Conversion of failed hemiarthroplasty to total hip arthroplasty
A short-term follow-up study
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Abstract
Purpose of this study was to evaluate the outcomes of patients underwent hemiarthroplasty for proximal femoral fracture converted to total hip arthroplasty (THA).

A total of 138 patients from October 2009 till October 2014 had conversion of their failed hemiarthroplasties following a proximal femoral fracture to total hip arthroplasty (THA) in Erfan and Milad hospitals, Tehran. We performed a prospective analysis of the outcome of conversion surgery in patients with failed hemiarthroplasty. The patients had clinical evaluations at 1 month, 6 months, 1 year, and annually thereafter. We used Harris Hip Score (HHS) to evaluate the results of conversion procedure in terms of relief of groin pain and functional improvement.

Dislocation occurred in 6 patients (4.34%). The mean period of follow-up was 42 months (range 36–60 months). HHS score improved from mean preoperative score of 44.93 ± 8.40 to 95.41 ± 2.27 at final follow-up. The survivorship analysis with revision of HHS score was 89.1%. Existence of infection (P = .038) and time of primary operation to being symptomatic (P = .009) can predict the postoperative pain significantly.

THA is a safe option which can lead to good functional and short-term and mid-term outcomes; and patients should be informed of the possibility of incomplete relief of groin pain or other symptoms postoperatively.

Abbreviations: CRP = C-reactive protein, DVT = deep vein thrombosis, ESR = estimated sedimentation rate, ETO = extended trochanteric osteotomy, HCL-PE = highly cross-linked-PE, HHS = Harris Hip Score, LLD = leg length discrepancy, THA = total hip arthroplasty.

Keywords: conversion, failure, hemiarthroplasty, total hip arthroplasty

1. Introduction
Displaced, unstable fractures of the femoral neck generally represent an indication for early surgical intervention. Established treatment options include internal fixation with cannulated or sliding hip screws, hemiarthroplasty, or total hip replacement. Well-recognized goals of surgical treatment are immediate pain relief, rapid mobilization and ambulation, accelerated rehabilitation, and maintenance of independent living. In addition to these prerequisites, the ideal implant must be associated with a low risk of surgical complications and subsequent revision.[1–3] Treatment of intracapsular fractures of femoral neck and their dislocation in geriatric patients is unipolar or bipolar hemiarthroplasty.[4] There is increasing evidence that primary hemiarthroplasty is a better treatment for displaced femoral neck fractures than osteosynthesis.[5,6] When hemiarthroplasty is used in mobile independent patients, it frequently requires conversion to total hip replacement, the result of which is reportedly inferior to a primary procedure.[7] Those whose hemiarthroplasties are not converted often suffer chronic hip pain with reduced mobility.[7]

Some hemiarthroplasties fail and they should be revised for complex of impaired walking, groin pain, or leg length discrepancy. Reoperation rate has been reported between 5% and 24% in patients with hemiarthroplasty failure.[8] Some previous studies performed showed that patients with failed hemiarthroplasty had functionally acceptable life style after total hip arthroplasty (THA).[9–12] The indications for conversion of hemiarthroplasty to THA include acetabular erosions and protrusion causing groin pain, femoral loosening and subsidence causing thigh pain and the typical “start-up” pain, dislocation, breakage of implant leading to loss of function, periprosthetic fracture and infection.[11] Conversion of a well-fixed hemiarthroplasty with failure on the acetabular side has been reported to be a simple procedure using a standard acetabular cup; the femoral stem may be left in situ.[13] Previous study showed that patients treated by THA have better condition such as mobility and pain relief after long-term follow-up rather than patients treated with hemiarthroplasty.[14] The need to replace the femoral stem depends on several factors: the indication for surgery, the type of failed hemiarthroplasty (including whether the failed implant has a removable unipolar or bipolar head), and compatibility with available components.[10]
There have been few reports have explored the results of conversion from hemiarthroplasty to THA in Iran and worldwide. Purpose of this study was to evaluate the outcomes of patients underwent hemiarthroplasty for proximal femoral fracture converted to THA.

2. Patients and methods

2.1. Patients

A total of 138 patients from October 2009 till October 2014 had conversion of their failed hemiarthroplasties following a proximal femoral fracture to THA in Erfan and Milad hospitals, Tehran. We performed a prospective analysis of the outcome of conversion surgery in patients with failed hemiarthroplasty. Twelve patients lost during follow-up. During period of study 90 men (65.2%) and 48 women (34.8%) with a mean age of 64.05 ± 15.08 years (range 25–87 years) at the time of conversion arthroplasty were entered. Seventy-five patients (54.3%) were community ambulators, 39 of them (28.3%) were homebound and rest of them (17.4%) were bedridden. Six patients (4.3%) had chronic kidney disease, 6 patients (4.3%) diabetes mellitus, and 6 patients (4.3%) rheumatoid arthritis. All noninfected patients checked for C-reactive protein (CRP) and estimated sedimentation rate (ESR) preoperatively which were negative for them.

2.2. Surgical procedures and prosthesis

Patients revised for infection had a 2-stage revision. Two-stage revision of infected bipolar arthroplasty was used in 8 patients (5.8%) (Fig. 1); standard direct lateral approach (Hardinge approach) in 94 patients (68.1%) (Figs. 2 and 3); extended trochanteric osteotomy (ETO) in 30 patients (21.7%) (Fig. 4) and 2-stage revision of infected unipolar arthroplasty in 6 patients (4.3%).

All prostheses used were of Zimmer Company (Zimmer, Warsaw, IN). Acetabular grafting with allograft (bulk) was used for 6 patients with acetabular erosion with use of cemented cups. Cementless prostheses were used in 123 patients (89.1%), cemented in 15 patients (10.9%). We used metal on highly cross-linked-PE (HCL-PE) in all patients. Two-stage revision arthroplasty including removal of the prosthesis and cement, thorough debridement and placement of an antibiotic-impregnated cement spacer performed for first stage in 12 patients (8.7%) and only placement of an antibiotic-impregnated cement spacer did for first stage in 18 patients (13%) and a delayed second-stage revision arthroplasty performed thereafter. Twenty-four patients (17.4%) underwent direct lateral approach and 6 patients (4.3%) ETO for second stage.

Preoperative prophylaxis against infection was given to all patients (cefazolin 1 g intravenously before the surgery followed by 1 g 3 times daily for 3 days). Subcutaneous clexane (40 mg...
once daily) starting on the day of surgery was given to all patients for 7 to 10 days in addition to antiembolism stockings as prophylaxis against deep vein thrombosis (DVT). Oral aspirin (130 mg once daily) was given for 3 to 4 weeks after discontinuation of anticoagulant. No routine screening for DVT was done. Early mobilization was used both to prevent DVT and to hasten the functional recovery (in-bed mobilization starting from the first postoperative day in all patients except when specifically contraindicated). Full weight-bearing was allowed from the third day onwards in all cases with hybrid arthroplasty. Patients with cementless components (n = 123) were allowed full weight-bearing after 12 weeks.

Complications local to each joint including fracture, dislocation, superficial wound infection, deep wound infection around the prosthesis and incidence of heterotopic ossification were recorded. We did not use prophylaxis for heterotopic ossification. Systemic complications including cardiac, gastrointestinal complications, cerebrovascular accidents, phlebitis/pulmonary embolism, and urinary tract infection were also noted.

2.3. Follow-up

We evaluated all patients clinically and radiologically with serial follow-ups to obtain the possible cause of failure. We used Harris Hip Score (HHS) for functional evaluation in the preoperative, postoperative, and follow-up assessment. The higher score in the HHS demonstrates the less dysfunction. A total score of 70 is considered a poor result; 70 to 80 is considered fair, 80 to 90 is good, and 90 to 100 is an excellent result. The mean period of follow-up was 42 months (range 36–60 months). We followed up the patients with mean of 4.67 times during the study.

The patients had clinical evaluations at 1 month, 6 months, 1 year, and annually thereafter following the conversion procedure and the second procedure in the 2-stage group. Although the HHS at final follow-up of 5 years was recorded for all patients, the 6-month HHS was used to evaluate the results of conversion procedure in terms of relief of groin pain and functional improvement. Any other complications and the details of any revision procedure were also noted.

2.4. Statistical analysis

We used descriptive statistical analyses to present mean and standard deviation of quantitative variables. Paired sample T test for comparison of pre and postoperative variables, linear regression test for predicting factors and Kaplan–Meier analyses used to calculate survival probabilities with 95% confidence limits at 5 years. For all analyses, we used SPSS (SPSS 19.0 for Windows; SPSS, Inc., Chicago, IL).
Table 1
Complaints of patients with previous hemiarthroplasty.

| Complaints                  | Frequency | Percent |
|-----------------------------|-----------|---------|
| Groin pain                  | 105       | 76.1    |
| Limping                     | 93        | 67.4    |
| Groin pain + LLD            | 90        | 65.2    |
| Limping + LLD               | 76        | 56.5    |
| Groin pain + limping        | 60        | 43.5    |
| Groin pain + limping + LLD  | 45        | 32.6    |
| LLD                         | 39        | 28.3    |

Table 2
Harris Hip Score based on indication of surgery.

| Etiology of hemiarthroplasty | Preoperative HHS | First follow-up HHS | Last follow-up HHS |
|------------------------------|------------------|---------------------|--------------------|
| Dislocation (n=12)           | 32.25 ± 3.86     | 91.50 ± 0.57        | 92.50 ± 0.57       |
| Stem loosening (n=54)        | 45.50 ± 10.04    | 92.39 ± 2.22        | 96.44 ± 1.75       |
| Acetabular Erosion (n=42)    | 47.00 ± 6.28     | 82.80 ± 19.97       | 95.00 ± 2.66       |
| Acetabular Erosion + femoral loosening (n=30) | 45.00 ± 2.09 | 91.00 ± 0.89 | 95.00 ± 2.19 |

HHS = Harris Hip Score

2.5. Ethics
We considered all ethical issues for patient’s information and procedures based on ethical committee of Tehran University and ethical statements. All patients were given an informed consent for surgery procedure and their surgery was done based on scientific indication and evaluations.

3. Results
The main indications for conversion arthroplasty were stem loosening in 75 patients (54.4%) (Fig. 3) and acetabular erosion in 66 patients (47.7%); there were also 12 patients (8.6%) with an unreduced dislocation (Fig. 4); 9 patients (6.5%) with femoral erosion and 6 patients (0.1%) with protrusion (Fig. 2).

The mean time from primary operation to appearance of symptoms in patients with alone stem loosing was 41 months (range 6–24 months), 34 months for combination of acetabular erosion and stem loosening (range 6–96 months), 15 months for dislocated hemiarthroplasty (range 6–24 months), and 96 months for femoral erosion (range 96–96 months).

The mean time of interval from appearance of symptoms to revision surgery in patients with alone stem loosing was 41 months (range 6–108 months), 57 months for alone acetabular erosion (range 18–108 months), 34 months for combination of acetabular erosion and stem loosening (range 6–96 months), 15 months for dislocated hemiarthroplasty (range 6–24 months), and 96 months for femoral erosion (range 96–96 months).

The mean time of interval from appearance of symptoms to revision surgery in patients with alone acetabular erosion (range 12–24 months), 13 months for combination of acetabular erosion and stem loosening (range 6–24 months), 12 months for dislocated hemiarthroplasty (range 6–18 months), and 17 months for all 3 cases of femoral erosion.

Table 1 shows the presenting complaints of patients. Groin pain (105, 76.1%) and limping (93, 67.4%) were the chief presenting complaint. Standard surgery approaches to the hip were used in all patients.

Ten patients (7.24%) had infection. The mean preoperative HHS score was 44.93 ± 8.40 in patients (ranged 30–62). The average of shortening was 1.79 ± 1.11 preoperatively in patients (ranged 0–3). Thirty-three patients (23.80%) had acetabular deficiency (23 patients Paprosky type I (69.6%) and 10 patients Paprosky type II (30.4%)) and 6 patients were managed with femoral bulk allograft; 6 patients with PE cemented; 12 of them with central IM Augment and 9 patients with reflection cup.

4. Discussion
Hemiarthroplasty is a quick and highly standardized procedure that allows for early weight bearing and recovery. However, most patients with a hip fracture have osteoarthritis, which may necessitate secondary conversion to total hip replacement, especially in active elderly people with higher physical demands. Also when hemiarthroplasty is used in mobile...
independent patients, it frequently requires conversion to total hip replacement, the result of which is reported to be inferior to a primary procedure. Those whose hemiarthroplasties are not converted often suffer chronic hip pain with reduced mobility and it had some complications for them.\[14\]

In this study we evaluated early outcome of patients with failed hemiarthroplasty which converted to THA. The most important finding in our study was the significantly better and excellent function in follow-up of all types of conversion procedures.

In our study 76.1% of patients who had failed hemiarthroplasty complained of groin pain, 67.4% limping, and 43.5% both of them. In Pankaj et al study,\[11\] 41% patients complained of groin pain, 25% of thigh pain and 14% had both. Pain following hemiarthroplasty is usually due to 1 of 2 pathological processes: articular cartilage degeneration in the acetabulum or loosening of the prosthesis. These pathological processes are exacerbated by many factors including incongruence between the femoral head and the acetabulum, excessive neck length, impaction at the time of injury, cementation of the prosthesis, physiologically young active patients and shear forces between the prosthesis and the cartilage.\[10,11,17–20\]

Previous studies indicated that conversion to total hip replacement would give satisfactory results.\[9,13\] But some other studies have reported that conversion of hemiarthroplasty to THA is associated with high complication and loosening rates as against primary THA.\[10,13,20,21\] Groin pain does not seem to be relieved completely in every patient after conversion to THA. Sharkey et al,\[22\] while reporting the results of conversion of painful hemiarthroplasty to THA in 45 patients observed that 20% of the patients continued to have groin or buttock pain after THA and they could not identify a factor that would predict an unsuccessful result. In Pakanj et al study 15 out of 18 (83%) patients who had isolated groin pain preoperatively experienced no pain postoperatively while 3 patients (17%) reported only partial improvement. Six patients who had both groin and thigh pain were relieved of both postoperatively.\[11\] It is suggested that patients should be informed of the probable results before the surgery and they may experience some groin pain postoperatively.

Our results showed that conversion of painful hemiarthroplasty gives good results with regard to the pain relief and functional scores which our HHS was improved in follow-up sessions and increased from a mean of 44.93 preoperatively to 89.76 at the last follow-up. This was in line with Hammad and Abdel-Aal\[10\] study which it also showed the improvement of HHS from preoperative to last follow-up. Also the results of Pankaj et al\[11\] study were similar to our results regarding HHS follow-up. In our study groin pain was significantly decreased at last follow-up. Also after last follow-up 36 patients could ambulate without support and 10 patients had minimally needed support for ambulation with walker. Our results were similar to Pankaj and Hammad studies.\[10,11\] These results supported the clinical efficacy of THA in patients with failed hemiarthroplasty in short-term follow-up and it will help them to suffer lesser pain after the surgery. In view of these results current evidence is emerging that favors THA over hemiarthroplasty for treatment of displaced fractures of the neck of the femur in patients who are elderly but have an active physical life.\[14,22\]

Our postoperative complications were dislocation in 6 patients necessitating revision surgeries, superficial infection in 6 hips responded to local wound care and antibiotics, persistent wound discharge in one hip and no surgery-related death was seen in our study group. We did not have any loosening at the end of follow-up. Data about intra- and postoperative complications of conversion arthroplasty were high. This issue led to difficulties of this surgery in patients, especially in elderly patients.\[12,23,24\] In Amstutz and Smith study they evaluated 41 patients with conversion arthroplasty; they had 5 intraoperative proximal femoral fractures, 2 perforations of the medial cortex with stem protrusion, 2 cases with instability, 2 cases with infection, 3 patients with deep venous thrombosis, and 6 patients with progressive loosening. Three patients had required revision by the end of follow-up at mean of 36 months.\[23\] Hammad and Abdel-Aal\[10\] showed that there were 9 complications occurred in 8 patients in their study; 1 patient had early wound infection which cured completely after debridement, suction–irrigation and 6 weeks of intravenous antibiotics; 2 patients had incomplete sciatic nerve lesion which recovered completely in 1 patient and improved in the other at 1 year follow-up; 6 patients had persistent groin pain. In Llinas et al\[25\] study they followed up patients at mean time of 87 months and they had a 6% revision rate which is comparable to the 5% revision rate for primary total hip in a similar period. Cossey and Goodwin\[9\] showed that 46 patients who had conversion arthroplasty; they had no loosening, no dislocation but 2 patients with superficial infection and 3 patients were dead at the time of study. The incidence of dislocation after conversion arthroplasty has been reported as varying from 0% to 50% in different series. Pankaj et al\[11\] had 1 dislocation and in the early postoperative period which they contributed it to postoperative instability and technique related. They also reported 1 patient with loosening. Sierra and Cabanela\[13\] study which was performed on 132 hemiarthroplasties converted to THA reported a 10% rate of loosening after a mean follow-up of 7.1 years and major complications in 45%, including 12 intraoperative femoral fractures (9%) and 13 dislocations (9.8%). These results showed that complications of THA in our study was lower than others and was similar to Pankaj et al study. It can contribute with short-term follow-up but we had fewer complications than similar follow-up studies. Because of this type of surgery and previous neck of femur fracture in the patients, it should consider careful selection of patients for each type of arthroplasty (hemiarthroplasty vs THA) to improve the outcome of arthroplasty for this group of patients. Lack of loosening in this study can be related to most usage of cementless prosthesis.

Persistent pain after implanting a hemiarthroplasty in the management of intracapsular fracture of the femoral neck is common and may be due to infection, acetabular erosion, aseptic loosening, and impingement.\[20,21\] For cementless prostheses, inadequate calcar seating, inappropriate choice of head size, subsidence and rotational instability of the prosthesis may also cause pain.\[26\] Capsular impingement against the inner bearing of the acetabular component has been described as a source of pain following bipolar hip arthroplasty.\[27\] Erosion of the acetabular cartilage might result from direct injury during the original incident, excessive pressure on the cartilage due to lengthening of the leg, local stress concentration due to a mismatch between the acetabulum and the prosthetic head diameters, as well as penetrative wear of the hard metallic head against soft articular acetabular cartilage. Degeneration of the articular cartilage has been correlated to the length of time since the hemiarthroplasty.\[28\]

We showed that the survivorship analysis with revision of HHS score was 89.1%, pain 82.6%, activity status 78.3% at 60 months. Pankaj et al\[11\] reported the survivorship analysis with revision of either component as an end point demonstrated a mean survival of 97.4% at 72 months. We showed that no systemic complications were recorded during the follow-up. This
was similar to Pankaj et al study[11] and Hammad and Abdel-Aal study.[10]

We demonstrated that existence of infection (P = .038) and time of primary operation to being symptomatic (P = .009) in our study group can predict the postoperative pain significantly. Gender (P = .009) and first follow-up HHS score (P = .011) can predict the activity of patients at the end of follow-up. These predicting factors for postoperative follow-up were not evaluated in other studies. Although type of our study is not good for this issue, but these factors can help surgeons to predict large population and multicentric research to obtain predicting factors of poor prognosis or outcome of THA.

For the first time in an Iranian population, we showed that conversion of failed symptomatic hemiarthroplasty to THA is a safe option which can lead to good functional and short-term and mid-term outcomes. It seems that patients should be informed of the possibility of incomplete relief of groin pain or other symptoms postoperatively. We also showed that time of primary operation to being symptomatic and infection in patients had poor prognosis in existence of pain postoperatively. Performing large scale studies with long-term outcome evaluation is recommended.

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