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Revision of Total Hip Replacement with Proximal Femur Bone Defect

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ABSTRACT

Background: The revision surgery has been evolving constantly. From polyethylene wear, osteolysis and loosening, to complexities such as pelvic discontinuity, there is a wide range of surgical options for successful reconstruction.
Objective: The aim of the present study was to provide optimal treatment to the increasing number of patients requiring revision surgery with femur bone defect.
Patients and methods: This study included 10 patients with failed primary total hip replacement and have femoral bone defects selected as purposive simple random sample requiring revision of total hip replacement at Zagazig University Hospitals.
Results: All of the patients had femoral defects which were difficult to evaluate accurately preoperatively by radiograph but were properly evaluated during surgery after removal of the loose implant by simple manual traction. Femoral bone defects were classified according to Paprosky classification, they were six patients type 1, three patients type 2 and one patient type 3A. No weight bearing was allowed on the affected limb for 4 weeks. All the patients reached full weight bearing between 7 – 9 weeks after surgery regarding preoperative mean Harris hip score, it was 89. There were no cases of dislocation or deep infection in this series up to the final follow up visit.
Conclusion: The revision surgery has been evolving constantly. However, we do not have complex solution. The optimal surgical approach for revision total hip arthroplasty (THA) varies considerably among different settings.
Keywords: Bone Defect, Revision Surgery, Total Hip Replacement.

INTRODUCTION

Total hip arthroplasty (THA) is one of the most successful surgical procedures with well documented survivorship at up to 25 years. With aging of the population and higher arthritis prevalence in older adults, the demand for the procedure increases worldwide [(1)]. In addition, over the last two decades the age range has been broadened to include younger patients. Over 270 000 hip replacements are performed annually in the US alone, and the annual volume of hip joint replacement is projected to double by the year 2030 [(2)]. Although very successful procedure, significant percentage of patients undergoing total hip arthroplasty require revision within 10 to 15 years after the surgery [(3)].

Aseptic loosening and the associated osteolysis have been recognized as the main reason for implant failure in 71% of cases. Other indications for revision include periprosthetic fracture, dislocation, and infection [(4)]. New technologies in implant design and advances in surgical technique have improved the outcomes after primary total hip arthroplasty and decreased the rate of complications. However, as a consequence of increased rate of primary THA's the prevalence of revision hip surgery is increasing proportionally. The increased rate and costs of revision procedures impose high demands on both surgeon and healthcare system [(3)].

Bone loss is the major challenge in revision setting. Femoral bone loss as a result of failed total hip arthroplasty is a problem that continues to challenge orthopaedic surgeons [(5)].

The amount of femoral bone loss and the bone quality of the remaining metaphyseal and diaphyseal bone dictate the selection of appropriate reconstructive option. The surgical approach for revision surgery is based on surgeon experience and utility of the planned reconstruction. Selection of surgical approaches also influenced by additional exposure (i.e., osteotomy), degree and location of bone deficits, presence of distorted anatomy (e.g. heterotopic ossification), and patient factors (e.g. high risk of instability) [(6)]. The extended trochanteric approach, which is most commonly used in the setting of revision THA, facilitates acetabular exposure and femoral component removal [(4)].

Therefore, this study aimed to provide optimal treatment to the increasing number of patients requiring revision surgery with femur bone defect.

PATIENTS AND METHODS

In this study 10 patients with failed primary total hip replacement and have femoral bone defects selected as purposive simple random sample requiring revision of total hip replacement, were included. The study was done at Zagazig University Hospital. The cases reports dated retrospective for 12 months.

Data were collected from medical records and by patient structure interview. This study compared fixed and variable data for the patients preoperatively and intraoperatively and postoperatively accordingly. Patients did primary total hip replacement then failed. There was some of femoral bone defects. The cause of

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revision is aseptic loosening in (7) cases and periprosthetic fracture in (3) cases.

Exclusion criteria: Patients have no femoral bone defects or have acetabular bone loss.

Patients were subjected to the following:

A thorough and detailed history was taken, as regards the age, sex. A complete clinical general and local orthopedic examination was performed. Laboratory investigations included CBC and SGPT and serum creatinine and CRP and E.S.R. In the preoperative visit prior to surgery, a brief explanation of the steps of the operation, the postoperative events.

Preoperative imaging: Digital X-ray, Harris Hip Score (HHS), Femoral bone defects according to Paprosky classification and type of stem used in the primary total hip replacement were determined.

Intraoperative procedures: The intraoperative anesthetic technique was the same for all patients, which was spinal anesthesia.

Surgical Approach:

Lateral approach "**Hardinge**" with patient in lateral position. Extended trochanteric osteotomy was needed in (3) cases. After extraction of the implant and bone cement, the fibrous tissue membrane were removed. The femoral canal was then reamed and prepared using successive reamers of the system under intraoperative radiology to safeguard against perforation of the canal and misdirection.

When reaming was completed the last reamer should be stable inside the medulla, then trials were done to determine the length, anteversion and test for stability. As a prophylactic step a stainless steel loop was fashioned around the distal femur throughout the trials and stem impaction to safeguard against iatrogenic fractures of the femur in cases with weak bone stock.

In one case, bone graft was taken from the iliac crest and impacted in the femoral canal to help good contact between the stem and bone. After impaction of the definitive stem, the extended trochanteric osteotomy fragment was reduced and fixed to the femur using steel wires cerclage. The wound then closed over suction drain.

In all cases Zimmer revision system was used. The mean blood loss was 1000 (range 750-2000) ml, and the mean operative time was 150 (range 120-240) min. Intravenous cephalosporin antibiotics was used until we the results of cultures taken intraoperatively appear, and then the antibiotics were continued according to culture. Early mobilization and mechanical measures against thromboembolism were started second day after the operation with the use of elastic stockings. Low-molecular-weight heparin was used routinely 24 hours postoperatively for 3 weeks.

Postoperative evaluation: Digital X-ray, monitor for any complication after surgery HHS and grading were determined.

Outpatient follows up:

Radiographically stable implant and Harris hip score. Failure was defined as revision arthroplasty or radiographic evidence of stem loosening. Vertical femoral migration of >5 mm was defined as subsidence.

The **Callaghan *et al.*** [7] criteria were used for evaluation of proximal femoral bone remodeling. According to them A) increased defect or no remodeling; B) small degree of remodeling; and C) significant bone remodeling. The bone remodeling was measured by the cortical thickening 1 cm below the lesser trochanter.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation and participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis:

Data were collected and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data qualitative were represented as number and percentage and quantitative as mean and range.

RESULTS

The age and sex of the studied patients are shown in table 1.

Table (1): Age and sex distribution of studied group

Age	**Studied group (n=10)**	
Mean age	58 years.	
Min-max	43-74 years.	
Sex	No.	%
Male	5	50
Female	5	50

Mean time in situ of the primary stem in the studied group was 2.8 **(Table 2).**

Table (2): Time in situ of the primary stem in the studied group

Time	**Studied group (n=10)**
Mean time	2.8 years
Min-max	1-6 years

Regarding preoperative mean Harris hip score, it was 41 **(Table 3).**

Table (3): The preoperative HHS in the studied group

HHS	Studied group (n=10)
Mean HHS	41
Min-max	24-56

The stem presented at the time of revision (8 cemented and 2 cementless) **(Table 4).**

Table (4): Stem presented at the time of revision in the studied group

Type of stem	Studied group (n=10)	
	No.	%
Cemented	8	80
Cementless	2	20

All of the patients had femoral defects which were difficult to evaluate accurately preoperatively by radiograph but were properly evaluated during surgery after removal of the loose implant by simple manual traction. Femoral bone defects were classified according to Paprosky classification **(Table 5).**

Table (5): Femoral bone defects in the studied group

Type of Paprosky	Studied group (n=10)	
	No.	%
Pa 1	6	60
Pa 2	3	30
Pa 3A	1	10

No weight bearing was allowed on the affected limb for 4 weeks. All the patients reached full weight bearing between 7 – 9 weeks after surgery **(Table 6).**

Table (6): Full weight bearing period in the studied group

Full weight bearing period	Studied group (n=10)
Mean period	8 weeks
Min-max	7 – 9 weeks

Regarding postoperative mean Harris hip score, it was 89 **(Table 7).**

Table (7): Postoperative HHS in the studied group

HHS	Studied group (n=10)
Mean HHS	89
Min-max	79 – 96

Postoperative HH grading showed 50 % of cases were excellent **(Table 8)**. There were no cases of dislocation or deep infection in this series up to the final follow up visit.

Table (8): Postoperative HH grading in the studied group

HH grade	Studied group (n=10)	
	No.	%
Poor	0	0
Fair	1	10
Good	4	40
Excellent	5	50

DISCUSSION

The goals of revision surgery are clear cut for patients. Patients hope to gain relief from thigh pain, a return of leg length lost to subsidence of the loose prosthesis, and improved hip function with the strength necessary to walk distances without crutches. The surgeon's task in revision is well defined [(8)].

A system for classification of bone loss should also permit a valid comparison of results from similar case mixes. However, because of the number of different classification systems, there is currently no consensus as to which system to use when determining femoral or acetabular bone defects. Many of the current systems are hard to remember and difficult to apply to all revision cases [(9)].

Subsequent reports of cementless, extensively coated femoral revisions have revealed decreased loosening rates. This technique has proved durable in the long term, with some surgeons reporting femoral implant stability in 93.4% of cases at a mean follow-up of 9.2 years [(10)].

In this series, the rate of loosening was 0% till the last visit for follow up due to short term of follow up. The reported incidence of dislocation after revision THA varies from 0 to 50% in literatures [(11)].

We have no postoperative dislocation in this series due to short term of follow up. A wide range of arthroplasty procedures have been conducted that used cemented femoral stems, collarless conical femoral stems, fixation to the distal shaft using extensively porous-coated cementless stems, and proximal or distal fixation using cementless modular stems [(12-14)].

The success rate of revision surgery using cemented femoral stems ranges between 50% and 90% according to **Hunter *et al.*** [(15)]. Early implant loosening may occur after surgery using cemented femoral stems, since a firm bond cannot be achieved in the medullary cavity using cement. On the contrary, revision using cementless femoral stems can preserve bone mass to the maximum extent without cement-related complications, and minimizes the risk of liner wear caused by cement wear debris [(16)].

In our study all revisions were done using cementless femoral stems. For proximal femoral defects of Paprosky type II and higher, modular femoral stems were used to improve stem stability and facilitate restoration of equal leg lengths. A modular distal fixation stem consists of a proximal sleeve and a shaft

component; it can easily and precisely provide stable fixation of the distal stem in the diaphyseal portion of the femur, which has relatively good bone quality, by bridging bone defects, and can be conveniently assembled at the desired anteversion angle or leg length intraoperatively [17].

In our study we used modular cementless stems with fixation. **Cameron** [18] conducted a 3.5-year follow-up of patients who underwent THA with modular femoral stems and reported a success rate of 94%. **Chandler *et al.*** [19] achieved favorable outcomes in more than 84% of 52 patients who underwent revision THA and were followed up for 3 years on average; only 4% of the patients complained of thigh pain. **Kwong *et al.*** [20] reported a success rate of 97.2% in hips after revision surgery that used the LINK MP modular distal fixation stems (Waldemar LINK, Hamburg, Germany); the mean follow-up in this study was 3.3 years. In a study by **Amanatullah *et al.*** [21] used stems of the same type, the mid-term follow-up results indicated a high success rate of osseointegration.

Proximal bone remodeling was achieved by different degrees in 6 cases our 10 cases. According to **Callaghan *et al.*** [7] one case was type A, 3 cases type b, and 2 cases type C. These findings are concordant with what of other many studies [22].

Clinically, there was a significant improvement in the mean HHS from 41 (24-56) preoperatively to 89 (79-96) points at the last follow up and these are similar to other results in the literature [20]. We did not detect any mechanical defects or stress shielding in the present study.

The pain following revision total hip arthroplasty may be due to acetabular erosion or loosening of the prosthesis. The pathology here may be caused by excessive length of the neck, impaction, or incongruences between the acetabulum and femoral head [23].

In this study no patients had thigh pain postoperatively. Seven patients (70%) who had isolated groin pain preoperatively experienced no pain postoperatively, and three patients had partial improvement. At the end of follow-up 6 (60%) of the patients were freely walking without support, 3 (30%) patients using cane for walking and limited for five blocks distance, and 1 (10%) needed walker for indoor movements. The classification of **Della Valle and Paprosky** [9] is extremely useful because there is a direct relationship between the stem migration and early mechanical failure.

We have no case with incidence more than 5 mm, until the last follow up.

This study has some limitations. Since we used a retrospective study design without controls, the successful restoration using the modular femoral stem system is difficult to compare to other systems. Moreover, the mid-term follow-up results are insufficient to fully examine the long-term survival rates or outcomes.

CONCLUSION

The revision surgery has been evolving constantly. From polyethylene wear, osteolysis and loosening, to complexities such as pelvic discontinuity. There is a wide range of surgical options for successful reconstruction.

Prerequisite for a successful and durable revision include viable host bone, adequate surgical technique, and stable and endurable implant. Current improvements in surgical techniques, implant designs, as well as biomaterials and bearing surfaces are a significant contribution for obtaining favorable outcome after revision hip arthroplasty.

However, we do not have complex solution. The optimal surgical approach for revision THA varies considerably among different settings.

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