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Original Article

Revision of failed hip hemiarthroplasty. Classification, management, and follow-up

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ABSTRACT

Background: Many types of failed hemiarthroplasties have been reported, but there is no classification of these failures.

Patients and methods: Revisions of 217 cases of failed hemiarthroplasty were studied with an average follow-up of 6.2 years. Classification system based on site of problem, mode of failure, and type of revision, was introduced.

Results: In most cases, the intra-operative assessment of failure correlated with the preoperative classification (99%). At the last follow-up, there were 15/217 re-revisions; giving a success rate of 93%.

Conclusion: This classification helps in choosing the appropriate revision method, leading to acceptable results.

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1. Introduction

Conversion of failed hip hemiarthroplasty (bipolar or unipolar) to total hip replacement (THR) represents an orthopedic challenge. Hip hemiarthroplasties are less invasive operations in that only one side of the joint is replaced, preserving bone stock for future THR procedures. On failure of these operations, a THR is indicated but the effect of these implants on the operative procedures and long-term outcomes of a subsequent THR has been debatable and not clear.^{1,2} The conversion of failed hip hemiarthroplasty to THR has been associated with high rates of intra- and

postoperative complications.^{3,4} However, clinical experience has defined specific recurrent patterns of failure of hip hemiarthroplasty,^{5,6} but there is no classification of these failures. By determining the site (whether acetabular or femoral or both) and the mode of failure, the surgeon can determine the type of revision and develop a rational plan for treatment. Based upon these criteria in 217 failed hip hemiarthroplasties, a systemic approach has been developed to classify these revisions. These cases were revised and were reviewed clinically and radiographically after a minimum of 4 years. This study outlines this classification system and proposes treatment options for each type of failure.

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2. Materials and methods

During 1997–2009, 217 patients underwent revision of failed hemiarthroplasty to THR by or under supervision of the senior author with an average follow-up period of 6.2 years (range 4–13 years). Patients, who did not have a minimum follow-up of 4 years, were excluded from the start. There were 101 men and 116 women with an average age of 59.4 years (range, 54–79 years). The average time since primary surgery was 84 months (range 4–132 months). Pre-operative Harris Hip Score (HHS) ranged from 15 to 62, with an average of 36. The average pre-operative shortening was 2.3 cm (range 0–4 cm). Antero-posterior radiographs of the pelvis, antero-posterior and lateral radiographs of the affected hip with thigh were obtained. Before surgery, each patient was evaluated clinically and radiographically and classified as types I–V.

2.1. Failed hip hemiarthroplasty classification

The hip revision classification system is based upon site and mode of failure. Revisions are classified by type, indicating

whether the problem in the acetabulum or femur or both; whether the revision will be in one or two stages; whether the revision will need bone graft or not; and finally indicating the type of prostheses required (Table 1). The revision types were divided into subtypes that corresponded to different types of hemiarthroplasties, and different modes of failure.

2.1.1. Type I: acetabular problem

This type displays an acetabular problem (most of them are protrusion), and a well fixed stable femoral prosthesis. It is divided into two subtypes according to type of femoral prosthesis. Type IA failure has a monoblock femoral prosthesis; either cemented Thompson or Austin Moore. In this subtype, the well fixed femoral prosthesis must be removed, and this usually leads to some bony destruction of the proximal femur. The revision is usually complicated and involves both the femoral and acetabular sides. Type IB failure has a well fixed bipolar femoral prosthesis; so it is not revised, but we shall change the large sized head. Just acetabular protrusion has to be managed.

Table 1 – Hip hemiarthroplasty classification system depending on site of problem, mode of failure and method of revision.

Type	Site of problem and mode of failure	Method of revision				
		One or two stages	Need of bone graft		Type of prostheses	
			Acetabulum	Femur	Acetabulum	Femur
Type I	Acetabular problem; protrusion and Well fixed stable femoral component	One stage				
Type IA	Monoblock femoral prosthesis (Thompson, Austin Moore)		Usually needed	Occasionally needed	Uncemented cup with screws or cup with ring	Long stem or custom- made femoral prosthesis
Type IB	Bipolar femoral prosthesis		Usually needed	Not needed	Uncemented cup with screws or cup with ring	Not revised
Type II	(femoral problem)	One stage				
Type IIA	Aseptic loosening with good bone stock		Not needed	Not needed	Cemented/ Uncemented cup	Standard femoral prosthesis
Type IIB	Aseptic loosening with bone stock loss		Not needed	Usually needed	Cemented/ Uncemented cup	Long stem or custom made femoral prosthesis
Type IIC	Peri-prosthetic femoral fracture		Not needed	Occasionally needed	Cemented/ Uncemented cup	Long stem femoral prosthesis
Type III	Various combinations of both femoral and acetabular problems as in types I and II	One stage	According to the mode of failure as in types I and II			
Type IV	Instability and recurrent dislocation	One stage	Not needed	Occasionally needed	Cemented/ uncemented cup	Long stem or custom-made femoral prosthesis
Type V	(infection)	Two stage	Two stage revision with cement spacer			

2.1.2. Type II: femoral problem

The mode of failure of this type is due to a femoral problem with no acetabular protrusion. This type is divided into three subtypes according to the modes of failure of the femoral component. Type IIA is aseptic loosening of the femoral prosthesis with good bone stock; while type IIB has aseptic loosening with femoral bone stock loss. Type IIC is a peri-prosthetic femoral fracture.

2.1.3. Type III: both femoral and acetabular problems

This type of failure has various combinations of acetabular and femoral problems mentioned in types I and II. Revision will be tailored according to mode of failure as in types I and II.

2.1.4. Type IV: instability and recurrent dislocation

This type of failure usually occurs in the early post-operative period either due to soft tissue laxity or because of the mal-position of the femoral prosthesis. The latter mode of failure will need revision of the mal-positioned and usually well fixed femoral prosthesis, with high incidence of iatrogenic some bony destruction of the proximal femur. Long stem or custom made femoral prosthesis with or without bone graft is needed.

2.1.5. Type V: infection

Established infection of hip arthroplasty is usually treated by two stages operation using cement spacer in the first stage.

2.2. Operative technique

2.2.1. Exposure

A more extensive incision in revision than in primary arthroplasty is required for better visualization of both the acetabulum and femur, and remaining bone stock. A modified Harding approach⁷ was used, incorporating the primary scar when appropriate. An extended trochanteric osteotomy⁸ was used, when well fixed femoral monoblock prosthesis had to be extracted.

2.2.2. Type I: revision

Acetabulum problems (N = 109) were all protrusion defects.⁹ They had been revised using uncemented cups with screws in 62/109 cases; cups with rings in 47/109 patients. Morsellised grafts were used in all cases. In type IA with well fixed monoblock femoral prostheses (cemented Thompson: 55/78 cases, Austin Moore: 23/78 cases), the prostheses were extracted in standard fashion¹⁰ using extended trochanteric osteotomy. All of these cases had some iatrogenic bony destruction of the proximal femur; and bone grafts were used in 25/78 cases. Long stem femoral prostheses were used in all of these patients.

In type IB with stable bipolar femoral prostheses (N = 31), we just confirmed the stability of femoral prostheses and managed the acetabular protrusion only.

2.2.3. Type II: revision

The acetabulae in type II (N = 45) were good with no protrusion, while the femurs had problems. Type IIA with aseptic loosening of the femoral prostheses (N = 17) were managed with standard femoral prostheses. Bone graft and long stem femoral prostheses were used in revision of type IIB (N = 21).

All cases of type IIC (N = 7) had the fractures around the tip of the loose femoral prostheses¹¹; and were revised with long stem femoral prostheses with cerclage wires. In all type II cases, the acetabulum was revised with uncemented cup prostheses.

2.2.4. Type III: revision

The various combinations of acetabular and femoral problems in type III (N = 46) were managed according to the side of problem and mode of failure using the same guideline methods used in types I and II.

2.2.5. Type IV: revision

In cases of recurrent dislocation and instability (N = 9), we should first determine the cause. If the cause was soft tissue laxity, abduction hip orthoses for 2 months were used, and no conversion to THR was required. In our series, one patient had soft tissue laxity and was mentally unstable, so revision with constrained THR was carried out. In cases of mal-position of femoral prostheses (8/9 cases), revision was done with extraction of the well fixed femoral prostheses after 4–6 months post-hemiarthroplasty. Some bony destruction of the proximal femur was un-avoided; and bone grafts were used in 5/8 cases. Long stem femoral prostheses were used in all of these patients.

2.2.6. Type V: revision

Infection of hip hemiarthroplasty (N = 8) should be first diagnosed properly.¹² Standard two stage revisions^{12,13} were done using antibiotic loaded cement spacer in the first stage.

2.3. Clinical and radiographic follow-up

Patients had clinical and radiographic evaluations at 1, 3, 6 months, and annually thereafter. HHS¹⁴ was used for clinical evaluation. The technique of DeLee and Charnly,¹⁵ and the criteria of Ranawat et al.,¹⁶ and Massin et al.¹⁷ were used for radiographic evaluation of acetabulae. Follow-up radiographs of femoral components were evaluated using the system of Gruen et al.¹⁸ and the criteria of Engh et al.¹⁹ Incidence of heterotopic ossification was recorded and classified as described by Brooker.²⁰ Complications were recorded in detail.

3. Results

Before and during surgery, the cases were evaluated to assess the site of problem and the mode of failure. The 217 cases consisted of 109 patients of type I, 45 type II, 46 type III, 9 type IV, and 8 type V. Of the type I cases, 78 patients were categorized as type IA, and 31 as type IB. Of the type II revisions, 13 patients were type IIA, 21 were type IIB, and 11 were type IIC.

In most cases (215/217), the intra-operative assessment of site and mode of failure correlated with the preoperative clinical and radiographic evaluation (99%). In two hips, pre-operative assessments were type I with acetabular protrusion and well fixed femoral prostheses. Intra-operatively, the femoral components in these two patients were loose at

Fig. 1 – A 61-year-old female patient with failed hemiarthroplasty of the left hip. (A) Pre-operative X-ray showing type IA revision with acetabular protrusion and a well fixed mono-block femoral prosthesis (Austin Moore). (B) One-month post-operative X-ray after revision both sides with bone graft. (C) Seven years post-operative X-ray with remodeling of bone grafts and stable prosthesis.

metal cement interface; and revisions with cement in cement technique were done.

Follow-up period was 6.2 years (range 4–13 years). HHSs improved from 36 (range 15–62) preoperatively to 92 (range 42–100) at final follow-up. 130 (60%) patients can walk without support, 69 (32%) patients could walk more than five blocks using a cane, and 18 (8%) needed walker for ambulation. Limb length discrepancy was corrected to less than 2 cm in all but two patients.

Radiographically, at final follow-up, non-progressive radiolucent lines less than 2 mm were noted in zone 7 in 9 revisions femoral stems; and in zone 1 or 3 in 13 revisions acetabulae. Five of the stems had nonprogressive subsidence of 0.5 cm. Incorporation of grafts was noticed in all grafted cases, either in acetabulae or femora at the end of 1 year (Fig. 1A–C). Extended trochanteric osteotomies got united in all patients after 3 months. The incidence of heterotopic ossification was 12% (26 out of 217 hips); all of them were Brooker's Grade 1 or 2.

Regarding complications, superficial infection occurred in six hips, and all cases responded to local wound care and antibiotics. Recurrence of infection occurred in one patient of infected type V cases, and the infection subsided after two debridements with retention of prostheses. Dislocation occurred in 12 hips on the first month postoperatively, which were reduced by closed manipulation under anesthesia. The patients were kept in an abduction brace for 2 months and there was no recurrence thereafter in 11/12 patients. The last patient underwent revision with constrained THR, because he was mentally unstable with recurrent dislocation.

Systemic complications included chest infection in four, myocardial infarction in two, urinary tract infection in 5, and clinically detectable DVT in 7 patients. No death was encountered that could be directly attributed to the surgery or its complications.

At the last follow-up, there were 15/217 revisions; giving a success rate of 93%. Revisions due to aseptic loosening were: 7/78 in type IA, 1/31 in type IB, 1/13 in type IIA, 1/21 in type IIB, 1/11 in type IIC, 2/46 in type III, and 1/9 in type IV. The last patient was type V, and revision was done because of recurrent infection as mentioned in the complications.

Detailed clinical and radiographic results as well as complications specific for each type of revision were shown in Table 2.

4. Discussion

Various types of failed hemiarthroplasties seen in revision hip surgery have been described, but no studies have proposed a complete classification system for both femoral and acetabular problems. The goal of this study was to describe a reproducible classification system for failed hemiarthroplasties, to propose a systematic approach to revise these hips, and to present follow-up data. Hemiarthroplasty (unipolar or bipolar) of the hip is a commonly performed procedure for the treatment of displaced intra-articular fractures of the neck of the femur in the elderly. Monoblock femoral prostheses such as Austin Moore and Thompson prostheses have been

Table 2 – Clinical and radiographic results, complications, and success rate for all types of hip hemiarthroplasty revisions.

Type	No.	Clinical evaluation (Harris Hip Score)		Radiographic evaluation		Complications	Success rate
		Pre-op.	Last follow-up	Femoral side	Acetabular side		
Type I	IA: 78 IB: 31 Total: 109	26–62	52–100	Five cases: lucent lines in zone 7 One case: subsidence	Seven cases: lucent lines in zone 1 or 3	Three superficial infection Seven dislocations Eight revisions due to aseptic loosening	IA: 91% IB: 96%
Type II	IIA: 13 IIB: 21 IIC: 11 Total: 45	15–60	42–96	Two cases: subsidence	Two cases: lucent line in zone 3 or 1	One: superficial infection Two dislocations Three: revisions due to aseptic loosening	IIA: 93% IIB: 95% IIC: 91%
Type III	46	28–56	48–88	Two cases: lucent line in zone 7 One case: subsidence	Two cases: lucent line in zone 1 or 3	Two: superficial infection Two dislocations Two: revisions due to aseptic loosening	96%
Type IV	9	30–52	66–98		One case: lucent line in zone 3	One revision due to recurrent dislocation	89%
Type V	8	33–58	56–84	Two cases: lucent line in zone 7 One case: subsidence	One case: lucent line in zone 1	One revision due to deep infection	87%

used for decades, but have been associated with a poor quality of life in the long term.²¹ Bipolar arthroplasty was introduced to improve the long-term outcome of hemiarthroplasty due to less wear of the metal–cartilage interface. However, studies comparing bipolar to unipolar hemiarthroplasty showed little difference.^{22,23}

Several studies have been published concerning the results of conversion of failed hemiarthroplasty to THR. Cossey et al.²⁴ and Hammad et al.²⁵ reported that conversion to THR would give satisfactory results. Other investigators, however, have reported that conversion of hemiarthroplasty to THR is associated with high complication and loosening rates compared to primary total hip arthroplasty.^{3,4}

Due to lack of classification system in these previous studies, we cannot determine which complication is expected to occur in which type of revision. Applying this classification system, we can anticipate the intra-operative as well as the post-operative difficulties and complications that might occur in each type of revision. Thus, we can try to prepare the patient (by discussing the operative difficulties, expected results and method and time of re-habitation), the surgeon (by planning for the difficulties and expected time of operations and planning for alternatives of solutions), and the operative theater (by preparing the required instruments and implants) to avoid or decrease these complications. A more important point is that this classification system plays a key role in the reporting of clinical and epidemiologic data, allowing uniform comparison and documentation of similar conditions. In addition, the main 5 types of this classification can be applied for any hip arthroplasty revision, but the subtypes are specific

for failed hemiarthroplasty revisions. However, the most important point is that this classification system is different from other hip revision classifications; in that it includes femoral and acetabular problems in simple, comprehensive, applicable, and predictable one. All classification systems in the literature are concerned with either femoral or acetabular problems; in spite that, each problem can affect the other, especially in clinical evaluation and success rates. For example, in type IA revisions (acetabular protrusion, well fixed femoral mono-block prosthesis e.g. cemented Thompson), other classifications will concentrate on the acetabular problem. In reality, the femoral component has to be revised and the incidence of iatrogenic bony destruction of the proximal femur is high. The surgeon and the operative theater should be prepared to deal with femoral and acetabular difficulties, and the post-operative results and success rates will be affected by the femoral revision. Finally, by strictly adhering to this classification system and performing the appropriate revision method, acceptable and predictable results can be expected.

5. Conclusion

Our study introduced a hip revision classification that considers both femoral and acetabular problems in one system. It allows uniform comparison and documentation of similar hip problems. It also helps in planning the appropriate revision method, leading to acceptable results with fewer complications.

Conflicts of interest

The authors have none to declare.

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