of the
AKPS is higher than this threshold with a coefficient of 0.81. This is identical for the Persian, Turkish and Chinese translations for patellofemoral pain [10,24,26]. To evaluate the construct validity, the AKPS was checked for correlations with HSS patella Score, VAS month, Oxford 12-item knee questionnaire and SF-36 subscales. These reference questionnaires were chosen as they are broadly used, validated and reliable. The AKPS was most strongly correlated with the Oxford 12-item knee questionnaire. The Oxford 12-item knee questionnaire is considered to be one of the most valuable questionnaires for assessing patients functional capabilities following TKA or UKA [15]. As AKP also affects functional possibilities, a strong association was expected between these two questionnaires.

The validation of the AKPS for AKP in TKA and UKA patients is important as it makes it possible to adequately follow up these patients and monitor them for AKP after surgery. Previous studies indicate that at least 10 percent of patients experience AKP after TKA [1,6,14,28]. Furthermore, in patients following UKA, it has been reported that up to 48% of patients had some form of AKP at two years after surgery [25]. The results of studies that report AKP are based upon more general questionnaires or Visual Analogue Scales (VAS) that do not assess AKP, or complaints following from AKP, specifically. Current outcome reports, like a recent study finding no relation between patellar blood flow and post-operative AKP [21] following TKA or UKA, might be underestimating the incidence and effect of AKP.

For example, in an excellent meta-analysis, no difference was found in AKP between patients with patellar resurfacing and patients without patellar resurfacing during TKA [14]. When looking at studies that randomized between patellar resurfacing versus non-resurfacing that used AKP as an outcome measure, 5 studies found no significant difference [2,7-8,22,29] and 6 studies did find significant difference [16,20,13,31,33-34]. The incidence of reported AKP was highly variable, ranging from 4 to 47%. This indicates that the studies are not comparable. Furthermore, in UKA patients, no difference was found in outcome two years after UKA between patients that reported AKP prior to surgery and patients that reported no AKP prior to surgery [3]. Patellar symptoms following surgery may be dependent on the patella friendliness of the TKA and UKA implants. The results, and the following recommendations, might be different if a more sensitive questionnaire would be used to assess AKP. The use of the Kujala AKP scale will aid strengthening the evidence and recommendations.
on the presence of AKP and AKP-related complaints following these generally successful considered treatments. Greater attention to and understanding of AKP will furthermore aid in developing new strategies for significant pain relief and overall patient satisfaction after TKA and UKA.

To perform studies into specific complaints of anterior knee pain, the now validated AKPS can be used in combination with other questionnaires for further research. The Dutch validated version will also make it possible to compare surgical outcomes with respect to AKP between Dutch and English literature. A limitation of the study is that no test-retest was performed. Test-retest results of the AKPS have been reported to be good in previous literature, and it was not deemed necessary to perform this analysis. The validation was performed in patients following TKA or UKA. The results of this study can therefore not be generalized for patients suffering from chronic PFPS, patellar dislocation, patellar tendonitis or patellofemoral osteoarthritis. However, we expect that the AKPS can be used for all patients with AKP or PFP.

The strength of this study was that a large group of patients filled out the questionnaires. Furthermore due to the multicenter approach, with patients from both teaching as well as private hospitals, the results are expected to be externally valid. The AKPS can now be used by orthopaedic surgeons as well as physical therapists to assess complaints of AKP in patients following knee arthroplasty and can be used to evaluate effectiveness of certain treatment options, i.e. patellar prosthesis addition or isometric training programs, on complaints.

**Conclusion**

The AKPS appears to be a reliable and valid instrument in patients following TKA or UKA, without ceiling and floor effects, and can be used to assess patients with anterior knee pain.

**Acknowledgement**

We would like to thank Saskia Susan for her outstanding work in data management.
Appendix 1: Dutch Kujala

Voorste kniepijn score:

Patiënten ID: ____________________________
Datum: ______________________________
Knie: R / L

Omcirkel bij iedere vraag de keuze (letter) die uw kniesymptomen het best omschrijft.

1. Loopt u mank?
   a. Nee (5)
   b. Soms (3)
   c. Constant (0)

2. Kunt u belast lopen?
   a. Kan volledig belasten zonder pijn (5)
   b. Met pijn (3)
   c. Belasten is onmogelijk (0)

3. Hoe ver kunt u lopen?
   a. Onbeperkt (5)
   b. Meer dan 2 km (3)
   c. 1-2 km (2)
   d. Onmogelijk (0)

4. Kunt u traplopen?
   a. Geen probleem (10)
   b. Met milde pijn bij trap af (8)
   c. Pijn bij zowel trap op als aflopen (5)
   d. Onmogelijk (0)
Chapter 5

5. Kunt u door uw hurken gaan?
   a. Geen probleem (5)
   b. Herhaaldelijk hurken pijnlijk (4)
   c. Iedere keer pijnlijk (3)
   d. Hurken is alleen mogelijk als ik niet volledig belast (2)
   e. Onmogelijk (0)

6. Kunt u hardlopen?
   a. Geen probleem (10)
   b. Pijn na meer dan 2 km (8)
   c. Milde pijn direct na start (6)
   d. Ernstige pijn (3)
   e. Onmogelijk (0)

7. Kunt u springen?
   a. Geen probleem (10)
   b. Geringe moeite (7)
   c. Constante pijn (2)
   d. Onmogelijk (0)

8. Kunt u langdurig zitten met gebogen knieën?
   a. Geen probleem (10)
   b. Pijnlijk na activiteit ervoor (8)
   c. Constante pijn (6)
   d. Door de pijn moet ik tijdelijk mijn knie strekken (4)
   e. Onmogelijk (0)

9. Heeft u pijn in uw knie?
   a. Nee (10)
   b. Soms milde pijn (8)
   c. Verstoort de nachtrust (6)
   d. Soms ernstige pijn (3)
   e. Constante ernstige pijn (0)
Kujala Anterior Knee Pain Scale

10. Is uw knie gezwollen?
   a. Nee (10)
   b. Na zware inspanning (8)
   c. Na dagelijkse activiteiten (6)
   d. Elke avond (4)
   e. Constant (0)

11. Heeft u een pijnlijke beweeglijkheid en/of voelt u instabiliteit van de knieschijf?
   a. Nee (10)
   b. Soms bij sport activiteiten (6)
   c. Soms bij dagelijkse activiteiten (4)
   d. Minstens een keer uit de kom geweest (2)
   e. Meer dan tweemaal uit de kom geweest (0)

12. Zijn uw bovenbeenspieren dunner/zwakker aan de pijnlijke kant?
   a. Nee (5)
   b. Iets dunner dan aan de andere kant (3)
   c. Veel dunner dan aan de andere kant (0)

13. Hebt u een beperking in het buigen van uw knie?
   a. Nee (5)
   b. Iets minder ver dan aan de andere kant (3)
   c. Duidelijk minder ver dan aan de andere kant (0)
Kujala Anterior Knee Pain Scale


