Comparing the expectations of patients and their surgeons regarding the outcomes of periacetabular osteotomy

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Boston University
COMPARING THE EXPECTATIONS OF PATIENTS AND THEIR SURGEONS REGARDING THE OUTCOMES OF PERIACETABULAR OSTEOTOMY

by

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DEDICATION

I would like to dedicate this work to the memory of late Dr. Michael Moore of Cleveland Clinic; a man who gave me the ability to believe in, and fight for possibilities.
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I would like to express profound gratitude, first, to my advisor and mentor Dr. Michael Millis for giving me the noble opportunity and responsibility of spearheading research work that has led to this thesis. His leadership in the Hip Preservation field of orthopaedics, his excellence in academic scholarship and clinical care, and infectious devotion to the optimum well being of his patients will always inspire my academic and career journey.

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Finally, I am grateful to God, my parents, brothers, soul sister and my boyfriend for their blessings, encouragement and support through all my years of life, particularly in this time of working towards my Master’s degree.
COMPARING THE EXPECTATIONS OF PATIENTS AND THEIR SURGEONS REGARDING THE OUTCOMES OF PERIACETABULAR OSTEOTOMY

GLORIA ATSOI BOYE

ABSTRACT

Purpose: The fulfillment of patients’ expectations is an essential factor in their satisfaction with outcomes of their surgery. It is therefore necessary to assess whether patients have realistic expectations of the likely effects of the prospective surgery on their symptoms and function. Comparison of the clinical outcomes anticipated by the patients and their surgeons provides important initial information in studying the formation of patients’ expectations. This study examined the level of agreement in the preoperative expectations of patients with DDH and their surgeons of the PAO surgery.

Methods: Two surgeons and their combined 72 patients preoperatively completed 4-point Likert-scales rating their realistic expectations of improvement (“not improved at all” to “greatly improved”) in six domains representing different hip symptoms after surgery. Domains included pain, stiffness, locking, stability, walking ability and athletic ability. Concordance between patient and surgeon expectation was evaluated by the percent of exact and partial (within one rating) agreement as well as Kappa coefficients.

Results: Exact agreement between patients and surgeons ranged from 17.4% (Stiffness) to 54.2% (Pain). Partial agreement between patients and surgeons ranged from 46.4% (Stiffness) to 100% (Pain). Agreement was consistently lowest regarding expected hip stiffness and highest regarding expected pain following surgery. Weighted Kappa estimates were low ranging from 0.07 to 0.45. In instances of disagreement, patients
consistently had higher expectations than the surgeon especially with respect to stiffness, walking ability and locking/catching of the hip.

**Conclusions:** There was discrepancy between patients and surgeons in their preoperative expectations of outcomes of the PAO, with most patients being more optimistic than their surgeons in every domain. In the domains of hip stiffness, locking, and walking ability, there was frequent discrepancy between patient and surgeon expectations. But for the pain domain, patients and surgeons were close in their expectations. Our findings highlight differences in perspectives between patients and surgeons regarding the effectiveness of the PAO in improving various hip symptoms and function.
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LIST OF ABBREVIATIONS

PAO .............................................................. Periacetabular osteotomy

FAI .............................................................. Femoroacetabular Impingement
INTRODUCTION

The periacetabular osteotomy (PAO) is a popular and common surgical treatment procedure for symptomatic acetabular dysplasia.\(^1\)\(^-\)\(^6\) Symptomatic acetabular dysplasia typically presents with hip pain and dysfunction in the skeletally mature, young and active population.\(^7\) In recent years, convincing evidence has emerged to support the hypothesis that acetabular dysplasia is a major etiological factor in the pathophysiology of hip osteoarthritis.\(^8\),\(^9\) The goals of PAO are two-fold: first, to alleviate associated hip symptoms; and second, to prevent or delay the progression of osteoarthritis.\(^1\)\(^-\)\(^6\),\(^9\)

Periacetabular osteotomy is part of a relatively new and emerging field in orthopaedic surgery known as hip preservation surgery. Hip preservation surgery aims to create a mechanically stable joint through the restoration of a more normal morphology of the hip in order to preserve the anatomic alignment and decrease the accelerated hip wear associated with a dysmorphic joint.\(^1\),\(^3\),\(^6\),\(^9\) Historically, assessments of outcomes in orthopaedic procedures have been derived from the surgeon’s perspective of results from radiographs and clinical assessments.\(^10\) However, in the past three decades, there has been a shift towards the patient’s perspective in the evaluation of outcomes after an orthopaedic procedure.\(^10\)\(^-\)\(^12\) Patient-reported outcome measures and “evidence-based-medicine” are now in widespread use within orthopaedics.\(^13\) Simultaneously, patient-centered care has gained rapid popularity in the wider sphere of healthcare delivery in recent times\(^14\), and patient satisfaction has been touted as a potential measure of the
quality of health care delivery.\textsuperscript{15,16} It is therefore important to identify the factors that influence patient satisfaction.

Patients’ expectations of treatment have been identified by many studies as a determining factor in patient satisfaction and patient-reported outcomes.\textsuperscript{17-35} Patient expectations influence how they perceive the efficacy of their treatment.\textsuperscript{32} Specifically in orthopaedic surgery, previous studies have shown that patients have several expectations of spine, hip, knee and shoulder surgery that cover symptom relief, improvement in physical function, and improvement in psychological well-being.\textsuperscript{19, 20, 25-28, 30, 31} Expectations vary according to type of surgery and have been shown to correlate with various demographic, psychological and clinical factors.\textsuperscript{31-33, 35} Substantial research has been done on patients’ expectations of total joint arthroplasty, which is usually indicated for end-stage osteoarthritis of the hip and knee.\textsuperscript{21-24, 29, 30, 32-44} The main findings from these studies indicate that patients usually have high expectations of outcomes after surgery; satisfaction with surgery is associated with fulfillment of expectations; and unmet expectations can lead to dissatisfaction with outcomes.\textsuperscript{43, 45} These findings from expectations research in the total hip and knee arthroplasty population prompt similar questions about the expectations of patients undergoing hip preservation surgery like the PAO.

To date, there is only one publication on the expectations of patients undergoing hip preservation surgery for femoracetabular impingement (FAI).\textsuperscript{45} This study showed that a patient-reported outcome that measured the success of the surgery depended on whether expectations were met or unmet. The apparent evidence on the role of patients’
preoperative expectations in determining patient satisfaction and patient-reported outcomes raises the question of whether patients have realistic expectations of treatment results. Prior to any elective surgery, it is therefore desirable that the treating surgeon communicates with the patient to ensure that realistic expectations of outcomes are set. Thus, comparing patients’ expectations with their surgeons’ expectations is one way in which we can assess whether patients’ expectations of a procedure are realistic.\textsuperscript{10,31}

The goals of PAO are different from total hip arthroplasty, and the indications and population that qualifies for the surgery also are different from those of total hip arthroplasty and hip impingement surgery. Since the topic of patients’ expectations has not yet been investigated for the PAO, there is reason to assess what outcomes PAO candidates expect from their surgery, and how they compare to their surgeons’ impressions. Examining how the PAO patient’s perspective differs from the surgeon’s will allow us to identify areas in which surgeon-patient communication concerning results of surgery has to be improved in order to manage patients’ expectations, and consequently, maximize patient satisfaction and outcomes.

\textit{Acetabular dysplasia}

Acetabular (hip) dysplasia is a condition in which there is inadequate development of the acetabulum. This developmental condition actually represents a varied and complex spectrum of hip disorders from neonatal hip instability, subluxation and frank dislocation, through adolescent and adult hip dysplasia.\textsuperscript{46} Historically, acetabular dysplasia was thought to be a congenital condition presenting in 5 in every
1000 live births.\textsuperscript{46-49} However, at least 40\% of acetabular dysplasia cases in young adults do not have a history of childhood dysplasia or the risk factors commonly associated with hip dysplasia.\textsuperscript{46} Acetabular dysplasia in the setting of young adulthood has gained rapid recognition and interest as one of the major sources of young adult hip pain, as well as a major predictor of early hip degeneration and osteoarthritis.\textsuperscript{8, 50, 51} For example, Murphy et al. noted that in a series of dysplastic hips followed over time, no patient had a well-functioning hip at age 65.\textsuperscript{51} Females are eight times more likely to be affected by acetabular dysplasia than males.\textsuperscript{52}

It was not until 2011 that the early clinical presentation of symptomatic acetabular dysplasia in skeletally mature individuals was fully characterized by Nunley et al.\textsuperscript{7} The patient population studied included 57 individuals with 65 symptomatic hips. Seventy-two percent were female and the mean age was 24 years. The initial presentation was insidious in 97\% of the hips with 77\% of the patients reporting moderate to severe pain on a daily basis. Eighty-eight percent reported activity-related hip pain, localizing to the groin (72\%) and/or the lateral aspect of the hip (66\%). They also discovered that the mean time from onset of symptoms to diagnosis of hip dysplasia was 5 years and the mean number of physicians seen before definitive diagnosis was 3.3, indicating that the diagnosis of acetabular dysplasia in the young adult is commonly delayed or potentially missed.

It is important to note that acetabular dysplasia is not always idiopathic and can be secondary to a variety of other disease conditions. Acetabular development may be affected by cerebral palsy, hereditary motor and sensory neuropathy, poliomyelitis,
hyperlaxity, Charcot-Marie-Tooth, and Down's and Ehlers-Danlos syndromes. Skeletal
dysplasias and Perthes' disease can also affect acetabular development, while the
triradiate cartilage can be injured by sepsis or trauma, which can also cause incomplete
acetabular growth.\textsuperscript{46}

The pathological mechanics of a dysplastic hip result from structural instability in
the hip joint, which generates joint reactive forces that progress hip osteoarthritis. The
insufficient coverage of the femoral head due to acetabular dysplasia leads to overloading
a portion of the acetabular rim and labrum during hip range of motion and weight
bearing. This causes damages such as acetabular rim fractures, labral tears, acetabular
chondromalacia, and synovial cysts.\textsuperscript{54}

Although symptomatic AD typically sets in in young adulthood, the hip joint may
still be in the pre-arthritic stages and a prosthetic total hip replacement is rarely indicated
at this point.\textsuperscript{8} Given the known correlation between acetabular dysplasia and hip
osteoarthritis, the most viable surgical options for this population are acetabular
osteotomies, which are cuts on the acetabulum to reorient the hip and correct the
pathomechanics of the hip joint in order to extend the life of the hip.\textsuperscript{54} Reinhold Ganz, an
orthopedic surgeon in Bern, Switzerland first described the periacetabular osteotomy
(PAO) in 1988.\textsuperscript{55}

\textit{Periacetabular Osteotomy (PAO)}

Periacetabular osteotomy is one of many remarkable innovations in the elective
surgical treatment of musculoskeletal conditions in recent years.\textsuperscript{55} It is the preferred and
most common surgical treatment for symptomatic adult AD\textsuperscript{1-6} and is indicated in skeletally mature patients with preserved articular cartilage.\textsuperscript{55, 56} It has advantages over other osteotomies because its cuts allow for multidirectional correction of the acetabulum, does not compromise pelvic and acetabular fragment stability, and preserves blood supply to the acetabular fragment.\textsuperscript{56} Even so the surgical techniques of PAO continue to be refined to reduce surgical morbidity, improve dysplasia correction and expand the utility of the procedure to correct other forms of acetabular deformities like acetabular retroversion.\textsuperscript{1}

Due to its purpose of correcting hip structural abnormalities in order to delay or prevent the progression of arthritis and the need for a hip replacement, PAO is considered a hip preservation surgery. Hip preservation is a developing field in orthopaedics that primarily evolved in response to the limitations of hip replacement technology for young adults with pain in hips that are not completely arthritic yet.\textsuperscript{57} The purpose of hip preservation surgery is two-fold.\textsuperscript{45} The long-term or ultimate goal is to delay or prevent the onset or development of mechanically induced osteoarthritis, so that the natural hip is preserved with time. Additionally, the short-term or immediate goal is to relieve symptoms and improve hip function. Advances in the understanding of structural hip deformities and refinement of the surgical technique have resulted in predictable clinical and structural outcomes for a previously debilitating condition.\textsuperscript{1}

A few studies have evaluated clinical outcomes following the PAO, and the number is still growing, as PAO is a relatively recent procedure. A retrospective long-term follow-up study was conducted on the first 63 patients (75 hips) to be treated with
PAO in Bern. The minimum follow-up time was 19 years and 41 hips (60%) were preserved at the last follow-up. PAO failure was defined as conversion to a total hip replacement or hip fusion at the time of follow-up. Another retrospective study on the intermediate to long-term results of the PAO by Matheney et al. defined PAO failure as having a Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain score greater or equal to 10 and/or requiring a conversion to total hip replacement. At an average of nine years follow-up, 76% of the 135 hips reviewed were preserved. Both long-term PAO outcome studies identified factors associated with PAO outcomes including age at surgery and clinical and radiographic parameters of hip joint congruency. Patients above 35 years of age and hips with damage to their articular cartilage were at higher risk of poor long-term PAO outcomes. More long-term cohort studies are needed to properly appraise the value of the PAO as a hip preservation measure. However, there are more studies on short-term outcomes of the PAO. A systematic literature review of 13 studies, containing 626 hips, on clinical outcomes following PAO confirmed reliable deformity correction and significant improvements in hip function. Combining all reviewed studies, the minimum follow-up period was 2 years and average follow-up was 5 years. 79% of patients experienced good or excellent clinical results with a low rate of conversion to total hip replacement (7.3%). Overall, PAO has been shown to reliably correct acetabular deformity, significantly relieve hip pain, and improve hip function and physical activity.

Studies on PAO outcomes have also led to better refinement of the patient selection criteria for the PAO. The ideal PAO candidate is physiologically young and
healthy, has a BMI less than 30 kg/m², has ample preoperative hip range of motion as native hip motion may be reduced, and has a viable hip joint with regard to the health of the articular cartilage.60

**Patient perspective in orthopaedic outcomes research**

Historically, the success of an orthopaedic procedure focused on pain, range of motion or radiological criteria, all verifiable by the surgeon during clinical examination. However, there is a growing realization that patients, and not surgeons, define the success of an orthopaedic procedure.10 In the same vein, while prior literature has defined the success of the PAO treatment as pain relief and delayed osteoarthritis, 58, 59 success of the procedure from the patient perspective may depend on their satisfaction with the outcomes. Ultimately, patient satisfaction with the PAO may be crucial in appraising the value of the treatment.

Over the last three decades, greater emphasis has been placed on the perceptions of patients in the evaluation of outcomes of orthopaedic procedures.10-12 Furthermore, outcomes research in orthopaedics is evolving along with the larger landscape of health care outcomes research. With the recent popularity of patient-centered care and research, there is also increasing awareness of the importance of incorporating the patient’s perspective in measuring and improving the quality of healthcare.14-16 Likewise, orthopaedic outcomes research is trending towards utilizing patient-reported outcomes and patient satisfaction in assessing the success, and even justifying the clinical benefits of existing and new interventions as the field advances.13
Interestingly, several studies have linked patient expectations of treatment to postoperative satisfaction and patient-rated outcomes. Consequently, there is significant interest among researchers in better understanding patients’ expectations and their role in satisfaction. Understanding how patients expectations influence post-treatment satisfaction will help surgical care providers optimize patient selection and preoperative education for satisfaction and good outcomes after surgery.

Patient expectations of a treatment are challenging to define, measure and analyze. They may vary based on numerous factors like patient population, disease morbidity or even the time point in the course of care. The relationship between expectations and satisfaction is an equally complex concept to describe. The most dominant theoretical model for the expectation-satisfaction concept is the idea that the actual result of treatment matching prior expectations of the result is necessary for satisfaction with treatment. Another idea is the influence of dispositional optimism, so that higher pre-treatment expectations set patients up for better outcomes. A third school of thought suggests that the actual post-treatment result determines satisfaction regardless of prior expectations.

The subject of patient expectations has been looked into quite extensively in orthopaedic surgery. Studies have revealed diverse patient expectations, depending on the type of surgery: hip, knee, back, or shoulder. The expectations encompass postoperative recovery, symptom relief, improvement in physical function and improvement in psychological well-being. These studies have found that patients often have unrealistically high expectations of surgical outcomes and that patients with realistic
expectations are more likely to be satisfied with the results of treatment.\textsuperscript{31, 43, 45}

With respect to hip surgery, specific studies on patient expectations have been reported for total hip replacement, \textsuperscript{34-43, 63} and one study has been published related to hip preservation surgery for hip impingement.\textsuperscript{45} In total hip replacement, there is evidence that patients’ expectations demonstrate a strong influence on postoperative outcome.\textsuperscript{32, 34, 63} Mancuso et al conducted a longitudinal study of 405 total hip replacement patients who had completed preoperative expectations surveys.\textsuperscript{63} They were interviewed approximately 4 years after surgery and asked whether each of the preoperative expectations they had cited was fulfilled. The results from this study showed that patients who had a greater proportion of their expectations fulfilled had better preoperative and postoperative lower limb functional scores. Furthermore, patients’ expectations have been shown to depend on demographic factors such as age, race and employment status.\textsuperscript{32, 33, 67} Preoperative hip function was also found to significantly impact patients’ expectations, with patients with poor preoperative hip states having higher expectations of total hip replacement.\textsuperscript{35}

Mannion et al. published the first, and only, expectations study related to hip preservation.\textsuperscript{45} Their study explored expectations of 86 patients undergoing hip preservation surgery for hip impingement. Among this patient population, the most frequent “top reason” for surgery was “alleviation of pain”, indicated by 33% of the patients. For 20% of the patients, “fear of worsening” was the top reason for surgery. Patients were asked about their realistic expectations of changes occurring after the surgery in relation to seven items encompassing hip symptoms, function and quality of
life. Preoperative expectations were found to be overly optimistic in more than 50% of patients for hip pain, sports, and general physical capacity. Moreover, whether preoperative expectations of pain and sports had been met after surgery had significant associations with patient-reported outcome. The findings from this study were the primary motivation for this thesis research on patient expectations of periacetabular osteotomy.

Expectations of patients undergoing PAO for acetabular dysplasia have not yet been investigated, but need to be for a number of reasons. First of all, PAO is the most common surgical treatment for one of the major causes of adolescent and hip pain.\textsuperscript{1-6} Secondly, the patient population for PAO differs on certain demographic factors from the patient population for total hip replacement and hip preservation surgery for hip impingement. Unlike in hip replacement, candidates for the PAO are typically younger, with ages ranging from 11 to 45 years, and physically active.\textsuperscript{7} Further, unlike hip replacement and hip impingement candidates, the majority of PAO candidates are female.\textsuperscript{7} Incidence of acetabular dysplasia also varies according to ethnicity.\textsuperscript{6,8} As there is evidence suggesting that expectations can depend on demographic factors, patient expectations should be explored in this unique population. Probably most important is the fact that PAO is a major elective procedure, and it ultimately has to prove worthy for the major stakeholders: the patient and the payer. If there is evidence that patients with unrealistically high expectations of surgery are set up to be dissatisfied with outcomes, then it is necessary to assess whether or not PAO patients have realistic expectations of the results of their surgery.
*Patient-surgeon agreement in expectations*

Although there is not a standard benchmark by which realistic expectations can be measured, previous studies have assessed the concordance between patient expectations and surgeon expectations of results of surgery.\(^{10}\) This approach to exploring patient expectations is worthwhile because the preoperative conversation between patient and surgeon is the main medium by which a patient’s expectations should be formulated and managed.

In the context of the PAO, the surgeon spends extensive time with the patient during preoperative consultation, discussing the hip condition and providing information on treatment. Ideally, the patient should receive personalized information on what to appropriately expect of the outcome of surgery, both short-term and long-term. Realistic expectations can be established if the patient develops adequate understanding of his or her hip pathology and its likely postoperative course with respect to the degree of symptom relief, improvement in physical activity, and progression of osteoarthritis.\(^{31}\) Thus the purpose of preoperative consultation should be that patients and surgeons have consistent expectations to jointly work towards the same goals. Alignment of preoperative expectations of the patient and surgeon makes it more likely the patient will be satisfied with surgery results.\(^{43}\)

Studies related to total joint replacement have reported different directions in which level of agreement between patients and their surgeons can go regarding expectations of surgery.\(^{43, 44, 67-73}\) In a cross-sectional study of 100 surgeons and 370
patients, Moran et al. found that surgeons predicted better postoperative functional scores than patients. Ghomrawi and colleagues have reported that patients are more optimistic than surgeons regarding recovery from surgery. Jourdan and colleagues compared the expectations of 132 patients and 16 surgeons in a multicenter study. They found that both patients and surgeons were highly optimistic of the results of Total Hip Replacement surgery.

Studies have also identified some factors that could be predictors of agreement between patient and surgeon expectations. Jourdan et al. found that more disabled patients as determined by patient-reported measures and patients from a low-income professional category were often more optimistic than their surgeons. McGee et al. discovered from their study that patients who were 45 years or younger had better agreement with their surgeon in their expectations of total hip replacement outcomes. In addition, both McGee and Brokelman found that the discrepancy between patients and surgeons was greater in patients who had less successful outcomes.

Examining the differences between PAO patients’ and surgeons’ preoperative expectations will not only allow for assessing how realistic patients’ expectations are, but also highlight areas where there is need for improvement in communication or information sharing. For instance, after a series of studies revealing multiple expectations of recovery after total hip and knee replacement, Mancuso et al. proved through a randomized controlled trial that patients’ expectations can be modified by providing pre-operative educational classes addressing recovery during the first year after surgery.
Study objectives

This thesis research constitutes preliminary research in the area of patients’ expectations and satisfaction with periacetabular osteotomy. The purpose of this pilot study was to compare patients’ and surgeons’ preoperative expectations of PAO outcomes in six domains representing different hip symptoms and functions.

The primary study question this research intended to answer was, “What is the level of agreement between patients and their surgeons on preoperative expectations of the outcomes of the PAO surgery in six domains representing different hip symptoms and functions?” The first aspect of the primary objective was to assess the frequency and strength of patient and surgeon agreement on post-operative outcomes. The second aspect was to assess the direction in which expectations differ between patients and surgeons, that is, who is more optimistic. Then, the third part was to identify the domains in which patient-surgeon expectations differ or agree. For this study population, we hypothesized that there would be disagreement between patients and surgeons in their expectations, with patients having higher expectations than surgeons of PAO results on their hip symptoms and function. This hypothesis was based on research on the expectations of patients having hip preservation surgery for FAI, which showed that these patients were very optimistic of outcomes.45

Secondary objectives of this study covered exploring possible factors or predictors of expectations. One was to determine which demographic and clinical parameters predicted patient-surgeon discrepancies in expectations. Another was to assess whether the demographic and clinical parameters were associated with patients’
expectations and surgeons’ expectations separately. This study also aimed to explore patients’ motivation to undergo PAO, as well as how important it was to patients that the PAO resulted in improvement in specific hip symptoms and physical abilities.
METHODS

Study design and setting

This was a cross-sectional survey of PAO candidates and their treating surgeons at a single site. The surveys were conducted during preoperative visits between October 2012 and April 2014. The site at which the study was conducted is internationally recognized for hip preservation surgery including the PAO. An institutional review board approved this research before any study activities were conducted.

Study subjects

Participants enrolled in this study were patients who were about to undergo the PAO and their treating surgeons. Patients were males and females who were skeletally mature, had experienced hip symptoms for at least 3 months, had radiographic evidence of acetabular dysplasia, and minimal or no radiographic evidence of osteoarthritis.

Exclusion criteria included advanced osteoarthritis, a primary or concurrent diagnosis of a hip disorder other than acetabular dysplasia, underlying inflammatory disease, and connective tissue disorders. Acetabular dysplasia secondary to Down syndrome, Perthes disease, and neuromuscular conditions such as Charcot-Marie-Tooth and Cerebral Palsy excluded patients. Any sort of cognitive impairment and illiteracy in English also excluded patients from the study.

All study subjects had completed one or more consultations with their surgeon before deciding to have the PAO. Two surgeons were surveyed in this study, and they had more than 24 years and 14 years respectively of performing PAO.
**Preoperative consultations**

During preoperative consultations, surgeons utilized radiographic imaging and a model of the hip to discuss with patients the nature of their structural hip disorder and how the PAO procedure corrects the disorder. Patients were informed of the potential short-term and long-term goals of the PAO. They were also educated on the recovery time course, the rehabilitation program and the potential intra-operative and postoperative complications.

**Informed consent and study exposure**

At the last consultation before surgery, eligible subjects were approached by a study coordinator for invitation to participate in a prospective longitudinal study of outcomes and effectiveness of PAO. After consenting to participate, study subjects received instruction on completing questionnaires as part of the study. They were given two questionnaires to fill out: an expectations questionnaire and a demographic and hip function questionnaire.

The treating surgeons were also given a section of the expectations questionnaire to complete independently. Both patients and surgeons were blinded to each other’s responses.
**Questionnaires**

**Expectations questionnaire**

We developed the expectations questionnaire for the purposes of this study (Appendix). It comprised a series of questions inquiring about patient baseline hip symptom and function state, the importance of having specific symptoms and functions improve after surgery, the reasons for undergoing the PAO and their realistic expectations of improvement after recovery from surgery. The questions covered six domains representing specific hip symptoms and functions usually affected by acetabular dysplasia. The domains were: 1) ability to play sports; 2) walking ability; 3) hip stiffness; 4) locking and catching of the hip; 5) hip stability; 6) hip pain.

The first portion of the survey asked subjects whether they experienced difficulty in relation to each of the six hip domains using a “yes-no” response construct. Then, they were asked to rate how important it was that the PAO improved each of the six hip domain states on a 4-point Likert scale (1=very important; 2=moderately important; 3=slightly important; 4=not important at all). To assess reasons for deciding to undergo the PAO, subjects were given the following options to rate importance: other therapies hadn’t helped, fear of a worsening of my current situation, to retain my independence, improvement in performance of everyday activities, improvement in ability to do sports, improvement in walking capacity, pain reduction, and recommended by my doctor.

Finally, subjects were asked for each of the six hip domains, “What is your realistic expectation of improvement in the following after surgery?” The response format for this question was also a 4-point Likert scale: 1=not improved at all; 2=slightly
improved; 3=moderately improved; 4=greatly improved. The surgeons also completed this specific portion independently for each of their patients in the study.

Demographic and hip functional questionnaire

This is a validated, self-administered questionnaire routinely required of most hip surgical candidates at the investigative site during their preoperative visit (Appendix). It contains a battery of questions and baseline assessments from which we selected potential factors that could be associated with patients’ and surgeons’ expectations of the PAO. Age at time of surgery, gender, hip surgical history and education level attained at the time of surgery were among the demographic factors evaluated in the analysis. Hip surgical history was dichotomized: whether the subject had hip surgery previously or not. Educational level was an ordinal measure of the number of years of formal education the subject had completed at the time of surgery.

Standardized health status assessments from this questionnaire used in this study were:

- The 12-item Short Form health survey (SF-12)- The SF-12 measures the general health status from the patient's point of view. Results are expressed in terms of two meta-scores: the Physical Component Summary (PCS) and the Mental Component Summary (MCS), with a range of 0 to 100. A higher score indicates better physical functioning. The PCS and MCS were designed to have a mean score of 50 and a standard deviation of 10 in a representative sample of the US population.\(^7^4\)
- Western Ontario and McMaster Universities Arthritis Index (WOMAC) sub-items for
pain and stiffness - The WOMAC is a 24-item self-administered, disease specific instrument for assessing pain, stiffness and physical function in osteoarthritis patients. Five items address pain on a score range of 0 to 20, and two items address stiffness on a score range of 0 to 8. Higher scores indicate a worse health state.\textsuperscript{75}

- University of California Los Angeles (UCLA) activity score - The UCLA is a 10-item instrument that measures the activity level of a patient. It has a simple scoring range from 1 (defined as “no physical activity, dependent on others”) to 10 (defined as “regular participation in impact sports”). \textsuperscript{76}

\textit{Statistical Analyses}

Concordance between patient and surgeon expectations was evaluated by percentage of exact and partial agreement. Agreement between the patient-surgeon pair was calculated for each of the six domains. To calculate agreement, the patient’s expectation rating was subtracted from his or her surgeon’s rating. For example, if a patient specified “2=slightly improved” for their expectation of improvement in ability to play sports, and the treating surgeon expected no improvement at all (“1”) in ability to play sports, then the agreement or discrepancy value is “-1”. Thus, agreement values ranged from -3 to +3, with negative values indicating higher patient expectations, positive values showing lower patient expectations and “0” specifying exact agreement. Partial agreement was defined as agreement within one ranking, that is, discrepancy values of -1, 0 and +1 counted as agreement.
To measure the precision or strength of agreement, kappa values with 95% confidence intervals were estimated for all responses in each domain. Quadratic weighted kappa values were estimated for exact agreement and simple kappa values were estimated for partial agreement. Kappa values were interpreted: <0.40 = poor; 0.4-0.75 = fair to good; >0.75 = excellent. The strength of association or the correlation between patients’ ratings and surgeons’ ratings was assessed using Spearman’s rank correlation analysis. Bowker’s and McNemar’s test of symmetry was used to examine whether one group tended to have higher or lower expectation ratings for each domain.

To evaluate possible associations between the level of agreement and certain demographic and clinical factors, Spearman’s rank correlation analyses and Wilcoxon sign rank test were used respectively for ordinal or continuous variables and binary variables. The same analyses were used to assess associations between the demographic and clinical parameters and the expectations of patients and surgeons separately. Statistical significance was set at p≤0.05 level.

Patient demographics, patient-rated measures of health and function, the baseline hip symptom and function states, the importance of having specific symptoms and functions improve after surgery, and their reasons for undergoing the PAO were all summarized descriptively. All statistical analyses were performed using the R project for statistical computing.
RESULTS

Between October 2012 and April 2014, there were 151 PAO cases that were eligible for this study. There were 122 (80.8%) completed expectations questionnaire out of the 151 cases. 4 subjects had two surgeries bilaterally within the recruiting timeframe, and so completed the expectations questionnaire twice, hence there were 118 individual subjects in this study. One surgeon (surgeon A) returned 59 questionnaires and the other (surgeon B) returned 13 questionnaires about their expectations of PAO outcomes. Thus at the end of recruiting, there were comparable questionnaires from both patients and surgeons for 72 PAOs.

**Study population characteristics**

Demographic and clinical characteristics were summarized (see Table 1) for the entire patient cohort (122 hips, 118 patients), as well as the sub-cohort that had their surgeons’ expectations (72 hips, 68 patients). Eighty-one percent (95/118) of the entire cohort was female, while 83.8% (57/68) of the sub-cohort was female. 32.8% (40/122) of the entire cohort had prior experience with hip surgery, but for the sub-cohort it was 34.8%. In addition to means, the median and interquartile range (25th percentile – 75th percentile) were also reported due to the skewed distribution of some of the clinical factors. The characteristic measures for the sub-cohort were similar to those of the entire cohort, suggesting that the sub-cohort is representative of the entire cohort.
Following is a summary of the entire cohort’s demographic and clinical characteristics. Age at the time of surgery ranged from 12 to 46 years, with an average age at 26.36 ± 9.33. The median WOMAC stiffness score was 4 (IQR: 2-5). The median WOMAC pain score was 7 (IQR: 4-10). The median UCLA activity score was 6 (IQR: 4-10). SF-12 PCS scores were more uniformly distributed than the SF-12MCS scores. The mean SF-12 PCS score was 38.04 ± 10.80. The median SF-12 MCS was 55.90 (IQR: 45.20-59.80).

<table>
<thead>
<tr>
<th>Demographic and Clinical Factors</th>
<th>Entire Cohort (n=122)</th>
<th>Sub-Cohort (n=72)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years; mean ± SD; median (IQR))</td>
<td>26.36 ± 9.33; 25 (18-35)</td>
<td>26.04 ± 9.37; 24 (17-35)</td>
</tr>
<tr>
<td>Sex (% female)</td>
<td>80.5</td>
<td>83.8</td>
</tr>
<tr>
<td>Education (years; mean ± SD; median (IQR))</td>
<td>14.41 ± 3.49; 15 (12-16.8)</td>
<td>14.23 ± 3.66; 15 (12-16)</td>
</tr>
<tr>
<td>Prior hip surgery (% positive)</td>
<td>32.8</td>
<td>34.8</td>
</tr>
<tr>
<td>SF-12 PCS ( mean ± SD; median (IQR))</td>
<td>38.04 ± 10.80; 37.1 (30.7-46.2)</td>
<td>38.02 ± 9.75; 37.1 (31.2-45.7)</td>
</tr>
<tr>
<td>SF-12 MCS ( mean ± SD; median (IQR))</td>
<td>52.14 ± 11.48; 55.9 (45.2-59.8)</td>
<td>52.68 ± 10.65; 56.2 (45.5-59.7)</td>
</tr>
<tr>
<td>WOMAC stiffness ( mean ± SD; median (IQR))</td>
<td>3.36 ± 2.13; 4 (2-5)</td>
<td>3.29 ± 1.99; 4 (2-4)</td>
</tr>
<tr>
<td>WOMAC pain ( mean ± SD; median (IQR))</td>
<td>7.42 ± 4.88; 7 (4-10)</td>
<td>6.94 ± 4.82; 6 (4-9.8)</td>
</tr>
<tr>
<td>UCLA activity ( mean ± SD; median (IQR))</td>
<td>6.55 ± 2.72; 6 (4-10)</td>
<td>6.87 ± 2.65; 6.5 (4.8-10)</td>
</tr>
</tbody>
</table>

**Patient-surgeon agreement in expectations of PAO outcomes**

Seventy-two paired expectations were available for patient-surgeon agreement analysis. In Table 2, the percentages of exact agreement and partial agreement between patients and surgeons expectations are reported for all six domains. The highest proportion of agreement was for hip pain, where there was 54.2% exact agreement and 100% partial agreement. The lowest agreement was in expectations of improvement in hip stiffness after the PAO, with 17.4% exact agreement and 46.4% partial agreement. Furthermore, kappa values showed agreement was strongest for expectations of hip pain (weighted kappa=0.45, simple kappa=1; Table 2). However, weighted kappa estimates
were low, ranging from 0.07 to 0.45. Also, simple kappa values ranged from 0.14 to 1. Patient–surgeon agreement was weakest for expectation of hip stability, walking ability and hip stiffness (Table 2). Figure 1 shows that there were more instances where patients expected more than their surgeons regarding outcomes after surgery.

Correlation analyses revealed that age, gender, prior surgery status, SF-12 scores, WOMAN stiffness and pain did not have statistically significant associations with the level of patient-surgeon agreement for all six domains. There was a negative association between the level of agreement for walking ability and the UCLA activity score that was statistically significant (r = -0.26, p=0.03; Table 4C). Another finding was that the discrepancy in expectation of improved hip stability had a positive association with the level of patients’ education (r = 0.30, p=0.02; Table 4C). This means that the lower the educational level, the higher the patient’s expectations for hip stability in relation to the surgeon’s expectations.

Tests of symmetry, as shown in Table 2, revealed that patients had more optimistic expectations than surgeons for improvement of symptoms and function (p<0.05 for all domains from Bowker’s test), particularly regarding stiffness, locking and catching and walking ability (p<0.001 for these domains from McNemar’s test). However, Spearman’s rank correlation analysis showed that association between ratings of patients and surgeons for hip locking or catching was statistically significant, with correlation strength of 0.4 (p=0.001; Table 3). This means that patients and surgeons were similar in their rating trend for locking and catching. Such rating similarity was not found for the other hip domains.
Table 2: Agreement between patient and surgeon ratings of preoperative expectations of outcomes in different domains

<table>
<thead>
<tr>
<th>Domain</th>
<th>% Exact Agreement</th>
<th>Weighted Kappa</th>
<th>95% CI</th>
<th>Kappa Description</th>
<th>Bowker's Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Pain</td>
<td>54.20%</td>
<td>0.45</td>
<td>(0.07-0.82)</td>
<td>Fair</td>
<td>0.0353</td>
</tr>
<tr>
<td>Hip Stability</td>
<td>30.80%</td>
<td>0.21</td>
<td>(0.003-0.43)</td>
<td>Poor</td>
<td>0.014</td>
</tr>
<tr>
<td>Athletic Ability</td>
<td>30.00%</td>
<td>0.12</td>
<td>(0.07-0.34)</td>
<td>None</td>
<td>0.0353</td>
</tr>
<tr>
<td>Hip Locking/Catching</td>
<td>26.50%</td>
<td>0.26</td>
<td>(0.12-0.39)</td>
<td>Poor</td>
<td>&lt; 2.2e-16</td>
</tr>
<tr>
<td>Walking Ability</td>
<td>24.60%</td>
<td>0.1</td>
<td>(0.04-0.24)</td>
<td>None</td>
<td>&lt; 2.2e-16</td>
</tr>
<tr>
<td>Hip Stiffness</td>
<td>17.40%</td>
<td>0.07</td>
<td>(0.03-0.18)</td>
<td>None</td>
<td>&lt; 2.2e-16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Domain</th>
<th>% Partial Agreement</th>
<th>Simple Kappa</th>
<th>95% CI</th>
<th>Kappa Description</th>
<th>McNemar's Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Pain</td>
<td>100.00%</td>
<td>1</td>
<td>--</td>
<td>Excellent</td>
<td>0.16</td>
</tr>
<tr>
<td>Athletic Ability</td>
<td>75.70%</td>
<td>0.52</td>
<td>(0.33-0.70)</td>
<td>Fair</td>
<td>0.01</td>
</tr>
<tr>
<td>Hip Stability</td>
<td>73.53%</td>
<td>0.47</td>
<td>(0.27-0.67)</td>
<td>Fair</td>
<td>0.07</td>
</tr>
<tr>
<td>Hip Locking/Catching</td>
<td>60.30%</td>
<td>0.31</td>
<td>(0.17-0.46)</td>
<td>Poor</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Walking Ability</td>
<td>59.40%</td>
<td>0.29</td>
<td>(0.13-0.44)</td>
<td>Poor</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hip Stiffness</td>
<td>46.40%</td>
<td>0.14</td>
<td>(0.02-0.25)</td>
<td>Poor</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Figure 1: Proportions of instances of agreement and disagreement in expectations of patients and surgeons.
Factors associated with patients’ expectations of PAO outcomes

Table 4A shows the results from the correlation analyses between expectations of PAO outcomes in the six domains and specific demographic and clinical factors for the entire cohort in this study. The analyses revealed two statistically significant associations. Patients with higher UCLA scores tended to have higher expectations of reducing hip stiffness (rho = 0.188; p = 0.048). Also, patients with lower SF-12 MCS scores were inclined to have higher expectations of the PAO improving locking/catching of their affected hips (rho = -0.30; p = 0.002).

Factors associated with surgeons’ expectations of PAO outcomes

The age of the patient, educational level, WOMAC stiffness and pain sub-scores, and SF-12 scores had statistically significant correlations with the surgeons’ expectations in certain domains (see Table 4B). Surgeons tended to expect more improvement in hip stability for older patients (r = 0.31, p = 0.01), and consequently, patients with more education (r = 0.31, p = 0.01). Conversely, surgeons were less optimistic about stability improving for patients with higher SF-12 PCS scores. Additionally, it seemed that
surgeons did not have much expectation for improvement in walking ability in patients with higher UCLA activity scores ($r = -0.25$, $p=0.04$), as well as patients with higher SF-12 MCS scores ($r= -0.34$, $p=0.005$). However, they anticipated more improvement in walking for patients with higher stiffness ($r=0.29$, $p=0.01$) and pain ($r=0.37$, $p=0.002$) scores. Higher pain scores were also found to be associated with higher expectations of improvement in stiffness ($r=0.32$, $p=0.007$) and locking/catching ($r=0.26$, $p=0.03$).

### Table 4: Possible determinants of patients' and surgeons' expectations

<table>
<thead>
<tr>
<th>Demographic and Clinical Factors</th>
<th>Patients' Expectations</th>
<th>Surgeons' Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age p-value</td>
<td>Sex p-value</td>
</tr>
<tr>
<td>Athletic Ability</td>
<td>-0.08 0.382 1079.50 0.792 -0.14 0.15</td>
<td>1494.00 0.777 -0.09 0.522 0.03 0.732 0.09 0.537</td>
</tr>
<tr>
<td>Hip Stiffness</td>
<td>0.04 0.675 1217.00 0.353 -0.04 0.67</td>
<td>1494.00 0.930 0.02 0.867 -0.12 0.231 0.10 0.298</td>
</tr>
<tr>
<td>Hip Locking/Catching</td>
<td>0.11 0.251 1128.50 0.213 -0.01 0.90</td>
<td>1225.50 0.113 -0.30 0.002 -0.10 0.299 0.12 0.213</td>
</tr>
<tr>
<td>Hip Stability</td>
<td>0.05 0.576 1149.00 0.343 -0.02 0.86</td>
<td>1378.50 0.472 -0.10 0.312 -0.10 0.316 0.11 0.247</td>
</tr>
<tr>
<td>Hip Pain</td>
<td>0.02 0.838 1208.00 0.235 0.07 0.48</td>
<td>1487.00 0.299 -0.01 0.916 -0.18 0.062 0.13 0.146</td>
</tr>
</tbody>
</table>

### B: N=72

<table>
<thead>
<tr>
<th>Demographic and Clinical Factors</th>
<th>Age p-value</th>
<th>Sex p-value</th>
<th>Education p-value</th>
<th>Prior Surgery p-value</th>
<th>SF-12 MCS p-value</th>
<th>SF-12 PCS p-value</th>
<th>Stiffness p-value</th>
<th>Pain p-value</th>
<th>UCLA p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athletic Ability</td>
<td>-0.06 0.634 358.00 0.719 0.01 0.922</td>
<td>633.50 0.465 0.13 0.316 -0.08 0.544 0.02 0.900</td>
<td>-0.05 0.938 0.19 0.120</td>
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</tr>
<tr>
<td>Walking Ability</td>
<td>0.04 0.743 404.00 0.221 -0.04 0.754</td>
<td>513.50 0.534 -0.34 0.005 -0.23 0.063 0.29 0.015 0.37 0.002 -0.25 0.039</td>
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<td></td>
</tr>
<tr>
<td>Hip Stiffness</td>
<td>-0.02 0.885 398.50 0.286 -0.12 0.338</td>
<td>624.50 0.519 -0.21 0.096 -0.07 0.566 0.20 0.096 0.32 0.007 0.12 0.347</td>
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</tr>
<tr>
<td>Hip Locking/Catching</td>
<td>0.18 0.136 430.50 0.316 0.04 0.761</td>
<td>517.00 0.463 -0.26 0.033 -0.09 0.470 0.22 0.070 0.26 0.028 0.01 0.931</td>
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<tr>
<td>Hip Stability</td>
<td>0.31 0.012 369.50 0.225 0.31 0.013</td>
<td>458.50 0.235 -0.15 0.226 -0.28 0.077 0.08 0.537 0.19 0.128 -0.02 0.882</td>
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<tr>
<td>Hip Pain</td>
<td>0.20 0.096 305.00 0.588 0.20 0.104</td>
<td>305.00 0.588 0.02 0.856 -0.12 0.333 0.04 0.730 0.19 0.107 0.06 0.644</td>
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</tbody>
</table>

### C: N=72

<table>
<thead>
<tr>
<th>Discrepancy in Expectations</th>
<th>Age p-value</th>
<th>Sex p-value</th>
<th>Education p-value</th>
<th>Prior Surgery p-value</th>
<th>SF-12 MCS p-value</th>
<th>SF-12 PCS p-value</th>
<th>Stiffness p-value</th>
<th>Pain p-value</th>
<th>UCLA p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athletic Ability</td>
<td>0.04 0.743 370.50 0.447 0.09 0.490</td>
<td>522.50 0.937 0.17 0.186 -0.04 0.729 -0.01 0.298 -0.11 0.365 -0.02 0.899</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking Ability</td>
<td>0.08 0.528 348.00 0.628 0.05 0.705</td>
<td>405.00 0.132 -0.21 0.094 0.00 0.978 0.13 0.283 0.09 0.451 -0.26 0.039</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Stiffness</td>
<td>-0.10 0.408 295.00 0.691 -0.16 0.220</td>
<td>613.50 0.201 -0.05 0.704 0.09 0.498 0.05 0.917 0.18 0.154 0.03 0.829</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Locking/Catching</td>
<td>0.09 0.470 263.50 0.642 0.12 0.367</td>
<td>582.00 0.450 0.01 0.914 -0.06 0.648 0.09 0.470 0.10 0.433 -0.06 0.636</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Stability</td>
<td>0.23 0.063 267.00 0.751 0.30 0.019</td>
<td>482.00 0.767 0.03 0.831 -0.15 0.238 -0.03 0.837 0.09 0.464 -0.12 0.357</td>
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</tr>
<tr>
<td>Hip Pain</td>
<td>0.23 0.060 301.50 0.559 0.17 0.168</td>
<td>660.50 0.209 0.04 0.752 0.02 0.889 -0.03 0.838 0.03 0.817 -0.10 0.428</td>
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</tr>
</tbody>
</table>

### The importance of PAO to patients in improving hip symptoms and abilities

Table 5 summarizes the importance of the PAO in improving their hip condition as reported in the 122 expectation questionnaires. Eighty-seven percent (106/122) of cases specified that playing sports was difficult. For 51.6%, it was very important that the
PAO improve their ability to play sports. Seventy-eight (95/122) of cases indicated that they experienced difficulty when walking, and it was very important for 88.5%, that the PAO improve their walking. Sixty-six percent (80/122) of cases experienced locking or catching of the hip, and 55.7% reported that it would be very important that the PAO reduced this symptom. Sixty-five percent (79/122) admitted to feeling hip instability, and it was very important that the PAO improve hip stability for 72.1% of the cases.

Concerning stiffness and pain in the hip, 85.2% (104/122) and 96.7% (118/122) of cases experienced these symptoms respectively. It was highly important to 64.7% that the PAO reduce hip stiffness. However, 93.4% noted that it was very important that the PAO reduce hip pain.

Regarding other issues influencing their decision to undergo the PAO, it was highly important to have the surgery because: 1) of the fear that the condition would worsen for 87.7%; 2) of improvement in ability to perform daily activities for 86.1%; 3) maintaining independence was essential for 82.8%; 4) the doctor recommended the surgery for 82.6%; and 5) other treatments had not helped for 79%. 
Table 5: Reasons for deciding to undergo PAO

<table>
<thead>
<tr>
<th>Importance of the PAO to patients</th>
<th>Very important</th>
<th>Moderately important</th>
<th>Slightly important</th>
<th>Not important at all</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain-specific items</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce hip pain</td>
<td>114</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Improve walking ability</td>
<td>108</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Improve hip stability</td>
<td>88</td>
<td>7</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Reduce hip stiffness</td>
<td>79</td>
<td>25</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Reduce locking or catching of the hip</td>
<td>68</td>
<td>15</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Improve athletic ability</td>
<td>63</td>
<td>28</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td><strong>Other Reasons for PAO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear that current condition could worsen</td>
<td>107</td>
<td>10</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Improve ability to perform daily activities</td>
<td>105</td>
<td>12</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Essence of maintaining independence</td>
<td>101</td>
<td>10</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Surgeon recommended PAO</td>
<td>100</td>
<td>19</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Prior treatments have not worked</td>
<td>94</td>
<td>8</td>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>
DISCUSSION

To our knowledge, this study is the first to examine patient expectations of PAO outcomes. We sought to define and understand patients’ preoperative expectations of the PAO. We suspect that the fulfillment of expectations will be an important factor in patient-related outcomes of this major orthopaedic procedure. Findings from this research raise and highlight important issues that merit further consideration and investigation in order to maximize the PAO candidate’s satisfaction and outcome of treatment. For example, it is not clear the influences of different factors in the formulation of expectations in different patient sub-groups.

Failure to achieve expected outcomes has been strongly associated patient dissatisfaction in many studies. But how do we determine that a patient has unrealistic expectations of surgery? Interestingly, the discrepancy between patients and surgeons has been reported to be greater in patients who had unsatisfactory outcomes, suggesting that alignment of the expectations of patients and surgeons is important for the achievement of patient satisfaction.

For our study, we developed a survey to capture probabilistic expectations, that is, the perceived likelihood of certain events happening, for both patients and their treating surgeons. The results demonstrated that compared to surgeons, patients were more optimistic of improvement of symptoms and function after surgery. Patients’ high optimism in this study of expectations of PAO resembles what Mannion et al found in FAI patients in the only other study of patient expectations for hip preservation surgery.
For total joint replacement, studies have shown that patient-surgeon disparity was highest in expectations of improved ability to perform sports and other activities requiring high range of motion, especially for younger people. On the other hand, expectations were most aligned in relation to hip pain and walking ability. However, we found that while the proportions of exact agreement were low across all domains, frequencies of partial agreement were high for hip pain and ability to play sports. Surgeons agreed the least with patients in their expectations of walking ability.

Unlike the case of total joint replacement, there are not as many restrictions to high-level physical activity after the PAO. Since research has shown that the level of physical activity and sports performance improved after the PAO, surgeons may be inclined to be more hopeful concerning outcomes related to sporting activity after the PAO. All the same, it is important that surgeons pay attention to managing patients’ expectations of improved sporting ability after the PAO because most of the dissatisfaction of young adults with total joint replacement and hip preservation surgery for FAI stems from unfulfilled expectations of improved ability to play sports.

Another noteworthy finding from our study was the relative pessimism of surgeons in relation to patients concerning walking ability after the PAO. It could be that because PAO candidates are less debilitated than total hip replacement patients, surgeons do not anticipate vast improvement from a baseline walking ability that is not severe. This finding highlights the differences that exist in the perspectives of patients versus surgeons in their evaluation of dysfunction and consequent expectations of the PAO to improve the dysfunction. It also suggests that surgeons may be unrealistically pessimistic
about outcome, which we hope to confirm in our ongoing prospective study of the role of preoperative expectations of patients and surgeons on outcomes and satisfaction.

That our study showed that agreement was strongest in expectations of pain relief after PAO is critical, as studies have documented that pain is the first and most common symptom that prompts an affected young adult to seek treatment for hip dysplasia.\textsuperscript{,7,53} Many PAO outcome studies have also acknowledged the effectiveness of the PAO in alleviating hip pain.\textsuperscript{9} Even in our study population, reducing pain was the most frequently cited motivating factor in deciding to undergo PAO (Table 5). Pain reduction has been reported as one of the most important reasons for surgery among both hip preservation and hip replacement candidates.\textsuperscript{45} Since hip pain is one of the primary motivations for undergoing PAO, it is encouraging that patients and their surgeons are quite on the same page concerning the likelihood and extent of pain relief.

In general, our study of expectations of PAO outcomes found that agreement was poor, as kappa statistics were low, and there was no consistency between expectations of patients and surgeons, like it has been reported for expectations of total hip replacement as well.\textsuperscript{67}

Investigating whether some demographic and clinical factors affected how patients and surgeons ranked their expectations of PAO allowed us to highlight differences in perspectives of patients and surgeons. While the SF-12 mental score was the only factor that had a statistically significant association with patients’ expectations of locking or catching, surgeons seemed to rate their expectations for different domains based on more clinical factors (WOMAC-sub scores, UCLA and SF-12 scores). Age and
education of patients also appeared to influence surgeons’ forecasting of hip stability after surgery. Interestingly, another study on expectations of total hip replacement also found that surgeons tended to rate their expectations based on hip-related clinical data while patients rated on criteria that were mainly psychological and non-hip related. Although the SF-12 MCS was the only psychological factor assessed in this study, patients with low scores had higher expectations of locking or catching of the hip. This finding is not conclusive but it does raise an issue needing further exploration. It is likely important that psychological factors are not overlooked while preparing patients for major, life-altering orthopaedic procedures.

Activity level of patients, measured by the UCLA score, seemed to influence surgeon’s expectations of walking ability and possibly explained the association between the discrepancy in patient-surgeon agreement for walking ability and activity level. Thus, subjects who were less active tended to assume that their walking ability would not improve as much as the doctors might think; whereas subjects who were more active are more hopeful than surgeons in the improvements in their walking ability. It also seemed like patients with higher activity levels had higher expectations for reduced hip stiffness, albeit with a weak correlation. These findings support what others have reported about active young adults having high expectations for surgery.

Overall, the discordant expectations of patients versus surgeons revealed in our study emphasize the need for improvement in patient-physician communication regarding the outcomes after PAO surgery. Especially for symptoms like hip stiffness, locking or catching, and hip stability, it is important that patient are clear on what the PAO can
achieve for these symptoms. The conversation surgeons have with patients should establish what the patient’s specific problems are, and address the likelihood that the surgery will tackle all the patient’s symptoms and limitations. If unfulfilled expectations result in poor postoperative outcomes and dissatisfaction, then exploring patients’ expectations is key to identifying issues that are relevant to the patient based on their lifestyle and needs. As has been pointed out by other researchers, surgeons may not be fully aware of certain patient perspectives unless specifically addressed. Mancuso et al suggested utilizing a validated expectations survey as a template for surgeons and patients to discuss expectations of Total Hip Replacement surgery. A similar strategy should be considered for the PAO and hip preservation surgery in general. The hip preservation community will benefit from developing an expectations survey with input from patient interviews and expert reviews, like was done by Mancuso et al, for total joint replacement.

**Limitations**

This study has several limitations. The data comes from a small cohort of patients and two surgeons at one tertiary care orthopaedic center. Although our study reveals some information on patient and surgeon expectations, our study population does not represent the entire PAO population, as well as surgeons who perform the PAO. It is possible that different surgeons may have different expectations for the same patient. Sub-analyses on our data revealed that there were differences in how both surgeons rated their expectations for each hip domain. One surgeon expected more than the other.
surgeon for certain domains, but only contributed to 25% of the surgeon’s expectations. However, there was still no obvious effect of this difference on the outcomes of the study because regardless of this, patients still over-projected in their expectations. Also, preoperative clinical characteristics of patients were similar for both surgeons, suggesting that there isn’t an apparent difference between the patients of each surgeon. Another issue is the small sample size for the analysis of agreement, which may have precluded some of the results from being statistically significant. A future study should have a larger number of patients with multiple patients across different centers to achieve definitive results.

The second major limitation of this study was the use of a non-validated questionnaire to measure expectations. We therefore cannot attest to the reliability, sensitivity and validity of the measuring instrument we used. However, as this was a pilot study, we modified a questionnaire that was used for patients undergoing hip preservation surgery for hip impingement, which was a modification itself of a validated questionnaire for spine patients. Most of the expectations survey instruments that have been developed and validated are specific to a particular surgical procedure or anatomic location. There isn’t one for the PAO or hip preservation yet, and thus future efforts should look into developing and validating such an expectations questionnaire.

Finally, the cross-sectional design and the analyses used in the study do not allow us to assume any causal relationships between preoperative expectations and characteristics. Only a few variables were assessed in this study, and there are so many other factors that could account for expectations that could not be investigated in this
study. Our statistical analysis did not control for any factors. Therefore, we cannot posit that any of the factors studied are predictive of patients’ or surgeons’ expectations.

**Future studies**

The next step to take this work further is to conduct a larger, multicenter prospective study of PAO candidates and their operating surgeons to assess how preoperative expectations relate to postoperative assessment of outcomes and satisfaction. Another benefit of a prospective study will be to see whether patients’ optimism is realistic from their perspective. Conversely, are surgeons also realistic in their expectations? The validated preoperative and postoperative questionnaires for the future study will be more comprehensive, taking into account other types of expectations pertinent to PAO candidates. For instance, prior studies have cited that patients’ understanding and expectations of complications from surgery are inadequate, \(^{10,31,67}\) and these factor substantially in postoperative satisfaction. Preliminary postoperative data on satisfaction of subjects in our cohort also suggest that postoperative complications lead to dissatisfaction. Out of those who responded to a postoperative satisfaction survey, 16% who reported that they found the PAO unhelpful had suffered complications after the PAO. In addition, a recently published study that examined a cohort of 52 PAO patients reported high satisfaction after significant improvements in social and sex life, \(^{79}\) suggesting that expectations of social and sex life may factor into postoperative assessments of the PAO. Thus expectations of social and sexual ability should also be looked into.
Ultimately, a randomized clinical trial to manage patients’ expectations will allow us to determine whether more focused information sharing will modify patients’ expectations and lead to more realistic assessments of postoperative events and outcomes. This study will help advance work on health behavior and better understanding of how patients formulate their expectations. It will also improve the dialogue between candidates for hip preservation surgery and their operative surgeons so that their expectations are more aligned.

**Conclusion**

The purpose of this research was to assess the level of agreement between patients and surgeons in their expectations of outcomes after PAO. This cross-sectional survey examined patient and surgeon expectations in six domains representing common hip symptoms and functional ability. Agreement analysis in this study consisted of percent of exact and partial agreement with kappa statistics. Correlation analyses were done to identify characteristics that were associated with expectations and discrepancy in expectations. The results of our study confirmed our hypothesis that patients were more optimistic than surgeons regarding post-surgical improvement in several domains of hip symptoms and functional ability.
APPENDIX

PRE-OPERATIVE PAO EXPECTATIONS QUESTIONNAIRE:

Please answer the following questions to the best of your ability.

1. Do you experience difficulty in playing sports?
   a. Yes
   b. No

2. In deciding to undergo a periacetabular osteotomy, how important is it for you to improve your ability to play sports?
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

3. Do you experience difficulty walking?
   a. Yes
   b. No

4. In deciding to undergo a periacetabular osteotomy, how important is it for you to improve your walking ability?
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all
5. Do you experience hip instability?
   a. Yes
   b. No

6. In deciding to undergo a periacetabular osteotomy, how important is it for you to improve your hip stability?
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

7. Do you experience hip stiffness?
   a. Yes
   b. No

1. In deciding to undergo a periacetabular osteotomy, how important is it for you to reduce your hip stiffness?
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

2. Do you experience locking or catching in your hip?
   a. Yes
   b. No
3. In deciding to undergo a periacetabular osteotomy, how important is it for you to reduce locking/catching in your hip?
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

4. Do you experience hip pain?
   a. Yes
   b. No

5. In deciding to undergo a periacetabular osteotomy, how important is it for you to reduce hip pain?
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

The following questions ask about your realistic expectations from your periacetabular osteotomy.

6. How improved do you expect to be in your athletic activities when you are fully recovered from this surgery?
   1. Not improved at all
   2. Slightly improved
3. Moderately improved
4. Greatly improved

7. How improved do you expect to be in your walking ability when you are fully recovered from this surgery?
   1. Not improved at all
   2. Slightly improved
   3. Moderately improved
   4. Greatly improved

8. How improved do you expect your hip stiffness to be when you are fully recovered from this surgery?
   1. Not improved at all
   2. Slightly improved
   3. Moderately improved
   4. Greatly improved

9. How improved do you expect to be in the locking/catching of your hip?
   1. Not improved at all
   2. Slightly improved
   3. Moderately improved
   4. Greatly improved

10. How improved do you expect your hip pain to be when you are fully recovered from surgery?
    1. Not improved at all
2. Slightly improved
3. Moderately improved
4. Greatly improved

11. How improved do you expect your hip stability to be when you are fully recovered from this surgery?
   1. Not improved at all
   2. Slightly improved
   3. Moderately improved
   4. Greatly improved

*How important were the following issues in impacting your decision to undergo surgery?*

12. How important was it to have this surgery because other treatments have not helped
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

13. How important was it to have this surgery because of the fear of worsening my current condition
   1. Very important
   2. Moderately important
   3. Slightly important
4. Not important at all

14. How important was it to have this surgery because keeping my independence is essential
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

15. How important was it to have this surgery because of improvement in my ability to perform every day activities
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all

16. How important was it to have this surgery because of the doctor’s recommendation that I undergo surgery
   1. Very important
   2. Moderately important
   3. Slightly important
   4. Not important at all
LIST OF JOURNAL ABBREVIATIONS

AAP..........................................................American Academy of Pediatrics
Arthritis Care Res........................................Arthritis Care & Research
Acta Orthop Belg.............................................Acta Orthopaedica Belgica
Ann Plast Surg.............................................Annals of Plastic Surgery
Ann Rheum Dis.............................................Annals of Rheumatic Diseases
Arthritis Rheum........................................Arthritis & Rheumatology
Arch Ophthalmol........................................Archives of Ophthalmology
Bone Joint J..............................................The Bone & Joint Journal
Bratisl Lek Listy.................................................Bratislava Medical Journal
Clin Orthop Relat Res...............................Clinical Orthopaedics and Related Research
eGEMs................................................Generating Evidence & Methods to improve patient outcomes
HSS J...........................................................Hospital for Special Surgery Journal
Hip Int........................................................Hip International
Instr Course Lec..........................................Instructional Course Lectures
Int Orthop................................................International Orthopaedics
ISRN Orthopedics.................................International Scholarly Research Notes- Orthopedics
J Arthroplasty.............................................The Journal of Arthroplasty
J Gen Intern Med........................................Journal of General Internal Medicine
J Hand Surg.................................................................Journal of Hand Surgery
J Pers.................................................................Journal of Personality
J Rheumatol...........................................The Journal of Rheumatology
Med Care..............................................Medical Care
Patient Educ Counsel.........................Patient Education and Counseling
Rheum Rehab........................................Rheumatology and Rehabilitation
Soc Sci Med..............................................Social Science & Medicine
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SUMMARY OF QUALIFICATIONS

• Experience and education in clinical research design, planning and management
• Trained in clinical research ethics and regulatory requirements including
  International Conference of Harmonization (ICH)-Good Clinical Practice (GCP)
  guidelines
• Experience with research protocol development and IRB submission

TECHNICAL PROFICIENCIES
REDCap, SPSS, R, East6, Microsoft Word, Excel and PowerPoint

EDUCATION
Boston University School of Medicine expected May 2016
Master of Science in Clinical Investigation
GPA: 3.79
Master’s Thesis: Comparing the expectations of patients and their surgeons regarding
the outcomes of periacetabular osteotomy

Mount Holyoke College May 2012
Bachelor of Arts, cum laude
Major: Physics Minor: Chemistry
GPA: 3.59

RESEARCH EXPERIENCE
Boston Biomedical Associates, Marlborough, MA October 2015-present
Clinical Project Coordinator
Consulting and Clinical Trial Management Services for Medical Devices, Biotechnology
and Pharmaceuticals
• Assisted in the planning and implementing of clinical studies within budget and
  schedule.
• Provided support to Clinical, Data Management, Safety and Regulatory teams at
  various stages throughout the life cycle of a project
• Collected, organized and maintained clinical trial master file (TMF) elements
• Used East®6 software to design and simulate clinical trial designs
• Planned, coordinated and ran Data Monitoring Committee (DMC) and Clinical
  Events Committee (CEC) adjudication meetings
Boston Children’s Hospital, Boston, MA December 2012-present
Graduate Research on Patients’ Expectations of Hip Surgery Outcomes
Child and Adult Hip Program, Orthopaedic Surgery
- Designed research studies and developed protocols to investigate the relationships between preoperative expectations of patients and postoperative outcomes and satisfaction
- Developed quantitative survey instruments to measure the expectations and satisfaction of hip preserving surgery patients
- Utilized on-line, phone and in-person interview methods to collect data on expectations and satisfaction of hip preserving surgery patients
- Performed statistical analysis using R code and SPSS to assess associations significant to patient expectations, satisfaction and outcomes

Boston Children’s Hospital, Boston, MA December 2012-August 2015
Research Coordinator
Child and Adult Hip Program, Orthopaedic Surgery
- Assisted Principal Investigators in developing design and execution of studies on hip preservation surgery outcomes and efficacy
- Maintained study documents and databases
- Prepared research study materials including the informed consent document, case report form, eligibility screening form, enrollment logs, and advertising fliers
- Submitted IRB applications and ensured compliance of research protocols with ethical standards
- Recruited eligible patients and administered the informed consent process for research studies

Harvard Medical School, Boston, MA June 2014-August 2014
Summer Intern
Paul Farmer Program in Global Surgery and Social Change
- Assisted in searching and reviewing relevant literature for the Lancet Commission for Global Surgery’s landmark report- Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development
- Collected secondary data on various global healthcare factors for the Lancet project-Global access to surgical care: a modeling study, and was acknowledged in the publication
- Used geospatial-mapping techniques to estimate timely access to surgical care in low and middle-income countries

UT Southwestern, Dallas, Texas June 2010-August 2010, June 2011-August 2011
Summer Undergraduate Research Fellow
Department of Biochemistry and Biophysics
- Utilized biochemical assay techniques to confirm the sub-lethal expression of microtubule-growth inhibiting mutants in yeast cells
• Imaged microtubule dynamics in yeast cells using time-lapse fluorescence microscopy
• Analyzed microtubule dynamics using image processing software and MS Excel

PUBLICATIONS
Manuscripts
• Nakul P Raykar, MD, Alexis N Bowder, BA, Charles Liu, BA, Martha Vega, MD, Jong H Kim, BA, **Gloria Boye, BA**, Sarah L M Greenberg, MD, Johanna N Riesel, MD, Rowan D Gillies, MBBS, John G Meara, MD, Nobhojit Roy, MD *Geospatial mapping to estimate timely access to surgical care in nine low-income and middle-income countries* – The Lancet, Volume 385, Special Issue, S16, 27 April 2015

Abstracts
• **Gloria N. Boye, BA**, Patricia Miller, MS, Young-jo Kim, MD PhD, Michael B. Millis, MD *Expectations of patients and their surgeons of the outcomes after PAO surgery* – published at the 2014 33rd Annual Meeting of European Pediatric Orthopaedic Society
• **Gloria N. Boye, BA**, Patricia Miller, MS, Young-jo Kim, MD PhD, Michael B. Millis, MD *Expectations and Satisfaction of patients of outcomes after PAO surgery* – published at the 2015 Annual Meeting of the Pediatric Orthopaedic Society of North America

LEADERSHIP EXPERIENCE
The I’mSMILE Hospital Service Project, Accra, Ghana March 2014-present
Founder
• Initiated a visitation program for hospitalized children, and mobilized and mentored high school students to volunteer play services at pediatric wards

Partners of Youth with Disabilities, Boston, MA October 2013-present
Mentor
• Met with my mentee on a regular basis to help him define and work towards personal goals, engage in social activities

Committee for Disability Services
Mount Holyoke College, South Hadley, MA September 2010-May 2012
Student Advisor
• Informed College Deans and the office of Disability Services on pertinent issues facing students with disabilities and advised on ways to accessibility of services to the students