

## ***Translation, validation and cultural adaptation of orthopaedic questionnaire IKDC 2000 subjective knee form to measure knee function***

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**Introduction** Subjective questionnaires have been developed and applied in orthopaedics and traumatology to access clinical outcomes, the patients' functional status and health related quality of life. **The aim** of the study was translation of the questionnaire into the Russian language, validation and cultural adaptation of the original International Knee Documentation Committee (IKDC) 2000 subjective knee form. **Methods** The IKDC 2000 was translated into Russian by two orthopaedic surgeons and back into English by a professional translator. IKDC 2000 final Russian version was available with revised translations. 100 patients (64 male and 36 female) with different pathologies of the knee joint completed the approved Russian version of IKDC 2000 and Oxford Knee Score (OKS). A subsample of 29 patients was asked to complete the IKDC 2000 subjective knee form again after 7–10 days for test-retest reliability. Cronbach's  $\alpha$  coefficient was used to measure internal consistency. **Results** Patients' mean age was  $38 \pm 1.08$  years (range, 11 – 76 years). The median IKDC 2000 score was 83.4 (interquartile range 61.0 – 91.1; range 12.6 – 100). There was a strong positive correlation observed between the IKDC 2000 Russian version and OKS measuring 0.89;  $p < 0.05$ . Cronbach  $\alpha$  was 0.93 for the IKDC 2000 Russian version; intraclass correlation coefficient (ICC) was 0.82 (0.95 %, 0.56–0.93;  $p < 0.0001$ ), no ceiling and floor effects revealed. **Conclusion** The IKDC 2000 Russian version exhibited high internal consistency, test-retest reliability and validity with no floor and ceiling effects noted. The questionnaire can be used for subjective evaluation of outcomes of patients with different pathologies of the knee joint including injuries to meniscus, ligaments and articular cartilage.

**Keywords:** International Knee Documentation Committee 2000 subjective knee form, IKDC 2000, subjective questionnaire

### INTRODUCTION

Subjective questionnaires have been developed and applied in orthopaedics and traumatology to access clinical outcomes, the patients' functional status and health related quality of life [1]. Clinical evaluations and diagnostic instrumental assessment do not always correlate with patient-derived subjective assessment of symptoms and function [2, 3]. Subjective scales are widely used for objectification of outcomes and comparison of different cohorts of patients by age, gender, pattern of injury, type of operative intervention [4–7]. International Knee Documentation Committee 2000 (IKDC 2000) Subjective Knee Evaluation Form was developed in 1987 for subjective assessment of knee function in patients with a variety of knee disorders [8], including meniscal and ligamentous

injuries, articular cartilage lesions and other pathological condition of the knee joint [8–10]. The IKDC 2000 subjective knee evaluation form is likely to be used in preference to other outcomes measures employed to assess the anterior cruciate ligament deficient knee [11]. IKDC 2000 subjective knee evaluation form has been translated, validated and adapted in Italian [12], Dutch [13], Portuguese [14], Polish [15], Chinese [16] and other languages.

**The aim** of the study was translation of the original English version of the International Knee Documentation Committee (IKDC) 2000 subjective knee form into the Russian language, its validation and cross-cultural adaptation to allow use in medical, scientific and educational institutions of the Russian Federation.

✉ Magnitskaya N.E., Ryazantsev M.S., Maisigov M.N., Logvinov A.N., Zaripov A.R., Korolev A.V. Translation, validation and cultural adaptation of orthopaedic questionnaire IKDC 2000 subjective knee form to measure knee function. *Genij Ortopedii*, 2019, T. 25, No 3, pp. 348–354. DOI 10.18019/1028-4427-2019-25-3-348-354. (In Russian)

## MATERIAL AND METHODS

**International Knee Documentation Committee 2000 (IKDC 2000) subjective knee form**

The IKDC 2000 subjective knee form was developed for identification and assessment of deficient knee function and related limitations in sports activity. The form consists of 10 questions in the domains of symptoms, current function of the knee and functioning during sports activity. The IKDC Subjective Knee Form score can be calculated when there are responses to at least 90 % of the items. The Form is scored by summing the scores for the individual items and then transforming the score to a scale that ranges from 0 to 100.

**Translation and adaptation**

Translations and cross-cultural adaptation were produced according to a set of standardized guidelines offered by Guillemin et al. [17]. The IKDC 2000 subjective knee form was independently translated from English into Russian by two orthopaedic and trauma surgeons with B2 English level. A Russian version was made with the two independent translations. The Russian version was translated back into English by a native English speaker and revised by the board of orthopaedic surgery.

**Patient survey**

The study included 100 patients (64 male and 36 female patients) who received treatment at

the European Clinic of Sports Traumatology and Orthopaedics for a variety of knee impairment. All patients were requested to complete approved Russian version of the IKDC 2000 subjective knee form and Russian version of the Oxford Knee Score (OKS) that was earlier translated into Russian and validated [18]. A subsample of 29 patients was asked to complete the IKDC 2000 subjective knee form again after 7–10 days for test-retest reliability.

**Statistical analysis**

Statistical analysis was performed using the tools of STATISTICA 12.0 (Stat Soft, Inc.) software. The Kolmogorov-Smirnov test was used to follow normal distribution of variables. The sample mean and standard deviation were calculated with normally distributed variables and the median and interquartile range (the 25th and 75th percentile) was defined for non-normal variables. Cronbach's alpha coefficient was used to measure internal consistency of questionnaire and intraclass correlation coefficient (ICC) was employed as a reliability index in test-retest. The Spearman Rank correlation was used to evaluate validity. For calculations, a significance level of 5 % ( $p \leq 0.05$ ) was adopted.

## RESULTS

The mean age of the patients was  $38 \pm 1.08$  years (range, 11 to 76 years). The median IKDC 2000 score was 83.4 (interquartile range 61.0 – 91.1; minimum value, 12.6; maximum value, 100). Distribution of patients with IKDC 2000 scores is presented in Figure 1. The median OKS score was 45 (interquartile range 39–91; minimum value, 11, maximum value, 76). Comparison of patients by gender showed no statistically significant differences ( $p > 0.05$ ).

**Validity**

Validity of the Russian version of the IKDC 2000 subjective knee form was measured with the Spearman Rank correlation coefficient. Correlation analysis of the Russian version of the IKDC 2000 subjective knee form and earlier validated OKS scale showed strong positive relationship of 0.89;  $p < 0.05$ .

**Floor and ceiling effects**

Floor and ceiling effects occur when a considerable

proportion of subjects score the minimum (0) or maximum (100) score. Two patients exhibited the highest scores with the Russian version of the IKDC 2000 subjective knee form. None of the patients demonstrated minimum score.

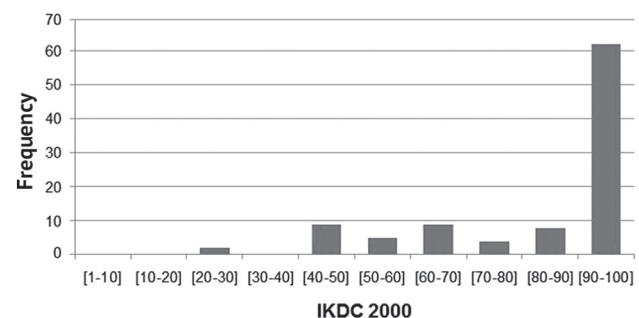


Fig. 1 Distribution of patients with IKDC 2000 scores

**Internal consistency**

Internal consistency of the Russian version of the IKDC 2000 subjective knee form was measured with

Cronbach's alpha coefficient normally ranged between 0 and 1 and allowed for evaluation of consistency of questions contained in questionnaires. Cronbach's alpha coefficient measured 0.93 for the Russian version of the IKDC 2000 subjective knee form that indicated to a high degree of internal consistency.

### **Test-retest reliability (reproducibility)**

A subsample of 29 patients was asked to complete the IKDC 2000 subjective knee form again after 7–10 days for test-retest reliability. An intraclass correlation coefficient (ICC) was 0.82 (0.95 %, 0.56–0.93,  $p < 0.0001$ ).

## **DISCUSSION**

Subjective questionnaires are widely used in orthopaedics for objective quantification of perceptions of patients with injuries or degenerative diseases of musculoskeletal system and evaluation of dynamics in patient's condition after treatment. Monitoring of clinical outcomes of patients with knee impairment is based on health related quality of life through knee related limitations and symptoms [19]. The majority of universally accepted orthopaedic questionnaires were primarily designed in English and adapted for Anglo-Saxon culture [8, 20]. Time-consuming process of validation and cultural adaptation in different languages are required to avoid controversies in scientific literature reporting clinical outcomes. Available version culturally adapted in a native language allows formation of registers, multicenter research obtaining quantitative data being comparable and sustainable for comparison with findings of researches performed in different countries.

The purpose of the study was validation and cultural adaptation of the International Knee Documentation Committee (IKDC) 2000 subjective knee form for Russian-speaking population. OKS, KOOS, WOMAC, ACL-RSI scales were earlier validated and culturally adapted in the Russian language [6, 7, 18, 21]. There is the need for a reliable and valid knee-specific measure of symptoms, function and sports activity that would be appropriate for patients with ligamentous and meniscal injuries in Russia. The OKS is specifically designed and developed to assess function and pain after total hip replacement surgery. KOOS and WOMAC scales are designed to assess pain, symptoms, activities of daily living, sport and recreation function of the knee and hip joints in osteoarthritis. The KOOS meets basic criteria of outcome measures and can be used to evaluate outcomes of anterior cruciate ligament (ACL) reconstruction as recorded in registers of Denmark, Norway, Sweden, UK and USA [4, 22–

25]. The IKDC subjective has been shown to be more useful than the KOOS questionnaire in terms of relevant questions, reproducibility of results, internal consistency and absence of floor and ceiling effects [1]. Three types of psychological responses believed to be associated with resumption of sport following athletic injury—emotions, confidence in performance, and risk appraisal—were incorporated into the earlier validated Russian version of ACL-RSI scale [26]. There is no Russian version of a validated scale being specific of knee symptoms and function available for patients with impaired cruciate ligaments and meniscus. Of general knee instruments, the IKDC 2000 Standard Evaluation Form contains the most items important to patients with injuries to anterior cruciate ligaments, meniscus and progressive gonarthrosis [8, 27]. The original version of IKDC subjective knee form has shown high test-retest reliability and internal consistency [8]. The IKDC subjective has been shown to be more useful than the KOOS questionnaire to evaluate both patients with recent ACL ruptures and those in the first year after ACL reconstruction [1].

High values of validity, internal consistency, test-retest and absence of floor and ceiling effects were characteristic of the Russian version of the IKDC 2000 Subjective Knee Form. High scores (from 90 to 100) can be ascribed to a great number of patients after knee ligament reconstruction (79 %). Irrgang et al. [8] reported on 51 % of patients after ACL reconstruction. Strong correlation between IKDC 2000 subjective and OKS indicates to a high validity of the Russian version.

Internal consistency describes the extent to which all the items in a test measure the same concept or construct and hence it is connected to the inter-relatedness of the items within the questionnaire. Put simply, internal consistency shows how adequately the questions correlate with each other. A high Cronbach alpha value of 0.93 we got in our study is

consistent with the results of IKDC 2000 subjective adapted in Chinese and Italian languages [12, 16]. Nevertheless, Cronbach alpha value greater than 0.9 can implicitly indicate to redundant elements in the test. To evaluate redundant elements in the questionnaire we consequently removed each of the questions in the form and measured Cronbach alpha coefficient in the process. This procedure allowed lower coefficient values that indicated to the lack of necessity to delete any question in the Russian version of IKDC 2000 subjective. Test-retest reliability of the Russian version of IKDC 2000 subjective with ICC of 0.82 showed high

consistency level of patients' answers after 7 to 10 days of the initial completion of the form [12, 14, 16]. Measurements of validity reported by different authors are presented in Table 1.

The mean time of completion for the Russian version of IKDC 2000 subjective was 15 minutes and no one had difficulties in understanding the questions. The basic difference between our study and researches on validity of IKDC 2000 in other countries comes from a great number of patients with a high score. This is likely to be associated with 79 % of the patients who completed the form after surgical treatment.

Table 1

Values of internal consistency and test-retest reliability of IKDC 2000 subjective knee form

|                                                          | Internal consistency<br>(Cronbach's alpha coefficient) | Test-retest reliability (ICC)      |
|----------------------------------------------------------|--------------------------------------------------------|------------------------------------|
| Padua et al., 2004 [12]                                  | 0.91                                                   | 0.90 (p < 0.01)                    |
| Haverkamp et al., 2006 [13]                              | 0.92                                                   | 0.96 (p < 0.001; 95 % 0.94–0.97)   |
| Metsavaht et al., 2010 [14]                              | 0.93                                                   | 0.99 (p < 0.001; 95 % 0.98–0.99)   |
| Fu et al., 2011 [16]                                     | 0.97                                                   | 0.87 (p < 0.0001; 95 % 0.70–0.95)  |
| <b>Russian version of IKDC 2000 subjective knee form</b> | 0.93                                                   | 0.82 (p < 0.0001, 95 %, 0.56–0.93) |

## CONCLUSION

The Russian version of the IKDC 2000 Subjective Knee Form has shown high values of validity, internal consistency, test-retest and absence of floor and ceiling effects. The form can be

used for subjective evaluation of clinical outcomes of patients with a variety of knee pathologies including injuries to meniscus, ligaments and articular cartilage.

## Evaluation form

### 2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

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Full name \_\_\_\_\_

Date of birth: \_\_\_\_/\_\_\_\_/\_\_\_\_

Today's date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Date of injury: \_\_\_\_/\_\_\_\_/\_\_\_\_

Knee joint: ☐ Right side ☐ Left side

### SYMPTOMS\*

\*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain:

- 4 ☐ Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 ☐ Strenuous activities like heavy physical work, skiing or tennis
- 2 ☐ Moderate activities like moderate physical work, running or jogging
- 1 ☐ Light activities like walking, housework or yard work
- 0 ☐ Unable to perform any of the above activities due to knee pain

2. During the past 4 weeks, or since your injury, how often have you had pain?

|       |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |  |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
|       | 0                        | 1                        | 2                        | 3                        | 4                        | 5                        | 6                        | 7                        | 8                        | 9                        | 10                       |  |
|       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Never |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          | Constant                 |  |

3. If you have pain, how severe it was?

|         |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |  |
|---------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
|         | 0                        | 1                        | 2                        | 3                        | 4                        | 5                        | 6                        | 7                        | 8                        | 9                        | 10                       |  |
|         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| No pain |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          | Worst pain imaginable    |  |

4. How stiff or swollen was your knee during the past 4 weeks, or since your injury?

- 4 ☐ Not at all
- 3 ☐ Mildly
- 2 ☐ Moderately
- 1 ☐ Very
- 0 ☐ Extremely

5. What is the highest level of activity you can perform without significant swelling in your knee:

- 4 ☐ Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 ☐ Strenuous activities like heavy physical work, skiing or tennis
- 2 ☐ Moderate activities like moderate physical work, running or jogging
- 1 ☐ Light activities like walking, housework or yard work
- 0 ☐ Unable to perform any of the above activities due to knee swelling

6. Did your knee lock or catch during the past 4 weeks, or since your injury?

- 0 ☐ Yes
- 1 ☐ No

7. What is the highest level of activity you can perform without significant giving way in your knee:

- 4 ☐ Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 ☐ Strenuous activities like heavy physical work, skiing or tennis
- 2 ☐ Moderate activities like moderate physical work, running or jogging
- 1 ☐ Light activities like walking, housework or yard work
- 0 ☐ Unable to perform any of the above activities due to giving way of the knee

## SPORTS ACTIVITY

8. What is the highest level of activity you can participate in on a regular basis?

- 4 ☐ Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 ☐ Strenuous activities like heavy physical work, skiing or tennis
- 2 ☐ Moderate activities like moderate physical work, running or jogging
- 1 ☐ Light activities like walking, housework or yard work
- 0 ☐ Unable to perform any of the above activities due to knee

9. How does your knee affect your ability to:

|    |                                    | Not difficult<br>at all    | Minimally difficult        | Moderately<br>difficult    | Extremely<br>difficult     | Unable to do               |
|----|------------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| a. | Go up stairs                       | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| b. | Go down stairs                     | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| c. | Kneel on the front of your<br>knee | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| d. | Squat                              | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| e. | Sit with your knee bent            | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| f. | Rise from a chair                  | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| g. | Бег по прямой                      | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| h. | Run straight ahead                 | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |
| i. | Stop and start quickly             | 4 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2 <input type="checkbox"/> | 1 <input type="checkbox"/> | 0 <input type="checkbox"/> |

## FUNCTION

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

## FUNCTION PRIOR TO YOUR KNEE INJURY:

|                                   |                          |                          |                          |                          |                          |                                   |                          |                          |                          |                          |                          |  |
|-----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
|                                   | 0                        | 1                        | 2                        | 3                        | 4                        | 5                                 | 6                        | 7                        | 8                        | 9                        | 10                       |  |
|                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Couldn't perform daily activities |                          |                          |                          |                          |                          | No limitation in daily activities |                          |                          |                          |                          |                          |  |

## CURRENT FUNCTION OF YOUR KNEE

|                                 |                          |                          |                          |                          |                          |                                   |                          |                          |                          |                          |                          |  |
|---------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
|                                 | 0                        | 1                        | 2                        | 3                        | 4                        | 5                                 | 6                        | 7                        | 8                        | 9                        | 10                       |  |
|                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Cannot perform daily activities |                          |                          |                          |                          |                          | No limitation in daily activities |                          |                          |                          |                          |                          |  |

**Conflict of interests:** Prof. A.V.Korolev is an official consultant and lecturer of Arthrex.

**Funding:** no financial support was provided for the study.

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Received: 03.06.2019

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