Health State Utility in Patients with Osteoarthritis of the Hip and Total Hip Arthroplasty

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Abstract: Understanding patients' perceived health status, as measured by health state utility, is important when evaluating the societal impact of hip osteoarthritis (OA) and total hip arthroplasty (THA). The purpose of this study was to measure health state utility in patients with hip OA and THA. A total of 231 patients from 2 institutions were enrolled into 1 of 6 cohorts: chronic hip OA, successful and failed primary THA, successful and failed revision THA, and infected THA. Average health state utilities were calculated using the time-trade-off method. Health state utilities were highest for primary THA (0.96) and lowest for infected THA (0.46). Our data demonstrate that THA results in substantial improvement in perceived health status in patients with chronic hip OA. However, health state utility is significantly worse after revision THA than primary THA, and failed primary or revision THA results in substantially reduced health state utility, similar to or worse than chronic OA.
Keywords: osteoarthritis, health state utility, arthroplasty, health-related quality of life.

Measuring health state utility in patients with osteoarthritis (OA) of the hip before and after total hip arthroplasty (THA) is important in evaluating the societal impact of arthritis and THA [1,2]. At the same time, individual patients and clinicians are faced with complex decisions involving many uncertain variables when considering THA as a treatment option for advanced OA of the hip. Variables to consider include the severity of the disease, the impact on the patient's quality of life, and patient expectations in terms of return to functional and recreational activities. In an era of limited health care resources, health status questionnaires are of particular importance when comparing the clinical benefits and cost-effectiveness of health care interventions such as THA. Complications and revisions, particularly those associated with infection [3], represent 2 of the most significant factors contributing to the global costs and poor patient outcomes associated with THA.

Health state utility, which is a preference-based measure of health status, refers to the desirability or preference that individuals or societies have for a given health outcome [4]. Health state utilities range from perfect health (weighted 1.0) to death (weighted 0). Although several authors have measured and reported health state utility values associated with hip OA and after successful primary THA, the results are somewhat conflicting [5-8]. Furthermore, health state utility values have not been measured for other health states associated with THA, such as revision THA, infection, and failed primary or revision THA. These utility values are necessary to assess the cost-effectiveness of the procedure. The purpose of this study was to measure health state utility in patients with advanced hip OA and THA, including those associated with complications and failure.

Methods

We prospectively evaluated health state utility in 231 patients from 2 academic medical centers (University of California, San Francisco, and New York University Hospital for Joint Diseases) who presented to an orthopedic surgeon with hip OA or prior primary or revision THA. This study was institutional review board approved at both institutions. Subjects who agreed to participate in the study were enrolled and assigned into 1 of 6 cohorts by the principal investigator at each study site: chronic OA of the hip (before surgery), successful primary THA (coming for routine follow-up after their THA), failed primary THA (excluding

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Table 1. Mean Utility Values for Patients in Cohorts

Group	No. of Patients Observed	Mean Utility	SD	Minimum	Maximum
Chronic OA of the hip	86	0.60	.34	.025	1
Successful primary THA	51	0.96	.09	.55	1
Failed primary THA	30	0.59	.34	.025	1
Successful revision THA	21	0.84	.28	.025	1
Failed revision THA	27	0.57	.36	.025	1
Chronically infected THA	16	0.46	.28	.025	.85

infection), successful revision THA, failed revision THA (excluding infection), and chronically infected THA. A primary or revision THA was considered a failure if the patient presented with recurrent dislocation, chronic pain, painful loosening, or another significant complication requiring treatment. We enrolled consecutive patients (who agreed to participate in the study) until we achieved an adequate sample size in each group. Patients were excluded if they had bilateral or contralateral THA or a history of another prior hip surgery, could not speak or read English, or were cognitively impaired.

Subjects were asked to complete an electronic time-trade-off (TTO) survey. The TTO technique is a commonly used tool for direct preference assessment that derives values for various health states by asking patients how many years in their current state of health they would be willing to give up to live a fixed number of years in excellent health [9,10]. The TTO survey used in this study asked how many years of life a patient would be willing to give up for their hip problems to be completely resolved [11,12]. In developing the TTO survey instrument, we aimed to create an online interactive algorithm that would help us determine the extent to which patients were burdened by their hip disease (Appendix 1; available online at www.arthroplastyjournal.org). A visual depiction of the TTO algorithm is presented in the Appendix, along with a description of the methodology used to derive health state utility using the TTO method.

The maximum number of years a subject was willing to give up was converted into a health state utility score, ranging from 0 to 1, where a score of 1 represents perfect health, using the TTO method. The TTO utility score was calculated as:

$$(\text{Expected Life Years} - \text{Years Willing to Give Up}) / \text{Expected Life Years}.$$

In our study, we anchored the expected life years at 20 years of life (for example, if a patient was willing to give up 5 years of life, their health utility score was 0.75). Average health state utility values were calculated for each health state and compared using the Wilcoxon rank sum test. All statistical analyses were performed using Stata Statistical Software: Release 10 (StataCorpLP, College Station, Tex).

Results

A total of 231 patients (mean age, 56.5 years; 54.5% women) met the inclusion criteria. The average health state utility for each health state is shown in Table 1 and is highest for successful primary THA (0.96) and lowest for chronically infected THA (0.46). Successful primary THA was associated with a significantly higher health state utility (0.96) than chronic hip OA (0.60) ($P < .001$) (Table 2). Successful revision THA (0.84) was associated with a significantly lower health state utility than successful primary THA (0.96) ($P = .03$). Both successful primary THA (0.96) and revision THA (0.84) were associated with significantly higher health state utilities than either failed primary (0.59) or revision (0.57) THA ($P < .001$ for all comparisons). However, there were no significant differences in health state utility between failed primary (0.59) and revision (0.57) THA ($P = .42$).

Discussion

Total hip arthroplasty has been recognized as an efficacious and cost-effective procedure [13-16]. However, both early and late failures can and do occur, and patients and their surgeons need to weigh the potential benefits of reduced pain and improved function against the potential risks, including the risk of complications and the need for future revision surgery, when considering THA for the treatment of advanced hip OA. Furthermore, from a societal perspective, in an era of limited health care resources, it has become increasingly important to consider the comparative clinical benefits and cost-effectiveness of various surgical and nonsurgical health care interventions, and assessment of health state utility values is necessary for these comparisons.

Table 2. Between-Group Comparisons Using the Wilcoxon Rank Sum Test

Chronic OA of the hip	Successful primary THA	$P < .001$ *
Successful primary THA	Successful revision THA	$P = .03$ *
Successful primary THA	Failed Primary THA	$P < .001$ *
Failed primary THA	Failed revision THA and chronically infected THA	$P = .42$
Successful revision THA	Failed revision THA and chronically infected THA	$P < .001$ *

* $P < .05$ is significant.

Laupacis et al [5] assessed health-related quality of life after THA in 188 Canadian patients using the TTO technique as a measure of utility. These investigators reported a mean preoperative utility score of 0.29 and a postoperative score at 2 years of 0.87. Katz et al [6] used a modified TTO method to estimate individual patient preference scores in 54 THA patients. They reported mean preoperative utility to be 0.69 and postoperative utility to be 0.9. James et al [17] performed a cost-utility analysis of various commonly performed orthopedic procedures for the purpose of prioritizing elective orthopedic procedures in the northwest of England. They used the EQ-5D, a generic, self-reported health-related quality-of-life measure of 5 dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression), and the Rosser classification of illness states, which provides pairwise groupings of 4 distress and 8 disability states experienced by the patient, to estimate the preoperative and postoperative utilities for both primary and revision THA. The values generated ranged from 0.14 for the preoperative revision THA state to 0.98 for the postoperative primary THA state. Utility values generated from the Rosser index were uniformly lower than those derived from the EQ-5D. Robinson et al [7] compared the improvement in health-related quality of life in 62 patients who underwent revision THA with that of 62 patients who had primary THA. They reported that 1 year after surgery, health-related quality of life in both groups had significantly improved, but there were no significant differences in the improvement in scores between the 2 groups. However, 4 years after surgery, patients who underwent revision THA had a significant decline in health-related quality of life relative to patients who underwent primary THA. Feeny et al [8] used both community preference–based and direct standard gamble measures to estimate health utility in patients with OA of the hip both preoperatively and postoperatively. The authors reported differences in utility scores depending on the instrument used and recommended that community preferences are not a substitute for directly measured utility scores at the individual level. Räsänen et al [18] evaluated patients who underwent hip or knee arthroplasty using the 15D health-related quality-of-life instrument, a generic, comprehensive, 15-dimensional, self-administered instrument for measuring health-related quality of life; health utility is measured on a 0-to-1 scale. They reported a mean health-related quality-of-life score of 0.858 for primary THA at 12 months and 0.823 for revision THA patients.

Our study used validated techniques to assess the impact of hip arthritis and hip arthroplasty on quality of life. In contrast to generic and disease-specific health-status instruments, which assess functional performance or capacity, preference-based utility measures are used to assess how particular health states are valued by patients and society, and they allow for comparison of interventions across the varied disciplines of health and medicine. Consequently, health state utilities play an important role in cost-effectiveness analysis. Our study builds on the work of previous authors by measuring health state utility not only in patients with hip OA and successful primary and revision THA but also in patients with failed primary and revision THA and chronic infection. This information will be very useful in future cost-effectiveness analyses related to hip OA and THA, including the evaluation of new techniques and technologies and in the comparison of cost-effectiveness with health interventions in other fields.

Our study is limited by the fact that we did not record the time elapsed from surgery (or duration of symptoms) at the time of assessment. However, despite that our patient population included a wide range of follow-up times, the relatively low standard deviation for the health state utility of patients with a successful primary THA confirms the temporal stability of the results. The standard deviation for the successful revision THA is higher, and the duration of follow-up and mechanism of failure could have affected the results. In addition, the duration of symptoms in failed or infected THA may affect the health state utility, which would likely decline over time. However, our data represent the health state utility of patients whose symptoms are severe enough to seek treatment, which is arguably the most clinically relevant time point. Our study is also limited to data from 2 institutions, with a relatively small number of patients in each cohort. Furthermore, because of the variability in the number and type of patients who sought care at each study site during the period of the study, the number of patients in each cohort was not the same.

We did not control for the specific type of complication when measuring the utility of failed THA or revision THA, or for the type of treatment or severity of infection in the infected THA cohort. Nonetheless, these differences are likely to be relatively small, especially when compared with successful primary or revision THA. Thus, our study provides useful data that can be easily applied in the clinical setting to counsel patients on the expected risk-benefit ratio of undergoing primary or revision THA. Furthermore, because the calculation of the incremental cost-effectiveness of an intervention is defined as the difference in cost divided by the difference in health state utility gained by a particular intervention, our findings will allow future investigators to evaluate the cost-effectiveness of primary and revision THA when compared with other health care interventions. Future studies with larger numbers of patients may be helpful in delineating differences in health state utility among patients with different types of complications and causes of primary or revision THA failure. In addition, longitudinal follow-up of the same patients could provide more precise information on the expected changes in health state utilities over time.

We found that patients with hip arthritis had severely compromised health state utility, and THA resulted in dramatic improvements in health state utility, comparable with or better than similarly aged patients without arthritis [19]. We also found that health state utility is significantly worse after revision THA than primary THA, and patients who had failed primary or revision THAs had markedly diminished health states, similar or worse to patients with arthritis. Patients with chronically infected THAs had extremely poor health state utilities, similar to patients with end-stage renal disease and complications related to diabetes [20,21].

Successful primary and revision THAs offer patients significant improvements in health-related quality of life. However, failed primary and revision THAs are associated with a significant reduction in the health state utility, with infection demonstrating the most significant reduction. These data have important implications for quantifying the societal impact of hip OA, THA, and failed THA, and for comparison of these health states to other health conditions. This information will also be helpful for patients and surgeons to consider when discussing the risks and benefits of primary and revision THA, and for evaluating the cost-effectiveness of primary and revision THA.

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Appendix 1: Time-Trade-Off Questionnaire

Time Trade-Off Questionnaire

This questionnaire asks you to think about how many years you would be willing to give up in order for your hip problems to be completely resolved.

No one can predict exactly how long you have to live, but let's imagine that you will live 20 more years in your current state of health with any medical problems you have.

This problem will present a series of choices between ***living 20 more years in your current state of health*** (SCENARIO A) ***and living fewer years without the burden of your hip problems*** (SCENARIO B).

SCENARIO A: Your current state of health.

SCENARIO B: You have **no problems relating to your hip**, for example:

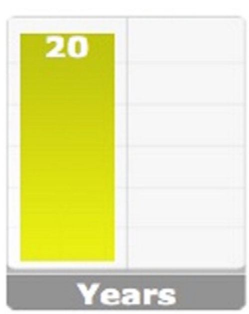
- No pain or discomfort
- No problems performing activities of daily living (e.g. driving, dressing, bathing, cooking, and self care)
- No problems performing physical activities (e.g. swimming, walking > 1 mile, stationary bicycle, light weights, golfing, skiing)
- No anxiety or depression due to hip problems

Please only use the buttons within the questionnaire itself and not the portal application buttons (i.e. "Home", "Previous" etc) for this particular survey.

Next Step

Which do you prefer?

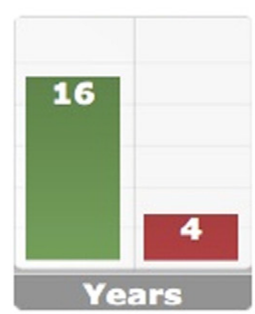
Scenario A



Scenario A

Continue to live in your current state of health (with whatever problems you may have related to your hip) for 20 years.

Scenario B



Scenario B

Continue to live WITHOUT problems related to your hip, including:

- No pain and discomfort
- No anxiety and depression
- No problems performing daily activities
- No problems performing physical activities

Live 16 years without hip related issues, but give up 4 years.

No preference between Scenario A and B

Undo last selection

Restart

The first Web page in the algorithm introduces the hypothetical situation of having 2 options: 20 years of life left to live their current state of health including all the pain/discomfort/functional limitation associated with their hip disease vs giving up a certain number of years to live the remaining years with no pain/discomfort/functional limitation related to their hip disease. After the introduction, the next Web page offers the survey taker the choice between these 2 options with a specified value for "years given up." The "years given up" and "years left to live" are also represented visually to aid the patient in comparing the 2 options. After a choice is made, the "years given up" is varied in a "ping-pong" style algorithm from 0 to 20, and the survey taker is repeatedly asked to choose between the 2 options until they reach a point when they have no preference. At this time, the algorithm terminates, and the "years given up" is saved for retrieval/data analysis. The TTO utility score is then calculated as:

(Expected Life Years −Years Willing to Give Up)/
Expected Life Years, with Expected Life Years
Anchored at 20 Years.