

# The Development and Validation of a Self-Administered Quality-of-Life Outcome Measure for Young, Active Patients With Symptomatic Hip Disease: The International Hip Outcome Tool (iHOT-33)

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**Purpose:** The purpose of this study was to develop a self-administered evaluative tool to measure health-related quality of life in young, active patients with hip disorders. **Methods:** This outcome measure was developed for active patients (aged 18 to 60 years, Tegner activity level  $\geq 4$ ) presenting with a variety of symptomatic hip conditions. This multicenter study recruited patients from international hip arthroscopy and arthroplasty surgeon practices. The outcome was created using a process of item generation (51 patients), item reduction (150 patients), and pretesting (31 patients). The questionnaire was tested for test-retest reliability (123 patients); face, content, and construct validity (51 patients); and responsiveness over a 6-month period in post-arthroscopy patients (27 patients). **Results:** Initially, 146 items were identified. This number was reduced to 60 through item reduction, and the items were categorized into 4 domains: (1) symptoms and functional limitations; (2) sports and recreational physical activities; (3) job-related concerns; and (4) social, emotional, and lifestyle concerns. The items were then formatted using a visual analog scale. Test-retest reliability showed Pearson correlations greater than 0.80 for 33 of the 60 questions. The intraclass correlation statistic was 0.78, and the Cronbach  $\alpha$  was .99. Face validity and content validity were ensured during development, and construct validity was shown with a correlation of 0.81 to the Non-Arthritic Hip Score. Responsiveness was shown with a paired  $t$  test ( $P \leq .01$ ), effect size of 2.0, standardized response mean of 1.7, responsiveness ratio of 6.7, and minimal clinically important difference of 6 points. **Conclusions:** We have developed a new quality-of-life patient-reported outcome measure, the 33-item International Hip Outcome Tool (iHOT-33). This questionnaire uses a visual analog scale response format designed for computer self-administration by young, active patients with hip pathology. Its development has followed the most rigorous methodology involving a very large number of patients. The iHOT-33 has been shown to be reliable; shows face, content, and construct validity; and is highly responsive to clinical change. In our opinion the iHOT-33 can be used as a primary outcome measure for prospective patient evaluation and randomized clinical trials.

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Traditionally, orthopaedic surgeons measured the success of their treatments by using so-called objective measures such as range of motion, strength, and radiographic appearance.<sup>1-16</sup> Unfortunately, these measures have been found to be poor indicators of the functional ability of patients.<sup>17-22</sup> To truly assess a patient's ability to return to an active life, subjective measures of symptoms, emotional health, and social health need to be included. Quality-of-life outcome measures have been developed to capture the subjective aspect of health.<sup>23-28</sup>

Most questionnaires for patients with hip pathology have been created for either patients with a hip fracture

or those undergoing total hip arthroplasty.<sup>3-16,20,29-31</sup> The existing outcomes often suffer from a ceiling effect, limiting their usefulness in the young, active population. These patients have different goals and expectations of their surgery and their quality of life in comparison with young patients with nonarthritic hip problems. Furthermore, most of these scores were not developed using rigorous methodology.<sup>22,32</sup>

Three systematic reviews have evaluated hip outcome tools.<sup>32-34</sup> Lodhia et al.<sup>32</sup> identified 3 patient-reported outcomes—the Hip Outcome Score (HOS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Non-Arthritic

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Hip Score (NAHS)—that “have shown clinimetric evidence to support their use to measure outcomes in FAI [femoroacetabular impingement] and labral pathology patients. The HOS has the greatest amount of clinimetric evidence and is the most proven instrument for use in this population. This review shows that further clinimetric evaluation of commonly used PRO [patient-reported outcome] instruments for non-arthritis hip pathology is warranted.” However, the HOS did not include patients in its development and represents a functional score only. The WOMAC is specific for patients with arthritis and was developed in an older population. The NAHS uses 10 questions from the WOMAC and suffers from the potential of ceiling effects.<sup>22</sup> A second systematic review focused on patient-reported outcome questionnaires when assessing hip and groin disability.<sup>33</sup> This review suggested that the Hip Dysfunction and Osteoarthritis Outcome Score is recommended for evaluating patients with osteoarthritis, and the HOS is recommended for patients undergoing hip arthroscopy. The authors resolved by stating that “a new PRO [patient-reported outcome] questionnaire focusing on the evaluation of hip and groin disability in young and physically active patients is needed.”<sup>33</sup>

The latest systematic review looked at psychometric evidence of outcomes used in hip arthroscopy.<sup>34</sup> The authors identified the Modified Harris Hip Scale (MHHS), the NAHS, and the HOS as the 3 possible outcome measures. They evaluated each outcome using the COSMIN (Consensus-Based Standards for the Selection of Health Status Measurement Instruments) checklist.<sup>35</sup> They concluded, on the basis of the available evidence, that a combination of the NAHS and the HOS should be used as outcome measures for patients undergoing hip arthroscopy.<sup>34</sup> They also stated that “more studies on the validity and reliability of these questionnaires are warranted.” The HOS was not patient derived, as noted earlier, and the MHHS is a clinician-based tool originally adapted for hip “mold replacement” surgery.<sup>6</sup>

The purpose of this study was to develop a self-administered evaluative tool to measure health-related quality of life in young, active patients with hip disorders. The main focus was to ensure that this measure was patient based and represented a young, active population with hip disorders, given that these patients have been shown to have different ideas about what is important than do their surgeons.<sup>36</sup> The measurement goal of the proposed outcome was to create an evaluative instrument that would be used to measure the

outcomes of various treatments in young, active patients with hip joint disorders.

## METHODS

The University of Calgary Sport Medicine Centre Research Ethics Board and the institutional review boards from all participating centers approved this prospective study. Members of the Multicenter Arthroscopy of the Hip Outcomes Research Network (MAHORN) participated, and patients were recruited from the MAHORN members' practices from Canada, the United States, England, and Switzerland. The International Hip Outcome Tool (iHOT) was developed using the methodology described by Guyatt et al.,<sup>37-39</sup> which has also been used to develop several other similar tools.<sup>23-25,27,28,40,41</sup>

### Inclusion/Exclusion Criteria

This outcome measure has been developed in young, active patients aged between 18 and 60 years presenting with hip pathology to orthopaedic surgeons (Table 1). A patient was defined as active if he or she had an activity level of 4 or greater on a modified Tegner Activity Scale (Table 2).<sup>42</sup> Hip pathology was defined as the abnormal functioning of the hip leading to pain, instability, stiffness, or physical impairment due to improper biomechanics of the joint. Patients with hip pain as a result of muscular strains or with referred pain from the back or knee were not included. Differential diagnoses included bony pathology such as avascular necrosis or osteochondral fracture, damage to the cartilage in the form of chondral lesions and arthritis, ligamentous injury, tearing of the labrum or

TABLE 1. Inclusion and Exclusion Criteria

Inclusion criteria	
Age 18-60 yr	
Primary musculoskeletal hip pathology	
Active ( $\geq 4$ on modified Tegner Activity Scale)	
Presentation with hip pain to orthopaedic surgeon	
Literate and English speaking	
Exclusion criteria	
Pre-existing comorbid medical conditions that interfere with patient's ability to participate in sports or other physical activities	
Polytrauma patients with ipsilateral or contralateral lower extremity injuries or spinal injuries with neurologic deficits	
Patients who have language, psychiatric, or cognitive difficulties that prevent reliable completion of questionnaire	
Active hip joint infection	
Local bone- or joint-related malignancy	

**TABLE 2.** *Modified Tegner Activity Scale*

	Level	Description
Competitive sports	10	Competitive sports played at a world or Olympic level or professionally
	9	Competitive sports such as track and field, racquet/ball sports, gymnastics, rowing, skiing, or martial arts played at a national or international level
	8	Competitive sports such as water sports, cycling, hockey, curling, or horseback riding/rodeo played at a national or international level
Physical fitness, moderate to strenuous work	7	Recreational sports such as running, ball/racquet sports, weight training, curling, rowing, golf, yoga, or gymnastics at least 5 times per week
	6	Recreational sports such as swimming, water sports, skiing, hockey, rollerblading, cycling, horseback riding, or mountain climbing at least 5 times per week
	5	Work—heavy labor such as construction Recreational sports at least twice weekly
	4	Work—moderately heavy labor such as truck driving Recreational sports once a week or less
Activities of daily living, light work	3	Work—light labor such as nursing Daily activities such as gardening, climbing multiple flights of stairs, carrying loads, pushing/pulling a load, or ability to run if late Recreational sports less than once a month
	2	Work—light labor Daily activities such as cleaning house, climbing 1 or 2 flights of stairs, or walking carrying a light load
	1	Work—sedentary (secretarial, computer based) Daily activities limited (e.g., do not take stairs, unable to carry loads)
Disability	0	Sick leave or disability pension because of health problems

joint capsule, inflammation in the hip joint and surrounding structures, loose bodies, or abnormal anatomy leading to dysplasia, impingement, or instability. Participants received a wide range of treatments, including pharmacologic, rehabilitative, and surgical interventions. Patients were included regardless of their stage of treatment. Some patients were treated non-surgically, with hip-preserving surgery, and some ultimately underwent resurfacing or total hip arthroplasty; however, the majority were treated with an arthroscopic procedure. No exclusions were made based on subsequent treatments.

### Initial Development of iHOT Questionnaire

The first phase of this methodologic approach was item generation as a 3-step process. The first step was to identify a comprehensive list of items from the existing hip outcome literature, including quality-of-life questionnaires for other orthopaedic conditions in populations of a similar age.<sup>25,28</sup> The list of items was organized into 5 categories: (1) symptoms; (2) functional limitations; (3) occupational concerns; (4) sports and recreational activities; and (5) social, emotional, and lifestyle concerns, as a result of hip problems. The second step was to ask orthopaedic surgeons and physiotherapists who routinely manage young, active patients with hip problems to add items

to this list. The final and most critical step was to interview eligible patients with an open-ended format to identify additional items that relate to how their quality of life is impacted by their condition. Comprehensiveness was ensured by repeated surveying of patients and sampling to the point of redundancy, when no new items were generated.<sup>43</sup> This process is generally considered the most important step in the process of creating a new outcome measure.<sup>43</sup>

The second phase was to perform item reduction. This phase was necessary to ensure that the final items/questions were important to patients, avoided redundancy, and were comprehensive with respect to all aspects of patient-related quality of life. The generated items were formatted into an item reduction questionnaire, which was distributed to a different group of eligible patients. An iterative quantitative and qualitative approach was used in the item reduction phase. The quantitative approach included calculation of frequency-importance products, factor analysis, and item-total correlation. The qualitative approach included consensus agreement between the research team and the MAHORN surgeons to address redundancy and comprehensiveness. Each item was rated by both eligible patients and the MAHORN surgeons for its relevance and importance, using a 6-point ordinal scale (0 to 5), where 0 indicated that



the item was “not experienced or important” and 5 indicated that the item was “experienced and extremely important.” On the basis of these responses, a frequency-importance product was calculated for each item by multiplying the frequency (i.e., the number of patients ranking the item above 0) by the mean importance of that item (i.e., the sum of all rankings, excluding 0, divided by the number of patients). On the basis of the patients’ responses, an a priori frequency-importance product of 50% or greater was considered the cut point for inclusion. Factor analysis was used to determine which items loaded on the same factors (i.e., belonged to the same domain or category defined in the item generation phase). Item-total correlations were calculated to confirm the reduced items. Pearson correlations were calculated between each item and the total score within each domain. Items that highly correlated with the a priori construct were identified as items that should be retained in the questionnaire.

The third phase involved formulating the items into actual questions with an appropriate response format. The reduced items were subsequently formatted into a self-administered pretest questionnaire. A visual analog scale (VAS) response format was used for each question. The 100-point VAS scale format was chosen because it has been used successfully in many other questionnaires.<sup>23-25,27,28</sup> The VAS scoring requires no mathematical transformation, and with a normal distribution of data, it allows for parametric statistical analysis.<sup>23-25,28,44</sup> Furthermore, the VAS response format has shown good internal consistency, is intuitively understood, and converts easily to computer- and Web-based administration.<sup>22-26,28</sup>

Each question is scored out of 100, with 0 representing the worst possible quality-of-life score and 100 representing the best. Totalling the scores from all questions answered and then dividing by the number of questions determined the patient’s final score out of 100. It is also possible to calculate a separate score for each domain. However, no attempt was made to analyze each domain separately.

The final component of the initial questionnaire development was pretesting the questionnaire. Pretesting ensured that the wording was clear and that the patients interpreted the items as they were intended.<sup>45</sup> A separate group of eligible patients completed the pretest questionnaire and participated in a formal 1-to-1 interview process. They were asked to give their interpretation of each item, identify questions with unclear wording, and confirm that all of their relevant concerns with respect to their hip condition

were addressed in the questionnaire. Groups of 5 patients were subsequently interviewed, with modifications being made to the questionnaire after each pretesting round. Changes to the questionnaire based on the patients’ comments were made only if group consensus was achieved. In addition, the patient responses on each item were analyzed to ensure that the response scale was appropriate and represented the full distribution of possible choices for the patient.

### Validation of iHOT

Validation of the iHOT questionnaire involved several components: measurement of test-retest reliability; evaluation of face, content, and construct validity of the outcome; and assessment of responsiveness and minimal clinically important difference (MCID).

**Reliability:** Reliability was assessed using a test-retest protocol. A group of 123 patients, who had not participated in any prior phases of this research, completed the questionnaire on 2 separate occasions at least 2 weeks apart but with no intervention between test points. The mean number of days between administrations was 24 days (range, 14 to 90 days). When completing the questionnaire the second time, the patients also completed a global rating scale to indicate whether their hip condition had improved, had deteriorated, or had no change since the previous administration of the questionnaire. This global assessment was measured using a single VAS ranging from -100 to +100. Fifty patients with less than 5% change on the global rating scale were included in the reliability analysis. The questions were then assessed for internal consistency with the Cronbach  $\alpha$  and test-retest correlations with Pearson and intraclass correlation coefficients. The reliability data were also analyzed using a principal component analysis and bi-plots to look at the variance within the data. Regression analysis was used to identify the items that accounted for the largest part of the variation. A forward-selection procedure was used to select these items.

**Face Validity:** Face validity is a qualitative measure that is present if the iHOT appears to measure the issues relevant to hip problems. This form of validity was determined throughout the development of the questionnaire by reviewing the relevant literature,<sup>22</sup> as well as through the direct involvement and contribution from representative samples of patients with hip problems, orthopaedic hip surgeons, and physiotherapists.

**Content Validity:** Content validity was assessed through consensus agreement with a group of participating orthopaedic hip arthroscopists. This group, the MAHORN, provided input at all stages of the development of the questionnaire. Members of the MAHORN provided feedback into the original set of items and rated each of the items with respect to importance in a similar fashion to the patients in the item reduction phase. The surgeons also evaluated each item in the pretest questionnaire for its relevance, whether the item would change as a result of treatment, and whether the response format was appropriate. In this way the treating surgeons were able to include input toward those items that were most likely to be evaluative and therefore responsive to change.

**Construct Validity:** Construct validity was determined by administering the iHOT to a separate group of 51 eligible patients and comparing the questionnaire with the results of the NAHS.<sup>46</sup> It was hypothesized that the iHOT and the NAHS should correlate highly because both were created for a population of young, active patients with hip disorders.

**Responsiveness and MCID:** Responsiveness and MCID were assessed by administering the iHOT questionnaire to an additional group of 27 young, active patients with hip problems preoperatively and postoperatively at 6 months after arthroscopy (i.e., the responsiveness cohort). A population of 50 patients from the reliability phase of validation was also used to act as a comparison group (i.e., the reliability cohort). Clinical change was determined using the same global rating scale used for reliability testing. An anchor- and distribution-based approach to determine the MCID was used. Responsiveness was determined using several different measures, including a comparison of baseline and 6-month data with a paired *t* test, standardized effect size, standardized response mean, and responsiveness ratio.<sup>37,47,48</sup>

## RESULTS

### Patient Population

Over 400 patients were involved at different stages of the project (Table 3, available at [www.arthroscopyjournal.org](http://www.arthroscopyjournal.org)). There were no differences in the demographics of the patients at any phase, with an equal number of male and female patients represented. The mean age of the entire group was 40 years (range, 18 to 60 years). The specific diagnosis was unknown in 127 cases.

### Item Generation

The item generation list was distributed to 51 patients, 4 orthopaedic surgeons, and 4 physiotherapists. Two hundred twenty-six items were generated. To avoid redundancy, similar or repetitive items were identified between and within each section and removed, combined, and/or reworded. These decisions were based on consensus agreement between the research team and participating orthopaedic surgeons. As a result, the list was decreased to 146 items, which were categorized into 5 domains: symptoms (27 items); functional limitations (36 items); sports and recreational activities (28 items); occupational issues (27 items); and social, emotional, and lifestyle concerns (28 items).

### Item Reduction

The 146-item reduction questionnaire was administered to 150 patients and 9 MAHORN surgeons. The process of item reduction decreased the number of items from 146 to 60 in 4 domains: (1) symptoms and functional limitations (21 items); (2) sports and recreational activities (18 items); (3) job-related concerns (9 items); and (4) social, emotional, and lifestyle concerns (12 items).

The items with a frequency-importance product of 50% or greater were retained; however, none of the items from the job-related concerns domain reached this cutoff point. Consensus agreement between the research team and the participating MAHORN orthopaedic surgeons was to include items from this domain. Therefore the top 12 items from the job-related concerns domain were retained because 1 of the following criteria was met: (1) at least 50% of the patients rated the item as important; (2) the mean rating for these items was greater than 3.5 (of 5); or (3) a significant proportion of patients rated the item as relevant and extremely important (i.e., 5 of 5 on the scale).

The factor analysis determined that the items in the symptoms and functional limitations domains loaded onto the same factor. This clearly indicated that all of these items belonged to 1 domain.

Frequency-importance products were then calculated for each item based on the responses from the 9 orthopaedic surgeons and were compared with the results from the patients. There was a discrepancy between the items identified as relevant and important from the patients' perspectives and from the surgeons' perspectives.<sup>36</sup> For example, the surgeons rated groin pain as the highest item, with an average importance

of 4.8 of 5. The patients rated this item at 2 of 5.<sup>36</sup> To reflect content validity, 10 additional items were included based on consensus agreement between the research team and the MAHORN surgeons. Therefore a total of 60 items were formatted into a pretesting questionnaire. Content validity was confirmed by the MAHORN surgeons, who evaluated the content of the questionnaire from a clinical perspective. These surgeons reviewed the formatted pretest questionnaire for wording and content validation. They were asked specifically if the content of each question would be amenable to treatment. This process confirmed the inclusion of all 60 items before reliability testing.

### Pretesting

Four rounds of pretesting were completed with 31 patients. Modifications included changes in wording, changes to the order of the questions, separation of items into 2 questions, and further identification and removal of redundant items. The 60 questions remained after this stage.

### Reliability Testing

One hundred twenty-three patients completed the questionnaires. Of these patients, 50 indicated less than 5% change in their hip condition. These 50 patients were considered stable clinically, and reliability was calculated on this sample. Each of the 60 questions was analyzed for test-retest reliability (repeatability) using Pearson correlation coefficients and calculating the difference between test periods. Those questions with a Pearson correlation of greater than 0.80 were retained, resulting in a total of 33 questions. The standard error of the difference in the total score was 3 points (95% confidence interval,  $-5.5$  to  $+6.8$ ). The intraclass correlation coefficient for the questionnaire using these 33 items was 0.78, and internal consistency measured by the Cronbach  $\alpha$  was .99.

The 33 questions were distributed within the 4 domains as follows: symptoms and functional limitations, 16 questions; sports and recreational activities, 6 questions; job-related concerns, 4 questions; and social, emotional, and lifestyle concerns, 7 questions. The scores of these 33 questions showed no floor or ceiling effects (Appendix 1).

### Scoring

A VAS response format ranging from 0 to 100 was used for each question, where a higher score represents better quality of life. For those patients who were retired or unemployed for reasons other than

their hip joint problem, the 4 “job-related” questions would be omitted. The overall score would still be calculated by taking the average out of 100 from the remaining questions.

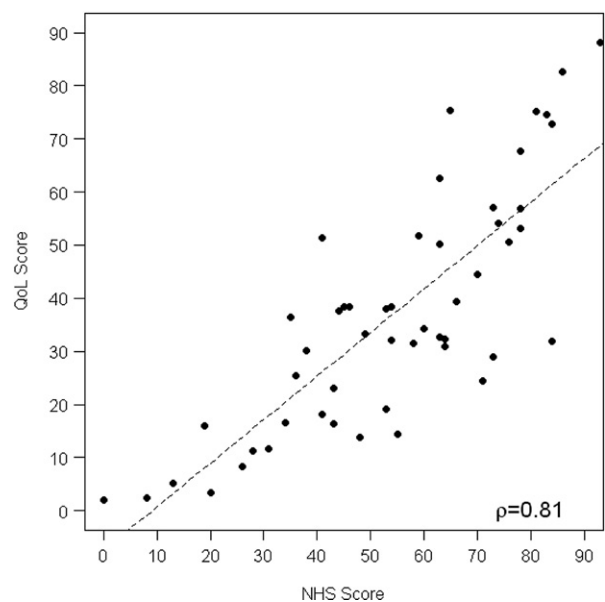
### Validation

Face validity was ensured because of patient involvement at all stages of the development of the questionnaire. The MAHORN surgeons addressed content validation.

Construct validation was addressed by comparing the 33-item International Hip Outcome Tool (iHOT-33) outcome with the NAHS. This construct showed that the new quality-of-life questionnaire showed a correlation coefficient of 0.81, indicating very good correlation (Fig 1).

### Responsiveness

The reliability cohort (50 patients) had no clinically meaningful change, and the responsiveness cohort (27 patients) had much improvement at the 6-month post-operative time point. The mean score was 32 of 100 at baseline and 65 of 100 at 6 months, with a mean change in score of 33 and SD of 19.3. The paired  $t$  test showed highly significant differences, with  $P \leq .01$ . By use of these 2 patient groups, the standardized effect size was 2.0, the standardized response mean



**FIGURE 1.** Correlation of iHOT-33 quality-of-life (QoL) score with Non-Arthritic Hip Score (NHS).

was 1.7, and the responsiveness ratio was 6.7. The MCID was calculated to be 6.1.

## DISCUSSION

There has been increasing interest in the evaluation and management of nonarthritic hip problems in young, active patients. This is because of a much greater understanding of hip biomechanics and improved imaging techniques.<sup>49-55</sup> However, there is a paucity of reports regarding validated hip outcomes in the younger person. Recently, there have been 3 outcome measures developed to assess patients treated with hip arthroscopy: the NAHS, the HOS, and the Copenhagen Hip and Groin Outcome Score (HAGOS).<sup>46,56-59</sup> The HOS included physician and physical therapy input during item generation without patient involvement. The HOS has been reported to show reliability and responsiveness within the context of its 2 subscales, activities of daily living and sports.<sup>58</sup> Similarly, it has been shown to be valid for patients with labral tears and in hip arthroscopy patients, but only with respect to physical function.<sup>56,57</sup> The HOS is not designed to measure symptoms; emotional, social, or lifestyle dimensions; or the impact of the patients' problems on their jobs. The NAHS was based on the WOMAC.<sup>60</sup> The WOMAC is a 24-item questionnaire completed by the patient and focusing on joint pain, stiffness, and loss of function related to osteoarthritis of the knee and hip.<sup>17</sup> It has 2 subscales: pain and function. The NAHS uses 10 items directly from the WOMAC from the domains of pain and physical function and adds 4 questions related to mechanical symptoms and 6 questions related to activity level.<sup>46</sup> All items from the WOMAC are patient derived. The additional 10 questions were generated through pilot test interviews with patients of varying educational levels and with health professionals.<sup>46</sup> The NAHS has been shown to be reliable and valid, but it also lacks specific items relating to other important aspects of patient-related quality of life.<sup>22</sup> The HAGOS has been developed using similar methodology to the iHOT.<sup>59</sup> However, the 37-item questionnaire involved a total of 126 patients who were used at more than 1 stage of the questionnaire development. The iHOT used over 400 patients with independent groups at each stage of questionnaire development. The basis for the item generation process for the HAGOS was 43 items/questions (40 from the Hip Dysfunction and Osteoarthritis Outcome Score and 3 from the HOS). An expert group (N = 7), comprising 2 orthopaedic surgeons, 1 physician, and 4 physiother-

apists, added an additional 8 questions. A representative focus group of 25 patients added 2 questions and removed 1 question, resulting in a 52-item questionnaire. Because item generation is considered the most important phase of questionnaire development, the HAGOS may have missed potentially important items.<sup>43</sup> The remaining stages of questionnaire development were based on 101 patients, resulting in a final questionnaire of 37 questions in 6 separate subscales: pain (10 items), symptoms (7 items), activities of daily living (5 items), sports/recreation (8 items), physical activities (2 items), and quality of life (5 items).<sup>59</sup> Content validity was suggested based on the input from the original 25 patients and expert group (N = 7) involvement. Test-retest reliability was measured 1 to 3 weeks after baseline, in 44 of the 101 patients. Responsiveness was determined at 4 months from baseline in 87 of 101 patients. Ironically, the subscale with the highest standardized response mean and effect size was the quality-of-life subscale, at 1.46 and 1.78, respectively. Construct validity was determined by comparing the HAGOS with the Short Form 36, which has significant limitations because the Short Form 36 is a generic outcome measure. The comparison with respect to a priori correlations was satisfactory but not consistent. Ultimately, evaluative patient-reported outcomes should be able to measure the minimal important change and/or minimal important difference. The HAGOS showed that the minimal important change for each subscale ranged from 10 to 15 points based on using the estimate of one-half of the reported standard deviation. The authors identified the limitation that if the HAGOS were used as the primary outcome measure in a clinical trial, more patients would be needed to achieve a meaningful sample size.<sup>59</sup>

Most recently, Briggs and Philippon<sup>61</sup> reported on the Vail Hip Score, which included 10 particular questions that were most responsive to patients treated with hip arthroscopy. These items were "mined" from a database of thousands of patients who had arthroscopic procedures and comprised 3 items related to pain, 2 with respect to stiffness, 1 with respect to limping, and 4 related to function.<sup>61</sup> The Vail Hip Score was not patient derived or generated. It specifically includes questions from the MHHS, the NAHS, and the HOS.

These outcome scores or measures, as well as many others that are currently used, have merit in 1 respect or another because most have been "validated" in certain contexts. There is a lot of similarity and some consistency between these measures. However, no



tool created to date has been based on the population of patients with hip disorders who are young and active and has included all dimensions of health-related quality of life.

The iHOT questionnaire was developed to address all of the previous deficiencies with respect to outcome assessment for young, active patients with hip disorders. The appropriate population for this tool includes patients aged between 18 and 60 years who have a Tegner activity level of 4 or higher, meaning that they are engaged in recreational physical activities at least once a week or have an occupation involving moderately heavy labor (Table 2). The development of the iHOT-33 involved 433 patients from Canada, the United States, England, and Switzerland. This number far exceeds similar validated outcome measures.<sup>23-28,60,62-64</sup> The large number and variety of patients involved in creating and testing this questionnaire imply generalizability for multiple populations of young patients with hip disorders. The confirmed and specific diagnosis was unknown in 32% of the patients. Nevertheless, every patient with an unconfirmed diagnosis had a hip joint problem, the majority were preoperative, and such patients were identified from the same practices as those where the diagnosis was confirmed.

The purpose of the described outcome tool is to evaluate patients so that they can be followed up over time and the success of various treatments can be assessed. Evaluative tools require the property of responsiveness.<sup>37</sup> Wright and Young<sup>65</sup> have published a comparison of the responsiveness properties of 5 different patient-reported outcomes. They compared multiple measures of responsiveness including the responsiveness statistic/ratio, standardized response mean, and effect size. The iHOT-33 showed a responsiveness ratio of more than twice the highest-ranked outcome (WOMAC disability domain).<sup>65</sup> The iHOT-33 has an effect size of 2.0, which is higher relative to the HOS activities of daily living and sports subscales, at 1.2 and 1.5, respectively. Similarly, the MCID of the iHOT-33, at 6.1, shows that it is very sensitive to change compared with the HAGOS (i.e., 10 to 15 points) and International Knee Documentation Committee subjective knee form, which is sensitive to change at a score of 11.5 points out of 100. Therefore, compared with similar questionnaires, the iHOT-33 is highly responsive with a small MCID, showing great value for use as an evaluative outcome measure.

Some quality-of-life questionnaires can discriminate between patients and thus guide treatment decision making.<sup>66</sup> The iHOT-33 has yet to be specifically

evaluated for its discriminative properties, and this requires a future study. The response format is a VAS. Although such a format is easily adaptable to a computer or Web-based interface, phone-based administration has only recently been evaluated in 1 setting and using the short form of the iHOT.<sup>67</sup> The age limits of 18 to 60 years were determined to represent younger active patients. Therefore assessing outcomes in the pediatric and elderly populations may not be appropriate. These limits were determined a priori to ensure that the questionnaire was self-administered and easily understood.

## CONCLUSIONS

We have developed a new quality-of-life patient-reported outcome measure, the iHOT-33. This 33-item questionnaire uses a VAS response format designed for computer self-administration by young, active patients with hip pathology. Its development has followed the most rigorous methodology involving a very large number of patients. The iHOT-33 has been shown to be reliable; shows face, content, and construct validity; and is highly responsive to clinical change. In our opinion the iHOT-33 can be used as a primary outcome measure for prospective patient evaluation and randomized clinical trials.

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## APPENDIX 1

## International Hip Outcome Tool (iHOT-33).

The header of the iHOT-33 form is a dark blue rectangle. On the left, the text 'iHOT<sup>33</sup>' is in large white font, with 'INTERNATIONAL HIP OUTCOME TOOL' in smaller white font below it. To the right, there are three white input fields: 'NAME', 'DATE OF BIRTH', and 'TODAY'S DATE'. Further right, a white box titled 'WHICH HIP IS THIS SURVEY ABOUT?' contains the instruction: 'If we've asked you to tell us about one hip in particular, tick that. Otherwise, tick the one which causes most trouble.' Below this instruction are two radio buttons labeled 'Left' and 'Right'.

QUALITY OF LIFE QUESTIONNAIRE FOR YOUNG, ACTIVE PEOPLE WITH HIP PROBLEMS

## INSTRUCTIONS

- These questions ask about the problems you may be experiencing in your hip, how these problems affect your life, and the emotions you may feel because of these problems.
- Please indicate the severity by marking the line below each question with a slash.
  - » If you put a mark on the far **left**, it means that you **feel you are significantly impaired**. For example:

SIGNIFICANTLY IMPAIRED \_\_\_\_\_ NO PROBLEMS AT ALL

- » If you put a mark on the far **right**, it means that you **do not think that you have any problems** with your hip. For example:

SIGNIFICANTLY IMPAIRED \_\_\_\_\_ NO PROBLEMS AT ALL

- » If the mark is placed in the middle of the line, this indicates that you are moderately disabled, or in other words, between the extremes of 'significantly impaired' and 'no problems at all'. It is important to put your mark at either end of the line if the extreme descriptions accurately reflect your situation.

**TIP** If you don't do an activity, imagine how your hip would feel if you had to try it.

- Please let your answers describe the typical situation in the last **month**.

## SECTION 1 | SYMPTOMS AND FUNCTIONAL LIMITATIONS

The following questions ask about symptoms that you may experience in your hip and about the function of your hip with respect to daily activities. Please think about how you have felt most of the time over the past month and answer accordingly.

**Q01** How often does your hip/groin ache?

CONSTANTLY \_\_\_\_\_ NEVER

**Q02** How stiff is your hip as a result of sitting/resting during the day?

EXTREMELY STIFF \_\_\_\_\_ NOT STIFF AT ALL



.....

**Q03** How difficult is it for you to walk long distances?

EXTREMELY  
DIFFICULT

NOT DIFFICULT  
AT ALL

.....

**Q04** How much pain do you have in your hip while sitting?

EXTREME PAIN

NO PAIN AT ALL

.....

**Q05** How much trouble do you have standing on your feet for long periods of time?

SEVERE TROUBLE

NO TROUBLE AT  
ALL

.....

**Q06** How difficult is it for you to get up and down off the floor/ground?

EXTREMELY  
DIFFICULT

NOT DIFFICULT  
AT ALL

.....

**Q07** How difficult is it for you to walk on uneven surfaces?

EXTREMELY  
DIFFICULT

NOT DIFFICULT  
AT ALL

.....

**Q08** How difficult is it for you to lie on your affected hip side?

EXTREMELY  
DIFFICULT

NOT DIFFICULT  
AT ALL

.....

**Q09** How much trouble do you have with stepping over obstacles?

SEVERE TROUBLE

NO TROUBLE AT  
ALL

.....

**Q10** How much trouble do you have with climbing up/down stairs?

SEVERE TROUBLE

NO TROUBLE AT  
ALL

.....

**Q11** How much trouble do you have with rising from a sitting position?

SEVERE TROUBLE

NO TROUBLE AT  
ALL

.....

**Q12** How much discomfort do you have with taking long strides?

EXTREME  
DISCOMFORT

NO DISCOMFORT  
AT ALL

.....

**Q13** How much difficulty do you have with getting into and/or out of a car?

EXTREME  
DIFFICULTY

NO DIFFICULTY  
AT ALL

.....

**Q14** How much trouble do you have with grinding, catching or clicking in your hip?

SEVERE TROUBLE

NO TROUBLE AT  
ALL

.....

**Q15** How much difficulty do you have with putting on/taking off socks, stockings or shoes?

EXTREME  
DIFFICULTY

NO DIFFICULTY  
AT ALL

.....

**Q16** Overall, how much pain do you have in your hip/groin?

EXTREME PAIN

NO PAIN AT ALL

## SECTION 2 | SPORTS AND RECREATIONAL ACTIVITIES

The following questions ask about your **hip** when you participate in sports and recreational activities. Please think about how you have felt most of the time over the past **month** and answer accordingly.

.....

**Q17** How concerned are you about your ability to maintain your desired fitness level?

EXTREMELY  
CONCERNED

NOT CONCERNED  
AT ALL

.....

**Q18** How much pain do you experience in your hip after activity?

EXTREME PAIN

NO PAIN AT ALL

.....

**Q19** How concerned are you that the pain in your hip will increase if you participate in sports or recreational activities?

EXTREMELY  
CONCERNED

NOT CONCERNED  
AT ALL

.....

**Q20** How much has your quality of life deteriorated because you cannot participate in sport/recreational activities?

EXTREMELY  
DETERIORATED

NOT  
DETERIORATED AT  
ALL

**Q21** How concerned are you about cutting/changing directions during your sport or recreational activities?

☐ I do not do this action in my activities

EXTREMELY  
CONCERNED

NOT CONCERNED  
AT ALL

**Q22** How much has your performance level decreased in your sport or recreational activities?

EXTREMELY  
DECREASED

NOT DECREASED  
AT ALL

### SECTION 3 | JOB RELATED CONCERNS

The following questions relate to your hip with respect to your current work. Please think about how you have felt most of the time over the past month and answer accordingly.

☐ I do not work because of my hip (*please skip section*)

☐ I do not work for reasons other than my hip (*please skip section*)

**Q23** How much trouble do you have pushing, pulling, lifting or carrying heavy objects at work?

☐ I do not do these actions in my activities

SEVERE TROUBLE

NO TROUBLE AT  
ALL

**Q24** How much trouble do you have with crouching/squatting?

SEVERE TROUBLE

NO TROUBLE AT  
ALL

**Q25** How concerned are you that your job will make your hip worse?

EXTREMELY  
CONCERNED

NOT CONCERNED  
AT ALL

**Q26** How much difficulty do you have at work because of reduced hip mobility?

EXTREME  
DIFFICULTY

NO DIFFICULTY  
AT ALL

#### SECTION 4 | SOCIAL, EMOTIONAL AND LIFESTYLE CONCERNS

The following questions ask about social, emotional and lifestyle concerns that you may feel with respect to your hip problem. Please think about how you have felt most of the time over the past month and answer accordingly.

**Q27** How frustrated are you because of your hip problem?

EXTREMELY  
FRUSTRATED

NOT FRUSTRATED  
AT ALL

**Q28** How much trouble do you have with sexual activity because of your hip?

☐ This is not relevant to me

SEVERE TROUBLE

NO TROUBLE AT  
ALL

**Q29** How much of a distraction is your hip problem?

EXTREME  
DISTRACTION

NO DISTRACTION  
AT ALL

**Q30** How difficult is it for you to release tension and stress because of your hip problem?

EXTREMELY  
DIFFICULT

NOT DIFFICULT  
AT ALL

**Q31** How discouraged are you because of your hip problem?

EXTREMELY  
DISCOURAGED

NOT  
DISCOURAGED AT  
ALL

**Q32** How concerned are you about picking up or carrying children because of your hip?

☐ I do not do this action in my activities

EXTREMELY  
CONCERNED

NOT CONCERNED  
AT ALL

**Q33** How much of the time are you aware of the disability in your hip?

CONSTANTLY  
AWARE

NOT AWARE AT  
ALL



TABLE 3. Patient Demographics

Phase (No. of Patients)	Mean Age (yr)	Gender	Affected Hip	Mean Time Hip Has Been a Problem (yr)	Diagnoses	Mean Tegner Activity Level
Item generation (n = 51)	38.2	29 M/21 F/1 unknown	23 L/20 R/7 both/ 1 unknown	2.5	After Perthes osteoarthritis, degenerative labral tear, early osteoarthritis, previous congenital hip dysplasia, previous osteotomy, FAI, grade 3 and grade 4 chondromalacia acetabulum and femoral head, chondromalacia rim of acetabulum, sclerosis, osteophytes, bursitis, snapping hip, iliopsoas syndrome, short iliotibial band, arthrosis, adhesive capsulitis, damaged bone	6.4
Item reduction (n = 150)	41.7	72 M/76 F/2 unknown	41 L/76 R/32 both/1 unknown	5.3	Torn labrum, possible minor labral tear and chondral lesion, arthritis, dysplasia, tendinitis, torn cartilage, impingement, bone lesion, ligament tears, bone spur, avascular necrosis, Perthes, joint replacement, piriformis syndrome, oversized femur, FAI, Ehlers syndrome, hypermobility, dislocation, hip pain, degenerative arthritis, bursitis, hip flexor contracture, iliotibial band syndrome	6.0
Pretesting (n = 31)	43.8	15 M/16 F	13 L/17 R/1 both	6.3	Possible ilioinguinal nerve entrapment or return of inguinal hernia, FAI, labral tear, bony abnormality, snapping iliopsoas tendon, early osteoarthritis, chondral injury, fibromyalgia/Sjögren syndrome, possible iliopsoas bursitis, early arthrosis with pincer impingement, Perthes disease, bilateral hip dysplasia	7.4
Reliability n = 123	39.9	46 M/77 F	38 L/62 R/22 both/1 unknown	5.3	Labral debridement, abnormal labrum and acetabulum with minor cam impingement, labral tear, osteoarthritis, mild hip dysplasia, hip pain, anterior-superior labral detachment, chondral damage, FAI, RA, gluteus medius tear, synovial chondromatosis	6.2
Reliability cohort n = 50	38.6	17 M/33 F	16 L/28 R/6 both	5.6	Labral debridement, abnormal labrum and acetabulum with minor cam impingement, labral tear, osteoarthritis, mild hip dysplasia, hip pain, anterior-superior labral detachment, chondral damage, FAI, arthropathy/RA, gluteus medius tear, synovial chondromatosis	6.1
Responsiveness (n = 27)	39.2	14 M/13 F	14 L/13 R	4.7	FAI, cam and pincer FAI, labral tear, chondromalacia acetabulum, os acetabulum, early osteoarthritis, chondral bruising, chondral damage, osteophyte, ligamentum teres tear/avulsion, synovial osteochondromatosis	6.8
Construct validity (n = 51)	35.1	20 M/31 F	21 L/24 R/6 both	4	FAI, labral tear, early osteoarthritis, instability, previous trauma, loose bodies, Perthes, avascular necrosis, slipped capital femoral epiphysis, hip dysplasia	6.5

Abbreviations: F, female; FAI, femoroacetabular impingement; L, left; M, male; R, right; RA, rheumatoid arthritis.