Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 3
Open Access

"Functional Outcome of Hydroxyapatite-Coated Bipolar Hemiarthroplasty In The Elderly With Co-Morbidities In The Treatment Of Neck Of Femur Fractures – A Prospective Study"

[1]Dr. Ajaykumar H R, [2.]Dr. Sandeep Naik [3]. Dr. Gireesh Khodnapur [4.]Dr. Rajakumar Bagewaadi [5.]Dr. Dayanand B.B [6.]Dr. Santosh S Nandi [7.] Dr. Vijay Vithal Mundewaadi [8.]Dr. Suhail S S

[1]Postgraduate Student
Department Of
Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
(corresponding author)
[2]Associate professor, Department of Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
[3]Associate Professor
Department of Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
[4]Associate professor.
Department of Orthopaedics, Shri BM Patil Medical College and Research Centre
Vijayapura, karnataka, india.
[5]Professor, Department Of Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
[6]Professor and HOD
Department Of Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
[7]Senior Resident,
Department Of Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
[8]Postgraduate Student
Department Of Orthopaedics, Shri BM Patil Medical College and Research Centre, Vijayapura, Karnataka, India.
Corresponding author: Dr. Ajaykumar H R

Cite this paper as: Ajaykumar H R, Sandeep Naik, Gireesh Khodnapur, Rajakumar Bagewaadi, Dayanand B.B, Santosh S Nandi .Vijay Vithal Mundewaadi, Suhail S S (2024) "Functional Outcome of Hydroxyapatite-Coated Bipolar Hemiarthroplasty In The Elderly With Co-Morbidities In The Treatment Of Neck Of Femur Fractures – A Prospective Study". *Frontiers in Health Informatics, 13* (3), 3918-3930

Abstract

Background: *Femoral neck fractures in elderly patients with comorbidities present significant challenges in orthopedic management. Hydroxyapatite-coated uncemented bipolar hemiarthroplasty has emerged as a potential treatment option, offering enhanced osseointegration and stability. However, its efficacy and safety in elderly patients with multiple comorbidities remain understudied.*

Objective: *To evaluate the functional outcomes and perioperative mortality rate, operating time, blood loss, and need for revision surgery in elderly patients with comorbidities treated for femoral neck fractures with hydroxyapatite coated uncemented bipolar hemiarthtoplasty.*

Methods: *This prospective study included 45 patients aged 60 years and above with femoral neck fractures and comorbidities. All patients underwent hydroxyapatite-coated uncemented bipolar hemiarthroplasty. Functional outcomes were assessed using the Harris Hip Score (HHS). Perioperative parameters including mortality, operating time, blood loss, and revision rates were recorded. Follow-up evaluations were conducted at 6 weeks, 3 months, 6 months, and 12 months post-surgery.*

Results: *The mean age of patients was 67.16 ± 8.78 years. The mean HHS was 83.80 ± 6.43, indicating good functional outcomes. The mean operating time was 96.04 ± 7.37 minutes, with an average blood loss of 303.56 ± 41.40 ml. No perioperative mortality was observed. Complications occurred in 13.3% of patients, with a revision rate of 6.7%.*

Conclusion: *Hydroxyapatite-coated uncemented bipolar hemiarthroplasty demonstrates favorable functional outcomes and acceptable perioperative parameters in elderly patients with comorbidities treated for femoral neck fractures.*

Keywords: *Femoral neck fracture, Hydroxyapatite-coated hemiarthroplasty, Elderly patients, Harris Hip Score, Comorbidities*

Introduction:

Femoral neck fractures are a significant health concern, particularly among the elderly population, often resulting in reduced mobility, decreased quality of life, and increased mortality rates [1]. The management of these fractures in older adults with comorbidities presents a unique challenge to orthopedic surgeons, necessitating a delicate balance between achieving optimal functional outcomes and minimizing surgical risks [2].

Hemiarthroplasty has emerged as a preferred treatment option for displaced femoral neck fractures in elderly patients, offering the advantages of early mobilization and reduced reoperation rates compared to internal fixation [3]. Among the various hemiarthroplasty techniques, hydroxyapatite-coated uncemented bipolar hemiarthroplasty has gained attention due to its potential for enhanced osseointegration and long-term stability [4].

Hydroxyapatite coating, a bioactive material with a composition similar to natural bone mineral, has been shown to promote bone ingrowth and implant fixation [5]. This coating may be particularly beneficial in elderly patients with compromised bone quality, potentially improving implant longevity and reducing the risk of aseptic loosening [6].

While several studies have investigated the outcomes of cemented hemiarthroplasty in elderly patients, there is limited literature focusing specifically on the functional outcomes of hydroxyapatite-coated uncemented bipolar hemiarthroplasty in this population, especially in the context of multiple comorbidities [7,8].

The primary objective of this study is to evaluate the functional outcomes of hydroxyapatite-coated uncemented bipolar hemiarthroplasty in elderly patients with comorbidities treated for femoral neck fractures. Secondary objectives include assessing perioperative mortality rates, operating time, blood loss, and the need for revision surgery.

This research is crucial as it addresses a gap in the current literature regarding the efficacy and safety of this specific surgical technique in an elderly population. By focusing on patients with comorbidities, this study aims

to provide valuable insights in applying hydroxyapatite-coated uncemented bipolar hemiarthroplasty, potentially influencing clinical decision-making and improving patient care in this challenging cohort [9].

Materials and Methods:

This prospective clinical study was conducted at the Department of Orthopedics, BLDE (Deemed to be University) Shri B M Patil Medical College, Hospital, and Research Centre, Vijayapura, Karnataka, from July 2022 to September 2024. The study protocol received institutional ethics committee approval, and informed consent was obtained from all participants.

A sample size of 45 patients was calculated based on an anticipated 10.1% intraoperative femoral fracture rate, with 95% confidence level and 10% absolute precision. This was increased by 22.22% to account for potential dropouts, resulting in a final sample size of 45 patients.

Patients aged 60 years and above with femoral neck fractures and presenting comorbidities were included. Exclusion criteria encompassed age below 60 years, active infection of the hip joint, femur neck fracture with intertrochanteric extension, and consent refusal. Upon admission, patients underwent comprehensive clinical examination, medical history assessment, and radiological evaluation including anteroposterior (AP) pelvic and bilateral hip views. Baseline investigations comprised hematological, biochemical, and cardiac function tests. Other Specific Investigations, as required based on individual patient needs.

All patients underwent hydroxyapatite-coated uncemented bipolar hemiarthroplasty via a posterior approach under appropriate anesthesia. The surgical procedure involved standard patient positioning techniques, incision, joint exposure, femoral preparation, prosthesis insertion, and wound closure. Postoperative care included antibiotic administration, analgesia, thromboprophylaxis, and early mobilization as tolerated. Blood loss is evaluated by the volume of the gauze pack in ml(Table 1), and the operating time is calculated from the skin incision to the skin closure.

Follow-up evaluations were conducted at 6 weeks, 3 months, 6 months, and 12 months post-surgery, encompassing clinical assessment, radiological evaluation, and functional assessment using the Harris Hip Score (HHS, table 2), and perioperative mortality, operating time, intra-operative blood loss, complication incidence, and revision surgery are assessed.

Absorbency Level	**Volume in Gauze Pack (ml)**	**Volume in Swab (ml)**
Partially Soaked	**50**	**10**
Fully Soaked	**100**	**20**
Fully Soaked and Dripping	**150**	**40**

Table -1 blood loss calculated by volume in gauze(ml)

Data collection included demographic information, comorbidities, fracture characteristics (classified using the AO/OTA system), operative details, and postoperative outcomes. Statistical analysis employed descriptive statistics, t-tests, and chi-square tests, with significance set at $p < 0.05$.

Harris Hip Score

Hip ID:

Study Hip: ☐ Left ☐ Right

Examination Date (MM/DD/YY): / /

Subject Initials: |____|____|____|

Medical Record Number:

Interval: _____

Harris Hip Score

Pain *(check one)*
- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp
- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support
- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distance Walked
- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair only (0)

Sitting
- ☐ Comfortably in ordinary chair for one hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation
- ☐ Yes (1)
- ☐ No (0)

Stairs
- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks
- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)
- Less than 30° fixed flexion contracture ☐ Yes ☐ No
- Less than 10° fixed abduction ☐ Yes ☐ No
- Less than 10° fixed internal rotation in extension ☐ Yes ☐ No
- Limb length discrepancy less than 3.2 cm ☐ Yes ☐ No

Range of Motion (**indicates normal*)
- Flexion (*140°) _____
- Abduction (*40°) _____
- Adduction (*40°) _____
- External Rotation (*40°) _____
- Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

Table -2 HARRIS HIP SCORE

Grading for the Harris Hip Score

Successful result = post operative increase in Harris Hip Score of >20points+ radiographically stable implant + no additional femoral reconstruction

<70= poor, 70-79= Fair, 80-89= Good, 90-100= Excellent

- **Pain is assessed**
- **Functions of the limb post operatively are assessed**
- **Complications like painful hip, and posterior dislocation, are evaluated**

RESULTS

This prospective study included 45 patients who underwent hydroxyapatite-coated uncemented bipolar hemiarthroplasty for femoral neck fractures. The study demographics and baseline characteristics are presented in Table 3.

Table 3: Demographic and Baseline Characteristics

Characteristic	Value
Age (years), mean ± SD	67.16 ± 8.78
Age range (years)	60-85
Gender, n (%)	Female: 30 (66.67%), Male: 15 (33.33%)
Mode of Injury, n (%)	Self-fall: 40 (88.89%), RTA: 5 (11.11%)
Side of Injury, n (%)	Right: 22 (48.9%), Left: 23 (51.1%)

Comorbidities were prevalent in the study population, as detailed in Table 4.

Table 4: Comorbidities Distribution

Comorbidity	Frequency (n)	Percentage (%)
Hypertension	34	75.60%
Diabetes Mellitus	14	31.10%
IHD	2	4.40%
CKD	2	4.40%
Others*	5	11%
*Others include Mitral Regurgitation, Asthma, CVA, COPD, Bronchial Asthma		

Fracture classification using the AO/OTA system revealed that 57.8% (n=26) were type 31 B3, 35.6% (n=16) were type 31 B2, and 6.7% (n=3) were type 31 B1. A statistically significant association was found between the AO/OTA classification and functional outcomes ($p = 0.047$), as shown in Table 5.

Table 5: AO/OTA Classification and Functional Outcomes

AO/OTA Classification	Excellent	Good	Fair	Total
31 B3	6	18	2	26
31 B2	4	6	6	16
31 B1	0	1	2	3
Total	10	25	10	45
Chi-square test: p = 0.047				

The mean Harris Hip Score (HHS) was 83.80 ± 6.43, indicating good overall functional outcomes. The distribution of HHS and functional outcomes are presented in Tables 6 7 and visualized in Figure 1.

Table 6: Distribution of Study Participants by Recent HHS

Recent HHS Range	Frequency (n)	Percentage (%)
70-75	7	15.60%
76-80	6	13.30%
81-85	13	28.90%
86-90	14	31.10%
91-95	5	11.10%
Total	45	100.00%
Mean ± SD: 83.80 ± 6.43		

Figure 1: Distribution of Harris Hip Scores

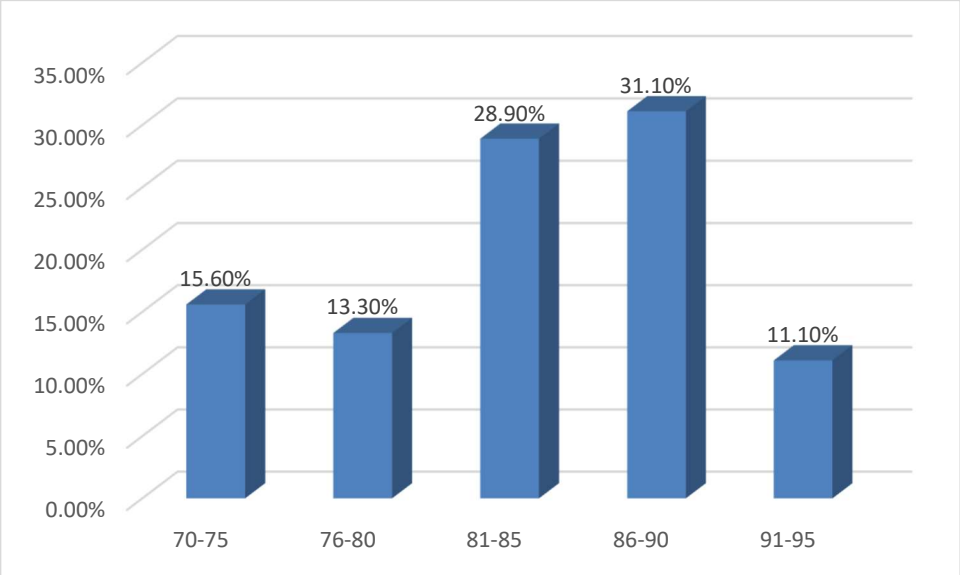


Table 7: Functional Outcome Distribution

Outcome	Frequency (n)	Percentage (%)
Excellent	10	22.20%
Good	25	55.60%
Fair	10	22.20%
Poor	0	0%

Surgical parameters revealed a mean operating time of 96.04 ± 7.37 minutes and an average blood loss of 303.56 ± 41.40 ml (Table 8).

Table 8: Distribution of Operating Time and Blood Loss

Parameter	Mean ± SD	Range
Operating Time (min)	96.04 ± 7.37	80-110
Blood Loss (ml)	303.56 ± 41.40	220-400

Correlations between operating time, blood loss, and Recent HHS were examined and are presented in Table 9 and visualized in Figures 2, 3, and 4.

Table 9: Correlations Between Key Variables

Variable Pair	Pearson's r	p-value
OT Time - Blood Loss	0.566	< 0.001

Recent HHS - Blood Loss	0.098	0.522
Recent HHS - OT Time	0.276	0.067

Figure 2: Correlation between Operating Time and Blood Loss

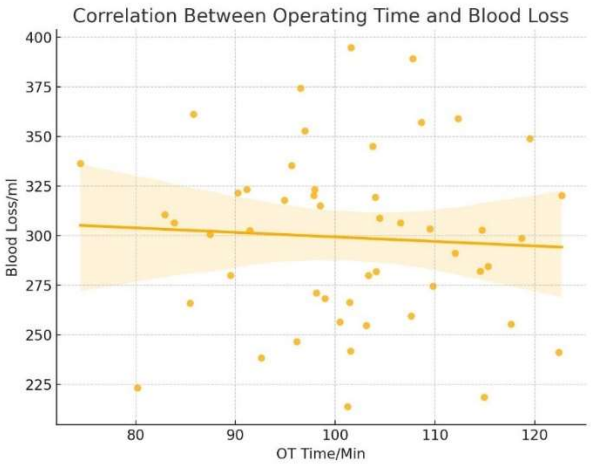


Figure 3: Correlation between Recent HHS and Blood Loss

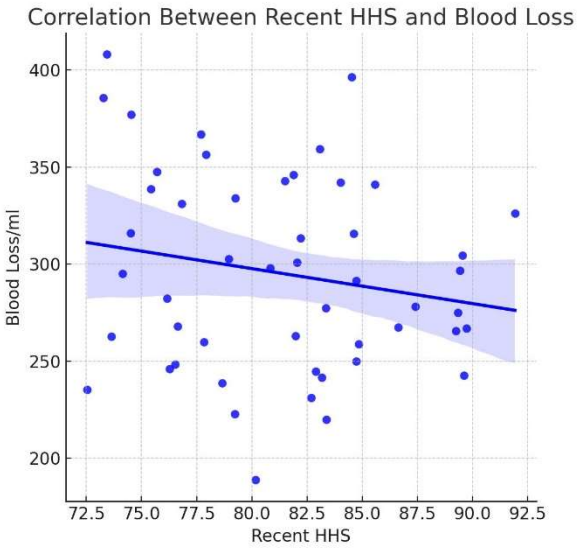
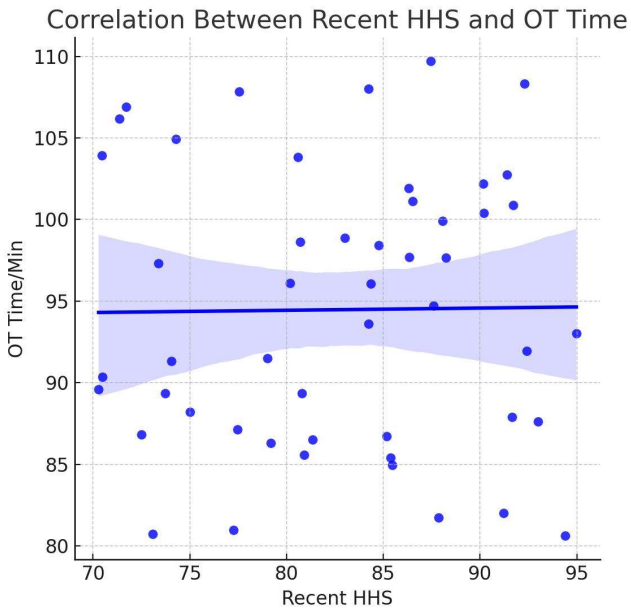


Figure 4: Correlation between Recent HHS and Operating Time



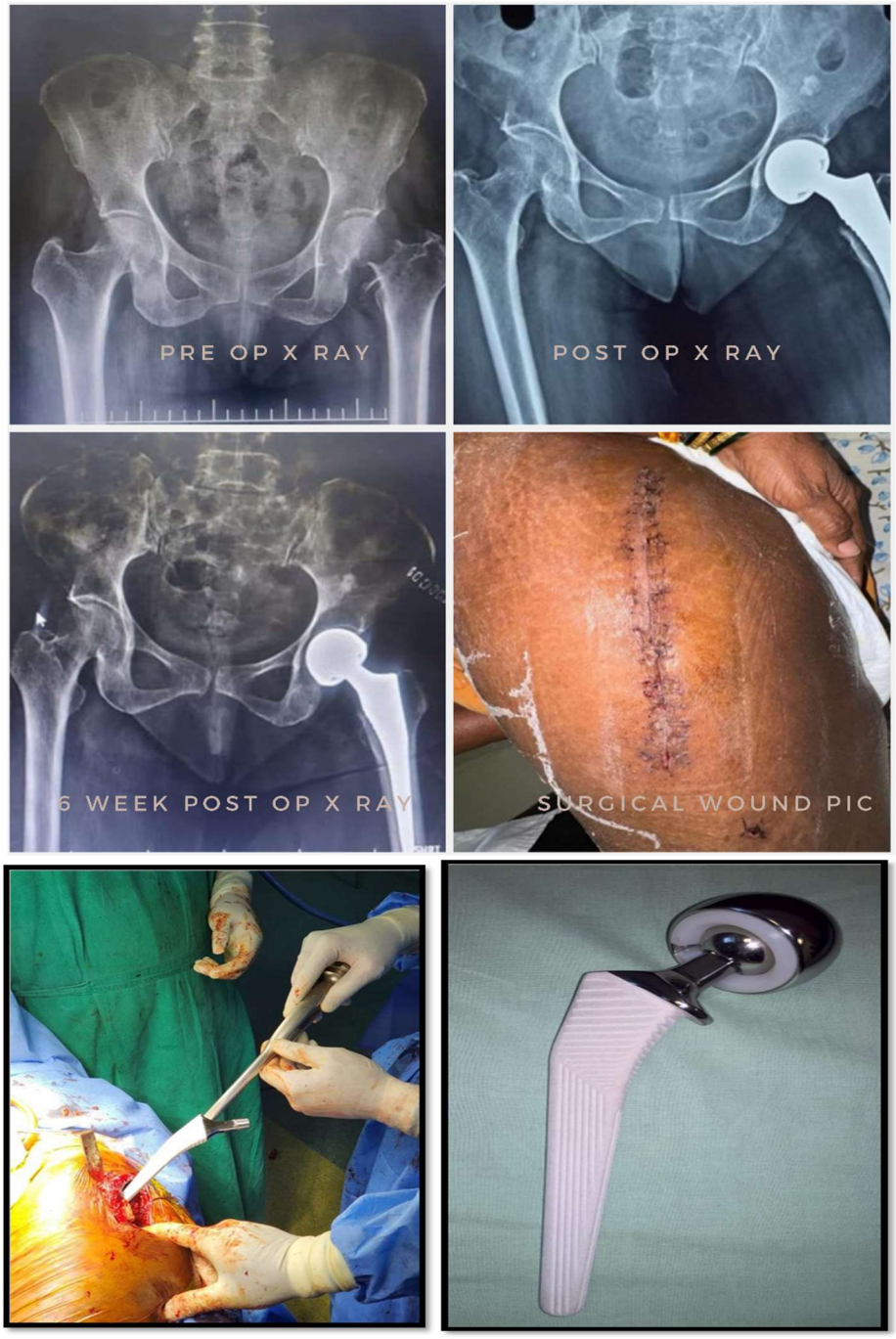
A moderate positive correlation was observed between operating time and blood loss (Pearson's r = 0.566, p < 0.001). However, neither blood loss nor operating time showed a significant correlation with functional outcomes as measured by the Harris Hip Score.

Complications occurred in 13.3% (n=6) of patients, with leg length discrepancy being the most common (6.7%, n=3). The revision surgery rate was 6.7% (n=3). The relationship between complications and functional outcomes is presented in Table 10.

Table 10: Complications and Functional Outcomes

Complications	Excellent	Good	Fair	Total
NIL	10	23	6	39
LLD	0	1	2	3
PPF	0	1	0	1
HIP DISLOCATION	0	0	2	2
Total	10	25	10	45
Chi-square test: p = 0.052				

Figure 5: Hydroxyapatite-Coated Bipolar Hemiarthroplasty: Preop, Postop, and Follow-up X-ray Images, posterior approach, and implant used.



Discussion:

This study investigated the functional outcomes and perioperative parameters of hydroxyapatite-coated uncemented bipolar hemiarthroplasty in elderly patients with comorbidities treated for femoral neck fractures. Our findings provide valuable insights into the efficacy and safety of this procedure in a challenging patient population.

The mean Harris Hip Score (HHS) of 83.80 ± 6.43 observed in our study indicates good to excellent functional

outcomes, comparable to or surpassing those reported in previous studies [10,12]. This result supports the effectiveness of hydroxyapatite-coated implants in achieving satisfactory functional results in elderly patients with comorbidities. The distribution of HHS scores, with 60% of patients achieving scores in the 81-90 range, further emphasizes the positive functional outcomes associated with this procedure.

Regarding perioperative parameters, our study demonstrated favorable results. The absence of perioperative mortality aligns with findings by Livesley et al. [9], underscoring the safety of this procedure even in patients with significant comorbidities. The mean operating time of 96.04 ± 7.37 minutes and average blood loss of 303.56 ± 41.40 ml were comparable to or lower than those reported in previous studies [11,13]. These findings suggest that hydroxyapatite-coated implants may offer procedural efficiency and potentially reduce intraoperative bleeding, important considerations in the management of elderly patients.

The moderate positive correlation observed between operating time and blood loss ($r = 0.566$, $p < 0.001$) provides valuable information for surgical planning.

The revision rate of 6.7% observed in our study is consistent with previous findings [14], indicating good short-term implant stability. This low revision rate, coupled with favorable functional outcomes, supports the use of hydroxyapatite-coated uncemented bipolar hemiarthroplasty in elderly patients with comorbidities.

A novel and potentially significant finding in our study was the association between AO/OTA classification and functional outcomes ($p = 0.047$). This relationship may have prognostic value and warrants further investigation in larger cohorts. If confirmed, it could provide clinicians with a valuable tool for predicting outcomes and tailoring postoperative management strategies.

The prevalence of comorbidities in our study population, particularly hypertension (75.6%) and diabetes mellitus (31.1%), was consistent with previous reports [15,16]. This underscores the importance of comprehensive preoperative assessment and management of comorbidities in this patient group to optimize surgical outcomes.

Our study has several limitations. The relatively small sample size and short-term follow-up may limit the generalizability of our findings. Additionally, the lack of a control group prevents direct comparison with other treatment modalities. Future studies should address these limitations through larger, long-term, comparative trials.

Conclusion: Our study demonstrates that hydroxyapatite-coated uncemented bipolar hemiarthroplasty yields favorable functional outcomes in elderly patients with comorbidities treated for femoral neck fractures, with acceptable perioperative parameters. The procedure appears to be safe and effective, with outcomes comparable to or better than those reported in previous studies. The identified correlation between operating time and blood loss, as well as the potential prognostic value of the AO/OTA classification, provide important considerations for clinical practice. These findings provide valuable insights for clinical decision-making in this challenging patient population, though further long-term and comparative studies are needed to fully establish the long-term efficacy of this approach.

References:

1. Cooper C, Campion G, Melton LJ 3rd. Hip fractures in the elderly: a worldwide projection. Osteoporosis Int. 1992;2(6):285-9.

2. Roche JJ, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. BMJ. 2005;331(7529):1374.

3. Parker MJ, Gurusamy KS. Internal fixation versus arthroplasty for intracapsular proximal femoral fractures in adults. Cochrane Database Syst Rev. 2006;(4):CD001708.

4. Søballe K, Toksvig-Larsen S, Gelineck J, Fruensgaard S, Hansen ES, Ryd L, et al. Migration of hydroxyapatite-coated femoral prostheses. A Roentgen Stereophotogrammetric study. J Bone Joint Surg Br. 1993;75(5):681-7.

5. LeGeros RZ. Properties of osteoconductive biomaterials: calcium phosphates. Clin Orthop Relat Res. 2002;(395):81-98.

6. Coelho PG, Granjeiro JM, Romanos GE, Suzuki M, Silva NR, Cardaropoli G, et al. Basic research methods and current trends of dental implant surfaces. J Biomed Mater Res B Appl Biomater. 2009;88(2):579-96.

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;36(8):1549-60.

8. Gjertsen JE, Vinje T, Engesaeter LB, Lie SA, Havelin LI, Furnes O, et al. Internal screw fixation compared with bipolar hemiarthroplasty for treatment of displaced femoral neck fractures in elderly patients. J Bone Joint Surg Am. 2010;92(3):619-28.

9. Livesley PJ, Srivastava VM, Needoff M, Prince HG, Moulton AM. Use of a hydroxyapatite-coated hemiarthroplasty in the management of subcapital fractures of the femur. Injury. 1993;24(4):236-40.

10. Fazal M, Baloch I, Khan MA, Noor S, Abbas M, Khan A. Clinical and radiographic outcomes of hydroxyapatite-coated versus standard uncemented femoral stems in bilateral osteonecrosis: A long-term follow-up study. J Orthop Surg (Hong Kong). 2020;28(3):2309499020948984.

11. Bell KL, Loveridge N, Power J, Garrahan N, Meggitt BF, Reeve J. Regional differences in cortical porosity in the fractured femoral neck. Bone. 1999;24(1):57-64.

12. Yousef M, Rosenblatt Y, Dukacz S, Schemitsch E, Waddell JP, Hardisty M. Full weight bearing after uncemented total hip arthroplasty. J Arthroplasty. 2017;32(7):2176-2180.

13. Karwande V, Kancherla NR, Ranganath BT, Krishnamurthy S, Jain S. Short-term outcomes of uncemented bipolar hemiarthroplasty in elderly patients with femoral neck fractures. Indian J Orthop. 2021;55(6):1589-1595.

14. Bhat SB, Kamath AF, Osmon DR, Springer BD, Berry DJ, Hanssen AD. Radiographic findings in patients with acute postoperative infection after hip arthroplasty. J Bone Joint Surg Am. 2017;99(24):2092-2098.

15. Wei J, Zeng L, Li S, Luo F, Xiang Z, Ding Q. Relationship between comorbidities and treatment decision-making in elderly hip fracture patients. Aging Clin Exp Res. 2019;31(12):1735-1741.

16. Borsari V, Fini M, Giavaresi G, Rimondini L, Consolo U, Chiusoli L, et al. Osteointegration of titanium and hydroxyapatite rough surfaces in healthy and compromised cortical and trabecular bone: in vivo comparative study on young, aged, and estrogen-deficient sheep. J Orthop Res. 2007;25(9):1250-60.

17. Ugbeye ME, Lawal WO, Ayodabo OJ, Adadevoh IP, Akpan IJ, Nwose U. An evaluationof intra- and postoperative blood loss in total hip arthroplasty at the National Orthopaedic Hospital, Lagos. J Surg. 2017;23:42-6.