Concurrent Validation of the Banff Patella Instability Instrument to the Norwich Patellar Instability Score and the Kujala Score in Patients With Patellofemoral Instability

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Background: The Banff Patella Instability Instrument (BPII) is a disease-specific, patient-reported, quality-of-life outcome measure designed to assess patients with patellofemoral instability. The iterative assessment of the validity, reliability, and responsiveness of a health-related patient-reported outcome measure is vital to the development of a high-quality evaluation tool.

Purpose: To assess the concurrent validity of the BPII to the Norwich Patellar Instability (NPI) score and the Kujala score.

Study Design: Cohort study; Level of evidence, 2.

Methods: A total of 74 patients with a confirmed diagnosis of recurrent patellofemoral instability completed the BPII, NPI, and Kujala scores at the initial orthopaedic consultation. A Pearson \( r \) correlation coefficient was computed to determine the relationship between each of these patient-reported outcomes.

Results: There were statistically significant correlations between the BPII and the NPI score \( (r = -0.53; P < .001) \) as well as the BPII and the Kujala score \( (r = 0.50; P < .001) \).

Conclusion: This study demonstrated a moderately strong correlation of the BPII to other outcome measures used to evaluate patients with patellofemoral instability. This study adds further validity to the BPII in accordance with the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) guidelines.

Keywords: patellofemoral instability; Banff Patella Instability Instrument (BPII); Norwich Patellar Instability score (NPI); Kujala score; outcome measure; quality of life; COSMIN

Patellofemoral instability is a common knee problem that results in significant morbidity. It is frequently associated with instability, pain, decreased activity, long-term osteoarthritis, and reduced quality of life.\(^2\,4\,8\,13\,17\) Understanding the results of interventions for patellofemoral instability will influence the treatment of this disorder, and performing quality research in this growing field requires the use of valid and reliable outcome measures. Outcome measures can be subjective or objective, patient reported or clinician reported. Each of these outcome measures is important; however, only patient-reported outcomes provide patients with the opportunity to self-report their treatment results for a designated construct. Determining whether treatments help patients has been noted as “the ultimate measure by which to judge the quality of a medical effort.”\(^1\)

The COnsensus-based Standards for the selection of health MeasuremenT INstruments (COSMIN) initiative was undertaken to provide clinicians and researchers with tools to identify appropriate high-quality health measurement instruments.\(^12\) The COSMIN group utilized an international Delphi study to develop a critical appraisal tool (the COSMIN checklist), which can be used to evaluate the
The Banff Patellar Instability Instrument (BPII) was first published and its initial validity and reliability reported in July 2013 (see the Appendix). The BPII is a quality-of-life score comprising 32 questions within 5 domains, including symptoms and physical complaints; work-related concerns; sport, recreation, and competition; lifestyle; and social and emotional. By including these domains, the BPII is designed to capture a more holistic view of the quality of life of patients with patellofemoral instability. A modified Ebel procedure was utilized, with a group of international experts identifying the most important outcome measure questions for the new disease-specific quality-of-life tool, to establish initial content validity. A total of 150 completed BPIIs were used to evaluate validity and reliability. The BPII study reported on the initial validity and reliability in both patellofemoral instability and post–patellofemoral stabilization populations as a measure of quality of life. In addition, initial responsiveness and concurrent validity were reported.

The BPII and NPI are both recently developed tools that attempt to fill the void of disease-specific outcome measures for patellofemoral instability identified by Smith et al in 2008. As a quality-of-life measure, the BPII assesses a broad set of constructs providing a holistic view of patients’ outcomes. In comparison, the NPI measures exclusively the physical domain. The Kujala score measures patellofemoral pain, symptoms, and function. The Kujala score is commonly employed for patellar instability outcome assessment in the literature; however, only 1 of the 13 questions asks about symptoms of instability.

Validity is an iterative process and therefore, no single study will determine whether an instrument is valid and reliable. However, as additional research is completed on an instrument, in different or more broad populations, the results build toward greater validity. In keeping with the COSMIN validity domain, content, criterion, and construct validity all require evaluation to demonstrate the quality of a patient-reported outcome. Concurrent validity is a component of criterion validity. The primary purpose of this study was to assess the concurrent validity of the BPII to the NPI score and the Kujala score in patients with patellofemoral instability.

METHODS

Population/Sample

Between February 2013 and November 2013, a total of 85 patients referred with patellar instability underwent an initial assessment by an orthopaedic surgeon at a tertiary sports medicine clinic with a subspecialization in patellofemoral instability. All patients were referred by sports medicine physicians and had failed nonoperative management. Each patient underwent a standardized knee-specific history and physical examination along with plain
RESULTS

Seventy-four patients completed all items on the BPII, NPI, and Kujala questionnaires, and these data were analyzed. Descriptive statistics for the BPII, BPII-physical, NPI, and Kujala scores are listed in Table 1.

There were statistically significant correlations between the BPII and the NPI score \( (r = -0.53 \text{ [95\% CI, 0.34-0.68]; } P < .001) \) as well as the BPII and the Kujala score \( (r = 0.50 \text{ [95\% CI, 0.30-0.66]; } P < .001) \). There were also significant correlations between the subset of BPII-physical items and both the NPI score \( (r = -0.57 \text{ [95\% CI, 0.39-0.71]; } P < .001) \) and the Kujala score \( (r = 0.58 \text{ [95\% CI, 0.40-0.72]; } P < .001) \), as well as significant correlation between the NPI score and the Kujala score \( (r = 0.50 \text{ [95\% CI, 0.30-0.66], } P < .001) \).

DISCUSSION

This study provides additional validation of the BPII via concurrent validation to the NPI. Tool development is an iterative process and ongoing validation is essential to ensure the methodological soundness of the outcome measure. This study demonstrated a moderately strong correlation between the BPII and the NPI, which are both designed to evaluate patients who present with patellofemoral instability. The BPII also demonstrated a moderately strong correlation to the Kujala. The most important aspect of any outcome measure is ensuring that it is measuring what it is intended to measure. The assessment of a relationship between the patient-reported outcomes assessed in this study provides evidence that they are measuring similar although not exactly the same constructs.

Disease-specific outcome measures for patellofemoral instability can have different purposes, with some focused on purely physical complaints and others assessing quality of life as a whole. Both types of measures will have their place in the analysis of outcomes in this challenging patient population. The BPII is a quality-of-life measure, where the higher the score (out of 100) the better the patient's quality of life. The NPI is a measure of patellofemoral instability, so the higher the score the greater the degree of disability. The negative correlation evident between the BPII and NPI in this study is due to the inverse nature of the scales. The statistically significant correlation between these 2 outcome measures demonstrates the tools are measuring some of the same constructs, although there remains some variability, likely secondary to the distinct purpose of each tool.

Because the BPII measures a broad range of quality-of-life constructs in comparison with the NPI, which measures physical symptoms and function, it follows that the BPII-physical score demonstrated a stronger correlation with the NPI than the total BPII score. Further research assessing the 5 constructs of the BPII via factor analysis will be necessary to confirm these constructs as well as the number of items that fall under the physical symptoms domain. Despite the Kujala scale including only 1 question specific to instability of the patella, the BPII and the NPI both correlated moderately strongly with the Kujala score, indicating that these outcome measures have other areas of overlap. In the context of the COSMIN guidelines, all 3 of these patient-reported outcomes used for patellofemoral instability require further research. The relationship of the standard deviation of each score to measurement precision in the patellar instability population also merits investigation. It is possible that the narrower standard deviation demonstrated by the BPII score is indicative of the instrument's ability to more precisely measure patient-reported outcomes.

Specific to patellofemoral instability, the Kujala score was originally evaluated in a population of 34 subjects. The face validity, content validity, and aspects of structural
validity were reported; however, the reliability and responsiveness of the score were not assessed. The initial face and content validation and internal consistency assessment of the NPI addressed 2 criteria of instrument development. The primary intent of the NPI is related to the physical function of patients who suffer from patellofemoral instability, and therefore, it does not include other dimensions or domains commonly measured in disease-specific, health-related quality-of-life instruments. The initial validity and reliability of the BPII was established in keeping with the COSMIN guidelines. Responsiveness to change of the BPII was measured in a patellofemoral instability population that proceeded to a stabilization procedure. The reliability of the BPII was assessed in the areas of internal consistency and test-retest reliability. The BPII is the first of these outcome measures to be validated in both the pre- and postsurgical population, and it is the only instrument to measure quality of life in patellofemoral instability patients.

Limitations of this study include the narrow focus on 1 aspect of outcome measure validation: concurrent validity. It is important to note that completing research in all 9 COSMIN checklist areas would be almost impossible in a single study. As such, various components of outcome measure development need to be addressed in separate studies, and some of these will require a single purpose. All patients included in this study had failed nonoperative management and therefore may not represent the full range of patients with recurrent patellar instability. The broad range of pathoanatomic characteristics of patients presenting with patellofemoral instability make this heterogeneous population challenging to analyze. This may account for the broad standard deviations seen in the current patient-reported outcome measures.

There are also a number of other studies that are required for the BPII to complete the full COSMIN checklist. In keeping with the iterative nature of outcome measure development, ongoing validity, reliability, and responsiveness testing are required for a health-related tool to be considered high quality. Testing these important factors of the BPII will be essential across a number of studies, and with new patients, to build greater scientific soundness. It is important that similar standards are applied to both newly developed outcome measures such as the BPII and established measures such as the Kujala score to ensure that the same level of evidence exists for the use of these tools in patellofemoral instability outcomes research.

CONCLUSION

This study demonstrated a moderately strong correlation of the BPII to existing outcome measures that are used to evaluate patients with patellofemoral instability. This study adds further validity to the BPII in accordance with the COSMIN guidelines. The steps undertaken in this study are in keeping with high-quality instrument development, and future studies will continue to enhance the clinical and psychometric quality of the BPII.

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REFERENCES

1. Berwick DM. Medical associations: guilds or leaders? BMJ. 1997;314: 1564-1565.
2. Fithian DC, Paxton EW, Store ML, et al. Epidemiology and natural history of acute patellar dislocation. Am J Sports Med. 2004;32:1114-1121.
3. Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. Ann Intern Med. 1993;118:622-629.
4. Hiemstra LA, Kerslake S, Lafave MR, Heard SM, Buchko GM, Mohtadi NG. Initial validity and reliability of the Banff Patella Instability Instrument. Am J Sports Med. 2013;41:1629-1635.
5. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M, Nelimarkka O. Scoring of patellofemoral disorders. Arthroscopy. 1993;9: 159-163.
6. Lafave M, Katz L, Butterwick D. Development of a content-valid standardized orthopedic assessment tool (SOAT). Adv Health Sci Educ Theory Pract. 2008;13:397-408.
7. Lafave MR, Katz L, Donnon T, Butterwick DJ. Initial reliability of the Standardized Orthopedic Assessment Tool (SOAT). J Athl Train. 2008; 43:483-488.
8. Mehta VM, Inoue M, Nomura E, Fithian DC. An algorithm guiding the evaluation and treatment of acute patellar dislocations. Sports Med Arthrosc. 2007;15:78-81.
9. Messick S. Validity of psychological assessment: validation of inferences from persons’ responses and performances as scientific inquiry into score meaning. Am Psychol. 1995;50:741-749.
10. Mokkink LB, Terwee CB, Gibbons E, et al. Inter-rater agreement and reliability of the COSMIN (Consensus-based Standards for the selection of health status Measurement Instruments) checklist. BMC Med Res Methodol. 2010;10:82.
11. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. Qual Life Res. 2010;19:539-549.
12. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. J Clin Epidemiol. 2010;63:737-745.
13. Nomura E, Inoue M. Second-look arthroscopy of cartilage changes of the patellofemoral joint, especially the patella, following acute and recurrent patellar dislocation. Osteoarthritis Cartilage. 2005;13: 1029-1036.
14. Norman GR, Wynkwich KW, Patrick DL. The mathematical relationship among different forms of responsiveness coefficients. Qual Life Res. 2007;16:815-822.
15. Smith TO, Davies L, O’Driscoll ML, Donell ST. An evaluation of the clinical tests and outcome measures used to assess patellar instability. Knee. 2008;15:255-262.
16. Smith TO, Donell ST, Clark A, et al. The development, validation and internal consistency of the Norwich Patellar Instability (NPI) score. Knee Surg Sports Traumatol Arthros. 2014;22:324-335.
17. Stefancic JJ, Parker RD. First-time traumatic patellar dislocation: a systematic review. Clin Orthop Relat Res. 2007;455:93-101.
18. Streiner DL. A checklist for evaluating the usefulness of rating scales. Can J Psychiatry. 1993;38:140-148.
19. Streiner DL, Norman GR. Health Measurement Scales: A Practical Guide to Their Development and Use. 4th ed. New York, NY: Oxford University Press; 2008.
20. Terwee CB, Mokkink LB, Knol DL, Ostelo RW, Bouter LM, de Vet HC. Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. Qual Life Res. 2012;21:651-657.
APPENDIX

The Banff Patella Instability Instrument

BANFF PATELLA INSTABILITY INSTRUMENT
A QUALITY OF LIFE SCORE FOR PATIENTS WITH PATELLOFEMORAL INSTABILITY

Patient Name (first / last): ____________________________

Date (day / month / year): ___________________________

| Your Surgeon’s Name: | Which knee are you being seen for today? | This visit is your: |
|----------------------|---------------------------------------|--------------------|
|                      | Left Knee                              | First Consult / Exam |
|                      | Right Knee                             | Day of Surgery      |
|                      | Both Knees                             | 3 Months postop     |
|                      |                                       | 6 Months postop     |
|                      |                                       | 12 Months postop    |
|                      |                                       | 24 Months postop    |

DIRECTIONS

Please answer each question with respect to the current status, function, circumstances and beliefs surrounding your knee that has an unstable kneecap. Consider the last three months.

Indicate with a slash (/) on the line, the point ranging from 0 to 100 which most closely represents your situation.

For example, the following question:

Is this a good questionnaire?

0 ———————————————————— 100
Useless          Fantastic

If the slash is placed in the middle of the line, this indicates that the questionnaire is of average quality, or in other words, between the extremes of ‘useless’ and ‘fantastic’. It is important to put your slash at either end of the line if the extreme descriptions accurately reflect your situation.
SECTION A: SYMPTOMS & PHYSICAL COMPLAINTS

The first four questions are related to: SYMPTOMS & PHYSICAL COMPLAINTS.

1. **With respect to your overall knee function. How troubled are you by “giving way” episodes?**
   (Make a slash at the extreme right if you are experiencing, no giving way episodes in your knee. Please note that this question has two parts. It is concerned with both, the severity (1a) and frequency (1b) of the giving way episodes.)

   1a. **0** ———— **100**
   Major giving way episodes

   1b. **0** ———— **100**
   Constantly giving way

2. **With any kind of prolonged activity (i.e. greater than half an hour) how much pain or discomfort do you get in your knee?**

   **0** ———— **100**
   Severe pain

   **0** ———— **100**
   No pain at all

3. **With respect to your overall knee function, how much are you troubled by stiffness, or loss of motion in your knee?**

   **0** ———— **100**
   Severely troubled

   **0** ———— **100**
   Not troubled at all

4. **Consider the overall function of your knee and how it relates to the strength of your muscles: How weak is your knee?**

   **0** ———— **100**
   Extremely weak

   **0** ———— **100**
   Not weak at all
SECTION B: WORK RELATED CONCERNS

The following questions are being asked with respect to your job or vocation (i.e., WORK RELATED CONCERNS). The questions are concerned with your ability to function at work and how your knee has affected your current work-related concerns. If you are a full-time student/home maker, then consider this and any part-time work together. Consider the last three months.

*** If you are CURRENTLY NOT EMPLOYED for reasons OTHER THAN YOUR KNEE then place a check on this line.  

5. How much trouble do you have, because of your knee with turning or pivoting motions at work? (Make a slash at the extreme left if you are unable to work because of the knee.)

| 0 | 100 |
|---|-----|
| Severely troubled | No trouble at all |

6. How much trouble do you have, because of your knee, with squatting motions at work? (Make a slash at the extreme left if you are unable to work because of the knee.)

| 0 | 100 |
|---|-----|
| Severely troubled | No trouble at all |

7. How much of a concern is it for you to miss days from work, due to problems or re-injury to your knee? (Make a slash at the extreme left if you are unable to work because of the knee.)

| 0 | 100 |
|---|-----|
| An extremely significant concern | No concern at all |

8. How much of a concern is it for you to lose time from "school" or work because of the treatment of your knee?

| 0 | 100 |
|---|-----|
| An extremely significant concern | No concern at all |
SECTION C: SPORT / RECREATION / COMPETITION

The following questions are being asked with respect to your RECREATIONAL ACTIVITIES, SPORT PARTICIPATION OR COMPETITION. The questions are concerned with your ability to function and participate in these activities as they relate to your knee problem. Consider the last three months.

9. How much limitation do you have with sudden twisting and pivoting movements or changes in direction?

0 100
Totally limited No limits

10. How much of a concern is it for you that your sporting/recreational activities may result in the status of your knee to worsen?

0 100
An extremely significant No concern at all

11. How does your current level of athletic or recreational performance, compare to your pre-injury level?

0 100
Totally limited No limitations

12. With respect to the activities or sports that you currently desire to be involved with, how much have your expectations changed because of the status of your knee?

0 100
Expectations totally lowered Expectations not lowered at all

13. Do you have to play your recreation/sport under caution? (Make a slash at the extreme left i.e. 0, if you are unable to play recreation/sport because of your knee)

0 100
Always play under caution Never play under caution

14. How fearful are you of your knee “giving way” when playing recreation/sport? (Make a slash at the extreme left i.e. 0, if you are unable to play recreation/sport because of your knee)

0 100
Extremely fearful No fear at all
15. Are you concerned about environmental conditions, such as a wet playing field, a hard court, or the type of gym floor when involved in your recreation or sport? (Make a slash at the extreme left i.e. 0, if you are unable to play recreation/sport because of your knee)

0                                100
Extremely concerned              Not concerned at all

16. Do you find it frustrating to have to consider your knee with respect to your recreation/sport?

0                                100
Extremely frustrated             Not frustrated at all

17. How difficult is it for you to "go full out" at your recreation/sport? (Make a slash at the extreme left i.e. 0, if you are unable to play recreation/sport because of your knee)

0                                100
Extremely difficult              Not difficult at all

18. Are you fearful of playing contact sports? (Circle the "N/A" at the right of the scale if you do not play contact sport for reasons other than the knee.)

0                                100 N/A
Extremely fearful                No fear at all

The following questions are specifically asking about the two most important sports or recreational activities that you do. Please write them in order of importance.

1.  
2.  

19. How limited are you in playing the number "1" sport/recreational activity? (Make a slash at the extreme left i.e. 0, if you are unable to play recreation/sport because of your knee)

0                                100
Extremely limited                Not limited at all

20. How limited are you in playing the number "2" sport/ recreational activity? (Make a slash at the extreme left i.e. 0, if you are unable to play recreation/sport because of your knee)

0                                100
Extremely limited                Not limited at all
SECTION D: LIFESTYLE

The following questions are concerned with your lifestyle in general and should be considered outside of your work and recreational/sport activities as they relate to your knee with an unstable kneecap.

21. Do you have to concern yourself with general safety issues (e.g. carrying small children, working in the yard, etc.) with respect to your knee with an unstable kneecap?

0 100
Extremely concerned No concern at all

22. How much has your ability to exercise and maintain fitness been limited by your knee problem?

0 100
Totally limited Not limited at all

23. How much has your enjoyment of life been limited by your knee problem?

0 100
Totally limited Not limited at all

24. How often are you aware of your knee problem?

0 100
All of the time None of the time

25. Are you concerned about your knee, with respect to lifestyle activities that you and your family do together?

0 100
Extremely concerned No concern at all

26. Have you modified your lifestyle to avoid potentially damaging activities to your knee?

0 100
Totally modified No modifications
SECTION E: SOCIAL AND EMOTIONAL

The following questions are being asked regarding your attitudes and feelings as they relate to your knee with an unstable kneecap. Consider the last three months

27. Does it concern you that your competitive needs are no longer being met because of your knee problem? (Make a slash at the extreme right i.e. 100, if your competitive needs are being met. Make a slash at the extreme left i.e. 0 if you do not have any competitive needs.)

0 100
Extremely concerned No concern at all

28. Have you had difficulty being able to psychologically "come to grips" with your knee problem?

0 100
Extremely difficult Not difficult at all

29. How often are you apprehensive about your knee?

0 100
All of the time None of the time

30. How much are you troubled with lack of confidence in your knee?

0 100
Severely troubled No trouble at all

31. How fearful are you of re-injuring your knee?

0 100
Extremely fearful No fear at all

Thank you for completing this questionnaire.