

## Hip Dislocation After Modular Unipolar Hemiarthroplasty

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**Abstract:** An institutional review board–approved retrospective review of hip fractures in elderly patients treated with a modular unipolar implant was carried out to identify factors predisposing to dislocation of a hemiarthroplasty. The main outcome measure evaluated was dislocation vs nondislocation. Two hundred seventeen patients underwent the surgery, and 174 were available for review at 6 weeks and 144 at 1 year. The incidence of dislocation was 6%. The average time of dislocation after surgery was 19.3 days. Clinical factors significant for dislocation were male sex and mental disease. Radiographic factors in dislocated hips included a smaller femoral neck and contralateral femoral neck offset. The center edge angle was also smaller in the dislocated patients. These patients had a higher mortality rate.

**Key words:** unipolar, hemiarthroplasty, dislocation, fracture neck femur, elderly.  
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Hemiarthroplasty of the hip is an accepted treatment of acute, displaced femoral neck fractures in the elderly. Some reports have indicated that even in minimally displaced and impacted fractures hemiarthroplasty is superior to internal fixation [1]. The advantages are immediate weight bearing, no risk of avascular necrosis or nonunion, and decreased rate of reoperation compared with internal fixation [2,3]. The disadvantages are that the native femoral head and neck are injured and replaced with an implant. The surgery is more extensive with greater surgical exposure and a greater amount of blood loss. There is also a higher perioperative mortality although the patients are usually older with greater comorbidities [2-5].

Although reports of dislocation after total hip arthroplasty abound in literature, they are sparse in the setting of a hemiarthroplasty. Early dislocation is a severe complication of hemiarthroplasty with a mortality rate of 65% to 75% at 6 months [6]. Factors that predispose a hemiarthroplasty to dislocation are technical, anatomical, and medical comorbidities. Cognitive impairment has been reported as a cause for dislocation [7]. The technical factors cited are surgical approach, excessive length of the residual neck, and smaller femoral neck offset. The anatomical factors include acetabular measurements indicative of hip dysplasia and shorter patients [8]. The purpose of this article is to analyze the radiographic and clinical data in determining the factors predisposing to dislocation after unipolar modular hemiarthroplasty of the hip in intracapsular fracture neck femur in the elderly.

### Materials and Methods

An institutional review board–approved retrospective review was undertaken on 217 patients who sustained a femoral neck fracture and underwent hemiarthroplasty with a unipolar modular

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Submitted December 10, 2007; accepted February 29, 2008.

No benefits or funds were received in support of the study.

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0883-5403/08/2405-0017\$36.00/0

doi:10.1016/j.arth.2008.02.019

**Table 1.** Anatomical measurements in dislocated and nondislocated hips

		Measurements in Dislocated Hips	Measurements in Nondislocated Hips
	Total	11	83
Femoral Neck Offset	Mean	29.86	35.86
	SD	7.59	7.42
Contralateral Femoral Neck Offset	Mean	29.02	37.27
	SD	6.85	7.53
Ratio of Femoral Neck Offset	Mean	1.05	0.98
	SD	0.29	0.21
Residual Femoral Neck	Mean	15.92	16.57
	SD	8.67	5.67
Prosthesis Femoral Neck shaft Angle	Mean	139.64	137.9
	SD	7.59	5.63
Acetabular Index	Mean	36.55	35.83
	SD	3.3	4.43
Center Edge Angle of Wiberg	Mean	30.36	37.39
	SD	5.29	9.15

prosthesis from January 2000 to August 2004. All patients included in the study presented with a displaced fracture and were older than 60 years. Their residential status was not a determining factor for inclusion in the study. Patients with undisplaced or minimally displaced fractures were excluded from the study. Also patients with rheumatoid arthritis, osteoarthritis, and fractures secondary to tumors were excluded. The age ranged from 61 to 95 years with a mean age of 77.3 years and an SD of

11.8 years. One hundred forty-nine patients were females (69%) and 68 were males (31%). One hundred ten patients sustained a left-sided femoral neck fracture, and 107 had a right-sided fracture. An evaluation of the mental status using the mini-mental status examination showed impairment in 48 patients (22%).

All patients were evaluated radiographically and treated with a cemented unipolar modular hemiarthroplasty (Conquest FX Hip System, Smith and Nephew, Memphis, Tenn). The operation was done within 24 hours of admission unless other comorbidities delayed the procedure. A posterior surgical approach (Moore/Kocher-Langenbeck) [9,10] was used on 174 patients, and in 43 patients, the lateral approach (Hardinge) [9,11] was chosen. The surgical approach was entirely the operating surgeons' choice. Standard anteroposterior and lateral radiographs of the hip were taken postoperatively, and patients were allowed to weight bear from the day after surgery. All patients were advised to limit the range of motion of the hip to less than 90° of flexion and 45° of external and internal rotation and to avoid adduction for first 6 weeks after surgery. Mentally impaired patients had additional hip precautions with the placement of an abduction pillow in the operating room before bed transfer and used pillows to maintain abduction while in bed. The main outcome measure evaluated was dislocation vs



**Fig. 1.** A, Femoral neck offset—distance from a vertical line of the midshaft femur to the center of the prosthesis head. B, Contralateral femoral neck offset—distance from vertical line of the midshaft femur to the center of the native contralateral head.

nondislocation. Two hundred seventeen patients underwent the surgery, and 174 were available for review at 6 weeks and 144 at 1 year.

Radiographic data of 11 dislocated patients were compared to 83 random patients in the nondislocated group (Table 1). The radiographic measurements included femoral neck offset [12] of the fractured and contralateral side (Fig. 1), femoral neck offset ratio (Fig. 1), residual femoral neck length [8] (Fig. 2), acetabular index [13] (Fig. 3), center edge angle of Wiberg [14] (Fig. 4), and prosthesis neck-femur shaft angle [7] (Fig. 5).

The clinical factors included age, sex, surgical approach, presence of mental impairment, and mortality rate at 1 year (Tables 2 and 3). Clinical data were collected using an electronic computer-based medical records tracking system. Radiographic data were analyzed on the electronic public access computer system (EPACS, Stentor, Brisbane, Calif).

### Statistics

A series of  $\chi^2$  analyses, with Yates continuity corrections, was used to evaluate the proportion of surgical approach, sex, and mental impairment with respect to the dislocation rate. The analyses were



**Fig. 2.** Residual femoral neck length—distance from prosthesis collar to lesser trochanter.

done separately for 6-week follow-up and for 12-month follow-up.

A series of Mann-Whitney rank sum tests were used to evaluate whether the patient age or any of the radiographic measurements differed significantly between patients who had dislocated vs patients who had no dislocated hips. The analyses were done separately for 6-week follow-up and for 12-month follow-up ( $P = .05$ ).

A backward, stepwise logistic regression was performed on the data at 6-week follow-up and at 12-month follow-up. Briefly, in these analyses, the output variable was the presence or absence of a dislocation. The surgical approach, sex, age, mental status, and all of the radiographic measurements were presented to the model as predictor variables. Predictor variables with a  $P > .20$  were removed from the model, and the logistic regression was repeated. At that point, predictor variables with a  $P > .15$  were removed from the model, and so on, until all predictor variables remaining in the model had a  $P < .05$ .

### Results

Among 144 patients followed up at 1 year, there were 11 dislocations. In 10 patients, hip dislocation occurred within the first 6 weeks of follow-up (Table 2). For these patients, the average time of dislocation after surgery was 19.3 days (range, 7-42 days). Median time of dislocation was 19 days. One patient had the hip dislocated at 364 days after surgery.

#### Isolated Effect of Age

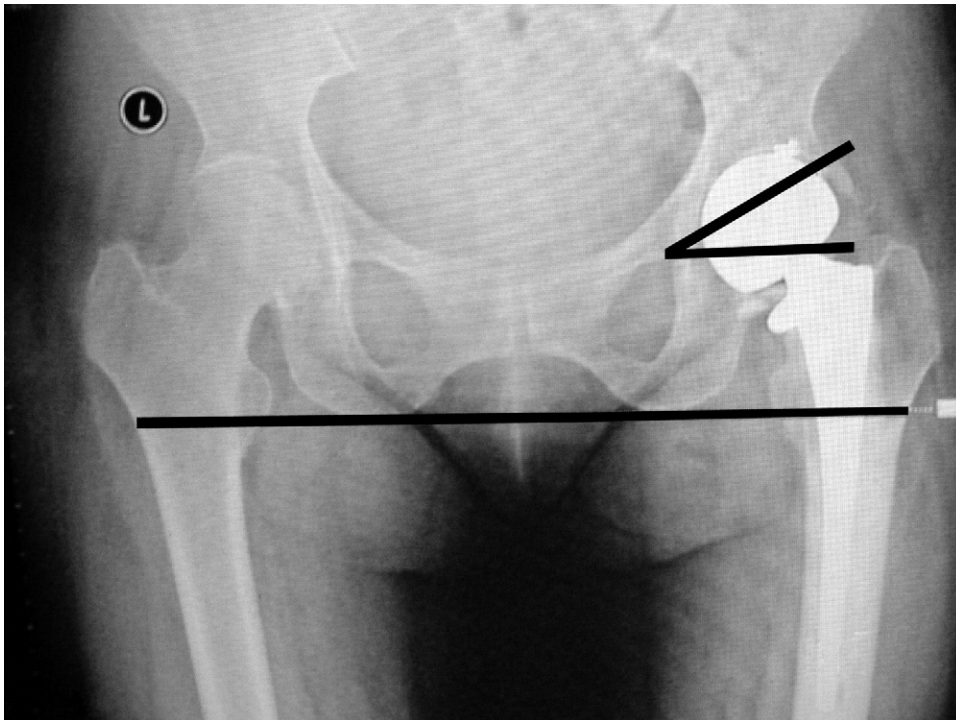
At 6 weeks ( $n = 185$ ), there was no demonstrable association between dislocation and age ( $P = .80$ ; power = 0.05). Again at 12 months ( $n = 144$ ), there was no demonstrable correlation between dislocation and age ( $P = .81$ ; power = 0.05).

#### Isolated Effect of Surgical Approach

At 6 weeks ( $n = 185$ ), there was no demonstrable correlation between dislocation and surgical approach ( $P = .069$ ; power = 0.06). A similar observation was made at 12 months ( $n = 144$ ), with no demonstrable correlation between dislocation and surgical approach ( $P = .82$ ; power = 0.05).

#### Isolated Effect of Sex

At 6 weeks ( $n = 185$ ), males were overrepresented among the patients who had dislocated hips ( $P = .01$ ). At 12 months ( $n = 144$ ), males were



**Fig. 3.** Acetabular index angle—measured as the angle between the roof and a horizontal line (line from the teardrop parallel to interischial line).

overrepresented among the patients who had dislocated hips ( $P = .03$ ).

#### Isolated Effect of Mental Impairment

At 6 weeks ( $n = 185$ ), there was no demonstrable correlation between dislocation and mental impairment. However, there was statistical trend toward more dislocations among the mentally impaired ( $P = .07$ ). At 12 months ( $n = 144$ ), those with mental impairment were overrepresented among the patients who had dislocated hips ( $P = .02$ ).



**Fig. 4.** Center edge angle of Wiberg—measured as the angle between a vertical line and a line from the center of the prosthesis head to the lateral edge of the acetabular roof.



**Fig. 5.** Prosthesis neck-femur shaft angle—line from tip of prosthetic head bisecting the neck and vertical line of the midshaft femur.

**Table 2.** Clinical data in dislocated hips

	6-Wk Follow-Up	1-Y Follow-Up
Total	10	11
Approach	Posterior, 8 Nonposterior, 2	Posterior, 9 Nonposterior, 2
Sex	Male, 7 Female, 3	Male, 7 Female, 4
Mental Disease	5	6

### Isolated Effect of Femoral Neck Offset

At 6 weeks (n = 114), there were no demonstrable differences between dislocated and nondislocated patients ( $P = .13$ ; power = 0.24). At 12 months (n = 94), there was a significant difference between dislocated and nondislocated patients ( $P = .02$ ; dislocated,  $29.9 \pm 7.6$ ; nondislocated,  $35.9 \pm 7.4$ ).

### Isolated Effect of Contralateral Femoral Neck Offset

At 6 weeks (n = 114), there was a significant difference between dislocated and nondislocated patients ( $P = .001$ ; dislocated,  $29.1 \pm 7.2$ ; nondislocated,  $36.7 \pm 8.4$ ).

At 12 months (n = 94), there was a significant difference between dislocated and nondislocated patients ( $P = .002$ ; dislocated,  $29.0 \pm 6.9$ ; nondislocated,  $37.3 \pm 7.5$ ).

### Isolated Effect of Ratio of Femoral Neck Offset to Contralateral Femoral Neck Offset

At 6 weeks (n = 114), there was no demonstrable differences between dislocated and nondislocated patients ( $P = .43$ ; power = 0.14).

At 12 months (n = 94), there was no demonstrable difference between dislocated and nondislocated patients ( $P = .61$ ; power = 0.05).

### Isolated Effect of Residual Femoral Neck

At 6 weeks (n = 114), there was no demonstrable differences between dislocated and nondislocated patients ( $P = .66$ ; power = 0.05). At 12 months (n = 94), there was no demonstrable difference between dislocated and nondislocated patients ( $P = .89$ ; power = 0.05).

### Isolated Effect of Acetabular Index Angle

At 6 weeks (n = 114), there was no demonstrable differences between dislocated and nondislocated patients ( $P = .85$ ; power = 0.05). At 12 months (n = 94), there was no demonstrable difference between dislocated and nondislocated patients ( $P = .67$ ; power = 0.05).

### Isolated Effect of Center Edge Angle of Wiberg

At 6 weeks (n = 114), there was a significant difference between dislocated and nondislocated patients ( $P = .001$ ; dislocated  $29.0 \pm 2.8^\circ$ ; nondislocated,  $37.6 \pm 8.7^\circ$ ).

At 12 months (n = 94), there was a significant difference between dislocated and nondislocated patients ( $P = .012$ ; dislocated,  $30.4 \pm 5.3^\circ$ ; nondislocated,  $37.4 \pm 9.1^\circ$ ).

### Isolated Effect of Prosthesis Neck-Femoral Shaft Angle

At 6 weeks (n = 114), there was no demonstrable differences between dislocated and nondislocated patients ( $P = .87$ ; power = 0.05).

At 12 months (n = 94), there was no demonstrable difference between dislocated and nondislocated patients ( $P = .57$ ; power = 0.05).

### Combined Effects of Clinical and Radiographic Factors

At 6-week follow-up (n = 114), the remaining predictor variables were as follows:

- Center edge angle of Wiberg ( $P = .006$ ; odds ratio, 0.772; 95% confidence interval [CI], 0.642-0.927). Higher values of center edge angle of Wiberg were associated with lower rates of dislocation.
- Sex ( $P = .014$ ; odds ratio, 8.644; 95% CI, 1.544-48.378). Males had higher rates of dislocation.

At 12-month follow-up (n = 94), the remaining predictor variables were as follows:

- Center edge angle of Wiberg ( $P = .010$ ; odds ratio, 0.829; 95% CI, 0.719-0.957). Higher values of center edge angle of Wiberg were associated with lower rates of dislocation.
- Mental impairment ( $P = .010$ ; odds ratio, 8.177; 95% CI, 1.671-40.023). Mental impairment was associated with higher rates of dislocation.

**Table 3.** Clinical data in dislocated hips

	6-Wk Follow-Up	1-Y Follow-Up	No Follow-Up
Total	174	133	33
Approach	Posterior, 139 Nonposterior, 35	Posterior, 106 Nonposterior, 27	Posterior, 27 Nonposterior, 6
Sex	Male, 48 Female, 126	Male, 36 Female, 97	Male, 13 Female, 20
Mental Disease	33	25	10

## Mortality Rate

Mortality rate was 36.4% for patients with dislocated hemiarthroplasty vs 16.8% for patients without hemiarthroplasty dislocation.

At 12 months postoperatively, no association could be demonstrated between mortality rate and dislocation ( $P = .452$ ; power = 0.109).

## Discussion

Postoperative dislocation of a hemiarthroplasty is a serious complication with a mortality rate of 60% to 75% at 6 months [7,8,15]. The rate of dislocation is increased by various factors such as age, medical condition, mental disorder, surgical approach, and prosthetic malposition [16]. The published incidence of dislocation of the hemiarthroplasty ranges from 1% to 15% [6,15,17].

We evaluated radiographic data for anatomical variability of patients and technical factors of surgery. Our data clearly show that dislocated hemiarthroplasties have a lower center edge angle of Wiberg compared to the nondislocated group suggesting an inherent instability within the hip. Femoral neck offset in a modern hemiarthroplasty is a factor that can be modified technically to increase the stability of the hip by adjusting the femoral neck component, head size, and placement of the femoral stem prosthesis. We measured the ratio of femoral neck offset to the contralateral neck offset and noted that it was close to or equal to 1.0 in all patients (Table 1). We observed that patients with low offset hips were more inherently unstable and hence prone to dislocations.

Although the patient population in our study was predominately females, the rate of hemiarthroplasty dislocation at 1 year follow-up for males was 4 times higher than that of females (16.3% vs 4.0%, respectively). There was a positive statistical significance between sex and the center edge angle of Wiberg ( $P = .02$ ). In this study, we observed that male patients had a lower mean center edge angle of Wiberg compared to females (33.3° vs 38.1°). We hypothesize that males' hips dislocated more because of colinearity secondary to hip dysplasia that was prevalent in our male patient population.

Mental impairment was associated with higher rates of dislocation. Our data show that mental impairment was present in 54.5% patients with dislocation vs 18.8% in nondislocated patients. Controversy exists over the applicability of endoprosthetic arthroplasty of the femoral head as compared to other treatments for femoral neck fractures in patients with mental impairment [18-21]. Reports

show that there is an unacceptably high dislocation rate of 37% and mortality rate of 75% in patients with neurologic impairment [2,16,18,22,23]. The inability to adhere to strict hip precautions and a flexion and adduction contracture predisposes these patients to higher rates of dislocations. However, a comprehensive review in patients with Parkinson disease did not substantiate these findings [24]. Furthermore, the studies performed involved non-modular endoprosthesis.

The incidence of dislocation with the posterior approach (9/139) was not any higher than with the use of the lateral approach (2/35). The posterior approach has been indicated in many studies as having a higher rate of dislocation [8,25,26]. A dislocation rate of 0.9% with the anterior approach vs 14% by a posterior approach [15] has been reported earlier. Another study found that the rate of dislocation was 16% for posterior approach and 3.2% for the direct lateral approach [8]. In a study comparing the dislocation rate after posterior and lateral approaches in more than 3500 patients, it was observed that the overall dislocation rate for the posterior approach was 9.0%, whereas that for the direct lateral was 3.3% [26]. Interestingly, it was noted that the results were not statistically significant, and the dislocation rates were dependent upon the operative experience and seniority of the surgeons. Researchers have advocated the posterior approach after reports of no dislocations in a series of 115 patients with posterior approach hemiarthroplasties [27]. Further in a series of 235 patients, the authors showed no statistically significant incidence of dislocation after an anterior or posterior approach [28]. The posterior capsule and posterior soft tissues are strong stabilizers of the hip and should not be compromised. The disruption of the posterior stabilizers while performing the posterior approach has been stated to increase the instability of the hip prosthesis ultimately leading to failure and dislocation. Significant stresses are imposed on the posterior stabilizers when the hip is in a flexed position as when getting out of a chair. However, most of the above studies used a Thompson or Austin Moore prosthesis that is not modular. In addition, those studies failed to mention posterior capsule or posterior soft tissue repair, which is now commonly performed.

Femoral neck fractures are associated with a high rate of mortality. Patients are often old and have many associated comorbidities. An earlier report states that patients operated on beyond 5 days of admission had a 1 year mortality rate of 35% and a 6% to 11% mortality rate at 1 year if operated on within 2 to 5 days of hospital admission [4,5]. It has

been reported that the medical condition of the patient will frequently deteriorate if hip fracture surgery is delayed [29]. Therefore, surgery should be performed as soon as possible after admission.

Although not statistically significant, in our study, the mortality rate at 1-year follow-up was 3 times higher in patients who had a dislocation of the hemiarthroplasty. Patients with hip fractures have mortality rate greater than that expected in normal population [5,9]. Furthermore, patients sustaining a dislocation have an even greater mortality rate [2,9,15].

In our retrospective review, we found that the factors predisposing to dislocation of the hemiarthroplasty are multifactorial. Mental impairment and the male sex are significant factors that may increase the incidence of dislocation. Radiographic factors such as femoral neck offset, contralateral femoral neck offset, and center edge angle were also contributing factors for hemiarthroplasty dislocation.

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