International Journal of Surgery Open 21 (2019) 68–72

Contents lists available at ScienceDirect

International Journal of Surgery Open

journal homepage: www.elsevier.com/locate/ijso

Research Paper

How is the outcome of primary difficult total hip arthroplasty? A cross-sectional study

Ismail Hadisoebroto Dilogo*, Muh Trinugroho Fahrudhin, Anissa Feby Canintika

Department of Orthopaedics and Traumatology, Cipto Mangunkusumo National Central Hospital, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia

ARTICLE INFO

Article history:
Received 1 May 2019
Received in revised form
22 October 2019
Accepted 22 October 2019
Available online 31 October 2019

Keywords:
Primary difficult THA
Total hip arthroplasty
Difficult hip disorders

ABSTRACT

Introduction: Total hip arthroplasty (THA) is the most common surgery for lower extremities. Improvement in surgical technique and advancement of surgical instrumentation extended the indications for difficult THA in previously impossible to treat.

Methods: 81 primary THA procedures were performed in Cipto Mangunkusumo National Hospital during the period from January 2012 to June 2017. Subjects consisted of 29 and 52 patients in the difficult and simple group, respectively. Intraoperative parameters including bleeding volume, operation time, complication rate, radiological outcome and functional outcome (Harris Hip Score) were recorded at the end of follow-up and analysed.

Results: The difficult group had significantly higher bleeding volume ($p < 0.001$), longer operation time ($p < 0.001$), and higher complication rate ($p=<0.012$), higher than the simple group. Radiological outcome was measured by the accuracy of component orientation placement in the safe zone resulted in no significant difference between two groups ($p = 0,333$). Functional outcome at the end of followup in the difficult group (88.67) did not have significant difference ($p = 0.080$) with the simple group (91.50).

Conclusions: Those with difficult hips did not have significant difference in terms of radiologic and functional outcome compared with the simple hips. It is necessary to identify each primary THA procedures whether there were any, types and levels of difficulties that would be faced intraoperatively in order to improve preoperative planning so the outcome would be optimal.

1. Introduction

Total hip arthroplasty (THA) is one of the most frequent and most successful surgeries in the orthopaedic field [1,2]. More than 200,000 THA procedures were performed in the United States annually, and the requirements continue to be projected to 572,000 THA procedures per year by 2030 [3–5]. Primary THA is performed in patients without any previous joint replacement procedures. Improvement in surgical technique and advancement of surgical instrumentation extended the indications for primary THA in difficult hip disorders that were previously impossible to treat [3]. In the event that there is an increased risk of intraoperative technical difficulties and complications, any THA should be considered difficult. Therefore by extension, a difficult primary hip is a challenging hip in which one anticipates intraoperative technical difficulties and complications that should be adequately prepared for and prevented [6]. These difficulties include bone and soft tissue abnormalities around the hip [4], as well as dysplastic hip, hip fusion, history of acetabular fracture, acetabular protrusion, skeletal dysplasia, neuromuscular disorders and history of internal fixation on the hip [3]. Primary difficult THA requires certain additional surgical techniques to achieve optimal outcome. Due to high complications rate, primary difficult THA needs adequate preoperative assessment and planning, such as surgical approach, type of implants to be used, and necessary additional procedures [5]. To date, there is a paucity of studies regarding the outcomes of difficult primary THA. This study aims to investigate the outcome of those undergoing difficult THA.

2. Methods

We used a cross-sectional study design. Subjects were patients who underwent THA at Cipto Mangunkusumo National Referral Hospital, Jakarta, Indonesia during the period between August 2017 and February 2018. We included those with a minimum of 6-month

* Corresponding author.
E-mail address: ismailortho@gmail.com (I.H. Dilogo).

https://doi.org/10.1016/j.ijso.2019.10.007

follow-up and already undergone postoperative radiographic examination of anteroposterior (AP) pelvis and lateral cross-table hip view. Exclusion criteria included revision THA, patients with other masking conditions such as lumbar or knee problem, have other comorbid conditions (cardiovascular or neuromuscular) or refused to join the study. The outcome analysis among the groups was measured in postoperative follow-up and medical record that consists of 4 parameters, which are perioperative assessment, complication rate, radiological outcome and functional outcome. The study protocol is presented in Fig. 1.

Perioperative assessment was performed through retrospective review of patient's medical record by one author. Parameters included amount of bleeding intraoperatively (blood loss), duration of surgery (operation time), and the length of stay after surgery until discharge. Complication rate is the pathological process that occurs after the THA procedure that may or not be related directly from the procedure. The presence of complication was assessed by physical and radiological examination. Functional outcome was assessed by means of the Harris Hip Score questionnaire during follow up. At the same time, an objective assessment of deformity and range of hip joint motion was also done. Radiological outcome was assessed by AP and lateral hip view shortly after surgery. Parameters included percentage of safe zone acetabular component orientation placement including acetabular abduction angle and acetabular anteversion angle. Acetabular abduction angle was the tilt angle of acetabulum against *trans*-ischial tuberosity line. Acetabular anteversion angle is the tilt angle formed between the connecting line of anterior and posterior ends of the acetabular cup with the horizontal line. Safe zone component orientation defines the range of orientation angle of the acetabular component considered to have the least complication risk and revision rate. Based on study by Seki and Lewinneck et al. [7] safe zone range for acetabular inclination was 30-50° and acetabular anteversion was about 5-25°.

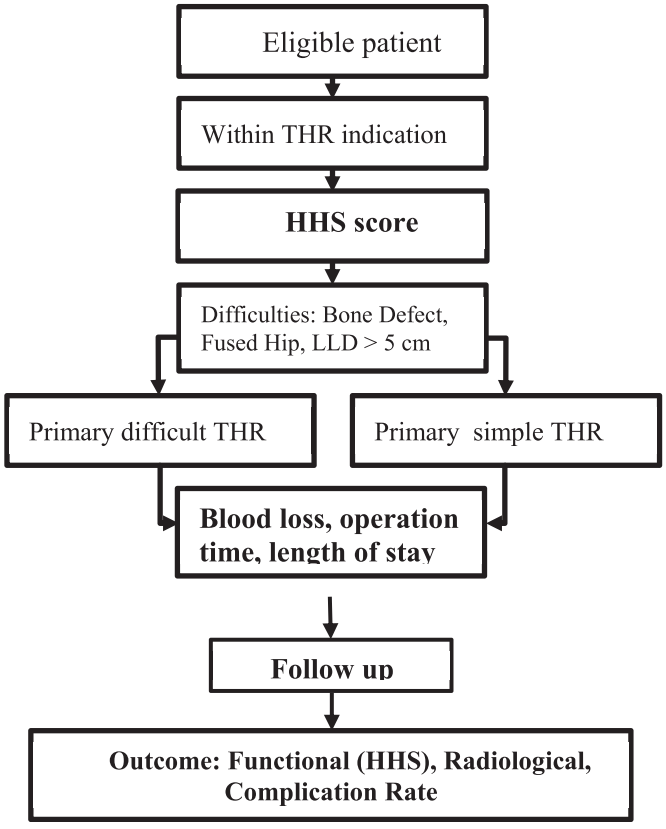

Fig. 1. Study protocol.

2.1. Statistical analysis

All statistical analyses were conducted using SPSS 20 for Windows. Numerical variables were analysed using independent *t*-test or Mann-Whitney test.

3. Results

A total of 81 subjects were recruited for this study. Characteristics of the subjects are presented in Table 1. Nine (31%) of the causes of the difficulties were acetabular bone defect (Table 2, Fig. 2). The blood loss and operative time were significantly higher in the difficult group than in the simple group (1185.17 ± 620.58 vs 636.15 ± 310.80, $p < 0.001$; 250 (160–600) vs 197.02 vs 55.57, $p < 0.001$, respectively) (Table 3). The acetabular component orientation is presented in Table 4. The difficult group had higher preoperative Harris Hip Score than the simple group (53.89 ± 14.11 vs 45 (8–72), $p < 0.001$) (Table 5). The complications also occurred more frequently in the difficult group (5/29 vs 1/52, $p = 0.012$) (Table 6).

3.1. Discussions

THA is one of the most successful medical procedures in the world with a significant impact on arthritic pain and restoring the patient's mobilisation function [3–5]. Improvement in surgical technique and the advance of surgical instrumentation extended the indications for primary THA to those who were previously impossible to treat. Such procedure is known as primary difficult THA which is performed in those with difficult hip disorders. These include bone defect of the hip, hip fusion, or soft tissue contracture [3–5]. Similar to other surgical procedures, THA also involves managing risks. Thereby, a difficult THA procedure is a THA that increases functional, infectious, and neurological risks or that involves technical difficulties, and the former may be linked to the latter [5]. Sathappan et al. [8] has described difficult THA as primary THA in patients with compromised bony or soft-tissue states, including but not limited to dysplastic hip, ankylosed hip, prior hip fracture, protrusion acetabula, certain neuromuscular conditions, skeletal dysplasia, and previous bony procedures about the hip. Some works had alluded to having a good number of difficult primary hips [9] and associated difficulties [6]. In this study, the number of difficult primary THA among those who underwent primary THA is 35.8%. The incidence of difficult hip disorders in Indonesia is estimated to have greater percentage compared to other countries, especially in developed countries. In our institution, primary difficult THA was performed in 27% of cases in 2016. This figure is quite large compared to the Korean population of 1.8% or Singapore of 7.3% [10]. To date, there are no studies that reported the outcomes of patients after primary difficult THA in Indonesia. Our study found that the majority of the difficult hips were acetabular bone defect.

During THA, soft tissue trauma should be limited in order to improve neurological and functional recovery while reducing the risk of infection (fewer haematomas, less tissue damage) and neurological complications. Biomechanics of the hip necessary to restore the centre of rotation must be respected, including restoring the lever arm and correct positioning of implants to limit impingement and wear from different components, which is a cause of long-term implant failure [5]. Those with significant anatomical abnormalities who should undergo THA present a challenge for orthopaedic surgeon. Selection of an appropriate

Table 1
Characteristics of the patients in primary difficult and simple THA.

Characteristics	Difficult group (N = 29)	Simple group (N = 52)	*P*-value
Age (years)	36.72 ± 12.5[a]	49.50 (21–82)[b]	0.011[b]
Evaluation time (months)	26.59 ± 12.09[a]	30.00 (10–65)[b]	0.167[b]
Sex			
Male	14 (48.3%)	18 (34.6%)	0.333[a]
Female	15 (51.7%)	34 (65.4%)	
Body mass index (kg/m^2)	26.59 ± 3.96[a]	22.17 (14.5–33.3)[b]	0.756[b]
Operated pelvic side			
Unilateral	21 (84%)	42 (89.4%)	0.404[a]
Bilateral	4 (16%)	5 (10.6%)	
Approach			
Posterior	13 (44.8%)	13 (25.0%)	0.113[a]
Anterolateral	16 (55.2%)	39 (75%)	

[a] Chi-square test.
[b] Mann-Whitney *U* test.

Table 2
Causes of difficulties in the difficult group.

Causes of difficulties	Primary difficult group (n = 29)
Acetabular bone defect	9 (31.0%)
Developmental displacement of the hip	4 (13.8%)
Traumatic chronic hip dislocation	7 (24.1%)
History of acetabular fracture	2 (6.9%)
Hip fusion conversion	6 (20.7%)
Internal fixation of proximal femur conversion	1 (3.5%)

implant is essential, and a modular prosthesis with options for calcar height, offset, length of neck and positioning of the sleeve is useful [11].

In our study, the mean age of primary difficult group was 36.72 years. This result was in accordance with a study by Imam et al. where the mean age of patients who underwent primary difficult THA was 30.5 years [12]. Primary difficult THA was performed in younger patients with hip dysplasia compared to patients with primary osteoarthritis [13]. In our study, the most common aetiology in primary difficult group was secondary OA due to AVN with acetabular bone defect, 9 cases (31.0%), followed by traumatic chronic hip dislocation, 7 cases (24.1%), conversion of fusion hip in 6 cases (20.7%) and DDH as many as 4 cases (13.8%). The proportion of cases is different from the study performed by Biant et al. [11] where DDH is the most common difficulties. All subjects in both groups of this study had results that did not differ significantly in the respondents' demographics of evaluation time, sex, body mass index, operated pelvic side and approaches used. In addition, in this study, the operating procedures performed on all respondents were performed by single surgeon. This can all reduce the probability of bias in this study.

In this study, we found that blood loss was higher in the difficult group compared with the simple group ($p < 0.001$). As for operation time, there was a difference where primary difficult group was significantly longer than primary simple group ($p < 0.001$). This is in accordance with a research by Dehaan et al. [14] that found the degree of surgical difficulty and patient morbidity was greater in the difficult group. This conclusion was derived from the findings that primary difficult THA had significant difference of intraoperative bleeding and operation time when compared to primary simple THA [14,15]. In line with a study by Mortazavi et al. [16], primary difficult THA with a history of proximal femur internal fixation had significant longer operation time and greater blood loss than simple group. Greater blood loss and longer operation time in primary difficult THA were due to some requirements of special procedure. For example, in DDH patient, a chronic hip dislocation requires lengthening correction of the legs by more than 5 cm. This can be achieved by soft tissue release, subtrochanteric osteotomy or more.

We found that there were no significant differences in Harris Hip Score between both groups. The mean postoperative HHS score in primary difficult group was 88.67 ± 6.88. This finding is in line with a study conducted by Imam et al. [12], which stated that the mean postoperative HHS score in DDH patients undergone primary THA was 88.6. In our study, we used techniques such as femoral subtrochanteric osteotomy to correct soft tissue contracture around the pelvis [12]. Li et al. [17] used a structural bone graft in primary difficult THA with 30% of the superolateral acetabular bone defects. The results of mean postoperative HHS at the end of follow-up were 91.2 which increased significantly compared to preoperatively.

Interestingly, when assessing the Harris Hip Score changes from preoperative to postoperative, significant higher values were obtained in the difficult group compared to simple group. This was due to significantly lower preoperative HHS in primary difficult groups. This result was similar when compared to a previous study by Boyle et al. [13] where a significant increase in functional outcome could be found in difficult group compared to simple group with primary osteoarthritis as a surgical indication. Lower preoperative hip function in primary difficult group was due to more difficultity of hip abnormalities.

We found that the incidence of complications was significantly higher in primary difficult THA. This is consistent with Morison et al. [18] who found that complications were higher in primary difficult THA with history of acetabular fracture compared to the simple group. Blomfeldt et al. [19] also found that primary difficult group with conversion of failed internal fixation had a complication rate of 26%, higher than simple group with an indication of primary osteoarthritis.

Nerve injury is the most common complication in the difficult group. In this study, those with difficult hips had shortening and soft tissue contractures around the pelvis due to LLD greater than 5 cm; thus, attempts to relocate centre hip of rotation back into

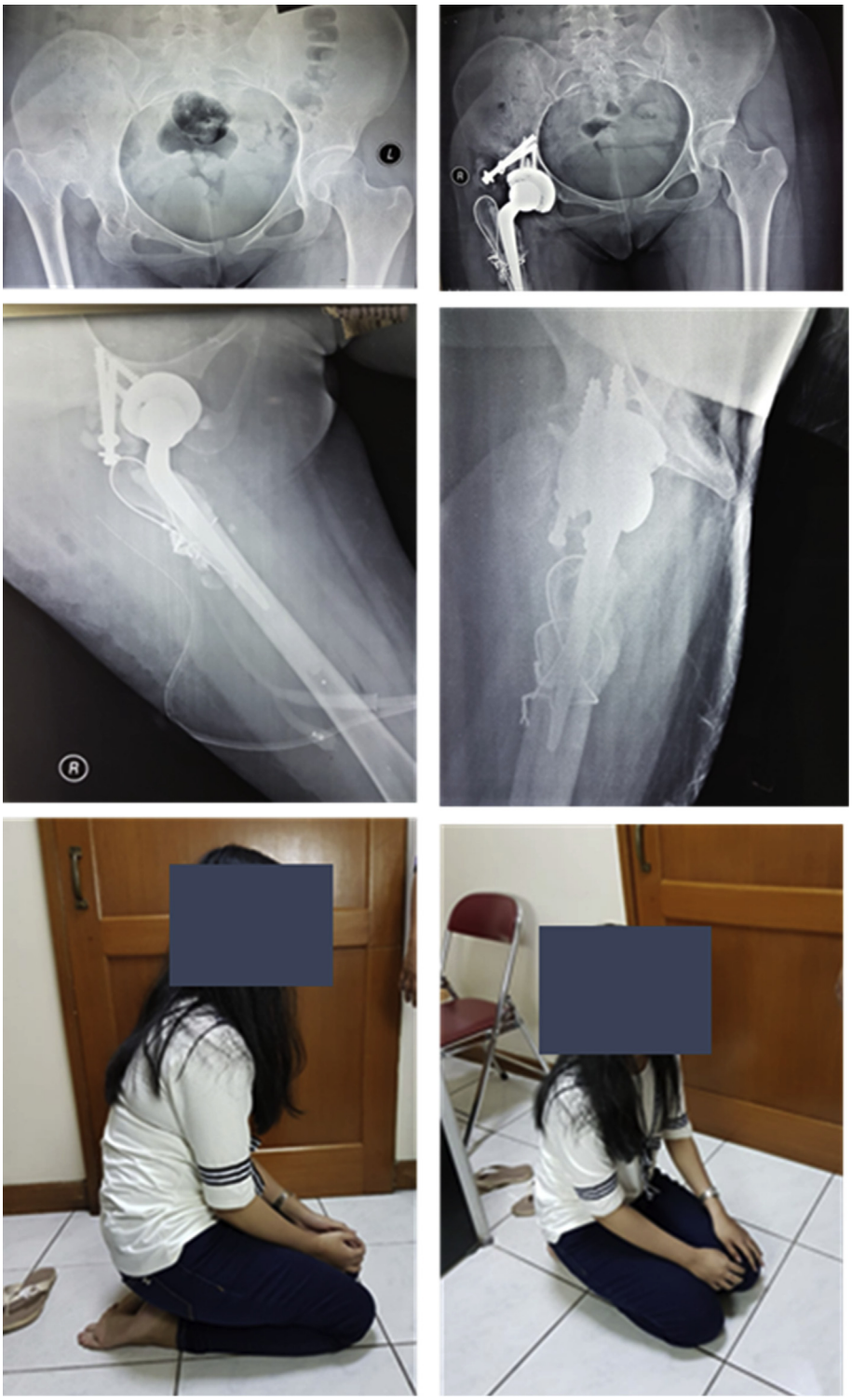

Fig. 2. A primary difficult THR case of developmental dysplasia of the hip.

Table 3
Perioperative assessment: Blood loss (in ml), operation time (in minutes), and length of stay (in days) in primary Difficult and simple THA.

Perioperative data	Difficult group (n = 29)	Simple group (n = 52)	P value
Blood loss	1185.17 ± 620.58	636.15 ± 310.80	<0.001[a]
Operation time	250 (160–600)	197.02 ± 55.57	<0.001[b]
Length of stay	4.24 ± 1.06	4 (3–10)	0.882[b]

[a] Independent *t*-test.
[b] Mann-Whitney *U* test.

Table 4
Radiological outcome: anteversion combination angle of acetabulum and femur in primary difficult and simple THA.

Characteristics	Difficult group	Simple group	P value
Acetabular component orientation			
Safe-zone	22 (79.3%)	42 (88.5%)	0.333[a]
Nonsafe-zone	7 (20.7%)	10 (11.5%)	

[a] Chi-square test.

Table 5
Functional outcome of *Harris Hip Score* in primary difficult and simple THA.

	Difficult group (n = 29)	Simple group (n = 52)	P value
Harris Hip Score			
Preoperative	53.89 ± 14.11	45 (8–72)	0.001[a]
Postoperative	88.67 ± 6.88	91.50 (48–100)	0.080[a]
Δ HHS	53.89 ± 14.11	46.85 ± 14.87	0.041[b]

HHS = Harris Hip Score.
[a] Mann-Whitney *U* test.
[b] Independent *t*-test.

Table 6
Intra and postoperative complication rates.

Primary THA complications	Difficult group (n = 29)	Simple group (n = 52)	P value
With complication	5	1	0.012[a]
Nerve injury	3	0	
Dislocation	1	0	
Surgical site infection	1	0	
Peri-implant fracture	0	1	
Without complication	24	51	

[a] Fisher's exact test.

normal place may result in injury to sciatic nerve. Identification of sciatic nerve, nerve clearance of adjacent soft tissues and non-acute correction by perform skeletal traction before surgery can be done to reduce the risk of such complications. Joshi et al. [20] reported a 12% incidence of complications in primary difficult THA and the most common complications were neuropraxia of sciatic nerve. Neuropraxia may improve over time and patients will regain function after about six months postoperatively. Therefore, the condition does not affect functional outcome at the final follow-up. Our study was limited by short duration of evaluation. No incidence of osteolysis, implant loosening and revision in both groups was an indicator of small number of samples and not long enough follow-ups to allow the occurrence of that events to be detected.

In conclusion, those with difficult hips have a greater degree of difficulties and challenges in the stages of surgical procedure when compared with those with simple hips. However, with good preoperative planning, primary difficult THA groups can have functional and radiological outcomes that are as good as those with primary simple THA. It was necessary to identify each primary THA procedures whether there were any, types and levels of difficulties that would be faced intraoperatively in order to improve preoperative planning; therefore, the outcome would be optimal.

Ethical approval

Ethical clearance was obtained from the Ethical Committee of Faculty of Medicine, *Universitas Indonesia*, Jakarta, Indonesia.

Funding

We have obtained ethical approval by Faculty of Medicine, *Universitas Indonesia* (reference number: 62D/UN2.F1/ETIK/2017).

Author contribution

Ismail Hadisoebroto Dilogo: conceptualization, methodology, supervision, study design, review & editing the paper.
Muh Trinugroho Fahrudhin: data collections, writing the paper.
Anissa Feby Canintika: data analysis, writing the paper.

Guarantor

Ismail Hadisoebroto Dilogo.

Research registration unique identifying number (UIN)

This was a cross-sectional study by reviewing medical records.

Declaration of Competing Interest

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijso.2019.10.007.

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