Assessing the progress of rehabilitation in patients with ACL reconstruction using the International Knee Documentation Committee Subjective Knee Form.

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Abstract. There are numerous assessment tools designed to provide information on the results of reconstructive surgery of anterior cruciate ligament (ACL). They are also used for monitoring progress and facilitating clinical decision-making during the rehabilitation process. A brief summary of some existing tools specifically designed to evaluate knee ligament injuries is presented in this article. Then, one of those outcome measures, the International Knee Documentation Committee Subjective Knee Form (IKDC) was applied to a group of patients (N = 10) who had undergone surgery for ACL reconstruction. The patients attended the same physiotherapy service and followed a unified rehabilitation protocol. The assessment was performed twice: four and six months after surgery. The results showed an improvement in the rehabilitation of most patients tested (verified by a difference equal to or greater than 9 points on the IKDC outcome between measurements 1 and 2). The IKDC probed to be an instrument of quick and easy application. It provided quantitative data about the progress of rehabilitation and could be applied in everyday clinical physiotherapy practice. However, the results suggested considering the IKDC as one component of an evaluation kit to make decisions regarding the progress of the rehabilitation treatment.

1. Introduction
After surgical interventions and during the early stages of rehabilitation programs it is necessary to measure and evaluate the evolution of the patient. Often tools for generic classification and diagnostic evaluation that rely on the initial pathology are implemented. A classification is used to describe the disease and the health status of the patient. An evaluation is utilized to understand the status and decide how to proceed.

1.1. WHO classifications
The World Health Organization (WHO) is responsible for issuing the diagnostic standards related to health conditions, using a classification system widely accepted. The objectives of the standards are to establish a common language on issues related to health and disease and to contribute to the epidemiological management and use of terminology in clinical practice. This family of classifications, as they are called, assists with the analysis and interpretation of data, information storage and retrieval, temporal and spatial comparison of population groups, incidence and prevalence of disease and identification of issues, characteristics and circumstances that affect the individual.

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Therefore it provides a consistent source of data to the responsible institutions in each country of the management and administration of health policies.

The International Classification of Function and Disability, ICF, part of the WHO Family of International Classifications, focuses on the description of health and health-related domains. These domains are classified from body, individual and societal perspectives by means of two lists: a list of body functions and structure, and a list of domains of activity and participation. Since the functioning and disability of an individual occurs in a context, the ICF also includes a list of environmental factors [1]. The domains in turn are organized into components. The domain of functioning and disability contains components such as body structures, body functions, activities and participation. The domain of environmental factors incorporate not only environmental but also personal factors, although these are not included in the classification itself but as part of the framework. The organization structure of the ICF is designed to help identify factors that prevent or improve the participation and integration of people within social, recreational or work environments [2].

The ICF guides a medical treatment towards a deficiency in the body structure, it guides the rehabilitation or training program towards certain activities and it also guides social policies and public health towards welfare and environmental factors. Hence the position within the classification relates with the development of structured assessment tools for evaluating results of intervention procedures and rehabilitation programs. Tools such as subjective evaluation questionnaires, functional tests and rating scales among others, go beyond the description of a condition. They are intended to quantify and qualify through the physical examination and diagnosis.

1.2. Evaluation instruments

Depending on the pathology to be evaluated different instruments are used. Especially in pathologies associated with the knee and given the structural and biomechanical complexity associated with it, many types of assessment instruments have been proposed. Overall, the instruments related to knee ligament can be divided in three categories: questionnaires, clinical tests and functional tests. The main between questionnaires and clinical tests is that the former measure disability while the latter measure the level of deterioration [3]. The high prevalence of anterior cruciate ligament injuries (ACL) [4] has bias the assessment tools toward the evaluation of functional state before and after injury. The tools are also designed to understand the processes of rehabilitation after ACL reconstruction (R-LCA), including other factors such as the level of activity at the time of intervention that can alter the outcome of treatment [5]. The requirements to be fulfilled by any evaluation before being accepted for administration are reliability, validity and responsiveness, the latter recently added as an important psychometric property to consider. Responsiveness is defined as the ability to detect clinically relevant changes, i.e. to detect improvement or deterioration in the patient over time [6, 7].

At the beginning of the 80s the need to compare the results of different surgical techniques or different methods of treatment was recognized. However, this was not possible due to the lack of standards for evaluation and the fact that different subjective rating scales provided different results. It was not easy to measure the evolution after surgery. Some efforts had been made using questionnaires that were administered by the surgeons themselves and presented in percentage scales [8]. Although the scales did not distinguish between objective, subjective and functional criteria, they provided the basis for the development of many evaluation frameworks [9].

The Lysholm score originally published in 1982 [10] has been one of the formats most widely used since its publication. It was intended to qualify knee instability in young patients and it was designed to be applied by qualified personnel in order to avoid bias. The scale evaluates among other things, different activities of varying intensities (generally, low demand activities). Since the activities do not necessarily represent a challenging effort to the patient, the final scores are often quite high. This affects the final analysis, given that in some cases the scale results in higher than expected values.

Another feature of the scale is that it does not include a physical examination, but it mainly focuses on the perception of the patient regarding their activities of daily living (ADL). The scale introduced the term instability, defined as a symptom [5], and reported as a sense of instability in the knee. After a
first version, this scale was further developed and organized in 8 parameters with a maximum of 100 points in total [11]. This new version was used to assess the patient's level in sports and work activities, highlighting important variables in the process of rehabilitation. The combination of these two scales continues to be used in following ACL reconstruction surgery [12, 13] and rehabilitation programs [14].

The Cincinnati Scale was designed specifically to evaluate ACL injuries with emphasis on symptoms and the perception of the patient regarding the functional knee [15]. Since its publication it has been subjected to numerous modifications and has been developed to assess symptoms and functional limitations in sports and everyday life. The evaluation system consists of 11 components, including physical examination and radiographic stability, which is useful in evaluation of multiple ligament injuries. Further studies were performed to determine its validity, reliability and responsiveness [16]. Although widely used, it takes some time to be completed and presents certain level of complexity.

1.3. Use of the International Knee Documentation Committee Subjective Knee Form (IKDC)

The creation of the International Knee Documentation Committee (IKDC) emerged from the need to implement a standard assessment of ligaments and to provide common and universal terminology. Despite the existence of previous tools to assess ligament injuries and treatment outcomes, the systems often assign numerical values to factors that are difficult to quantify, which led to assigning arbitrary values that hampered comparisons with other tools. The initial objectives of the evaluation system would be to facilitate the publication of results of treatments and interventions of the knee [17], to include the essential criteria for evaluating results in a reproducible manner and to allow the use of the system in clinical practice with or without assistance of an experienced professional [18].

The original assessment includes a section on general information (documentation), a section of qualifications and a section of evaluation. The evaluation, the largest part, consists of four areas: subjective assessment, symptoms, range of motion and ligament examination. It was essentially designed to be used before the reconstruction and for the subsequent monitoring of patients until 10 years after surgery.

The Subjective Knee Form IKDC (S-IKDC) [18] emerged as an appendix to the original format and focused on the evaluation of improvement or worsening of symptoms, daily function and level of sports activity experienced by patients who had a variety of conditions, including injuries to ligaments, meniscus, cartilage and / or patellofemoral pain. The format consists of various subjective factors such as symptoms, functional abilities and sporting activities grouped into 18 questions. The questions on activities of daily living include walking on different surfaces, climbing stairs, standing still, kneeling, squatting, sitting with knees bent and rising from a chair. And with regard to sport activities, the format assesses abilities to run, jump using involved leg, move and stop and turn quickly. In summary, the S-IKDC was designed to detect symptoms and deterioration in function and sports activities due to knee injury and to maximize the reliability, validity and responsiveness of the test. Based on the evidence, the S-IKDC has proven to be a good indicator for evaluating the course of rehabilitation programs in subjects from different functional activity levels [19-21].

According to the criteria for certifying one such test, the validity and reliability was assessed as satisfactory by Irrgang in 2001. Also from the study, it was concluded that a true change is represented by a total change equal to or more than 9 points in the final score of the S-IKDC [18].

While the use of scales is recommended in the literature and supported by investigations regarding their reliability, validity and sensitivity, they are not used in everyday clinical practice. The aim of this study was, therefore, to assess the implementation of the S-IKDC in order to evaluate the rehabilitation progress of patients with ACL reconstruction.
2. Methods

2.1. Subjects
For this study, 10 patients (9 M, 1 F), age 16 to 40 years (mean 29.6 ± SD 9.5), weight 82.8 ± 16.2 kg, height 1.73 ± 0.05 m (Table 1) attending a physiotherapy service in Paraná, Entre Ríos were recruited. All of them had been diagnosed with unilateral ACL injury and all had undergone semitendinosus-gracilis graft reconstructive surgery. The surgeries were performed between June and October 2010. All subjects attended the same physiotherapy service and followed a unified rehabilitation protocol that began two weeks after surgery and included physical activities of closed and open kinetic chain exercises.

Table 1. Characteristics of the participants

| Subject | A | Ag | RK | TIS | TA1 | TA2 | CI               |
|---------|---|----|----|-----|-----|-----|------------------|
| FS      | 2 | 22 | R  | 4   | 5   | 7   | Contact sport    |
| DA      | 2 | 40 | L  | 6   | 4   | 6   | Occupational accident |
| FF      | 1 | 40 | L  | 1   | 4   | NA  | Occupational accident |
| R       | 1 | 20 | R  | 12  | NA  | 6   | Non-contact sport |
| EP      | 2 | 23 | L  | 7   | 4   | 6   | Contact sport    |
| AC      | 2 | 22 | L  | 2   | 4   | 6   | Contact sport    |
| O       | 1 | UD | UD | UD  | NA  | 6   | Occupational accident |
| CG      | 2 | 39 | L  | -60 | 4   | 6   | Contact sport    |
| DY      | 1 | 31 | L  | 4   | 4   | NA  | Occupational accident |
| V       | 2 | 16 | R  | <1  | 4   | 6   | Non-contact sport |

A: Number of assessment  
Ag: Age  
RK: Reconstructed Knee (R: right, L: left)  
TIS: Time between injury and surgery (months)  
TA1: Time between surgery and the first assessment (months)  
TA2: Time between surgery and the second assessment (months)  
CI: Cause of injury  
UD: Unavailable Data  
NA: The patient did not attend the evaluation session

All patients were informed of the purpose of the study and were invited to sign an informed consent before starting the procedure.

2.2. Procedure
The Subjective Knee Form IKDC was administered twice: 16 ± 1 weeks after surgery and 24 ± 1 weeks after surgery. The questions were read by the evaluator. For the interpretation of the results only data from patients who attended both sessions was analysed.

3. Results
Ten patients were recruited. Of those, six completed both assessments, two did not attend the second session and two did not attend the first session (Table 1). For processing the data obtained from the S-IKDC, Microsoft Excel® software was used, following the instructions of the evaluation form [18]. The results are presented in Table 2.

For the six patients analyzed, the leading cause of injury was contact sports activity (N = 4). The predominant age group was 16 to 23 years (N = 4), 39 and 40 years (N = 2).

All six patients reported continuing the rehabilitation program 3 times per week for at least 3 months, as offered by the health insurance systems. Five of them continued with individual training
programs afterwards, and one reported having taken a one month break after the three months period and having started a physical program on his own after that.

The patients reported their pre-injury physical activity as practice of sports a few days a week (N = 3) and receive training and sports frequently (N = 3). At the time of the second assessment four patients had resumed or initiated training program every day (N = 2), 3 or 4 times a week (N = 2) or had started jogging (N=2).

Of the six patients who completed both evaluations, five showed an improvement in the second visit. This improvement was demonstrated by a difference in the results of the S-IKDC equal to or greater than 9 points between measurements 1 and 2 (Table 2). One patient presented a negative difference (of -1.1 points).

Table 2. Subjective Knee Form IKDC results for the first and second assessment and the difference (Diff) between assessments.

| Subjects | 1°   | 2°   | Diff. |
|----------|------|------|-------|
| FS       | 70.1 | 79.3 | 9.2   |
| DA       | 69.0 | 88.5 | 19.5  |
| FF       | 51.7 | -    | -     |
| R        | -    | 81.6 | -     |
| EP       | 64.4 | 74.7 | 10.3  |
| AC       | 66.7 | 80.5 | 13.8  |
| O        | -    | 59.8 | -     |
| CG       | 65.5 | 77.0 | 11.5  |
| DY       | 54.0 | -    | -     |
| V        | 92.0 | 90.8 | -1.1  |

4. Discussion
The results obtained are in the same range of those reported in the literature for one year [22], 5 years [20] and 6 years [23] after reconstructive surgery.

The administration of this subjective assessment proved to be fast (completing the questionnaire took no longer than 10 minutes) and easy procedure. However, it is not used in everyday clinical practice. Several factors could contribute to this state of affairs. One could be related to the healthcare coverage, which limits the visits for physical therapy to a fix number and it is unalterable by the opinion of the clinicians regarding the state of the patient. Hence, the assessment would not have a direct effect on the visits covered. Also, clinicians need to be familiar with the range of measures available and they should be able to evaluate the suitability of the measures for their clinical practice.

In general, there was no difficulty in interpreting and answering the questions of the form. The exception was shown in the section on sports activities. Some patient had not tried at the time of the first assessment some tasks such as jumping on one foot (N = 5) or kneeling (N = 2). The patients explained that either they were afraid of undertaking the activity which could affect the graft or rehabilitation process or that the physical therapist advised against performing the activity. For the second evaluation, only two patients had not attempted jumping and while all reported having kneeled (or attempted to).

One patient showed a change of -1.1 point from first to second assessment. This difference can not be considered a real change in the condition of the patient. However, the result is in partly explained by the high level of activity that the patient performed already at the fourth month of rehabilitation, i.e. the first assessment session (which is shown in the high value of the first session result of the S-IKDC (92.0)). This particular patient performed intense sports activities before the injury and he was trying to quickly return to the same activities. For this particular patient it would have been difficult to define his readiness to return to regular sports activity at the fourth month using the S-IKDC as the only
evaluation procedure. In this case, other outcome measurements (such as assessment of muscle strength) would be useful to increase the information and for the decision–making process.

The general characteristics of the patients recruited for this study correlate well with the findings of previous studies, where the higher percentage of ACL injuries and reconstruction are found in recreational athletes and basketball players and only a small percentage on competitive athletes [20]. The subjects of this study participated in contact team sports, such as football (N = 3) and rugby (N = 1), with regular participation in sport games and competitive pre-injury level.

The S-IKDC has been submitted to several revisions in order to reduce the percentage of unanswered questions in the test groups. While this objective was in part achieved, the present study shows that there are still questions that patients find difficult to answer. The criteria to be used in evaluation of activities that patients do not performed (either for fear or pain), which are therefore responses left blank in the questionnaire, should be investigated in future studies.

Within the set of instruments designed to measure outcomes from the patient’s perspective, a recent study supports the S-IKDC as a measuring instrument of general but not universal applicability [24].

In conclusion, this study showed that the Subjective Knee Form IKDC is a tool of quick and easy application that provides quantitative data about the rehabilitation stage of the patient and could be applied in everyday clinical physiotherapy practice. However, its value as a status assessment of patient recovery is limited, which was also manifested by other researchers [25]. Hence, it would be sensible to use it as one component of an evaluation set. The whole set should be used then for decisions about the progress of the rehabilitation treatment.

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