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Role of cephalomedullary nail in proximal femur fractures

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ABSTRACT

Background: Hip fractures are recognized to be a major public health problem. Key determinants of hip fractures include age, osteoporosis, and falls. In these determinants socioeconomic status, have not been well explored. Under eccentric loading, high bending loads occur, leading to failure of the osteosynthetis anchorage at the center of the femoral head. The introduction of the reconstruction nail has broadened the indications for the intramedullary fixation of difficult femoral fractures. The operative technique is however complicated. Some technical difficulties encountered during its use are presented together with guidance to allow these problems to be avoided.
Methods: This Study had included 47 cases which were operated by single surgeon and use of different implant (cephalomedullary nail) was randomized irrespective of fracture types and pattern. This study was done over a period of 12 months (October 2013 to October 2014) with 1 month, 3 months, 6 months, 12 months follow up. At every visit patient were assessed as per Oxford hip score. Type of implant used was PFNA**,** Intertan**,** Sirus Nail.
Results: The mean age of the patients was 65.68 (±13.55) years. Severe pain was observed among majority of the patients at one month (70.2%) which became mild (40.4%) and moderate (34%) at 3 months. Very mild pain was found in 36.2% patients at 6 months and in 61.7% at 12 months. The limping was all the time among all the patients at one month. However, the limping was found often in 46.8% at 3 months and sometimes in 57.4% at 6 months and 53.2% at 12 months. The hip score was found to be severe among all the patients at one month. However, moderate to severe hip was in 46.8% patients at 3 months, mild to moderate was in 57.4% at 6 months and satisfactory joint function was in 68.1% at 12 months. The comparison of Hip score according to long or short nail at one 3, 6 and 12 months showed no difference.
Conclusions: Cephalomedullary nails with adequate technique so that the lag screws by purchase in the centre-centre or posterior-inferior quadrant combines the benefit of sliding hip screw as well as intramedullary implants. So we recommend the use of cephalomedullary nails in proximal femur fractures especially the unstable fractures.

Keywords: Proximal femur fracture, Cephalomedullary nail

INTRODUCTION

Hip fractures are recognized to be a major public health problem in many Western nations, most notably those in North America and Europe. Incidence rates for hip fracture in other parts of the world are generally lower than those reported for these predominantly Caucasian populations. Incidence rates for hip fracture from various parts of the world to projected populations in 1990, 2025 and 2050 in order to estimate the numbers of hip fractures which might occur in each of the major continental regions.[1] The projections indicate that the number of hip fractures occurring in the world each year will rise from 1.66 million in 1990 to 6.26 million by 2050.[2] While Europe and North America account for about half of all hip fractures among elderly people today, this proportion will fall to around one quarter in 2050. Osteoporosis will truly become a global problem over the next half century, and that preventive strategies will be required in parts of the world where they are not currently felt to be necessary.[1]

Hip fracture incidences are available from many countries across Asia, including from Singapore, Taiwan, Japan, Malaysia, China, and the Middle East. Unfortunately, in India only projected figures are available, which is second most populous country in the world.[3]

Studies on hip fracture incidence rates are available from Japan, particularly from the Tottori prefecture, a region representative of the Japanese population in terms of demographic and economic status.[4] Secular trends on hip fracture from Hong Kong suggest that over the last three decades the age-specific incidence increased 2.5 fold in women and 1.7 fold in men.[5]

Interestingly there has been no significant improvement in mortality or functional recovery over the past 50 years of surgical treatment. Paradoxically, the last 50 years of acquiescence to the status quo of hip fracture treatment are related to false assumptions that have been a hindrance to improvement in the management of the hip fracture patient.[6]

Key determinants of hip fractures include age, osteoporosis, and falls. In these determinants socioeconomic status, have not been well explored.[7] Failure of Osteosynthesis is related to the anatomy of the proximal end of the femur and its loading patterns. Under eccentric loading, high bending loads occur; leading to failure of the osteosynthetis anchorage at the center of the femoral head.[8] The introduction of the reconstruction nail has broadened the indications for the intramedullary fixation of difficult femoral fractures. The operative technique is however complicated. Some technical difficulties encountered during its use are presented together with guidance to allow these problems to be avoided.[9]

METHODS

This prospective study was done at Department of Orthopaedics, Vivekanand Polyclinic &Institute of Medical Sciences, Lucknow, U.P. All male or female patients above 18 years of age, with proximal femoral fractures were included in the study. Patients who were medically unfit for surgery, were excluded from study. This Study had included 47 cases which were operated by single surgeon and use of different implant (cephalomedullary nail) was randomized irrespective of fracture types and pattern. This study was done over a period of 12 months (October 2013 to October 2014) with 1 month, 3 months, 6 months, 12 months follow up. At every visit patient were assessed as per Oxford hip score.

All patients were examined with detailed history to ascertain age, sex, mechanism of injury, type of injury (open /close/polytrauma), neurovascular status, preinjury ambulatory status and co-morbidity that may affect recovery. X-ray pelvis with both hips AP view, X-ray hip with thigh AP and lateral view of affected hip was taken preoperatively to study the fracture geometry and plan for treatment.

Surgical procedure was carried out by placing the affected extremity into a boot after the reduction manoeuvre. Surgical steps have been described in the following paragraph:

Make an approximately 3 cm incision, beginning 3 cm proximal to the tip of the greater trochanter and extending proximally. Incise the aponeurosis of the gluteus maximus. Localize a guide pin on the medial aspect of the greater trochanter (modified medial trochanteric portal). Insert the guide pin 2 to 3 cm distally into the proximal fragment. At this point use fluoroscopy to assess the guide pin placement in both planes. Use the proximal reamer to ream over the guide pin to a depth just below the level of the lesser trochanter. Place the ball-tip guide pin down the shaft of the femur to the physeal scar, and measure the guide pin to determine the appropriate length of the intramedullary nail. Ream to a diameter 1.5 mm larger than the diameter of the intramedullary nail. Insert the nail with the guide facing anteriorly to use the bow of the nail to make insertion easier. Rotate the guide laterally after the nail has been inserted approximately halfway down the intramedullary canal. Insert the nail to a depth that allows center-center positioning in the femoral head with the lag screw. Remove the ball-tipped guide pin. Make a small incision laterally through the skin and fascia, and place the appropriate drill sleeve into the lateral aspect of the femur. Advance a guide pin to within 5 mm of subchondral bone. Confirm appropriate center-center position in the femoral head. Measure for the length of the lag screw. Ream for lag screw. Insert the lag screw. After releasing traction, place the desired amount of compression using the compression screw. Place distal interlocking screws.

Follow up patients was done at 1 month, 3 months, 6 months, 1 year (with Oxford hip score), we allow our patient to walk with partial weight bearing with walker at 1 month and full weight bearing walk after 3 months. Type of implant used was PFNA**,** Intertan**,** Sirus Nail.

Functional outcome was assessed by Oxford hip score.Oxford hip score is calculated based on 12 simple questions as listed:

1. Description of pain in hip.

2. Troubled by pain from hip in bed at night.
3. Did any sudden, severe pain (shooting, stabbing, or spasms) from affected hip.
4. Have been limping when walking because of hip.
5. For how long have been able to walk before the pain in hip becomes severe (with or without a walking aid).
6. Have been able to climb a flight of stairs.
7. Have been able to put on a pair of socks, stockings or tights.
8. After a meal (sat at a table), how painful has it been to stand up from a chair because of hip.
9. Have had any trouble getting in and out of a car or using public transportation because of hip.
10. Have had any trouble with washing and drying (all over) because of hip.
11. Could do the household shopping on own.
12. How much has pain from hip interfered with usual work, including housework.

The Oxford hip score is: __/48

Grading for the Oxford hip score

- Score 0 to 19**:** May indicate severe hip arthritis.
- Score 20 to 29**:** May indicate moderate to severe hip arthritis.
- Score 30 to 39: May indicate mild to moderate hip arthritis.
- Score 40 to 48**:** May indicate satisfactory joint function.

Statistical analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA). The results are presented in mean ± SD and percentages. The change in hip score from one month to subsequent follow-ups was compared by using Wilcoxon rank sum test. The Mann-Whitney U test was used to compare the Hip score between ORIF and CRIF and short and long nail. The $p<0.05$ was considered significant.

RESULTS

This study had 47 patients (23 males and 24 females) above 17 years of age. About one third of the patients were between 61-70 years (31.9%) followed by 71-80 (25.5%), 51-60 (21.3%) and <50 and >80 (10.6%) years. The mean age of the patients was 65.68 (±13.55) years. 5 patients had subtrochantric fractures and 42 had intertrochantric fractures. According to AO classification, Pertrochanteric multifragmentary (40.4%) was observed among most of the patients followed by pertrochanteric simple (34%) and transverse (17%). Rests were intertrochantric, oblique, fragmented wedge and spiral fractures. Postoperatively all the parameters of Oxford Hip Score were calculated. All the parameters followed a uniform trend and all fell to a satisfactory level with increasing time in follow up. Only selected 4 of the 12 parameters have been discussed here (Tables 1-4).

Table 1: Description of pain in hip.

	One month		3 months		6 months		12 months	
	No.	%	No.	%	No.	%	No.	%
Severe	33	70.2	0	0.0	0	0.0	0	0.0
Moderate	12	25.5	12	25.5	7	14.9	1	2.1
Mild	2	4.3	19	40.4	18	38.3	10	21.3
Very mild	0	0.0	16	34.0	17	36.2	29	61.7
none	0	0.0	0	0.0	5	10.6	7	14.9

Table 2: Have been limping when walking because of hip.

	One month		3 months		6 months		12 months	
	No.	%	No.	%	No.	%	No.	%
All of the time	47	100.0	0	0.0	0	0.0	0	0.0
Around the house only	0	0.0	11	23.4	8	17.0	2	4.3
5 to 15 minutes	0	0.0	22	46.8	7	14.9	6	12.8
16 to 30 minutes	0	0.0	14	29.8	27	57.4	25	53.2
No pain for 30 minutes or more	0	0.0	0	0.0	5	10.6	14	29.8

Severe pain was observed among majority of the patients at one month (70.2%) which became mild (40.4%) and moderate (34%) at 3 months. Very mild pain was found in 36.2% patients at 6 months and in 61.7% at 12 months (Table 1).

The limping was all the time among all the patients at one month. However, the limping was found often in 46.8% at 3 months and sometimes in 57.4% at 6 months and 53.2% at 12 months (Table 2).

The 'walking time' of patients i.e., how long have been able to walk before the pain in hip becomes severe, was noted. No patient could walk without severe hip pain at one month, 51.1% were able to walk 5-15 minutes at 3 months, 16-30 minutes (63.8%) at 6 months and 55.3% at 12 months (Table 3).

The disability of patients caused by pain interfering in their usual work, including household work was noted. All the patients had pain interfering in usual work at one month. However, 74.5% had moderate pain at 3 months, 61.7% had a little bit difficulty at 6 months and 53.2% had no difficulty at all at 12 months (Table 4).

Table 3: For how long have been able to walk before the pain in hip becomes severe (with or without a walking aid).

	One month		3 months		6 months		12 months	
	No.	%	No.	%	No.	%	No.	%
Not at all	47	100.0	0	0.0	0	0.0	0	0.0
Around the house only	0	0.0	3	6.4	1	2.1	1	2.1
5 to 15 minutes	0	0.0	24	51.1	9	19.1	2	4.3
16 to 30 minutes	0	0.0	20	42.6	30	63.8	26	55.3
No pain for 30 minutes or more	0	0.0	0	0.0	7	14.9	18	38.3

Table 4: How much has pain from hip interfered with usual work, including housework.

	One month		3 months		6 months		12 months	
	No.	%	No.	%	No.	%	No.	%
Totally	47	100.0	0	0.0	0	0.0	0	0.0
Greatly	0	0.0	3	6.4	1	2.1	1	2.1
Moderately	0	0.0	35	74.5	9	19.1	7	14.9
A little bit	0	0.0	6	12.8	28	59.6	14	29.8
Not at all	0	0.0	3	6.4	9	19.1	25	53.2

Table 5: Severity of hip score.

	One month		3 months		6 months		12 months	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Severe	47	100.0	9	19.1	2	4.3	1	2.1
Moderate to severe	0	0.0	22	46.8	7	14.9	1	2.1
Mild to moderate	0	0.0	16	34.0	27	57.4	13	27.7
Satisfactory joint function	0	0.0	0	0.0	11	23.4	32	68.1

Table 6: Comparison of hip score according to long and short nail at 1, 3, 6 and 12 months.

Follow up	Hip score (Mean±SD)						
	Long intertan (n=7)	**Long PFNA (n=2)**	**Long PFNA2 (n=24)**	**Short intertan (n=3)**	**Short PFNA2 (n=8)**	**Long sirus nail (n=3)**	**P value**
1 month	1.42 0.53	1.50 0.70	1.75 1.39	2.00 0.00	1.37 0.51	2.00 0.00	0.82
3 months	22.14 9.40	24.50 0.70	26.91 5.71	34.33 4.72	25.25 7.83	20.00 6.92	0.14
6 months	29.42 8.92	35.50 0.70	34.66 6.81	41.00 3.46	33.12 8.02	27.33 10.7	0.11
12 months	35.85 7.42	44.00 1.41	40.62 4.70	45.33 1.52	40.62 5.60	32.00 15.13	0.06

Kruskal-Wallis test.

The change in severity of hip score from one month to subsequent follow-ups was noted. The hip score was found to be severe among all the patients at one month. However, moderate to severe hip was in 46.8% patients at 3 months, mild to moderate was in 57.4% at 6 months and satisfactory joint function was in 68.1% at 12 months (Table 5).

The comparison of Hip score according to long or short nail at one 3, 6 and 12 months showed no difference.

DISCUSSION

Dynamic hip screw fixation is the gold standard for the treatment of stable intertrochanteric femur fractures.[10-12] The treatment of unstable intertrochanteric femur fractures still remains controversial. For this reason, we aimed to perform role of Cephalomedullary nail in proximal femoral fractures. The proximal femoral intramedullary nail provides more stability and allows for earlier weight bearing than the locking plate when used for the treatment of unstable intertrochanteric fractures.[13]

Early operative treatment of trochanteric fractures reduces both the mortality and morbidity giving best chance of early independency and reducing the risks of prolonged bed rest.[14-17] Nowadays, proximal femur fracture is labeled as stable, if the posteromedial cortex is intact and valgus angulation is maintained.[18]

The optimal fixation device is still controversial at present. Many authors compared the intramedullary nail (IMN), which involved gamma nail, intramedullary hip screw (IMHS), and PFN, with sliding hip screw (SHS) for treatment of extracapsular proximal femoral fractures and concluded no statistically significant difference in the cut-out rate while total failure rate and re-operation rate were greater with IMN.[19-21] In another similar study, authors concluded no significant difference between the groups in terms of blood loss and transfusion, fixation complications, and post-operation complications and hospital stay.[22]

Comparative studies show that failure of fixation occurs at approximately the same frequency for intramedullary and extra- medullary devices, and that intramedullary nails have the added disadvantage of being associated with femoral shaft fractures.[17,23-25] In most prior studies, first generation intramedullary nails were used and had proximal nail diameters of 17 mm, available distal diameters between 12 and 16 mm, mediolateral curvature of 10° and a length of 200 mm. These nails required 2 mm over reaming of the femoral medullary canal for easier insertion and this may have been an explanation of the high incidence of secondary fractures intraoperatively.[26] The cephalomedullary nails like gamma nail, proximal femoral nail attempts to combine the advantages of a sliding lag screw with those of intramedullary fixation while decreasing the lever arm as compared with that of a sliding nail plate system. It can be inserted by a closed procedure, which retains the fracture haematoma, an important consideration in fracture healing and reduces both the exposure and dissection thereby reducing the chances of infection and morbidity.

The fact that the gamma Nail is said to be more rigid and to allow full weight bearing earlier than the dynamic hip screw even in cases of very complex fractures, and that dhs fixation requires more extensive surgery than GN fixation did not have any marked effects on the functional outcome. Similar results have also been reported by Hoffman and Lynskey.[27] However cephalomedullary nailing is theoretically the most stable and least invasive method of fixation. Biomechanical examinations have shown that intramedullary devices might be superior to plating systems, especially in unstable extracapsular fractures.[28,29] The rate of failure of fixation in our patients lies in the range reported by other authors using other intramedullary nails. Failure of fixation is related to the quality of fracture reduction and positioning of the screws. The supero-medial quadrant of the femoral head has been identified as a high-risk zone for cutouts[30,31]

The aim of our study was to assess the functional outcomes of cephalomedullary nail in proximal femoral fractures with this newer method of intramedullary fixation with proximal femoral nail. In an experimental study Gotze et al compared the load ability of osteosynthesis of unstable intertrochanteric fractures and found that the PFNA could bear the highest loads among all the devices.[4] Menezes et al studied 155 patients treated with proximal femoral nail, reported failure of fixation in 2%, femoral shaft fractures in 0.7%.[32] In our study there was one case of implant failure and one case of nonunion. Most of the study has compared the outcome of intramedullary nail radiologically or by Harris hip score method, we tried the same with simple set of 12 questionnaires as per Oxford knee score which shows the comparison of severity of hip score from one month to subsequent follow-up till 1 year. Robinson et al did a study of cephalomedullary nailing of subtrochanteric fractures caused by low – energy trauma and found favourable functional outcome.[33] Hong et al similarly compared the functional outcome of the long and short cephalomedullary nails in the treatment of osteoporotic pertrochanteric fracture and found no significance difference in clinical and functional outcome of the patients treated with long and short cephalomedullary nail.[34] In our study, all the 12 parameters of Oxford hip Score including presence of limp, the walking time before appearance of severe pain and interference of pain in normal day to day activity was considerably high at one month but subsided significantly at 3 months, 6 months and one year follow up. Hip score was severe in all the patients at one month, moderate to severe hip in 46.8% patients at 3 months, mild to moderate was in 57.4% at 6 months and satisfactory joint function was in 68.1% at 12 months. Considering that in unstable proximal femoral fractures, a sliding hip screw with side plate doesn't prevent medialisation of distal fragment and overall doesn't provide so stable construct to allow early mobilisation and weight bearing, cephalomedullary nails provided better results in form of early weight bearing and quick restoration to normal day to day activities. Therefore the results and functional outcome of cephalomedullary nails were good and satisfactory. Cephalomedullary nails with adequate technique so that the lag screws by purchase in the centre-centre or posterior-inferior quadrant combines the benefit of sliding hip screw as well as intramedullary implants. So we recommend the use of cephalomedullary nails in proximal femur fractures especially the unstable fractures.

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