



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

International Journal of Current Research
Vol. 15, Issue, 04, pp.24337-243341, April, 2023
DOI: <https://doi.org/10.24941/ijcr.45022.04.2023>

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

RESEARCH ARTICLE

ELDERLY NECK FEMUR FRACTURE MANAGEMENT USING HA COATED BIPOLAR PROSTHESIS

¹Dr. Harishankar Meena, ^{2,*}Dr. Sachin Kumar Pachori, ³Dr. Rupendra Singh and ⁴Dr. Saksham Sharma

¹Senior Resident, Department of Orthopaedics, SN Medical College, Jodhpur

²Senior Resident, Department of Orthopaedics, SJP Medical College, Bharatpur

³Post Graduate Resident, Department of Orthopaedics, GMC, Kota

⁴Assistant Professor, Department of Orthopaedics, SJP Medical College, Bharatpur

ARTICLE INFO

Article History:

Received 04th January, 2023
Received in revised form
10th February, 2023
Accepted 16th March, 2023
Published online 25th April, 2023

Key words:

HA Coated, Bipolar,
Elderly Neck Femur Fracture

*Corresponding Author:

Dr Sachin Kumar pachori

ABSTRACT

Elderly neck femur fractures are usually managed by hemiarthroplasty around the globe, the question arises about the implant to be used. The general consensus is in favor of bipolar prosthesis, the conventional prosthesis are to be used with bone cement and bone cement insertion is met with a lot of intra operative complications and difficulties. This prospective study was done to ascertain the outcomes of elderly fracture neck femur managed using hydroxy appetite coated uncemented bipolar prosthesis in terms of pain, mobility and intra operative complications encountered

Copyright©2023, Harishankar Meena et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Dr. Harishankar Meena, Dr. Sachin Kumar Pachori, Dr. Rupendra Singh and Dr. Saksham Sharma. 2023. "Elderly neck femur fracture management using HA coated Bipolar Prosthesis". *International Journal of Current Research*, 15, (04), 24337-243341.

INTRODUCTION

Femoral neck fractures, one of the most common injuries in the elderly. The prevalence of these fractures has increased with improvement in life expectancy, increased incidence of osteoporosis, poor vision, neuro-muscular in coordination and changes in lifestyle leading to sedentary habits. The incidence of these fractures are expected to double in the next twenty years and triple by the year 2050¹. Despite of marked improvements in implant design, surgical technique and patients care, hip fractures consume a potential proportion of our health care resources². As life expectancy increases and the mean age of society shifts progressively towards the geriatric age category and the incidence of hip fractures will rise accordingly. In elderly population and approximately 90% of these injuries are the result of simple fall from standing position. It has been observed that age specific incidence of hip fracture doubles every 5 - 6 years after the age 30 in women reaching 18 fractures per 1000 per year in women over 85³. Limited and unprotected blood supply to the femoral head, the intracapsular location and severe trabecular atrophy of femoral neck are the factors that inhibit fracture healing and leads to osteonecrosis and late segmental collapse of femoral head⁴. In Elderly patients, prolonged recumbency leads to many problems such as bed sores, cardiac and respiratory problem, thromboembolism, renal problems and dementia.

This led many surgeons to abandon the native treatment of immobilization and osteosynthesis procedure for displaced femoral neck fracture in elderly patients, in favor of primary hemi replacement arthroplasty, which has certain advantages such as early ambulation, shortening the period of hospitalization and also avoids danger of non-union and avascular necrosis This forces one to totally abandon the complete immobilization to achieve a bony union, or to resort early ambulatory procedures by surgery⁵. The hip is a weight bearing joint and has to perform many functions. An operation at the hip joint should aim to provide painless, stable hip with wide range of movements. But none of the accepted procedures have been able to achieve this goal. The patient also needs to go through in many multiple surgical procedures and a prolonged rehabilitation in order to preserve his original joint. The introduction of a single piece unipolar metal prosthesis by Thompson in 1954 and Austin Moore in 1957, to replace the femoral head in the era of hemiarthroplasty of the hip as a management for these fractures. Experience of the last four decades has shown that hip arthroplasty is the best treatment for intracapsular fracture neck of femur in elderly in Term of both short-term and long-term results⁶. Currently, surgeons can decide between unipolar hemiarthroplasty, bipolar hemiarthroplasty and total hip arthroplasty in the treatment of intracapsular fractures of the neck of femur in the elderly⁷. The problems encountered with unipolar prostheses (Austin Moore's Prosthesis and Thomson's Prosthesis) were acetabular erosion and loosening of stem giving rise to pain. Bateman in 1974

introduced the Bipolar prosthesis (initially popular as the Bateman's prosthesis) which had mobile head element and had additional head surface to allow movement within the acetabulum. This led to reduced wear of acetabular surface and hence reduced incidence of pain and acetabular protrusion because motion is present between the metal head and the polyethylene socket (inner bearing) as well as between the metallic head and acetabulum (outerbearing)⁸. Initially the Bipolar prostheses were of non-modular design followed presently by the modular prostheses. The modular nature of the prosthesis allows for neck length adjustment with interchangeable stems. Future conversion to a total hip replacement is easier with a modular prosthesis because only the acetabular component needs to be added. Hemireplacementarthroplasty by using vitallium or stainless steel was popularly practiced by Austin Moore's produced fair results⁹. But it had its limitations in loosening and reactions at acetabulum etc. Many of the shortcomings of this procedure were overcome by a new type of prosthesis, which had the advantage of second joint, below the acetabulum. It was named as bipolar prosthesis, since it had an outer head of metal which articulates with the acetabulum and a second inner small metallic head which articulates with the high density polyethylene (HDPE), lining the inner surface of the outer head. This results were found to be encouraging¹⁰. With the superiority of prosthetic replacement over internal fixation in elderly being well established, primary Total Hip Replacement (THR) is being offered at many centres as a treatment option for these fractures. Total hip arthroplasty is still not popular as a treatment modality for fracture neck of femur in our country because majority of the patients do well with hemiarthroplasty and also due to the high costs involved¹¹. Bipolar hemiarthroplasty thus appears to be the best option for acute fracture neck femur in the elderly in our population. However, not much literature is available about its long term results. Some authorities have also expressed a doubt regarding the degree of inner bearing motion on long term use, thus putting into doubt its effectiveness¹².

However Osteoporotic bone in elderly makes it difficult for the prosthesis to hold in cementless prosthesis and increases the incidence of complication like periprosthetic fracture.¹³ However modern hydroxyapatite coated stems have made use of cementless hemiarthroplasty possible even in weaker osteoporotic bones¹⁴. Cemented hemiarthroplasty has been preferred by many because of good initial fixation, low risk of fracture however, the disadvantage of cementation are the risk of pulmonary embolism & longer duration of surgery¹⁵. The use of uncemented femoral components are associated with an increased risk of intraoperatively femoral fractures and the risk of potentially compromised implant fixation in elderly hip fracture, patients with poor bone quality. The coating of modern femoral stem designs with HA has proven successful in THA with good clinical results, osseous integration & long term survivorship¹⁶. Although HA is known to enhance fixation of an implant with potential benefits in elderly patients. It remains to be seen if these benefits in patients with osteoarthritis also apply to elderly patients with DFNF and osteoporosis. Few studies have explored the clinical and radiographic outcome of modern HA coated hemiarthroplasties for treatment of displaced fracture of neck femur¹⁷. Hydroxyapatite (HAp) materials have drawn great interest from researchers because they are widely applied as biomedical materials, including such uses as bone fillers, bone tissue engineering scaffolds, bioactive coatings, soft tissue repairs because of their excellent biocompatibility, osteoconductive properties, and similarity to the inorganic component of human bones¹⁸. This clinical study presents the short term results of prospective study of hemiarthroplasty for the treatment of displaced femoral neck fractures in the elderly. Outcomes at 6 weeks, 3 months and 6 months were analyzed by modified Harris hip scoring system.

AIMS AND OBJECTIVES

- To study the functional outcome of Intracapsular fracture of femoral neck with Hydroxyapatite Coated Uncemented Bipolar Prosthesis in Elderly.
- To study the end results of Bipolar prosthesis with respect to pain, mobility and stability.
- To study the complications of Bipolar hemiarthroplasty

MATERIALS AND METHODS

SELECTION OF CASES

30 cases of intracapsular fracture neck of femur were included in this study.

INCLUSION CRITERIA

- Displacement fractures of the intracapsular part of the femoral neck.
- Age of patient ≥ 60 years.
- Failed internal fixation.
- Avascular necrosis of femoral head secondary to fracture of the femoral neck.
- Door's A & B with good bone stock⁹³.

EXCLUSION CRITERIA

- Patients below 60 years.
- Patients with arthritic changes involving the acetabulum.
- Pathological fractures
- Patients not willing for surgery
- Patient medically unfit for surgery
- Door's C with poor bone stock⁹³

SURGICAL PROCEDURE

All cases were done under regional anaesthesia which included spinal or epidural anaesthesia. The choice of the anaesthesia was according to the discretion of the anaesthetist

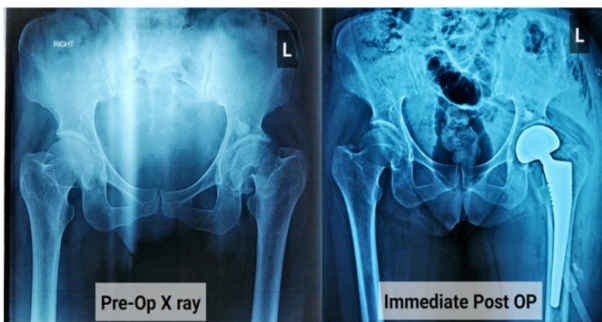
Surgical Approach – Southern & Moore Posterior Approach to the hip¹⁹: After induction of either spinal or epidural anaesthesia the patient was placed on the lateral position on the operative table with the affected side facing up. The PA incision starts approximately 5 cm distal to greater trochanter (GT) at the lateral center of the femoral diaphysis. It continues proximally along the posterior border of GT and then curves toward the posterior superior iliac spine for another 5–7 cm. The skin and subcutaneous fat are incised down to the fascia lata and iliotibial band (ITB). The fascia lata and Iliotibial band are incised longitudinally and proximally to split along the fibers of gluteus maximus. A Charnley retractor can be placed to hold retraction of the split gluteus maximus. Deep dissection proceeds with hip internal rotation and identification of piriformis and the other short external rotators (SERs). SER are then detached from GT close to their insertion. They are reflected posteriorly with stay sutures to both protect the nearby sciatic nerve and expose the posterior hip capsule. Anterior and superior part of joint capsule can now be seen. The capsule is incised by a T-shaped incision, and the hip flexed, adducted and internally rotated to dislocate the hip joint. Using a head extractor and bone levers, head is delivered out of the acetabulum and the acetabulum is cleared of debris. The size of the extracted head is measured by using measuring gauze, and the size of prosthesis is selected.

Insertion of the bipolar prosthesis: The appropriate sized prosthesis is inserted into the unreamed canal by using boxchisel. Taking care to place it in 10-15 degree of anteversion. The final seating of the prosthesis is by gentle blows with the help of a mallet and the insertor. Adequate seating of the prosthesis on the calcar is visualized directly. The hip joint is reduced by gentle traction with external rotation of the hip and simultaneous manipulation of the head of the prosthesis into the acetabulum. The range of movement in all directions is checked by taking the joint through the whole range of movements. The stability of the prosthesis and its tendency to dislocate is checked by flexing and adducting the hip. The limb is kept in slight abduction and external rotation for suturing the wound. Great care is taken to achieve adequate closure of the posterior capsule and anatomical reattachment of the short external rotators. The rest of the wound is closed in layers over a suction drain placed beneath the gluteus maximus. Haemostasis is maintained throughout the procedure.

POSTOPERATIVE PROTOCOL: All the patients who were operated were kept in supine position with the involved lower limb in 20-30degree abduction. Adequate analgesics, IV antibiotics will be given upto 5th post operative day. After IV antibiotics oral antibiotics will be administered till removal of sutures. Drain will be removed at end of 24 hours. Post OP check X-rays will be obtained. Patient was Seated on bed and Static quadriceps exercises started from 2nd day. Mobilization with a walker was started between third and seventh post-operative day. Patients were initially advised toe-touch weight bearing, partial weight bearing and later advised progress to full weight bearing as tolerated. Sutures will be removed on 12th -15th post operative day. The study patients were discharged after 5th day or stitch removal.

FOLLOW UP: Regular follow up of all cases was done at 6 weeks, 3 months, 6 months, 9 months and one year. At each follow up patients were evaluated clinically using the Harris Hip Score and radiologically with appropriate X-rays.

ILLUSTRATION



PRE-OP X RAY

IMMEDIATE POST-OP



3 MONTH FOLLOW UP



6 MONTH FOLLOW UP



9 month Follow up



CLINICAL PICTURE

DISCUSSION

The aim of replacement surgery in fracture neck femur is early return to daily activities. This is particularly applicable to the elderly age group where complications need to be prevented.

Age Distribution: The mean age of the patients in the present study was 70 years. The aim of assessing age is to estimate the patient’s mean survival time and their ability to comply with rehabilitation protocol. Patients with hip fractures have an increased mortality rate during the first year after fracture but after one year the mortality rate is comparable to that of the general population. Similar age distribution has been reported by Venkateswara & Ashok (2015) 65.3years, Srinivasan & pugazhendhi (2018) 67.52years, Sharanprasad & pattanshetty (2018) 63.9 years, Zahid & Zubair (2020) 67.63 years and Rather & Mosvi (2021) 72.4 years. The results of our study showed that age of the patient had minimal influence on the final clinical result.

Sex Incidence: In our study the intracapsular fracture of femoral neck were found to be more common in females . Female preponderance has been reported in several studies Venkateswara & Ashok (2015) 63.64%, Srinivasan & pugazhendhi (2018) 64%, Zahid & Zubair (2020)60% and Rather & Mosvi (2021)¹¹ 63.3%. In our study 60% of the patients were females.

Side of Fracture: Left side is more affected than right in our study. Similar results were observed in several studies. Venkateswara & Ashok (2015) reported 54.55% fractures on left side. D’Arcy and Devas reported 55.4% fracture in left side. In our study 63.33% of patients had left side fractures.

Type of fracture: Depending on the anteroposterior radiographic view available they were grouped into transcervical, basicervical and subcapital type. In our study 86.66% patients transcervical fracture and 10% had basicervical type of fracture. All the fracture in our study belonged to displaced fractures of Garden Type I, II, III & IV Fractures. There were 8 (26.66%) Garden’s type III fracture and 18 (60%) Garden’s type IV Fracture. Similar observations made by other studies. Venkateswara & Ashok (2015) had 36.36% type III & 63.64% type IV garden fracture, Sharanprasad & pattanshetty (2018) had type III 66% & 18% type IV Garden Fracture, Rather & Mosvi (2021) had type III 43.33% & type IV 56.66%.

Mode of Injury: Majority of our study patients (70%) sustained the injury due to a trivial trauma like tripping or slipping. This is a very common occurrence in elderly population where poor vision and lack of neuro-muscular coordination is a problem.

Most of such injuries can be classified as “indirect” trauma. four patients (13.33%) sustained the injury due to a fall from a height and five (16.66%) patients due to a Road Traffic Accident. This is in accordance with majority of the studies reported Venkateswara & Ashok (2015) had trivial trauma 86.36%, Srinivasan & pugazhendhi (2018) had trivial trauma 84% and Sharanprasad & pattanashetty (2018) had trivial trauma 75.8%.

Associated Medical Problems: Hypertension was found to be the most common co-morbidity seen in 26.66% of the study patients. All patients had hypertension and were on oral anti-hypertension agents. The other co-morbid conditions seen in the order of frequency were diabetes (23.33%) and heart diseases (13.33%), COPD (16.66%), ipsilateral knee osteoarthritis (13.33%) and chronic kidney disease (6.66%). It was observed that the post-operative rehabilitation of patients was significantly affected by the presence of the above co-morbidities. Our study had similar co morbid medical conditions as compared to other studies of Sharanprasad & pattanashetty (2018) HTN 18.2%, DM 12.1% and Hinchey and Day HTN 26.5%, DM 13.26%.

Type of prosthesis: We have used the HA Coated Uncemented Bipolar Hemiarthroplasty technique in all of our cases. All patients were operated after being put into lateral decubitus position by the posterior approach of Moore. Some studies showed better clinical ratings with uncemented bipolar than cemented bipolar. The peri-operative variables like duration of surgery, amount of blood loss, length of hospital stay and postoperative complications (DVT, chest infection, mortality) were found to be less in the uncemented prosthesis group. The size of prosthesis commonly used was 41mm & 53mm for female and 45mm & 47mm for male cases.. The rasps used for broaching the canal were part of the instrumentation that came with the prosthesis. The advantage was that the rasp corresponded to the exact length and width of the prosthesis which prevented any additional rasping of the canal and subsequent loose seating of the prosthesis. All the prostheses were inserted by press fit technique and did not require any additional augmentation with cement. Technical difficulties encountered with the procedure were most often related to the operating surgeons’ learning curve. The main difficulty faced was calculating the angle of the neck osteotomy which in the case of the bipolar prosthesis was more vertical as compared to the traditional Austin Moore’s Prosthesis. This resulted in poor seating of the prosthesis collar on the neck and calcar. The second difficulty encountered was miscalculation of the amount of neck to be resected. Inadequate resection of the neck resulted in the prosthesis sitting proud of the calcar and subsequent limb lengthening in some cases.

Time to presentation after Injury: A little more than half of our study patients were brought to the hospital within three days of sustaining the injury. 26.66% presented within 24 hours, 30% presented between 24 hrs - 72 hrs, 30% presented between 72 hrs– 1 wk and 13.33% patients presented after a delay of 1 week.

Duration of Hospital Stay: The minimum duration of hospital stay amongst the study patients was 7 days and maximum duration was 24 days with the average being 13.8 days. This is in accordance with the studies of Marya & Thukral (2011) average day 11.9 days, Bloomfield R et al (2007) 21 average day 11.4 days and Zahid & Zubair (2020) average day 13.7 days.

Blood Loss: The average blood loss was 300 ml (Range 150 – 450 ml). These findings are comparable to the findings of Blomfield R et al (2007) and Zahid & Zubair et al (2020). It has been reported in literature that the average blood loss with hip hemiarthroplasty is less in the anterior approach as compared to the posterior approach. Most of the surgeries were completed between 30-45 minutes of starting the procedure. Neither the intra- operative blood loss nor the duration of the procedure had any effect on final function.

Complications: The complications following the hemiarthroplasty for fracture neck of femur is reported in varying incidences. We had no operative deaths in our series. In our study one patient (3.33%) had superficial wound infection. Superficial infection in the form of a

wound dehiscence was seen in one patient (3.33%) who was a diabetic. She was managed by debridement and secondary suturing with adequate control of the diabetic status and appropriate antibiotics based on culture-sensitivity results. The infection resolved without any sequelae and there was no late reactivation of the same. There were no late postoperative complications like loosening, dislocation, erosion, secondary osteoarthritis, protrusion acetabuli or periprosthetic fracture. Limb lengthening (<1 cm) was observed in two patients (6.66%) post- operatively due to technical errors in the form of the prosthesis sitting proud of the calcar. We are unable to comment upon long term acetabular erosion due to relative short follow up.

RESULTS

The main criteria for the functional result of the patient was the return to the pre fracture state. Patient should have good range of flexion, extension, abduction, adduction, internal and external rotation at the hip and full flexion at the knee to perform daily need activities. Harris hip scoring was applied for the evaluation of functional results at 6 weeks, 3 months and 6 months in patients treated with cemented bipolar hemiarthroplasty for fracture neck of femur in elderly. In our study, satisfactory results i.e. good and excellent. results were 83.33% which were comparable to other studies of Marya and Thukral (2011) 85%, Venkateswara and Ashok (2015) 86.37%, Srinivasan and Pugazhendhi (2018) 88%, sharanprasad et al (2019), Zahid Bashir et al (2020) and Rathe and Mosvi (2021) 88.3%. We observed poor results (6.67%) in patients who had comorbid conditions like hypertension, diabetes mellitus following cemented bipolar arthroplasty. Favourable results of bipolar might be contributed to the fact the bipolar prosthesis provides early mobilization, good pain relief and good functional status in majority of patients with minimal complications .

In our study, at the end of final follow-up, there was no evidence of loosening, radiolucent zones, distal migration or subsidence of prosthesis. Our study is not without its own shortcomings. Firstly, our duration of follow- up of one year is very less in assessing the longevity and functional endurance of the prosthesis used and hence come to definitive conclusions. Secondly, we have not evaluated the degree of intra-prosthetic motion at the inner bearing at each follow-up. Such studies are complicated and beyond the facilities available at our institution. Such studies are indicated because there are claims that the motion at the inner bearing reduces over time and most prostheses behave as unipolar prostheses over a period of time

SUMMARY

The Prosective study was conducted in the Govt Medical College and associated group of hospitals in kota during the period between 2019-21 in 30 patients who satisfied all the inclusion criteria of the study undergoing replacement surgeries for the fracture of neck of femur with HA Coated uncemented Bipolar Hemiarthroplasty. All the patients completed the study without any exclusion and they followed up till one year. Patients with age 60 years and above were with acute fracture neck of femur were included in the study. The average age of the study patients was 70 years with involvement of the left side in 63.33%. Radiological results are excellent in current study. At final one year follow-up by Harris Hip scoring system, 40% had excellent result, 43.33% had good results, 10 % had fair results. Following the surgeries there was an improved range of motion of the hip. There was improved flexion, abduction, and external rotation. These movements are important for Indian social habits. There was no case with subluxation or dislocation of prosthesis. There was no case with symptomatic loosening of femoral stem. There was no case with poor radiological results. There was no case with protrusion acetabuli. There was no case with acetabular erosion. The incidence of infection was low with one case of superficial infection, no reported case of deep infection, attributed to strict aseptic techniques and standard use of prophylactic antibiotics. There were two reported cases with limb lengthening less than 1cm but these patients had good Harris hip score. The patients who had poor pre operative mobility and were confined to bed for long time showed poor range of motion following surgery. Proper physiotherapy and good mobility following surgery are important for obtaining good clinical results. The results of our study are compared with other standard studies like marya and thukral

(2011), Venkateswara and Ashok (2015), Srinivasan and Pugazhendhi (2018), Sharanprasad et al (2019), Zahid Bashir et al (2020) & Rathe and Mosvi (2021) of bipolar hemiarthroplasty performed for fracture neck of femur.

CONCLUSION

Hydroxyapatite Coated Uncemented Bipolar hemiarthroplasty for fractures of the femoral neck provides better range of movement, freedom from pain and more rapid return to unassisted activity with acceptable complication rate. Uncemented hemiarthroplasty is a suitable method of treatment for femoral neck fractures in elderly patients with high risk clinical problems especially of a cardiopulmonary nature. This method decreases the risk of hypotension and fat embolism associated with cemented hemiarthroplasty. Uncemented hemiarthroplasty is an easy surgical procedure with shorter surgery time and less blood loss. Shorter surgery time with uncemented hemiarthroplasty decreases the risk of anaesthesia/ intra-operative complications. The end functional results depend on the age of the patient, associated co-morbidity and optimum post-operative rehabilitation. Though out of the purview of the present study our experience that an uncemented hemiarthroplasty can be treat displaced intracapsular femoral neck fractures with good clinical and radiographic outcomes at short term follow-up. The long term results using uncemented bipolar hemiarthroplasty needs further study for a longer period in a larger sample. In conclusion uncemented bipolar hemiarthroplasty for displaced femoral neck fracture in elderly patients appear to be an excellent procedure to achieve good clinical and radiographic results we intend to continue follow up to evaluate long term results. In view of the shorter operating times and low mortality rates due to the absence of cement related complications like thermal necrosis, loosening, osteolysis, canal pressure induced post operative thigh pain, Bone Cement Implant Syndrome (BCIS) – Exothermic reaction, anaphylactic reaction, Reflex bradycardia, Embolic phenomenon, Pulmonary hypertension, Hypotension, Cardiogenic shock. Cementless bipolar hemiarthroplasty with hydroxyapatite Coated stem is a good option for femoral neck fractures in Elderly patients with cardiopulmonary complications without risking the harmful effects of cementing. Uncemented bipolar procedure give better press fitting, better three point fixation of prosthesis, less time consuming, immediate primary stability and rapid osteointegration of the implant than cemented procedure. Hemiarthroplasty Using HA Coated Uncemented bipolar prosthesis for fracture of the displaced femoral neck in Elderly provide pain relief, better range of movement and more return to unassisted activity with an acceptable complication rate.

REFERENCES

1. Schmidt AH, Swiontkowski MF. Femoral neck fractures. *Orthop Clin North Am* 2002;33(1):97-111.
2. Mark F. Smiontkoski et Al. Current concepts review of intracapsular fracture of hip. *JBJS* 1994; 76A : 129 -135.

3. Robert W.B, James D.H. Rock wood Green's Fracture in Adults. 5th Edition. Lippincot Williams & Wilkins, 2001.
4. Canate TS. Campbell's operative orthopaedics. 10th Edition. Mosby; 2003
5. Elizabeth O Johnson et Al. Vascular anatomy and microcirculation of skeletal zones vulnerable to osteonecrosis. *Clinical Orthop* 2004; 35: 285-291.
6. Bhandari M, Devereaux PJ, Swiontkowski MF, Tornetta P, Obremskey W, Koval KJ, et al. Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. *J Bone Joint Surg Am* 2003; 85:1673-1681.
7. Ioro R, Schwartz B, Macaulay W, Teeney SM, Healey WL, York S. Surgical treatment of displaced femoral neck fractures in the elderly: a survey of the American Association of Hip and Knee Surgeons. *J Arthroplasty* 2006;21(8):1124-1133.
8. Zofka P. Bipolar hip hemiarthroplasty. *Acta Chir Orthop Traumatol Cech* 2007;74(2):99-104.
9. Austin T. Moore and H.R. Bohlman: Metallic hip joint, a case report. *JBJS* 1963;25: 688- 92.
10. Bateman J. E : Single assembly total hip arthroplasty, preliminary report. *Orthop Digest* 1974; 15:35-43.
11. Maini PS, Talwar N, Nijhawan VK, Dhawan M. Results of cemented bipolar hemiarthroplasty for fracture of the femoral neck – 10 year study. *Indian Journal of Orthopaedics* 2006;40(3):154-156.
12. Harkess JW, Crockarell JR: Arthroplasty of Hip. In: Campbell's Operative Orthopaedics. Ed: Canale ST, Beaty JH. 11th edn. Pennsylvania: Mosby 2008; 312-482.
13. Parker MJ, Gurusamy K. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. *Cochrane Database Syst Rev.* 2006;3:CD001706.
14. 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. 1993;24(4):236-40.
15. Figued W, Opland V, Frihagen F, Jervidal T, madsen JE, Nordsletten L. Cemented versus uncemented hemiarthroplasty for displaced femoral neck fractures. *Clin Ortho Relat Res* 2009;467:2426-35.
16. Hardy DC. Fractures of the femoral neck treated with a full HA-coated femoral stem a ten-year survey of 110 - consecutive patients. *Surg Technol Int* 2010;19:177-84.
17. Schewelov TV, Ahlberg H, Sanzén L, Besjakov J, Carlsson A. Fixation of the fully hydroxyapatite-coated Corail stem implanted due to femoral neck fracture. *Acta Orthop* 2012; 83:153-8.
18. Dorozhkin, S.V. Calcium Orthophosphate Cements and Concretes. *Materials* 2009, 2, 221-291.
19. Hoppenfeld S, DeBoer P: Surgical Exposures in Orthopaedics – The Anatomical Approach. 3rd edn. Philadelphia, Lippincott Williams and Wilkins 2002; 365-454.
