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ORIGINAL ARTICLE • HIP - ARTHROPLASTY

Comparison of functional outcome of bipolar hip arthroplasty and total hip replacement in displaced femoral neck fractures in elderly in a developing country: a 2-year prospective study

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Abstract
Purpose To compare the short-term functional outcome between bipolar hip arthroplasty (BHA) and total hip replacement (THR) in displaced femoral neck fractures in elderly patients in a developing country.
Materials and methods A prospective study was conducted which included a total of 42 patients of age more than 60 years with closed displaced femoral neck fractures, and the patients were randomized into two groups of 21 patients each and their outcomes were compared.
Results At 24-month follow-up, patients in BHA group had a mean modified Harris hip score of 83.85 ± 6.62 and patients in THR group had a mean modified Harris hip score of 88.00 ± 5.76 (p value = 0.067). Seven (35%) patients in BHA group and 11 (55%) patients in THR group had hip scores from 91 to 100 (excellent), 9 (45%) patients in BHA and seven patients (35%) in THR had hip scores 81–90 (fair) and 4 (20%) patients in BHA group and 2 (10%) patients in THR group were rated 71–80 (good) and none was found in poor category. Total amount of blood loss while performing BHA was 238.15 ± 20.43 ml compared to 336.85 ± 23.56 ml in THR ($p < 0.0001$). Mean of total duration of surgery was found to be 51.80 ± 8.70 min in BHA group which was significantly lesser than 119.10 ± 16.75 min of THR group ($p < 0.0001$).
Conclusion BHA being comparable to THR in terms of functional outcome by modified Harris hip scoring with significantly less blood loss during surgery, less duration of surgery, more cost-effective can be recommended as first line of surgical management in elderly patients with displaced femur neck fractures in developing countries.
Level of evidence Level II, lesser-quality randomized controlled trial.

Keywords Hemiarthroplasty · Total hip replacement · Elderly · Harris hip score

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Introduction

Hip fractures are debilitating injuries that most commonly affect the geriatric population owing to their poor bone quality [1–3], presenting as a challenge to both the healthcare system and society [4–6]. It has been shown to have an increasing trend with each decade due to improved life expectancy [7]. Arthroplasty has been accepted as a standard mode of treatment over osteosynthesis for femoral neck fracture in patients of old-age group (> 60 years) to promote early mobilization and weight bearing. This helps in reducing comorbidities secondary to being bedridden [8]. But the problem remains an enigma unsolved till today regarding choice of procedure as hemiarthroplasty and total hip arthroplasty both have their own merits and demerits in various trials [9–15]. This clinical study aims to present the short-term results of prospective randomized trial of bipolar hemiarthroplasty (BHA) and total hip replacement (THR)

for the treatment of displaced femoral neck fractures in the elderly in terms of functional outcome using modified Harris hip score (MHHs) [16].

Materials and methods

Study group

This prospective hospital-based comparative interventional study included 42 patients irrespective of sex who presented to us with displaced femoral neck fractures from September 2011 to November 2012, and the patients were randomized into two equal groups of 21 patients each. Patients of age more than 60 years with closed intracapsular femoral neck fracture and giving informed consent were included in this study. Patients having ipsilateral lower limb fractures with psychiatric and neurological disorder and not giving informed consent were excluded.

Expecting difference of median score in total evaluation of function 9 ± 10 and assuming alpha error 0.05 and power 80%, the sample size was calculated 20 for each. First simple random technique thereafter alternate systemic random sampling was used. All cases were followed up for 24 months. At the end of 6 months following surgery, one patient died of myocardial infarction unrelated to surgery and one patient lost to follow-up. The functional results were therefore analysed for the remaining 40 patients. Once the patient was admitted to the hospital, all data were recorded in the proforma prepared for this study. They were asked to come for follow-up regularly to the outpatient department. Those who did not come were reminded by post. Five patients who could not come answered the necessary questions through post. The follow-up summary was recorded in the follow-up chart of the proforma. The clearance had been obtained from ethical committee.

Surgical technique

All surgeries were performed on an elective basis using standard aseptic precautions and were performed under spinal anaesthesia. Lateral decubitus position with the patient lying on the unaffected side was used. In all cases, the stem was cemented in place using standard cementing techniques—lavage, cleaning, drying and plugging of the canal. Absolute haemostasis was obtained (Figs. 1a, b, 2a, b).

Statistical analysis

The data were analysed using computer statistical software (Microsoft Excel, SPSS 20 and primer). Descriptive statistics (mean, SD and proportions) were used to summarize the study variables. The 95% confidence intervals for difference of mean were used. Chi-square test was used to observe an association between the qualitative study and outcome variables. Unpaired *t* test was used for analysis of quantitative data. A p value of < 0.05 was considered statistically significant.

Results

Demography: The mean age was 65.3 (range 61–73) years and 66.4 (range 60–74) years in BHA group and THR group, respectively, with 30% males in BHA group and 35% males in THR group. *Laterality*: Left side was injured in 55% patients in BHA group and 65% patients in THR group. *Type of fracture*: There were, respectively, 35 and 65% patients with Garden type 3 and Garden type 4 fracture in BHA group compared to 45% Garden type 3 and 55% Garden type 4 fracture in THR group. *Mode of injury*: Majority (55% in BHA group, 60% in THR group) of the patients had minimal trauma; most of them slipped and fell down on flat ground or in bathroom (Table 1). *Blood loss during*

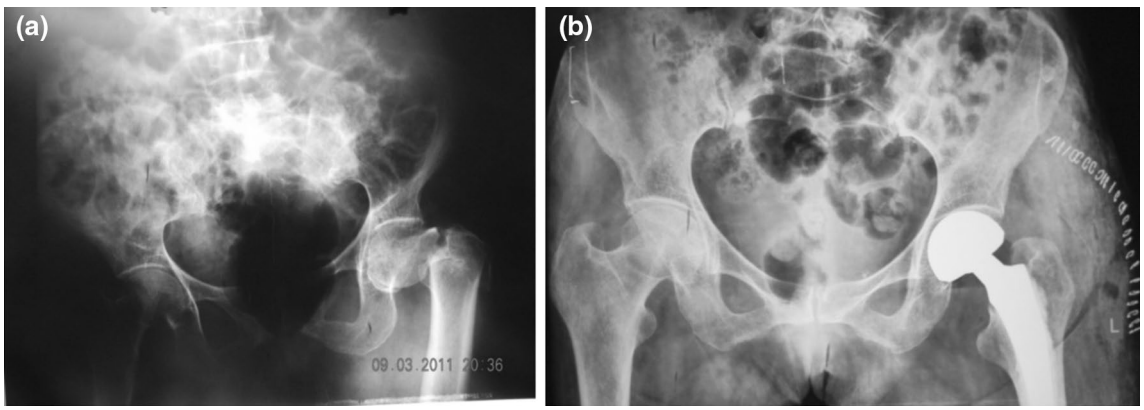


Fig. 1 **a** Preoperative radiograph in BHA group. **b** Post-operative radiograph in BHA group

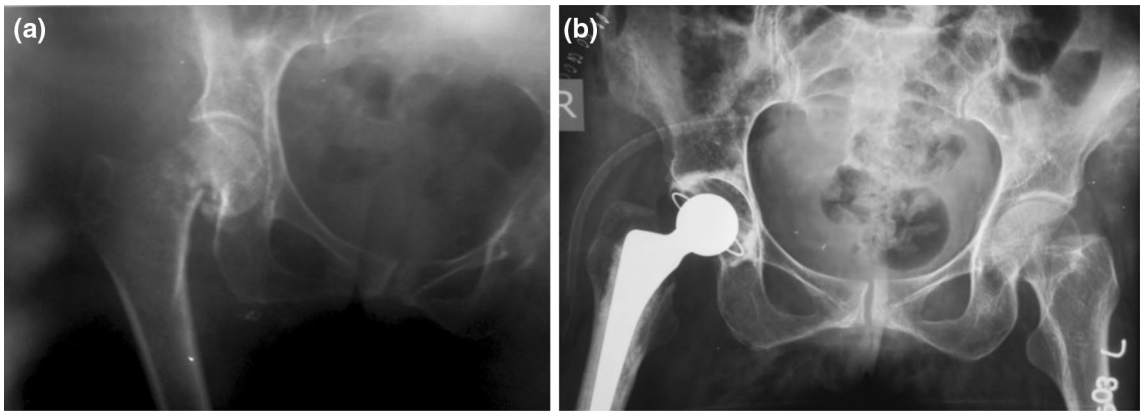


Fig. 2 **a** Preoperative radiograph in THR group. **b** Post-operative radiograph in THR group

Table 1 Patient parameters

Parameter	BHA ($n = 20$)	THR ($n = 20$)
Number of males:females		
60–70	5:12	6:10
70–80	1:2	1:3
Mode of injury		
Fall	11	12
RTA	5	7
Fracture type		
Garden 3	7	9
Garden 4	13	11
Laterality		
Left	11	13
Right	9	7

Table 2 Blood loss during surgery and duration of surgery

	BHA ($n = 20$)	THR ($n = 20$)	p value
Blood loss during surgery (in ml)	238.15 ± 20.43	336.85 ± 23.56	0.0001**
Duration of surgery (in min)	51.80 ± 8.70	119.10 ± 16.75	0.0001**

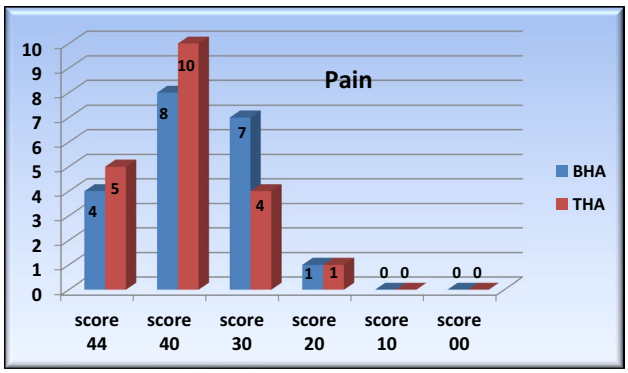
** < 0.01 = statistically significant

surgery: Total amount of blood loss while performing BHA was 238.15 ± 20.43 ml compared to 336.85 ± 23.56 ml in THR ($p < 0.0001$). *Duration of surgery*: In BHA group, mean of total duration of surgery was found to be 51.80 min which was significantly lesser than 119.10 min of THR group ($p < 0.0001$) (Table 2). *Pain score*: 40% of patients in BHA and 50% of patients undergoing THR had slight pain at 2-year follow-up (Table 3, Graph 1). *Limp*: Majority

Table 3 Distribution of the sample by criteria of pain

Criteria	Score	BHA $n = 20$	THR $n = 20$
None	44	6	8
Slight	40	12	12
Mild	30	2	0
Moderate	20	0	0
Marked	10	0	0
Pain at bed	0	0	0
Mean ± SD		40.2 ± 3.94	41.6 ± 2.01
p value		0.168 > 0.05	

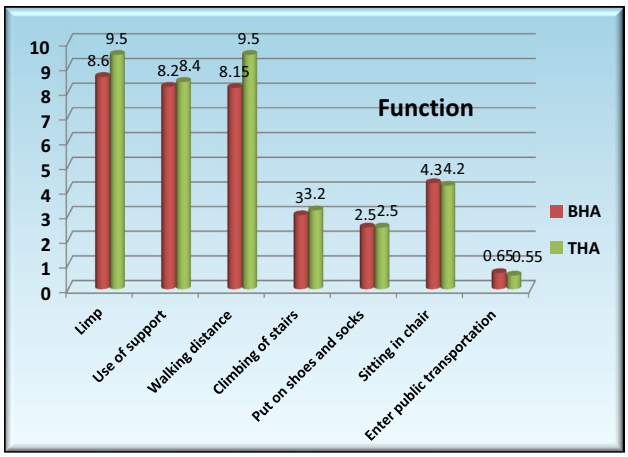
of the patients in our series had slight or no limp (85% in BHA, 90% in THR group) (Table 4). *Use of support*: In our series, 30–35% of patients used cane for long walks only and only 15–20% of the patients used cane most of the time in both groups. Twenty patients didn't use anything for support (Table 4). *Walking distance*: Majority of the patients (75% in BHA group, 90% in THR group) were able to walk for considerable distance and only one of the patients of BHA group was restricted to indoors (Table 4). *Ability to put on shoes*



Graph 1 Distribution of the sample by criteria of pain

Table 4 Distribution of sample on basis of Function

Function		Score (total = 47)	BHA mean	THR mean
1	Limp	11	8.6	9.5
2	Use of support	11	8.2	8.4
3	Walking distance	11	8.15	9.5
4	Climbing of stairs	4	3.0	3.2
5	Put on shoes and socks	4	2.5	2.5
6	Sitting in chair	5	4.3	4.2
7	Enter public transportation	1	0.65	0.55
Mean ± SD			35.35 ± 6.50	37.80 ± 5.61
p value		0.21 > 0.05		



Graph 2 Distribution of sample on basis of function

Table 5 Distribution of the sample by range of movements

Range of motion	BHA		THR	
	n	(%)	*n*	(%)
Flexion (140)	19	95	20	100
Adduction (40°)	20	100	20	100
Abduction (40°)	18	90	19	95
Int rotation (40°)	20	100	19	95
Ext rotation (40°)	17	85	19	95
Score 5	9	45	12	60
Score 4	10	50	8	40
Score 3	1	5	0	0
Total	20	100.0	20	100.0
Mean ± SD	4.3 ± 0.802		4.6 ± 0.501	
p value	0.165 > 0.05			

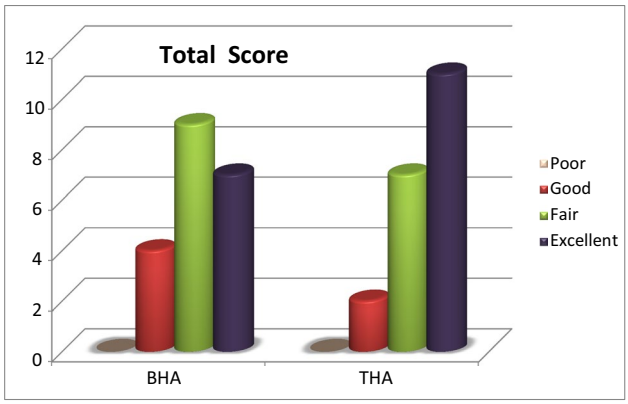
and socks: In case of patients who were not using shoes and socks were asked about their ability to bend and cut their toe nails, 40% of patients in both groups were able to do these tasks without any difficulty (Table 4). *Stair climbing*: Majority of the patients (55% in BHA group, 65% in THR group) in our series were able to climb the stairs without using railing (Table 4). *Sitting*: Majority of the patients (70% in BHA group, 60% in THR group) were able to sit on ordinary chair for more than 1 h (Table 4). *Entering public transportation*: Majority of the patients (65% in BHA group, 55% in THR group) were able to enter into public transportation (Table 4, Graph 2). *Deformity at the hip*: None of our patients show significant deformity in both groups. *Range of movements*: Majority (95%) of the patients had good range of movements (Table 5). *Functional MHHs*: In our series, total MHHs at the end of two years ranged from 24 to 100. Seven (35%) patients in BHA group and 11 (55%) patients in THR group had hip scores from 91 to 100 (excellent), 9 (45%) patients in BHA group and 7 (35%) patients in THR group had hip scores 81–90 (fair) and 4 (20%) patients in BHA group and 2 (10%) patients in THR group were rated 71–80 (good) and none was found in poor category. Thus, 85% of the hips were

Table 6 Total modified Harris hip score

Modified Harris hip score	BHA (*n* = 20) Mean ± SD	THR (*n* = 20) Mean ± SD	*p* value
Total score (100)	83.85 ± 6.62	88.00 ± 5.76	0.067 > 0.05
Pain (44)	40.2 ± 3.94	41.6 ± 2.01	0.168 > 0.05
Function (47)	35.35 ± 6.50	37.8 ± 5.61	0.21 > 0.05
Deformity (4)	4 ± 0	4 ± 0	
Range of motion (5)	4.3 ± 0.80	4.6 ± 0.50	0.16 > 0.05

Table 7 Distribution of cases by functional results at the end of 2 years

Results	Total score	BHA		THR	
		n	(%)	*n*	(%)
Excellent	91–100	7	35	11	55
Good	81–90	9	45	7	35
Fair	71–80	4	20	2	10
Poor	61–70	0	0	0	0
Total		20	100.0	20	100.0



Graph 3 Distribution of cases by functional results based on MHHs at the end of 2 years

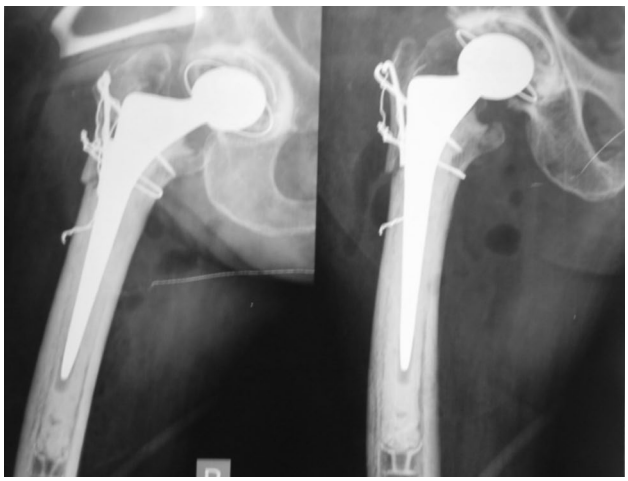


Fig. 3 Periprosthetic fracture in THR group treated with cerclage wiring

classified as having a fair to excellent result and 10% of the patients had a poor result (Tables 6, 7, Graph 3). *Complications*: Apart from 1 death, one patient was lost for follow-up. These two patients were excluded from the follow-up study. One patient had periprosthetic fracture of femur, five patients had bed sore and one had prosthetic dislocation. Minor limb length discrepancy was shown by nine patients (Fig. 3).

Discussion

In developing country, majority of the fractures are seen late enough and the patients rarely agree for a second surgery. Poverty, ignorance, illiteracy and life expectancy have significant impact in the rehabilitation of these patients who come from rural areas [17]. Thus, a one-time procedure considering all these is preferred. Osteosynthesis for fracture neck of femur has been globally declining due to high rates of non-union, implant failure, leading to revision surgeries in old-age group [18–20]. Unipolar hemiarthroplasty, bipolar hemiarthroplasty, total hip arthroplasty are the ones accepted by patients and surgeons based on needs.

This study was done to evaluate the functional outcome of BHA and THR in fracture neck femur in Indian elderly patients, and we found that BHA was comparative with THR in terms of functional outcome calculated by MHHs at the end of 2 years and can be considered as modality of treatment being very cost-effective in developing countries. Vanden et al. [9], Cadossi et al. [21], Giannini et al. [22], Hedbeck et al. [23] and Macaulay et al. [24] also found comparable results between BHA and THR in terms of MHHs at end of 2 years.

Dislocation of prosthesis is every surgeon's nightmare and patient's role is very crucial in preventing this complication [25]. In our series, none of the patients in BHA group had dislocation and one patient in THR group suffered from hip dislocation which was closed reduced in emergency. Avery et al. [26], Vanden et al. [9] and Macaulay et al. [24] reported 3 (7.5%), 8 (6.95%) and 1 (5.88%) hip dislocations, respectively, in THR group and none in BHA group. Poignard et al. [27] reported 13% dislocation with THR compared to 5% in BHA in retrospective analysis.

Duration of surgery and proportionally blood loss were significantly higher in THR group than in BHA group which can be attributed to additional acetabular component preparation in THR. This was in accordance with earlier published trials [9, 22–26], while Cadossi et al. [21] reported comparatively higher duration of surgery in BHA group.

BHA has been shown to have higher revision rates due to acetabular erosion, implant loosening, heterotrophic ossification [9, 27, 28]. Kasetti et al. [28] showed 19 (20.8%) in BHA group due to such complications. In our study, one patient in BHA group started showing acetabular erosion at 1 year and none of our patients required revision surgery in BHA group. Current studies also show that conversion rate of BHA to THR is very low at long-term follow-up [29]. One (5%) patient had periprosthetic fracture in THR group in our study which required cerclage wiring.

Limitations

Our study had 20 patients per group which could have been higher for better comparison, and also maximum follow-up in our study was 24 months; thus, long-term complications such as implant loosening, hip dislocations, sinking of prosthesis, ectopic bone formation were difficult to comment on in our study which can further influence the results.

Conclusion

BHA being comparable to THR in terms of functional outcome by MHHs with significantly less blood loss during surgery, less duration of surgery, more cost-effective can be recommended as first line of surgical management in elderly patients with displaced femur neck fractures in developing countries.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

References

1. Poole KE et al (2017) Focal osteoporosis defects play a key role in hip fracture. Bone 94:124–134
2. Metcalfe D (2008) The pathophysiology of osteoporotic hip fracture. McGill J Med 11(1):51–57
3. Ip TP, Leung J, Kung AWC (2010) Management of osteoporosis in patients hospitalized for hip fractures. Osteoporos Int 21(Suppl 4):605–614. doi:10.1007/s00198-010-1398-8
4. Majumdar SR et al (2017) Economic evaluation of a population-based osteoporosis intervention for outpatients with non-traumatic non-hip fractures: the "Catch a Break" 1i [type C] FLS. Osteoporos Int. doi:10.1007/s00198-017-3986-3
5. Mehra T et al (2017) Impact of structural and economic factors on hospitalization costs, inpatient mortality, and treatment type of traumatic hip fractures in Switzerland. Arch Osteoporos 12(1):7. doi:10.1007/s11657-016-0302-3
6. Guy P et al (2017) The burden of second hip fractures: provincial surgical hospitalizations over 15 years. Can J Surg 60(2):101–107. doi:10.1503/cjs.008616
7. Rosengren BE et al (2017) Recent hip fracture trends in Sweden and Denmark with age-period-cohort effects. Osteoporos Int 28(1):139–149
8. Ye C-Y et al (2016) Arthroplasty versus internal fixation for displaced intracapsular femoral neck fracture in the elderly: systematic review and meta-analysis of short-and long-term effectiveness. Chin Med J 129(21):2630–2638. doi:10.4103/0366-6999.192788
9. Tol MCJM et al (2017) Hemiarthroplasty or total hip arthroplasty for the treatment of a displaced intracapsular fracture in active elderly patients. Bone Joint J 99(2):250–254
10. Liodakis E et al (2016) Major complications and transfusion rates after hemiarthroplasty and total hip arthroplasty for femoral neck fractures. J Arthroplasty 31(9):2008–2012
11. Bishop J et al (2016) Evaluation of contemporary trends in femoral neck fracture management reveals discrepancies in treatment. Geriatr Orthop Surg Rehabil 7(3):135–141. doi:10.1177/2151458516658328
12. Lim JW et al (2016) Total hip replacement for neck of femur fracture: comparing outcomes with matched elective cohort. Injury 47(10):2144–2148
13. Cram P et al (2017) Trends in operative and nonoperative hip fracture management 1990–2014: a longitudinal analysis of Manitoba administrative data. J Am Geriatr Soc 65(1):27–34
14. Rogmark C, Leonardsson O (2016) Hip arthroplasty for the treatment of displaced fractures of the femoral neck in elderly patients. Bone Joint J98(3):291–297
15. Pal CP et al (2016) Role of bipolar hemiarthroplasty and total hip arthroplasty in unstable intertrochanteric fracture femur. J Orthop Allied Sci 4(2):69–74. doi:10.4103/2319-2585.193844
16. Kroll M, Ganz S, Backus S, Benick R, MacKenzie C, Harris L (1994) A tool for measuring functional outcomes after total hip arthroplasty. Arthritis Rheum 7(2):78–84
17. Mathers CD et al (2001) Healthy life expectancy in 191 countries, 1999. Lancet 357(9269):1685–1691
18. Kang JS et al (2016) Osteosynthesis versus endoprosthesis for the treatment of femoral neck fracture in Asian elderly patients. BMC Musculoskel Disord 17(1):264. doi:10.1186/s12891-016-1123-7
19. Kain MS, Marcantonio AJ, Iorio R (2014) Revision surgery occurs frequently after percutaneous fixation of stable femoral neck fractures in elderly patients. Clin Orthop Relat Res 472(12):4010–4014
20. Han SK et al (2016) Clinical results of treatment of garden type 1 and 2 femoral neck fractures in patients over 70-year old. Eur J Trauma Emerg Surg 42(2):191–196
21. Cadossi M, Chiarello E, Savarino L, Tedesco G, Baldini N et al (2013) A comparison of hemiarthroplasty with a novel polycarbonate–urethane acetabular component for displaced intracapsular fractures of the femoral neck: a randomised controlled trial in elderly patients. Bone Joint J 95:609–615
22. Giannini S, Chiarello E, Cadossi M, Luciani D, Tedesco G (2011) Prosthetic surgery in fragility osteopathy. Aging Clin Exp Res 23:40–42
23. Hedbeck CJ, Enocson A, Lapidus G, Blomfeldt R, Tornkvist H et al (2011) Comparison of bipolar hemiarthroplasty with total hip arthroplasty for displaced femoral neck fractures: a concise four-year follow-up of a randomized trial. J Bone Joint Surg Am 93:445–450
24. Macaulay W, Nellans KW, Iorio R, Garvin KL, Healy WL et al (2008) Total hip arthroplasty is less painful at 12 months compared with hemiarthroplasty in treatment of displaced femoral neck fracture. HSS J 4:48–54
25. Jepson P et al (2013) Assistive devices, hip precautions, environmental modifications and training to prevent dislocation and improve function after hip arthroplasty. The Cochrane Library, Cochrane
26. Avery PP, Baker RP, Walton MJ, Rooker JC, Squires B et al (2011) Total hip replacement and hemiarthroplasty in mobile, independent patients with a displaced intracapsular fracture of the femoral neck: a seven- to ten-year follow-up report of a prospective randomised controlled trial. J Bone Joint Surg Br 93:1045–1048
27. Poignard A, Bouhou M, Pidet O, Flouzat-Lachaniette CH, Hernigou P (2011) High dislocation cumulative risk in THA versus hemiarthroplasty for fractures. Clin Orthop Relat Res 469:3148–3153
28. Ravikumar KJ, Marsh G (2000) Internal fixation versus hemiarthroplasty versus total hip arthroplasty for displaced subcapital fractures of femur—13 year results of a prospective randomised study. Injury 31:793–797
29. Grosso MJ et al (2017) Hemiarthroplasty for displaced femoral neck fractures in the elderly has a low conversion rate. J Arthroplasty 32(1):150–154