

# Perceived complexity of total hip arthroplasty: results of a survey of orthopedic surgeons

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**Abstract. – OBJECTIVE:** No analysis of the perception of the complexity of total hip arthroplasty (THA) has been performed so far. This study aimed to evaluate the perceived complexity of the disorders faced by orthopedic surgeons in the evaluation process prior to THA.

**SUBJECTS AND METHODS:** A three-part online survey was administered to orthopedic surgeons. In the first part, the participants were asked questions about demographic and academic knowledge, as well as their experiences with THA. In the second part, it was asked to rate the complexity of certain disorders, such as soft tissue abnormalities, ankylosis/arthrodesis, dysplastic hip, high dislocated hip, post-traumatic arthrosis, protrusio acetabuli, etc., on a scale of one to five. Perceived complexity was classified as mild if the calculated mean score was <1.67, moderate if it was between 1.67 and 3.34, and complex if it was >3.34. In the last section, the effects of perceived complexity on surgical preferences were investigated.

**RESULTS:** THA administered for femoral neck fracture was graded as the least complex surgical challenge (mean score of  $1.85 \pm 0.99$ ), while high dislocated hip (Crowe III-IV) was scored with the highest mean score of  $4.10 \pm 0.99$ . None of the disorders were evaluated as easy by orthopedic surgeons. Disorders of the high dislocated hip (Crowe III-IV) and protrusio acetabuli were identified as the most complicated cases by surgeons.

**CONCLUSIONS:** Perception of complexity affected preference for surgical approach. Besides, the level of education after participating in a course related to THA may affect the preferences of orthopedic surgeons when planning an operation.

## Key Words:

Total hip arthroplasty, Coxarthrosis, Perception of complexity, Quantitative assessment.

## Introduction

Total hip arthroplasty (THA) offers satisfactory long-term results in the treatment of patients with coxarthrosis. Consequently, elderly individuals with low functional expectations and young patients who hope to regain their quality of life, including physically demanding activities, consult with clinics for hip replacement surgery<sup>1</sup>. While hip arthritis in elderly individuals often occurs due to primary causes, arthritis observed in the young population is often due to secondary causes, challenging due to the patient's activity level and the devastating effects of the primary disorder. Although the emergence of modern surgical techniques and implants enables orthopedic surgeons to achieve more successful long-term radiological results in young individuals undergoing THA, clinical results are still not satisfactory<sup>2</sup>.

Genetic, developmental, acquired, or traumatic diseases affecting the hip joint could be the reason for complexity. The most notable difficulties encountered during total hip arthroplasty are soft tissue anomalies, including increased subcutaneous fat layer thickness due to obesity that precludes optimal surgical technique or previous scar, biomechanical alterations at the previously operated hip, such as significant offset changes, coxa vara, ankylosis, acetabular dysplasia, post-

traumatic sequelae, acetabular protrusio, bone dystrophies, neuromuscular problems or failed internal fixation of hip<sup>3,4</sup>.

As in the whole world, medical education and orthopedic surgery expertise in our country are obtained after a long and difficult training process. Apart from subspecialties, such as hand surgery or oncological surgery, that require multidisciplinary teamwork, an orthopedic surgeon successfully applies most trauma, sports medicine, spine, and joint surgery cases. The long-term successful results of major joint surgery have increased interest in this subspecialty. Experiences in both orthopedic residency and post-graduate surgical practice may lead to different perception processes among surgeons in the planning and management of coxarthrosis, which occurs due to the above-mentioned reasons other than primary coxarthrosis, even if they are equipped with literally similar information. However, no analysis of the perception of complexity has been performed among these surgeons regarding complex hip replacement surgeries<sup>5</sup>. The aim of the current study was, therefore, to evaluate the perceived complexity of the hip disorders faced by general orthopedic surgeons in planning before performing total hip arthroplasty.

## Subjects and Methods

The study was conducted in accordance with the principles of the Declaration of Helsinki, and the study protocol was approved by the University of Health Sciences, Gazi University Ethics Committee (Date: 11.01.2022, No.: 2022-251). A three-part online survey was administered to general orthopedic surgeons working at secondary hospitals between 15 February and 15 March 2022. The survey was created with no personal identifying information requested from the participants, using a widely available online application (<http://forms.google.com>). Informed consent was obtained from the patients before their surgery. Only the results of individuals who were qualified to work as orthopedic surgeons were included in the survey; the data of those who did not complete the whole survey, employees in a part-time tertiary hospital, and those who had not yet completed their orthopedic surgery training were excluded from the study.

In the first part, the participants were asked questions about their demographic and academic knowledge as well as their experiences with

THA. In the second part, it was asked to rate between one and five the complexity of various disorders mentioned as follows: soft tissue abnormalities (skin and muscle problems), neuromuscular problems (such as cerebral palsy, poliomyelitis, Parkinson's disease), obesity, biomechanical abnormalities (such as increased lateral offset, coxa vara, length difference), ankylosis/arthrodesis, dysplastic hip (Crowe I-II), high dislocated hip (Crowe III-IV), post-traumatic arthrosis, protrusio acetabuli, osteochondrodysplasias, femoral neck fracture, osteodystrophies (Paget's disease, osteomalacia), osteoporosis, and previous hip surgeries.

Perceived complexity was classified as mild if the calculated mean score was <1.67, moderate if it was between 1.67-3.34, and complex if it was >3.34. In the last section, it was asked the effects of perceived complexity on surgical preferences. Besides, the effects of age, surgical experience, being educated about total hip arthroplasty, and encountering complications during surgery on preoperative preparation processes and/or surgical approaches in challenging cases were investigated according to survey results.

## Statistical Analysis

Statistical analyses were performed using Jamovi v.1.8.2.0 (The Jamovi Project, Sidney, Australia). Descriptive statistics were presented as numbers and percentages for categorical variables and mean  $\pm$  standard deviation, median (minimum value–maximum value) for continuous variables. Normal distribution for continuous variables was assessed with visual (histograms and probability graphics) and analytic methods (Kolmogorov-Smirnov and Shapiro-Wilk's tests). In the data that did not fit the normal distribution, the Mann-Whitney U test was used for comparative analysis between the two independent groups, and the independent sample *t*-test was used for the data that fit the normal distribution. Comparison analyses for categorical variables between independent groups were performed by Chi-square test. Statistical significance was considered at  $p < 0.05$ .

## Results

158 participants filled in the online survey. Sixteen respondents were excluded due to not answering all of the questions in the survey, five of them were excluded due to working at a

tertiary hospital, and five of them were excluded due to being residents at the time of the survey. Finally, all analyses were based on the answers given by the remaining 132 orthopedic surgeons. The mean age was 40.9±6.9 (range: 30-59) years, while the mean surgical experience was 10.2±7.2 (range: 1-31) years. A similar number of participants from all levels of surgical experience were observed in the study. The number of participants who performed 0-25 THA surgeries and more than 200 THA during their career was 33 (25%) for both. Of them, 64 (49%) participants reported participating in a course on THA. The rate of respondents who stated having experienced a complication during THA surgery was 58% (n=77). Baseline demographics and characteristics of respondents are summarized in Table I.

In the perceived complexity assessment, THA administered for femoral neck fracture was degreed as the least complex surgical challenge, which was scored as a mean of 1.85±0.99 by participants. High-riding dysplastic hip (Crowe III-IV) was scored with the highest mean score of 4.10±0.99 (Table II). According to a novel perceived complexity classification of challenges

during THA, it was determined that orthopedic surgeons did not evaluate any surgical difficulty as easy. At the same time, neuromuscular problems, ankylosis/arthrodesis, high dislocated hip (Crowe III-IV), and protrusio acetabuli were defined as complex (Table III).

98 (74%) participants stated that challenging factors affected the pre-surgical preparation processes and/or surgical approaches, and it was observed that the effect increased with age (Yes: 41.9±7.20; No: 38.06±5.33,  $p=0.005$ ) and surgical experience (Yes: 11.5±8.12; No: 7.06±5.25,  $p=0.007$ ) increased. It was determined that the subjects who participated in the THA-related course changed the surgical approach or the technique preferred according to the difficulty encountered ( $p=0.044$ ). It was observed that surgeons with 50 or more cases per year ( $p<0.001$ ) and those who had performed more than 200 THA during their careers ( $p=0.003$ ) prefer pre-surgical templating more. However, it was demonstrated that the tendency for preoperative CT extraction ( $p=0.524$ ) and surgical approach preferences ( $p=0.474$ ) were not affected by the experience.

**Table I.** Baseline demographics and characteristics.

	<b>Total N = 132</b>
Age, year	
Mean ± SD	40.9 ± 6.9
Median (min-max)	40 (30-59)
Surgical experience, year	
Mean ± SD	10.2 ± 7.2
Median (min-max)	9 (1-31)
Current position, n (%)	
Tertiary care	91 (69%)
Secondary care	26 (20%)
Private clinic	15 (11%)
Number of THA performed per year, n (%)	
0-10	73 (56%)
10-25	28 (21%)
25-50	16 (12%)
50 and over	15 (11%)
Number of THA performed in career, n (%)	
0-25	33 (25%)
25-50	24 (18%)
50-100	28 (21%)
100-200	14 (11%)
200 and over	33 (25%)
Participating a course on THA, n (%)	
Yes	64 (49%)
No	68 (51%)
Complications encountered during THA, n (%)	
Yes	77 (58%)
No	55 (42%)

SD: Standard deviation, THA: Total hip arthroplasty.

**Table II.** Perceived complexity scores of challenges during THA.

N = 132	Mean ± SD	Median (range)	95% CI
Soft tissue abnormalities	2.82 ± 1.11	3 (1-5)	2.63-3.01
Neuromuscular problems	3.61 ± 1.21	4 (1-5)	3.41-3.82
Obesity	3.33 ± 1.02	3 (1-5)	3.15-3.50
Biomechanical abnormalities	3.25 ± 1.03	3 (1-5)	3.07-3.43
Ankylosis/arthrodesis	3.72 ± 1.07	4 (1-5)	3.54-3.90
Low riding dysplastic hip (Crowe I-II)	3.20 ± 1.06	3 (1-5)	3.02-3.38
High riding dysplastic hip (Crowe III-IV)	4.10 ± 0.99	4 (1-5)	3.93-4.27
Post-traumatic arthrosis	2.71 ± 1.19	3 (1-5)	2.51-2.92
Protrusio acetabuli	3.48 ± 1.19	4 (1-5)	3.28-3.69
Osteochondrodysplasias	3.14 ± 1.17	3 (1-5)	2.94-3.34
Femoral neck fracture	1.85 ± 0.99	2 (1-5)	1.68-2.02
Osteodystrophies	3.08 ± 1.15	3 (1-5)	2.89-3.28
Osteoporosis	2.56 ± 1.04	2 (1-5)	2.38-2.74
Previous hip surgeries	3.31 ± 0.98	3 (1-5)	3.14-3.48

SD: Standard deviation, CI: Confidence interval, THA: Total hip arthroplasty.

### Discussion

The current data represent the first quantitative assessment of the perceived complexity of the various disorders encountered when performing THA. One of the noticeable results was that the perception of complexity affected preference for the surgical approach and the technique as age and surgical experience increased. Besides, the level of education after participating in a course related to THA may affect the preferences of orthopedic surgeons when planning an operation. Another important finding of the current study was that the participants classified no surgical difficulty as mild.

There is a strong expectation that better functional outcomes and longer implant survival could be achieved in patients undergoing total hip arthroplasty by experienced surgeons<sup>6</sup>. It was reported in a study conducted by Ravi et al<sup>7</sup> that patients operated on by surgeons who performed the THA procedure less than a year ago were also at increased risk for complications such as dislocation and early revision. On the other hand, radiological results and complication rates of patients operated by trainee surgeons under supervision were similar to those of experienced surgeons, but functional results were statistically significantly lower in a meta-analysis<sup>8</sup>. The current study demonstrated that experienced surgeons were more prone to change the techniques used in the face of surgical difficulties. The mentioned effect may arise that senior surgeons could confidently perform several surgical techniques with increasing experience. The clinical implications of this study's results could be as follows: in cases defined as challenging with a high risk of complications, completing the procedure with the guidance of an experienced surgeon, an increase in the number of such cases, and ultimately gaining more experience would lead to the best surgical outcomes and patient satisfaction.

THA improves the quality of life more than most elective surgical interventions. The most important factors developing the current outcome are the constantly evolving implant technology and new techniques defined, especially with increasingly smaller incisions<sup>9</sup>. Besides, increased complication rates can be expected in novel surgical techniques than traditional methods. In a

**Table III.** A novel perceived complexity classification of challenges during THA according to survey.

Mild (< 1.67)	None
Moderate (1.67-3.34)	Soft tissue abnormalities Obesity Biomechanical abnormalities Dysplastic hip (Crowe I-II) Post-traumatic arthrosis Osteochondrodysplasias Femoral neck fracture Osteodystrophies Osteoporosis Previous hip surgeries
Complex (> 3.34)	Neuromuscular problems Ankylosis/arthrodesis High dislocated hip (Crowe III-IV) Protrusio acetabuli

study by Pincus et al<sup>10</sup>, the anterior surgical approach was associated with a statistically significantly increased risk of major surgical complications compared to the posterior or anterolateral surgical approach. A similar result was reported by Aggarwal et al<sup>11</sup>, and it was demonstrated that the surgical approach plays an important role in the incidence of complications. It was mentioned that the anterior approach contributes most to the early complication rates of periprosthetic fracture and surgical site infection.

Orthopedic surgeons who want to provide patient benefits without increasing the risk of complications are increasing their interest in specific training courses, especially cadaveric hands-on training for surgical specialties. In a global need assessment analysis<sup>12</sup> of 319 orthopedic surgeons, more than half of respondents indicated they were more willing to attend courses that included practical exercises and anatomy labs. However, the mentioned courses are effective in using novel developed instruments and surgical techniques more effectively, just like traditional methods<sup>13-15</sup>. In the current study, it was demonstrated that surgeons who had specialized training in THA were more likely to change their surgical approach and techniques when faced with complex cases. The reason for the mentioned situation was that surgeons participating in THA-specific training activities were more knowledgeable about novel developed instruments and surgical approaches.

Theoretical lectures and practical exercises carried out as part of the learning objectives of THA-specific courses increase the awareness of the participants about complex cases<sup>12</sup>. The fact that none of the disorders were classified as mild in the current study could be due to the above-mentioned increase in awareness and the relatively young surgeons involved.

### **Limitations**

The most important limitation of the current study was that the random selection of respondents was not classified according to current activity and career experience. Another limitation of the study was that the participants consisted entirely of surgeons serving in the same country. Adjusting the rating used in classification with a simple method and not performing advanced statistical analysis could be counted among the limitations of the study. A final limitation of the study was that it was based only on surgeon opinions, without regard to morbidity and mortality. Although the technical complexity of a procedure

was not associated only with its morbidity and patient outcomes, its inclusion in the evaluation could have increased the contribution of the study to the literature. In addition, the data obtained from participants working in secondary hospitals as general orthopedic surgeons who do not work in tertiary hospitals can be considered as the strength of the study since it includes a more concentrated group than those with joint arthroplasty subspecialties.

### **Conclusions**

Although the present study was subjective in nature, it was the first time that it provided information on perceived complexity of total hip arthroplasty. While it was not surprising that disorders of high riding dysplastic hips (Crowe III-IV) and protrusio acetabuli were shown by surgeons to be the most complicated cases, the current study's data provided a relatively simple, quantitatively derived, generalizable classification that could be easily referenced in studies that associate technical complexity. More comprehensive and internationally participated studies in this manner will enable to inform about orthopedic surgeons to better determine the perspective, planning and management of difficult and complex coxarthrosis cases.

### **Conflict of Interest**

The authors declare that they have no conflict of interests.

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### **Ethics Approval**

The study was conducted in accordance with the principles of the Declaration of Helsinki and the study protocol was approved by the University of Health Sciences, Gazi University Ethics Committee (Date: 11.01.2022, No.: 2022-251).

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### Data Availability

Data can be provided upon request.

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### Authors' Contribution

ATE, MAT, and ÖÖ performed the measurements, İD and HŞ were involved in planning and supervising the work, MAT and MÖ performed the analysis and wrote and drafted the manuscript.

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### Informed Consent

Not applicable, since the survey was created with no personal identifying information requested from the participants, using a widely available online application (<http://forms.google.com>).

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