

Clinical Research

Dislocation following total hip arthroplasty: A series of 6 cases and literature review

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ABSTRACT

ABSTRAK

Introduction: Despite being one of the most successful operative procedures in the field of orthopaedic, total hip arthroplasty (THA) could lead to devastating complications, one of which is dislocation. Such condition is one of the most common causes of both patient and surgeon dissatisfaction, and impairs the quality of life. To our knowledge, there are no studies regarding factors associated with dislocation following THA in our country.

Methods: We conducted a cross-sectional study by reviewing medical records of patients who underwent primary and revision THA at Cipto Mangunkusumo Hospital, Jakarta, Indonesia, during the period between January 2017 and December 2018. Those who were diagnosed with dislocation following the surgery were included. Individuals who had previous THA in other hospitals, and those who had neoplasms, were excluded. We recorded the underlying disease, THA approach, implants used, component placements, type of dislocation, reduction performed, the interval between the procedure and dislocation, adherence to hip precaution and whether revision was needed.

Results: A total of 68 patients (73 hips) had undergone THA in our center. Five hips were excluded, as four of them had undergone THA in other centers, and one had history of malignancy. Thus, the final hips reviewed in this study were 68 (42, 13, and 13 had primary, primary difficult, and revision THA, respectively). None of those who had undergone primary THA developed dislocation; whereas, four (30.7%) and two (15.4%) subjects who had undergone primary difficult and revision THA, respectively, had dislocation.

Conclusion: We observed higher rates of dislocation compared to previous findings, which probably occurred because our center was a national referral hospital, which treated more complex cases. We found two patients who did not adhere to hip precaution, two patients with septic loosening and multiple prior surgeries. We recommended the use of hip precaution, particularly in patients who underwent primary difficult THA. This study confirms findings from previous reports, which states that two-stage revisions for infection and history of previous surgery predisposes to dislocation. We found that non-compliance to hip precaution also contributes to dislocation.

Pendahuluan: Walaupun merupakan salah satu operasi dengan tingkat keberhasilan paling tinggi di bidang orthopaedi, penggantian sendi panggul (Total Hip Arthroplasty/ THA) memiliki risiko yang berat, salah satunya dislokasi. Kondisi tersebut merupakan salah satu penyebab ketidakpuasan dan penurunan kualitas hidup untuk pasien. Sampai saat ini, belum ada penelitian yang menganalisis factor yang berhubungan dengan dislokasi pasca di Indonesia.

Metode: Kami melakukan sebuah studi potong lintang dengan meninjau rekam medic pasien yang menjalani THA primer maupun revisi di RS Cipto Mangunkusumo selama periode Januari 2017 sampai Desember 2018. Pasien yang menjalani operasi THA di RS luar, dan pasien dengan penyakit dasar neoplasma dieksklusi. Kami meninjau penyakit yang mendasari, approach, implant yang digunakan, penempatan komponen, jenis dislokasi, jenis reduksi, interval antara prosedur dan dislokasi, dan apakah tindakan revisi diperlukan.

Hasil: Sebanyak 68 pasien (73 panggul) menjalani THA selama kurun waktu penelitian. Lima panggul dieksklusi karena 4 pasien menjalani THA di tempat lain dan satu pasien memiliki riwayat tumor sehingga jumlah panggul yang diobservasi sebanyak 68 (42 primer, 13 primer sulit dan 13 THA revisi). Pasien yang menjalani THA primer tidak ada yang mengalami dislokasi, sedangkan masing-masing empat pasien (30.7%) dan dua pasien (15.4%) mengalami dislokasi pasca THA primer sulit dan THA revisi.

Kesimpulan: Kami menemukan angka dislokasi yang lebih tinggi dibandingkan studi lain, salah satu factor penyebab hasil tersebut yaitu banyaknya kasus sulit pada rumah sakit kami. Kami menemukan dua pasien yang tidak mengikuti protocol pencegahan dislokasi, dan dua pasien dengan infeksi dan beberapa operasi sebelumnya. Kami merekomendasikan protocol pencegahan terutama pada pasien yang menjalani THA primer sulit. Penelitian ini mengkonfirmasi temuan-temuan sebelumnya, yang menyebutkan bahwa revisi dua tahap pada kasus infeksi pasca THA dan riwayat operasi sebelumnya memiliki predisposisi terhadap dislokasi. Kami menemukan bahwa ketidak patuhan pada protocol pencegahan dislokasi juga berkontribusi terhadap dislokasi.

Keywords: dislocation; total hip; risk factor.

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INTRODUCTION

Total hip arthroplasty (THA) is one of the most successful surgeries in the orthopaedic field.¹ This surgery provides pain relief and function improvements for patients with advanced osteoarthritis. However, even if planned and executed properly, the surgery can be fraught with numerous complications, including thromboembolism, fractures, infection and dislocations. Of these, dislocations are the most common complication requiring revision surgery.² This is important as the number of hip arthroplasties is expected to grow and dislocation is one of the leading factors associated with increased cost and decreased quality of life.²

Several factors contributing to dislocations include patient and surgical risk factors.³ Risk factors derived from the patients include presence of neurological and cognitive disorders, fracture as underlying disease, evidence of prior surgery in the same hip, and compliance to post-operative hip precautions.³ The presence of cognitive and neuromuscular disorder decreases the compliance of patients to hip precaution and thus, placing them in greater risk for extreme positions which can illicit dislocation.⁴

Surgical approach, component position, component size and profile, soft-tissue balancing, and surgeon experience have also been proposed as surgical risk factors. THA can be performed with multiple approaches such as anterolateral (Watson-Jones), Lateral (Hardinge), Posterior (Southern), Transtrochanteric (Charnley), each with their own advantages and disadvantages. Posterior approach is believed to have the highest rate of dislocation. Soft tissue balancing includes repair of joint capsule, muscles, and producing enough muscle tension to produce hip stability.

Incorrect component positioning places the hip at risk for dislocation. Too much femoral anteversion makes the hip prone to anterior dislocation, while acetabular component, which are too inclined, places the hip in danger of posterior dislocation. Soft-tissue reconstruction, be it capsular, external rotators, or gluteus medius, protects against dislocation, and proper tensioning of the abductor is also of particular importance. To our knowledge, there is no study which reports the incidence and factors associated with the development of dislocation following THA. In this series, we present six cases of dislocation following THA.

METHODS

We conducted a retrospective study from 2017 and 2018 at Cipto Mangunkusumo Hospital in Jakarta, Indonesia. Medical records of patients who had undergone primary THA and/or revision surgery from all underlying disease were included. Those who had previous THA surgery at other centers, and those who had history of malignancies, were excluded from the study.

In our center, total hip replacement was done with the following steps, the patient lies in lateral decubitus position with the affected hip on top, using anterolateral approach whenever applicable, except in the case of THA with reconstruction, and choice of implant was selected according to the underlying disease or patient factors. Patients with poor bone quality, as evidenced by Dorr classification, or had history of infection in the affected hip, underwent cemented hip replacement. For young patients, and patients who are expected to undergo revision in later years, we opted for cementless fixation. We used Johnson and Johnson or Smith and Nephew implants, regardless of the choice of fixation. For revision THA, we follow the approach that was used in the index procedure.

Postoperative protocol at our center includes administration of venous thromboembolism (VTE) prophylaxis (oral rivaroxaban or dabigatran), immediate postoperative rehabilitation including muscle strengthening exercise and early weight bearing, and hip precaution protocol which include restriction of squatting movements, flexion beyond right angles, and abduction/adduction restriction according to the approach.

After thorough medical record and registry check, we reviewed the underlying disease, approach (anterolateral or posterior), implants, component placements (with angles), as well as the type of dislocation (anterior or posterior), type of reduction performed, the interval between the procedure and dislocation, and whether or not the patient needed component revision. We will also review whether the patient had a primary difficult or complex THA (defined as a total hip arthroplasty in patients with compromised bone or soft tissue surrounding the hip). This could include previously infected hip, with congenital or acquired dislocation, fracture involving the proximal femur or acetabulum or in which extraordinary steps needed to be taken, such as 2-stage procedure, acetabuloplasty or ORIF).

RESULTS

From our study, there were 64 patients who underwent

total hip arthroplasty in our center involving 73 hips (9 patients underwent bilateral procedures). Two patients underwent THA as construction procedures following tumor removal and thus excluded from this series. From these 71 procedures, 13 were THA revisions. For the remaining 58 cases, 13 were difficult cases. There were 10 dislocations in nine patients, however three patients un-

derwent the index procedure at other centers, therefore those cases were excluded. Finally, there were 7 episodes of dislocations in 6 patients included in this study. The characteristics of the subjects are presented in Table 1.

Case 1.

A 45-year-old male presented to our clinic with pain on

Table 1. Characteristics of the subjects

Patient	Sex	Age	Procedure	Underlying disease	Reduction	Interval	Duration of Follow up
A	M	45	Revision THA	Femoral neck fracture, Septic loosening	Open + implant revision	2	14
B	F	62	Primary difficult THA	Non-union Femoral neck fracture	Open + implant revision	2	5
C	M	57	Revision THA	Femoral neck fracture, Septic loosening	Closed	2	8
D	M	18	Primary difficult THA	Posttraumatic arthritis (dislocation + Acetabular Fx)	Closed	6	13
E	M	37	Primary difficult THA	Pathological Femoral neck fracture	Open + Implant revision	4	15
F	M	24	Primary difficult THA	Posttraumatic arthritis (dislocation + Acetabular Fx)	Closed	2	12

F = female, M = male, interval and duration of follow-up are stated in months.

Table 2. Component placements in dislocated patients

Subjects	Procedure	Approach	Direction	Femoral head size	Acetabular inclination
A	THA Revision	Posterior	Posterior	36	35
B	Primary difficult THA	Anterolateral	Posterior	28	52
C	THA Revision	Posterior	Posterior	28	47
D	Primary difficult THA	Posterior	Anterior	28	46
E	Primary difficult THA	Anterolateral	Posterior	28	49
F	Primary difficult THA	Anterolateral	Posterior	28	27

his left hip. He had undergone two prior surgeries; the first one was a bipolar hemiarthroplasty due to neglected femoral neck fracture for 2 years, and the second one was conversion to THA due to dislocation 3 months after the previous surgery. He developed septic loosening and underwent two-stage THA revision at our center. Two months after the revision, the dislocation occurred (Figure 1A) after the patient sat on a low chair. He underwent open reduction, implant revision to correct the femoral

anteversion which was too steep, and gluteus maximus advancement (Fig 1B). At the last follow up (2 years after surgery), the patient could walk (full-weight bearing).

Case 2.

Female, 62 years of age, came to our center for painful left hip. She had broken her left hip three years prior from fall in the bathroom (Fig. 2A). She had 5 cm limb-length discrepancy and underwent two-stage THA

(Fig. 2B). Two months after the surgery, she had dislocation which was able to be reduced via closed means (Fig. 2C). However, she underwent another dislocation three weeks after the first one which necessitates an open reduction and component revision. Intraoperatively, we checked for stability of the components and found that there was significant telescoping, and thus we exchanged the femoral head with a longer offset (Fig. 2D). The hip was stable in extreme positions. At the last follow up (2 months after the open reduction) the patient could walk full-weight bearing with a walker.

Case 3

A 56-year-old male came to our center because of copious discharge coming from his old surgical wound. He initially had femoral neck fracture which was fixed by a hemiarthroplasty and had previously undergone THA conversion at our center 5 years prior (Fig. 3A). He underwent a couple of debridement before a THA revision could be undertaken (Fig. 3B). Two months after the surgery he had dislocated his right hip (Fig. 3C) which was then reduced via closed means (Fig. 3D). At the last follow-up, a year after last surgery, the patient could walk with walker.

Case 4.

An 18-year-old male suffered from posterior dislocation of right hip with acetabular fracture (Fig. 4A). He visited our center a year after the initial accident. Physical examination found 5 cm limb-length discrepancy, and radiographic examination revealed avascular necrosis of the femoral head. We decided to perform a 2-stage THA (Fig. 4B). The dislocation occurred 6 months after the index procedure when the patient was sleeping, and he did not recall any prior trauma (Fig. 4C). He subsequently underwent closed reduction and at the last follow up, one year after the closed reduction, he could walk unaided (Fig. 4D).

Case 5.

A 37-year-old male came to our center due to fall in the bathroom. The patient also suffered from chronic kidney disease, and he underwent dialysis regularly. Upon investigations, we found severely osteoporotic bone and left femoral neck fracture (Fig. 5A). The patient underwent primary difficult total hip replacement on his left hip (Fig. 5B). Four months after the index procedure, the patient came to our ER due to posterior dislocation (Fig. 5C) after he fell down a flight of stairs and he sub-

sequently underwent closed reduction (Fig. 5D). On the last follow up, 6 months after the last surgery, he walked with a walker.

Case 6.

A 24-year-old male came to our center after fall from a tree a year prior. He had 4.5 cm limb length discrepancy and sciatic nerve palsy. Upon investigation, we found posterior dislocation of the right hip with avascular necrosis of the femoral head and transverse acetabular fracture (Fig. 6A). The patient underwent a 2-stage THA and acetabuloplasty (Fig. 6B). Two months after the index procedure, the patient sat on a low closet and dislocated his right hip (Fig. 6C). He underwent a closed reduction (Fig. 6D). At the last follow up, the patient still on a bilateral crutch (due to drop foot).

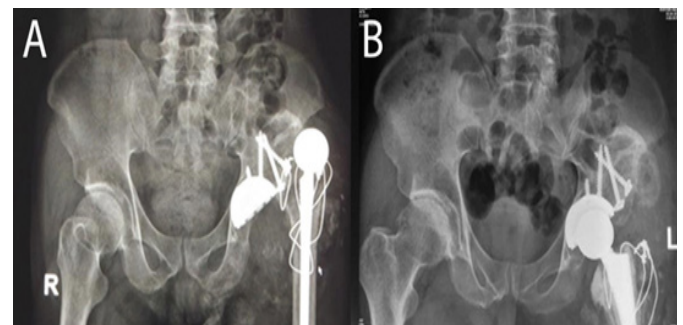


Figure 1A-B. A. Dislocation 2 months after undergoing revision surgery with acetabuloplasty and tension band wiring for broken greater trochanter. B. after open reduction and insertion of longer offset head.

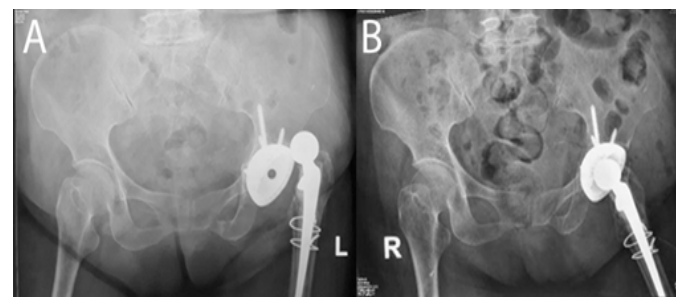


Figure 2 A-B. A. Posterior dislocation 2 months after staged THA following neglected femoral neck fracture with 5 cm LLD. B. After open reduction and replacement of femoral head with longer offset.

From our study, we found that the rate of dislocation for primary THA were 0% (0 out of 42), 30% for primary difficult THA (4 out of 13), and 15% for THA revision (2 out of 13). If we took the standard THA and the difficult ones, we would have got a rate of 7.2%. The age of the patients varied greatly as the age ranged from 18 to 62

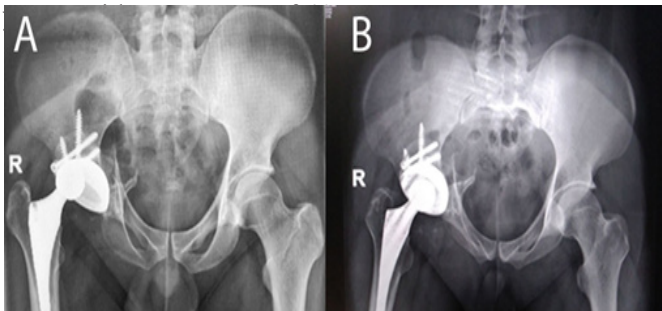


Figure 3 A-B. A. Posterior dislocation 2 months after THA revision with cemented implants, note that the patient had a plate spanning the entire length of the femur. B. After closed reduction.



Figure 4 A-B. A. Anterior dislocation 6 months following a 2-stage primary difficult THA and acetabuloplasty using femoral head allograft with cementless implant. B. After closed reduction.

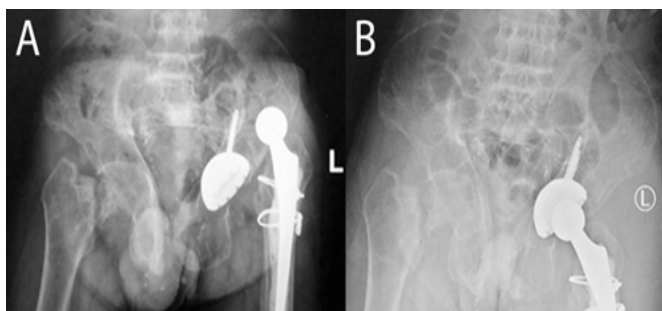


Figure 5 A-B. A. Posterior dislocation 6 months after primary difficult THA due to femoral neck fracture. B. After open reduction.

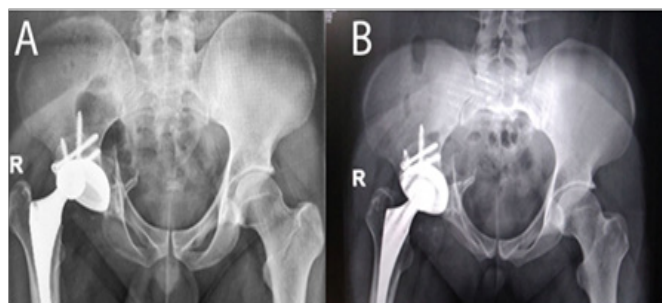


Figure 6 A-B. A. Posterior dislocation after 6 months following primary difficult THA due to femoral neck fracture. B. After closed reduction.

All of the dislocations were directed posteriorly, except for one patient. The most common underlying disease was femoral neck fracture, whether it was a new fracture, pathological or non-union, followed by post-traumatic arthritis caused by fracture around the hip. Both patients who suffered dislocation after THA revisions had septic loosening from the previous surgery. The average time for dislocation was 3 months, with the most common within 2 months postoperatively. The dislocation could be reduced by closed means in 3 patients, while the other three had to undergo open reduction and implant revision in the form of femoral head exchange.

We also reviewed the approach that were utilized during the surgery and component placements, as summarized in Table 2. In terms of approach, anterolateral was the more common approach to be performed (77%) had a lower rate of dislocation at 5.4% (3 out of 56), compared to posterior which had 18.8% (3 out of 16). All patients had femoral head sized 28, except for one patient who had a size of 36 mm implanted. All patients had acetabular inclination outside the recommended angle (40-45°). It should be noted that one patient had dislocation although he had lower inclination than recommended.

We found that several patients had comorbidities which was relevant to the occurrence of dislocation. One patient (patient E) suffered from chronic kidney disease and underwent hemodialysis; this particular patient had severe osteoporosis. One patient (patient A) had recurrent dislocation prior to revision THA, in fact, she had loosening, infection, and dislocation prior to revision THA. Patient C had four prior surgeries before the revision, first the index procedure which was bipolar hemiarthroplasty for femoral neck fracture, then he had conversion to THA due to acetabular pain. He underwent 2 more surgeries because of septic loosening and underwent several debridement. Patient C also had accident after THA conversion and thus, had a plate fixation on his femur bone.

DISCUSSION

Dislocation after total hip arthroplasty is a major cause of concern, both for the patient and the surgeon.⁵ In fact, it is the single most common cause for revision arthroplasty.² As such, it is imperative that each center attempts to prevent the occurrence of dislocation by improving the quality of surgery and providing the appropriate treatment, should it happen. In order to gain a better perspective of the causes of the dislocation, the

Table 3. Classification of dislocation following THA and their management¹²

Type	Acetabular Component Orientation	Femoral Component Orientation	Abductor-Trochanteric Complex	Impingement	Late Wear	Intervention
I	Incorrect	Correct	Intact	Absent	Absent	Acetabular component revision
II	Correct	Incorrect	Intact	Absent	Absent	Femoral component revision
III	Correct	Correct	Absent	Absent	Absent	Constrained liner
IV	Correct	Correct	Intact	Present	Absent	1. Remove sources of impingement 2. Upsize modular head and liner
V	Correct	Correct	Intact	Absent	Present	1. Modular component exchange 2. Upsize modular head and liner
VI	Correct	Correct	Intact	Absent	Absent	Constrained liner

underlying pathology of the patient, surgical technique, and results should be reviewed.

Our center is a national referral hospital which is also a teaching center for orthopaedic residents, and accordingly, the cases vary in difficulty, from standard primary THA to complex and revision cases. Being a teaching center, we are obliged to introduce the concept and the surgical technique of total hip arthroplasty to our final-year residents. Therefore, some of the easier cases will be performed by the final year residents under direct supervision of a consultant hip surgeon (senior author). This review will also help us to govern our policy. However, for more difficult cases, a hip surgeon undergoing fellowship or the senior author himself will perform the surgery.

From our study, we found that no patient had dislocation after primary total hip arthroplasty, regardless of the approach. However, when primary difficult or complex cases are also taken into account, the dislocation rate rises to 7.2% (4 out of 55 cases). This is somewhat higher than most centers, which falls between 2.1-3.2%.³ For revision THA, the dislocation rate was 15%, twice as high than the report by Blom, *et al* (8.1%).⁷ However, they had more cases and the higher rate of dislocation may in part be explained by the limited sample size of the current study. Moreover, Parvizi, *et al*⁸ reported 0.3-10% incidence of primary THA and up to 28% of revision cases. The studies by Blom and Parvizi, however, did

not specify the exact cause of the revisions so that when looking at the rate of dislocation following 2-stage revisions for infection, the study by McAlister, *et al*⁹ is the most comparable as they only included patients with infection. Even then, the current study at 15% still have higher rate compared to them (10%).

When looking at a case of dislocation, we have to review the patient, the surgical technique, as well as the results. From our review, we found that two subjects did not adhere to our prescribed hip precaution. While the current evidence discourages the use of routine hip precaution in anterolateral approach, currently there is no recommendation for posterior approach, which these two patients had.¹⁰ The majority of hip and knee surgeons in the USA still prescribes some degree of hip precaution as a means to prevent dislocation, particularly after posterior approach.¹¹ Our current perspective is that while it may not be necessary in primary standard THA, it is the surgeon's task to determine whether the hip is stable enough intraoperatively, and therefore, the precaution prescribed accordingly. Alternatively, if the patient had undergone primary difficult THA or had a 2-stage surgery whereby the hip will be dissected at least twice in a matter of several days, some degree of hip precaution is advised.

This period of hip precaution has a basis for application. Brooks reported that 60-70% of dislocations occurred before 6 weeks postoperatively, and only one percent

would be dislocated many-many years after.⁵ This is comparable to a study by Blom, *et al*⁷, where they found that 64.2% of patients who had dislocation did so in the first 3 months after surgery. This is consistent with our current study (average of 3 months postoperative).

As our center is a tertiary care, we inadvertently ran into cases which are very challenging. Cases of neglected fracture about the hip, with or without secondary arthritis or avascular necrosis are to mention a few. These cases are fraught with complications as they present with altered bony anatomy, soft tissue envelope, and may have implanted hardware from previous surgery. From our cases, we found that 3 patients had superior migration of the femur: 2 patients from posterior dislocation and one from non-union of femoral neck. These patients had excessive tension on their abductor muscles, which contributed to the development of the dislocation.

We also reviewed the revision cases which had dislocation. We found that two patients had several surgeries prior to the revision, and both were revised due to septic loosening (one patient had dislocation prior to the loosening). Both patients underwent two-stage revision, meaning that they first had implant removal and complete and thorough debridement with antibiotic-impregnated cement inserted as spacer, prior to reimplantation. This type of surgery is often the only treatment method available, as a single stage surgery is deemed unsafe in cases of chronic infection. However, they are also associated with higher rate of dislocation. A recent study by McAlister, *et al*⁹, showed that two-stage revision for infection is associated with cumulative probability of 8.9% at 1-year, with higher risk for women and those who had prior dislocation before the 2-stage revision.

Even after meticulous surgical technique and proper component implantation, dislocation can still occur. As such, treatment strategy must be aimed to prevent a second dislocation, beginning with thorough history and physical assessment, including leg-length discrepancy and abductor muscle tension, followed by infection markers and imaging (standard pelvis AP, hip AP, and axial cross table). Timing of dislocation also points the examiner into the underlying cause. A dislocation which occurs in term of months suggests inadequate soft tissue tension, improper component placement, infection, or non-compliance of patient.

After initial work up, the patient should undergo a

reduction via closed means followed by a period of bracing.³ The patient should undergo re-evaluation if another dislocation occur, and the causative factor should be addressed accordingly. Wera, *et al*¹² described the classification and proposed intervention in managing the underlying problem, as seen in Table 3. They identified 5 problems from component malposition, abductor-trochanteric complex, impingement, and wear. If the underlying problem is malposition, component revision procedure to re-orient the placement should be performed, because constrained cup cannot compensate for malalignment. However, if the dislocation is thought to stem from insufficient abductor mechanism, then a constrained cup should be inserted to overcome the problem.

We identified the limitations of our study, as this is a single-centered study, with limited time period and included only a small number of patients. However, we believe that this study could be a stepping stone for the basis of future studies.

CONCLUSION

Dislocation after THA is a very devastating complication. Surgeons who perform THA should have a thorough knowledge on the patient factor, and they should apply proper surgical technique and component placement which ensures hip stability. When stability is in question, it is the task of the surgeon to prescribe hip precaution measures. When coming across a dislocation after THA, the surgeon must be able to evaluate for causative factor and treat accordingly. We recommend a larger, multi-centered studies with longer follow-up for future studies to better understand and improve the quality of hip arthroplasties performed in Indonesia.

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REFERENCES

1. Knight SR, Aujla R, Biswas SP. Total Hip Arthroplasty - over 100 years of operative history. *Orthop Rev (Pavia)*. 2011;3(16):2-4.
2. Bozic BKJ, Kurtz SM, Lau E, Ong K, Vail TP, Berry DJ. The Epidemiology of Revision Total Hip Arthroplasty in the United States. *J Bone Jt Surg Am*. 2009;128-33.
3. Soong M, Rubash HE, Macaulay W. Dislocation After Total Hip Arthroplasty. *J Am Acad Orthop Surg*.

- 2004;12:314–21.
4. Kraay M, Bigach S. The neuromuscularly challenged patient: total hip replacement is now an option. *Bone Jt J.* 2014;96(11):27–31.
 5. Brooks PJ. Dislocation following total hip replacement causes and cures. *J Bone Jt Surg Br.* 2013;95(11):67–9.
 6. Alberton GM, High WA, Morrey BF. Dislocation After Revision Total Hip Arthroplasty: An Analysis of Risk Factors and Treatment Options. *J Bone Jt Surg Am.* 2002;84(10).
 7. Blom AW, Rogers M, Taylor AH, Pattison G, Whitehouse S. Dislocation following total hip replacement : the Avon Orthopaedic Centre experience. *Ann R Coll Surg Engl.* 2008;90:658–62.
 8. Parvizi J, Picinic E, Sharkey PF. Revision total hip arthroplasty for instability: Surgical techniques and principles. *J Bone Jt Surg Am.* 2008;90(5):1134–41.
 9. McAlister IP, Perry KI, Mara KC, Hanssen AD, Berry DJ, Abdel MP. Two-Stage Revision of Total Hip Arthroplasty for Infection Is Associated with a High Rate of Dislocation. *J Bone Jt Surg Am.* 2019;101(4).
 10. Barnsley L, Occupational B, Hons T, Barnsley L, Epi GC, Racp F, et al. Are Hip Precautions Necessary Post Total Hip Arthroplasty ? A Systematic Review. *Geriatr Orthop Surg Rehabil.* 2015;6(3):230–5.
 11. Clohisy JC, Carli A V, Beaul PE. Variation in Use of Postoperative Precautions and Equipment Following Total Hip Arthroplasty : A Survey of the AAHKS and CAS Membership. *J Arthro.* 2018;33:3201–5.
 12. Wera GD, Ting NT, Moric M, Paprosky WG, Sporer SM, Valle CJ Della. Classification and Management of the Unstable Total Hip Arthroplasty. *J Arthroplasty.* 2012;27(5):710–5.