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Conversion arthroplasty after failed extracapsular hip fracture fixation is associated with high complication rates

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Ethics Committee Approval
The study was approved by Cukurova University ethics committee approval was obtained (Date:12.02.2021, Number: 108/20).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: There is no standard treatment of choice that addresses all extracapsular fractures, which account for approximately half of the elderly hip fractures. Arthroplasty is mostly favored secondary to unsuccessful fixation or unstable primary fractures. However, conversion arthroplasty complication rates are high in the literature. This study compares arthroplasty performed after unsuccessful fixation and primary arthroplasty for unstable extracapsular hip fractures.

Methods: In this retrospective study, we compared the first-year results of the groups that underwent conversion arthroplasty (cHA) and the primary arthroplasties (pHA) for extracapsular hip fractures. In the cHA group, patients were indicated for operation if there was a failure of fixation after extracapsular hip fractures (n=44). In the pHA group, patients were for unstable extracapsular hip fractures (n=44). In the cHA group, failure of fixation causes were cut-out of lag screws (54.5%), cut-through of lag screws (9.1%), non-union of fractures (27.3%), and osteonecrosis of femoral heads (9.1%). While total hip replacement was applied to all patients in the cHA group, total hip replacement was applied to ten patients in the pHA group and hemiarthroplasty to 34 patients. In comparing groups, duration of operation, amount of bleeding, intraoperative complications, post-operative complications, mobilization capacities, functional status, and mortality rates were used.

Results: There were 44 patients in both groups. The surgical time (134.3 [34.5)] vs. 66 [16], [P<0.001]), the amount of bleeding (1000 ml [400] vs. 300ml [200], [P<0.001]), the need for red blood cell transfusion in the operations (80% vs. 32%, [P<0.001]), and the frequency of intraoperative femur fracture (30% vs. 0%, [P<0.001]) were larger or longer in the cHA group compared to pHA group (P<0.001). While 14 complications requiring surgical intervention were observed in 12 of 44 patients in the CHA group in the post-operative 1st year, four complications were observed in four of 44 patients in the pHA group. There was no difference in mortality rates (3 vs. 3, [P=1]), mobilization capacities (5.9 [2.1] vs. 5.7 [2.0], [P=0.597]), and functional status (12.5 [3.3] vs. 13.0 [2.7], [P=0.434]) between the groups.

Conclusion: Arthroplasty performed as conversion surgery after unsuccessful fixation has a higher risk of intraoperative and post-operative complications than primary arthroplasty performed after extracapsular hip fractures. We believe the cases prone to implant failure, non-union, or restricted mobilization because of the patient and fracture-type reasons should be treated with primary arthroplasty.

Keywords: conversion arthroplasty, unstable hip fracture, hip arthroplasty

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Introduction

Hip fractures are one of the major causes of morbidity and mortality in the elderly and create more burden on health systems with the aging of society. In Turkey, approximately 42,000 hip fractures were seen in 2019 among those over 50 years of age. It is estimated that this amount will increase by 12% at the end of 2024 [1]. In the first 6 months after injury, mortality can reach up to 50%, although it varies according to the patient's age, comorbid diseases, the treatment method performed and the mobilization time after treatment [2-4].

Intracapsular proximal femoral fractures in the elderly tend to be treated with arthroplasty rather than fixation methods due to the poor healing potential and high reoperation rates [5]. However, this consensus does not come true for extracapsular fractures, which account for about half of all hip fractures [6]. While fixation is a successful treatment option for stable fractures [7-9], the success rate is low, and complication rates are high in unstable fractures [7,8,10,11]. Some complications, such as loss of fixation, cut-out, and non-union, sometimes lead to irreparable situations to perform internal fixation [10,12,13]. In such cases, arthroplasty is the treatment of choice as a salvage procedure [14,15]. However, when arthroplasty is performed after failed fixation, a more challenging procedure is waiting for the surgeon with high complication rates [15-16]. For this reason, arthroplasty can be preferred as the primary treatment method in unstable fractures of the elderly where the chance of success is low fixation only [2,17].

Our study aims to determine whether arthroplasty is more successful as the first treatment in unstable trochanteric fractures by comparing our cases of conversion arthroplasties and primary arthroplasty cases after failed fixation.

Materials and methods

Çukurova University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee (Date: 12.02.2021, Number: 108/20) approval was obtained before the study. Between January 2015 and December 2019 at our hospital, 44 hips of 44 patients (27 female, 17 male) over the age of 60 underwent conversion hip arthroplasty (cHA) due to fixation failure of proximal extracapsular hip fractures, excluding the diagnosis of infection. In 29 of 44 hips (65.9%), intramedullary devices (short or long) were used for fracture fixation in the first operation, while plate-screw constructs were used in 15 hips (34.1%). The mean time between the fixation and conversion procedure was 10.45 months. The indication for cHA was a cut-out of the lag screw in 24 (54.5%) patients, cut-through in four (9.1%), and non-union more than 12 months after fixation in 12 (27.3%). In four (9.1%) patients, hip arthroplasty was done due to osteonecrosis in the femoral head.

The cases who underwent conversion hip arthroplasty after the failure of fixation (cHA group) were matched with a control group consisting of 44 patients who were admitted with the diagnosis of unstable extracapsular proximal femur fractures and underwent primary hip arthroplasty (total/partial) (pHA) by the same team during the same period (pHA group). Written informed consent was obtained from all participants. Patients were matched one to one according to age, sex, body mass index (BMI), and the American Society of Anesthesiologists (ASA) rating.

Patient medical records, operative notes, and radiographs were retrospectively reviewed. All operations were performed by the same team using a posterolateral approach and cementless implants. We routinely performed hematologic tests to rule out infection in the cHA group, including complete blood cell count, erythrocyte sedimentation rate, and C-reactive protein (CRP) before operation. In suspected cases, preoperative joint aspiration and microbial cultures are routinely performed. In addition, samples were taken from all patients from the implant periphery and hip joint for microbiological examination during the operation. In our hospital, red blood cell transfusions were standardized according to a protocol based on the guidelines for perioperative transfusion by the National Institutes of Health Consensus Conference [18].

In cHA cases, the length of the femoral stems was at least 30 mm distal to the last screw of the previous implant (Figure 1). Short femoral stems were preferred if a long intramedullary nail was used in the previous operation. The pHA group preferred fully porous coated stems with distal fit or grit-blasted titanium niobium alloy stems (Figure 2). The acetabular component was selected according to the adequacy of the abductor mechanism and the presence of any neurological disease leading to instability. Constrained components were preferred when the abductor mechanism was severely impaired or in the presence of neurological disease. In the pHA group, bipolar cups were used in patients with short life expectancy and without hip degeneration, while total hip arthroplasty was performed in patients with hip degeneration and long life expectancy.

The patients in both groups were allowed to walk with full weight bearing with an assistive device the day after the operation, as they tolerated. The same antibacterial and thromboembolic prophylaxis was applied in both groups. All patients were followed routinely at the 6th week, 3rd month, 6th month, and 12th month postoperatively. In the follow-up, the observation was mainly aimed at the capacity and the quality of mobilization and the need to use the assistive device in addition to the routine hip examination.

We compared the length of the operation, intra-operative blood loss, the requirement of transfusion, intraoperative complications, and hospital stay between the two groups. The comparison continued on post-operative complications, reoperation for any reason, ambulation status (preinjury and 12th month follow-up), and post-operative mortality rate until the first year follow-up. With the information obtained from the patient or family members, the ambulatory capacity before the fracture and at the 12th month after the operation was classified with a Parker score [19]. The functional status of the patients was evaluated with the Postel Merle d'Aubigné score [20].

Figure 1: (A-B) Anteroposterior and lateral hip radiographs of the patient who developed a cut-out at the post-operative 3rd month after extracapsular hip fracture fixation. (C-D) Post-operative anteroposterior hip radiographs of the patient who underwent conversion arthroplasty. The femoral stem was at least 30 mm distal to the last distal screw (black arrow).

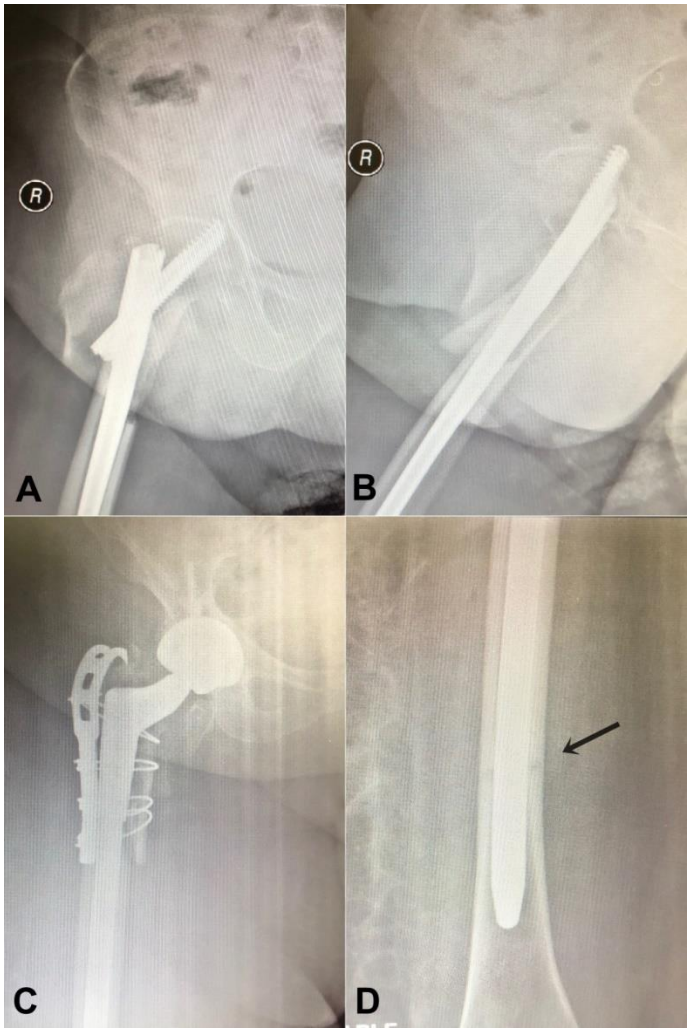

Figure 2: (A) Preoperative and (B) post-operative radiographs of a patient with an unstable extracapsular hip fracture treated with primer hip arthroplasty.

Statistical analysis

Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarized as mean, standard deviation, and median and IQR where appropriate. The chi-square test was used to compare categorical variables between the groups. The normality of distribution for continuous variables was confirmed with the Shapiro-Wilk test. For the comparison of continuous variables between two groups, the Student's t-test or Mann-Whitney U test was used depending on whether the statistical hypotheses were fulfilled or not. For comparison of preoperative-postoperative Parker measurements, paired samples t-test was used. For comparing hospitalization duration between ASA scores, the Kruskal Wallis test was used, and Bonferroni adjusted Mann Whitney U test was used for multiple comparisons of groups. For univariate analysis, event-free survival was calculated by the Kaplan-Meier method, and the log-rank test was performed to compare OS between study groups. All analyses were performed using IBM SPSS Statistics Version 20.0 (IBM SPSS Statistics for Windows, IBM Corp. Released 2011, Armonk, NY: IBM Corp) statistical software package. The statistical level of significance for all tests was considered to be 0.05.

Results

There was no difference in gender, ASA score, and BMI between the groups, but the mean age of the pHA group was higher (P=0.011). The patients' demographic data are given in Table 1. The surgical time (134.3 [34.5] vs. 66 [16], [P<0.001]), the amount of bleeding (1000 ml [400] vs. 300ml [200], [P<0.001]), the need for red blood cell transfusion (80% vs. 32%, [P<0.001]), and the frequency of intraoperative femur fracture (30% vs. 0%, [P<0.001]) were larger or longer in the cHA group compared to pHA group (Table 2).

Table 1: Patients' characteristics

	Groups		*P*-value
	cHA	**pHA**	
Age, Mean, (SD)	71.2 (9.5)	75.6 (6.1)	0.011
Gender, n (%)			
Male	17 (%39)	11 (%25)	0.170
Female	27 (%61)	33 (%75)	
BMI, Mean (SD)	29.8 (4.2)	29.4 (5.2)	0.750
ASA Score, n (%)			
1	5 (%11)	3 (%7)	0.814
2	25 (%57)	26 (%59)	
3	14 (%32)	15 (%34)	
Side, n (%)			
R	16 (%36)	21 (%48)	0.280
L	28 (%64)	23 (%52)	
Preoperative hemoglobin level g/dL, Mean (SD)	12.4 (2.4)	12.1 (1.5)	0.591
Preoperative hematocrit level %, Mean (SD)	38.0 (5.2)	36.4 (4.2)	0.107
Preoperative INR, Mean,(SD)	0.99 (0.15)	1.02 (0.13)	0.541

BMI: Body Mass Index, ASA Score: American Society of Anesthesiologists Score, INR: International Normalized Ratio

Table 2. Intraoperative characteristics

	Groups		*P*-value
	cHA	**pHA**	
Surgical time (Minutes), Mean (SD)	134.3 (34.5)	66.0 (16.0)	<0.001
Intraoperative bleeding amount (ml), median (IQR)	1000 (400)	300 (200)	<0.001
Intraoperative red blood cell transfusions, median (IQR)	1.5 (1)	0 (1)	<0.001
Intraoperative red blood cell transfusions, n(%)			
0	9 (20%)	30 (68%)	<0.001
1	13 (30%)	10 (23%)	
2	12 (27%)	3 (7%)	
3	8 (18%)	1 (2%)	
4	1 (2%)	0 (0%)	
6	1 (2%)	0 (%0)	
Intraoperative fractures, n(%)			
No	31 (70%)	44 (100%)	<0.001
Yes	13 (30%)	0 (0%)	

cHA: conversion hip arthroplasty, pHA: primary hip arthroplasty, IQR: interquartile range, SD: standard deviation

Total hip arthroplasty was performed in all 44 patients in the cHA group. Revision femoral stem was used in 32 (72.7%) of these patients, while primary stem was used in 12 (27.3%) patients. Hemiarthroplasty was performed in 34 patients (77.3%) in the pHA group, while total hip arthroplasty in 10 (22.7%). Constrained cups were used in three patients in the cHA group

for abductor arm defect and/or neurological imbalance, while no constrained systems were used in any patients in the pHA group.

No significant difference was observed between the groups in terms of hospitalization time and transfusion during the post-operative follow-up period in the hospital. When the total amount of transfusions were compared, it was observed that more patients and more transfusions were performed in the cHA group than in the pHA group (P<0.001) (Table 3).

Table 3: Postoperative characteristics

	Groups		*P*-value
	cHA	pHA	
Length of hospitalization, days, median(IQR)	5 (2)	4 (1	0.084
Post-operative red blood cell transfusion, Median (IQR)	0 (2)	0 (1)	0.456
Post-operative red blood cell transfusion, n (%)			
0	22 (51%)	23 (52%)	0.198
1	7 (16%)	14 (32%)	
2	11 (26%)	5 (11%)	
3	3 (7%)	2 (5%)	
Total red blood cell transfusion, median (IQR)	2 (1)	1 (2)	<0.001
Total red blood cell transfusion, n (%)			
0	5 (12%)	16 (36%)	<0.001
1	5 (12%)	16 (36%)	
2	16 (37%)	6 (14%)	
3	10 (23%)	6 (14%)	
4	3 (7%)	0 (0%)	
5	3 (7%)	0 (0%)	
6	1 (2%)	0 (0%)	

IQR: interquartile range

Twelve of 44 patients in the cHA group have shown 14 complications requiring surgical intervention in the first year follow-up. Of these 14 surgical interventions, nine were surgical debridement due to wound problems, two were open reduction for dislocation, one was an acetabular revision due to recurrent dislocation, one was a two-stage total revision due to infection, and one was femoral revision due to the subsidence of the femoral stem. In the pHA group, four complications were observed in four of 44 patients during the same period. Two were wound problems requiring surgical debridement, and two were dislocations treated with closed reduction. In the first year, three deaths occurred in both groups. The main causes of death in the pHA group were myocardial infarction in one patient, ischemic stroke in one, and lung disease in one. In the cHA group, two patients died from ischemic stroke and one from myocardial infarction (Table 4).

Table 4: 1st year complications, mortality and functional status

	Groups		*P*-value
	cHA	pHA	
1st year complications, patients (%)			
No	32 (73%)	40 (91%)	0.027
Yes	12 (27%)	4 (9%)	
1st year mortality, patients(%)			
No	41 (93.2%)	41 (93.2%)	1
Yes	3 (6.8%)	3 (6.8%)	
Parker Score at 1st, (SD)	5.9 (2.1)	5.7 (2.0)	0.322
The Merle d'Aubgine Postel Score at 1st year, mean (SD)	12.5 (3.3)	13.0 (2.7)	0.434

At the 12th month of the operation, the walking capacity of all patients decreased compared to pre-injury. While the mean Parker score was 7.9 (1.6) before injury in the cHA group, it was 5.9 (2.1) at the 12th-month follow-up (P<0.001). These values were 7.5 (1.2) and 5.7 (2.0) in the pHA group, respectively (P<0.001). No difference was observed when the functional levels of the groups were compared in the 12th month. The mean Merle d'Aubgine Postel score in the 12th month was 12.5 (3.3) in the cHA group and 13.0 (2.7) in the pHA group (P=0.434).

Discussion

Hip fractures significantly burden health systems with the aging of society [1]. Mortality in hip fractures in the first 6 months can reach up to 50% even with modern treatment methods [3,17,21]. Surgical treatment methods have lower mortality rates than conservative methods because the patient can be re-mobilized quickly [3]. Factors that increase mortality are advanced age, high ASA grade, delayed surgery, low mobilization capacity before fracture, and delayed mobilization with full weight bearing [2,4,21–26]. Among these mortality factors, we can only change the time delay of surgery and early mobilization with full weight bearing. Ottesen et al. [4] stated that early mobilization and full weight-bearing after hip fracture surgery reduce complications and mortality, so the chosen surgical method should be a method that will allow early full weight-bearing.

Similarly, many publications state that mobilization with early full weight bearing decreases mortality and complications [23-25]. Patients admitted to our clinic with a hip fracture are targeted to undergo surgery within the first 24 h unless they have significant contraindications. Thirty-six (82%) of 44 patients in the pHA group in our study were operated on within the first 48 h (28 within the first 24 h). The most common reasons in patients with a delay of more than 48 h were antiaggregant usage and unstable cardiac condition. The mortality rate of these 44 patients within 12 months was 6.8%. In the literature, 12-month mortality rates of various surgical methods vary between 14.5% and 30% [2,9,11,17,27]. We believe that this success rate and decreased mortality in our series is due to early surgery, which allows full weight bearing with an assistive device in the early post-operative period.

Fixation is the primary treatment method for stable extracapsular hip fractures [7-9]. However, this consensus does not exist for unstable fractures. In unstable fractures, the success of fixation methods decreases and complication rates increases [7,8,10–11]. Loss of fixation and position of the fracture, cut-out, non-union, and infection are common complications [10,12,13]. The reason for the continuous evolution of the hip screws is because of these unwanted but expected problems of these instruments. These complications sometimes cause irreparable problems, and arthroplasty is used as a conversion procedure [14,15]. However, arthroplasty procedures after failed fixation are more challenging and have high complication rates [15-16]. Due to the necessity of implant removal, deranged anatomy, and the requirement for revision frequently stems, conversion arthroplasty is a longer and more complicated procedure, with more bleeding [15,27–30]. The incidence of intraoperative fracture, which is one of the most important complications of conversion arthroplasty performed on the ground of extracapsular fracture, is up to 47% [28,30-32]. In our series, in the cHA group, the operation time was longer (134.3 [34.5] min vs. 66.0 [16.0] min), and the bleeding volume was higher (1000 ml [400] vs. 300 ml [200]) compared to the pHA group. In addition, while no intraoperative fractures were observed in the pHA group, 13 (30%) of 44 patients in the cHA group developed fractures. The reasons for more common intraoperative fractures in cHA are decreased bone density due to prolonged immobilization after fracture, defects in the bone during removal

of old implants, and increased need for revision stems. Therefore, Archibeck recommended placing prophylactic cables in the area of old screw holes [15].

Our study had some limitations. Our study, which was designed retrospectively, lacked randomization. Although ASA grade, gender, and age were taken into account when choosing the pHA group, the mean age of patients in the pHA group was higher than that of the cHA group. Our study compared only the first-year follow-up after the operation. Different results can be obtained with a longer follow-up time. Arthroplasty and fixation in extracapsular hip fractures should be compared with large patient groups over longer periods.

Conclusion

In conclusion, arthroplasty performed as conversion surgery after unsuccessful fixation has a higher risk of intraoperative and post-operative complications than arthroplasty performed after a fracture. We believe that cases prone to implant failure, non-union, or prolonged immobilization due to unreliable fixation should be treated with primary arthroplasty to avoid undesired complications.

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