

## Unipolar, Bipolar or Total Hip Endoprosthesis after Femoral Neck Fracture: What is a Right Decision?

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The aim of this study was to recognize differences in mid-term clinical outcome after femoral neck fracture and hip endoprosthesis implantation. A total of 145 patients were examined, 32 patients with unipolar, 70 with bipolar and 43 patients with total hip endoprosthesis. The mean values of Harris Hip Score, after  $3.8 \pm 1.9$  years, were:  $72.1 \pm 17.8$ ,  $74.27 \pm 19.1$ ,  $78.2 \pm 22.5$  for patients with unipolar, bipolar and total hip endoprosthesis, respectively. No statistically significant difference was observed ( $p = 0.704$ ). The in-hospital mortality rates were: 4.3%, 4.6%, and 5.3% for groups of patients with bipolar, unipolar and total hip endoprosthesis, respectively. Considering clinical outcomes, general health and costs, it can be concluded that the choice of endoprosthesis does not pose an obstacle to a patient's recovery.

**Key words:** Hip, Fracture, Endoprosthesis, Result, Function.

### Introduction

The consequences of aging on the hip joint (osteoporosis, varisation of the femoral neck), the reduction of psycho-physical abilities of a patient (neuromuscular incoordination, fear from activities) and comorbidities predispose the elderly to the hip joint fracture. The cumulative risk run by women was shown to be 18% while for men it amounted to 6% (1). Approximately 30% of bed capacity in surgical facilities is occupied by patients with this particular injury (2). The cost of treatment for patients

with the hip fracture in the U.S. is exceeding \$ 8.7 billion per year, and an assessment is that it would exceed 16 billion by the year 2040 (3).

Because of all the above-indicated reasons, a choice of the most rational treatment is important in medical and economic terms for patients and society as well. However, opinions about a type of endoprosthesis that should be implanted after femoral neck fracture differ from one author to another. Some authors prefer implantation of unipolar partial hip endoprosthesis, while others prefer

bipolar partial endoprosthesis after displaced femoral neck fracture in elderly persons (4-19). Total hip endoprostheses, according to a majority, achieve the best mid-term clinical outcome. But their disadvantages, compared with partial endoprostheses are as follows: more extensive and longer operative procedures, increased blood loss, increased infection risks and mortality, longer rehabilitation period and higher costs (20, 21). Total hip endoprosthesis was shown to be a satisfactory salvage procedure after failure of other surgical solutions for femoral neck fracture (22).

“In vitro” experiments cannot offer absolutely accurate data, due to many complex characteristics of structures of implant, bone, cement, and some uncertain numerical parameters. This emphasizes a need for clinical studies, which could ensure more reliable data about the behavior of different endoprosthetic devices “in vivo” in order to validate the present methods applied in treatment, but also to point to some critical moments. There is no published study which compared mid-term clinical outcomes among unipolar, bipolar and total hip endoprostheses after femoral neck fracture.

The aim of this study was to compare mid-term clinical outcomes after implantation of three different types of hip endoprosthesis after femoral neck fracture.

### **Patients and Methods**

In the present study we collected hospital archive data only for patients with following inclusion criteria:

- dislocated medial femoral neck fracture (Garden type III and IV),
- absence of visible X ray, degenerative pathological changes,
- unilateral lesion,
- implantation of cemented hip endoprosthesis as primary procedure by lateral surgical hip approach,

- minimal follow-up period of 18 months,
- surgical procedure performed in Jan/88-Jun/01 period

The patients were divided into three groups:

- The first group consisted of 32 patients treated with partial unipolar hip endoprosthesis manufactured by “Austin Moore, Instrumentaria DOO Zagreb, Croatia”,
- The second group consisted of 70 patients treated with partial bipolar hip endoprosthesis manufactured by “Vario-cup, Link GmbH&Co Hamburg, Germany”,
- The third group consisted of 43 patients treated with total hip endoprosthesis manufactured by “Lubinus, Link GmbH&Co Hamburg, Germany”. Three groups differed only in respect of the type of implanted endoprosthesis.

The unipolar partial endoprosthesis is constructed as one piece; the head, neck and the stem are made from the same material, differing only in the radius of the head and length of the neck and stem. The bipolar endoprosthesis consists of a smaller polyethylene cup, tightened to the stem. The external cup’s outside surface articulates with the acetabulum and inside surface with the internal cup. This double mobility decreases a number of motions between the acetabular cartilage and the articulation surface of the endoprosthesis, and consequently, it provokes acetabular erosion. In case of complications, it is possible to transform the bipolar endoprosthesis into the total hip endoprosthesis by implanting the artificial acetabulum, while the unipolar partial endoprosthesis has to be completely removed in case of complications.

All patients were followed up for an average period of  $3.8 \pm 1.9$  years and their clinical outcomes were evaluated by the Harris Hip Score System.

The Harris Hip Score System evaluates the following hip parameters:

- hip pain (painless hip 44 points),

- presence of deformity (no deformity 4 points),
- range of motions (full motions 5 points),
- functional tests (complete functionality 47 points):
- completely healthy hip 100 points.

We have chosen the Harris Hip Score System for evaluation of mid term clinical outcomes because of its high validity and accuracy, but also for its easy comparison with other evaluation scales (23, 24). Henning deems that satisfactory and better clinical outcomes are over 50 points by HHS, but for Lestrage, fair clinical outcomes are HHS values over 70 points (25, 26).

Statistical analysis was performed by Chi<sup>2</sup> test and one-way ANOVA (Analysis of variance). The p value of 0.05 was deemed statistically significant.

## Results

Hospital archive data for 692 patients was collected according to the above mentioned inclusion criteria. Patients lost to follow-up, dead patients and patients with incomplete data were excluded from any further analysis. In the examined group of one hundred forty-five patients, 85% were females with the average age of  $76 \pm 5.1$  y. A mean period from injury to surgery was  $2.9 \pm 1.3$  days. The most common comorbidities were: cardiovascular diseases in 66% (96 patients), diabetes mellitus in 17% (25 patients), neurological diseases in 13% (19 patients) and pulmonary diseases in 10% (14 patients).

There were no statistically significant differences among the three described groups in respect of parameters which could influence the mid-term clinical outcome (age, follow-up, comorbidities).

Total hip endoprosthesis achieved the highest values by the Harris Hip Score,  $78.23 \pm 22.46$ , but it did not differ significantly ( $p = 0.704$ ) from the scores of unipolar and bipolar hip endoprostheses.

Table 1. Age, follow-up, and frequency of comorbidities with level of significance in three groups.

Parameter	Unipolar p.	Bipolar p.	Total p.	p
Age <sup>1</sup>	75	78	73	0.091
Follow up <sup>1</sup>	3.31	3.91	4.08	0.073
Cardio vascular <sup>2</sup>	53	68	70	>0.1
Neurological <sup>2</sup>	16	11	13	>0.1
Pulmonary <sup>2</sup>	12	10	11	>0.1
Diabetes mellitus <sup>2</sup>	16	17	16	>0.1
Pain <sup>1</sup>	37.7	37.9	36.87	>0.1
Limping <sup>1</sup>	6.27	9.63	7.77	0.001
Hhs <sup>1</sup>	72.06	74.27	78.23	>0.1
In-hospital mortality <sup>2</sup>	4.3	4.6	5.3	>0.1

<sup>1</sup>-numerical parameters measured in years, statistical difference calculated by ANOVA; <sup>2</sup>-frequencies of diseases measured in percentages, statistical difference calculated by Chi<sup>2</sup>-test

The mean of HHS values in all three groups ( $74.95 \pm 19.52$  96), can be considered as fair, according to Lestrage (26). The patients with implanted unipolar endoprosthesis had a lower in-hospital mortality rate, but statistically not significant.

## Discussion

In our study, the majority of patients were octogenarian females with numerous comorbidities. Comorbidities and pre-injury conditions are significant factors that influence hip fracture after a mild trauma (27). Since the percentage of elderly people has lately increased geriatric diseases and injuries are becoming an increasingly important issue. Due to difficulties in treatment of the hip fracture, the recovery period is exhausting for patients, but at the same time expensive for society.

The Harris Hip Score System is an objective method of measuring mid-term clinical outcomes and the best tool in evaluating treatment. An average value of HHS  $74.95 \pm 19.52$  (similar to results obtained in other studies) indicated that a patient

with implanted hip endoprosthesis after the femoral neck fracture had periodic pain that did not affect her/his activities; the patient could walk without a major problem for at least 500 meters, limped to a certain degree, used a cane, could climb stairs holding a handrail, sat in the chair for a long time, put on shoes and socks with minor difficulties, used the public transportation and had no distinct deformity of the hip. With that level of hip functionality regained after endoprosthetic hip replacement, our patients are able to live independently which, in turn, is the main personal, medical and social goal for their age. Although average HHSs in all three groups were in the domain of "fair" (by LeStrange), HHS of the bipolar partial endoprosthesis evaluated in this study is 2 points above HHS of the unipolar endoprosthesis (74 vs. 72), and only 4 points below (74 vs.78) for total endoprosthesis

The mean in-hospital mortality rate in all three groups (4.7%) was similar to Goldhill's report (5.7%), and Lyons's report (4.3%) (28, 29). A slightly higher in-hospital mortality rate in the group of patients with implanted total hip endoprostheses (5.3%) compared with groups of patients with partial hip endoprostheses (4.5%) could be attributed to a longer and more extensive surgery of implantation of total hip endoprosthesis and an increased blood loss during surgery. Patients with the implanted bipolar endoprosthesis had the lowest level of pain, limp and in-hospital mortality rate. Ichihashi favours the use of the bipolar endoprosthesis in femoral neck fractures even after avascular necrosis of the femoral head, though he was uncertain about the use of this endoprosthesis in patients suffering from hip arthrosis (30).

Considering the clinical results of this study, blood loss, duration of surgical procedure, possibility of revision, time of functional recovery and price of endoprosthesis, all types of endoprostheses are valuable for surgery of the hip. Although our groups

were uniform and their HHS values were similar, a decision about the type of endoprosthesis should not be uniform. Total endoprosthesis is a logical option for patients with the previously damaged hip; unipolar endoprosthesis is a most rational choice for patients with a shorter life expectancy, while for other patients with displaced femoral neck fractures, the bipolar partial endoprosthesis seems to be an acceptable and middle-ground approach to treatment.

The limitations of this study are as follows: a relatively small number of participants, lack of severity of the illness score and a relatively short follow-up period. However, studies with similar limitations have been published in the literature and may have helped clinicians in decision making. Clearly, a more comprehensive study on this subject, which would be helpful in answering newly arisen problems in this particular domain, is currently lacking.

In conclusion, a choice of endoprosthesis is not a crucial obstacle to a patient's recovery to the pre-surgery state. It is only natural that, on the one hand, a choice of an implant must be evaluated in accordance with the clinical benefits of a chosen endoprosthesis, while on the other hand, due attention should be paid to a patient's overall condition and cost-benefit analysis.

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