



Total hip arthroplasty for femoral neck fractures as an urgent procedure

Totalna artroplastika kuka za prelome vrata femura kao urgentna procedura

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Abstract

Background/Aim. Total hip arthroplasty (THA) is one of the most widely accepted operative methods for femoral neck fracture (FNF) in elderly. However, the data on the early THA for FNF are very limited. The aim of this study to determine if there were differences in postoperative complications and functional outcomes between an urgent and delayed THA following FNF. **Methods.** This prospective study included a total of 244 patients who had THA following FNF from January 2010 to January 2013. In the first group 41 FNF patients were treated with THA within less than 12 hours of admission. A total of 203 FNF patients were operated in delayed settings, of whom 162 required prolonged preoperative processing and comorbidities correction. The group II consisted of 41 FNF patients who were fit for the early surgery at admission, but the operation was delayed due to institution related reasons. Main outcome measurements included mortality, functional outcome assessment, cardiological and pulmonary complications, pressure ulcers, dislocations, infections, length of hospitalization and revisions. **Results.** There were no differences in terms of age, gender, type of implants, neither in mortality, nor complications. There were differences in hospital length of stay [$t(51.72) = -10.25, p < 0.001$]. The patients operated within less than 12 hours of admission, had significantly better scores at all three time points of functional outcome assessment: at discharge $t(80) = 2.556, p < 0.012$; one month $t(80) = 4.731, p < 0.001$; three months $t(80) = 5.908, p < 0.001$. **Conclusion.** THA for FNF as an urgent procedure is not a widely accepted concept. Our findings indicate that the early operative treatment, does not worsen clinical outcomes, and our results give an advantage to the policy of the early THA for FNF.

Key words:

femoral neck fractures; arthroplasty, replacement, hip; time factors; treatment outcome; orthopedic procedures.

Apstrakt

Uvod/Cilj. Totalna artroplastika kuka (*total hip arthroplasty* – THA) je jedna od najčešće primenjenih metoda za lečenje preloma vrata femura (*femoral neck fracture* – FNF) kod starijih. Međutim, retki su podaci o ranoj primeni THA za FNF. Cilj ovog rada bio je da se utvrdi razlika u postoperativnim komplikacijama i funkcionalnom ishodu između urgentne i odložene THA nakon FNF. **Metode.** Ovom prospektivnom studijom obuhvaćena su 244 bolesnika kojima je izvedena THA nakon FNF u periodu od januara 2010. do januara 2013. U prvoj grupi, kod 41 bolesnika izvedena je THA u prvih 12 sati od prijema. Ukupno 203 bolesnika su operisana odloženo, od kojih je kod 162 bila potrebna dodatna korekcija komorbiditeta. Zbog toga je druga grupa sastavljena od bolesnika ($n = 41$) koji su mogli da budu operisani neposredno po prijemu, ali je operacija odlagana usled institucionalnih razloga. Praćeni su mortalitet, funkcionalni ishod, kardiološke i pulmološke komplikacije, dekubitusi, dislokacije, infekcije, dužina hospitalizacije i revizije. **Rezultati.** Nije bilo razlika u godinama starosti, polu, tipu implantata, mortalitetu niti komplikacijama. Utvrđene su razlike u dužini bolničkog lečenja [$t(51.72) = -10.25, p < 0.001$]. Bolesnici operisani u prvih 12 časova od prijema imali su značajno bolje skorove u sva tri vremena procene funkcionalnog ishoda: na otpustu, $t(80) = 2.556, p < 0.012$; nakon jednog meseca, $t(80) = 4.731, p < 0.001$; i nakon tri meseca, $t(80) = 5.908, p < 0.001$. **Zaključak.** Metoda THA kao urgentna procedura za FNFs nije široko prihvaćen koncept. Naši nalazi pokazuju da rani operativni tretman ne pogoršava klinički ishod. Rezultati daju jasnu prednost ranoj THA kod bolesnika sa FNF.

Ključne reči:

femur, prelomi vrata; artroplastika kuka; vreme, faktor; lečenje, ishod; ortopedске procedure.

Introduction

Femoral neck fractures (FNF) as well as hip fractures in general, represent a major challenge for today's healthcare systems, mostly due to mortality, morbidity, and frequent lengthy hospitalization followed by a number of complications^{1,2}.

Patients with hip fractures are faced with significantly higher rates of mortality and morbidity than those patients of the same age without fractures³. Mortality rates within a year of FNF range from 12% to 36%⁴.

Despite the fact that 50% of the total hip fracture population has a displaced FNF, the optimal surgical option for FNF in the elderly is still the subject of an ongoing scientific and clinical debate^{5,6}.

Traditionally, hip hemiarthroplasty (HA) and total hip arthroplasty (THA) are the most widely accepted operative methods for FNF in the elderly. Taking all the advantages into account (reduced dislocation rates, simple procedure, shorter operating time, less blood loss, lower initial costs), a number of authors prefer HA to THA^{7,8}. On the other hand, there is ample evidence that THA, with its advances in operative techniques and implants, provides better function, satisfaction, offers fewer complications and reduces the need for revisions⁹⁻¹¹.

In addition, there is an ongoing controversy regarding the ideal timing of operative treatment^{12,13}. Numerous studies have linked the increase in mortality and complication rates with delay in surgical treatment¹⁴⁻¹⁷.

Although the impact of surgical delay on the early mortality after hip fractures has been extensively presented in the orthopaedic literature, the data on the subject of the early THA for FNF are exceptionally limited.

Therefore, the aim of this study was to determine if THA, performed as an urgent intervention for FNF, within 12 hours of admission, affects the outcome in relation to the same but delayed procedure.

Methods

We conducted a prospective comparative study in a single center, university hospital, to determine differences if any in postoperative complications and functional outcomes between an urgent and delayed THA following FNF. The study included a total of 244 patients who had THA following FNF from January 2010 to January 2013.

The inclusion criteria for THA after FNF were as follows: FNF patients, aged 60 to 80 years, without mental and neurological impairments, the American Society of Anesthesiologists (ASA) score grade I/II. Additional prerequisites were that patients sustained a FNF on the day of admission, and that they were fit for the early surgery, with no need for preoperative comorbidities correction.

The follow-up protocol consisted of physical and radiological assessments, and those were done at discharge, one month, 3 months, 1 and 2 years after the surgery. The patients were regularly postoperatively followed-up for at least 2 years (average 2.6 years). All the patients were available for the follow-ups.

In the group I, 41 FNF patients were treated with THA within less than 12 hours of admission. A total of 203 FNF patients were operated in delayed settings, of whom 162 required prolonged preoperative processing and comorbidities correction. Therefore, the group II consisted of 41 FNF patients who were fit for the early surgery at admission, but the operation was delayed due to institution related reasons (weekends, holidays, unavailability of operating theaters or surgeons who routinely perform THA).

Preoperatively, all the patients were evaluated by anesthesiologists and if needed by other medical specialists. Most commonly requested consultations were by cardiologists, endocrinologist and pulmonologists. Preoperative evaluations of FNF patients, besides orthopedic examinations, routinely included complete blood counts, hematocrit and hemoglobin levels, biochemical analyses, electrolyte levels, EKG and chest radiograph, as well as some additional examinations requested by other specialists.

All the patients in both series received intravenous antibiotic prophylaxis consisting of the second- or third-generation cephalosporins, and low-molecular-weight heparins (LMWH) administered for 4 weeks postoperatively. The patients in the delayed group were given thromboprophylaxis preoperatively. General anesthesia was performed in all the cases. Surgical approach was posterolateral. Immediate weight bearing was allowed in all cases, and physical therapy was started on the first postoperative day. The time of admission was registered as the time when a patient arrived at the emergency room (ER). The patients in the early surgery group were transferred to the ward after operation.

Outcome assessments included mortality, pressure ulcers, cardiac complications, functional outcome assessment by the Harris hip score (HHS), dislocations, infections, length of hospitalization and revisions.

As far as THA implants are concerned, 28 mm heads (metal/polyethylene combination) were used in both investigated groups (Figures 1 and 2).



Fig. 1 – Cementless total hip arthroplasty.



Fig. 2 – Cemented total hip arthroplasty.

Statistical analysis

Statistical analysis was performed using statistical package PASW 18. Long rank analysis of the null hypothesis was performed between the two timing approaches (with $p < 0.05$).

All procedures performed in the study were in accordance with the ethical standards of the institution and/or the National Research Committee, as well as with the 1964 Declaration of Helsinki and its later amendments. Moreover, informed consent was obtained from all individual participants included in the study.

Results

In the group I operated in the period less than 12 h of admission there were 31 females and 10 males, and the average age was 66.8 years (range 60–81). According to the American Society of Anesthesiologists (ASA), 24 patients

were in ASA risk group 1, and 17 patients were in the ASA risk group 2. In the group II (operated on in delayed settings) there were 32 females and 9 males, and the average age was 67.5 years (range 62–78); 26 patients were in ASA risk group 1, and 15 were in the ASA risk group 2. Comorbidities, risk factors and types of THA used in both groups of patients are presented in Table 1.

According to the interval from admission to the surgery, in the group I there were 12 patients in 0–6 hours period in whom THA was performed.

In the group II THA was performed in the following way: in a 12–24 h post admission period in one patient; 24–48 h in 8 patients; 2–4 days in 18 patients; 5–6 days in 12 patients and 7–8 days in 2 patients.

Most of the patients in the group I were operated on during the late afternoon, evening and early morning hours. In the early group we performed 18 THAs, in the period from 3 pm to 10 pm, and 23 THAs were performed during the night in the period from 10 pm to 5 am.

One patient (a 67-year-old woman) in the delayed group died at her home 6 days after her discharge from hospital, on the 12th postoperative day. The autopsy report showed that pulmonary embolism and cardiac arrest were the cause of her death. The hybrid THA was performed in that case.

A patient (81-year-old male, cemented THA) in the delayed group, and a patient (76-year-old woman) in the group I died within the first year of the surgery (8 and 11 months postoperatively, respectively), due to the reasons that can not be directly linked with their hip fractures or consequent THA surgeries. During the follow-up period neither of the patients in both groups showed signs of aseptic loosening of any prosthetic component. Two patients with THA infections and septic loosening required revision procedures, so the two-stage revision with articulating hip spacers was performed in both cases.

Both groups had the same number of male and female patients ($\chi^2(1) = 0.069$, $p < 0.794$), as well as the same number of cementless, cemented and hybrid THAs ($\chi^2(2) = 0.271$, $p < 0.873$). *T*-test analysis revealed no difference between the two groups when it comes to the age of patients [$t(80) = 0.587$; $p < 0.559$].

Table 1
Comorbidities, risk factors and type of total hip arthroplasty (THA) according to the timing of surgery

Parameter	Group I	Group II	χ^2	<i>p</i> - values
Hypertension	9	8	$\chi^2(1) = 0.074$	< 0.785
Well controlled diabetes type 2	3	2	$\chi^2(1) = 0.213$	< 0.644
Stable angina	1	1	-	-
Rheumatoid arthritis	1	1	-	-
Well controlled thyroid disorder	0	1	$\chi^2(1) = 1.012$	< 0.314
Obesity	2	3	$\chi^2(1) = 0.213$	< 0.644
Smoking	2	2	-	-
Alcoholism	0	1	$\chi^2(1) = 1.012$	< 0.314
Uncemented THA	27	29	$\chi^2(1) = 0.225$	< 0.635
Cemented THA	11	9	$\chi^2(1) = 0.265$	< 0.607
Hybrid THA	3	3	-	-

Group I – THA performed in the period less than 12 hours of admission;

Group II – THA performed in delayed settings.

The average length of hospital stay in the group I was 7.1 (range 5 to 9) days, and in the group II it was 13.5 (range 7 to 19) days. The data relate to the initial hospitalizations after fractures, not to the days of revisions. The patients in the delayed group had the mean postoperative stay of 8.6 days. The patients who were operated within less than 12 hours required shorter hospitalization ($\bar{x} \pm SD = 7.1 \pm 1.446$ days) than it was the case with those operated on in the delayed procedure ($\bar{x} \pm SD = 13.5 \pm 3.736$ days). *T*-test revealed a statistical significance between the groups, $t(51.72) = -10.25, p < 0.001$. In comparison of just postoperative length of stay (eliminating the amount of time the patient spent in hospital prior to surgery) the value of *t*-test was $t(69.97) = -3.79, p < 0.001$.

The patients operated within less than 12 hours of admission, had significantly better scores at all three time points of functional outcome assessment: at discharge $t(80) = 2.556, p < 0.012$; one month $t(80) = 4.731, p < .001$; three months $t(80) = 5.908, p < 0.001$.

There would not be any statistically significant differences regarding functional outcome at the time point of three months ($t(80) = 1.936, p < 0.058$) if patients in the delayed group who needed revision procedures, were excluded from the final functional outcome assessment.

When it comes to postoperative complications, even though there were more complications in the group operated in the delayed procedure, those differences were not statistically significant. All registered dislocations in both groups were one-time events, noted within the first 6 postoperative weeks and did not require surgical revisions. The results of χ^2 -tests are shown in Table 2. Log rank analysis of the null hypothesis was performed (Mantel $\chi^2 = 1.00, p < 0.317$) and there were no significant differences in mortality between these two timing approaches.

surgical techniques, and choice of implants, as well as influence of comorbidities, and postoperative care modalities that vary across different institutions and countries, so as to hinder the unification and standardization of optimal treatment.

There is limited research on timing of THA for FNF, and even less data are available on the subject of the early THA for FNF. A recent study on the early hip fracture surgery¹⁸ finds that surgeries done within 36 hours of FNF were associated with reduced mortality compared to the surgeries done after that time. The same outcomes were shown for the surgeries done within 12, 24, 48, 60 and 72 hours. The authors have not found the minimum amount of time prior to which surgery failed to confer a survival benefit, but the limiting factor for comparison with our analysis, was that only one THA procedure (out of 2,056 patients) was registered. According to one systematic review and meta-analysis¹⁷, early surgery was associated with a lower risk of death and lower rates of postoperative pneumonia and pressure sores among elderly patients with hip fractures. Rudelli et al.¹¹, who strongly advocate THA for FNF, performed 88 THAs over the period of 12 years for FNF, and reported time frame of 8 hours to 34 days, from fracture to operation, with patients in ASA groups 1 to 4 and hospitalization range of 6 to 35 days. But they have not clearly defined, neither have they studied differences between patients operated early and those THAs performed in delayed settings.

Several authors noted a higher incidence of complications after THA for FNF: Sharma et al.¹⁹ reported 22% of local complications and 19% of general complications (7% of deep vein thrombosis), Narayan et al.²⁰ found 4% of dislocations, Džupa et al.²¹ reported 9% of revisions.

Jameson et al.²² analyzed the UK National Joint registry THA data for acute FNF (4323 procedures were studied) and the following was found: 3.25% of revision rate,

Table 2
Postoperative complications and functional outcome according to Harris hip scores (HHS)

Parameter	Group I	Group II	χ^2 / t	<i>p</i> - value
Infection	0	3	$\chi^2(1) = 3.114$	< 0.078
DVT	0	3	$\chi^2(1) = 3.114$	< 0.078
PE	0	3	$\chi^2(1) = 3.114$	< 0.078
Cardiologic complications	1	4	$\chi^2(1) = 1.917$	< 0.166
Pressure ulcers	0	2	$\chi^2(1) = 2.050$	< 0.152
Dislocations	2	3	$\chi^2(1) = 0.213$	< 0.644
Revisions	0	2	$\chi^2(1) = 2.050$	< 0.152
HHS at discharge	59.4	51.6	$t(80) = 2.556$	< 0.012
HHS 1 month after surgery	87.3	75.3	$t(80) = 4.731$	< 0.001
HHS 3 months after surgery	95.3	89.2	$t(80) = 5.908$	< 0.001

Group I – total hip arthroplasty (THA) performed in the period less than 12 hours of admission; Group II – THA performed in delay settings; DVT – deep venous thrombosis; PE – pulmonary embolism.

Discussion

The impact of surgical delay on the outcome following hip fractures has been extensively presented in the orthopedic literature. When it comes to the proximal femur fractures research, there are other major concerns besides the timing of surgery, such as significant diversity of fracture patterns,

3.2% of mortality within 90 days and increased risk of mortality with higher ASA score. Thus, they concluded that there are no benefits of using head sizes > 28 mm or bearings other than metal-on-polyethylene, and that THA is a good option in patients aged < 75 years and with ASA 1/2.

Chaudhry et al.²³ reviewed the randomized controlled trials involving THA approach for FNF. Even though their

study did not evaluate the timing of surgery, they identified considerable variability in both the surgical approach and choice of implants. Therefore, they determined that standardization was needed in order to reduce complication rates.

FNF mortality rates, for arthroplastic procedures, range from 4.3% to 20% in the first 4 months following the surgery, and from 4.3% to 48% in the first postoperative year²⁴. Specifically for FNF, albeit disregarding the influence of timing, Sebestyén et al.²⁵ concluded that gender, age and accompanying diseases significantly influence early mortality, whereas early postoperative complications do not have a significant impact on the mortality risk. Despite the fact that patients in both our series were older than 60 years and had hip fractures, early and late mortality rates were much lower (5% to 11.7%) than in other reports^{26, 27}. It is likely due to the study inclusion criteria. One of the major concerns of THA for FNF lies in the possible higher incidence of dislocations, various authors reported different rates, ranging from 0% to 22%^{24, 28}. The incidence we reported in both groups, was in the typical range reported by other authors. There were no statistically significant differences in procedure-related specific complications, such as dislocations and infections, even though 69% of THA in the 12-hour group were performed during the evening and night hours.

Low mortality rates as well as other complications registered, which are generally atypical of hip fractures, could be explained by patient selection and low ASA scores. Since the patients in both groups did not require prolonged comorbidities correction, burden of comorbidities which is typical for hip fractures, did not influence the delay. We may assume that differences in functional outcome and hospital stay were not caused by the presence or absence of comorbidities, but by the delay itself.

In line with previous reports, we found direct association between surgical delay and length of hospital stay and functional outcome. There was no significant statistical difference in mortality and complications between the two groups, but when it comes to mortality, the inspection of survival function gives a slight advantage to the group of patients who were operated on within less than 12 hours of admission, and the difference in infections, deep vein thrombosis

and pulmonary embolism was on the verge of statistical significance in favor of early surgery.

Limitations

The number of patients enrolled in this study is lower than in other papers dealing with hip fractures. Therefore, it limits the accuracy and statistical power of the study. Narrowing the criteria for enrollment enabled the homogeneity but also reduced the number of patients in both groups. Power analysis revealed that sample sizes of both groups should have been larger (317 patients in each group) at the given probability of type I error of 0.05 and probability of type II error of 0.2 for the recorded mortality rate of 2.44%, to show a statistically significant difference between the two groups. Even though the study might be underpowered to demonstrate a significant difference in mortality and complication rates, it shows that early surgery may have a positive effect on functional outcome and length of hospital stay.

Conclusion

THA for FNF as an urgently performed procedure is not a widely accepted concept. The literature on the subject is consequently insufficient and without clear evidence to support or challenge the fast track approach.

Our findings indicate that immediate operative treatment, THA for FNF, is not associated with worse outcomes, and our results give an advantage to the policy of early THA for FNF in ASA 1 and 2 patients. Standardization efforts towards optimal outcomes of FNF, besides pre- and postoperative management, surgical approach and choice of implants, should consider the concept of early surgery in appropriately selected THA for FNF cases.

Conflict of interest statement

Each author certifies that he has no commercial associations (e.g., consultancies, stockownership, equity interest, patent/licensing arrangements, etc.) that might pose the conflict of interest regarding the submitted article.

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