Defining Variations in Outcomes of Hip Arthroscopy for Femoroacetabular Impingement Using the 12-Item International Hip Outcome Tool (iHOT-12)

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Investigation performed as part of the Multi-Center Arthroscopic Study of the Hip (MASH) Study Group

Background: As health care moves toward a value-based payment system, it will be important that patient-reported outcome measures (PROMs) define variations in outcome over a follow-up period that allows a patient to achieve maximal improvement. Although there is evidence to support the use of PROMs to assess postoperative outcomes after hip arthroscopy, there is limited information available to assess for variations in outcome at a 2-year follow-up interval.

Purpose: To identify substantial clinical benefit (SCB) and patient acceptable symptom state (PASS) cutoff scores for the 12-item International Hip Outcome Tool (iHOT-12) that define patient status across a spectrum of potential outcomes after hip arthroscopy at a 2-year follow-up interval.

Study design: Cohort study (diagnosis); Level of evidence, 2.

Methods: These data were collected from a research registry of patients having hip arthroscopy for femoroacetabular impingement and/or chondrolabral pathology. On initial assessment and 2 years (±2 months) postoperatively, patients completed the iHOT-12, and categorical self-rating of function. They also completed a visual analog scale of postoperative satisfaction. Receiver operator characteristic analysis was performed to determine absolute SCB iHOT-12 scores associated with an “abnormal,” “nearly normal,” or “normal” self-report of function, and PASS scores for those reporting at least 50%, at least 75%, and 100% satisfaction with their surgery.

Results: Out of 723 eligible patients, 658 (91%) met the inclusion criteria. The patients consisted of 462 (70%) women and 196 (30%) men, with a mean age of 35.3 years (SD, 13 years) and mean follow-up of 722 days (SD, 69 days). Absolute SCB and PASS iHOT-12 scores ranging from 38 to 86 were accurate in identifying those who had abnormal, nearly normal, and normal self-reported function and were at least 50%, at least 75%, and 100% satisfied with surgery. The areas under the curve were >0.70, with sensitivity and specificity values ranging from 0.78 to 0.92.

Conclusion: This study provides absolute SCB and PASS iHOT-12 cutoff scores that can be used to define variations in 2-year (±2 months) outcomes in patients after hip arthroscopy for femoroacetabular impingement and chondrolabral pathology. iHOT-12 scores of 38, 60, and 86 were associated with abnormal, nearly normal, and normal reports of function respectively, with scores of 60, 71, and 86 associated with at least 50%, at least 75%, and 100% satisfaction after surgery, respectively.

Keywords: hip joint; arthroscopic surgery; outcome measure; quality of life

Optimizing health care value by improving quality and reducing cost has become an area of interest, with the advent of such terms as “value-based care” and “merit-based incentive payment systems.”2,9,23 Patient-reported outcome measures (PROMs) play a prominent role in quality care and outcome assessment because these instruments measure function and symptoms from the patient’s perspective.2 Hip arthroscopy has become an accepted surgery to address nonarthritic sources of hip pain. Although the outcomes of hip arthroscopy are generally positive, not everyone has the same level of success.6,26,27 As the rate of hip arthroscopy increases,3,30 it will become important to define variations in postoperative outcomes. Although there is evidence to support the use of PROMs to assess postoperative outcomes after hip arthroscopy, there is limited information available to assess for variations in outcome.
To effectively assess quality care and patient outcomes using PROMs, evidence to support the interpretation of obtained scores over a meaningful follow-up period should be available. Scores obtained from PROMs can be interpreted with values for minimal clinically important difference (MCID), substantial clinical benefit (SCB), and patient acceptable symptom state (PASS). As opposed to the change score associated with MCID, absolute SCB and PASS scores can be used as stand-alone assessments to define patient status. A PASS score represents a satisfactory outcome, while an absolute SCB score defines a health status that the patient would consider as excellent. A number of PROMs have evidence to support their use in hip arthroscopy outcome assessment, including the 12-item International Hip Outcome Tool (iHOT-12). Similar to its parent, the 33-item iHOT, the iHOT-12 was designed to measure the effect of nonarthritic hip disease and the effect of treatment in active individuals, but with a lower response burden. The iHOT instruments were developed using rigorous psychometric methodology and patient input to create a comprehensive list of relevant items. PASS and absolute SCB values to assess outcomes at a 1-year postoperative follow-up interval have been defined for the iHOT-12. However, patients who undergo hip arthroscopy may show a change in symptoms and function for at least 2 years after surgery, with patients achieving varying levels of outcome. As health care moves toward value-based payment, it will be important that PROMs define these variations in outcome over a follow-up period that allows a patient to achieve maximal improvement.

The purpose of this study was to identify SCB and PASS cutoff scores for the iHOT-12 that define patient status across a spectrum of potential outcomes after hip arthroscopy at a 2-year follow-up interval. It was hypothesized that absolute SCB scores would be accurate in identifying those with “abnormal,” “nearly normal,” or “normal” self-report of function and PASS scores would be accurate in identifying those reporting at least 50%, at least 75%, or 100% satisfaction with their surgery at a 2-year postoperative follow-up interval.

METHODS

This was a retrospective review of prospectively collected data maintained in a secure electronic registry. The registry consisted of patients who were assessed by their surgeon and consented to undergo hip arthroscopy at 1 of 7 centers between January 2015 and April 2017. Inclusion criteria specific to this study included primary surgery for femoroacetabular impingement (FAI) and/or chondral pathology with preoperative PROMs available. Exclusion criteria for this study included revision surgery. As part of the agreed-upon a priori study design, follow-up data were required to be collected 2 years ± 2 months after surgery. Exclusion criteria for the registry included primary lumbopelvic pathology, advanced hip arthrosis (Tonnis grade >1), or other conditions contraindicated for arthroscopic hip surgery. An inability to read or understand English was also an exclusion criterion for the registry. An investigator (B.R.K.) assessed data and applied the inclusion and exclusion criteria for this study. The a priori collection and storage of agreed-upon clinical data points was granted according to individual institutional requirements, and institutional review board approval was granted to review the de-identified registry of patient data.

On initial assessment, patients were given PROMs that included the iHOT-12 and a categorical self-rating of function to complete. For 2-year (±2 months) follow-up data collection, patients were emailed the iHOT-12, the self-rating of current function, and postoperative satisfaction visual analog scale (VAS) to complete between 670 and 790 days after surgery. The self-rating of function consisted of the following question: “How would you rate your current level of function?” The patients had the following categorical responses from which to choose: “severely abnormal,” “abnormal,” “nearly normal,” or “normal.” The postoperative satisfaction VAS considered...
the following question: “What is your overall satisfaction with your surgery?” It was scored using a 100-mm horizontal line with the anchors defined as “0% satisfied” (0 mm) and “100% satisfied” (100 mm). Patient characteristics were recorded from the electronic registry.

Psychometric Analysis

Absolute SCB and PASS cutoff scores were calculated with anchor-based methods in a similar fashion to that previously described. Absolute postoperative SCB and PASS scores were calculated with receiver operator characteristic (ROC) analysis calculating the area under the curve (AUC) at a 95% confidence interval (95% CI). Three absolute postoperative SCB cutoff scores were calculated to determine a score that would be associated with a self-report of being abnormal, nearly normal, or normal at 2 years ± 2 months after surgery. Three PASS cutoff scores were calculated to determine a score that would be associated with a patient report of being at least 50% (≥50 mm), at least 75% (≥75 mm), or 100% satisfied (100 mm) with surgery at 2 years ± 2 months after surgery. The AUC of the ROC analysis defines the strength of association and the accuracy of the instrument in distinguishing between groups. An AUC >0.7 and a 95% CI that does not contain 0.5 are considered acceptable levels of responsiveness. The Youden index was used to optimize sensitivity and specificity values to identify an absolute score that is likely to represent a patient who reports the following: (1) abnormal function, (2) nearly normal function, (3) normal function, (4) being at least 50% satisfied with surgery, (5) being at least 75% satisfied with surgery, or (6) being 100% satisfied with surgery. Statistical analysis was performed using the SPSS software package (version 26; IBM Corp).

RESULTS

Participants

Out of 723 eligible patients, 658 (91%) met the inclusion criteria for this study and had follow-up outcome data available for analysis. The average follow-up time was 722 days (SD, 69 days). Patient information, including age, sex, body mass index (BMI), diagnosis, and procedures performed, is presented in Table 1. It should be noted 518 (79%) of the patients had multiple procedures performed.

Psychometric Results

Mean preoperative and 2-year postoperative iHOT-12 scores, preoperative and postoperative ratings of function, and those reporting at least 50%, at least 75%, or 100% satisfaction with their surgery are presented in Table 2. The preoperative iHOT-12 scores were skewed slightly positive, with the median of 32 being less than the preoperative mean (skewness statistic, 0.52). The 2-year (±2 months) scores were skewed slightly negative, with the median of 81 being greater than the postoperative mean (skewness statistic, –0.99). The results of the ROC analysis for absolute SCB iHOT-12 scores associated with an abnormal, nearly normal, or normal rating of function, and the PASS scores for those reporting at least 50%, at least 75%, or 100% satisfaction with their surgery are presented in Table 3. The iHOT-12 scores of 38, 60, and 86 were associated with abnormal, nearly normal, and normal function, respectively. Scores of 60, 71, and 86 were associated with at least 50%, at least 75%, and 100% satisfaction after surgery, respectively. These absolute SCB and PASS cutoff scores for the iHOT-12 were accurate, as the AUCs were >0.70 with 95% CIs not containing 0.5.
TABLE 3
Absolute SCB and PASS Values for the iHOT-12 at 2-Year Follow-Up

<table>
<thead>
<tr>
<th>Rating of Function</th>
<th>Absolute SCB Values</th>
<th></th>
<th></th>
<th>AUC (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal</td>
<td>38</td>
<td>0.89</td>
<td>0.92</td>
<td>0.96 (0.93-0.98)</td>
</tr>
<tr>
<td>Nearly normal</td>
<td>60</td>
<td>0.89</td>
<td>0.89</td>
<td>0.93 (0.92-0.95)</td>
</tr>
<tr>
<td>Normal</td>
<td>86</td>
<td>0.81</td>
<td>0.84</td>
<td>0.89 (0.86-0.91)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfaction With Surgery</th>
<th>PASS Values</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>50% satisfied</td>
<td>60</td>
<td>0.84</td>
<td>0.82</td>
<td>0.88 (0.84-0.92)</td>
</tr>
<tr>
<td>75% satisfied</td>
<td>71</td>
<td>0.83</td>
<td>0.87</td>
<td>0.90 (0.87-0.93)</td>
</tr>
<tr>
<td>100% satisfied</td>
<td>86</td>
<td>0.78</td>
<td>0.78</td>
<td>0.83 (0.80-0.86)</td>
</tr>
</tbody>
</table>

*AUC, area under the curve; iHOT-12, 12-item International Hip Outcome Tool; PASS, patient acceptable symptom state; SCB, substantial clinical benefit.

**DISCUSSION**

The most important findings from this study are the absolute SCB and PASS iHOT-12 cutoff scores that can be used to define variations in 2-year (± 2 months) outcomes in patients after primary hip arthroscopy for FAI and chondrolabral pathology. For absolute SCB values, reaching iHOT-12 scores of 38, 60, and 86 was associated with patients reporting abnormal, nearly normal, and normal levels of function, respectively. For PASS values, reaching iHOT-12 scores of 60, 71, and 86 was associated with being at least 50%, at least 75%, and 100% satisfied with surgery, respectively. The hypothesis of this study was supported, as these absolute SCB and PASS scores were associated with a high degree of accuracy. This information can potentially be used by surgeons to assess 2-year (± 2 months) outcomes after hip arthroscopy.

It should be noted that the absolute SCB and PASS cutoff scores defined in this study are estimates and represent scores that are most likely to predict whether someone identifies themselves in a respective category or not. These are not threshold scores. As a patient’s score gets closer to a cutoff score, the more likely he or she is to be in that respective category. For example, the greater a patient’s iHOT-12 score is above 86, the more likely he or she is to report a normal level of function and be 100% satisfied with his or her surgery. As a score gets closer to 71, patients are more likely to identify themselves as having a nearly normal level of function and be 75% satisfied. A patient with a score closer to 60 would likely report being nearly normal and 50% satisfied. To illustrate this, the average 2-year iHOT-12 score of the patients in this study was 73. Therefore, the average patient would likely report a nearly normal level of function and be 75% satisfied with the surgery. It would seem that the appropriate 2-year follow-up goal after hip arthroscopy for FAI and chondrolabral pathology would be an iHOT-12 score of 86 or greater. Likewise, an iHOT-12 score of less than 60 would seem to represent an undesirable outcome. It is known that patient factors such as age, BMI, chondral damage, arthritis, previous surgery, sex, radiographic findings, smoking, and mental health status can affect outcomes of hip arthroscopy. Therefore, it may not be realistic that all patients attain an iHOT-12 score of 86. Patients in this current study who were older than 50 years of age and those who had a BMI greater than 30 had lower than average iHOT-12 scores of 66 and 67, respectively. These scores indicate that these patients would likely report a nearly normal level of function and be 50% satisfied with their surgery. The patient-specific absolute SCB and PASS scores identified in this study could be used to help in educating patients in appropriate outcomes and be helpful in managing patient expectations. Being able to define absolute SCB and PASS scores that are unique for all patients based on their specific characteristics would be an area of future research.

Studies have provided absolute SCB and PASS iHOT-12 scores that allow for interpretation of outcomes at 1 year after hip arthroscopy. Martin et al25 found that a patient who scored 86 or better was likely to have a normal rating of function, whereas a patient with a score of 56 or less was likely to have an abnormal rating of function. Kivlan et al19 found that a patient with a PASS score of 75.2 or greater was likely satisfied with his or her physical state. Nwachukwu et al33 found that a patient with a PASS score of 63 was satisfied with his or her current state, taking into account pain level and functional impairment for all activities during daily life. The absolute SCB and PASS values defined in this current study are consistent with these previous findings. It is interesting that there was no difference in the iHOT-12 absolute SCB score for a report of normal level of function between the 1-year and 2-year follow-ups. Previous studies found that a desired outcome may be achieved within 6 months after surgery, but improvements may continue for at least 2 years. Given that the SCB and PASS values seem similar between the 1- and 2-year follow-up periods, future work to define the characteristics of patients who continue to improve beyond 1 year would be an area of interest.

A number of PROMs have been studied in hip arthroscopy, including the 33- and 12-item iHOT instruments. One of the advantages of the iHOT instruments was the extensive item development phase, which included patient involvement in both item generation and assessment of item importance. These items are used to assess the domains of symptoms, quality of life (social, emotional, and lifestyle concerns), and functional limitations in activities of daily living, sports/recreational activities, and work. The 33-item iHOT was developed for research purposes and has evidence to support the interpretation of scores, including being the most sensitive instrument to measure change. The 12-item iHOT was developed to have similar psychometric properties to the iHOT-33 but a lower response burden, and it is therefore more appropriate for clinical use. Although the iHOT-12 is 60% shorter, 12 items account for 96% of the total variation in the iHOT-33 score. Additionally, the iHOT-12 scores have shown excellent agreement with the iHOT-33 and almost identical sensitivity to change after treatment. The current

§§References 4, 5, 7, 12, 13, 15, 24, 28, 35, 38, 39.
The iHOT-12 has advantages over the categorical rating of function and the global rating scale. As opposed to the 4-category rating of function, the continuous scoring from 0 to 100 on the iHOT-12 can help identify how close patients are to one category or another. For example, a patient with an iHOT-12 score of 81 and a nearly normal rating of function could be identified as doing better than a patient with a nearly normal rating of function but a score of 65. Additionally, the items on the iHOT-12 can identify specific symptoms, and the extent to which these symptoms are limiting activity. Specific activities the patient is performing either poorly or well may also be identified. This information may help with patient education and guide further potential treatment decisions, particularly in the areas of symptom management and functional rehabilitation.

It should be noted that these findings are limited to the anchor-based questions and responses for self-reported level of function and VAS for postoperative satisfaction used in this study. Only patients with complete data sets were included, and a majority of patients were women, which could introduce bias and affect the results. Also, these findings are only generalizable to English-speaking patients who underwent primary surgery for FAI and/or chondrolabral pathology, looking at the change in scores from preoperatively to the 2-year (±2 months) follow-up. Other methods to determine SCB and PASS values using patients with different characteristics are likely to produce different SCB and PASS values. Different methods could also include looking at changes in scores between the 1- and 2-year follow-ups.

CONCLUSION

This study provides absolute SCB and PASS iHOT-12 cutoff scores that can be used to define variations in 2-year (±2 months) outcomes in patients after hip arthroscopy for FAI and chondrolabral pathology. iHOT-12 scores of 38, 60, and 86 were associated with abnormal, nearly normal, and normal reports of function, respectively, with scores of 60, 71, and 86 associated with at least 50%, at least 75%, and 100% satisfaction after surgery, respectively.

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