

# Treatment of intracapsular fractures of the proximal femur with bipolar hemiarthroplasty in patients under the age of 70: clinical and radiographic results at mean 20 years follow-up

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**Summary.** *Background and aim of the work:* Hemiarthroplasty (HA) for femoral neck fractures in relatively young patients has been reported to have poor results. Moreover, cotyloiditis has been described for HA as a possible cause of revision. Nonetheless, in the literature there is lack of studies specifically evaluating this topic, particularly in relatively young patients. Aim of the study was to evaluate bipolar HA clinical and radiographic results at long term follow up in patients treated under the age of 70. *Methods:* Study population counted 137 patients treated between 1990 and 2000. In 2015 alive patients who did not undergo implant revision were clinically evaluated. Harris Hip Score and EQ-5D questionnaire were administrated. Acetabular erosion was identified and classified on follow-up radiographs. *Results:* At follow-up there were 39 living patients, mean age 64, 80.5% women. 3 patients were not traceable. Revision rate was 32% (12/37), because of cotyloiditis in 2 cases. In the 22 non-revised patients at mean 20 years follow up 3 cases presented moderate to severe acetabular erosion. Mean HHS and EQ values were 73.23 and 0.527 respectively. *Conclusions:* Bipolar HA provided satisfying results in relatively young patients at long term follow-up. In the present study age turned out to be the most relevant variable to influence results. Data suggest that acetabular erosion might have a secondary role in determining both the implant's survival and the long term clinical results. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** hemiarthroplasty, young, long-term, acetabular, erosion, cotyloiditis

## Introduction and aim of the work

Femoral neck fractures are among the most frequent fractures in the elderly. Europe counts 500,000 new cases each year, and the incidence has been estimated to increase to 1 million by 2050 due to the progressive aging of the population. One year after the event mortality is between 15% and 30% and only 30% to 40% of patient recover to the same degree of independence on daily living activities (DLA) they had before trauma (1-3). Hemiarthroplasty (HA) is the treatment of choice for intracapsular fractures of the proximal femur in elderly patients with low functional demands, because of its lower technical demand, fewer

surgical time, less blood loss and simpler rehabilitation in comparison to total hip arthroplasty (THA) (4,5). At the contrary, in younger patients with higher functional demands, especially under the age of 70, many authors report better functional and clinical results with THA (6,7). Moreover, the risk of cotyloiditis has been described for HA, defined as progressive acetabular cartilage and bony erosion caused by friction between the head of the prosthesis and the articular surface of the acetabulum. This condition has been described as a possible cause of pain and subsequent revision to THA. Nonetheless, in the literature there is lack of studies specifically evaluating this topic, in particular concerning a relatively young patient population.

Aim of the study was to evaluate clinical and radiographic results and quality of life at long term follow up in a population of patients treated under the age of 70 with bipolar HA for an intracapsular fracture of the proximal femur. In particular, the study evaluated the incidence of cotyloiditis in correlation with clinical results and quality of life.

## Materials and methods

All patients treated for femoral neck fracture with bipolar HA under the age of 70 at the Orthopaedics and Traumatology Unit of Cattinara Hospital in Trieste (Italy) between January 1999 and August 2000 were retrospectively evaluated. Inclusion criteria were to be able and independent and to walk with no aid before fracture and absence of pathological or previous fracture and pre-existing hip arthropathy. Considering the aforementioned criteria, the study population included 137 patients, one of whom underwent bilateral HA, for a total of 138 cases. There were 101 women and 36 men, with an average age at the time of the operation of 64.48 years (range 37 to 70). Bipolar HA were cemented in 126 cases and uncemented in 12. Surgical approach was direct lateral according to Hardinge in all cases. Patients deceased later on were identified between April and May 2015. The Kaplan-Meier survival curve was obtained to show the mortality incidence throughout the examined time interval. Among the living patients, the ones who had undergone surgical revision were excluded. Indeed, within the obtained subgroup of patients cause of revision and implant survival were recorded. Between June and August 2015, alive patients who did not undergo implant revision were clinically evaluated by one of the authors (F.R.). The following data were recorded: patient's mental status through the Short Portable Mental Status (SPMS) questionnaire (8); current lifestyle, distinguished in able/independent and inactive/dependent on DLA; BMI (Body Mass Index), with results divided in underweight/normal weight ( $BMI < 25$ ) and overweight/obese ( $BMI > 25$ ). Patients presenting severe neurological and/or neuromuscular disorders at follow up were excluded from the study.

Functional outcome was evaluated by means of the Harris Hip Score (HHS) (9), while quality of

life through the EQ-5D questionnaire (10). Patients with a Harris Hip Score inferior to 70 (=poor) were compared with patients whose score was superior to 70 (70-79=mediocre, 80-89=good, >90=excellent). The independent variables taken into consideration were age and follow-up time, while dependent variables were the EQ-5D questionnaire and lifestyle. The radiographic evaluation was based on the most recent images disposable, taken no more than 3 years before clinical evaluation. Two of the authors (G.C., V.S.), blind with respect to clinical evaluation results, independently evaluated radiographic images. Acetabular erosio was identified identifying and classified according to criteria proposed by Baker et al. (11)

Patients were therefore divided into two groups according to the grade of acetabular erosion: absent/slight (grade 0-1 according to Baker) and moderate/severe (grade 2-3 according to Baker) (Figure 1). Independent variables taken into consideration were age, follow-up time and BMI. Dependent variables were HHS, pain and functionality (derived from the HHS) and EQ-5D results.

Statistical evaluation was carried out by means of the SPSS and STATA14 software. The statistical methodology included the use of descriptive statistics (average, standard deviation, maximum and minimum), survival curves, parametric statistical tests



**Figure 1.** 83 years old patient presenting 21 years after right hip bipolar HA implantation a grade 3 acetabular erosion according to Baker, corresponding to acetabular protrusion

(one and two-way ANOVA) and non-parametric tests (Mann-Whitney). In particular, the normality of the variables was defined through the Shapiro-Wilk test of normality. The survival curves were elaborated by means of the Kaplan-Meier curves

## Results

At follow-up 98 out of the 137 included patients had deceased (mortality 71.5%). The Kaplan-Meier curve (Figure 2) shows a mortality rate of 7.3% (10/136) after 3 months and of 10.2% (14/136) after one year. The mortality rate after 5, 10 and 13 years was 30, 46 and 50% respectively. Three of the 39 living patients were not traceable.

The resulting population therefore amounted to 36 patients, 80.5% of whom women. One patient underwent bilateral HA, giving a total of 37 cases. The average age at the time of the operation was 64 years. Implant revision was carried out in 12 cases, with a revision rate of 32% (12/37). The causes of revision were the following: periprosthetic fractures (50%), aseptic loosening of the stem (25%), cotyloiditis (16.6%), dislocation of the prosthesis (8.3%). In this subgroup of patients the average age was 61.83 years (range 48-72) at the time of the first intervention, the average prosthesis survival time was 5 years and 7 months and 67% of revisions took place within the first 4 years. Of the 25 patients who maintained the original implant at follow-up, three were excluded from the study because of severe neurological and/or neuromuscular disorders

(1 Parkinson's disease, 1 advanced stage Alzheimer's disease, 1 hemiparesis on the operated side due to a stroke). The final study population therefore amounted to 22 patients, 4 men (18%) and 18 women (82%). The average age at the time of the operation was 67.5 years and average follow-up time 19 years and 3 months (Table 1).

Follow-up revealed 19 patients had intact (14) or slightly deteriorated (5) intellectual functions. No patient had severe deterioration of intellectual functions. Current lifestyle was able and independent in 55% of cases (12). The average BMI was 22.16, with 5 patients having values >25 (overweight) and 2 <18.5 (underweight). The Harris Hip Score average value was 73.23 (range 33-97). The EQ-5D was 0.527 (0.075-1.00). HHS and EQ-5D scores are resumed in Table 2.

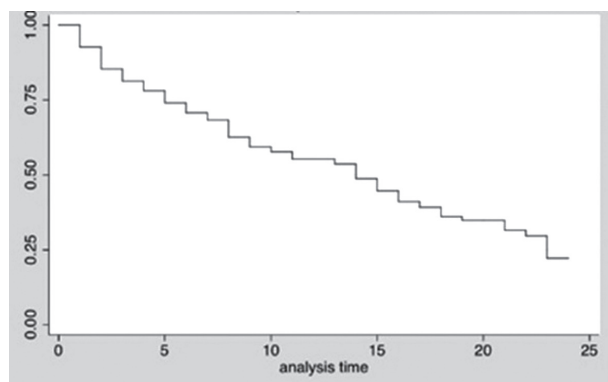
All patients leading an inactive/dependent lifestyle (10 cases) scored EQ-5D <0.500, that is a fair or poor quality of life. In 41% (9/22) of patients Harris Hip Score score was poor (HHS <70), with an average age of 86.45 years and a follow-up time of 20 years

**Table 1.** Demographic characteristics of patients who did not undergo implant revision at follow-up

	Male	Female	Total
Patients	4 (18%)	18 (82%)	22
Age at the time of the implant	65,5 (63-70)	65 (57-70)	65,09
Age at follow-up	85,2 (82-87)	83,9 (74-91)	84,13
%Cemented HA	75% (3/4)	72% (13/18)	73% (16/22)
Follow-up	20,00 (17,24)	19,06 (15-23)	19,3

**Table 2.** Harris Hip score and EQ-5D at follow-up

Average Harris Hip score (N=22)	<b>73,23 (33-97)</b>
Average pain (44-0)	32,73
Average functionality	32,18
Poor (<70)	9 Patients (41%)
Fair (70-79)	3 Patients (13%)
Good (80-89)	6 Patients (28%)
Very good (>90)	4 Patients (18%)
EQ-5D quality life (N=22)	0,527 (0,075-1,00)
Poor (<0,250)	6 Patients (27%)
Fair (0,250-0,500)	4 Patients (18%)
Satisfactory (0,500-0,50)	4 Patients (18%)
Good (>0,75)	8 Patients (36%)



**Figure 2.** Kaplan-Meier survival curve at about 20 years follow-up

and 2 months. In 59% (13/22) of patients Harris Hip Score scored  $>70$ , with an average age of 82.54 years and a follow-up time of 18 years and 7 months. The age difference between the two groups in relation with the HHS resulted statistically significant ( $p<0.05$ ), while follow-up difference between the two groups in relation with the HHS did not. Within the analyzed sample, patients with a poor HHS had an EQ-5D equal to 0.265, while the ones with an HHS  $>70$  had EQ-5D equal to 0.71. The difference in terms of quality of life between the two groups was statistically significant ( $p<0,05$ ). Radiological evaluation was possible for 18 patients out of the 22 who were clinically evaluated. Inside this subgroup, the average age was 84.27 years (74-91) and 83% were women. Mean clinical follow-up time was 18 years and 11 months, mean radiographic follow-up 17 years and 6 months. Incidence of acetabular erosion according to Baker's classification resulted as follows, with 100% agreement between the two evaluators: Grade 0=3 patients (16.5%); Grade 1=12 patients (67%); Grade 2=1 patient (5.5%); Grade 3=2 patients (11%). Therefore 3 patients (16.5%) had a moderate/severe acetabular erosion while in 15 cases (83.5%) it was slight or absent. The 3 patients with moderate/severe acetabular erosion had an average age of 80 years and a follow-up time of 19 years and 8 months. From a clinical point of view, these patients accused slight crural pain. The average HHS in this group was 72, pain score equal to 26.67 and functionality score equal to 36.67. The EQ-5D score corresponded to 0.67. The 15 patients with Baker grade 0-1 had an average age of 85.13 years and a follow-up time of 18 years and 9 months. Average HHS and EQ-5D were, respectively, 69.87 and 0.48. Pain score was 32.13 and functionality score 29.67. The age difference between the two groups was statistically significant, group 0-1 being older ( $p<0.05$ ). The follow-up difference was not statistically significant. As far as BMI is concerned, 15 of the 18 patients presented a value inferior to 25 while in 3 cases it was superior. Patients with Baker 0-1 had a BMI average value of 21.75. BMI was  $<25$  in all 3 patients with Baker 2-3, with an average value of 22.34.

There were no statistically significant difference between the two groups with respect to HHS, pain, functionality and EQ-D5.

## Discussion

The present study retrospectively evaluated at mean 20 years of follow-up a sample of 137 patients (138 cases) treated under the age of 70 by means of hip HA for femoral neck fracture. At follow-up the mortality rate reached 71.5%, that means 98 patients deceased. At our knowledge, the only study in the literature that is comparable to the present for follow-up duration is the study of Von Roth et al (12), published in 2015. Starting from a population of 376 patients with an average age of 79 years, treated with cemented HA, the authors reported a mortality rate of 94% at minimum 20 years follow-up. The difference in mortality existing between the two studies is probably due to the average age difference amounting to 15 years (64 vs. 79). The mortality rate on the medium and long term is effectively lower in the present study if compared to others in literature (12-22).

The present study revealed a revision rate of 32% among living patients. Most frequent causes were periprosthetic fractures and aseptic loosening of the stem, accounting for 75% of cases. Acetabular erosion was much less frequent, with 2 of 12 cases corresponding to 16.6%. Present data are in line with what reported by Ravikumar et al, who noted a revision rate of 24% at mean 13 years follow-up in a population of patients who underwent bipolar HA at a mean age of 81 years (65 in the present study). To be noted that at the same follow-up time (13 years) revision rate in the present study population was 27%. Nonetheless, other long term studies showed a considerably lower revision rate compared to the present study (15,16,23). All these papers differ from the present study in terms of mean age at the intervention, with mean values ranging from 82 to 85 years.

Literature lacks studies taking into consideration populations with an average age comparable to that of the present study. The comparison of the present study data with what reported in the literature suggest how age might be an important variable to influence revision rate, probably because of younger patients functional demand which may lead to earlier implant failure (14, 17). Van de Bakerom et al. compared two groups on the basis of age and reported that the group of patients younger than 75 had a considerably higher

number of complications and a higher revision rate than older patients (complications 39% vs 6%; revision rate 25% vs 3%) (24). In the present study, 67% of implant revisions were performed in the first 4 years, to support the hypothesis according to which an increase in age corresponds to a diminished revision rate due to lower functional demands, as other authors have already stated (14, 17).

Only 5.5% of patients (16.6% of revisions) in the present study population underwent surgical revision by converting to THA because of painful acetabular erosion. These patients were all treated within the first 3 years. The low incidence of HA revisions due to cotyloiditis is confirmed in literature for bipolar HA. Several studies report even lower revision rates due to acetabular erosion, concerning in particular populations with a higher average age (25). On the other hand, Baker et al noted a 7% revision rate due to cotyloiditis in patients with an average age of 75, all within the first 3 years (11,26). Van de Bekerom et al (24) reported 9 revisions out of 320 cases, of which 8 in patients under the age of 75.

Data reported in the present study and in literature reveal a discrepancy between the theoretical risk of long term acetabular erosion, caused by HA implantation, and the real incidence of prosthesis revision due to cotyloiditis. On the other hand, authors agree on the correlation between younger age and higher functional demand and the incidence of symptomatic acetabular erosion, in particular regarding the first years following the operation.

In the present study 22 alive patients who did not undergo prosthesis revision were clinically evaluated at mean 19 years follow-up. The average Harris Hip Score was 73.23 (33-97; ds: 17.5). Reported data revealed HHS decrease with the increase in patients age at follow-up. Moreover, HHS result worsens as the follow-up duration increases. Probably because of the small sample size such trends did not result as statistically significant. Nonetheless, patients with HHS<70 were significantly older than patients with HHS>70 ( $p<0.05$ ). Data reported in the present study are comparable with results reported in literature (5,24,27-31). In the present study patients with HHS<70 had a significantly lower quality of life in comparison with patients with HHS>70 ( $p<0.05$ ). In addition, 80% of pa-

tients in the HHS >70 group were still able and independent, while 89% of patients with HHS<70 were inactive/dependent. This correlation was also reported in literature. In Hedbeck et al paper (29) a progressive deterioration of the EQ-5D score was reported in relation with HHS decrease and aging. The same relation has been reported by Baker and Avery (11,26) using the SF-36 quality of life index.

Radiographic evaluation was conducted in 18 of the 22 patients who did not undergo prosthesis revision, focusing on acetabular erosion classified according to Baker criteria. In 16.5% of cases there were no radiographic signs of acetabular erosion (Baker grade 0), while 67% showed a slight erosion (Baker grade 1). In 3 cases only a moderate to severe erosion was present. Baker et al (11,26) reported at 3 years follow up 11 patients not presenting acetabular erosion, 13 grade 1, 6 grade 2 and 2 grade 3 cases in a population of mean 75 years. Hedbeck and Blomfeldt (5) showed only 5 patients (14%) within a sample of 34 with an average age of 81 presenting erosion, all grade 1. Compared to literature, results in terms of incidence and gravity of acetabular erosion in the present work appear to be in line with Baker's study. They are, on the other hand, in contrast with Hedbeck's study. Such data may be justified by the age difference at the time of surgery between the two populations in exam (present study: 65 years; Baker: 75 years; Hedbeck: 87 years). The different authors agree that younger patients are more at risk of developing cotyloiditis because of their higher functional requirements. Nonetheless, in the present study two groups of patients were compared, one with moderate/severe acetabular erosion ( $n=3$ ), the other with slight or absent ( $n=15$ ). A significant age difference emerged between the two groups ( $p<0.05$ ), with considerably younger patients belonging to the group with moderate/severe acetabular erosion in equal follow-up conditions. At the contrary, there were no statistically significant differences between the two groups in terms of HHS, articular pain and functionality and quality of life.

## Conclusions

The treatment of proximal femoral fractures by means of bipolar HA in a population of relatively

young patients seems to provide satisfying results if functional requirements are not particularly high. In the present study age turned out to be the most relevant variable to influence revision rate, causes of revision, clinical result and incidence and degree of acetabular erosion. Data reported in the present study and in the literature suggest that acetabular erosion might have a secondary role in determining both the implant's survival and the long term clinical results.

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