International Journal of Research in Medical Sciences
Sakthivel RN et al. Int J Res Med Sci. 2016 Feb;4(2):465-471
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20160297

Research Article

A study of hip arthroplasty using bipolar endo-prothesis for fracture neck of femur

Rajarajan Nagu Sakthivel[1]*, Balaji Ponna puvula Subramanyam[2], Vijayan Balakrishnan[1]

[1]ESIC Medical College, K. K. Nagar, Chennai, India
[2]Consultant Orthopaedic Surgeon, SRM Hospital, Chennai, India

Received: 08 December 2015
Revised: 08 December 2015
Accepted: 06 January 2016

***Correspondence:**
Dr. Rajarajan Nagu Sakthivel,
E-mail: drnsrajarajan@yahoo.com

ABSTRACT

Background: The purpose of this study is to analyze 20 cases of bipolar hip arthroplasty done for fracture neck of femur from August 2011 to January 2013. The technique, overall functional results were tabulated in a proforma and analyzed, complications if any were noted and analysed. A conventional Austin Moore and Thompson device has been routinely deployed, however in long term follow-up, unsatisfactory results remained high due to femoral stem loosening, acetabular erosion, intrusion of prosthesis into the pelvis and difficulties with total hip revisions. These factors led to the development of bipolar prosthesis.
Methods: 20 patients were operated by cemented bipolar hemiarthraoplasty for fracture neck of femur. All the patients had displaced fracture neck of femur and were in the elderly age group.
Results: 20% of the patients had excellent results and 80% had good results. There was a significant incidence on the postoperative functional out come. There was a significant increase in the postoperative score by 4 grades.
Conclusions: For elderly patients with fracture neck of femur cemented bipolar hemiarthroplasty gives good functional outcome, except for some difficulties in routine daily activities like sitting cross legged and squatting.

Keywords: Fracture neck of femur, Bipolar prosthesis, Hemiarthroplasty, Functional outcome, Rural patients

INTRODUCTION

Fracture neck of femur remains an unsolved fracture to Orthopedic surgeon as far as treatment and results are concerned. There is still a dilemma over either internal fixation or arthroplasty in the treatment of fracture neck of femur in middle age group.

The first efforts on treating hip fractures concentrated on alignment of fracture fragments by traction and closed reduction. The reduction was maintained by long term traction, spica casts or internal fixation. However, despite the most accurate anatomic alignment and most rigid fragment fixation, many patients failed to regain normal use of their hips. Non-union of the femoral neck, avascular necrosis of the femoral head and the degree of fracture commination affected results in many. Non-anatomic reduction and inadequate fixation cause prolonged disability, pain, immobility and repeated surgical procedures.

It is because of these inherent problems, replacement of femoral head and neck became the treatment of choice of many Orthopedic surgeons in elderly people to avoid complications of recumbence. A conventional Austin Moore and Thompson device has been routinely deployed, however in long term follow-up, unsatisfactory results remained high due to femoral stem loosening, acetabular erosion, intrusion of prosthesis into the pelvis and difficulties with total hip revisions. These factors led to the development of bipolar prosthesis.

In 1974, Dr James Ennis Bateman an Orthopedician and Averill, a bio-engineer devised bipolar prosthesis, which

is a self-articulating prosthesis designed for femoral head replacement. The bipolar concept was to establish firm fixation of the stem in femoral shaft, yet eliminate shear forces between the metallic prosthetic head and acetabular cartilage. Bateman in 1974 and Gilberty 11 years later reported the bipolar endo-prosthesis, an intermediate step between Moore type of endo-prosthesis and a total hip system. [1]

Bipolar prosthesis can be revised to total hip arthroplasty by retaining the femoral stem, by virtue of its unique articulation with the acetabulum, would function without eroding acetabular bone. If it is impossible to produce a snug press-fit of the stem in medullary canal and if the bone is osteoporotic, then methyl methacrylate bone cement can be used.

Torisu[2] has reported the use of the bipolar implant in a series of 37 hips with significant acetabular deficiency Cameron has treated acetabular defects in some 37 cases using a bipolar implant. All cases have done well.[3]

Bipolar system embraces friction principle, but does not require as much tissue disruption as total hip arthroplasty. It retains the original acetabulum.

Wilson and R. D. Scott reported successful use of bipolar implant in 47 cases for reconstruction of deficient acetabulum.[4]

Garrahan and Madden recommended the use of long stem. They reported no evidence of acetabular erosion or protrusio acetabulae. [5] The three point fixation of the long stem remains secure within the femoral canal with a tendency to limit severe calcar stress.

This study includes cemented bipolar hip arthroplasty for fracture neck of femur. The follow up of these cases were done to assess the end results, especially as related to their functional rehabilitation.

METHODS

From August 2011 to January 2013, 20 patients who had undergone bipolar hip arthroplasty for fracture neck of femur in the department of Orthopedics were taken up for this study.

The indications, for which bipolar hip arthroplasty was done, included both fresh and old fracture neck of femur. The inclusion criterion was patients between the age of 46 years and 65 years.

Preoperative evaluation

The patients selected for bipolar hip arthroplasty underwent a thorough preoperative assessment. The pros and cons of surgery were well explained to the patients. More so for our rural patients because they demand sitting cross-legged and squatting which will be restricted after bipolar hip arthroplasty, due to fear of dislocation of prosthetic hip.

Radiological evaluation

The aim of preoperative radiological evaluation is to confirm the diagnosis, to study the type of fracture, anatomy of proximal femur and acetabulum, for accurate restoration of joint anatomy and biomechanics. The quality of bone, osteoporosis & bone stalk was also studied.

The standard radiological evaluation includes pelvic roentgenogram AP view including both hips and proximal femur taken with hips in 15 degrees of internal rotation. A traction internal rotation view was taken to note the amount of calcar femorale left behind. In some cases where indicated, roentgenogram of spine & knee joints were taken.

Preoperative planning was done to determine the size of bipolar prosthesis. The templates were used for selection of proper implants with correct fit, adequate size and a neck length that is required to correct limb length discrepancy was selected.

X-rays were taken with magnification markers and the corresponding templates were placed on the film and the size that most precisely matches the contour of the proximal femur was selected. Allowances were made for the thickness of desired cement mantle, if cement was used. The diameter of the canal below the stem tip was measured to assess the cement plug, when a cemented prosthesis was used.

X-rays of hip, both AP (standing) and frog-leg lateral views were taken. They were compared with the immediate post-op X-rays for the following:

- Assessment of movement in both bearing surfaces.
- Alteration of the position of the femoral stem.
- Subsidence of femoral component.
- Loosening of femoral stem.
- The femoral cement mantle.

Surgery

Epidural or general anesthesia was used. The patient was positioned in lateral position. . The anterior superior iliac crest was kept free of towel clips so that it can be palpated through the drapes to judge the position of the pelvis.The posterior approach – moore / southern was used for all the patients in this study.

Implantation of prosthesis

Cement fixation is indicated when the femoral cortex is thin or osteoporotic and secure press-fit fixation is unlikely. All of 20 cases were cemented bipolar hip arthroplasty.

Immediately following introduction of cement, the prosthesis is inserted with 5 to 10 degrees of anteversion. Firm pressure is maintained after impacting the prosthesis.

Post-operative regime and rehabilitation

Patients were allowed to sit up from second day and sutures removed on eleventh day.After drain removal, patients were made to walk with walker support. Gradual weight bearing was advised for the operated limb. Patients are advised not to sit cross-legged or squat on the floor. They are also instructed to avoid adduction and internal rotation. Usually patients were discharged by two weeks. They were advised to have a follow-up by three weeks, six months, and one year. The walker or crutches were weaned off as the patient gained confidence.

RESULTS

During the period between August 2011 to January 2013, 20 patients had undergone bipolar hip arthroplasty for fracture neck of femur in the Department of orthopedics, were taken up for this study. The indications for which bipolar hip arthroplasty was done included fracture neck of femur, fresh as well as old fracture. This study comprises of 20 hips in 20 patients. In all 20 cases bipolar press-fit prosthesis was used with PMMA cement.

Age distribution

The age incidence between 56 to 60 years was the commonest in this study with an incidence of 35%.

Table 1: Age distribution.

Age	Nos
46-50	3
51-55	5
56-60	7
61-65	5

Sex distribution

In the present study, males constituted the majority of 14 cases with an incidence of 70%.

Side preponderance

In the present study out of 20 cases, 11 hips were on left side and the other 9 hips were on right side.

Time interval between injury and surgery

In this study 12 cases of fracture neck of femur got admitted within 3 weeks of injury and eight cases of fracture neck of femur got admitted after 3 weeks of injury. All cases in this study were operated within 48 hours of admission.

The results of bipolar hip arthroplasty were analyzed based on the Merle 'D' Aubigne score system. The preoperative and postoperative scores were compared.

Table 2: Merle 'D' aubigne – charnley hip score.

Grade	Pain	Ability to walk	Range of movements
1.	Severe spontaneous	Bedridden cannot walk	0-30 degrees
2.	Severe spasm on attempting to walk	Needs 2 crutches for a few steps	30-60 degrees
3.	Rest pain permits limited activity	Needs 1 crutch for short distance with gross limp	60-100 degrees
4.	No rest pain Pain only after activity	Limited distance without cane Long distance with cane/ crutch	100-160 degrees
5.	Mere discomfort	Long distances without cane	160-210 degrees
6.	No pain	Normal	More than 210 deg

Pain

Average pre-op pain grade was: 2.4

Average post-op pain grade was: 5.15

In this study 80% of the patients had complete relief of pain, while 20% had mere discomfort.

Table 3: Pain relief.

Results	No. of patients	Improvement by %
Excellent (5-6)	16	80%
Good (2-4)	4	20%
Poor (<2)	-	-

Ability to walk

Average pre-op grade was: 1.0.

Average post-op grade was: 4.40.

In this study 60% of the patients were able to return to their normal routine work consistent with means of daily living. Other 40% were able to walk with some resistance.

Table 4: Ability to walk.

Results	No. of patients	Improvement by %
Excellent (5-6)	12	60%
Good (2-4)	8	40%
Poor (<20)	-	-

Range of motion

Average pre-op grade was; 1.0.

Average post-op grade was: 4.35.

In this study 9 cases, constituting 45% of the patients had sufficient range of motion consistent with daily living, except for enforced restrictions following surgery like squatting and sitting cross-legged.

Table 5: Range of motion.

Results	No. of patients	Improved by %
Excellent (5-6)	9	45%
Good (2-4)	11	55%
Poor < 2	-	-

Overall grading (total score)

Average pre-op grade was: 3.2

Average post-op grade was: 14.05

End result

In this study, 4 cases (20%) had excellent results and 16 cases (80%) had good results

Table 6: Overall results.

Grade	No. of	Percentage (%)
Excellent (16-18)	4	20%
Good (10-16)	16	80%
Poor (<10)	-	-

Average grading

Table 7: Average grading.

	Pre-op	Post-op
Pain	2.4	5.15
Gait	1.0	4.40
Rom	1.0	4.35

Complications

Table 8: Complications.

Complications	Number of cases	Percentage (%)
Limb length discrepancy	2	10
Superficial infection	1	5
Nerve injury	1	5
Femoral stem loosening	1	5
Dislocation	-	-
Heterotopic ossification	-	-

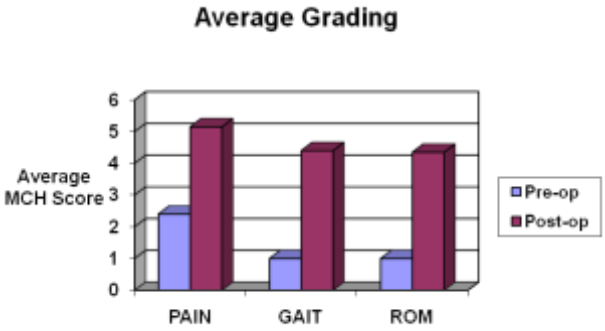

Figure 1: Average grading.

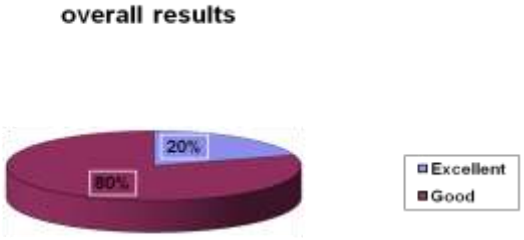

Figure 2: Overall results.

DISCUSSION

20 bipolar hip arthroplasties were done for fracture neck of femur over a period from August 2011 to January 2013 in the department of orthopedics, were taken for the study to evaluate the functional outcome using the Merle 'D' Aubigne Charnley hip score.

Age group

In this study the commonest age incidence between 56-60 years comprised of 7 cases constituting an incidence of 50% of the cases. In the Gallinaro et al study of 88 cases

of bipolar hip endoprosthesis for femoral neck fractures, the highest age incidence was 70-80 years accounting for 50% of the cases.[7] Higher age incidence was muc this study because the longevity of the Indian patients is less than the western world. Most of these patients were unaffordable for total hip arthroplasty; so bipolar hip arthroplasty was preferred over conventional hemiarthroplasty, as it improved the longevity of our Indian patients.

Sex distribution

The male female ratio in this study was 2.3:1. In Gallinaro's study the ratio was 0.26:1 with female preponderance and Lestrange et al study of 496 hips also showed female preponderance.[7,8]

Approach

The posterior, Southern/Moore approach was used in all cases. Bateman used posterolateral approach in all cases.[1] In Labelle series all 128 cases were done through a posterior approach.[6]

Mortality

In this study of 20 cases, there was no mortality constituting a 0% incidence.

Complications

In this study we had 2 cases of limb lengthening, 1 case of sciatic nerve injury and one case of superficial infection.

Limb length discrepancy

In this study 2 cases (10%) had limb lengthening of <1cm, so none of the patients required shoe heel raise. All these patients had Good / Excellent results. In Gallinaro series of 88 cases, one case had mild limb length discrepancy.[7]

Nerve injury

In this study there was 1 case (5%) of sciatic nerve injury, which recovered fully with splinting and electrical stimulation over a period of six months. In Bateman series of 760 cases there were two transient peroneal paralyses.[1] Nottage and McMaster noted 3.9% sciatic nerve injuries in their series of 76 cases.[9]

Infection

One case (5%) in this study had superficial infection during early postoperative period, which was treated with specific antibiotics. Lestrange quoted 2.8% infection in his series of 496 bipolar hip arthroplasties.[8] In Gallinaro's series of 88 patients, the infection rate was 4.4%.

Dislocation

In this study there were no cases of dislocation. In Moshein series of 87 cases, the dislocation rate was 2.3%.[10] Labelle reported only one early dislocation (0.8%), which occurred one month after surgery.[6] The metal cup separated from polyethylene lining, by open reduction the component snapped securely together and revision was not required.

Deep vein thrombosis

There was no clinical evidence of deep vein thrombosis or pulmonary embolism in this study. We did not use any prophylaxis for deep vein thrombosis in any of our cases. In a series of 76 bipolar hip arthroplasties Nottage and McMaster noted thromboembolic complications in 4 patients (3.1%).[9] In Bateman series 2 cases were reported, which was controlled by heparin therapy.[1]

Aseptic loosening

In this study we did not encounter any case of femoral stem loosening, as we had a maximum follow-up of only 2 ½ years. In Bateman series there were 6 cases of aseptic loosening.[1] All cases were revised successfully with longer stem and cement augmentation.

Functional results

The results were analyzed on the pre-operative and post-operative Merle 'D' Aubigne Charnley hip score.

Pain

Table 9: Pain grade.

	Average Pre-op grade	Average Post-op grade
LaBelle[6] study	1.0	5.5
Gallinaro[7] study	1.0	4.9
Present study	1.2	5.2

In this study the pain improved from an average pre-operative score of 1.2 to an average post-operative score of 5.2, an increase by an average of 4 grades. In the Labelle series the pain improved from average pre-operative score of 1 to post-operative score of 5.5, an increase by an average of 4.5 grades and Gallinaro study by 4.9 grades.[6,7]

Ability to walk

In this study the pain improved from an average pre-operative score of 1.0 to an average post-operative score of 4.5, an increase by an average of 3.5 grades. In the Labelle study the pain improved from average pre-operative score of 1 to post-operative score of 4.1, an

increase by an average of 3.1 grades and Gallinaro series by 4.3 grades.[6,7]

Table 10: Ambulation grade.

	Average Pre-op grade	Average Post-op grade
LaBelle[6] study	1.0	4.1
Gallinaro[7] study	1.0	5.3
Present study	1.0	4.5

Table 11: ROM grade.

	Average Pre-op grade	Average Post-op grade
LaBelle[6] study	1.0	5.4
Gallinaro[7] study	1.0	4.8
Present study	1.0	4.3

In this study the pain improved from an average pre-operative score of 1.0 to an average post-operative score of 4.3, an increase by an average of 3.3 grades. In the Labelle study the pain improved from average pre-operative score of 1 to post-operative score of 5.4, an increase by an average of 4.4 grades and Gallinaro study by 3.8 grades.[6,7]

Follow up

Table 12: End result.

	Excellent	Good	Poor
LaBelle[6] study	75%	25%	-
Gallinaro[7] study	63%	27%	-
Present study	20%	80%	-

In this study all patients had Good / Excellent results similar to that of Labelle study and Gallinaro study.[6,7] Both Labelle and Gallinaro study showed excellent results in 75% and 63% respectively, while this study showed only 20% excellent results. In this study 8 cases had undergone some form of native treatment and came late for surgery with considerable restriction of movements, fixed deformities and hence the postoperative range of motion was reduced. Thus reducing the overall hip score. However all the patients were satisfied with the functional outcome of the procedure.

In a group of 400 arthroplasties, Vazquez-Vela reported the results on 114 rheumatoid arthritics.[9] In this group, there were 4 examples of protrusio acetabulae. Two of the protrusio required total hip replacement with an autogenous graft supporting the acetabulum.

Dennis Mess and Riad Barmada analyzed a group of 47 hips with osteonecrosis.[10] In one case acetabular wear or moderate protrusio was encountered.

Bochner, Pellicci and Lyden[11] reviewed bipolar motion in patients treated for femoral neck fractures. Motion was maintained in both bearing surfaces after 2 years.

Yamamuro has reported results in conditions with the occasional use of supra-acetabular bone grafts.[12] Twenty percent of theses cases showed an upward migration of the head, but the migration was not a deterrent clinically in any of these cases.

Torisu has reported the successful use of the bipolar implant without bone grafting in dysplastic osteo-arthritis in a series of 36 hips of the steep and shallow acetabulum.[13] Torisu assessed the internal function of the bipolar implant in 20 of 24 hip joints noting the preponderant use of inner bearing motion increased significantly with weight bearing.

Torisu et al, has evaluated the results in performing excavation of the steep and shallow acetabulae.[13,14] The results of this procedure showed that 84.6% retained improvement to an average of 87 points on the Harris scale as long as 8 years afterwards.

William Murray et al have reported on the revision of 106 total hip arthroplasties with acetabular salvage required. [15] He reserved the use of the bipolar device for the patients in who contact between viable bone and prosthesis is less than 50 percent. Bone grafting was necessary in most of these patients.

According to Drinker and Murray three reference lines were used to measure inner bearing and outer cup motion in abduction and adduction.[16] Line1 is an extension of the straight edge of the outer cup, line 2 runs down to the neck of the prosthesis and line 3 is the acetabular index. The angle formed between line 1 and 3 determines the outer cup motion. The angle formed between line 1 and 2 determines the inner bearing motion. The arc of motion was identified after drawing the described reference lines.

Colwill et al concluded in their series, of 88 cases in the elderly, that the overall results were gratifying.[17]

Nottage and Mcmaster concluded that bipolar prosthesis had significant advantages to fixed stem prosthesis for fractures and reconstruction of the hip.[18]

Moshein et al reported that moderate to severe post operative pain was reduced to 12% with the bipolar implant as compared with 42% pain persistence with Moore prosthesis.[19]

In a Bateman series of 760 osteoarthritic cases, follow-up studies were done at 6 months, 5 years, 10 years and 15 years. Studies of the acetabulum showed healthy bone preservation as long as 15 years post-surgery.

In the published reports by western authors, excellent score is ascribed to majority of operated cases; since the

demand of the hip to squat for toilet purpose and to sit cross-legged does not arise. Whereas Indian patients of rural origin are used to squat and sit cross-legged on the floor and hence the criteria of excellence does not necessarily fit in.

CONCLUSIONS

Bipolar hip arthroplasty is a good operation for fracture neck of femur with 100 % satisfactory results in rural patients as confirmed by this study, but however patients need to modify their daily routine activities like squatting and sitting cross-legged on the floor.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Bateman JE, Berenji AR, Bayne O, Greyson ND. Long-term results of bipolar arthroplasty in osteoarthritis of the hip. Clin Orthop. 1990;251:54-66.
2. Torisu T, Utsunomiya K, Maekawa M, Ueda Y. Use of bipolar hip arthroplasty in states of acetabular deficiency. Clin Orthop. 1990;251:119-25.
3. Cameron HU, Jung YB. Acetabular revison with a bipolar prosthesis. Clin Orthop. 1990;251:100-3.
4. Wilson MG, Scott RD. Reconstuction of the dificient acetabulum using the Bipolar socket. Clin Orthop. 1990;251:126-33.
5. Garrahan WF, Madden EJ. The long-stem bipolar prothesis in surgery of the hip. Clin Orthop. 1990;251:31-7.
6. LaBelle LW, Colwill JC, Swanson AB. Bateman bipolar hip arthroplasty for femoral neck fractures. A five-to ten year follow-up study. Clin Orthop. 1990;251:20-5.
7. Gallinaro P, Tabasso G, Negretto R. Brach del Prever EM. Experience with bipolar prosthesis in femoral neck fractures in the elderly and debilitated. Clin Orthop. 1990;251:26-30.
8. Lestrange NR. Bipolar. arthroplasty for 496 hip fractures Clin Orthop. 1990;251:7-19199.
9. Vazquez-Vela E, Vazquez-Vela G. Acetabular reaction to the Bateman bipolar prosthesis. Clinorthop. 1990;251:87-91.
10. Vazquez-Vela G, Vazquez-Vela E, Dobarganes FG. The Bateman bipolar prosthesis is osteoarthritis and rheumatoid athritis: A review of 400 cases. Clin Orthop. 1990;251:82-6.
11. Mess D, Barmada R. Clinical and motion studies of the Bateman bipolar prosthesis in osteonecrosis of the hip. Clin Orthop. 1990;251:44-7.
12. Bocher, pellicci and Lyden (JBJS) – Review of bipolar motion on weight bearing. 1988.
13. Yamamuro T, Ueo T, Okumura H, Iida H, Hamamoto T. Five-year results of bipolar arthroplasty with bone grafts and reamed acetabular for osteoarthritis in young adults. Clin Orthop. 1990;251:75-81.
14. Torisu T, Utsunomiya K, Maekawa M, Ueda Y. Use of bipolar hip arthroplasty in states of acetabular deficiency. Clin Orthop. 1990;251:119-25.
15. Torisu T, Izumi H, Fujikawa Y, Matsui S. Bipolar hip arthroplasty without acetabular bone-grafting for dysplastic osteoarthritis. Results after 6-9 years J. Arthroplasty. 1995;10,(1):15-27.
16. Murray WR. Acetabular salvage in revision total hip arthroplasty using the bipolar prosthesis. Clin Orthop. 1990;259:212-9.
17. Drinker H, Murray WE. The universal proximal femoral endoprosthesis: A short term comparison with hemiarthroplasty. J Bone Joint Surg. 1979;61A:1167.
18. Nottage WM, McMaster WC. Comparison of bipolar implants with fixed-neck protheses in femoral-neck fractures. Clin Orthop. 1990;251:38-43.
19. Moshein J, Alter AH, Elconin KB, Adams WW, Isaacson J. Transcervical fractures of the hip treated with the Bateman bipolar prosthesis. Clin Orthop. 1990;251:48-53.

Cite this article as: Sakthivel RN, Subramanyam BPP, Balakrishnan V. A study of hip arthroplasty using bipolar endo-prothesis for fracture neck of femur. Int J Res Med Sci 2016;4:465-71.