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Original article

DUAL MOBILITY CUPS REDUCE DISLOCATION RATE IN TOTAL HIP ARTHROPLASTY FOR DISPLACED FEMORAL NECK FRACTURES.

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SUMMARY:

PURPOSE: To assess the dislocation rate after total hip arthroplasty with dual mobility cup (DMC) for displaced femoral neck fractures and to compare the results with that of conventional total hip arthroplasty (THA) and bipolar hemiarthroplasty (BHA) in the same clinical setting at our institution.

MATERIALS AND METHODS: 49 cases (47 patients) treated with total hip arthroplasty with DMC, 38 cases (38 patients) with BHA and 29 patients (29 cases) operated on with conventional THA were retrospectively reviewed.

RESULTS: In the DMC total hip arthroplasty group, there were no dislocations (0%). %). One dislocation (3,1%) occurred in the BHA group, and 3 dislocations occurred (11,1%) in the THA group.). There was a statistically significant difference in favour of DMC group compared to THA group regarding dislocation rate (p=0,05). Dislocation rate did not differ significantly between DMC and BHA groups. There was no significant difference in mortality, complications and re-operation rate between groups.

CONCLUSION: Dual mobility cups significantly reduce dislocation rate in total hip arthroplasty performed for displaced femoral neck fractures compared to conventional total hip arthroplasty while sImilar advantage over bipolar hemiarthroplasty could not be demonstrated in the current study.

Keywords: dual mobility cup, dislocation, total hip arthroplasty, femoral neck fractures.

BACKGROUND:

In patients over the age of 65 treatment of displaced femoral neck fractures (Garden 3-4) often relies on hip arthroplasty: bipolar hemi- or total due to lower risk of reoperation and better functional results when compared to osteosynthesis [1, 2].

However, the most appropriate type of arthroplasty to be used in this clinical setting is still under debate. Total hip arthroplasty (THA) is usually recommended in patients with a high life expectancy and a satisfying pre - operative autonomy and mobility (Parker >5), presence of osteoarthritic changes in the acetabulum, generally healthy or with compensated comorbidities. THA leads to better functional results and less revisions than hemiarthroplasty (HA), but the dislocation risk after THA is 2 to 3 times compared to HA [3, 4, 5, 6, 7].

Dislocation is the most frequent complication when a total hip arthroplasty is implanted to treat displaced fractures of the femoral neck [8]. A metaanalysis reported a median dislocation rate of 10,7% in femoral neck fracture patients treated with THA, five time higher as compared to arthroplasty indicated for osteoarthritis [9]. Dual mobility cups (DMC) have been reported to have a low rate of postoperative dislocation not only in primary total hip arthroplasties but also in revision procedures and as a treatment for recurrent dislocation of hip arthroplasty [10, 11, 12, 13]. At our institution, we have a 5 years experience with primary and revision total hip arthroplasty with dual mobility cups.

Thus the aim of this study was to assess the dislocation rate after THA with dual mobility cup for displaced femoral neck fractures in elderly patients and to compare the results with that of conventional THA and bipolar hemiarthroplasty in the same clinical setting at our institution. To the best of our knowledge, this is the first study in our country reporting results of THA using DMC in displaced femoral neck fractures in the elderly.

MATERIALS AND METHODS

116 cases of displaced femoral neck fractures (FNF) in 114 patients, treated by hemi- or total hip arthroplasty in our department from January 2012 to January 2017, were retrospectively reviewed. All cases were operated on through a modified posterior approach with piriformis tendon sparing and posterior capsule and short external rotators repair. Patients with pathologic femoral neck fractures were excluded from the study. Patients were evaluated through patient record review, clinical examination with control X ray images and telephone interview with patients and relatives. Information regarding dislocation incident, any surgery-related complications or revision surgery and mortality was selectively obtained. Five patients in the DMC group, 6 patients in the BHA group and 2 patients in the THA group were lost to follow-up. Patient demographics and and follow-up period in the three groups studied are enlisted in Table 1.

Table 1. Patient demographics

group	n/pts	mean age (yrs.)	Sex M/W	Mean follow up (months)	Mobility (avg. PARKER score)
DMC	44 / 42	73,4 (44 -94)	12/30	29,7 (6-65)(SD 13,67)	6
BHA	32 / 32	83,5 (67-94)	6/26	23,1 (6-64)(SD 14,13)	4
THA	27 / 27	70 (52-86)	12/15	36,6 (7-63)(SD 16,14)	7

Characteristics of the implants used are enlisted in Table 2.

Table 2. Characteristics of used implants

	DMC	BHA	THA
cementless cup (n.)	41		8
cemented cup (n.)	3		19
Cementless stem (n.)	19		8
Cemented stem (n.)	22	32	19
22,2 mm head in internal articulation (n.)	2		
28 mm head in internal articulation (n.)	42		
28 mm femoral head (n.)			1
32 mm femoral head (n.)			23
36 mm femoral head (n.)			3
10º elevated PE insert (n.)			8

The primary aim of this study was to compare dislocation rates following surgical treatment for displaced FNF with either DMC total hip arthroplasty, bipolar hemiarthroplasty or conventional THA. The secondary goal was to compare mortality rate and re-operations of any kind (including open reduction) between three groups.

STATISTICAL METHODS

Results are reported as means with standard deviations with 95 % confidence intervals (CI). Differences between groups were analysed using paired t-test, ANOVA test and post hoc test (Tukey HSD). The level of significance was set at p d”0.05.

RESULTS

The three groups are comparable to each other except for duration of follow-up. Duration of follow-up showed a significant difference between BHA group and THA group (p=0,005). We found a statistically significant difference in favour of DMC group compared to THA group regarding dislocation rate (p=0,05). Dislocation rate did not differ significantly between DMC and BHA groups. In the dual mobility total hip arthroplasty group there were no dislocations (0%). One dislocation (3,1%) occurred in the bipolar hemiarthroplasty group which was treated by closed reduction. In the conventional total hip arthroplasty group, 3 dislocations occurred (11,1%); two were successfully treated by close reduction and one surgically treated with head and stem exchange due to cemented stem loosening upon attempted closed reduction maneuvers. ANOVA test demonstrated no significant difference in mortality rates between the three groups (p=0,247). Mortality rate was 7,1% in the DMC group, 15,6% in the BHA group and 3,7% in the THA group, respectively. In one of the deceased patients from the THA group, two episodes of dislocation were registered in the first 3 months following surgery. Patient suffered from type I diabetes and died 6 months after surgery from a non-surgery related cause. Data regarding dislocation rate and mortality in the three groups compared is shown in table 3.

Table 3. Dislocation rate and mortality rate

	DMC	BHA	THA
dislocation	0/44 (0%)	1/32 (3,1%)	3/27 (11,1%)
mortality	3/42 (7,1%)	5/32 (15,6%)	1/27 (3,7%)

There was no significant difference between groups regarding complication rate and re-operation (p=0,362). Complications and re-operations are listed in table 4.

Table 4. Complications and re-operations

	DMC	BHA	THA
Periprosthetic fracture of femur	1 (Vancouver B2)	1 (Vancouver B1)	
Greater trochanter fracture		3	
m. iliopsoas tendinitis	1		
Heterotopic ossification (Brookner II)	1		
Re-operation	1	1	1

There were two periprosthetic femoral fractures in the studied groups. One was classified as Vancouver type B2 in a patient with dual mobility cup and a cementless stem and was treated by distally locked revision cementless stem; the other occurred in a patient with bipolar hemiarthroplasty and cemented stem that was classified as Vancouver type B1 and was treated by internal fixation.

DISCUSSION

It is generally accepted that displaced FNF should be treated with hip arthroplasty in patients over the age of 80 and with internal fixation in patients younger than 60 years [14]. Optimal treatment for patients between 60 and 80 years of age is still controversial. The method of choice depends on type of fracture and time from injury, patients expectations and compliance, comorbiditites and general medical condition and surgeon preference [15].

Total hip arthroplasty as primary treatment for displaced FNF is debatable since it is characterised by higher dislocation rate, greater amount of blood loss and longer surgery duration and in the same time better pain relief and functional results and lower risk for re-operation compared to hemiarthroplasty [3, 4, 5, 6, 7, 16]. Total hip arthroplasty is associated with higher dislocation risk in patients with displaced FNF than in osteoarthritic hips [9].

Numerous factors like patient characterisitcs, implants used, surgical approach, patient compliance to postoperative protocol and adequate rahabilitation care by dedicated specilaists may influence the dislocation risk.

All surgeries in the current study were performed through a modified piriformis tendon sparing posterior approach with posterior capsular repair. Enocson et al. reported higher dislocation risk with posterior approach compared to anterolateral approach in patients undergoing total hip arthroplasty for femoral neck fracture [17]. No dislocation was found in the group of patients treated by total hip arthroplasty with dual mobility cup despite the abovementioned risk factors and the fact that the DMC group represents the authors' learning curve with that type of implant. This can be explained with the design features of the dual articulation system and the systematic repair of the posterior capsule and short external rotators.

The dual mobility cup was introduced in France in the 1970-s by G. Bousquets. It is biomechanically characterized by a large effective femoral head diameter providing more favourable head/neck ratio, greater range of motion and a bigger jumping distance [10].

Our results demonstrate that dual mobility cup significantly reduces dislocation rate compared to conventional total hip arthroplasty in patients with displaced FNF. The dislocation rate in our group of patients treated with conventional THA is similar to the 8%-11% dislocation rate reported in several metaanalyses [3, 4, 6, 7].

Dislocation rate in the dual mobility total hip arthroplasty was also lower than that in the bipolar hemiarthroplasty group, but that was not statistically significant. Dislocaton rate in the BHA group was similar to the 3%-5% dislocation rate In a number of metanalyses [3, 4, 6, 7].

A french prospective multicentre study of 214 patients older than 70 years old treated with dual mobility total hip arthroplasty for displaced fractures of the femoral neck found a dislocation rate of 1.4% (three patients) while majority of cases were performed through a posterior approach. Furthermore, it should be noted that this study included unselected patients [18].

Tarasevicus et al. observed no dislocations at all one year post-operatively when comparing 42 consecutive patients operated on with dual mobility total hip arthroplasty with another 56 consecutive patients treated with THA with a conventional cup with femoral head diameters 28 mm and 32 mm. Eight dislocations were recorded in the second group, and posterior approach was used in all cases in both groups [19].

In a retrospective study comparing two groups of surgically treated patients with displaced FNF Bensen et al. reported significantly lower dislocation and re-operation rate using dual mobility total hip arthroplasty compared to bipolar hemiarhthroplasty. Of notice, posterior surgical approach similar to the one used in our patients was utilized in both groups included in the study [20].

We found no significant difference in mortality rate in the group of patients treated with DMC total hip arthroplasty compared to the BHA and THA groups although patients were non-randomly distributed in the three groups depending on age, general medical condition and

comorbidities and autonomy level. Similarly, several metaanalyses report no significant difference in mortality rate between total- and hemiarthroplasty for displaced FNF during the first year after surgery [3, 4, 5, 6, 7].

We could not demonstrate correlation between preoperative mobility and autonomy and mortality rate in the separate groups which Parker et al. described as a predictor for mortality after hip fracture [21].

There was no difference between the three groups of patients regarding complications and re-operation rate. A number of studies demonstrate lower re-operation rate (5%-11%) with conventional total hip arthroplasty compared with hemiarthroplasty (9%-14%) [3, 4, 5].

This difference can possibly be explained by the small number of patients included in the three groups.

In the current literature, there are only short- to mid-term results present regarding the use of DMC total hip arthroplasty for displaced FNF. On the other hand, a number of papers demonstrate very good long term results with dual mobility cups in total hip arthroplasty for osteoarthritis and avascular necrosis of femoral head with low rates of complications especially in patients over 70 years old [13]. The possibility of cementing a dual mobility cup directly in the acetabular bone bed or in reinforcement device represents a reliable option in case of osteoporotic bone of poor quality. In the DMC group of FNF patients, there were only 3 cemented cups. In the rest of the cases, adequate primary fixation by press-fit implantation of a cementless dual mobility cup with subsequent osteointegration was reliably achieved. This could be explained by contemporary dual mobility implants design and coating characteristics.

The current study has some limitations. Patients were retrospectively reviewed and non-randomly-distributed in the three groups. Older patients with low preoperative level of mobility and autonomy were indicated for bipolar hemiarthroplasty while younger and more active patients were treated with total hip arthroplasty. In the conventional THA group femoral heads of different diameter and elevated and non-elevated PE inserts were used, therefore no conclusion regarding the influence of those factors on dislocation risk could be made. After the introduction of DMC in our department, we rarely use conventional THA for displaced FNF which made the subdivision in the group according to prosthetic head dismeter and PE insert design irrationale.

CONCLUSION

Dual mobility cups significantly reduce dislocation rate in total hip arthroplasty performed for displaced femoral neck fractures compared to conventional total hip arthroplasty while a similar advantage over bipolar hemiarthroplasty could not be demonstrated in the current study. Dual mobility cups represent a reliable method of treatment for patients with FNF once an indication for total hip arthroplasty is retained. Further studies with longer follow-up are necessary to determine the value of dual mobility cup in total hip arthroplasty foe displaced fractures of the femoral neck.

REFERENCES:

1. Wang J, Jiang B, Marshall RJ, Zhang P. Arthroplasty or internal fixation for displaced femoral neck fractures: which is the optimal alternative for elderly patients? A meta-analysis. *Int Orthop.* 2009 Oct;33(5):1179-87. [PubMed] [CrossRef]

2. Johansson T, Jacobsson S A, Ivarsson I, Knutsson A, Wahlstrom O. Internal fixation versus total hip arthroplasty in the treatment of displaced femoral neck fractures: a prospective randomized study of 100 hips. *Acta Orthop Scand.* 2000 Dec; 71(6):597-602. [PubMed] [CrossRef]

3. Liao L, Zhao Jm, Su W, Ding Xf, Chen Lj, Luo Sx. A metaanalysis of total hip arthroplasty and hemiarthroplasty outcomes for displaced femoral neck fractures. *Arch Orthop Trauma Surg.* 2012 Jul;132(7):1021-9. [PubMed] [CrossRef]

4. Yu L, Wang Y, Chen J. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures: meta-analysis of randomized trials. *Clin Orthop Relat Res.* 2012 Aug;470 (8):2235-43. [PubMed] [CrossRef]

5. Hopley C, Stengel D, Ekkernkamp A, Wich M. Primary total hip arthroplasty versus hemiarthroplasty for displaced intracapsular hip fractures in older patients: systematic review. BMJ. 2010 Jun;340:c2332. [PubMed] [CrossRef]

6. Parker MJ, Gurusamy KS, Azegami S. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. *Cochrane Database Syst Rev.* 2010 Jun 16; (6):CD001706. [PubMed] [CrossRef]

7. Burgers PT, Van Geene AR, Van den Bekerom MP, Van Lieshout EM, Blom B, Aleem IS, et al. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures in the healthy elderly: a meta-analysis and systematic review of randomized trials. *Int Orthop.* 2012 Aug;36(8): 1549-60. [PubMed] [CrossRef]

8. Tarasevicius S, Jermolajevas V, Tarasevicius R, Zegunis V, Smailys A, Kalesinskas RJ. Total hip replacement for the treatment of femoral neck fractures. Long-term results. *Medicina (Kaunas).* 2005;41:465-9. [PubMed]

9. Iorio R, Healy WL, Lemos DW, Appleby D, Lucchesi CA, Saleh KJ. Displaced femoral neck fractures in the elderly: outcomes and cost effectiveness. *Clin Orthop Relat Res*. 2001 Feb;(383):229-42. [PubMed]

10. Grazioli A, Ek ETH, Rudiger HA. Biomechanical concept and clinical outcome of dual mobility cups. *Int Orthop.* 2012 Dec;36(12): 2411-8. [PubMed] [CrossRef]

11. Stroh A, Naziri Q, Johnson AJ, Mont MA. Dual-mobility bearings: a review of the literature. *Expert Rev Med Devices.* 2012 Jan;9(1):23–31. [PubMed] [CrossRef]

12. Langlais FL, Ropars M, Gaucher F, Musset T, Chaix O. Dual mobility cemented cups have low dis-

location rates in THA revisions. *Clin Orthop Relat Res.* 2008 Feb;466(2): 389-95. [PubMed] [CrossRef]

13. Philippot R, Adam P, Farizon F, Fessy MH, Bousquet G. [Survival of cementless dual mobility sockets: ten-year follow-up.] [in French] *Rev Chir Orthop Reparatrice Appar Mot.* 2006 Jun;92(4):326-31. [doi.org/] [PubMed] [CrossRef]

14. Heetveld MJ, Rogmark C, Frihagen F, Keating J. Internal fixation versus arthroplasty for displaced femoral neck fractures: what is the evidence?. J Orthop Trauma. 2009 Jul;23(6):395-402. [PubMed] [CrossRef]

15. Zlowodski M, Tornetta P, Haidukewych G, Hanson BP, Petrisor B, Swiontkowski MF, et al. Femoral neck fractures: evidence versus beliefs about predictors of outcome. *Orthopaedics.* 2009 Apr;32(4). [PubMed]

16. Macaulay W, Nellans KW, Garvin KL, Iorio R, Healy WL, Rosenwasser MP, et al. Prospective randomized clinical trial comparing hemiarthroplasty to total hip arthroplasty in the treatment of displaced femoral neck fractures: winner of the Dorr Award. *J Arthroplasty*. 2008 Sep;23(6 Suppl 1):2-8. [PubMed] [CrossRef]

17. Enocson A, Hedbeck CJ, Tidermark J, Pettersson H, Ponzer S, Lapidus LJ. Dislocation of total hip replacement in patients with fractures of the femoral neck. *Acta Orthop.* 2009 Apr;80(2):184-9. [PubMed] [CrossRef]

18. Adam P, Philippe R, Ehlinger M, Roche O, Bonnomet F, Mole D, et al. Dual mobility cups hip arthroplasty as a treatment for displaced fracture of the femoral neck in the elderly. A prospective, systematic, multicenter study with specific focus on postoperative dislocation. *Orthop Traumatol Surg Res*. 2012 May; 98(3):296-300. [PubMed] [CrossRef]

19. Tarasevicius S, Busevicius M, Robertsson O, Wingstrand H. Dual mobility cup reduces dislocation rate after arthroplasty for femoral neck fracture. BMC Musculoskelet Disord. 2010 Aug;11:175. [PubMed] [CrossRef]

20. Bensen AS, Jakobsen T, Krarup N. Dual mobility cup reduces dislocation and re-operation when used to treat displaced femoral neck fractures. *Int Orthop*. 2014 Jun;38(6):1241-5. [PubMed] [CrossRef]

21. Parker MJ, Palmer CR. A new mobility score for predicting mortality after hip fracture. J Bone Joint Surg (Br). 1993 Sep;75(5):797-8. [PubMed].

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