

A Prospective Interventional Study on the Functional and Radiological Outcome in Vertical Angle Femoral Neck Fractures in Young Adults Treated by Lag Screw with Dynamic Hip Screw

Kanti Lal Roat, Narendra Joshi, Rakesh Dhukia, Mayank Ganeshani, Shivendra Rathore

Abstract: ***Introduction:** The vertical angle fractures (Pauwels type III) are a challenging clinical scenario to manage and are more commonly encountered in young patients. With proper patient selection, proper instruments, quality image intensifier and standard surgical technique, Dynamic Hip Screw along with a lag screw is a highly rewarding surgery in Pauwels type III fracture neck of femur in patients where we want to preserve the femoral head. **Methodology:** This prospective study was conducted on 40 cases with Pauwels type III fractures neck of femur coming to casualty of Sawai Man Singh Medical College and Hospital Jaipur (Rajasthan) during the study period from July 2020 to September 2022. 135 degree Dynamic Hip Screw (DHS), 6.5mm & 16mm partially threaded cancellous screws were used as implants. Depending upon the position of comminution as evident on CT scan insertion of screws was done. Follow up was done at 2 weeks, 4 weeks, 8 weeks, 12 weeks, 24 weeks and 1 year. Harris Hip Score was measured at the end of 1 year. **Result:** Mean age of the patients was 38.28±9.39 years. M: F ratio of 7: 3. Mean Harris Hip Score was 89 with the maximum score being 100 and the minimum score being 83. On the basis of patient's own assessment, Out of 40 patients, 28 (70%) patients graded themselves as excellent grade followed by 12 (30%) patients who reported as good. 28 (70%) patients reported no pain post - surgery. Only 9 (22.5%) study participants reported requirement of single cane for long walking for a period of three to six months. On climbing stairs after surgery, 19 (47.5%) required support of railing. Among 40, 28 (70%) patients post - surgery can wear shoe and shocks with ease & 35 (95%) of the patients can sit in ordinary chair for one hour post - surgery. **Conclusion:** After studying thoroughly, one can safely conclude with proper patient selection, proper instruments, quality image intensifier and standard surgical technique, Dynamic Hip Screw along with a lag screw is a highly rewarding surgery in Pauwels type III fracture neck of femur in patients where we want to preserve the femoral head.*

Keywords: Pauwels type III, Fracture neck of femur, Lag screw, Dynamic hip screw, Vertical high shear Fracture neck of femur

1. Introduction

Femoral neck fractures are those that occur between the femoral head and the basal region of the femoral neck. These fractures are encountered mainly in elderly population due to osteoporosis^{1, 2}. But high energy trauma in young population can lead to vertical angle type of femoral neck fractures. Pauwels classification, which was initially introduced in year 1935 is an important classification for fracture neck of femur. The Pauwels type III fractures (vertical angle fracture) have a verticality of more than 50 degrees^{3, 4}.

The vertical angle fractures are a challenging clinical scenario to manage and are more commonly encountered in young patients⁵. These fractures are susceptible to high degree of shear forces & are both axially and rotationally unstable which complicate their management and result in complications such as varus collapse of the neck of femur, non - union and osteonecrosis of the femoral head⁶.

Surgical management of neck femur fractures is very challenging where the management plan depends on various factors like age, activity level, type of fracture and bone density. Management protocol of femoral neck fractures has been debated over many years with the aim of either preserving the head or replacing it^{7, 8}. Osteosynthesis either with multiple cannulated screws (MCS) or dynamic hip screw (DHS), hemiarthroplasty or total hip replacement are the surgical management options available⁹.

In younger age group, reoperation and salvage procedures like osteotomy and arthroplasty are not advocated due to high level of activity. Therefore, anatomic reduction and stable internal fixation are essentials for achieving the goals of treatment in this young population allowing preservation of the femoral head while minimizing rates of non - union and avascular necrosis¹⁰. Biomechanical studies have indicated that fixed angle Dynamic hip screw constructs are stronger than multiple cannulated screws especially in high energy vertically oriented femoral neck fractures (Pauwels type III)¹¹.

This study is done to assess the outcome of a technique for management of vertical fractures of the neck of femur utilizing computed tomography (CT) followed by the employment of the lag screws and a dynamic hip screw (DHS) plate.

2. Methodology

This prospective study was conducted on all the patients with fracture neck of femur coming to casualty of Sawai Man Singh Medical College and Hospital Jaipur (Rajasthan) during the study period from July 2020 to September 2022. Patients were carefully evaluated & after applying inclusion & exclusion criteria, 40 cases with Pauwels type III fractures neck of femur were selected for the study. Required permission of ethical committee & written consent from all the patients were taken.

Inclusion Criteria:

- Patient with age between 18 - 60yr
- Recent trauma
- Pauwels type III fractures neck of femur
- No other associated bony injury

Exclusion Criteria:

- Patients with age <18 and >60yrs
- Neglected fractures
- Patients with metabolic bone disorders, pathological fractures or neuromuscular disorders.
- Pauwels type I and II fractures
- Patient not fit for surgery

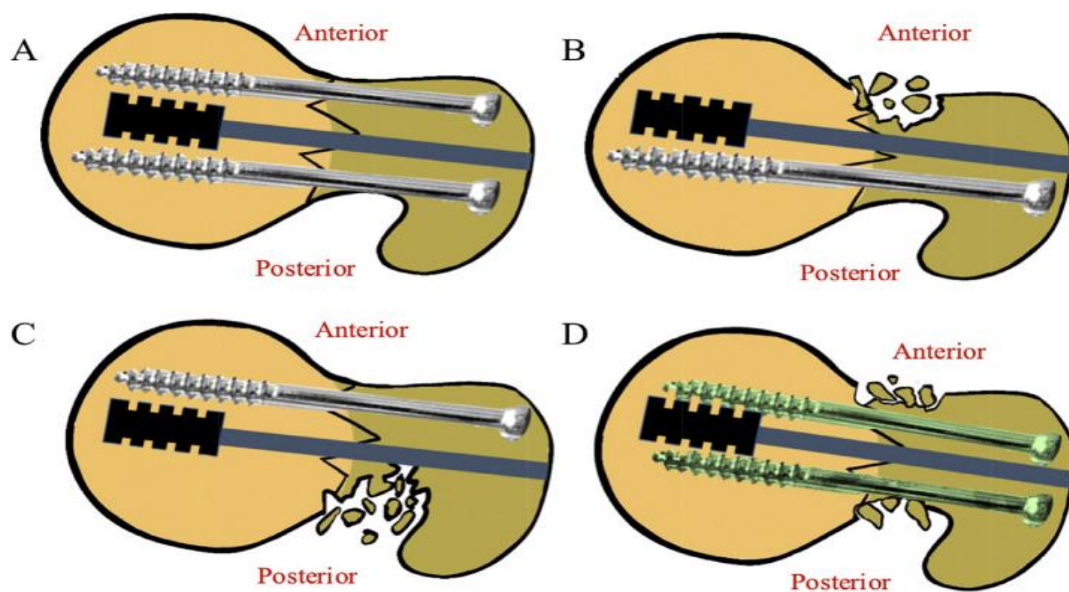
Pre - operative care

All the patients were evaluated in the casualty & life threatening conditions with underlying fractures were

managed. Immobilization of affected extremity and skin traction was applied for pain relief. After stabilization of vitals, X - ray & CT scan of the affected extremities were carried out. The fracture pattern was grouped according to classification/inclusion criteria. All the routine investigations & pre - anaesthetic examination was done.

Surgical technique

Patient was put on a fracture table in a semilithotomy position. Flynn's manoeuvre was performed to achieve reduction. 135 degree Dynamic Hip Screw (DHS), 6.5mm & 16mm partially threaded cancellous screws were used as implants. Incision was made at the vastus ridge and extended distally from the lower border of greater trochanter. Depending upon the position of comminution as evident on CT scan, there can be four scenarios for insertion of screws -



(Jacob G, Pai S, Huggi V, Kotekar MF, Yogesh K, Kumar MA, Tirumalesh GN, Shetty MS. Lag screw with DHS (LSD) for vertical angle femoral neck fractures in young adults. *Injury*.2020 Nov; 51 (11): 2628 - 2633. doi: 10.1016/j.injury.2020.07.050. Epub 2020 Jul 25. PMID: 32739149.)

- 1) There is no comminution in either cortex therefore lag screws are inserted in both cortices along with the DHS implant to prevent collapse.
- 2) There is comminution in the anterior cortex therefore a lag screw is placed in the posterior cortex along with the DHS implant to prevent collapse.
- 3) There is comminution in the posterior cortex therefore a lag screw is placed in the anterior cortex along with the DHS implant to prevent collapse.
- 4) In this scenario there is comminution in both cortices the same screws were applied as position screws in which case final tightening of these screws were carried out after DHS tightening. These are placed to hold the fracture reduction while inserting the DHS implant to prevent collapse.

Postoperative care

Broad - spectrum antibiotics coverage was given and regular dressing was done under sterile environment. Postoperative early mobilization of hip joint with non - weight bearing was

encouraged. Clinical follow up was done at 2 weeks, 4 weeks, 8 weeks, 12 weeks, 24 weeks and 1year & every patient was assessed clinically regarding hip and knee function, walking ability, fracture union and deformity. Harris Hip Score was measured at the end of 1year. X - ray of the involved hip with femur was done to assess fracture union and implant bone interaction was done before full weight bearing walking.

Harris hip scoring (modified)

- Maximum points possible - 100
- Pain relief - 44
- Function - 47
- Range of motion - 5
- Absence of deformity - 4

Total Harris hip score:

- 90 - 100 - Excellent
- 80 - 89 - Good
- 70 - 79 - Fair

- <70 – poor

3. Result

The present study was done on 40 cases of Pauwels type III fractures neck of femur came to casualty of Sawai Man Singh Medical College and Hospital Jaipur (Rajasthan) during the study period from July 2020 to September 2022. Out of 40, 37 (92.5%) of the patients belong to the age group of 30 - 50 year. Mean age of the patients was 38.28±9.39 years. Among 40 patients, 28 (70%) were males and 12 (30%) were females, with M: F ratio of 7: 3.

Mode of injury was road traffic accident in 36 (90%) and 4 (10%) were from FFH. Out of all the 40 patients, 29 (72.5%) had involvement of right side & rest 11 (27.5%) had left side involvement. In majority of the participants, 33 (82.5%) had posterior fracture comminution on CT scan and only seven (17.5%) had anterior fracture comminution on CT scan.

Out of 40, 28 (70%) patients reported no pain post - surgery followed by 12 (30%) patients who had slightly occasional pain & no compromise in activities. In the present study only 9 (22.5%) study participants reported requirement of single cane for long walking rest 31 (77.5%) required no support while walking. Among all the patients no limping was seen in 35 patients while slight limping was present in 5 (12.5%).

On climbing stairs after surgery, 19 (47.5%) required support of railing. Among 40, 28 (70%) patients post - surgery can wear shoe and shocks with ease followed by 12 (30%) who can wear shoe and shocks with difficulty. None of the patients had any problem while entering in public transport post - surgery. Majority (95%) of the patients can sit in ordinary chair for one hour post - surgery while only five (5%) can sit in high chair for one half hour. Among 40, 36 (60%) of patients post - surgery can walk to unlimited distance while (40%) patients can walk up to six blocks of distance.

In our study, mean Harris Hip Score was 89 with the maximum score being 100 and the minimum score being 83. On the basis of patient's own assessment, out of 40 patients, 28 (70%) patients graded themselves as excellent grade followed by 12 (30%) patients who reported as good.

Only one patient presented with lag screw pullout, 3month after surgery who was then treated with screw removal. On radiological assessment of the fracture union, 19 (47.5%) had union of the fracture at 12 weeks followed by 14 (35%) patients at 14 weeks & only 7 (17.5%) patients had union by 16 weeks.

4. Case Illustration

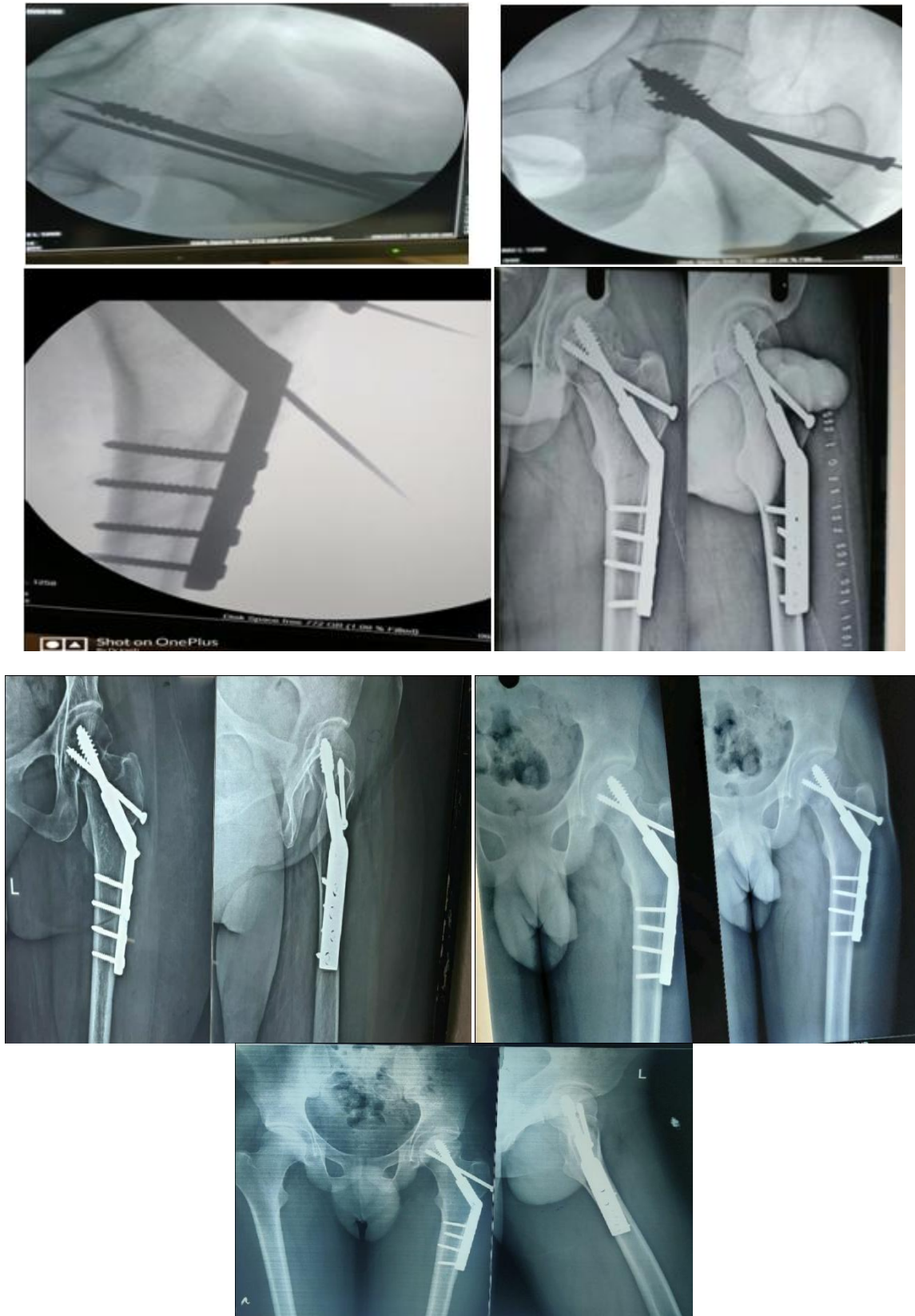
Case 1: Gulshan 22yr Male

Mode of injury - Fall from Height

Harris Hip Score

EXCELLENT





Case example with posterior cortical comminution A: Preoperative xray and Coronal CT Scan shows a vertical pauwels type III vertical fracture. The axial image shows comminution in posterior cortices B: Intraoperative. C - arm images in showing 2 perpendicular holding screws and DHS in situ C: post - operative radiograph showing satisfactory fracture reduction and position of implant D: post - operative xray and 3, 6 & 12 month post - operative Xray showing

union at the fracture site with implants in situ (Abbreviation: Dynamic Hip screw: NOF, Neck of Femur: GT Grater Trchanter)

5. Discussion

Vertical femoral neck fractures are mostly caused by high - energy trauma. Due to the unstable nature of the fracture,

chances of complications during the management are high. Including conservative management, there are many surgical management options available like osteosynthesis either with multiple cannulated screws (MCS) or dynamic hip screw (DHS), hemiarthroplasty or total hip replacement are the available. The current study is focused on the clinical and radiological outcomes in Pauwels type III fracture neck of femur fixation using dynamic hip screw along with derotation screw.

Out of total 40 patients included in the current study, 37 (92.5%) of the patients belong to the age group of 30 - 50 year. Mean age of the patients was 38.28±9.39 years. Among 40 patients, 28 (70%) were males and 12 (30) were females. In majority of the participants 33 (82.5%) had posterior fracture comminution on CT scan and only seven (17.5%) had anterior fracture comminution on CT scan.

Similar study was done by George Jacob et al., in which operated 15 patients less than 60 years old with vertical high shear angle neck of femur fractures in which ten of these patients were male and five female with a mean age of 42.6 (26 - 60) years. Of the 15 patients, 13 (86.6%) had some degree of comminution identified on CT scan. Of these 13 patients, 3 (23%) had comminution in the anterior cortex, 4 (30.7%) in the posterior cortex and 6 (46.1%) comminution in both cortices⁵.

In a study done by Karl Stoffel et al. he concluded that among all 207 patients, the Harris hip score was 86.2 ± 18.9 (range 10–100) & 88.4% were pain free, 83.6% had good mobility, 80.7% of patient were able to put shoes and socks with ease¹². Similarly in the present study, mean Harris Hip Score was 89 with the maximum score being 100 and the minimum score being 83. Out of 40, 28 (70%) patients reported no pain post - surgery followed by 12 (30%) patients who had slightly occasional pain & no compromise in activities. In the present study only 9 (22.5%) study participants reported requirement of single cane for long walking. Among all the patients no limping was seen in 35 patients while slight limping was present in 5 (12.5%). Among 40, 28 (70%) patients post - surgery can wear shoe and shocks with ease followed by 12 (30%) who can wear shoe and shocks with difficulty. None of the patients had any problem while entering in public transport post - surgery.

In a study done by Samsami S, et al for experimental testing on cadaveric bone samples and finite element analysis (FEA) for three fracture fixation techniques, namely cannulated screws (CSs), dynamic hip screw with derotational screw (DHS + DS), and proximal femoral locking plate (PFLP) showed that results of bone - implant stiffness, average femoral head displacement, failure load, failure energy, and relative position of the fractured fragments indicated that DHS + DS offers the strongest structure for stabilizing a vertical femoral neck fracture¹³.

Sameer gupta et al. in their study on 60 patients of fracture neck of femur stated that with the use of Dynamic hip screw, the desirable valgus orientation could be achieved at the fracture site. In their study, bone union was achieved in 56 patients after a mean of 3.9 (range, 3–5.5) months (Figs.2

and 3). The mean Harris hip score improved from 65 to 87.5. Outcome was excellent in 30 patients, good in 24, and poor in 6 patients¹⁴. In the current study union was achieved in all the patients with, 19 (47.5%) had union of the fracture at 12 weeks followed by 14 (35%) patients at 14 weeks & only 7 (17.5%) patients had union by 16 weeks.

Studies done by Azhar Lakhani et al¹⁵ & Baitner et al¹⁶ also showed that use of Dynamic Hip screw provides good results due better compression across the fracture site & less shearing displacement leading to early mobilization and better results.

6. Conclusion

In the present study, 40 patients with Pauwels type III fracture neck of femur were surgically managed dynamic hip screw along with lag screw on the basis of antero - posterior comminution on CT scans. Head preserving procedure such as Dynamic hip screw placement is a better option than arthroplasty in young patients because of higher level of activity required in younger age group. Dynamic hip screw has the advantage of preventing collapse at the fracture site as the lag screw slides in the barrel as the person bears weight. After studying thoroughly, one can safely conclude with proper patient selection, proper instruments, quality image intensifier and standard surgical technique, Dynamic Hip Screw along with a lag screw is a highly rewarding surgery in Pauwels type III fracture neck of femur in patients where we want to preserve the femoral head.

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