

Outcomes of salvage total hip arthroplasty after failed osteosynthesis for collum femoris fractures

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ABSTRACT

BACKGROUND: This study is an investigation of the outcomes of salvage total hip arthroplasty (THA) to treat collum femoris fractures that resulted in complications or failure after osteosynthesis.

METHODS: Twenty patients (6 male, 14 female; mean age: 56.7 years) who underwent salvage total hip arthroplasty (THA) between 1988 and 2012 due to failure developing after closed reposition and osteosynthesis in the treatment of collum femoris fractures were included in the study. The type of osteosynthesis, and the length of time until failure and before THA application after collum femoris fracture were recorded. Cementless acetabular and femoral components were used in all of the patients. Complications were defined as those occurring during and after surgery. The clinical results were assessed with the Harris Hip Score (HHS) and the presence of loosening was assessed with radiological evaluation in follow-up.

RESULTS: The mean length of the follow-up period was 59.4 months (range: 15–178 months). The collum femoris fractures of the 20 patients were classified as: 5 Garden type II, 13 type III, 2 type IV, and 3 Pauwels type I, 8 type II, and 9 type III. Cannulated screws were used in 13 patients (65%) and dynamic hip screw (DHS) fixation was used in 7 patients (35%). Complications observed after osteosynthesis were nonunion in 4 cases (20%), malunion in 2 (10%), avascular necrosis in 10 (50%), and implant failure in 4 (20%). A mean of 9.66 months (range: 3–54 months) elapsed before osteosynthesis failure and the mean length of time until THA was 31.6±51.7 months. There was no statistically significant difference between cannulated screw and DHS fixation in the development of complications ($p=0.084$). Early dislocation (5%), periprosthetic fracture (5%) and acetabular protrusion (5%) were recorded as complications. A revision was made upon determination of loosening in the 10th year in the patient who developed early dislocation. While the mean HHS was 54.05±8.22 before THA, it was evaluated to be 86.45±8.73 at the last follow-up, which was a statistically significant difference ($p<0.0001$).

CONCLUSION: The study findings demonstrated that THA applied with suitable surgical technique is a safe and successful method that may be used after failed osteosynthesis in cases of collum femoris fracture.

Keywords: Hip arthroplasty; hip fracture; osteosynthesis.

INTRODUCTION

Osteosynthesis is recommended as the first treatment of choice in the early period of collum femoris fracture treatment. There is some divergence of opinion about treatment options in patients of advanced age, especially in cases of displaced collum femoris fracture.^[1–3] Although some authors

recommend total hip arthroplasty (THA), stating that there is high rate of failure after osteosynthesis, the traditionally accepted view is to use the osteosynthesis technique in patients over 65 years of age.^[2] Osteosynthesis treatment includes open and closed reposition surgical options in combination with cannulated screw or dynamic hip screw (DHS) application. Independent of the option, the failure rate of osteosyn-

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thesis in advanced age is reported to be 22.6%.^[4] THA is a salvage therapy in the treatment of failure developing after osteosynthesis. There is no consensus in the literature about the success or complications of hip arthroplasty performed as salvage therapy. While some authors report poor clinical outcomes and high complication rates, others report successful clinical outcomes and low complication rates.^[5,6]

This study was an evaluation of the clinical and radiological outcomes of THA applications performed as salvage therapy in the treatment of problems occurring related to osteosynthesis for collum femoris fractures.

MATERIALS AND METHODS

Twenty patients who underwent THA between 1988 and 2012 due to the development of failure after closed reposition and osteosynthesis following a collum femoris fracture were included in the study. Patients with union occurring after closed reposition but coxarthrosis developing in the late period were not included in the study. Nonunion, avascular necrosis, and implant failure were considered to be preoperative osteosynthesis failures. Femoral stem with cement procedures and hemiarthroplasty cases were excluded from the study. The mean age of the patients included in the study was 56.75 ± 12.15 years. The collum femoris fractures were classified according to the Garden and Pauwels systems and the surgical implant was performed with cannulated screw or DHS fixation.

After removal of osteosynthesis materials in the lateral decubitus position with a lateral approach as the standard method, the anterior capsule and labrum were partially resected to achieve standard exposure. The acetabular component was press fit and an acetabular screw was added for extra stability. The femoral component was press fit without cement. A highly cross-linked polyethylene acetabular insert was used in the last 14 cases that were operated on after 2006. A 28-mm metal cobalt chrome femoral head was used in all of the patients. Patients with a cemented femoral component were excluded from this study to create a homogenous series.

The length of time between the fracture and osteosynthesis as well as between the osteosynthesis and the application of salvage THA was recorded. The presence of >3 mm or $>2^\circ$ change in position of the femoral component observed on X-ray, or the presence of $>2^\circ$ or ≥ 2 mm change in position of the acetabular component and presence of pain were considered to indicate loosening.^[7]

Enoxaparin was administered at a dose of 0.4 cc subcutaneously as prophylaxis for deep-vein thrombosis and the patients were discharged with directions for the use of 300 mg oral acetylsalicylic acid. The use of a cephalosporin antibiotic initiated for prophylaxis before surgery was maintained for 48 hours and then discontinued.

The patients were allowed to walk with tolerated weight-bearing within 48 hours after the surgery. Full weight-bearing was initiated at 6 weeks after surgery. The HHS was used in the clinical assessment of the patients. Complications that developed after surgery and their treatments were determined. IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA) was used to perform the statistical analysis. A t-test was used for intergroup comparisons of quantitative data and a chi-square test for intergroup comparisons of qualitative data. Post-hoc power analysis was performed by using G*power version 3.1.7 (Faul, F. et al., Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). The comparison of preoperative and postoperative HHS values had a level of $\alpha=0.05$, power 100% ($1-\beta=1.00$), and impact magnitude (d) of 6.50 (cannulated screw) and 3.69 (DHS).

RESULTS

Twenty hips of 6 male and 14 female patients were included in the study. The development of a complication after osteosynthesis occurred at a mean of 9.66 months (range: 3–54 months) and THA was performed at a mean 31.6 ± 51.7 months (range: 5–240 months) after osteosynthesis surgery (Table 1).

The mean duration of the follow-up period of the patients included in the study was 59.4 ± 52.4 months (range: 15–178 months). Five patients were classified as type II, 13 patients as type III, and 2 patients as type IV according to the Garden classification system, and 3 patients were considered to be type I, 8 patients type II, and 9 patients type III according to the Pauwel classification system. The mechanism of the fracture was a simple fall for 11 patients, 7 patients had a fall from a height, and 2 patients were involved in traffic accidents. Osteosynthesis applied due to a collum femoris fracture was performed on a traction table using 3 cannulated screws in 13 patients (65%) (Fig. 1a, b) and DHS in 7 patients (35%) after closed reposition. Complications developing after osteosynthesis were nonunion in 4 patients, malunion in 2 patients, symptomatic avascular necrosis in 10 patients, and implant failure in 4 patients (Table 1).

Femoral components used for THA as prosthesis options were inserted into the femur without cement (Fig. 1c). An acetabular component with screw fixation was used in 18 of the patients and a porous-coated acetabular component without screw fixation was used in 2 patients. The diameter of the implants inserted into the acetabulum was between 46 and 54 mm. Anterolateral entry was used in all patients, with a standard lateral approach.

Due to excessive reaming in 1 patient during preparation of a line-to-line presplit of the acetabular component, the medial acetabular wall was breached. It was not possible to press fit the acetabular component or to use only cement. This problem was resolved with an acetabular reconstruction cage and an acetabular liner with cement. Dislocation was seen in 1

Table 1. Patient demographic data and clinical and radiological results

Patient	Age	Sex	Side	Garden	Pauwels	Osteosynthesis material	Osteosynthesis failure	Osteosynthesis-THA time (months)	THA follow-up (months)	Complication	Femoral head	Preop HHS	Control HHS	Loosening
C.A.	63	F	L	4	2	Cannulated screws	Nonunion	5	84	Femoral fissure	28	47	78	No
D.A.	52	F	L	2	3	Cannulated screws	Avascular necrosis	37	102	No	28	60	92	No
F.E.	45	F	R	3	3	Cannulated screws	Avascular necrosis	240	58	No	28	64	97	No
M.O.	42	M	L	3	3	Cannulated screws	Avascular necrosis	35	10	No	28	64	96	No
N.Y.	70	M	L	3	2	Cannulated screws	Avascular necrosis	67	157	Postoperative dislocation	28	59	83	No
R.I.	70	F	R	3	3	Cannulated screws	Avascular necrosis	8	102	No	28	42	75	No
S.K.	67	M	L	3	3	DHS	Nonunion	7	6	No	28	41	89	No
F.A.	60	F	R	4	3	Cannulated screws	Avascular necrosis	26	37	No	28	57	94	No
H.C.	33	M	R	3	3	Cannulated screws	Implant failure	36	16	No	28	44	79	No
V.Ç.	52	M	L	3	3	Cannulated screws	Malunion	18	34	No	28	55	92	No
Z.U.	55	F	R	3	2	DHS	Avascular necrosis	9	23	No	28	41	65	No
S.S.	78	F	L	3	2	DHS	Avascular necrosis	8	13	No	28	46	73	No
M.K.	40	F	R	3	1	DHS	implant failure	7	118	No	28	47	83	No
E.D.	44	F	L	2	1	Cannulated screws	implant failure	24	2	No	28	64	94	No
A.S.	52	F	L	3	3	Cannulated screws	Nonunion	9	17	No	28	56	92	No
B.A.	60	F	L	3	2	Cannulated screws	Nonunion	5	12	No	28	59	94	No
H.D.	63	F	R	3	2	Cannulated screws	Avascular necrosis	14	178	No	28	60	89	No
N.T.	61	M	L	2	2	DHS	Avascular necrosis	12	96	No	28	55	89	No
S.U.	65	F	R	2	1	DHS	Implant failure	48	84	No	28	64	92	No
S.Ş.	73	F	R	2	2	DHS	Malunion	17	8	No	28	56	83	No

THA: Total hip arthroplasty; HHS: Harris hip score; F: Female; M: Male; L: Left; R: Right.

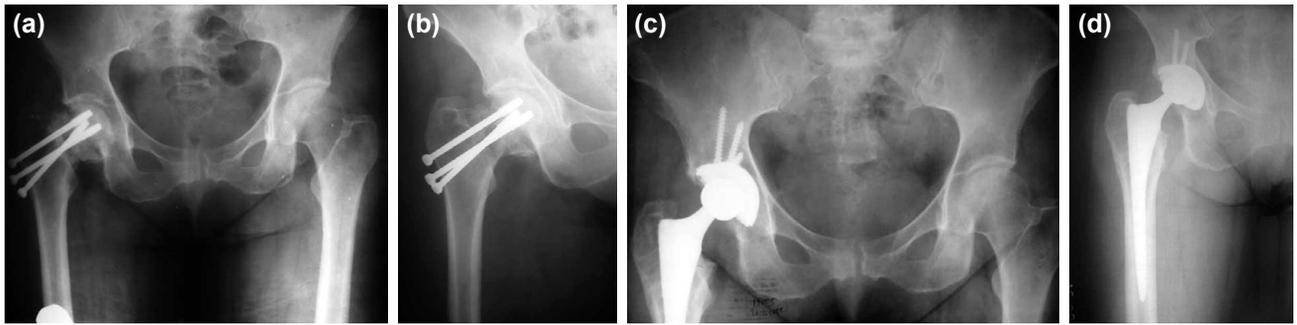


Figure 1. (a) A 63-year-old female referred for pain in the right hip. (a) Preoperative pelvis anteroposterior (AP) and (b) hip AP X-ray revealing failed osteosynthesis with cannulated screws. (c) Early postoperative X-ray. (d) Control X-ray demonstrating enough union.

patient in the early period and treated with open reduction and femoral component revision. The femoral component was malpositioned and the abductor tension was loose. The position of the femoral component was adjusted with a lateralized component. Debridement was performed and a second surgery was performed for this patient due to a superficial surgical site infection in the early period. Loosening of the arthroplasty was encountered at the 10th year follow-up of the patient. Deep infection was not encountered in any of the patients. Due to the occurrence of a nondisplaced fracture during the insertion of the femoral component in 1 patient during the surgery, osteosynthesis was provided with a surgical cable.

Final follow-up radiological evaluations were conducted in all but 2 cases; the patients had died due to diseases not related to the THA surgery (Fig. 1d). Those 2 patients had 84 months and 8 months of radiological follow-up. Revision was performed in 1 patient (5%) after loosening. Radiological loosening and corrosion of polyethylene components was not observed in any of the other patients.

The mean HHS assessment performed in the clinical evaluation of the patients before the salvage THA was 54.05 ± 8.22 , and the mean value recorded in the last follow-up visit was 86.45 ± 8.73 , which demonstrated a statistically significant difference ($p < 0.0001$).

DISCUSSION

Ordinarily, the first treatment of choice in a collum femoris fracture is osteosynthesis.^[1,8] In a meta-analysis regarding displaced collum femoris fractures, the failure rate of correction within the first 2 years was reported to be 26% to 30%.^[9] Parker et al.^[10] reported that the failure rate in cases of osteosynthesis was high and secondary surgeries were required. Failure can be treated with the application of salvage THA.^[5,11] Some authors suggest performing THA in the first instance due to the failure rate of osteosynthesis, especially in patients over 70 years of age with a displaced collum femoris fracture.^[1]

McKinley et al.^[5] compared the results of THA performed in the early period after a collum femoris fracture and the

results of THA performed as salvage treatment, and they reported higher complication rates and a low survival rate in the patients who underwent a salvage procedure after an open collum femoris fracture. In a comparative study performed by Oztürkmen et al.,^[12] the authors found a higher rate of failure in salvage THA cases compared with primary THA cases. The authors reported a higher complication rate with salvage THA after failure of osteosynthesis performed following proximal femur fractures, but the cases with a collum femoris fracture were not evaluated separately.^[13,14]

Archibeck et al.^[15] reported that THA used to treat failure after osteosynthesis for a collum femoris fracture had a successful and acceptable complication rate. Mortazavi et al.^[16] found that among THA cases, collum femoris fractures had a more successful course with a lower complication rate compared with intertrochanteric fractures. However, both successful and unsuccessful results have been published in the literature.^[5,6] Said et al.^[17] reported a study which included eight patients with salvage THA. In this study, six patients had achieved good functional outcome and pain-free gait and the other two patients had unsatisfactory result. Archibeck et al.^[15] reported a mean HHS of 82 at the last follow-up in salvage THA cases. The mean HHS was determined to be 86.45 ± 8.73 in the follow-up of the cases included in our study. The clinical success rate in our study was higher than that of similar studies. A complication rate of 15% was determined in the present study. Mortazavi et al.,^[16] Archibeck et al.,^[15] Mehlhoff et al.,^[18] McKinley et al.,^[5] and Oztürkmen et al.^[12] reported complications related to orthopedics at a rate of 10%, 12%, 15%, 18%, and 60%, respectively.

Complications that may develop after salvage THA include early dislocation, periprosthetic fracture, and infection developing during surgery. The rate reported for early dislocation in the literature ranges between 0% and 20%. While McKinley et al.^[5] and Oztürkmen et al.^[12] reported early dislocation at a rate of 20%, Mortazavi et al.,^[16] Lombardi et al.^[19] and Mehlhoff et al.^[18] reported early dislocation at a rate of 0% with salvage THA performed after collum femoris fracture. In the study performed by Mortazavi et al.,^[16] they found that most of the dislocation cases in the literature were cases of

surgery with the posterolateral incision technique and this could be a risk factor for early dislocation. A lateral approach was used in our study, and we observed early dislocation at a rate of 5%, which was less than the rate reported in much of the literature.

The rate of infection developing in salvage THA performed after collum femoris fracture is between 1.2% and 12% in the literature.^[12,14-16] In our study, no instance of prosthesis infection in the early or late period was encountered. The rate of infection developing after primary salvage THA performed following collum femoris fracture has been reported to be 2.9%.^[12]

Furthermore, there was no case of periprosthetic fracture impairing the stability of the prosthesis. The subtrochanteric region was passed over sufficiently with the primary prosthesis and cannulated screw and short DHS fixation were used. In 1 patient (5%), nondisplaced fracture developed at the upper level of the screw entrance while a larger size prosthesis measured during surgery with a template was being placed but uneventful improvement was seen after fixation with a cable. Fractures developing during surgery occur generally at the level of implant entry in the lateral cortex in cases of arthroplasty performed after peritrochanteric fracture. Protective cable application is recommended to prevent fractures occurring during surgery.^[15] While DeHaan et al.^[14] determined a risk for periprosthetic fracture of 9%, the rate has been reported to be 2.5% in the application of salvage THA after a collum femoris fracture. Oztürkmen et al.^[12] reported a higher rate of 14.7%, while Archibeck et al.^[15] found a rate of 4%.

There are not enough data in the literature to adequately define a high complication rate after salvage THA for a failed proximal femoris fracture. Franzén et al.^[20] noted greater risk in patients over 70 years of age, but noted that the complication rate was similar to that of primary THA for treatment of a collum femoris fracture. Recently, Tetsunaga et al.^[21] presented their research comparing the results of THA after failed peritrochanteric and collum femoris fractures, and they observed that THA after a failed collum femoris fracture had a lower complication rate. Abductor muscle insufficiency, trochanteric malunion, and the lack of restoration of vertical and lateral offset associated with dislocation are potential reasons for complications after salvage hip arthroplasty.^[15,18-21]

Weaknesses of our study are the retrospective design and small sample size. A different feature of our study from others is that the mean age is >65 years in the literature, while the mean age of the patients in our group was 57 years.

While osteosynthesis is the first treatment of choice after a collum femoris fracture, arthroplasty options are current methods of treatment in the event of failure. In our study,

we obtained highly successful clinical results after cementless THA performed after collum femoris fractures with a low complication rate. THA performed with a suitable surgical technique is a safe and successful method of treatment after failed osteosynthesis in cases of a collum femoris fracture.

Conflict of interest: None declared.

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ORJİNAL ÇALIŞMA - ÖZET

Femur boyun kırıklarında osteosentez sonrası gelişen komplikasyonların tedavisinde total kalça protezi uygulamalarının sonuçları

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AMAÇ: Bu çalışmada osteosentez sonrası komplikasyon gelişmiş veya başarısız olunmuş kollum femoris kırıklarının, kurtarıcı total kalça artroplastisi (TKA) ile tedavisinin sonuçları araştırıldı.

GEREÇ VE YÖNTEM: 1988 ile 2012 yılları arası kollum femoris kırığı tedavisinde kapalı reposisyon ve osteosentez sonrası başarısızlık gelişen ve kurtarıcı TKA yapılan 20 hasta (6 erkek, 14 kadın; ortalama yaş: 56.7) çalışmaya alındı. Kollum femoris kırıkları sonrası osteosentez şekli, başarısızlık gelişme süresi ve TKA uygulama süreleri kaydedildi. Hastalara sementsiz femoral ve asetabuler komponent kullanıldı. Komplikasyonlar operasyon esnası ve sonrası olarak belirlendi. Son kontrolde Harris kalça skorlaması ile klinik sonuçlar ve çekilen grafler ile gevşeme varlığı değerlendirildi.

BULGULAR: Hastaların takip süreleri ortalama 59.4 (dağılım, 15–178) ay idi. TKA uygulanan 20 hastanın kollum femoris kırıklarının sınıflaması osteosentez sonrasında komplikasyonlar kaynamama 4 (%25), malunion 2 (%10), avasküler nekroz 9 (%45), implant yetersizliği 4 (%20) idi. Komplikasyonlar gelişmesinde kanüle vida ve DHS arasında istatistiksel anlamlı farklılık bulunmamakta idi ($p=0.084$). Komplikasyon olarak erken dislokasyon (%5), protez çevresi kırık (%5) ve asetabuler protrüzyon (%5) saptandı. Erken dislokasyon gelişen hastada 10. yılda gevşeme saptanması üzerine revizyon yapıldı. TKA öncesi HHS 54.05 iken son kontrolde 86.45 olarak değerlendirildi ve istatistiksel olarak aralarında anlamlı bir fark saptandı ($p<0.0001$).

TARTIŞMA: Çalışma bulgularımız, kollum femoris kırıklarında başarısız osteosentez sonrası TKA uygun cerrahi teknik ile başarılı ve güvenli bir yöntem olduğunu göstermektedir.

Anahtar sözcükler: Femur boyun kırığı; kalça protezi; osteosentez.

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