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ORIGINAL PAPER

Re-dislocation after revision total hip arthroplasty for recurrent dislocation: a multicentre study

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Abstract
Purpose Although most case of dislocations after total hip arthroplasty (THA) can be managed with conservative treatment, recurrent dislocation may require surgical intervention. This multicentre study was conducted to evaluate the re-dislocation rate after revision THA for recurrent dislocation, and to determine the risk factors for re-dislocation.
Methods We retrospectively reviewed the 88 hips in 88 patients who underwent revision THA for recurrent dislocation at five institutions between 1995 and 2014. The mean patient age at surgery was 68.5 years and the mean follow-up period was 53.1 months. Multivariate logistic regression was performed to identify risk factors for re-dislocation.
Results Sixteen hips in 16 patients (18.2 %) re-dislocated at a mean of 25.5 months (range, 1–83 months) after revision THA. Multivariate analysis identified osteonecrosis of the femoral head (odds ratio [OR] = 5.62 vs. osteoarthritis) and a femoral head size < 32 mm (OR = 3.86) as independent risk factors for re-dislocation. Eight hips required additional revision THA for re-dislocation.
Conclusion The re-dislocation rate after revision THA for recurrent dislocation remains high, suggesting the need for prevention measures. We recommend the use of a femoral head size ≥ 32 mm.

Keywords Revision total hip arthroplasty · Dislocation · Recurrent dislocation · Osteonecrosis of femoral head · Large femoral head

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Introduction

Dislocation is among the leading causes of failure after primary and revision total hip arthroplasty (THA) [1–4], with reported dislocation rates after primary THA of 1.7–4.8 % [1, 4–7]. Notably, dislocation is more frequent after revision THA, with rates ranging from 5.1 % to 27 % [2, 3, 5, 8]. Although most dislocations can be managed with conservative treatment, recurrent dislocation substantially impairs a patient's activities of daily living, and such cases frequently require surgical interventions. However, revision THA for recurrent dislocation is not always successful; notably, Jo et al. [9] and Daly and Morrey [10] have reported high re-dislocation rates of 15.9 % and 39 %, respectively.

Several studies have attempted to identify the risk factors for dislocation after revision THA. Previous studies have identified femoral head size, severe acetabular bone loss, previous dislocation, number of previous hip surgeries, and acetabulum-only revisions as risk factors for dislocation after revision THA [3, 5, 11–13]. It would also be interesting to identify the independent risk factors of re-dislocation after revision THA for dislocation. However it is difficult to

identify the risk factors for re-dislocation because this procedure has not been performed frequently. Additional diversified investigations of various treatment options and patients' backgrounds are therefore needed.

Accordingly, the purpose of this multicentre study was to evaluate the overall rate of re-dislocation and identify the risk factors for re-dislocation after revision THA for recurrent dislocation.

Materials and methods

This study was approved by the institutional review board. Between 1995 and 2015, a total of 105 hips in 105 patients were subjected to revision THA for recurrent dislocation at five institutions. Among them, 13 hips in 13 patients were excluded because they were lost to follow-up within one year, and four hips in four patients were excluded because their follow-up periods at the present time were less than 12 months post-operatively. The remaining 88 hips in 88 patients were included in this study (Table 1). The mean patient age at revision THA was 68.5 years and the mean follow-up period was 53.1 months (minimum, 12 months). Before revision THA, 72 hips had dislocated posteriorly, 15 hips had dislocated anteriorly and one hip had dislocated both anteriorly and posteriorly.

Among the 88 patients, 59 had osteoarthritis (OA), ten had osteonecrosis of femoral head (ONFH), and four had rheumatoid arthritis. The remaining 15 patients had other diseases including fracture and ankylosing spondylitis. The possible reasons for dislocation were cup malposition in 39 hips, stem malposition in five hips, joint laxity in 18 hips, patients' carelessness in 18 hips, and unknown in eight hips. Seventy-three and 15 hips were subjected to revision THA via the posterolateral and lateral approach, respectively. Sixty-one hips underwent liner and head revision, 22 underwent acetabular-only revision, and four underwent femur-only revision. A flat liner was used in 20 hips, an elevated liner in 66 hips, and a constrained liner in two hips. The revised femoral head diameters were 36 mm in ten hips, 32 mm in 35 hips, 28 mm in 35 hips, 26 mm in six hips, and 22 mm in one hip.

Factors possibly related to re-dislocation were researched. Evaluated patient variables included age, gender, body mass index (BMI), primary hip disease, and single vs. multiple revision THA (the latter defined as more than two revision THAs). The surgical approach was evaluated as a surgical variable. Implant factors included the femoral head size, which implants were revised, and liner type.

Statistical analysis

JMP 11.0 software (SAS Institute, Cary, NC, USA) was used to perform statistical analyses. Univariate and multivariate analyses were conducted to determine the risk factors associated with re-dislocation. We compared re-dislocated and stable hips using t-statistics for continuous variables and χ^2 statistics or Fisher's test for categorical variables. In the multivariate analysis, patient and implant variables were analysed separately via logistic regression. P values < 0.05 were considered significant.

Table 1 Patient characteristics

Characteristic		Value, mean ± SD (range)
Age at revision THA (years)		68.5 ± 10.5 (30–87)
BMI (kg/m^2)		23.4 ± 4.1 (13.9–38.5)
Follow-up period (months)		53.1 ± 43.5 (12–213)
Gender (patients)	Male	20
	Female	68
Primary hip disease (hips)	OA	59
	ONFH	10
	RA	4
Surgical approach at revision THA (hips)	Posterolateral	73
	Lateral	15
Direction of dislocation before revision THA (hips)	Posterior	72
	Anterior	15
	Bilateral	1
Possible reason for dislocation (hips)	Cup malposition	39
	Stem malposition	5
	Joint laxity	18
	Patients carelessness	18
	Unknown	8

THA total hip arthroplasty, *SD* standard deviation, *BMI* body mass index, *OA* osteoarthritis, *ONFH* idiopathic osteonecrosis of femoral head, *RA* rheumatoid arthritis

Results

The mean time to re-dislocation after revision THA was 25.5 months (range, 1–83 months), and the mean number of dislocations after revision THA was 2.2 (range, 1–5 times). Re-dislocation occurred in 16 hips (18.2 %), of which five dislocated anteriorly and 11 dislocated posteriorly. The possible reasons for re-dislocation were the joint laxity in seven hips including the necrosis of gluteus muscles due to adverse reactions to metal debris in one hip, patients' carelessness in eight hips, and fall in one hip. In two patients, the direction of dislocation after revision THA differed from that before revision THA. One such patient, an 81-year-old woman, experienced anterior dislocation before revision and posterior dislocation after revision; the other patient, a 58-year-old man, experienced posterior dislocation before revision and anterior dislocation after revision. In both cases, primary and revision THA were performed through a posterolateral approach.

The univariate analysis revealed significantly more re-dislocations in patients with the following characteristics: younger age, ONFH, and femoral head size < 32 mm. In addition, no re-dislocation had occurred in patients who underwent femur-only revision; however, only six hips were treated via femur-only revision, and therefore this difference was not statistically significant. Previous revision surgery, surgical approach and isolated liner exchange were not the predictors of re-dislocation in this study (Table. 2). Adjusting with age and gender, we observed a significantly higher risk of re-dislocation with ONFH vs. OA (odds ratio [OR] = 5.62; 95 % confidential interval, 1.05–31.34). After adjusting for implant revision and liner type, a femoral head size < 32 mm was significantly associated with re-dislocation (OR = 3.86; 95 % confidential interval 1.16–15.30; Table 3).

Among the 16 re-dislocated hips, eight (9.1 %) underwent re-revision THA for re-dislocation. Additional re-revision THA was performed on two hips for aseptic loosening and periprosthetic fracture. Overall re-revision THA for any reason was performed on ten hips (11.3 %) at a mean of 41.0 months (range, 1–74 months) from the index revision THA. Among the eight hips subjected to re-revision for re-dislocation, further dislocation occurred in five hips (Fig. 1).

Discussion

A high re-dislocation rate (16 hips, 18.2 %) after revision THA for recurrent dislocation was observed in this series of 94 hips. Multivariate analysis identified that ONFH had a 5.62-fold higher risk of re-dislocation vs. OA and a 3.86-fold higher risk of re-dislocation with a femoral head size < 32 mm.

Table 2 Univariate analysis of risk factors for re-dislocation

Patient variables	Re-dislocation		P value
	+ (n = 16)	– (n = 72)	
Female (%)	13 (81.3 %)	56 (77.8 %)	0.7570
Age	62.3 ± 12.6	69.8 ± 9.6	0.0096*
BMI	22.6 ± 3.6	23.6 ± 4.2	0.3810
Primary hip disease			
OA (%)	7 (43.8 %)	52 (74.3 %)	0.0215*
ONFH (%)	5 (31.3 %)	5 (7.1 %)	0.0149*
RA (%)	1 (6.3 %)	3 (4.3 %)	0.7456
Multiple revision (≥2)	4 (25.0 %)	15 (20.8 %)	0.7178
Surgical variables			
Posterolateral approach (%)	15 (93.8 %)	59 (81.9 %)	0.2013
Implant variables			
Revised implant			
Acetabular-only revision (%)	4 (25.0 %)	18 (25.0 %)	1
Liner and ball exchange (%)	11 (68.8 %)	50 (69.4 %)	0.8232
Femur-only revision (%)	0 (0.0 %)	4 (5.6 %)	0.1993
Liner			
Flat (%)	2 (12.5 %)	18 (25.0 %)	0.2549
Elevated (%)	14 (87.5 %)	52 (72.2 %)	0.1758
Constrained (%)	0 (0.0 %)	2 (2.8 %)	0.3672
Femoral head size < 32 mm (%)	12 (75.0 %)	30 (42.3 %)	0.0161*

BMI body mass index, *OA* osteoarthritis, *ONFH* idiopathic osteonecrosis of femoral head, *RA* rheumatoid arthritis

* Statically significant p-value < 0.05

Table 3 Multivariate analysis of risk factors for re-dislocation, separated into patient and implant variables

Patient variables	Adjusted odds ratio	95 % confidential interval	P value
Age (per 10 year increment)	0.59	0.31–1.05	0.0727
Female	2.02	0.47–11.80	0.3631
ONFH / OA	5.62	1.05–31.34	0.0436*
RA / OA	3.56	0.15–36.98	0.3571
Implant variables			
Acetabular only revision / Liner and ball exchange	1.07	0.25–3.98	0.9208
Flat liner / elevated liner	0.37	0.05–1.65	0.2068
Femoral head size < 32 mm (%)	3.86	1.16–15.30	0.0265*

OA osteoarthritis, *ONFH* idiopathic osteonecrosis of femoral head, *RA* rheumatoid arthritis

* Statically significant p-value < 0.05

Previous studies reported higher re-dislocation rates after revision THA specifically for recurrent dislocation, compared to primary or revision THA for other reasons [9, 10, 14]. Daly and Morrey [10] identified 39 % re-dislocation rate in their report, which was the first to investigate re-dislocation after revision THA for recurrent dislocation in 1992. However, the reported re-dislocation rates have decreased recently possibly because the use of larger femoral head sizes has become more widespread. Carter et al. [15] noted a 21.2 % re-dislocation rate in a series of 156 hips, and Jo et al. [9] described a 15.9 % re-dislocation rate in a series of 539 hips at mean of 2.8 years from revision THA. These findings are consistent with the 18.2 % re-dislocation rate observed in our cohort.

In most cases in our study, the same direction of dislocation was observed before and after revision THA, suggesting the difficulty associated with revision THA for dislocation. However, we found that in two cases, the direction of dislocation after revision differed from that before revision. Over-treatment, including over-correction of the implant position [16], might result in re-dislocation in a direction different from that observed before revision THA.

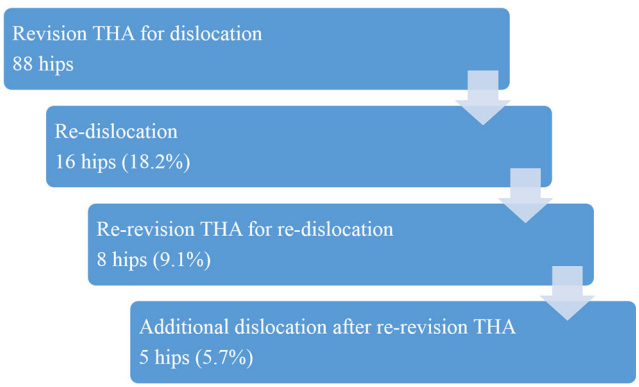

Fig. 1 Re-dislocation, re-revision THA for re-dislocation, and further dislocation rate. Among 88 hips, re-dislocation occurred in 16 hips (18.2 %). Eight hips (9.1 %) underwent additional re-revision THA for re-dislocation and further dislocation occurred in five hips (5.7 %)

Previous studies indicated multiple revision surgeries, previous dislocation, abductor deficiency, severe acetabular bone loss, surgical approach, and acetabulum-only revision as risk factors for dislocation after revision THA [3, 5, 11–13]. In addition, isolated liner exchange, previous revision arthroplasty, and a small femoral head size were reported as risk factors for re-dislocation after revision THA for recurrent dislocation [9, 15]. In the present study, we also identified a femoral head size < 32 mm as a risk factor for re-dislocation. However, isolated liner exchange and previous revision arthroplasty were not the predictors of re-dislocation in our series. A larger head size has been reported to reduce the incidence of dislocation because of an increasing jumping distance and head neck ratio [14, 17–19]. Jo et al. [9] reported a lower re-dislocation risk after revision THA for dislocation with a femoral head size ≥ 36 mm, and Carter et al. [15] reported a higher re-dislocation risk with a 28-mm head vs. a larger head. Our study could provide additional evidence to recommend use of a larger head size at revision THA for dislocation.

In addition, ONFH was identified as another risk factor for re-dislocation in this study. Similarly, we previously reported that ONFH was a significant risk factor for dislocation after both primary and revision THA for any reason [8, 20]. In the Nordic Arthroplasty Register, Bergh et al. [21] also reported that patients with ONFH had a higher risk of revision because of dislocation, compared to patients with OA. ONFH is thought to increase the dislocation risk in a complex manner. First, alcohol consumption has serious deleterious effects on the cognitive status [22] and may result in poor patient compliance in terms of avoiding dislocation. Second, corticosteroid use may result in secondary changes in the soft tissues around the hip joint [19]; therefore, patients with ONHF have much less soft tissue stiffness, which caused a higher range of motion and could induce dislocation [23].

Our cohort study found a 11.3 % re-revision rate after revision THA for recurrent dislocation. Notably, few reports have investigated the re-revision rate after revision THA for

recurrent dislocation. Previously, Jo et al. [9] reported a 22.6 % re-revision rate in 539 hips. One reason for our lower re-revision rate was that only two patients received a constrained liner; although the use of a constrained liner can restore and maintain hip stability [11, 24], it also increases the risk of re-revision [25]. Another reason for this difference was the short follow-up period used in our study. The minimum follow-up period was only 12 months, and therefore a longer follow-up needed to clarify increasing number of dislocation in re-revision THA. In the present study, eight of 16 re-dislocated hips required re-revision THA, in contrast to only two of 72 stable hips. This finding suggests that re-dislocation might be associated with re-revision THA, and therefore avoiding re-dislocation would potentially prevent re-revision THA.

This study has some limitations. As mentioned above, minimum follow-up periods of 12 months was short, and observation over a longer period would likely increase the number of re-dislocation and re-revision events. However, because re-dislocation occurred at a consistently high rate, we believe that our study was valuable. Additionally, a number of unaddressed factors, including inter-institutional differences, surgeon volume, social status, physical activity level and rehabilitation programs might have acted as confounders in analyses of re-dislocation. Moreover, we included previous THA but not other previous hip surgeries in our evaluation. However, it is very difficult to review these factors through multicentre studies, and there is no reason to believe that these factors would have uniquely affected our results.

Conclusion

In our series of 88 hips subjected to revision THA for recurrent dislocation, re-dislocation occurred in 16 hips (18.2 %) and eight hips (9.1 %) required re-revision THA because of re-dislocation. ONFH and a femoral head size < 32 mm were found to be independent risk factors for re-dislocation. The observed higher re-dislocation rate after revision THA for recurrent dislocation suggests the need of prevention measures. We recommend the use of a femoral head size ≥ 32 mm. Although a constrained liner increases the risk of re-revision, it might help to restore hip stability in some difficult cases.

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