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# Comparison of patients undergoing revision total hip arthroplasty and patients undergoing re-revision

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**Abstract. – OBJECTIVE: The aim of this study is to compare the demographic, clinical, and surgical characteristics of patients who underwent revision hip replacement surgery and those who underwent re-revision surgery. The secondary outcome is the investigation of the factors that play a role in estimating the time between primary arthroplasty surgery and revision surgery.**

**PATIENTS AND METHODS: The patients who underwent revision hip arthroplasty in our clinic between 2010- 2020, patients with at least 2 years of follow-up, and who underwent re-revision surgery if needed were included. Demographic and clinical data were investigated.**

**RESULTS: Of the 153 patients who met the study criteria, 120 (78.5%) underwent revision (Group 1) and 33 (21.5%) underwent re-revision (Group 2). The mean age of Group 1 was 53.5 (32-85), and of Group 2 was 67 (38-81) ($p$=0.003). In both groups, patients who underwent hip replacement due to fracture had more revisions and re-revisions ($p$=0.794). While 53.3 of the patients in Group 1 did not need additional implants, 72.7% of the patients in Group 2 needed additional implants ($p$=0.010). Fracture-dislocation, fistula, and the need for debridement after the revision were statistically significantly higher in patients who underwent re-revision. Harris hip scores (HHS) were statistically lower in patients who went for re-revision.**

**CONCLUSIONS: The need for reoperation in patients who have undergone revision total hip arthroplasty (THA) surgery is due to the fact that the patient's age is advanced and the indication for surgery is a fracture. While the rate of fistula, fracture, dislocation, and debridement increases after re-revision surgeries, the HHS values that indicate clinical success also decrease. We believe that studies with larger participation and longer follow-up periods are needed to explain this issue better.**

*Key Words:*
Revision, Re-revision, Hip arthroplasty, Surgery, Dislocation, Complication.

## Introduction

The number of total hip arthroplasty (THA) increasing day by day has naturally led to an increase in the number of revision THA and re-revision THA[1-3]. After revision, and especially after re-revision of THA, which is technically more difficult, patient satisfaction rates and clinical outcomes are lower than after primary THA[4,5]. As expected in hip arthroplasty surgeries, which are very beneficial for patient mobilization, revision surgeries are even more complicated. After a well-planned and performed THA, revision is required at a later time.

Primary THAs are subject to revision or re-revision due to different reasons, such as aseptic loosening, dislocation, infection, implant failure, and fracture. After these surgeries, which have a high risk of postoperative complications, survival decreases with each new surgery[5-7]. Success in patients undergoing revision THA depends on the characteristics of the patient, the surgeon's experience, and the implant used[8]. Thorough examination and investigation of patients with complications after revision THA may prolong the total survival time after hip arthroplasty[9].

Repetition of hip arthroplasty revision surgeries creates severe financial and psychological burdens for patients and the health system[10]. We compared the demographic, clinical, and surgical characteristics of patients who underwent revision THA and those who underwent re-revision THA. We aimed to understand the factors that cause re-revision and want to reduce re-revision surgery as much as possible. We also investigated the factors affecting the time elapsed between primary prosthesis surgery and revision prosthesis surgery.

## Patients and Methods

This study was conducted as a retrospective study at our university and included patients who

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were operated between January 2010 and December 2020. Patients who underwent revision hip arthroplasty after total hip arthroplasty and had at least two years of follow-up were analyzed. This study protocol was approved by the ethics committee (Date: 15.12.2021, No.: 2021-18/9). Informed consent was obtained from all participants.

Patients who underwent revision THA surgery in our clinic and patients who underwent re-revision THA surgery in our clinic during the follow-up were included in the study. There are cases in which the primary THA was not performed in our clinic. The fact that primary THA surgery was not performed in our clinic was not used as an exclusion criterion. Patients whose medical information and radiographs could not be obtained and those whose recurrent surgeries in a different center or in whom radiographs could not be taken correctly were excluded. The study did not include patients who underwent only debridement due to infection after primary THA. In order to take full advantage of the participants, we did not exclude patients we could not follow up until death.

During the study period, a total of 1,761 hip replacements were performed at our clinic. Of these, 1,524 were primary, 185 were revision, and 52 were re-revision. 153 patients who met the study criteria were identified. Of these patients, 120 (78.5%) had undergone revision (Group 1) and 33 (21.5%) had undergone re-revision (Group 2).

In our study population, we divided the patients into two groups. Group 1, patients who were followed up after revision hip arthroplasty and did not need revision (n:120). Group 2, patients underwent re-revision surgery while being followed up after revision (n:33). All revision and re-revision surgeries were performed by a single senior surgeon.

Diagnosis is made with a lumbar-based dual-energy x-ray absorptiometry (DEXA) scan with osteopenia having a T-score of 1 to 2.5 standard deviations below the peak bone mass of a 25-year-old individual, and osteoporosis having a T-score >2.5 standard of deviations below the peak bone mass of a 25-year-old individual. We checked the hip dysplasia on the pelvis roentgenogram and evaluated it according to the Crowe classification. Patients' data were collected from their electronic-based health records and included their age, gender, additional diseases, dual-energy x-ray absorptiometry (DEXA), primary arthroplasty diagnosis, revision reasons, re-revision reasons, follow-up times, implants replaced in surgeries, and additional implants used. For clinical outcomes, we used patients' HHSs, and complications were investigated. In addition, regression analysis was performed between follow-up times and age, gender, and bone densitometry values were used to determine whether these factors could give an idea about the length of follow-up between primary arthroplasty surgery and revision surgery.

### Statistical Analysis

Statistical analysis was carried out using the SPSS (Statistical Package for the Social Sciences) program (version 20; IBM Corp., Armonk, NY, USA). The Shapiro-Wilk test was performed to evaluate the normality of the distribution of the variables. Student *t*-test was used to compare normally distributed continuous variables, while the Mann-Whitney U test compared non-normally distributed continuous variables between two groups. For categorical variables, Chi-square and Fisher's exact test were used for comparisons. The descriptive statistics were expressed as mean±standard deviation for normally distributed variables, median (minimum-maximum) for non-normally distributed variables, and frequency or percentages for categorical variables. Multiple Linear Regression analysis was used with the enter method as the regression analysis method. A $p$-value $<0.05$ was considered statistically significant.

## Results

The demographic and clinical characteristics of the patients are presented in Table I. The mean age of revision patients was 53.5 (32-85) and of re-revision patients 67 (38-81) ($p$=0.003). In both groups, patients who underwent hip replacement due to fracture had more revisions and re-revisions ($p$=0.794). No other demographic and clinical characteristics were significantly different between the two groups.

Table II summarizes the operative approach and complications of patients: 40% of the patients in Group 1 underwent revision due to implant failure, 20.8% due to instability or dislocation; 45.5% of the patients in Group 2 underwent revision due to infection, and 30.3% due to instability or dislocation ($p$<0.001). While 45.8% of the patients in Group 1 had implant replacement in the femur + acetabulum, 27.5% had replacement only in the acetabulum, and 11.7% did not need implant replacement. In Group 2, 54.5% of the implants were changed in the femur + acetabulum and 18.2% in the acetabulum, while 6.1% did not require implant replacement ($p$=0.002). While 53.3% of the patients in Group 1 did not need additional implants,

**Table I.** Demographic and clinical characteristics of patients.

| | REVISION (n:120, 78.5) | RE-REVISION (n:33, 21.5) | p |
|---|---|---|---|
| **Age** | 53.5 (32-85) | 67 (38-81) | **0.003** |
| Gender | | | 0.233 |
| Female | 76 (63.3) | 17 (51.5) | |
| Male | 44 (36.7) | 16 (48.5) | |
| **Comorbidity** | | | 0.165 |
| Yes | 68 (56.7) | 24 (72.7) | |
| No | 52 (43.3) | 9 (27.3) | |
| **Comorbidity-2** | | | 0.367 |
| None | 52 (43.3) | 9 (7.5) | |
| Hypertension | 14 (11.7) | 7 (5.8) | |
| Diabetes Mellitus | 9 (27.3) | 3 (9.1) | |
| Chronic obstructive pulmonary disease | 10 (8.3) | 1 (3) | |
| Coronary artery disease | 7 (21.2) | 3 (9.1) | |
| Other | 28 (23.3) | 10 (30.3) | |
| **DEXA** | | | 0.460 |
| Normal | 43 (35.8) | 8 (24.2) | |
| Osteopenia | 38 (31.7) | 13 (39.4) | |
| Osteoporosis | 39 (32.5) | 12 (36.4) | |
| **Primary Diagnosis** | | | 0.794 |
| Primary coxarthrosis | 28 (23.3) | 9 (27.3) | |
| Hip dysplasia | 27 (22.5) | 5 (15.2) | |
| Avascular necrosis | 24 (20) | 24 (20) | |
| Fracture - Trauma | 41 (34.2) | 11 (33.3) | |

Values were presented as n (%) or median (min-max). *p*-value <0.05 was statistically significant.

**Table II.** Operative approach and complications of patients.

| | REVISION (n:120) | RE-REVISION (n:33) | p |
|---|---|---|---|
| **Revision Reason** | | | **<0.001** |
| Aseptic loosening | 13 (10.8) | 3 (9.1) | |
| Instability - Dislocation | **25 (20.8)** | **10 (30.3)** | |
| Infection | 16 (13.3) | **15 (45.5)** | |
| Fracture | 11 (9.2) | 3 (9.1) | |
| Implant failure | **48 (40)** | 2 (6.1) | |
| Pain (unknown cause) | 7 (5.8) | - | |
| **Follow-up period from primary to revision (months)** | 19 (1-240) | 24 (1-270) | 0.277 |
| **Implant Replacement** | | | **0.002** |
| No | **14 (11.7)** | **2 (6.1)** | |
| Femur | 18 (15) | 3 (9.1) | |
| Acetabulum | **33 (27.5)** | **6 (18.2)** | |
| Insert | - | 4 (12.1) | |
| Femur + acetabulum | **55 (45.8)** | **18 (54.5)** | |
| **Additional Implant** | | | **0.010** |
| No | **64 (53.3)** | 9 (27.3) | |
| Plate, Screw, Cable | 56 (46.7) | **24 (72.7)** | |
| **Fracture-Dislocation after Revision** | | | **<0.001** |
| Yes | - | 8 (24.2) | |
| No | 120 (100) | 25 (75.8) | |
| **Fistula after Revision** | | | **0.001** |
| Yes | 2 (1.7) | 6 (18.2) | |
| No | 118 (98.3) | 27 (81.8) | |
| **Debridement after Revision** | | | **<0.001** |
| Yes | - | 7 (21.2) | |
| No | 120 (100) | 26 (78.8) | |
| **Ex** | | | **0.007** |
| Yes | 34 (28.3) | 18 (54.5) | |
| No | 86 (71.7) | 15 (45.5) | |

Values were presented as n (%) or median (min-max). *p*-value<0.05 was statistically significant.

72.7% of the patients in Group 2 needed additional implants ($p$=0.010). The incidence of fracture-dislocation, fistula, and debridement after revision was statistically significantly higher in patients who underwent revision. Ex rates (independent of orthopedics) were substantially higher in patients who underwent re-revision during follow-up ($p$=0.007). In Table III, indications for surgery in patients undergoing revision or re-revision are presented.

The mean HHS improved from 38 (range, 14-70 points) preoperatively to 78 (range 34-95 points) at the latest follow-up. Of the 153 hips, 98 hips (73%) had a good or excellent result, 40 hips had a fair result, and 15 hips had a poor result. When the HHS change rates in revision patients were compared with the HHS change rates in re-revision patients, the rates of change in re-revision patients were statistically significantly lower ($p$=0.010).

Age, gender, comorbidity, DEXA, and primer diagnosis variables were compared with the enter method of Multiple Linear Regression Analysis to estimate the primary revision day follow-up period (Table IV). The primary revision day is the time between primary THA surgery and revision THA surgery. The model with the best performance according to the results; protein arginine methyltransferases (PRGTS) was determined as 0.330 (age) + 25.972 (gender) + 30.222 (DEXA) (R2: 0.411, $p$<0.001).

## Discussion

Patients with a fracture indication in the primary hip arthroplasty and patients with an infection indication in the revision hip arthroplasty are at high risk of having a revision. In the revision and re-revision of THA, more femur and acetabular components need to be replaced, and the risk of re-revision increases as the additional implants used increase.

In our study, it was found that the risk of revision and re-revision was high in patients with a primary hip arthroplasty fracture indication. In their study, Clohisy et al[7] found that patients under the age of 55 who underwent revision surgery had a high risk of undergoing revision surgery. Herman et al[11] also found that, of the demographic variables, only age affects treatment success, and younger age is risky for failure. In our study, however, we can attribute the increase in revisions with increasing age to racial characteristics, different socio-economic conditions, the opportunities of elderly patients living in our country, personal problems, or differences in personal opportunities.

While patients with implant failure and instability as revision indications were more in Group 1, patients with revision indication, infection, and instability were more in Group 2. In other words, infection and instability were found to be the most common causes of revision failure in our study. Khatod et al[12] in their study, found the reasons for re-revision to be instability, infection, and aseptic loosening, respectively, while Springer et al[3] found instability, aseptic loosening, and infection, respectively. According to Basile et al[13] study, risk factors are associated with the development of PJI. PJIs are the undesired result of the complex interaction of several factors according to the type of microorganism involved, the type of implanted prosthesis, and the characteristics of

**Table III.** Indications for surgery in patients undergoing revision or re-revision.

| | Revision Indication | Re-revision Indication |
|---|---|---|
| Aseptic loosening | 3 (9.1%) | 2 (6.1%) |
| Instability - Dislocation | 10 (30.3%) | 12 (36.4%) |
| Infection | 15 (45.5%) | 17 (51.5%) |
| Fracture | 3 (9.1%) | 2 (6.1%) |
| Implant failure | 2 (6.1%) | -- |

**Table IV.** Indications for surgery in patients undergoing revision or re-revision.

| | B | OR | p |
|---|---|---|---|
| Age (year) | 0.330 | 1.712 | 0.089 |
| Gender | 25.972 | 2.517 | **0.013** |
| DEXA | 30.222 | 2.386 | **0.018** |

B: Standardized regression coefficient. OR: odds ratio. DEXA: dual-energy x-ray absorptiometry. $p$-values with statistical significance ($p$ <0.05) are shown in bold.

the patient undergoing surgery. With these findings, our study is in line with the literature.

In both Groups 1 and 2, the numbers of patients who had both femur and acetabulum implants replaced are high. While the prosthesis system is being revised, all parts should be carefully evaluated, and the necessary ones should be changed. In fact, the need for the acetabulum and femur to be replaced together is greater than the need to replace either one only. Re-revision of failed revision THA can be a complex and technically challenging procedure with substantially different resource requirements, primarily in cases of bone loss[14,15]. Revision surgeries that require additional implants comprise a higher number of revisions. In this case, it should be borne in mind that patients who require additional implants have a higher risk of sooner follow-up and revision. In addition, revision surgery constitutes major surgery; all implants and sizes should be available. A plan B should also be prepared, considering the situations that will cause intraoperative plan changes.

Revision surgery carries a high risk of complications and a high risk of needing re-revision[16]. Viste et al[9] found in their study that the rate of dislocation after revision hip arthroplasty (5-25%) was higher than primary hip arthroplasty (0.2-9%). Bonner al[17] found a complication rate of 35% in their study. Postoperative complications (infection, debridement, fistula, dislocation) were higher in the re-revision group as expected.

Among the strengths of the present study is the fact that we discussed difficult orthopedic surgeries and complications. Analyses of the revision of total hip arthroplasty are present in the literature, but there is still not enough data about revision surgery. Our regression analysis showed that the risk factors play a role in estimating primary revision day follow-up. In addition, the fact that all revisions and re-revisions were made and followed up in a single center reveals the experience of our clinic in this regard.

### Limitations

Our study has some limitations. First, it was retrospective in design. Therefore, the determination of re-revision risk factors was limited. Second, sufficiently long follow-up periods had not yet transpired for these patients. Third, most patients with hip arthroplasty had their first surgery at a different center. Our most important limitation is that we did not perform the first arthroplasty surgeries of all patients in the study group. This situation may also have affected the results of our regression.

## Conclusions

The need for reoperation in patients who have undergone revision THA surgery is due to the fact that the patient's age is advanced and the indication for surgery is fracture. While the rates of fistula, fracture, dislocation, and debridement increase after re-revision surgeries, the HHS values that indicate clinical success also decrease. We believe that studies with larger sample sizes and longer follow-up periods are needed to explain this issue better.

### Ethics Approval

This study protocol was approved by the Ethics Committee from Bursa Uludag University (Date: 15.12.2021, No.: 2021-18/9).

### Informed Consent

Written informed consent was obtained from the participants of the study to publish this paper.

### Availability of Data and Materials

The data presented in this study is available on request from the corresponding author.

### Conflicts of Interests

The authors declare no conflict of interest.

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### Authors' Contributions

Supervision-AEY, MSB; Data curation-AEY, AED, GE; Formal analysis-GE, AEY; Conceptualization-AEY, AED; Writing Review and Editing-AEY, MSB. All authors have read and agreed to the published version of the manuscript.

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