DOI: 10.7860/JCDR/2022/56473.16342

Original Article

Orthopaedics Section

A Retrospective Study on the Functional and Radiological Outcomes of Basicervical Femoral Neck Fractures Treated with Proximal Femoral Nail

JIPIN GOPI[1], NR FIJAD[2], PP UNAIS[3], AARABHY JAYAN[4]

ABSTRACT

Introduction: Basicervical fractures are one of the rarest peri-trochanteric fractures. They have an inherent instability which make makes them notoriously prone for treatment failure. Because they cannot be classified as neither strictly intertrochanteric, nor intracapsular fractures, their treatment protocol is also not standardised. Newer implants are regularly tested in their management, with varying degrees of success.

Aim: To assess the functional and radiological outcome of basicervical neck of femur fracture with the use of the proximal femoral nail.

Materials and Methods: This retrospective study was conducted in Department of Orthopaedics at Malabar Medical College, Hospital and Research Centre, Kozhikode, Kerala, India, from September 2021 to December 2021. It was performed on 31 patients who were identified from a patient pool of 1526 individual with neck of femur fracture, as having basicervical fracture, but one patient follow-up details were not available hence, total sample size was 30. The patients were followed-up for a year and the functional outcome was assessed using modified Harris Hip Score and classified as poor, fair, good, or excellent. Radiological outcome was assessed based on reduction. Reduction was classified as anatomical (deviation <5°), acceptable (deviation 5-10°) or bad (deviation >10°) as per the classification suggested by Hardy et al. Descriptive statistical measures, namely mean, frequency and standard deviation were calculated.

Results: With the Proximal Femoral Nail (PFN), anatomical reduction was attained in 22 subjects (73.3%), acceptable in 6 subjects (20%) and bad in 2 subjects (6.7%). There were no instances of deep vein thrombosis, non union or avascular necrosis head of femur. The average time to radiological union was 13.5±1.8 weeks. Using modified Harris Hip Score, functional outcome was poor in 2 patients (6.7%), good in 2 patients (6.7%) and excellent in 26 patients (86.6%).

Conclusion: The PFN, even though, phased out in first world countries, is a safe and viable implant choice for the management of basicervical femoral neck fractures, with good functional and radiological outcome.

Keywords: Bone screws, Femur, Fracture fixation, Intramedullary, Surgical wound infection, Venous thrombosis

INTRODUCTION

Basicervical neck fractures are one of the rarest types of Femoral Neck fractures (FNFs). They constitute just about 1.2% of all proximal femoral fractures, and are seen to be most common in the elderly population [1]. When present in the younger age group, they are caused due to high velocity trauma, such as road traffic accidents. In either demographic, these fractures are clinically important because of:

1) The associated severity of morbidity [2], and
2) The varying management protocols [3-5].

Basicervical fractures are a rare sub-category of femoral neck fractures in which the fracture line passes very close to, or just proximal to, the intertrochanteric line, and is extracapsular. Blair B et al., described these as "fractures in which the fracture line moves through the base of the femoral neck at its junction with the intertrochanteric region" [6]. Due to this precarious location between the base of the femur and the intertrochanteric line, basicervical fractures are seen to be biomechanically more unstable, and are consequently associated with higher instances of both short-term and long-term implant related complications [7].

Treatment protocols for this category of fractures are designed around its extracapsular nature and are usually managed with closed reduction and internal fixation. The "gold standard" for fixation of peri-trochanteric fractures was traditionally the Dynamic Hip Screw (DHS) [8]. But basicervical fractures being unstable in nature, this has given way to modern implants which have improved on the design of the Cephalomedullary Nailing (CMN) [3-5,7,9].

The aim of the present study was to assess the clinical and radiographic outcomes of the management of acute basicervical neck fractures with proximal femoral nail.

MATERIALS AND METHODS

This retrospective study was conducted in Department of Orthopaedics at Malabar Medical College, Hospital and Research Centre, Kozhikode, Kerala, India, from September 2021 to December 2021. Institution Ethics Committee approval was obtained (No:MMCH&RC/IEC/2021).

Inclusion criteria: The patients with presence of Basicervical Femoral Neck Fractures (BFNF) and were available for follow-up period of more than one year were included in the study.

Exclusion criteria: Pathological fractures and cases treated with other implants, as well as cases which had to undergo open fracture reduction following inacceptable reduction using closed reduction techniques. Fractures in which the lesser trochanter had separated, fractures in which the fracture line ran distal to the lesser trochanter or out the lateral cortex of the greater trochanter, and transcervical fractures were also excluded from the study.

The definition given by Blair was used wherein a basicervical fracture was defined as "proximal femur fractures through the base of the femoral neck at its junction with the intertrochanteric region" [6]. Of the 1526 cases of peritrochanteric fractures surgically treated in the centre, from February 2018 to August 2020, a complete enumeration of all cases identified as Basicervical Femoral Neck Fractures, was done and included in the study.

Operative Procedure

All cases were performed under Subarachnoid Block (SAB). The patient was positioned in the standard fracture table. The fracture was first reduced under the guidance of an image intensifier, and a Proximal Femoral Nail (PFN) was inserted. Two guide pins were placed into the femoral head with the aid of the PFN-jig. Once the positions of the pins were confirmed both on Anteroposterior (AP) and lateral views, the two proximal locking bolts were inserted in sequential manner. Distal locking screws were also inserted to complete the procedure. Reduction was confirmed on table and classified as [10]:

- Anatomical- varus-valgus anteversion-retroversion deviation <5°
- Acceptable- deviation 5-10°
- Poor- deviation >10°

Postoperative management: Patient mobilisation was started from day one. Active range of movements of both hip and knee joints were initiated as early as tolerated by the patient. Non weight bearing was ensured for the initial three weeks postsurgery. Partial weight bearing was initiated by the beginning of the 4th week using a quadrangular walker. The partial weight bearing was incremented by 20% of body weight every week, till full weight bearing was attained at the end of nine weeks postsurgery.

Follow-up: Follow-up was performed at 6 months and 12 months postsurgery.

Radiological assesssment: Bone healing was assessed radiologically by taking into account varus-valgus as well as anteversion-retroversion angulations [10]:

- Anatomical-varus-valgus anteversion-retroversion deviation <5°
- Acceptable- deviation 5-10°
- Poor- deviation >10°

Screw cut-out, varus angulation, non union and avascular necrosis were the complications observed.

Clinical assessment: The clinical assessment was performed using the modified Harris Hip Score (mHHS) by Rai AK et al., [11], where the scoring ranged from:

- 0- which signified the worst functional outcome and maximum pain,
- 100 points signifying the best functional outcome and least pain.

The outcome was interpreted as:

- Poor result in scores <40,
- Fair result in scores of 41-60,
- Good result in scores between 61-80 and
- Excellent result in scores 81-100.

STATISTICAL ANALYSIS

Results were analysed using Statistical Package for the Social Sciences (SPSS) version [1.0.0.1406]. Age, sex and mechanism of injury were the independent variables. Dependent variables were time to surgery, complications, time to union and follow-up period. The present study being descriptive in nature, descriptive statistical measures, namely mean, frequency and standard deviation were calculated.

RESULTS

All the study subjects had sustained the fracture following a fall in their domestic settings. One of the test subjects was lost to follow-up, bringing the study population to 30. All study details have been tabulated in [Table/Fig-1].

These 30 subjects were followed-up for an average of 18.9±4.8 months (ranging between 12 months to 28 months). Male to female ratio was 1:2(10 males and 20 females), and the average age of the subjects was 74.1+8.9 years. The average duration between admission and surgical intervention was 2.3±0.79 days (ranging between 2 to 5 days). The mean duration of hospital stay, from admission to discharge postsurgery, was 6.5±1.2 days. All surgeries were performed by senior Orthopaedic Surgeons under Sub-arachnoid Block (SAB). Average duration of surgery was 57.6±12.9 minutes and the average blood loss was found to be 249±100 mL, (ranging between 120 to 550 mL).

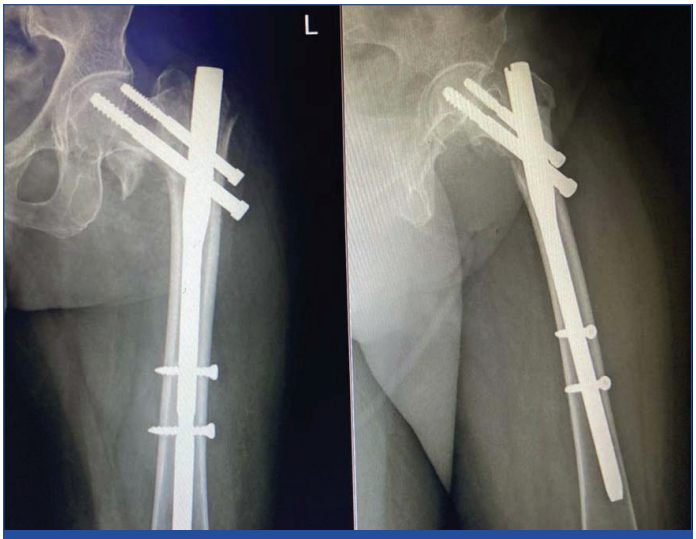
Patient no.	Age	Sex	Mechanism of injury	Time to surgery (days)	Time to union (weeks)	Complications	Follow-up (months)	Modified Harris Hip score
1	56	F	Fall	2	10	Nil	28	91
2	80	M	Fall	2	16	Nil	26	85
3	78	F	Fall	5	14	Nil	25	82
4	71	F	Fall	2	16	Nil	25	82
5	89	F	Fall	2	12	Nil	25	86
6	85	M	Fall	2	13	Nil	24	88
7	69	F	Fall	2	14	Nil	24	85
8	85	F	Fall	2	15	Infection	23	82
9	76	M	Fall	2	12	Nil	23	88
10	50	F	Fall	2	11	Nil	22	91
11	85	F	Fall	2	11	Nil	22	88
12	70	M	Fall	2		Screw cut-out	21	24
13	68	F	Fall	3	12	Nil	20	87
14	72	M	Fall	2	11	Nil	19	84
15	69	F	Fall	3	15	Nil	18	84
16	76	F	Fall	2	14	Nil	18	83
17	86	M	Fall	3	16	Nil	18	84
18	79	F	Fall	2	13	Nil	17	85
19	68	F	Fall	2	12	Nil	17	87
20	73	F	Fall	2	14	Nil	16	86
21	65	F	Fall	2	14	Nil	16	78
22	82	F	Fall	5	16	Nil	15	82
23	74	F	Fall	2	14	Infection	15	86
24	78	M	Fall	2	16	Nil	14	88
25	63	F	Fall	2	12	Nil	14	85
26	69	M	Fall	2		Screw cut-out	13	32
27	74	F	Fall	2	14	Nil	13	79
28	71	M	Fall	2	15	Nil	12	83
29	85	F	Fall	2	14	Nil	12	82
30	77	M	Fall	2	12	Nil	12	88

[Table/Fig-1]: Details of all subjects studied.

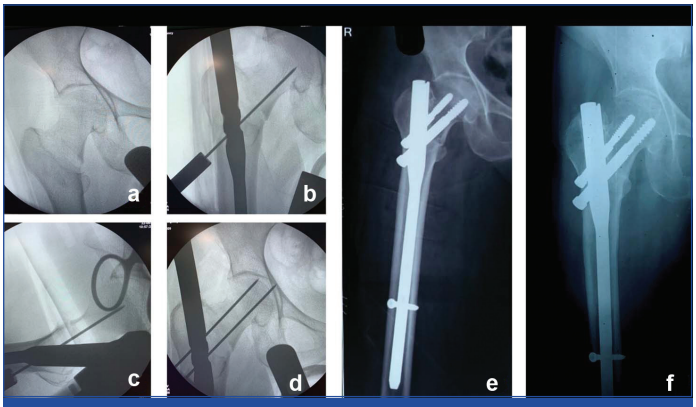
Anatomical reduction was attained in 22 subjects (73.3%), acceptable in 6 subjects (20%), and bad in 2 subjects (6.7%). Two of the 30 subjects contracted surgical site infection, detected during the first follow-up at 2 weeks (6.7%). They were managed adequately with wound debridement and systemic antibiotics. There were no cases of Deep Vein Thrombosis (DVT).

Two subjects presented with screw cut-out at second follow-up at 6-8 weeks [Table/Fig-2]. Further surgical intervention was offered, but the caretakers were unwilling, citing patients' ages (69 years and 70 years) and co-morbidities. The Average time to radiological union in the remaining 28 was 13.5±1.8 weeks. None developed any deformity of union, and there was no instance of avascular necrosis of femoral head.

Two subjects obtained a poor result with scores less than 40 (6.7%), and 2 (6.7%) had good outcome in the mHHS and 26 (86.6%) subjects showed an excellent outcome in the mHHS. Average outcome score was 81.16±14.8. Intraoperative, immediate postoperative and two years follow-up radiographs of patient no. 5 are demonstrated in [Table/Fig-3].



[Table/Fig-2]: Radiological image demonstrating screw cut-out detected (in case no. 26).



[Table/Fig-3]: a) Intraoperative image intensifier showing basicervical neck of femur fracture. b,c,d) Anterioposterior and lateral views confirming position of guide pins e) Immediate postoperative x-ray showing excellent reduction. f) 2 year follow-up showing complete union.

DISCUSSION

The management of Basicervical femoral neck fractures is a topic of much debate not only because of its rarity, but also because of the site of fracture which is neither intertrochanteric nor intracapsular [6]. This is also the reason why there have been so few studies regarding its management, and why there are no clear protocols yet. A perusal of available comparable studies has revealed different approaches with different implants, and varying degrees of success. These studies, and their comparison with the present, have been compiled in [Table/Fig-4]. The average age in the present study was 74.1 years, comparable to the age demographic in the studies by Massoud El [5], 68.9 years, and Tasylkan L et al., [12], 71 years.

The predominant population was female [3,12,13], including the present study. A female population, as we know, is more prone to osteoporotic fractures and the neck of femur is a common site, especially with advanced age [10].

In the present study, the implant we used to fix the basicervical femoral neck fractures is the Proximal Femoral Nail (PFN). In recent years, this implant has been phased out in favor of more advanced and improved implants in first world countries, whereas it is still widely used in third world countries. Comparing the implants used in other studies there was no other studies where PFN was the implant of choice [Table/Fig-4] [3-5,12-14]. However, the implants used included the Dynamic Hip Screw (DHS), PFN-Antirotation (PFN-A), Profin® PFN, Cephalo-Medullary Nail (CMN), Gamma Nail and cancellous screw [3-5,12-14].

The average time to radiological union ranged from 10.5 weeks in study by Tasylkan L et al., and 14.7 weeks in study by Hu SJ et al., [12,13]. In the present study, radiological union was attained at an average of 13.5 weeks, a median value.

Study	Country	Cases	Implant	Union time	Screw cutout	Assess-ment	Complica-tions
Massoud El [5] (2010)	Egypt	13	Gamma nail/DHS/ Cancellous screws	11.5 weeks	0	Modified criteria of Kyle et al.,	Infection- 1 DVT-NM AVN-NM
Hu SJ et al., [13] (2013)	China	30	PFNA	14.7 weeks	0	Harris social index (86.5)	Infection- 0 DVT-NM AVN-0
Tasylkan L et al., [12] (2015)	Turkey	28	PROFIN	10.5 weeks	0	Harris Hip Score (81.2) Modified Barthel index (81.1)	Infection- 0 DVT-NM AVN-NM
Watson ST et al., [3] (2016)	USA	11	CMN	NM	5	NM	Infection- NM DVT-NM AVN-NM
Lee YK et al., [14] (2018)	South Korea	69	DHS/ PFNA	NM	6	NM	Infection- 0 DVT- 0 AVN-NM
Kulambi VS et al., [4] (2019)	India	35	DHS	12.28 weeks	0	Modified Harris Hip Score	Infection- 1 DVT-NM AVN-0
Present study Gopi J et al., (2022)	India	30	PFN	13.5 weeks	2	Modified Harris Hip Score (81.2)	Infection- 2 DVT- 0 AVN-0

[Table/Fig-4]: Results from different study and comparison with the present study [3-5,12-14].
DVT: Deep vein thrombosis; AVN: Avascular necrosis; NM: Not mentioned; DHS: Dynamic hip screw; pfn: Proximal femoral nailing; PFNA: Proximal femoral nail antirotation system; PROFIN: Proximal femoral nail SYSTEM; CMN: Cephalomedullary nails

The two most common postoperative complications encountered were found to be screw cut-out and surgical site infection [3-5,14] [Table/Fig-4]. Watson ST et al., using a CMN implant, reported a screw cut-out frequency of 45.5% (5 out of 11 subjects) [3]. Lee YK et al., reported a frequency of 8.7% (screw cut-out in 6 of 69 subjects) while using DHS/PFN-A implants [14]. The present study observed a frequency of 6.67% (2 out of 30 patients), using PFN implants.

Surgical site infection was reported by Massoud El in 1 patient (7.7%, Gamma Nail/DHS/Cancellous screw implants), and by Kulambi VS et al., in 2.9% (1 of 35 patients) [4,5]. In the present study, two patients contracted surgical site infection, a frequency of 6.7%, which, though not too high a value, is a cause for concern, and would need further evaluation.

The modified Harris Hip Score (mHHS) which we used to assess the functional outcome was used by only one other study by Kulambi VS et al., [4]. Kulambi VS et al., obtained excellent functional outcome in 28 subjects (80%) and a good outcome in 11.4% (4 out of 35 subjects) [4]. In the present study, authors obtained a good result in 24 of 30 subjects (80%) and an excellent result in 6.7% (2 out of 30 subjects). The outcome assessment in other studies have been tabulated in [Table/Fig-5] [4,12,13].

By its nature, the proximal fragment is prone to rotate and destabilise while using a triple reamer for the application of dynamic hip screw. Hence, some studies advice using a second guide pin for "providing a temporary rotational stability, which prevents the head from spinning around the triple reamer" [4]. The inherent nature of the implant, PFN, used in the current study, is such that its application requires two guide pins to be inserted first into the femoral head for the application of the two proximal femoral bolts. This by itself stabilises the fracture and prevents spinning of the head, while using the reamer drill bits.

Study	Cases	Implant	Assessment	Results			
				Excellent	Good	Fair	Bad
Hu SJ et al., [13] (2013)	30	Proximal femoral nail antirotation system	Harris social index (86.5)	11	15	4	0
Tasylkan L et al., [12] (2015)	28	Proximal femoral intramedullary nail	Harris Hip Score (81.2) Modified Barthel index (81.1)	12	7	3	6
Kulambi VS et al.,[4] (2019)	35	Dynamic hip screw	Modified Harris Hip Score	28	4	2	1
Present study (2022)	30	Proximal femoral nailing	Modified Harris Hip Score (81.2)	2	24	2	2

[Table/Fig-5]: Comparison of outcome assessment between international study and present study [4,12,13].

Limitation(s)

Since the present was a retrospective study, there was a possibility for selection bias and recall bias. Study population, being small, it may not be possible to generalise the study findings to a larger population.

CONCLUSION(S)

Proximal femoral nailing is a safe and viable implant choice for the management of basicervical fractures, with good functional and radiological outcome, and without compromising on treatment quality. Even though, further studies are required to establish the efficacy of the PFN, it is good to bear in mind that, one must not get prejudiced by so-called, established protocols and be willing to tailor implant and treatment modalities for each patient.

Acknowledgement

Authors would like to place on record the immense gratitude to Dr. M.K. Ravindran Sir, Head of the Department of Orthopaedics, and Dr. S Sadanandan Sir, Unit Chief, Department of Orthopaedics, for their unwavering support and expert guidance. Authors would also like to thank the colleagues Dr.Vaisakh, Assistant Professor and Dr. Krishna, Junior Resident, Department of Orthopaedics for their valuable input.

REFERENCES

[1] Chen CY, Chiu FY, Chen CM, Huang CK, Chen WM, Chen TH. Surgical treatment of basicervical fractures of femur-A prospective evaluation of 269 patients. J Trauma. 2008;64(2):427-29.
[2] Yoon HK, Park C, Jang S, Jang S, Lee YK, Ha YC. Incidence and mortality following hip fracture in Korea. Journal of Korean Medical Science. 2011;26(8):1087.
[3] Watson ST, Schaller TM, Tanner SL, Adams JD, Jeray KJ. Outcomes of low-energy basicervical proximal femoral fractures treated with cephalomedullary fixation. Journal of Bone and Joint Surgery. 2016;98(13):1097-102.
[4] Kulambi VS, Satish AS, Rangaraja P. Surgical management of basicervical fracture neck of femur with dynamic hip screw and Derotation Screw: A prospective study. International Journal of Research in Orthopaedics. 2019;5(4):712.
[5] Massoud EI. Fixation of basicervical and related fractures. International Orthopaedics. 2009;34(4):577-82.
[6] Blair B, Koval KJ, Kummer F, Zuckerman JD. Fixation of basicervical fractures of the proximal femur. Journal of Orthopaedic Trauma. 1993;7(2):194.
[7] Su BW, Heyworth BE, Protopsaltis, TS, Lipton CB, Sinicropi SM, Chapman CB, et al. Basicervical versus intertrochanteric fractures: An analysis of radiographic and functional outcomes. Orthopedics. 2006;29(10):919-25.
[8] Wang Q, Gu X, Li X, Wu J, Ju Y, Huang W, et al. Management of low-energy basicervical proximal femoral fractures by proximal femoral nail anti-rotation. Orthopaedic Surgery. 2019;11(6):1173-79.
[9] Kweon SH, Lee SH, Kook SH, Choi YC. Outcomes of cephalomedullary nailing in basicervical fracture. Hip & Pelvis. 2017;29(4):270.
[10] Akan K, Cift H, Ozkan K, Eceviz E, Tasyikan L, Eren A. Effect of osteoporosis on clinical outcomes in intertrochanteric hip fractures treated with a proximal femoral nail. Journal of International Medical Research. 2011;39(3):857-65.
[11] Rai AK, Agarwal R, Singh S, Ratan R. The BHU bicentric bipolar prosthesis in fracture neck femur in active elderly. J Trauma Manag Outcomes. 2008;2(1):7.
[12] Tasylkan L, Ugutmen E, Sanel S, Soylemez MS, Ozkan K, Solakoglu C. Short-term results of surgical treatment with cephalomedullary nails for basicervical proximal femoral fractures. Acta Orthop Belg. 2015;81:427-34.
[13] Hu SJ, Yu GR, Zhang SM. Surgical treatment of basicervical intertrochanteric fractures of the proximal femur with cephalomeduallary hip nails. Orthopaedic Surgery. 2013;5(2):124-29.
[14] Lee YK, Yoon BH, Hwang JS, Cha YH, Kim KC, Koo KH. Risk factors of fixation failure in basicervical femoral neck fracture: Which device is optimal for fixation? Injury. 2018;49(3):691-96.

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Orthopaedics, Malabar Medical College, Hospital and Research Centre, Kozhikode, Kerala, India.
2. Assistant Professor, Department of Orthopaedics, Malabar Medical College, Hospital and Research Centre, Kozhikode, Kerala, India.
3. Assistant Professor, Department of Orthopaedics, Malabar Medical College, Hospital and Research Centre, Kozhikode, Kerala, India.
4. Associate Professor, Department of Anatomy, Malabar Medical College, Hospital and Research Centre, Kozhikode, Kerala, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Aarabhy Jayan,
Associate Professor, Department of Anatomy, Malabar Medical College, Hospital and Research Centre, Ulliyeri, Kozhikode-673315, Kerala, India.
E-mail: aarabhy@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Mar 24, 2022
- Manual Googling: Apr 11, 2022
- iThenticate Software: Apr 14, 2022 (2%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Mar 18, 2022**
Date of Peer Review: **Mar 30, 2022**
Date of Acceptance: **Apr 12, 2022**
Date of Publishing: **May 01, 2022**