



The Outcome of Dual Mobility Tripolar Cup-for Primary and Revision Total Hip Replacement to Patients with High Risk of Dislocation

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Abstract:

Background: Although long-term reports of total hip arthroplasty (THA) showed successful results, instability remains a major complication. Recently, dual-mobility cups (DMC) have gained more and more interest among clinicians, with encouraging results in terms of lower rate of dislocation associated with good clinical results, but a lack of evidence exists regarding the real efficacy of this implant design. **Aim:** To assess short term clinical, functional and radiographic outcome of dual mobility cups and its reliability in prevention of dislocation in patients presented with one or more risk factors for dislocation. **Patients and methods:** This study was a prospective clinical cohort study that had been conducted in Beni-Suef University hospital and Al-Agouza Police Hospital including 30 patients who required THR either primary or revision. All patients were subjected to dual-mobility cups. Standard radiographs were made for all patients at subsequent follow up examinations. **Results:** There was significant improvement in Harris hip score (HHS) after 6 months postoperative compared to HHS preoperatively with few complications. **Conclusion:** The DMC is an effective solution for the management of high-risk cases undergoing total hip replacement to reduce the incidence of postoperative instability.

Keywords: THA, DMC. Hip, Dislocation.

INTRODUCTION

Dislocation after total hip arthroplasty (THA) remains a troublesome complication and a source of frustration for the patient and the surgeon⁽¹⁾. Early recurrent dislocation may lead to revision surgery and is associated with high risk of complications⁽²⁾. The prevalence of re-operation for instability is highly variable and is reported approximately as 1/3 of the dislocating THAs^(3,4).

Although the incidence rate of hip dislocation was found varying from 1% to 9% depending on published reports, the rate was found to be higher in certain groups of patients. Patients with previous hip surgery and failed fracture fixation have a higher rate of dislocation.^(5,6,7) We aim to evaluate the effectiveness of using dual mobility cups-unconstrained tripolar cup-in primary and revision THRs in preventing dislocation for those who presented with one or more risk factors for dislocation.

The dual mobility (DM) cup was developed by Professor Gilles Bousquet and André. Rambert (engineer) in 1974 and combined the “low friction” principle of THA popularized by Charnley with the McKee-Farrar concept of using a larger diameter femoral head to enhance implant stability.⁽¹⁷⁾

The dual-mobility hip is a fixed porous-coated or cemented metal cup, which articulates with a large mobile polyethylene liner. Into the latter, a standard head (usually 22 or 28 mm) is inserted forming a bipolar head. The articulation between the head and the liner



is constrained, while the articulation between the liner and the metal cup is unconstrained. The original goal of the DM cup, introduced at the end of the 1970s as an alternative to standard sockets, was to reduce the risk of THA dislocation.⁽¹⁸⁻²⁰⁾ The dual mobility component can dramatically increase the ROM and delay prosthetic impingement in hip positions at risk for dislocation.⁽²¹⁾

PATIENTS AND METHODS

This study was a prospective clinical cohort study that had been conducted in Beni-Suef University hospital and Al-Agouza Police Hospital including 30 patients during the period from January 2020 to July 2022.

Inclusion criteria include the patients who require THR either primary or revision who have one or more risk factors for dislocation as patients with previous hip surgery, patient with failed proximal femoral or acetabular fracture fixation, patients with neuromuscular, cognitive disorders or mental dysfunction, patient with muscle weakness, general imbalance, and inability to comply with activity restrictions and patients with history of inflammatory arthritis or avascular necrosis .

Skeletally immature patients not candidate for total hip arthroplasty, patients with active infection or septic focus endangering the procedure of hip replacement and patients unfit for surgery were excluded from the study.

All patients were subjected to full history taking, Harris hip score (HHS) assessment patients before and after surgery to determine improvement.

Imaging and templating: Fig.:1,2.

Imaging:

Antero-posterior projection: To perform proper templating. After anatomical landmarks were recognised, radiographs were examined for limb length inequality and the medial femoral offset.

Templating:

The general goals were mainly to restore as nearly as possible the anatomic hip centre of rotation and femoral offset and equalizing limb length discrepancy if present.

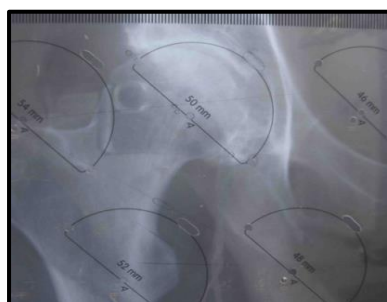


Fig1: Acetabular side templating:

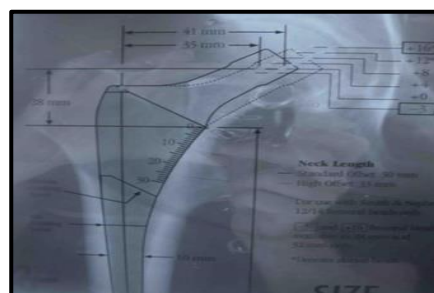


Fig 2 : Femoral side templating

❖ Operative Technique:

Exposure: Rady's approach: (a modified lateral approach), and Posterolateral approach

Acetabular preparation:

When reaming reached this concentric socket and bleeding subchondral bone and adequate reamer size, a trial cup was inserted to check the size and fitting, then the original cup was inserted. (fig 3,4,5,6).



Fig. (3): Reaming of the acetabulum.



Fig. (4): Trial acetabular cup.



Fig. (5): Cemented acetabular metal shell.



Fig. (6): Acetabular shell impacted into acetabulum.

Femoral preparation: Fig. (7)

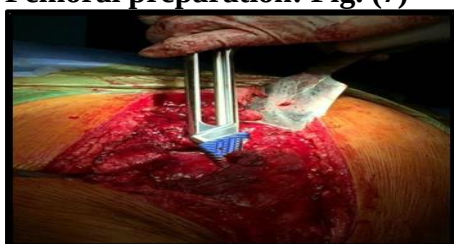


Fig. (7): Femoral broaching

Trial of reduction was done with the After ensuring good orientation, the chosen femoral broach using a trial head femoral broach was removed and the actual with the proper length stem was inserted. Trial of reduction was repeated with the actual stem. After ensuring proper orientation and determining the length of the head needed, assembly of the metal head with mobile polyethylene liner with compression device is done. The assembled head-polyethylene liner is impacted over the actual stem then introduced into the acetabular shell..

Wound closure and ambulation protocol:

After subcutaneous and skin closure, the patient was brought back to the supine position. Immediate hip and knee flexion, rapid foot pumps, and deep breathing exercises were emphasized to minimize thromboembolic and pulmonary complications. Walking was started on the first postoperative day. Weight bearing as tolerated is allowed, and all cases were instructed to be full weight bearing immediately after the operation, and the supporting method was used for balance only in the form of a walker or 2 crutches. In Patients with transfemoral osteotomy and patients with graft reconstruction of acetabular defects weight bearing was delayed for 6 weeks, then started after that gradually with walking aids as described above.

After discharge: All patients had clinical and radiological evaluation at regular periods during their follow up.

Clinical evaluation: Harris hip score was used for clinical evaluation of patients at 6 weeks, 6 months, and last follow up.



Statistical analysis

The collected data will be, tabulated, and statistically analyzed using SPSS program (Statistical Package for Social Sciences) software version 26.0. Independent t-test and Mann Whitney U test were used.

RESULTS

Table (1): Baseline data of the studied patients.

Parameters		Studied patients (n=30)	
		N	%
Gender	Male	21	70.0%
	Female	9	30.0%
Age (years)	Mean± SD	57.70± 11.75	
	Median	63.0	
	Range	38.0 – 78.0	
Pathology	AVN after corticosteroid MS	3	10.0%
	AVN after fracture acetabulum	5	16.7%
	AVN after fracture acetabulum and infection	1	3.3%
	Dislocation after primary total hip	3	10.0%
	Failed DHS	4	13.3%
	Fracture neck femur with parkinsonism	2	6.7%
	Fracture neck femur with stroke	4	13.3%
	Loosening after primary total hip replacement	6	20%
	Neck femur with malunited sub trochanteric fracture	1	3.3%
	Revision after infected total hip	1	3.3%

Out of 30 cases, there was 21 (70%) males and 9 (30%) were females with male to female ratio was 2.33:1. The age of patients ranged from 38 to 78 years with mean ±SD was 57.70± 11.75 years and median was 63 years. The preoperative diagnosis depends on pathology showed that 3 cases had AVN after corticosteroid MS, 5 cases had AVN after fracture acetabulum and one case had AVN after fracture acetabulum with infection. Dislocation after primary total hip replacement was found in three cases and failed DHS in 4 cases. There was fracture neck of femur (6 hips) in patients with high risk of postoperative dislocation (old stroke 4 and parkinsonism 2). Six cases had loosening after primary total hip replacement. Neck femur with malunited sub trochanteric fracture was found in one case and one case showed revision after infected total hip (Table 1).

Table (2): Distribution of the studied patients regarding operative data.

Parameters		Studied patients (n=30)	
		N	%
Surgical approach	Modified lateral	20	66.7%
	Posterior	10	33.3%
Prosthesis	Cemented	13	43.3%
	Cemented cup with cementless long stem	4	13.3%
	Cementless	8	26.7%



Interoperative complications	Cementless with augment	3	10.0%
	hybrid long stem	2	6.7%
	Nil	23	76.7%
	Difficult finding best position for augment	2	6.7%
	Fracture femur fixed by circular	2	6.7%
	Difficult in reduction on trial	1	3.3%
	False passage in stem	1	3.3%
	Difficult finding true acetabulum	1	3.3%

Modified lateral approach was the most frequent surgical approach used in the studied patients (66.7%) followed by posterior approach that used in 10 (33.3%) patients. Cemented dual mobility cups was the most common type used in the studied patients (43.3%) followed by cementless dual mobility cups that used in 8 (26.7%) patients. Cemented cups with cementless long stem was used in 4 (13.3%) patients, cementless with augment was used in 3 (10%) patients and finally hybrid long stem that was used in two (6.7%) patients. 23 (76.7%) of the cases had no interoperative complications. 7 (23.3%) of cases had complications which included difficult finding best position for augment (2 cases, 6.7%), fracture femur fixed by circular (2 cases, 6.7%), difficult in reduction on trial (one case, 3.3%), false passage in stem (one case, 3.3%) and difficult finding true acetabulum (one case, 3.3%) (Table 2).

Table (3): Comparison of Harris hip score (HHS) pre and postoperative in the studied patients

HHS		Studied patients (n=30)	Wilcoxon Signed Ranks Test	
			Test value*	p- value
Preoperative	Mean± SD	32.92± 4.64	4.375	<0.001
	Median	30.0		
	Range	30.0 – 40.0		
6 months Postoperative	Mean± SD	82.17± 6.52		
	Median	80.0		
	Range	70.0 – 90.0		

The mean preoperative Harris hip score was 32.92± 4.64, ranging from 30 to 40. While the mean Harris hip score was 8132.92± 4.64 6 months post-operative with range from 70 to 90. There was significant improvement (increase) in Harris hip score after 6 months postoperative compared to HHS preoperatively (p<0.001) (Table 3).

Table (4): Distribution of the studied patients regarding postoperative complications.

Postoperative complications		Studied patients (n=30)	
		N	%
Infection	No	27	90.0%
	Yes	3	10.0%
Leg length discrepancy (LLD)	No	18	60.0%
	1 cm	7	23.3%
	2 cm	5	16.7%
Sciatic nerve injury	Intact	27	90.0%
	Injury	3	10.0%
DVT	No	26	86.7%
	Yes	4	13.3%



Superficial infection was reported in 3 (10%) cases, two of them managed by debridement and doing culture and sensitivity and one case needed serial debridement then removal of implant with putting spacer. Leg length discrepancy (LLD) was reported in 12 (40%) cases, the discrepancy was about 1cm in 7 cases and 2 cm in 5 cases. In addition, Sciatic nerve injury was observed in 3 (10%) cases. 4 (13.3%) cases suffered from DVT (Table 4).

Cases (1) fig.8: Male 70 years old patient, had a history of total hip since 5 years after AVN after fracture acetabulum. Patient came with dislocated total hip after falling on the ground and failed trial of closed reduction . change cementless cup of THA with dual mobility cemented cup cementless stem not changed it wase stable and good postion.. The immediate postoperative X-rays were excellent and the prosthesis was stable. The postoperative HHS was 95 (excellent) at the latest follow up (6months post-operative). The final leg length discrepancy (LLD) was about 1cm.



Fig. (8a): Preoperative



Fig. (8b): Immediate post operative

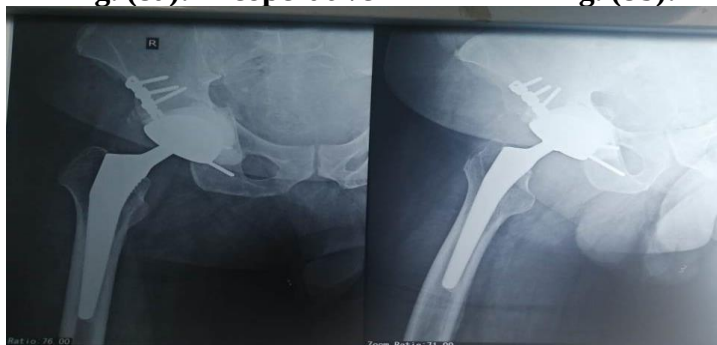


Fig. (8c): After 6 months

Case 2 fig.9: Female 66 years old patien who was diabetic, had sever osteoarthritis of Lt hip the preoperative HHS was 40 (poor), cemented dual mobility was done and the prosthesis was stable. The full weight bearing was allowed immediate postoperatively. The follow up X- ray (6mothes postop.) was stable, HHS after 6 month was 80.



Fig. (9a): Preoperative



Fig. (9b): Immediate post operative

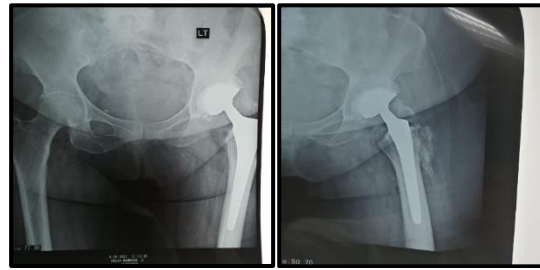


Fig. (9c): 6month postoperative

DISCUSSION:

Dislocation after total hip arthroplasty (THA) remains a troublesome complication and a source of frustration for the patient and the surgeon⁽¹⁾. We aim to evaluate the effectiveness of using dual mobility cups-unconstrained tripolar cup-in primary and revision THRs in preventing dislocation for those who presented with one or more risk factors for dislocation.

Our study included 30 cases, there was 21 (70%) males and 9 (30%) were females with male to female ratio was 2.33:1. The age of patients ranged from 38 to 78 years with mean $\pm$ SD was 57.70 ± 11.75 years and median was 63 years.

The preoperative diagnosis depends on pathology showed that 3 cases had AVN after corticosteroid MS, 5 cases had AVN after fracture acetabulum and one case had AVN after fracture acetabulum with infection. Failed DHS in 4 cases. There was fracture neck of femur (6 hips) in patients with high risk of postoperative dislocation (old stroke 4 and parkinsonism 2). One case had lossing after primary total hip replacement, one case had lossing cup primary total hip replacement and four cases had lossing after primary total hip replacement. Neck femur with malunited sub trochanteric fracture was found in one case and one case showed revision after infected total hip.

Mahmoud,⁽²⁵⁾ showed that patient related risk factor of dislocation were variable for each patient. 55% of patients (11 cases) had 1 risk factors of dislocation, 35% (7 cases) had 2 risk factors while 10% of patients (2 cases) had 3 risk factor of dislocation.

In their review of 10,500 THAs, **Woo and Morrey** found that the incidence doubled from 2.4% to 4.8% for patients who have had previous hip surgery.⁽⁵⁾ Patients with neuromuscular and cognitive disorders consistently demonstrated a higher risk for postoperative dislocation⁽⁸⁻¹⁰⁾. In a randomized controlled trial of 100 patients aged 75 years and older, **Johansson et al** found that the dislocation rate rises to 32% in patients had cognitive dysfunction⁽¹¹⁾ as well as patients with mental dysfunction.⁽¹²⁾ Muscle weakness, general imbalance, and inability to comply with activity restrictions are all considered to be the likely causative factors.⁽¹⁰⁾ **Woo and Morrey and Berry et al** showed that the incidence of dislocation is 2–3 times higher in women than in men.⁽⁵⁾ Guyen et al considered female sex as a risk factor when associated with an age of more than 70 years.⁽¹³⁾ Also reported risk factors are inflammatory arthritis, avascular necrosis, neurological disorders such as Parkinson's disease and cerebral palsy.^(14,15,16)

In our study the mean Harris hip score was 82.17 ± 6.52 after 6 months post-operative with range from 70 to 90. The mean preoperative Harris hip score was 32.92 ± 4.64 , ranging from 30 to 40. There was significant improvement (increase) in Harris hip score after 6 months postoperative compared to HHS preoperatively

Mahmoud et al.⁽²⁶⁾ aimed to retrospectively assess postoperative rate of dislocation and functional outcome in patients with preoperative risk factors for dislocation treated by DMC THA. In their study, there was marked clinical improvement, where the mean HHS was 11.8 (range: 9–30) preoperatively, and became 78.6 (range: 65–90) postoperatively,



Ukaj et al. ⁽²⁷⁾ found that DMC THA gives better outcome than hemiarthroplasty in treatment of fracture neck of femur regarding functional outcome and postoperative dislocation.

Moreover, **Stucinskas et al.** ⁽²³⁾ showed that DMC THA had lower risk of re-revision owing to dislocation and other reasons when compared with other prosthetic designs used for revision THA owing to recurrent dislocation.

In our study, 23 (76.7%) of the cases had no intraoperative complications. 7 (23.3%) of cases had complications which included difficult finding best position for augment (2 cases, 6.7%), fracture femur fixed by circular (2 cases, 6.7%), difficult in reduction on trial (one case, 3.3%), false passage in stem (one case, 3.3%) and difficult finding true acetabulum (one case, 3.3%). Superficial infection was reported in 3 (10%) cases, two of them managed by debridement and doing culture and sensitivity and one case needed serial debridement then removal of implant with putting spacer. Leg length discrepancy (LLD) was reported in 12 (40%) cases, the discrepancy was about 1cm in 7 cases and 2 cm in 5 cases. In addition, Sciatic nerve injury was observed in 3 (10%) cases. 4 (13.3%) cases suffered from DVT and 2 (6.7%) cases had dislocation.

In **Kyavater et al.** ⁽²²⁾ study 87.88% (29) of the cases had no complications. 12.12% (4) of cases had complications which included superficial infection (2 cases, 6.06%) which resolved 3 weeks postoperatively, Vancouver type A periprosthetic femur fracture involving lesser trochanter (1 case, 3.03%) and pulmonary thromboembolism (1 case, 3.03%). At the latest follow-up none of the patients had hip dislocation, X-rays taken during follow-up have not shown any evidence of loosening around the acetabulum.

In **Mahmoud et al.** ⁽²⁹⁾ study 1 case had complication. The complication was periprosthetic fracture after a fall while the prosthesis remain stable and was managed with reduction and fixation and the fracture healed with good final results and no intraoperative complication occurred.

The results of our study are comparable with that of **Romagnoli et al.** ⁽²⁴⁾, who stated in their systematic review that dual mobility THR reduces the risk of postoperative dislocation even in those patients with high risk for postoperative dislocation. Our results also coincides with **De Martino et al.** ⁽²⁸⁾, who documented that DMC THA reduces dislocation rate in both primary and revision THA.

CONCLUSION :

Instability remains a significant issue after THA in patients who are at high risk for dislocation. The DMC is an effective solution for the management of high-risk cases undergoing total hip replacement to reduce the incidence of postoperative instability. Its use in younger, high demand patients should be used with caution in view of complications like accelerated wear.

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