The Patient Acceptable Symptomatic State of the 12-Item International Hip Outcome Tool at 1-Year Follow-Up of Hip-Preservation Surgery

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Purpose: To determine the patient acceptable symptomatic state (PASS) cutoff score for the 12-item International Hip Outcome Tool (iHOT-12) for patients after hip-preservation surgery. **Methods:** A multicenter hip arthroscopy registry containing deidentified patient data was analyzed to discriminate patients who achieved satisfactory results from patients who did not. Patients eligible for inclusion in the study were between 18 and 75 years of age, consented to undergo elective hip arthroscopy, and completed preoperative patient-reported outcome questionnaires. A receiver operating characteristic analysis was performed to determine the PASS cutoff score for the iHOT-12 at 1 year after surgery based on the sensitivity and specificity of achieving satisfaction with surgery. A visual analog scale rating patient satisfaction 1 year after surgery was documented and compared between subjects who achieved the PASS score for the iHOT-12 and those who did not achieve it through an independent *t* test with an a priori α set at .05. **Results:** A total of 647 subjects (66% women) aged between 18 and 73 years (mean, 36.5 years; standard deviation [SD], 12.0 years) were included in the study. A cutoff score of 75.2 for the iHOT-12 yielded a sensitivity of 0.91 and specificity of 0.81. Satisfaction averaged 89.5% (SD, 18.0%) for the patients with iHOT-12 scores greater than the PASS cutoff score versus 60.9% (SD, 30.61%) for those who did not achieve the PASS iHOT-12 score. **Conclusions:** The PASS cutoff score of 75.2 for the iHOT-12 establishes a "minimal" target score at which the patient is highly likely to be satisfied with the physical state of his or her hip joint at 1 year after hip arthroscopy. **Level of Evidence:** Level III, case-control study.

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A patient's perception of "clinically meaningful" improvement after medical intervention is a significant piece in determining beneficial and cost-effective treatment interventions for musculoskeletal disorders.[1-3] Thus, many patient-reported outcome measures (PROMs) have been developed to evaluate the patient's perspective on the outcome of treatment intervention for his or her musculoskeletal condition.[1,2] These clinical tools have been developed with varying degrees of psychometric evidence to support the reliability, validity, and responsiveness of the instruments. A piece that is often missing in the evaluation of a PROM is its ability to determine a clinically meaningful outcome.

Determining whether a patient has achieved a clinically meaningful outcome is arguably the most important information that can be gained from a PROM. Statistically, a clinically meaningful change in a PROM score is commonly expressed as the minimal clinically important difference. The minimal clinically important difference is the smallest difference in a score that patients perceive as beneficial.[4] This represents a low threshold of improvement needed to make a change in their condition.[5] However, a more important value may be the score on the PROM that patients must achieve at which they may consider themselves "well" or "unwell."[5,6] This value is known as the "patient acceptable symptomatic state" (PASS).[5,6]

A number of PROMs are used to measure patient outcomes after hip-preservation surgery. The modified Harris Hip Score (mHHS) and the Hip Outcome Score (HOS) are among the most commonly used PROMs for patients undergoing hip arthroscopy.[3] More recently, the 33-item International Hip Outcome Tool (iHOT-33) and 12-item International Hip Outcome Tool (iHOT-12) were created to assess patients with nonarthritic hip pain.[7,8] The iHOT-33 was developed with scientific rigor to establish strong evidence of reliability, validity, and responsiveness. The iHOT-33 is intended to be used for research purposes and has evidence to support the interpretation of scores over time.[8] The iHOT-12 was developed to have psychometric properties similar to the iHOT-33 but with a smaller number of questions to reduce patient and caregiver burden.[7] Although the iHOT-12 is considerably shorter than the iHOT-33, the iHOT-12 was found to be psychometrically similar to the iHOT-33.[7] PASS cutoff scores for the mHHS and HOS at 1 year after hip arthroscopy have been established in the literature.[9] Establishing a PASS cutoff score for the iHOT-12 may be helpful to clinicians, given its widespread clinical use.

The purpose of this study was to determine the PASS cutoff score for the iHOT-12 for patients after hip-preservation surgery. The hypothesis was that the results of the analysis would yield a sensitive and specific iHOT-12 cutoff score to determine whether the patient has achieved a satisfactory "symptomatic" outcome after surgery.

Methods

A retrospective analysis of a multicenter hip arthroscopy registry formed by the practices of 8 independent hip arthroscopists (J.J.C., A.B.W., S.J.N., J.P.S., T.J.E., G.V.T., D.M., D.S.C.) was performed. The collection and storage of agreed on clinical data points were allowed according to individual institutional requirements, and the Institutional Review Board at Duquesne University granted approval (No. 2018/03/9) to review the deidentified registry of patient data.

All surgeons contributing patient data to the registry have a minimum of 5 years' experience performing hip arthroscopy and perform at least 100 cases per year. The shared registry contains deidentified patient data describing physical, morphologic, and demographic characteristics and includes preoperative and 1-year postoperative PROMs. The PROMs of interest for the purpose of this investigation included the mHHS, the HOS Activities of Daily Living subscale (HOS-ADL), and the iHOT-12.

Only patients for whom hip arthroscopy was deemed medically appropriate were eligible for the study. Surgeons from participating centers mutually agreed that patients with primary lumbopelvic pathology, advanced hip arthrosis (Tönnis grade $>$ 1), or other medical conditions for which arthroscopic hip surgery was contraindicated would not be included for the purpose of this study. Patients who elected to undergo hip arthroscopic treatment for their hip condition and were compliant with preoperative and 1-year postoperative PROMs were included in the study for data analysis. An analysis of 1-year postoperative data was chosen for this study to compare iHOT-12 scores with research that reported the PASS scores at 1-year follow-up for the mHHS and HOS-ADL.[9] Subjects who had an inability to read or understand the English language and subjects who were not compliant with the completion of the required PROMs were excluded from the study.

A receiver operating characteristic (ROC) analysis was performed using previously established PASS values for the mHHS and HOS-ADL[9] as anchors to determine which patients achieved a satisfactory result 1 year after hip surgery and which patients did not. The ROC analysis calculated the area under the curve (AUC) at a 95% confidence interval (CI). The AUC of the ROC analysis defines the strength of association and the accuracy of the instrument in distinguishing between groups.[10] An AUC greater than 0.8 and a 95% CI that does not contain 0.5 are considered properties of excellent responsiveness.[10] Statistical analysis was

performed using the SPSS software package (version 24; IBM). The Youden index was calculated to optimize the sensitivity and specificity values that establish the cutoff score for the iHOT-12 that groups patients into those who achieved satisfaction with surgery (meeting PASS values for both the mHHS score and HOS-ADL) versus those who did not achieve satisfaction (not meeting PASS values for the mHHS score and HOS-ADL).[11]

A secondary analysis was performed to evaluate the validity of the established PASS cutoff score. A visual analog scale rating patient satisfaction 1 year after surgery was documented in addition to the 1-year follow-up PROMs. Patient satisfaction was scored using a 100-mm horizontal line (visual analog scale) that was marked by the patient. The scores ranged from 0 to 100, with a higher score indicating higher satisfaction. Satisfaction scores were then compared between subjects who achieved the PASS cutoff score for the iHOT-12 and those who did not achieve it through an independent t test with an a priori α set at .05. A post hoc analysis to report the percentage of patients who exceeded the established PASS cutoff score was also performed.

Results

A total of 677 patients electing to undergo hip-preservation surgery were enrolled in the multicenter hip arthroscopy registry and were eligible to participate in this research study. Of these patients, 30 were not compliant with completing the postoperative PROMs and were excluded from the analysis. The remaining 647 subjects were predominantly women (66% women), and the average body mass index was 25.9 (standard deviation [SD], 10.7). The ages of the subjects ranged between 18 and 73 years (mean, 36.5 years; SD, 12.0 years), with most subjects aged between 30 and 50 years, as shown in Figure 1. The most common surgical procedures performed in the subjects and analyzed for the purpose of this study were as follows: labral repair (434 [67.1%]), labral reconstruction (57 [8.8%]), labral debridement (30 [4.6%]), femoroplasty (410 [63.4%]), acetabuloplasty (278 [43.0%]), and microfracture (21 [3.2%]). The characteristics of the 647 subjects included in this study are outlined in Table 1.

The ROC analysis showed an AUC of 0.93 (95% CI, 0.91-0.95), with $P < .001$. A cutoff score of 75.2 for the iHOT-12 yielded a sensitivity of 0.91 and specificity of 0.81 in discriminating patients into the satisfied and unsatisfied groups. There was a significant effect on satisfaction after surgery and the iHOT-12 PASS score, with $t_{647} = -15.0$ and $P < .001$. The subjects who scored greater than the PASS cutoff score for the iHOT-12 had self-reported satisfaction with their surgery at 1-year follow-up that averaged 89.5% (SD, 18.0%) compared with average satisfaction of 60.9% (SD, 30.61%) for patients who did not achieve the PASS iHOT-12 score. At 1 year after hip-preservation surgery, 53% of the subjects met the PASS cutoff score.

Discussion

The most important finding of this study was that a PASS cutoff score was established for the iHOT-12 at 1 year after hip arthroscopy. A cutoff score of 75.2 for the iHOT-12 yielded a sensitivity of 0.91 and specificity of 0.81 that supported the primary hypothesis that the computed cutoff score would accurately predict whether the patient achieved an acceptable level of satisfaction 1 year after hip-preservation surgery. The

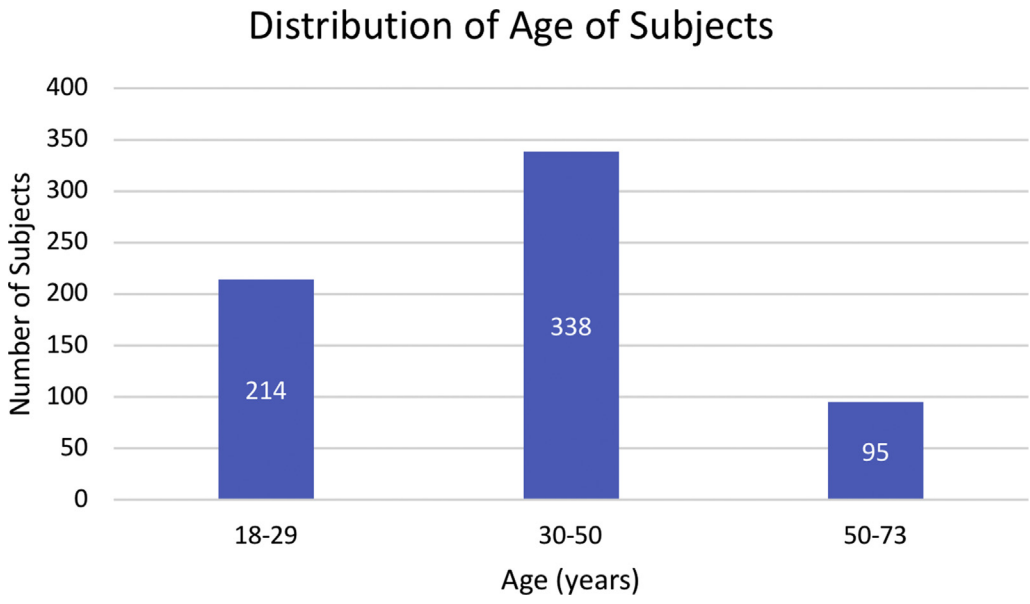

Fig 1. Distribution of age of subjects.

Table 1. Characteristics of Subjects Included in Registry

Characteristic	Data
Age, mean (SD), yr	36.5 (12.0)
Body mass index, mean (SD)	25.9 (10.7)
Female sex, n	427 (66.0%)
Surgical procedure, n	
Labral repair	434 (67.1%)
Femoroplasty	410 (63.4%)
Acetabuloplasty	278 (43.0%)
Microfracture	21 (3.2%)

SD, standard deviation.

PASS cutoff score for the IHOT-12 in a multicenter population of patients has not been established. Given its widespread use as a PROM for patients undergoing hip arthroscopy, the findings from this research could affect how postoperative outcomes after hip-preservation surgery are interpreted.

The PASS cutoff score is a value that defines the clinical context of an individual's iHOT-12 score after surgery. For example, a patient who scores 80 on the iHOT-12 can be considered with relatively high certainty to be satisfied with the condition of his or her hip after surgery based on the results of our study. However, a patient who scores 70 on the iHOT-12 postoperatively is less likely to be fully satisfied with his or her hip after surgery. Thus, the PASS cutoff score provides a target score for patients to attain to be satisfied with the state of their hip after surgery. Only the mHHS, HOS-ADL, and HOS Sports subscale (HOS-Sports) have established PASS cutoff scores reported in the literature for patients undergoing hip arthroscopy.[9] With each instrument normalized to a 100-point scale, the PASS scores for the mHHS (74), HOS-ADL (87), and HOS-Sports (75) are comparable to the cutoff score this research study projected for the iHOT-12 (75.2). Although all these instruments have strong psychometric properties, the iHOT-12 is the only one of these PROMs for which question items were derived from patient input as to the important aspects of symptoms, quality of life (social, emotional, and lifestyle concerns), and functional limitations in activities of daily living, sports and recreational activities, and work that are relevant to a patient with non-arthritic hip pathology.[8] The iHOT-12 has gained popularity in clinical use throughout the world and has been internationally recognized and translated into Dutch, German, Portuguese, Spanish, and Swedish.[12-15] Establishing the PASS score for an instrument as widely used and efficient to complete as the iHOT-12 makes it an attractive tool to track patient outcomes.

Previous studies have established the substantial clinical benefit (SCB) values of PROMs used for patients who have received hip arthroscopy.[9,16,17] The SCB value differs from the PASS score in that it represents a change in score that distinguishes a subject as feeling "normal" versus "abnormal."[16] The SCB value for the iHOT-12 was recently reported as a change in score of 28. An iHOT-12 score of 86 or greater was calculated to have high sensitivity (0.90) and specificity (0.86) in classifying a patient as feeling normal. This is markedly higher than the PASS score of 75.2 calculated in our study. The differences in scores likely relate to the methodology used to determine the cutoff scores. The SCB value was anchored from a question asking how normal the patient feels. The PASS score in our study related to how "satisfied" the patient is with his or her hip after surgery. Thus, the SCB and PASS scores, although similar, have slightly different meanings. It was determined that a higher score on the iHOT-12 was needed to feel normal ($\geq$86)[16] than to feel satisfied (>75.2) with the condition of the hip joint after arthroscopic surgery. Therefore, it is conceivable that a patient may be satisfied with his or her hip without necessarily feeling as though the hip is normal.

The grouping of patients for analysis in our study was performed based on the criterion that both the HOS-ADL and mHHS PASS cutoff scores were surpassed. This would likely elevate the cutoff score for the iHOT-12 and lower the total number of subjects who surpassed the cutoff score compared with previous studies that used less rigorous modes of grouping of subjects. This trend was confirmed because researchers have shown an SCB absolute score of 63.5 on the iHOT-33 compared with the iHOT-12 PASS score of 75.2 in our study.[16] Although the iHOT-33 and iHOT-12 are psychometrically similar, this rather large difference between the 2 computed scores could be explained by the differences in the criteria used to group the subjects in the respective studies.[16] There also proved to be fewer subjects who surpassed the PASS score for the iHOT-12 in our study than for other PROMs. A post hoc analysis found that 53% of patients surpassed the PASS cutoff score for the iHOT-12 in our study, whereas previous work by Chahal et al.[9] reported that 69%, 65%, and 60% of patients exceeded the PASS thresholds for the HOS-ADL, HOS-Sports, and mHHS, respectively, at 1 year after surgery. This comparison illustrates that cutoff scores are specific to the instrument and the anchor method used to establish the cutoff scores.

The findings of our research study may help shape how patient-reported outcomes for the hip can be evaluated moving forward. The PASS score allows more individualized assessment of the patient.[18] With the establishment of the PASS cutoff score, researchers can report outcomes based on the proportion of patients who achieved the PASS score threshold that suggests a high likelihood of satisfaction with the condition of their hip and do not have to rely on preoperative scores as a comparison to determine a significant change in the score.

Limitations

Although this study is important in providing evidence on the PASS score for the iHOT-12, there are limitations that need to be acknowledged. First, the time frame of the study should be considered. Data to compute the PASS score were collected at 1-year follow-up. Thus, the PASS score is only applicable to patients at 1-year follow-up and should not be generalized to other time intervals. Outcomes of hip-preservation surgery have been shown to relate to a surgeon's level of experience performing hip arthroscopy.[19] Thus, there may be a performance-related bias because the results of this study reflect those obtained in the practices of experienced hip arthroscopists. Although the iHOT-12 has been translated into different languages,[12-15] the subjects in our study were English language—speaking Americans. Thus, the findings are not generalizable internationally or in other non-English languages. In addition, this study used previously established PASS scores for the mHHS and HOS-ADL to group patients into those who were satisfied versus those who were unsatisfied with their postsurgical hip condition. The HOS-ADL and mHHS are PROMs that have historically been used in the hip arthroscopy literature despite varying levels of evidence of psychometric properties to support their clinical use.[20] Both the HOS-ADL and mHHS, however, have established PASS scores for direct comparison with our study.[9] As mentioned earlier, other methods have been applied using anchor-based questions to establish grouping of satisfied versus unsatisfied patients.[9] We chose the former method of grouping based on evidence that the mHHS and HOS-ADL PASS scores met the rigor of peer review and showed high sensitivity and specificity in grouping patients appropriately.[9] By use of this technique, a small percentage of patients may have been grouped incorrectly. However, the secondary analysis that compared the groups based on the established PASS cutoff score offers strong evidence of the validity of the cutoff score. The secondary analysis showed a significant difference between the patients who exceeded the PASS cutoff score, with a self-reported level of satisfaction of 89.5%, and the patients who did not meet the PASS cutoff score, with a 60.9% satisfaction level. Finally, the HOS-Sports PROM also has an established PASS score.[9] This was not included as part of the anchoring methodology because it did not seem appropriate to the patient population from which the data were derived. The population in this study generally comprised young and active patients but not necessarily competitive athletes. Thus, the HOS-Sports was not considered a relevant PROM to include in the anchoring methodology for this study.

Conclusions

The PASS cutoff score of 75.2 for the iHOT-12 establishes a "minimal" target score at which the patient is highly likely to be satisfied with the physical state of his or her hip joint at 1 year after hip arthroscopy.

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