



Early results of long stem bipolar cementless hemiarthroplasty for the treatment of unstable intertrochanteric fractures in elderly patients

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General Note

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ABSTRACT

Aims and objectives: The study aimed to evaluate the early results of long stem bipolar cementless hemiarthroplasty for the treatment of unstable intertrochanteric fractures in senior patients and functional rehabilitation after surgery. *Methodology:* This

prospective research included 68 intertrochanteric fracture patients aged over 75 years, with type A2 and A3.3 of AO foundation classification (Arbeitsgemeinschaft für Osteosynthesefragen), treated with long stem bipolar cementless hemiarthroplasty at the 7A Military Hospital from Jan 2016 to October 2019. Studied patients were monitored and evaluated for three months after the operation. *Results:* The average age of the patients was 84 ± 9 years. There were 22 male and 45 female patients. Domestic accidents accounted for all cases. Two cases had surgical wound infection with retentive mucus; in one case, the femoral stem pierced the bone cortex, and two cases had ruptured fixation steel suture, one case had pierced cortical bone caused by the femoral stem. No case resulted in death within the postoperative three months. Remarkably, 56/58 cases (82.4%) had soon resume walking (postoperative day fourth – day seventh). Functional rehabilitation results (based on Modified Harris scale) were “very good” and “good” in 89.4% cases, “average” in 8.8% cases, and “poor” in 1.8% cases. *Discussion:* Long stem bipolar hip replacement was found to be suitable to treat intertrochanteric fractures in the elderly as it provided fast rehabilitation. Modified Handinger incision approach and various fixation techniques such as steel cord and stem installment were discussed and proved to be effective. MHHS showed advantages to be used in Vietnam conditions. *Conclusion:* Long stem bipolar cementless hemiarthroplasty for the treatment of unstable intertrochanteric fractures in the elderly was shown to result in good outcomes. The treatment enabled walking and muscular rehabilitation in the patients, enabled the patients to resume daily activities quickly, reduced care burden, and promoted life quality for the patients.

Keywords: Hemiarthroplasty; Intertrochanteric fractures; Rehabilitation; Elderly.

1. INTRODUCTION

Femoral neck fractures account for 1/5 of total bone fractures in the elderly due to trauma such as falling on hard surfaces and as a direct result of osteoporosis, especially in older women. Patients with femoral neck fractures usually have to stay longer in bed and are susceptible to complications such as pneumonia, urinary tract infections, embolism, ulcers, mental breakdown, and decreased quality of life. These complications are the leading cause of mortality in the first year after trauma. The mortality rate is approximately 25% in the first year due to insufficient or ineffective femoral neck fracture treatments (Kiran-Kumar et al., 2013; and Celktas et al., 2015). Intertrochanteric fracture is the most common type of osteoporotic hip fractures that cause the highest morbidity, mortality, and disability rates (Poole et al., 2017). Until now, early surgery (within 24–48 hours post-trauma) is still the most optimal treatment for quick functional rehabilitation and to reduce fatality risks and complications due to prolonged bed confinement such as pneumonia or compressive lesion (Choy et al., 2010)

In elderly patients, preservative treatments can only be used for cases with little displacement fractures and for patients who are too frail and have too many combined chronic diseases to withstand an operation (Harwin et al., 1990). Internal bone fusion (using dynamic hip screw-DHS, locking screws, or Gamma nails) also helps in bone fixation and pain remedy. However, this method has certain disadvantages, such as prolonged bed confinement, slow walking rehabilitation, and bone union, and frequent apparatus loosening because of osteoporosis. Moreover, under increasing life quality nowadays, it is even more essential to quicken rehabilitation and cut down burden in care (Kayali et al., 2006; Sinno et al., 2020). Long stem hip replacement is a suitable option to meet these demands as it enables quick and immediate muscle power recovery and walking rehabilitation and curtails care burden, which bone fusion is unable to satisfy completely (Wolfgang et al., 1982 and Haidukewych et al., 2001).

Hip replacement surgery has been developed since 1946 by Sir J. Charnley và R. Judet. Total hip arthroplasty is a surgery when the femoral head is removed and replaced by a hip prosthesis with metal or ceramic femoral head and a stem set in the femur. The acetabulum is also replaced with an artificial socket. In hemiarthroplasty, only the femoral head is replaced. The unipolar prosthesis has a one-piece design, where the artificial head contact directly with the acetabulum when the hip moves. In bipolar prosthesis, there is an additional artificial joint between the head and the stem, eliminating the contact when moving, reducing pain, and the long-term wear-and-tear (While et al., 1987; Kim et al., 2005; De Farncce et al., 2019). There are four groups of incision approaches in hip arthroplasty: posterior approach (54%), direct lateral approach (37%), anterior lateral approach (3%), and incision through greater trochanter (1%). The direct lateral approach was described for the first time in 1903, then modified by McFarland and Osborne in 1954, and by Hardinge in 1982 (Hardinge, 1982; Khan et al., 2007; Vincent et al., 2017).

Direct lateral incisions are the second most popular approach after posterior incisions. In Vietnam, the posterior approach is mainly used. In this study, we use the modified Hardinge direct lateral approach. The 7A Military Hospital is among the medical center in Ho Chi Minh city, Vietnam, which applied most of the hip replacement technology and breakthroughs yielding positive results; such operations have become daily affairs. This study is aimed to evaluate early surgical outcomes and post-operative functional rehabilitation to assess the effectiveness of the treatment in elderly patients.

2. METHODOLOGY

Subject, time and place of the research

The study was carried out on 68 patients aged over 75, had unstable intertrochanteric fractures type A2 and A3.3 (AO classification), treated with cementless long stem bipolar hemiarthroplasty at the 7A Military Hospital, Ho Chi Minh City, Viet Nam, from Jan 2016 to October 2019.

Selected patients were over 75 years of age, having osteoporosis but good pre-fracture walking conditions; already failed in bone fusion treatment, and meeting requirements for surgery according to the regulations ASA 1,2,3 of American Society of Anesthesiologists (ASA) (Khan & Knowles, 2007; Vincent et al., 2017).

Excluded patients were those had stable fractures which were more favorable for bone fusion, had inflammation at the hip or other locations, had pre-fracture mental issues, Alzheimer's disease or incapacitation, ASA level 4 or above; younger patients with good skeletal conditions and narrow medullary channel (White et al., 1987) intertrochanteric fractures at.

Study design

The study had a prospective research design. The patients all went through the conventional procedures: disease selection, pre-operative examinations, radiograph combined with CT-Scanning (if required), surgical operation, post-operative care, functional rehabilitation, scheduled re-examinations with radiography, data analysis according to study objectives. Short-term outcomes and complications within three months after surgery were monitored and evaluated based on the Modified Harris Hip Score (MHHS). MHHS based on the standard Harris Hip Score (HHS), which considered a valid and standard tool for evaluating hip replacement outcomes. MHHS has the same questionnaires as HHS but excludes the clinical examination part, which is regarded as not important and exposing to observers bias (Wamper et al., 2010). In our study, MHHS has four levels: Very good (81-91), Good (71-80), Average (61-70), and Poor (<61).

Techniques: Modified Hardinge incisions and surgical stages

Anesthesia: Spinal anesthesia/analgesia.

Administration of pre-incision epidermic preventive antibiotics

The patients were lying on their side with supports at the front side of the pubic bone and the backside of the coccyx. Then made an incision at the outer side of the thigh 4cm above the greater trochanter apex to 5-7cm below the greater trochanter apex. The incision could be longer if needed. Cut open the fascia lata and gluteus maximus to expose the gluteus medius. Dissected the frontal 1/3 of gluteus medius from the attachment site in the greater trochanter, the move back to the joint capsule, which closely approached the periosteum to expose the femoral head. Dissected the femoral neck to remove the head, but kept the other broken parts – including the calcar femoral – as much as possible. Rotate the operated limbs to the cross-leg posture with perpendicular knee bending, then fashioned the femoral medullary canal for the installment of the prosthetic stem using a specialized drill. Before installment, wound the steel suture cord twice around the femoral shaft to prevent cracking.

The used prosthetic part was cementless Wagner Cone Prosthesis Long Hip Stem (Zimmer®). Installed the stem inside the bone, fixed the femoral calcar and femoral proximal parts in case of large fractures. Installed the prosthetic head and relocated the joint. Fixed the greater trochanter to the femoral proximal end by winding twice (8-shaped) the steel cord as a compressive clamp, and then reinforced the site with FiberWire® suture already threaded before into the top open end of the prosthetic stem. Examined the hip joint motion postures. Carefully cleaned the sites, stopped the bleeding, and installed a drainage tube if needed. Closed the joint capsule, re-fixed the gluteus medius – greater trochanter attachments, and properly closed the surgical cuts. All the patients were administered with a postoperative coagulant (Pradaxa 75mg x 2 tablets/day).

Data analysis

Data were collected using a predesigned questionnaire form. We used SPSS 16.0 software to analyze the data description and tabulated to conclude.

Ethical declaration

The patients and their relatives were explained clearly about their illness and the treatment procedures. They were asked to take part in the study, and they volunteered to sign the participant agreement. Medicine Scientific Research Ethics Committee of the 7A Military Hospital approved this study (Number: 013/QĐ-HĐYĐ-BV7A, date: 29.01.2016)

3. RESULTS

Patient ages and sexes

The minimal age was 75, and maximal was 98, the average age was 84 ± 9 . There were 46 female patients and 22 males.

Causes

All patients got fractures from falling and domestic accidents.

Time from fractures to surgery

Fifty-six patients (82.4%) had surgery early, within three days after fractures, after having blood and electrolyte supplement, preventive shock therapy, and other pre-operative conventional procedures. Nine patients (13.2%) were operated from 72h to 1 week, and three patients (4.4%) had even later surgery after one week. Late surgery cases usually had ASA3 accompanying diseases, late hospital admission, and usually suffered from post-operative complications such as pneumonia, asthenia, required intensive internal care to stabilize accompanying conditions, and had slow rehabilitation.

Average hospital stay

The average hospital stay was 12 days.

Blood transfusion

The amount of blood transfused in most cases was 250 – 750ml (60 patients, 88.2%) before and during operation since most patients had anemia or pre-operative hemorrhage at fracture sites.

Hip replacement positions

Replacement of one hip (either left or right) occurred in 95.6% of the cases. Three cases required replacement of both but not concurrently since fractures happened in different instances.

Operation temporal length

Operation length was measured from the first incision to the final skin suturing. The shortest operation time was 45 minutes, and the longest one was 120 minutes. The average time was 75 ± 15 minutes.

Accompanying diseases

All patients had heart sonography, and ejection fraction (EF) of at least 55% was required. ASA classification was used as a criterion. Common accompanying illnesses were cardiovascular diseases (22 patients, accounting for 32.4%), endocrine diseases (18 patients, 26.5%), hepatic and renal diseases (5 patients, 7.3%), and chronic lung diseases (23 patients, 33.8%).

Early postoperative outcomes

Post-operative Joint Motion

The post-operative joint motion was significantly improved in all cases, and all patients were satisfied with the outcome. As blood dynamic was stabilized after surgery, postural drainage, breathing exercises, and light in-bed exercises were carried out.

Post-Operative Walking Rehabilitation

Early resume of walking (day 4 – day 7 after surgery) happened in 56/68 patients (82.4%). Ten patients (14.7%) started walking later from 7 days to 3 weeks and two patients (2.9%) resumed walking capability later than 3 post-operative weeks because of accompanying illnesses, late hospital admission, poor physical conditions, and surgical wound infection. Bone cracking complication cases also had the slower resume of walking. Figure 1 showed a case of femoral neck fractures before and after surgery.

Surgical Complications

Two cases (2.9%) had femoral proximal cracks, which were easy to take place due to the thin bone cortex; nonetheless, the issue was not severe since the bone was already reinforced by the steel cord winding around. In one case (1.5%), the femoral stem pierced the bone cortex, maybe due to errors of canal fashioning, C-arm examining. Sub-stem cracks occurred in two cases (2.9%), during the joint fixation procedures of surgery which was C-arm examined during operation. Bone was fused using locking screws together with many steel cord windings around femoral proximal parts, one screw per cortex (see Figure 2).

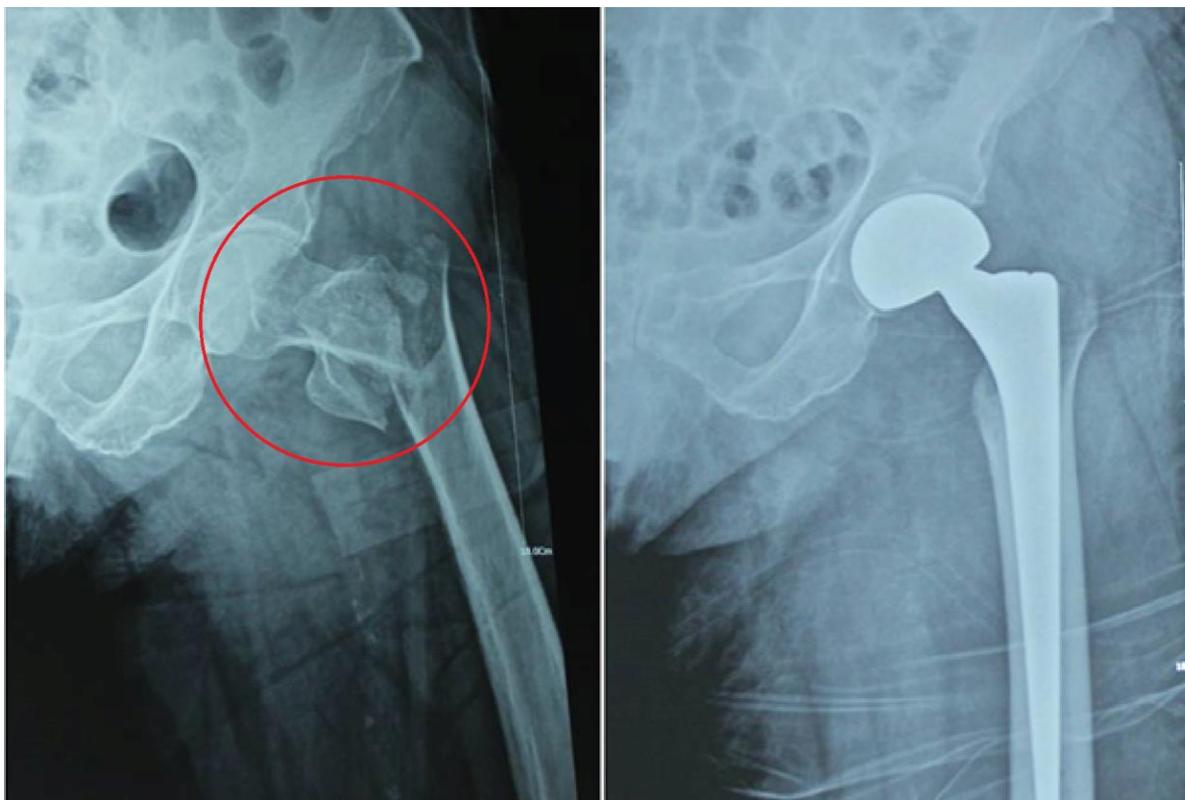


Figure 1 A Femoral neck fracture case in a female 93 year old patient: before (red circle – left) and after the surgery (right).



Figure 2 A case of a 75-year-old patient having bone crack reinforced with steel cord.

The surgical wound 66 cases (97.1%) healed well with no infection. Two cases (2.9%) had infected wound with leaked mucus and burst steel cord. Treatment required twice debridement with vacuum-assisted closure (VAC) and another operation to fix the steel cord. The two patients were hospitalized in three weeks and one month then stabilized. Pre-and post-operative psychosis was

observed at 13 patients (19.1%) and was collectively treated with Aminazin, resulted in stabilization. The cause probably was blood loss before surgery and a high level of pain.

Results 3 months after surgery

We could only follow up on 57 cases over 68 cases. Amongst the 57 re-examined patients, 45 patients (78.9%) resumed walking without a cane, seven patients (12.3%) required canes, four patients (7.0%) could walk short distances but still had to rely mainly on the wheel chair, and one patient (1.8%) could still not walk and required wheel chair or was confined in bed.

The post-operative burst of steel cord at the greater trochanter happened in 5 cases (8.8%), as the patients tended to lie on the side of the healthy limb and crossed the wounded limb over, which overstretched the gluteal muscles attached to the greater trochanter. Joint dislocation, coupled with steel cord burst occurred in 2 cases (3.5%), required surgery for relocation and reinforced of the more significant trochanter attachment sites. Surgical outcomes based on MHHS were 43 patients with Very Good scores (75.4%), eight patients with Good scores (14.0%), five patients with Average scores (8.8%), and one patient with Poor scores (1.8%).

4. DISCUSSION

Pain management is an essential factor, and it enables quick walking rehabilitation and recovery and minimizes post-operative complications. Quick walking resumption is a crucial mental factor that keeps an optimistic mood and promotes recovery for the patients. Physical health improvement (supplement of carbohydrates, proteins, electrolytes) helps in fast recovery. Long stem hip replacement for the treatment of intertrochanteric fractures meets the demand of fast rehabilitation, as in this study, 82.4% of the patients resumed their walking ability within one week after surgery, a high rate compared with other methods, for example, DHS or Gamma nails which required one month for such outcome. This result was observed in the studies of Kayali et al. (2006); and Sinno et al. (2010). Internal diseases took part in late admission or prolonged bed confinement (>1 week) cases, with ASA level 3 and required stabilizing treatment with internal medicine.

In the case of long-stem hip replacement for intertrochanteric fractures, modified Hardinge incision is very useful in trochanteric, and calcar fixation enables convenient manipulation of the broken parts. This method was used by most of the foreign authors (White et al., 1987; Wolfgang et al., 1982; Goyal et al., 2016 and DeFrance et al., 2019). For the surgical strategy, the objective is the stabilization of implanted prosthetic hip since an unstable implant leads to worse results. Stable implant enables quick walking resumption and prevents complications caused by bed confinement. Fundamental requirements of the surgery include tight and stable prosthesis installment without breaking the bone and proper fixation of the greater trochanter (gluteal muscle complex) to the femoral proximal end. All of which require practical experiences.

For surgical techniques, fixation of the greater trochanter to the femoral shaft is critical in quick walking rehabilitation and prevention of later dislocation. For the local condition in this study, it was convenient to reinforce the femoral shaft and calcar by using the 8-shaped twice windings of the steel cord, but the cord was also prone to bursting thus requires further reinforcement with FiberWire® suture threaded into the top open end of the prosthetic stem. The patients should even not lie down on the side of the healthy limb and cross the treated limb over during the first two months after surgery to avoid overstressing the gluteal muscles, prevent bursting of the steel cord, and promote fusion of the fractured parts into the femoral bone. Canal fashioning and stem installment should be careful and required experiences to avoid bone cracking as senior patients had a poor bone quality and suffered from osteoporosis. According to experiences twice windings of steel cord below the lesser trochanter is a safe choice and it also serves as temporary stitches for later 8-shaped clamping of the greater trochanter. It was convenient to thread the cord around the femoral shaft, and the trochanteric complex thanked the improved cord hooks of different sizes.

This kind of surgery had several advantages: operation time was not much longer than standard bone fusion; incision wound was not excessively long, required few dissections of the muscles, and enabled quick exposure of the joint and all the fractured parts when needed. The patients could resume walking several days after the operation and recovered full pre-operative muscular power. It also prevented prolonged bed confinement complications such as compressive lesions, pneumonia, or surfacing of chronic illnesses. Quick walking resumption was beneficial for patients mental, and it brought good moods. The surgery also satisfied the needs of increasing life quality for patients and relatives and decreased the family's burden of patient care.

In our opinion, the Modified Hardinge incision is suitable for hip replacement both in simple or difficult cases, convenient in trochanteric complex and calcar fixation for unstable intertrochanteric fractures. The incision has the advantages of quick performance, limited blood loss, and post-operational dislocation; it enables quick rehabilitation and a good range of motion and can open or easily manipulate the fractured parts. According to the literature, however, this incision may risk damaging the superior gluteal nerve and weakening limb muscles, which was not seen in this study, though (Tyler et al., 2012; Goyal et al., 2016; Aavikko et al., 2018). For functional evaluation based on Modified Harris score, 89.4% of the patients get "good" and "very good" outcomes and

compatible with some study in Vietnam, which was 82.6% (Dong et al., 2019) and from other countries, which was 79.5% (Sinno et al., 2010).

By choosing MHHS instead of HHS, we found it to be more advantaged. Although having the clinical examination part excluded, MHHS was reported to have a strong correlation with HHS (Kumar et al., 2019) and recommended to be used for hip replacement assessment (Gupta et al., 2018). The MHHS is more straightforward and can be done by nurses or technicians without taking up time from doctors for physical examination, which is, in our opinion, a clear advantage for the Viet Nam situation, as our hospitals are always crowded and work for doctors are always overloaded.

The study had some limitations. The short following up time (only 3 months) could not properly present the long term recovering of patients, especially for the elderly where recovering rate is low. The study did not compare the long stem bipolar cementless hemiarthroplasty with other treatment approaches such as short stem hemiarthroplasty, total hip replacement, internal fixations. These comparisons would be topics for our group in the future.

5. CONCLUSION

Long stem bipolar hemiarthroplasty for the treatment of unstable intertrochanteric fractures in the elderly was shown to result in good outcomes. It enabled the quick resumption of daily activities, full restoration of pre-operative muscular power, reduced prolonged bed confinement complications, and care burden on family and society. Hence it helped raise the life quality for elderly patients and their relatives.

List of abbreviation

A/O Foundation:	Arbeitsgemeinschaft für Osteosynthesefragen;
ASA:	American Society of Anesthesiologists;
DHS:	Dynamic Hip Screw;
EF:	Ejection Fraction;
HHS:	Harris Hip Score;
MHHS:	Modified Harris Hip Score;
VAC:	Vacuum-Assisted Closure.

DECLARATION

Scientific Responsibility Statement: The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement: All procedures performed in this study 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.

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