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# Role of Dynamic Hip Screw in the Management of Trochanteric Fractures of the Hip

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**ABSTRACT**

A study of the management of trochanteric fractures of the hip using dynamic hip screw is carried out to note the difficulties (technical errors) and associated fracture complications arising out of its use, and to assess the functional results obtained in treating trochanteric fractures with DHS. Technical errors in terms of inadequate fracture reduction and poor placement of lag-screw and barrel plate are noted, associated deficiencies identified and preventary techniques evaluated. Fracture complications occurring in trochanteric fractures fixed with DHS with technical errors and without technical errors are recorded and the seriousness of the technical error estimated. Functional results in terms of pain, gait, range of movement, shortening and time taken to return to pre-injury functional status are assessed and overall functional results evaluated. This is mainly to confirm the efficacy of dynamic hip screw in fixing trochanteric fractures.

## INTRODUCTION

Classically, an intertrochanteric fracture occurs along the line between the greater and lesser trochanters however all fractures occurring from basal region of the neck i.e., extra capsular part of neck of the femur to level of the lesser trochanter are classified as trochanteric fractures. They account for nearly half of all the fractures of the proximal femur; while the proximal femur fractures themselves constitute upto 30% of all Orthopaedic Admissions.

Trochanteric fractures primarily occur in the Elderly (Seventh & Eighth decades), following minor injuries as slip and fall; with decreasing trends in mortality rate and increase in the percentage of the older age group, the incidence of these fractures is increasing especially comminuted unstable types. These fractures also occur in younger patients, following a history of violent injury as Motor Vehicle accidents or fall from a height; with the advent of urbanization and increased use of Mechanized transport, these fractures are becoming common in the younger age group also.

Fortunately for these fractures union is not a problem due to the cancellous nature of the bone at the fracture site with excellent blood supply and a wide cross-sectional area at the fracture site. Therefore the Trochanteric fracture will unite whether treated by conservative methods or by operative methods. But with conservative treatment, marked varies displacement of the Head and Neck of the femur, with an associated external rotation deformity resulting in a short-leg gait with limp occurs. Also prolonged immobilization with enforced bed rest in the elderly, required in conservative treatment, can result in secondary complications of Pneumonia, Pressure-sores over sacrum and heel, Thrombo - embolic disease, urinary tract infections, etc. Thus the goal of the surgical treatment is to prevent malunion and early mobilization of the patient avoiding the ills of enforced bed rest.(2)

Concerning Operative treatment Modalities, a stable trochanteric fracture will unite with good result irrespective of the type of the implant used. But in the unstable intertrochanteric fractures best results are obtained with sliding Screw-plate devices and it is here the role of sliding compression hip Screw is best appreciated. The growing familiarity with the technique, affordable prices of the sliding compression hip screw have led to its increasing use in the recent years.

## MATERIALS AND METHODS

The present Thesis work involves a postoperative study of 25 cases of Trochanteric fractures treated surgically in the department of orthopaedics, Government General Hospital, Rajiv Gandhi institute of medical sciences to assess the functional results obtained in fixing trochanteric fractures with DYNAMIC HIP SCREW and to note the difficulties and complications arising out of the use of DHS implant.

Of the 32 cases of trochanteric fractures treated surgically with Dynamic Hip screw fixation between October 97 to September

99, 7 cases were excluded due to incomplete records and irregular follow up, and 25 cases considered for this study. Measure taken in the acute stage for haemodynamic stabilization of the patient due to the fracture or due to other reasons are not considered. The patients ambulatory status before the injury is considered. *Evans* fracture classification was used for analysis. Functional results were accessed using *Evans* criteria.

**Method of treatment:**

On admission to the hospital, immediate immobilization of fractured limb with Buck's traction with about 5 pounds weight is done to give comfort to the patient and to prevent further soft-tissue damage. After the limb is immobilized, (radiographs are taken to confirm the diagnosis delineate the fracture pattern and the quality of Bone present. All the fractures are classified according to *Boyd* & *Briffin; Evans* and A O classification systems. All routine investigations are done for Anaesthetic fitness.

If operative treatment is considered, the following factors, which determine the strength of fracture-implant assembly, namely the Bone quality, Fracture geometry, Fracture reduction, Implant design, and Implant placement were stressed upon. The anaesthesia employed is left to the Anaesthetists choice. Every patient is given prophylactic antibiotic of 1 gm parental ceftriaxone just before surgery. The surgery is carried out on fracture table under image intensifier control.

Postoperatively parental antibiotics are continued for 7 days. Wound inspection and suction-drain removal are done on the 3rd postoperative day. Quadriceps setting exercises and active ankle exercises are begun as soon as possible. From the 3rd postoperative day patient is allowed to sit and do active knee extension against gravity. Patients are discharged on the 10th postoperative day after suture removal.

**Postoperative advice:**

Patients are advised non-weight bearing with active hip, knee and ankle exercises or non-weight bearing with crutch walking from the day of discharge. Patients are reviewed at 6 weeks after surgery with fresh radiographs to monitor the progress of fracture union. Partial weight bearing using tripod walker is advised at 6-8 weeks postoperatively. However in old UN cooperative patients, in fractures with technical errors at implant fixation, and in patients with grossly osteoporotic bones, weight - bearing is not advised until 12 weeks of postoperative period.

All patients are reviewed again at 12 weeks postoperatively to check for fracture union with fresh radiographs. After confirming fracture union, the patients are allowed protected full-weight bearing with the support of a walking stick. They are advised to continue physiotherapy exercises throughout the postoperative period. This standard regime is delayed in cases where the fracture has not yet united, especially in comminute unstable trochanteric fractures and in fractures with technical errors at implant fixation.

Following radiological fracture union, the patients are followed up every 2 months for the first year. The range of movements achieved is noted. Patient is evaluated specifically for complaints such as limp, pain, shortening, ability to sit cross-leg and squat and whether he or she has gone back to pre-injury functional status and occupation. Thus overall functional assessment done. Implant removal is done 1 to *11/2* years after surgery especially in younger patients and in patients with technical complications. Protected weight bearing is done for 4 to 6 weeks after implant removal. *Evans* criteria for evaluation of functional results in patients with trochanteric fractures is done at 6 months postoperatively.

## OBSERVATIONS AND ANALYSIS

**1. Age & Sex Distribution:**

| Range in years | No. of Males | No. of Females | Total No. of Age Group | Percentage |
|---|---|---|---|---|
| **Below 20** | **0** | **0** | **0** | **0** |
| **20-29** | **1** | **0** | **1** | **4** |
| **30-39** | **1** | **1** | **2** | **8** |
| **40-49** | **6** | **1** | **7** | **28** |
| **50-59** | **2** | **3** | **5** | **20** |
| **60-69** | **5** | **2** | **7** | **28** |
| **70-79** | **1** | **2** | **3** | **12** |
| **TOTAL** | **16** | **9** | **25** | **100** |

The age of the patients ranged from 24 years to 75 years. Of the 25 patients taken up for study 16 were males and 9 were females. The ratio of females to male according to Western studies ranges from 2:1 to 8:1. This ratio in India is unity or even reversed *(Mohanty* and *Chacko).* Western series comment that the preponderance of females is due to postmenopausal osteoporosis. The mean age was 52.8years .yhe mean age of male patients was 50.5years.the mean age for female patients was 56.7years.

**2. Occupation status of patients:**

| occupation | No. of Cases | Percentage |
|---|---|---|
| Household | 16 | 64 |
| Sedentary work | 2 | 8 |
| labourer | **7** | **28** |

Patients who were households were more commonly affected with trochanteric fractures mainly due to old age ,and probably household have greater muscular atrophy with decreased joint hold and tendency to fall.

**3. BUILT:**

| Type of Built | No. of Cases | Percentage |
|---|---|---|
| Thin | 13 | 52 |
| Moderate | 10 | 40 |
| Heavy | 2 | 8 |

Thin built patients were noted to be more commonly affected with trochanteric fractures probably because they have lesser thickness in soft tissue cover over the trochanter leading to greater forces being transmitted to the bone during a fall.

**4. Side of injury:**

| Side of Injury | Male | Female | Total | Percentage |
|---|---|---|---|---|
| **Right** | **11** | **6** | **17** | **68** |
| **Left** | **5** | **3** | **8** | **32** |

There is relatively high incidence of trochanteric fractures involving right hip noted in both sexes (2:1 ratio).

**5. Mechanism of injury:**

| Mechanism | No. of Cases | Percentage |
|---|---|---|
| Slip and Fall | 14 | 56 |
| RTA | 6 | 24 |
| Fall from a height | 3 | 12 |
| Others | 2 | 8 |
| Total | 25 | 100 |

Slip and fall (56%) accounts to be the commonest mechanism of injury with trochanteric fractures involving elderly patients, whereas road traffic accidents and fall from a height are the two common mechanisms occur in younger patients with trochanteric fractures.

**6. Incidence based on various fracture classification systems:**

**(a) Boyd & Griffins**

| | Type I | Type H | Type ffl | Type IV | Total |
|---|---|---|---|---|---|
| Number of Cases | 8 | 14 | 0 | 3 | 25 |
| Percentage | 32 | 56 | 0 | 12 | 100 |

**(b) Evans classification**

| | Type I | | | | Type H |
|---|---|---|---|---|---|
| | Sub Type 1 | Sub Type 2 | Sub Type 3 | Sub Type 4 | |
| Number of cases | 8 | 8 | 4 | 5 | 0 |
| Percentage | 32 | 32 | 16 | 20 | 0 |

**c) A O Classification**

| | A1 | | | A2 | | | A3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1.1 | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 3.3 |
| No of cases | 6 | 6 | 0 | 7 | 3 | 2 | 0 | 0 | 1 |
| Percentage | 24 | 24 | 0 | 28 | 12 | 8 | 0 | 0 | 4 |

In *Boyd* and *Griffin* classification system Type I fractures are stable, fracture Types III and IV are unstable, and fracture type II is either stable or unstable depending upon the Postero-medial cortical comminution. *Evans* fracture Type I subtypes 3 & 4 and Type II are unstable while A O fracture type A2 & A3 are unstable. *Evans* classification system is being used in this thesis work to evaluate trochanteric fractures as it is a simple classification and this is the most accurate system in predicting the possibility of both anatomical reduction and secondary fracture displacement after internal fixation, leads to better decision making in fixing these fractures and permits a more accurate prediction of prognosis. Based on *Evans* classification system 64% of trochanteric fractures in this study are stable, 36% are unstable.

**7. Associated Medical Problems:**

| S.no | Medical Problem | No. of Patients | Percentage |
|---|---|---|---|
| 1 | Anemia | 8 | 32 |
| 2 | Diabetes Mellitus | 5 | 20 |
| 3 | Diastolic Hypertension | 6 | 24 |
| 4 | Hemiplegia (C.V.A) | 1 | 4 |
| 5 | Ischaemic heart disease | 3 | 12 |

Associated Medical problems were present in 50% of the patients. These were responsible for the delay in surgery in most cases, as these patients were not on any medication prior to injury.

**8. Associated Injuries:**

| S. no | Injury | No. of Cases | Percentage |
|---|---|---|---|
| 1 | Colles fracture | 2 | 8 |
| 2 | Surgical neck of Humerus | 1 | 4 |
| 3 | Ipsilateral fracture shaft femur | 1 | 4 |
| 4 | Fracture pelvis | 1 | 4 |

Associated injuries were present in 20% of the patients, and were treated accordingly.

**9. Type of Fracture reduction:**

| | | | |
|---|---|---|---|
| 1 | Closed reduction | 20 cases | 80% |
| 2 | Non anatomical stable reduction by means of medial displacement osteotomy *(Dimon* and *Hughstori* | *5* cases | 20% |

Emphasizing that restoration of medial continuity is essential to successful internal fixation of three and four-part intertrochanteric fractures, *Dimon* and *Hughston* technique of osteotomy in the trochanteric area with Valgus nailing and medial displacement to improve stability was done in 5 cases. Trochanteric part is then fixed again to the shaft by means of a

wire loop in a figure of 8 fashion to prevent post operative weakness of abductor mechanism. Even though this technique is inferior over anatomical reduction internally fixed with a sliding compression hip screw, still occasionally useful in some extremely comminuted fractures where anatomical reduction is not feasible. However, the surgeon must be willing to accept the shortening and possibly a limp when choosing osteotomy to stabilize an intertrochanteric fracture.

**10. Operative procedure:**

| s.no | Operative procedure | No. of cases | Percentag |
|---|---|---|---|
| 1 | D.H.S (4 to 5 holes side | 23 | 92 |
| 2 | D.H.S + Bone grafting | 1 | 4 |
| 3 | D.H.S + Long DCP femur | 1 | 4 |

Most intertrochanteric fractures were fixed with 135° barrel-plate with 4 or 5 holes. In 2 cases 130° barrel-plate was used. Bone grafting was used in one patient with gross comminution of postero medial cortex.

**11. Length of lag-screw:**

| s. no | Length | No. of Males | No. of Females |
|---|---|---|---|
| i | 65 mm and less | 0 | 4 |
| 2 | 70mm | 1 | 4 |
| 3 | 75mm | 2 | 1 |
| 4 | 80mm | 8 | 0 |
| 5 | 85mm | 3 | 0 |
| 6 | 90mm | 2 | 0 |

Male patients required on an average 80mm length lag-screw to fix trochanteric fractures while in female patients 60 to 65mm lag-screw length was more often used.

**12. Mode of discharge:**

| s. no | Mode of Discharge | No. of Cases | Percentage |
|---|---|---|---|
| i | Non-weight bearing with hip, knee and ankle exercises | 10 | 40 |
| 2 | Non-weight bearing walking | 15 | 60 |

Patients with technical errors (20%) at fracture fixation, osteoporosis and in patients with an unstable reduction Non-weight bearing active exercises was advised. Patients with stable trochanteric fractures fixed with DHS without technical errors at fixation were advised non-weight bearing crutch walking postoperatively.

**13. Technical errors:** The total number of technical errors in terms of angulation deformities at he hip joint, inadequacy at reduction of unstable trochanteric fractures, poor lag-screw placement were 6. hi one patient both varus deformity of the hip and high placement of the lag screw occurred. Thus the total number of cases with technical errors were 5 amounting to 20%.All the cases of trochanteric fractures in this study were fixed with D.H.S under image intensifier control. Under "C" arm control probably the number of technical errors would have been much low.

**14. Fracture Complications**

| Sl. No | Complication | Fractures with technical | Fractures with out technical errors | Total |
|---|---|---|---|---|
| 1 | Medial migration of lag - Screw | 1 | 0 | 1 |
| 2 | Cutting out superiorly of lag - screw | 0 | 0 | 0 |
| 3 | Implant Failure | 0 | 0 | 0 |
| 4 | Coxa vara | 1 | 1 | 2 |
| 5 | Non union | 0 | 0 | 0 |

The total number of fracture complications noted in this study were 3 amount to 12%.Fracture complications in trochanteric fractures with technical errors at implant fixation were 2 (out of 5) amounting to 40%. Fracture complications in trochanteric fractures without technical errors was 1 (out of 20) amounting to 5%. One case of trochanteric fracture fixed with DHS with technical error of the medial migration of lag screw. The implant was removed 12 months post operatively. The two cases of Coxa vara were treated symptomatically with the elevation of sole of foot wear.

**POST-OPERATIVE COMPLICATIONS :**

| Sl. No | Complication | No. of cases | Percentage |
|---|---|---|---|
| 1 | Bed sores | 2 | 8 |
| 2 | Deep vein thrombosis | 0 | 0 |
| 3 | Urinary tract infection | 1 | 4 |
| 4 | Wound infection Deep Superficial | 0 2 | 0 8 |
| 5 | Post. Operative death | 0 | 0 |

The total number of post operative complications were 5 amounting to 20%.Both the cases of bed sores were superficial without sloughing of skin (Dermis) healed well in 10 days. The problem was noticed especially in old, fragile patients, more so when associated medical problems (eg Hemiplegia) that prevented them from change of position in bed. These bed sores were healed once they were able to sit and turn about comfortably in the post operative period. It was here noted the clear advantage of surgery over non operative treatment. Urinary tract infection occurred in one post operative patient with urinary catheter, were treated with catheter removal and antibiotics. Two cases of superficial infection responded to intermittent skin suture removal, antibiotics and regular dressings for 15 days.The risk of wound infection was noted to be high in patients with anemia, patients with prolonged operative time and profuse intra operative bleeding.

**REVISION SURGERY**

In one case with medial migration of lag screw (Joint Penetration) was operated around one year post operatively where in the implant was removed after fracture union.

**DURATION OF FOLLOW UP**

The average duration of follow up is 10 months, ranging from 26 months to 3 months. Minimum duration of follow up was 4 months, however in 1 case with 3 *[1]A* months follow up with pre-injury functional status recovery was included for the sake of completion of the series.

**RADIOLOGICAL ASSESSMENT**

**Fracture union:** Most cases of trochanteric fractures with Evans Type I (Sub types 1 & 2) were united within 3 to 4 months. Most cases of sub type 3 and 4 fractures united with in 4 months. In 3 cases with sub type 3 and 4, fracture union occurred in 5 months, all of them were due to technical errors while fracture fixation. (Inadequate reduction of fracture).

R/tPIQLQGiC/H ASSESS/KENT **(Evans classification used for fractures)**

| Modality assessed | | Type I | | | | Type II |
|---|---|---|---|---|---|---|
| | | S T - I | S T - 2 | ST-3 | S T - 4 | |
| 1 | Time for union | | | | | |
| | Upto 3 months | 5 | 3 | 1 | - | - |
| | 3 to 4 months | 3 | 5 | 2 | 1 | - |
| | 4 to 5 months | - | - | 1 | 4 | - |
| | beyond 5 months | - | - | - | - | - |
| 2 | Neck Shaft Angle After union | | | | | |
| | <120° | 2 | _ | _ | _ | - |
| | 121 to 130° | I | 1 | 2 | 2 | _ |
| | 131 to 140° | 5 | 7 | 2 | 3 | - |
| 3 | Medial Drift of Nil | 6 | 5 | 2 | 2 | - |
| | < 0.5 cm | 1 | 2 | 1 | 2 | - |
| | 0.6 to 1 cm | 1 | 1 | 1 | 1 | - |
| | > 1 cm | - | - | - | - | - |

**Neck - Shaft angle:** In most cases (68%) the neck shaft angle following fracture union was between 131° and 140°. In a few cases (24%) the neck - shaft angle was between 121 ° and 130 ° primarily due to fixation of the trochanteric fracture in a lower neck - shaft angle. In two cases the neck - shaft angle "was less than 120 (developed coxa vara deformity), one case was due to poor lag -screw placement.

**Medial Migration of Shaft Femur:** Medial migration of shaft of the femur, occurred in 10 cases of the present study. With collapse occurring at fracture site, in the process of development of fracture stability, medial migration of shaft was occurring on an average about 0.5 cm of medial shift was present.

**FUNCTIONAL RESULTS**

**(Evans classification used for fractures)**

| Modality assessed | | Type I | | | | Type |
|---|---|---|---|---|---|---|
| | | S T - 1 | S T - 2 | S T - 3 | S T - 4 | |
| 1 | PAIN No pain Slight & occasional Moderate pain Severe pain | 6 2 | 8 | 3 1 | 3 1 1 | · |
| 2 | GAIT Normal gait Painless limp Painful limp Inability to walk | 6 2 | 6 2 | 2 2 | 3 2 | · |
| 3 | RANGE OF MOVEMENT Normal range Near normal range Moderate restriction Gross restriction | 4 2 2 | 3 5 | 1 2 1 | 3 2 | · |
| 4 | SHORTENING Nil or < 1cm 1 to 2 cm. 2 to 5 cm >5 cm. | 6 1 1 | 4 4 | 2 2 | 5 | - |
| 5 | OVERALL FUNCTIONAL RESULT Excellent Good Fair Poor | 4 2 2 | 3 5 | 1 2 1 | 3 2 | M |

**FUNCTIONAL RESULTS:**

**Pain :** There was no pain in 80% of cases, slight and occasional pain in 12% of cases and in 8% (2 cases) moderate to severe pain was present. Moderate pain occurred in one case with technical error of fracture fixation and in another case severe pain occurred due to penetration of implant into the joint.

**Gait:** Normal gait was present in 56% of patients. Minimal painless limp, few using a stick was present in 36% of patients. 8% of patients required support of a stick and could walk only a few yards at a time due to pain in the hip.

**Range of movement** : Normal and near normal range of movement of the hip joint was present in 80% of cases. 12% of cases had moderate limitation in the range of movement. In 2 cases (8%) there was gross limitation of movements due to medial migration of implant in one case and due to fracture complication in another case.

**Shortening** : Normal limb length or negligible shortening (<1 cm) was present in 48% of cases. Slight shortening (1-2 cm) was present in 48% of cases. Moderate shortening (2-5 cm) was present in one case (4%). Gross shortening (more than 5 cm) was however absent. Shortening was noted in all cases where Dimon and Hughston medial displacement osteotomy was done to achieve medial cortical continuity. However the shortening

occurred was slight (1 - 2cm) and managed by heal raise. Shortening was noted to be related more to varus deformity of hip joint and much less to fracture comminution. There was about 1 to 2 cm shortening in cases of unstable ihtertrochanteric fractures occurring along with medial drift of shaft of femur. Shortening was absent in almost all cases in which the neck shaft angle was greater than 135°.

**Return to pre - injury functional status :** Most patients were able to return to pre - injury functional status with in 4 months. Patients with comminuted trochanteric fractures required 5-6 months.

**Overall functional results:** Excellent functional results were noted in 32% of cases, good results in 48% of cases, fair results in 12% of cases, and poor results in two cases (8%).

The two cases with poor functional results were due to joint penetration of implant in one, technical error of inadequate fracture reduction in another case noted. Fair results occurred in 3 cases; two cases had coxa vara deformity and moderate limitation of joint movements, one case of unstable trochanteric fracture with technical error of inadequate fracture reduction.

## DISCUSSION

### PRESENT STUDY

Trochanteric fractures constitute a large portion of old age fractures. 25 cases were taken up for study after excluding 7 cases with incomplete records and irregular follow up. The average age of the patients was 52.8 years. The male female ratio is 1.8 :1.Patients were followed up for an average duration of 10.1 months. An analysis of pre injury functional status of the patients reveals that most of them were house holds and relatively thin built. Slip and fall accounts to be the commonest mechanism of injury with trochanteric fractures. Both conservative and operative regime yield comparable results and each has its own advocates. Conservative treatment usually leads to union in unacceptable position in addition to prolonged bed rest with all its accompanying ills viz., bed sores, stiff knee, disuse osteoporosis, late drift into varus, not to mention the cost of hospital stay and the loss of working days for the patient.

Using Evans classification system 64% of trochanteric fractures in this study were stable, and 36% were unstable. Associated medical problems were present in 50% of the cases. These were responsible for the delay iri surgery in most cases, as these patients were not on any medication prior to 'surgery. Associated injuries were present in 20% of cases and were treated accordingly. Non anatomical stable reduction by means of medial displacement osteotomy of Dimon and Hughston type was required in 5 cases (20%) of severely comminuted trochanteric fractures where anatomical reduction is not feasible.(1) 135° DHS barrel plate was used most commonly for fracture fixation. Most male patients required on an average 80mm length lag screws, while most female patients required 60 - 65 mm length in lag - screws. Non weight bearing crutch walking was the commonest mode of discharge, was advised mostly in stable trochanteric fractures fixed with DHS without any technical errors at fixation.

Technical errors at DHS implant fixation were present in 20% of the cases. The trochanteric fractures in this series were fixed under image intensifier control which has increased the operation time drastically to an average of two hours and decreasing the accuracy of lag screw placement in the head of the femur. The technical errors probably would have been much low had 'C'-arm been available. Fracture complications in patients treated with DHS fixation with technical errors was 40%, while in patients treated with DHS fixation without technical errors was 5% and the overall fracture complication rate in fixing trochanteric fractures with DHS implant was 12%. Post - operative complications occurred in 20% of patients were treated accordingly. Two cases of superficial infection were treated with intermittent suture removal, parental antibiotics and regular dressings, had healed well. Radiological fracture union was noted in most patients with stable trochanteric fractures with in 3 months and in patients with unstable trochanteric fractures with in 4 months. Most patients (92%) were pain free when assessed post operatively at 4-6 months. However 2 patients (8%) had moderate to severe pain, one with inadequate fracture reduction (technical error), one with joint penetration of the implant.

Most patients (92%) had normal gait or slight painless limp. However 2 patients (8%) required support of stick and could walk only a few yards at a time due to pain. Most patients had normal or near normal range of hip movements. Most patients (96%) have normal limb length or slight shortening (<2 cm) only. Moderate shortening (2 - 5cm) was present in one case (4%). Gross shortening was however absent. In most patients (80%) excellent to good overall functional results were noted. In 3 cases (12%) fair results were noted, while in 2 cases (8%) poor functional results occurred. The overall functional results correlated well with Evans classification of trochanteric fractures, with more complex fractures having higher incidence of complications of implant fixation and poorer functional results in the form of limp, shortening and pain.

**Comparative Study:**

**Procedure:**

Ender's pin fixation is noted to be a relatively simpler procedure requiring 20-30 mts of time to accomplish the surgery, with an average blood loss of 150 to 200 ml. All other modalities of internal fixation of trochanteric fractures require 60 to 90 mts of surgical time with an average blocd loss of 400 to 500 ml. Other advantages of Ender's pin fixation: Can be done in patients with medical problems because of the lesser amount of surgical stress. Can be done in patients with decubitus ulcers and other skin changes around the hip. Does not require to open the

fracture site and thus the soft-tissue attachments around hip are not disturbed, resulting in earlier ambulation and earlier functional recovery. When DHS, Jewet nail - plate, and condylar plate are compared, condylar plate fixation of trochanteric fractures is a more extensive procedure.

**Complications:**

Technical errors were noted to be highest with condylar plate fixation (40%) of trochanteric fractures, and relatively high with dynamic hip screw fixation (22%), when compared with other modalities of internal fixation (around 8%). Thus the operative technique using dynamic hip screw is not considered easy, with many potential pitfalls even for the experienced surgeon. Condylar plate fixation requires a relatively high skill on the part of the surgeon.

**Fracture complications**: The overall fracture complications in treating trochanteric fractures with various modalities of internal fixation were noted to be similar (8 to 10%), with a slightly higher incidence occurring with condylar plate fixation (13%). The specific advantage of dynamic hip screw fixation of trochanteric fractures lies in the relatively lesser incidence of fracture complications occurring in trochanter fracture fixation with technical errors (20-30% with DHS) in comparison with other internal fixation devices, especially Jewet nail-plate(87%) Also dynamic hip screw fixation has better results in unstable trochanteric fractures compared with other internal fixation devices because of the collapse it allows at the fracture site leading to better stability. A specific complication noted with Ender's pin fixation of trochanteric fracture was supracondylar fracture of the femur at the site of pin insertion (Mulstar et al series).

**Implant Failure:** Implant failure rate was noted to be highest with condylar plate fixation (5.5%) and almost nil with dynamic hip screw and Ender's pin fixation of trochanteric fractures, and moderate with Jewet nail-plate fixation (4.3%). This is probably because condylar plate and Jewet nail - plate do not allow the fracture ends to collapse at the fracture site to attain more stability of the trochanteric fracture, which is not the case with DHS or Ender's pins.

**Revision Surgery:** Re-do surgery rate was noted to be high with condylar plate fixation (8.6%) of trochanteric fractures probably due to the high rates in fracture complication and implant failure.Revision surgery was noted to be least with dynamic hip screw fixation (2-3%). Revision surgery with Ender's pin fixation (3-5%) was mostly to deal with pin recession at the site of introduction i.e., the lower end of the femur.

**Non-union:** Non-union was noted to be absent in Ender's pin fixation of trochanteric fractures, and around l%-2% in all other modalities of internal fixation. This may be due to the fact that the fracture site need not be opened in Ender's pin fixation.

**C. Functional Results:**

The overall functional results in treating trochanteric fractures with various internal fixation devices were similar with an excellent to good function in 80% of the cases. Zimmerman et al series using DHS had a slightly lower rate of good results (76%) probably because the average age of the patients in their series was slightly higher (86years). Ganz et al series using condylar plate fixation of trochanteric fractures also had slightly lower rate of good results (72%), probably because of the increased incidence of complications associated with the use of condylar plate. In Mulstar et al series using Ender's pin fixation of trochanteric fractures, excellent results were fewer although overall good results were comparable with other internal fixation devices. Moderate pain and limitation of movements were noted to be higher (10%) with wet nail-plate fixation and Condylar plate fixation of trochanteric fractures. Most patients treated with Ender's pins had limitation of internal rotation of hip, and some (15%) had moderate degree of external rotation deformity (>20%).

Shortening of the limb more than 2 cm. was noted to be higher with the use of Ender's pin fixation (16%) and Condylar plate fixation (10%) and lower with DHS (Wolfgang et al series - 3%). Considerable lengthening of the limb (more than 2 cm.) was noted to occur in Condylar plate fixation (2%) which did not occur in case of trochanteric fractures fixed with other implants. This is probably due to the Valgus osteotomy often used in Condylar plate fixation. Similar results were noted in the Wolfgang et al series and the present series both using DHS fixation in trochanteric fractures, except that there was no implant failure in present series while Wolfgang et al had 1:6% implant failure rate. Because of the increased incidence of shortening and external rotation deformity noted to occur with Ender's pin fixation of trochanteric fractures, it is advocated mostly in patients over the age of 70 to 75 years.

**D. Other Series:**

Clawson found the sliding screw-plate device superior to the fixed angle nail-plate device. Daun et al and Friedenberg et al compared DHS with pugh Nail (Sliding nail plate device) noted that the later often fails to slide with better results occurring with the use of DHS in trochanteric fracture fixation. Harrington and Johnston compared the use of Jewet nail-plate device, and DHS in medial displacement fixation of unstable intertrochanteric fractures and noted a higher rate (19%) of loss of fixation with Jewet nail plate device compared to only 6% loss of fixation with DHS.

**Technical Discussion:**

A fracture table used during surgery is very useful to reduce the fracture and maintain the reduction during surgery, and also allows a good Roentgen graphic control as compared to the lateral position on a standard operating table (the later may be preferable in reverse oblique trochanteric fractures. Good Roentgen graphic control is essential for optimum lag-screw placement. 'C' - arm is superior to standard image intensifier and allows optimum lag-screw placement on the first insertion. The procedure requires a stable reduction to be

successful. Reduction of the fracture especially the postero-medial cortical contact is regarded to be more important than the fixation device used.

Medial displacement fixation (eg. Dimon & Hughston procedure) allows to reduce the number of fracture complications in unstable trochanteric fractures from 19% to 10% (Wolfgang et al) but is associated with poorer functional results in terms of shortening and Range of movement (Roberts and Colleagues). When medial displacement fixation is used the sleeve, of the side plate must not rest against the proximal fragment or impaction might be prevented. Slotting of the shaft laterally to accommodate the sleeve of the side plate is necessary for medial displacement fixation. The guide pin placement should be central in both antero-posterior and lateral roentgen graphic views, advancing into subchondral bone without penetrating the articular surface. Low posterior placement of a lag-screw provides much less rotational stability when compared tctriffin nail (Pugh nail). Stability of reduction with a lag-screw depends on a combination of central screw placement and creation of bone stability of the fracture with an appropriate reduction.

Insertion of a second guide wire to control rotation during reaming or lag-screw insertion is required in the presence of fracture comminution or fractures approaching the basi-cervical area. This second guide wire also helps to re-insert an inadvertently removed guide pin with the help of a guide pin inserting device. The lag-screw should not be inserted without the use of a guide wire, since a guide wire can be repositioned several times without destroying bone stock which is not the case with lag-screw. Failure to advance the lag-screw deep enough (within 2 cm. and preferably within 1 cm. from articular surface of the femoral head) can result in poor purchase of the weak cancellous bone of the proximal fragment and on rare occasions, a delayed stress fracture of the femoral neck. Advancement of the lag-screw too deeply can result in articular cartilage damage.

One must reduce the fracture in a manner which does not block the telescoping action of the sliding screw side plate device. If the base of the proximal fragment abutts on the collar of the barrel-plate impaction cannot occur resulting in fracture complications. Lag-screw length is important. A lag-screw that is too short to allow the compression screw to engage it, may disengage from the side plate post operatively especially so in medial displacement fixations. When the lag-screw is short the compression screw must engage the lag-screw and must be left in place. If the lag-screw is too long, it should be replaced with a shorter lag-screw or the compression screw should be removed since further impaction telescopes the lag-screw laterally, and added protrusion of the compression screw increases the risk of painful bursitis. Articular surface penetration can occur when the lag-screw length is incorrectly measured or when the operator fails to keep the inserting T-wrench tightly pressed on the base of the lag-screw during insertion of a correct length lag-screw.

Most Surgeons agree that 135° side plate is easiest to fix trochanteric fractures. Use of 150° side plate involves a more difficult lag-screw placement and often results in an unacceptably high lag-screw position in the femoral head. Various angle side plates are necessary in this procedure since the strength of the side plate will not allow bending, and forcing a side plate of incorrect neck-shaft angle into position may lead to medial distraction of the fracture and loss of impaction. The post-operative regimens must be individualized in all cases. A stable fracture adequately reduced with good bone stock with good lag-screw placement in a patient physically and mentally able to ambulate may be advised partial weight bearing immediate post-operatively. On the contrary fracture comminution with instability, poor lag-screw placement, osteoporosis, and physically incapable patient may be advised non weight bearing ambulation or active hip exercises only.

## CONCLUSIONS

Trochanteric fractures constitute one of the commonest fractures encountered in oldage. Evans classification of trochanteric fractures is more practically applicable in the selection of treatment modality and assesment of prognosis. Effective treatment for a patient with an intertrochanteric fracture, regardless of advanced age, is surgery and early mobilization. Rigid fixation with interfragmentary compression using the dynamic hip screw permitted us to begin early mobilization and early partial weight bearing in most cases. The specific advantages with dynamic hip screw were the better results noted with its use even in unstable inter-trochanteric fractures and the lower fracture complications resulting even in cases with technical errors

at implant fixation. At present dynamic hip screw appears to be the best implant for fixation of trochanteric fractures, enhancing fracture stability and union by allowing dynamic compression over the lag-screw. The DHS implant has very high fatigue Vstrength and therefore implant failure in terms of breakage, disassembly, or separation of side plate from the shaft are minimal. Technical errors at implant fixation were common (20%) therefore the operative technique is not considered easy, with many potential pi tfalls for both the inexperienced surgeon and the veteran. However fracture complications in trochanteric fracture fixed with DHS with technical errors at fixation were minimal. Use-of image intensifier could decrease the number of technical errors.

One specific complication appears to be double placement of lag-screw, i.e., second time placement of the lag-screw following misplacement of the lag-screw during the first instance. In these cases the lag-screw often migrates superolaterally and may extrude out through the neck resulting in poor functional results. If the position of the lag-screw is unacceptable, it seems better to insert a flanged nail in the postero- inferior quadrant, rather than a second attempt at lag-screw placement in a second track. Postoperative regimen cannot be standardized and must be considered in light of many

variables including fracture stability, comminution, bone quality, stability of reduction, position of lag-screw, and ability of the patient to mentally and physically co-operate with the postoperative instructions. The overall functional results were noted to be excellent to good in most cases. Most of the patients returning to their pre-injury level of activity within 4-6 months.

**Specific features of the dynamic hip screw:**

**a) Advantages**: Applies compression across the fracture, Shares load, Permits controlled collapse of fracture with time leading to: Progressive improvement in bony contact. Continuous increase of stability ,Constant decrease in stress on the plate. Resists bending and torsion loads.

**b) Cause of complications:** Poor in sertion technique., Non-optimal fracture reduction, ensuing instability consequent device overloading and failure., Poor bone quality Overloading by patient.

**c) Optimum requirements:**

- Site of screw placement is central, Angle of barrel plate - 135° to 140°, Screws for side plate - 4 screws and 8 cortices, Compression - Normal bone density.

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**Figure.1**

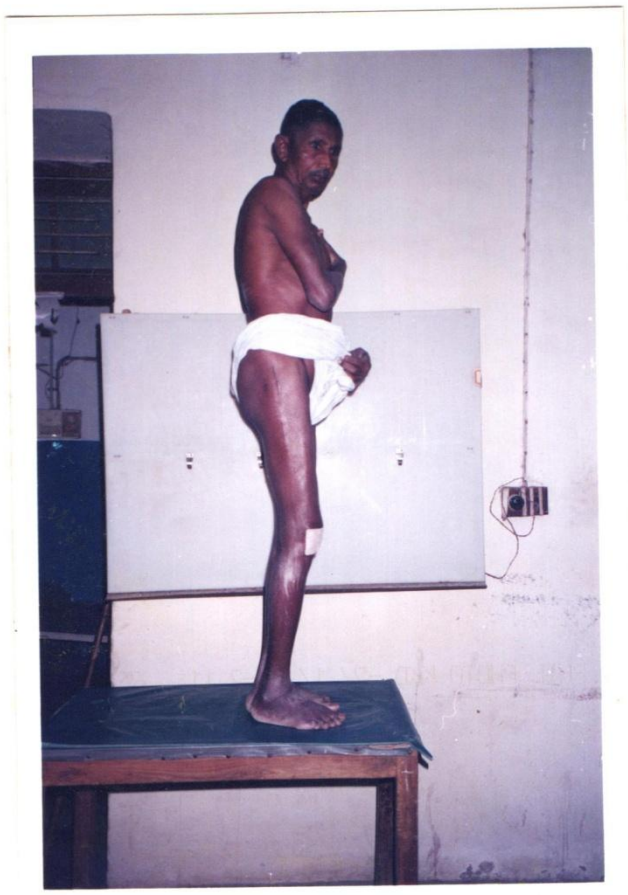

**Figure.2**

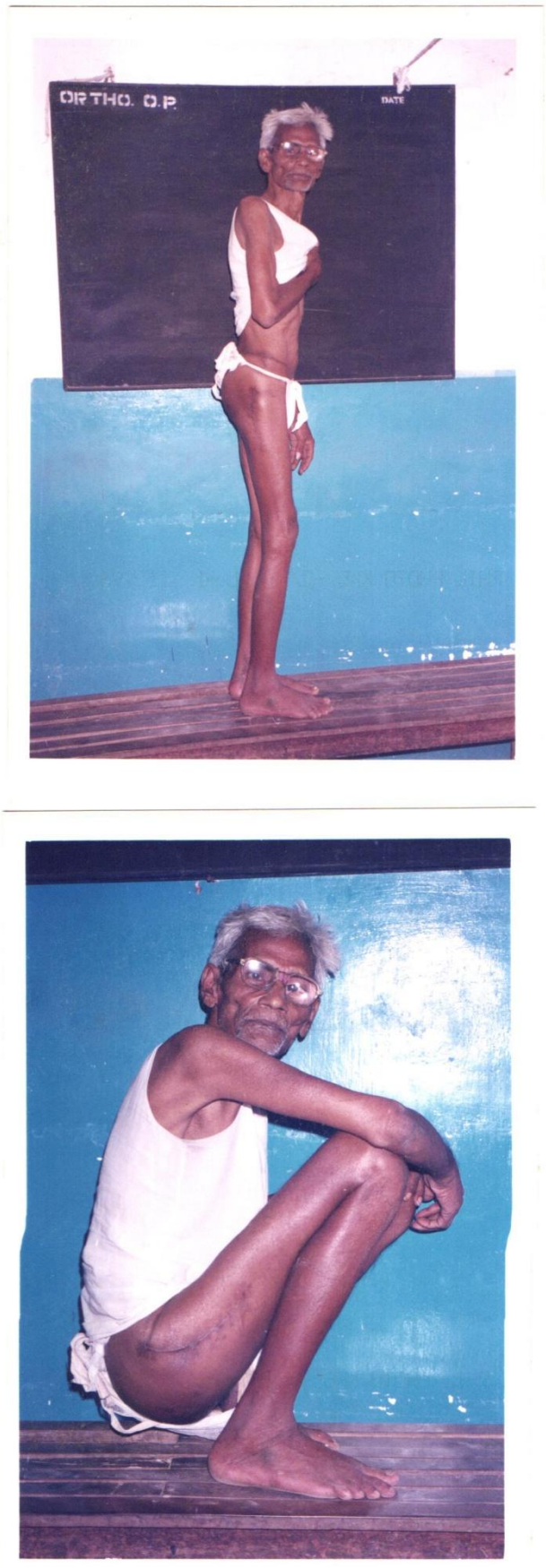

**Figure.3**