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Functional and Radiological Outcome of Revision Total Hip Arthroplasty in the Indonesian National Referral Hospital

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ABSTRACT

Background: Revision total hip arthroplasty (rTHA) rate has increased until 12-20% in the past few decades, despite the 95% success rate of THA approach in 10 years and 80% in 20 years. The most common causes of rTHA are dislocation, periprosthetic fracture, aseptic loosening, and periprosthetic joint infection. This study is aimed to describe the outcome of rTHA in Indonesia where there are limited types of revision implant and funding.

Material and Methods: An analytic cross-sectional study was conducted on 31 rTHA in the Indonesian national referral hospital from January 2014 to December 2019. Data on the causes of rTHA was extracted. All subjects met the criteria underwent examination for functional outcome (Harris hip score) and radiological outcome (Harris or Engh criteria). All complications and outcomes after rTHA were identified.

Results: Sixteen subjects met the criteria with the mean age of 48.13 (18.74). The most common causes of rTHA were dislocation, aseptic loosening, and perirosthetic joint infection (five cases each, 31.25%). The Harris hip score after complete rTHA was 79.42 (SD 6.14, range 70.50 – 91) with the mean follow up of 29.50 (SD 16.88, range 7 – 70 months). Only one possible loosening was identified in hybrid prosthesis (femoral component) from radiological exam. Three complications were observed, i.e. drop foot, recurrent dislocation, and extension knee contracture.

Conclusion: Revision THA produces fair to good results in terms of functional outcome and no loosening in radiological exam. Revision THA is still a reliable technique to manage complications of THA.

Keywords: Hip Arthroplasty, Revision, Aseptic Loosening,

Level of Evidence : Descriptive study, level III

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Introduction

Over the last few decades, primary total hip arthroplasty (THA) has been proven to be a surgical procedure that has a high success rate for reducing pain and improving hip joint function in patients with symptomatic osteoarthritis. Thousands of THA procedures have been performed annually in America due to its high reliability and reproducibility, while on the European continent as many as 3.2 million primary THA have been performed per year.[1,2] While the clinical success rate of primary THA is close to 95% within the 10-year clinical evaluation and 80% in the 20-year clinical evaluation, there were a small number of patients who continued to experience pain and impaired function after the THA procedure that subsequently required revision THA (rTHA). The need for rTHA has increased by more than 20% over the last 15 years and is expected to double in the next 10 years. Along with the increase in human life expectancy in general, there is an increase in the rTHA rate to 12%.[3]

The rTHA has the same goal as the primary THA, which is to improve hip function and biomechanics and relieve complaints in the hip region. Hip instability, periprosthetic fracture, aseptic loosening, implant failure, and periprosthetic joint infection are some complications which underlie the needs for revision surgery.[4.5] The rTHA is a relatively difficult procedure with a much higher risk and burden, and requires more costs compared to primary THA.[5] Complications such as death, infection, hospitalization, nerve injury, femoral fracture, and postoperative dislocation also increase in rTHA.[4] Therefore, to achieve the goal of rTHA in the condition of deficient bone stock and soft tissue disruption with possibilities of infection, proper planning and selection of appropriate surgical techniques are needed.[6,7] Adequate evaluation of clinical symptoms, radiological and laboratory examinations are necessary to sharpen the indications for rTHA.[8,9]

A meta-analysis study by Saleh showed the longevity of rTHA is almost the same as primary THA, while the functional outcome (Harris and global hip score) of rTHA does not show as good results as primary THA and results in higher morbidity and mortality rates.[10] However, other studies have shown a good long-term outcome of rTHA by taking into account the surgical approach, bone defects, varus remodeling, and the correct type of fixation.[11,12] The need for rTHA in Indonesia has also increased, but the limited revision implants and the relatively high cost of rTHA further emphasize the importance of optimal rTHA. Therefore, this study aims to evaluate the outcomes of rTHA and the number of complications occur after rTHA in Indonesia. It is expected that the findings of the current study could serve as a basis for preoperative planning of rTHA in Indonesia.

Material and Methods

This analytic cross-sectional study was conducted at Cipto Mangunkusumo National General Hospital (RSCM) Jakarta. There were 31 rTHA performed between January 2014 and December 2019 in our institution based on the data from our institutional arthroplasty registry. All patients who had completed rTHA for a minimum of 6 months prior to the study and came to our clinic were included. The exclusion criteria were patients with lost to follow up, lower limb congenital deformity, and refusal to participate or could not be contacted. The study was approved by the Ethics Committee of the Faculty of Medicine, University of Indonesia – Cipto Mangunkusumo Hospital and the patients provided their consent prior to the examination.

Each patient who fulfilled the criteria was consecutively included into the study. The secondary data was obtained from medical records which included age, gender, preoperative diagnosis, type of prostheses, and management of rTHA complications. Whereas the primary data of functional and radiological outcomes were obtained when the patients came to the clinic after the surgery. The functional outcome was examined using Harris Hip Score (HHS), while the radiological outcome was measured using Harris criteria for cemented stem or Engh Criteria for noncemented stem.

Data was analysed using SPSS version 21 and evaluated for its frequencies, mean values, and standard deviation, when the data distribution was normal according to the Kolmogorov-Smirnov normality test, with $p>0.05$. If the distribution was not normal, median and minimum to maximum data was displayed.

Results

A total of 16 patients, consisted of 5 male (31.25%) and 11 female (68.75%) who met the study criteria, were included in this study (Table 1). The mean age of patients at the time of rTHA was 48 years (SD 18.74, range 19 – 75 years). Whereas the mean of follow up time was 29.5 months (SD 16.88, range 7 – 70 months).

Preoperative indications for rTHA in this study were aseptic loosening of either acetabular and femoral components (5 patients), periprosthetic joint infection (5 patients), hip dislocation (5 patients) and periprosthetic fracture (1 patient). The type of prostheses used in this study were 7 noncemented prosthesis (44 %), 6 cemented prostheses (38%), and 3 (18%) hybrid prostheses (using noncemented prostheses of acetabular component and cemented prostheses of femoral component).

The data of HHS was normally distributed based on the Kolmogorov-Smirnov test. The mean value of HHS in this study was 79.42 (SD 6.14, range 70.50 – 91) which was categorized as fair (Figure 1). Only one patient had an excellent score, while 7 patients were included in good category, and the rest (8 patients) were categorized as fair.

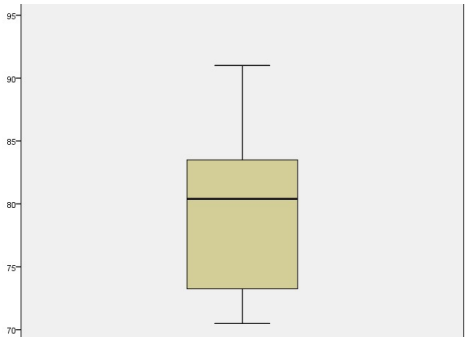
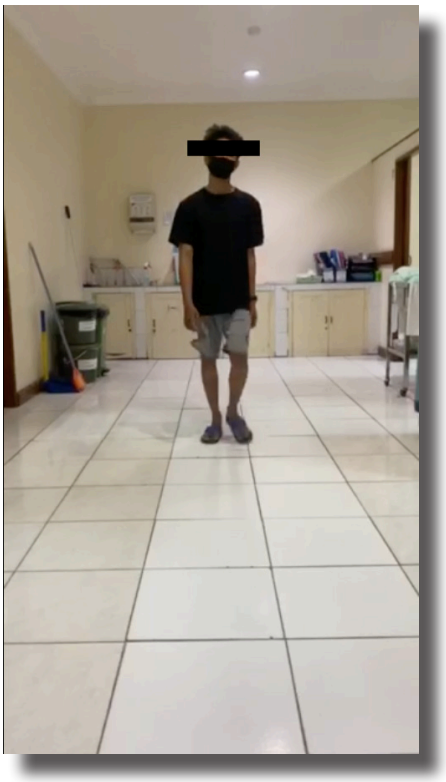


Figure 1. Harris Hip Score box plot

A patient with HHS of 83.8 showed an excellent squatting position and he could walk without limping 24 months after rTHA (Figure 2).

(A)



(B)

Figure 2. Clinical outcomes of 24 months post rTHA: (A) squatting position and (B) walking

There were 3 complications identified in this study: one nerve injury causing foot drop, one hip dislocation, and one extension knee contracture.

The first patient was 49-year-old female who had ischiadic nerve injury post operatively with pre-existing systemic lupus erythematous (SLE) treated with oral steroid for 7 years. The indications for revision were aseptic loosening and acetabulum dissociation. The revision included cage reconstruction application, ischiadic nerve exploration, neurolysis, and nerve stimuli to treat the complication. She was also using ankle foot orthosis (AFO).

There was partial improvement of motoric power, grade 3 ankle dorsi-flexor and grade 4 ankle plantar-flexor at the final follow up, with final HHS evaluation (51 months) of 72.8.

The second patient was 19-year-old female who experienced recurrent hip dislocation at the first week and 1 month following her revision surgery. The hip was well reduced after closed reduction and skin traction at the first dislocation. The patient underwent repeated revision surgery of femoral head and stem with soft tissue reconstruction after recurrent hip dislocation. The management of hip instability gave a successful result at 12 months follow up after the final revision surgery. The patient showed good HHS (83.9) although there is still minimal pain at certain activities.

Extension contracture of knee was experienced by the third patient, a 34-year-old male patient. The indication of revision surgery was neglected dislocation after Austin Moore Prostheses hemiarthroplasty.

Two-stage revision surgery was done because the patient had 12 cm leg length discrepancy. Gradual skeletal trac1tion until 30 kilograms load for 5 weeks had been applied initially to accommodate leg length discrepancy. Patient can still bend his knee until 90 degree during the traction. The first stage revision surgery was acetabular component placement. While in the second stage, 3 weeks afterwards, femoral stem placement was done while the traction still continued. There was still 2 cm leg length discrepancy after the final revision surgery. His HHS was 72.5 at final follow up (70 months).

Leg length discrepancy was found in 5 patients with the maximum of 4 cm discrepancy due to any indications. The patients with 0.5 and 1 cm leg length discrepancy had HHS of 91 and 81.8 respectively. Meanwhile fair HHS (70-79) was found in patients with 1 to 2 cm leg length discrepancy.

Radiological outcomes

There were only 12 patients' radiographs obtained in this study which met the criteria for a minimum of 6 months post rTHA at the final evaluation. Final evaluation of x-ray radiographs in the noncemented and cemented groups showed excellent results, as indicated by good position/alignment of acetabular component, inclination within normal limits, and no loosening between acetabular component and bone. The radiographs of femoral stem also showed no radiolucent line (loosening) between the stem and bone, and no subsidence of the femoral stem (Figure 3). The radiographs of the patient in figure 2 are shown in figure 3 (C and D)

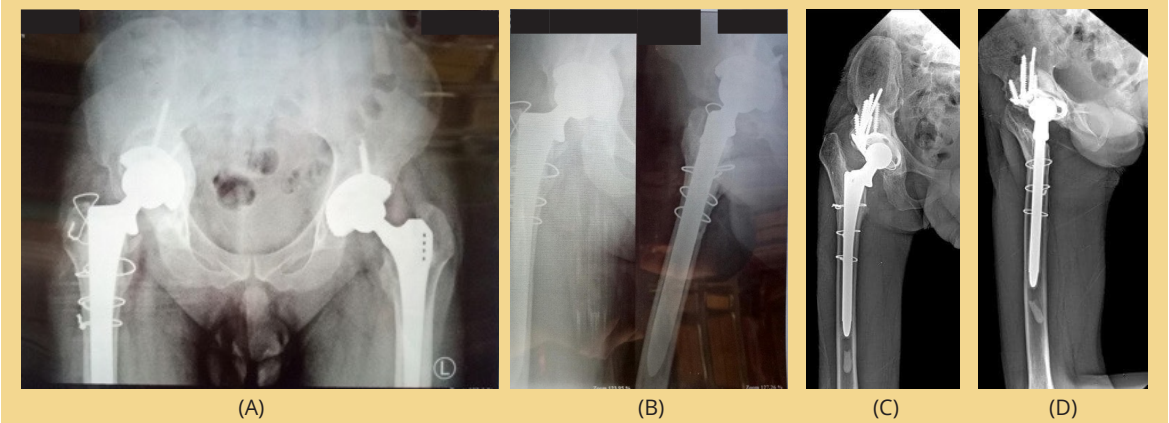
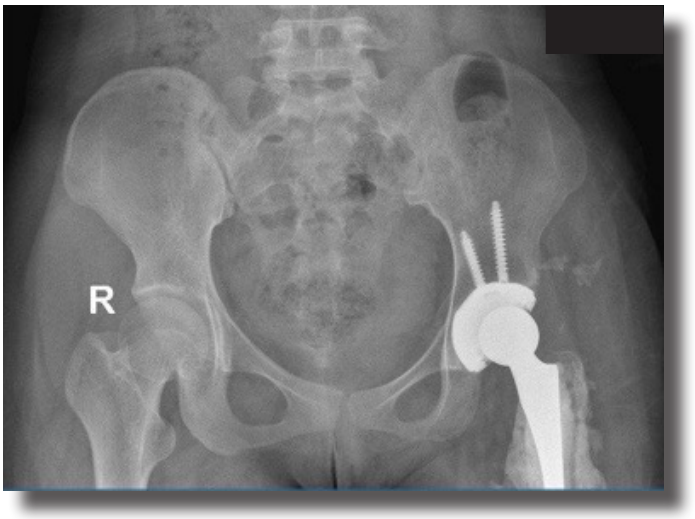


Figure 3. Radiographs of 33 months after rTHA pelvic x-ray (A) and AP and axial hip x-ray (B). Radiographs of 24 months after rTHA from AP (C) and axial hip (D).

In the hybrid group (Figure 4), there was one patient who had radiolucent lines on almost all surfaces of the femur and bone cement on the radiograph, which was categorized as possible loosening. On the contrary, there was no migration or subsidence of the femoral stem that was found. Other patients in the cemented group showed no signs of malalignment of the acetabular component and femoral stem, no radiolucent line and subsidence of the femoral stem, and also no loosening of the acetabular component.



(A)

(C)

(B)

(D)

Figure 4. Radiographs of 13 months after revision Total Hip Arthroplasty pelvic (A) and AP (B), axial (C), and lateral (D) hip x-rays

Discussion

The participants in this study had a mean age of 48.13 years with predominantly female patients undergoing rTHA (68.75%). The mean age of rTHA in this study is different from other studies with the mean age of 59.35 years and 68.6 years.[26,46,13,14] This difference is due to the younger age of patients underwent primary THA in Cipto Mangunkusumo Hospital (RSCM) with indications for primary THA such as secondary osteoarthritis caused by long-term steroid consumption, hip joint infection (tuberculosis), and neglected femoral neck fracture. Other studies also demonstrated that more female underwent rTHA with although the frequency varies in each study.[15,16]

The most common preoperative diagnosis of rTHA in this study are aseptic loosening, periprosthetic joint infection, and hip dislocation (each diagnosis occurred in 5 cases, 31.25%), while periprosthetic fractures only occurred in one case (6.25%). Similar preoperative indications of rTHA such as mechanical failure due to aseptic loosening or a fractured or worn-out polyethylene liner (36.5%), metallosis (21.4%), dislocation or instability (14.6%), periprosthetic fracture (10.4%), and infection (9.9%) are shown by Kelmer.[15] A study performed within 2 years after primary THA indicates mechanical failure (25.7%), infection (19.1%), dislocation (18.4%), and periprosthetic fracture (16.9%) as preoperative diagnosis for rTHA.[15]

Functional outcomes of rTHA

The functional outcomes in this study were measured using the Harris Hip Score (HHS). The mean value of HHS is 79.42, categorized as fair, with an evaluation period of 29.50 months in average. Previous studies on functional outcomes after rTHA found good clinical outcomes.[13,16,17,18] The meta-analysis study conducted by Saleh et al conclude that rTHA still produces slightly lower functional outcomes (based on global hip scores method) when compared to those of primary THA outcomes, although rTHA is a safe and effective procedure for hip joint replacement failure.[10] However, Rahman et al's study which included similar number of patients as in the current study, shows a significantly improved postoperative HHS compared to that of the preoperative.[13]

A meta-analysis by Saleh et al found a mean value of postoperative HHS ranging from 72.1 to 90 with the evaluation period of 22 to132 months. Good or excellent functional outcomes increase during 6 to 7 years follow up, after which the increase is not significant anymore.[10] The long-term study by Engelbrecht et al shows good functional outcomes despite poor radiological outcomes.[18] The mean HHS in this study was measured after a short follow up period (29.50 months). Even though the mean HHS in this study was within the upper limit of fair category of functional outcomes, an evaluation of the functional outcomes over a longer period of time (6-7 years) is required to obtain better HHS. Good functional outcomes within 4.1 years follow up period and a good survival rate are also demonstrated by the study of Smith et al.[19]

The fair category of HHS obtained in this study probably is most likely due to patients' unfavorable preoperative conditions, such as comorbidities (SLE) and neglected dislocations with large leg length discrepancy (12 cm). SLE comorbidities are usually detected at a young age and can result in reduced bone stock due to long-term steroid therapy. Repeated rTHA are most likely needed if the primary THA was performed at a young age and in patients with decreased bone stock.[14] The study from Parvizi et al on rTHA in limb length discrepancy cases shows good category of functional outcomes (HHS of 83.2), however the results were obtained from patients with a mean value of limb length discrepancy of 4 cm long (ranging from 2 to 7 cm).[20]

Complications of rTHA found in this study are sciatic nerve injury, hip dislocation and extension contracture of knee. Similar complications are also identified in Saleh et al's meta-analysis study in which the highest complication rates are periporsthesis fracture, infection, hip dislocation, and loosening.[10] Engelbrecht et al distinguishes the complications into systemic, local and late complications. Systemic complications occurred in 3.7% of subjects in the form of pulmonary embolism with one case of

perioperative death. Meanwhile, local complications were dislocation (2.9%), infection (1.6%), and periprosthetic fracture (1.4%). Late complications occurred in the form of trochanteric nonunion (22.5%) and ectopic bone formation (39.85%), but there was no relationship between late complications and functional outcomes.[18]

Patient who had complications of nerve injury and extension contracture of knee in our study showed fair HHS (72.8 and 72.5), while patients with dislocation had good HHS (83.9). Rahman et al's study also shows several complications following rTHA such as dislocation, infection, and nerve injury, but the HHS in those patients was lower than that of our study.[13] Complications after rTHA significantly affects the outcome in which poorer function and more severe pain at 24 months postoperative are observed. These complications may require further surgical revision and the number of surgical revisions performed eventually affects the functional outcomes of rTHA.[14]

Radiological outcomes

The current study identifies good radiological outcomes, especially for the noncemented and cemented groups, with no vertical subsidence or loosening components, according to the Harris and Engh criteria. In the hybrid group, there is one patient with possible loosening but still has good functional outcome (HHS of 83.4). Similar results are also demonstrated by Unger et al on rTHA with noncemented acetabular components, in which seven cases (11.86%) had radiolucency on x-ray radiographs but none required revision.[21]

Smith et al showed that although seven subjects (8.43%) experienced subsidence, the rTHA was only carried out in three patients, two of them with the indications of infection and loosening in one patient. Thus, no revisions are made based solely on the incidence of subsidence of the THA component.[19] Different results are found in the study by Engelbrecht et al, in which a significant relationship between loosening of the femoral component on radiological features and the clinical/functional outcome of the patient is demonstrated.

This condition is likely due to routine trochanteric osteotomy and bone cement. Meanwhile, there is no significant relationship between loosening of the acetabulum component and clinical/functional outcomes. This study also states that non-cemented acetabulum components are found to have more loosening on the screw and acetabular bone surfaces and in patients with poor bone stock.[18]

This study has succeded in demonstrating that rTHA results in fair functional outcomes, while radiological results do not show loosening events. The study findings indicate that there is a need for improvements in the management of rTHA with comorbidities, prevention and management of complications after rTHA, as well as proper management of bone stock in rTHA. Revision of THA still gives promising results when properly conducted by experienced doctors. In addition, the advancement of prosthesis technology also affects the durability (longevity) of the prosthesis for primary and rTHA.

We acknowledge several limitations, firstly, there was no preoperative HHS, thus we cannot compare objective functional outcomes before and after rTHA. Secondly, there was a possibility of a recall bias and in addition, given that this study was conducted in a national referral center, the indications for rTHA identified may not adequately represent those of the general population.

We argue that further studies on various rTHA surgical techniques, especially in patients with comorbidities, are recommended. Further exploration on the relationship between surgical techniques and functional and radiological outcomes is also worthwhile to obtain better functional and radiological outcomes, thus creating new surgical techniques. At last, this will lead to better outcomes and increased quality of life of the community.

Conclusions

The current study has assessed the functional and radiological outcomes of rTHA. The functional outcomes are considered to be fair based on the HHS criteria, whereas the radiological outcomes assessment shows no loosening of either the components of the cemented prosthesis using the Harris criteria and the noncemented prosthesis using the Engh criteria. Multicenter studies, with longer and regular follow up, may be beneficial to assess the targeted outcomes of a wider society, including those of different ages, ethnicity and daily activities. More studies should also include the evaluation of preoperative and postoperative functional and radiological outcomes and examine the influencing factors of the outcomes.

Conflict of Inferest

The authors declare no conflict of interest.

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No	Age (years)	Diagnosis	Management	Type of implant	HHS	Radiological outcome	Compli-cation	Follow up (months)
1	72	Aseptic loosening	ETO + rTHA	cementless	77.85	No loosening	No	30
2	74	Periprosthetic fracture	Implan removal + ORIF + rTHA	cemented	73.7	NA	No	23
3	40	Aseptic loosening	rTHA long stem + acetabular ring reinforcement	cementless	71	No loosening	No	21
4	34	Posterior hip Dislocation	rTHA	hybrid	72.5	NA	knee contract ure	70
5	49	Aseptic loosening	rTHA using cage	cemented	72.8	No loosening	Parese n. Ischiadic	51
6	52	Posterior hip dislocation	L rTHA	cementless	87.8	No loosening	No	56
7	51	Aseptic loosening + dislocation	rTHA + ETO + ORIF cerclage wire	cementless	83.6	No loosening	No	33
8	36	PJI	2 stage rTHA	hybrid	83.4	No loosening	No	19
9	42	Posterior hip dislocation	Open reduction, femoral head replacement, soft tissue proc (partial release iliopsoas insert, transferring gluteus max muscle insertion	cementless	76.7	No loosening	No	20
10	73	Posterior hip dislocation	2 stage rTHA: soft tissue augment by gluteus max transfer	cemented	79.8	No loosening	No	12
11	56	PJI	2 stage rTHA	cemented	81.8	NA	No	27
12	27	Aseptic loosening	rTHA	cementless	91	No loosening	No	33
13	75	PJI	2 stage rTHA	Hybrid	81	NA	No	33
14	19	Posterior hip dislocation	1. Soft tissue: Glut max transfer to capsul + capsuloraphy with MESH 2. Femoral stem and head offset revision	cemented	83.4	Possible loosening	recurren t dislocati on	13
15	19	PJI	2 stage rTHA	hybrid	83.8	No loosening	No	24
16	51	PJI	2 stage rTHA	cemented	70.5	No loosening	No	7