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Effectiveness of dynamic hip screw in surgical management of trochanteric fractures: A clinical study

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Abstract
Introduction: Trochanteric fractures of femur has significant structural, clinical, anatomical and biochemical characteristics that distinguish them from intracapsular fractures. In past few decades, the treatment for intertrochanteric fractures has gained tremendous changes. The dynamic hip screw (DHS) development created a revolution in the management of unstable fractures of femur.
Aims: To study the effectiveness of Dynamic HIP Screw in surgical management of Trochanteric fractures, to evaluate functional and anatomical outcome.
Materials and Methods: The study consisted of 25 cases of Trochanteric Fractures treated surgically with Dynamic Hip Screw during the period of one and half years. The operative procedure which is commonly done for Trochanteric Fracture is Dynamic Hip Screw fixation the results were recorded and discussed. The average follow up period was for 6.64 months varying from 5 months to 1 ½ years.
Results: Forty percent (10 patients) were less than 50 years age. Males outnumbered the females (19:6). Right-sided fractures outnumbered the left-sided (14:11). Fourteen out of twenty five patients were associated with severe violence. The younger age group patients were most often associated with severe violence (90%). The older age group patients were associated with trivial trauma (33%). Four out of the twenty-five patients (16%) were associated with other fractures. Type-I fracture had an excellent or a good result. 89% of Type-II fractures had an excellent or good result. 50% of Type-III and 57% of Type-IV fractures had a good result.
Conclusions: Patients treated with this device have recovered early with painless hip movements, Hence Dynamic Hip Screw is an ideal implant for surgical management of Trochanteric Fractures.

Keywords: Trochanteric fractures, dynamic hip screw, hip movements

Introduction

Trochanteric Fractures are amongst the most common fractures encountered by an Orthopaedic surgeon day-in and day-out. Though these are most commonly seen in elderly age group, the younger age groups are not spared, in whom it is because of severe violence. The incidence in the younger age group is increasing day by day due to increase in high velocity road traffic accidents, when it is usually associated with other fractures. On an average about one to two cases of trochanteric fractures are admitted in hospital as Orthopaedic casualty every day. The evolution in treatment of Trochanteric fractures has been from conservative treatment to operative treatment in the form of nail plate device, dynamic HIP screw and replacement by a prosthesis. But the gold standard of treatment has been Dynamic HIP Screw which offers the advantage of mobilising the patient early, prevention of problems of recumbency and immobilisation (Infection, decubitus ulcers, deep vein thrombosis), provision of dynamic and static compression at fracture site along with sound fixation which favours union with reasonable cost efficiency ratio.

DHS is a standard technique to treat trochanteric fractures which has biomechanical disadvantage because of wider distance between the weight bearing axis and the implants [1, 2]. Proximal femoral nail has become most prevalent method to treat trochanteric fractures which associated with few technical errors and expensive [3, 4]. An attempt has been made to evaluate the results of DHS in management of Trochanteric fractures. As the implant was not available in Osmania General Hospital free of cost, we selected patients who could afford it.

Material and Methods

The study consisted of 25 cases of Trochanteric Fractures treated surgically with Dynamic Hip Screw at ---------- Hospital during the period of one and half years from ---------- ----. The two modes of treatment adopted for Trochanteric Fractures at our hospital are conservative and operative. The operative procedure which is commonly done for Trochanteric Fracture in our hospital is Dynamic Hip Screw fixation. Surgery is advised for all patients who are able to afford to buy the implant. For the purpose of evaluating the results, 30 patients with Trochanteric Fracture treated with Dynamic Hip Screw were followed up. Only the patients, who reported regularly for follow up were included in the study group (25 patients). The results were recorded and discussed. The average follow up period was for 6.64 months varying from 5 months to 1 ½ years.

Investigations

Like haemoglobin percentage, blood ure/sugar, blood grouping and RH typing were done in all patients. In patients over 40 years of age an ECG, Chest X-Ray, 2D-Echo, Cardiologist's opinion were taken.

The anaesthesia employed in all these patients was regional anaesthesia i.e. spinal or epidural anaesthesia. The recovery was smooth and uneventful in all these patients.

Operative procedure

Patient is placed supine on the fracture table (Albee's) with the buttocks resting on a cassette holder. Roentgenographic control was used. Nearly all fractures were reduced by gentle traction and abduction in moderate external rotation followed by gentle internal rotation. The affected hip is kept in neutral flexion and extension. After manipulate reduction both extremities are fastened to the foot plates and enough traction is applied on the affected side to restore length and the normal neck shaft angle. The affected hip is abducted 15 to 20 degrees. The unaffected hip is abducted to maximum to facilitate placement of X-ray machine to take lateral view of affected hip.

Reduction was checked by anteroposterior and lateral x-ray and further manipulation or adjustments are made accordingly after seeing check x-rays. Open reduction was done in one case with a Type-III fracture in which, manipulations were unsuccessful. After taking check x-ray the part is cleaned and draped.

Through lateral approach the trochanteric region is exposed. For stability and to prevent the rotations of the head and neck during the compression screw placement, a guide pin (2.4 mm) is inserted through lateral cortex of the femur just below the ridge of greater trochanter ad drilled through the trochanter and superior neck and head across the joint into the acetabulum.

A drill hole is made and an adjustable angle guide set at 135 degrees in the lateral cortex 2.5 cms below the tuberculum innominatum and a 2.4 mm guide pin is inserted to within 1.3 cms of the articular margin. The position of the guide wire is confirmed by A.P. and lateral x-rays. It is desirable to have the guide pin in the exact centre of the femoral head and neck. If an off centred position is accepted the pin should be posterior and inferior. The tip-apex distance should be less than 24 mm. Then the protruding guide pin beyond the lateral cortex of the femur is measured. After the measurement is made, the guide pin is drilled into the acetabulum to prevent it from loosening during reaming and to provide additional stability to the head. The triple reamer, which allows reaming for the compression screw, the barrel of the side plate and the plate barrel junction at the same time, is employed to ream through the trochanter, neck and head. This triple reamer is placed over the guide pin and reamed into the head and neck unti the depth-stop touches the lateral cortex.

After noting the calibrations on the tap, the hole is tapped to the same depth achieved previously by the reamer and then the lag screw is selected which is 1.3 cm less than the measured length of the guide pin within the head and neck. The lag screw is inserted completely by using a wrench. We used 135 degree angle plate and the screw was inserted until the calibration present over the top of the wrench has reached the lateral cortex of the femur. Then guide pin and other stabilising pins were removed, barrel was inserted. Before attempting to slide the plate barrel on the lag screw shaft, the groove and its alignment were checked properly. Then the plate is clamped to the shaft and fixed with screws. Then the compression screw is threaded into the distal end of the lag screw shaft and tightened to compress the fracture. Before completion of the tightening, traction on the leg on the operating side is released. Finally the position of the implant is confirmed by x-ray. The wound is closed in layers after keeping suction drain.

Post-operative management

Patient was kept on injectable antibiotics (Third generation cephalosporins) for 48 hours followed by oral antibiotics for 10 days. Primary dressing was done after 48 hours. Wound inspection was done and drain was removed if the collection on the second post-operative day was minimal. Quadriceps exercises and active hip and knee movements were taught and practised right from the first post-operative day.

The patient was allowed to more out of the bed in a wheel chair after 48 hours of surgery. Patients were discharged after ten days post operatively after suture removal with advice to come to the outpatient department 4-6 weeks later. Patients were advised not to bear weight on affected limb during this period.

Follow up

Patients were examined for presence of pain during hip movements, range of motion, shortening, tenderness, limb and radiographs were taken to see the signs of healing, position of the lag screw and plate and the deformity if present. Most patients were advised to bear weight partially after 4-6 weeks post operatively. Full weight bearing was advised only after the fracture showed signs of union both clinically and radiologically.

Results

Table I: Demographic details in present study

Age group	Number of patients	Percentage
20-29 yrs	1	4%
30-39 yrs	5	20%
40-49 yrs	2	8%
50-59 yrs	5	20%
60-69 yrs	8	32%
70-79 yrs	4	16%
Gender		
Males	19	76%
Females	6	24%

The age of the patients ranged from 20 years to 77 years with an average of 55.56 years. Forty percent (10 patients) were

less than 50 years age. Males outnumbered the females (19:6). The younger age group patients presented early i.e. within 24 hours. The older aged patients presented late i.e. from 2 days to 1 week after injury.

Table 2: Nature of Violence

Age Group Nature of Violence	≤ 50 yrs	≥50 yrs	Number of patients	Percentage of patients
Severe	9 (90%)	5 (33.33%)	14	56%
Trivial	1 (10%)	10 (66.66%)	11	44%
	10 (100%)	15 (100%)	25	100%

Fourteen out of twenty five patients were associated with severe violence. The younger age group patients were most often associated with severe violence (90% of them had severe violence). The older age group patients were associated with trivial trauma (only 33% were accounted for severe violence).

Table 3: Side and associated injuries in present study

Side	Number of Patients	Percentage
Right Side	14	56%
Left Side	11	44%
Associated injuries		
No Associated injuires	21	84%
Ipsilateral colle's fractures	2	8%
Ipsilateral Both Bones of leg	1	4%
Contralateral fracture shaft of femur	1	4%

Right-sided fractures outnumbered the left-sided (14:11). Four out of the twenty-five patients (16%) were associated with other fractures. Two of them had ipsilateral colle's fractures (Treated conservatively), one had a fracture of Ipsilateral Both Bones of leg (Treated by a Dynamic Compression Plate), and the other had contralateral fracture shaft of femur (Treated by an intramedullary nail).

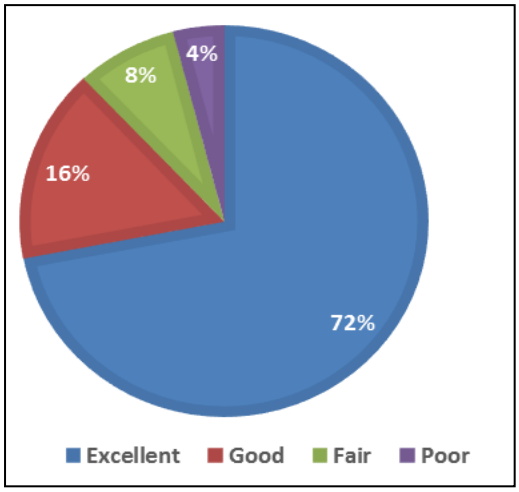

Fig 1: Results after performing surgery in present study

Most of the subjects in present study reported excellent (72%) after performing surgery.

Table 4: Outcome in comparision with type of fracture

Type of Fracture	Type-I	Type-II	Type-III	Type-IV
Excellent	7(100%)	7(77.11%)	1(50%)	3(42.8%)
Good	Nil	1(11.11%)	1(50%)	2(28.5%)
Fair	Nil	1(11.11%)		1(14.2%)
Poor	Nil	Nil	Nil	1(14.2%)
Total	7	9	2	7

X-ray of the pelvis including both hips with both hips in internal rotation and traction were taken after admission and were typed according to Boyd and Griffin's classification. Seven (28%) were Type-I, Nine (36%) were Type-II, Two (8%) were Type-III, Seven (28%) were Type-IV).
Type-I fracture had an excellent or a good result. 89% of Type-II fractures had an excellent or good result. 50% of Type-III and 57% of Type-IV fractures had a good result.

Table 5: Complications occurred after surgery

Complications / Type of Fracture	Coxavara	Coxavalga	Shortening (≥1/2in)	Implant Failure	Infection	Knee Stiffness	Non-Union	6 months mortality
Type-I(7)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Type-II(9)	NIL	NIL	1	Nil	Nil	Nil	Nil	Nil
Type-III(2)	1	NIL	Nil	Nil	Nil	Nil	Nil	Nil
Type-IV(7)	Nil	1	Nil	1	1	1	1	Nil
Total(25)	1(4%)	1(4%)	1(4%)	1(4%)	1(4%)	1(4%)	1(4%)	Nil

1 out of the 25 patients (4%), we had operated on had coxavara. One developed after implant failure. We had operated upon had knee stiffness (4%). Only one case of nonunion 4%.

Discussion

Trochanteric Fractures are among the most common fractures encountered in Orthopaedic practice. The speciality of a Trochanteric Fracture lies in the fact that it can be managed both conservatively and surgically. Both modes of management have their own advocates who quote the pros and cons of management by either method. The orthopaedic surgeon is greatly helped if the knows which method to adopt, what implants to be used and the likely complications. Several studies comparing the results of conservative and operative treatment reported that there was no difference in mortality but the internal fixation had the advantages of increased patient comfort, better nursing care, decreased hospital stay, economy of beds, better anatomical results and lesser incidence of sequelae of prolonged immobilisation.
In recent years trend has changed from conservative to surgical management and surgery is offered to all patients with a Trochanteric Fracture. Even the patient who carries a poor risk for surgery is considered as a candidate for internal fixation as such patient with frail general condition is likely to tolerate surgery better than prolonged immobilisation.
Two piece telescoping devices (Ex: Dynamic Hip Screw) have an advantage over single piece device or non-telescoping devices (Ex: SP Nail and Mclaughlin's plate) in that they allow compression at the fracture site by allowing for collapse without compromising rigid fixation, thereby favouring union. They also have reduced incidence of joint penetration. It was found that the telescoping Richards Screw provided a stronger and better fixation in the proximal fragment because of

increased contact due to greater surface area provided by screw threads.

In this study we had 30 patients with trochanteric fractures treated surgically by means of a Dynamic Hip Screw. Only the patients who reported regularly for follow up were included in study group (25 patients).

The average age group of the study group was 55.56 years. This is lower compared to that quoted by most authors in literature as Study by Daniel F.A *et al*., and Gallaghar *et al*., stated that fractures were more common in between age group 50-80 years [5, 6]. Most often it is believed that the inter-trochanteric fractures of femur are usually sustained by elderly patients. But in our series the younger age group patients (less than 50 years) constituted a significant number (40%). This is probably due to greater mobility of younger age group patients, mechanisation of transport, increase in the incidence of high velocity road traffic accidents.

In our study we had a male preponderance. 19 (76%) of the 25 patients we had operated on were males. This is in contrast to the studies done in western world where there was a female preponderance [5, 6]. This is probably because in India, males are engaged in more strenuous activities compared to females who have a contained life. Hence males are more prone to trauma. The other reason lies in the fact that we had operated upon those patients who were able to afford to buy the implant. The females being the socially neglected group, hence constituted a lesser. Number.

The injury which resulted in the fracture was a severe one in 14 patients (56%) and trivial in 11 patients (44%). Severe injuries most often resulted from high velocity road traffic accidents or fall from height etc. These were most often seen in younger age group in whom 9 out of 10 (90%) patients sustained injury due to severe violence. Fractures caused by trivial injuries were seen most often in older age group patients in whom 10 out of 15 (66.67%) were due to trivial trauma. The higher incidence of fractures due to severe violence in our series is in contrast to that reported in literature (R.C. Gupta series which reported higher incidence of trivial injury) [7]. This is probably due to increased number of younger age group patients in our series who needed more force of impact to sustain a fracture compared to the older age group patients.

In our study right-sided fractures were more common than left sided fractures (56% to 44%). In the studies by R.C. Gupta 77 right- sided fractures were more common [7]. In the studies made by Kenzor *et al*. 74 and Cleveland *et al*. 12 left sided fractures were common [8, 9]. In the present study none of the cases had a bilateral intertrochanteric fractures, whereas in Cleveland's12 series two patients had sustained bilateral trochanteric fractures and in R.C. Gupta's77 series only one patient had bilateral trochanteric fractures [7].

In our series there were 4 patients (16%) who had associated fractures. This incidence is high compared to that quoted in literature. Two patients had an ipsilateral colle's fracture, one had ipsilateral fracture both-bones and the other had contralateral fracture shaft femur. Among these 4 patients 2 had Type-II fractures. Type-I and Type-IV accounted for one each. 2 out of these 4 patients (75%) had severe violence as the mode of injury.

In our series Type-II fractures constituted highest number (36%). Type-I and Type-IV constituted a significant percentage of cases (28% each). This is in contrast to other series which reported a higher incidence of Type-I fracture.

Table 6: Type of series

Series	Excellent	Good
T. Sahlstrand1 [10]	72%	18%
Sernbo *et. al*. [11]	82%	18%
Sethi *et. al*. [12]	72%	18%
Present study	72%	16%

The average follow up period for our patients was 6.64 months. The average time for union was 15.25 weeks.

In our series functional and anatomical results were graded according to Evans criteria as excellent, good, fair and poor. 18 out of the 25 patients (72%) had an excellent result. 7 out of these patients had Type-I fracture. These patients had sound union both clinically and radiologically within 3 months. None of these patients had varus deformity or shortening. The excellent recovery made by these patients is probably because of a stable anatomical reduction that was achieved and compression effect facilitated by the Richard's Screw which permitted early mobilisation without failure of implant or delaying union.

In 4 patients (16%) we had a result which was categorised as 'good'. These patients had painless mild limp with negligible shortening (<1/2 inch) and walked independently 4-6 months after surgery. Only in 1 cases we noticed Coxavara of 10 degrees.

2 patients had an outcome which was classified as fair. In these patients union delayed and patient walked with a limp and with an assistance of a stick or had varus deformity of 10-20 degrees and a shortening of one or more inches. Among these 2 patients one belonged to Type-II and 1 were Type-IV fractures. One patient had a poor result. This patient had implant failure one year after surgery and the fracture had not united. Patient had become non ambulant with severe restriction of movements.

In summary all cases with Type-I fracture had an excellent or a good result. 88% of Type-II fractures had an excellent, good and fair results. 50% of Type-III and 57% of Type-IV fractures had a good result. 2 out of the 25 patients (8%), we had operated on had coxavara. One of them had coxavara which developed after implant failure. This incidence of coxavara similar to other studies. 1 patients (4%) had coxavalga ≥ 10 degrees. 1 out of the 25 patients (4%), had shortening ≥ ½ inch. This is higher compared to other studies.

We had 1 cases (4%) of implant failure, due to breakage of implant at the proximal screw hole. One of these patients had a Type-III fracture. We had no case of screw cutout (Compared to 16.5% incidence of mechanical failure with screw cut out as the cause in three-quarters of cases as reported by J.L. Sher, T.R.C. Davis). We had no mortality at 6 months (Compared to 24% quoted by Hornby & Grimley Evans and Haentjens). This probably could be accounted for the 5 patients who were lost to follow up, whose outcome was not available and also a preponderance of younger patients who tolerate the trauma and surgery better than the aged patients.

One out of the 25 patients we had operated upon had knee stiffness (4%). This is similar to the incidence of stiffness by conservative management (4% in Murray and Frew series). We had one case with non-union consequent to implant failure for whom we have done 95 degrees Condylar Blade Plating and Bone grafting, which eventually went on to unite after another 5 months, without further complications. We had no case of A vascular necrosis of head following internal fixation in our series. None of the 25 cases we operated upon developed bed-sores, deep vein thrombosis, hypostatic

pneumonia. Cleveland *et al*. and Kyle *et al*. reported an incidence of 0.8% of avascular necrosis. Only seven cases of avascular necrosis have been reported in the literature [9, 11].

Conclusions

After evaluation of the results in the present series, which were quite satisfactory and encouraging, we have come to the following conclusions regarding the role of Dynamic Hip Screw fixation in the surgical management of Trochanteric Fractures. This technique is not very demanding, with experience it is a simple procedure which can be performed by any average surgeon. The device facilities impaction at the fracture site and provides rigid internal fixation. So the patient can be mobilised immediately post-operatively thereby avoiding problems of prolonged immobilisation and recumbency (Decubitus ulcers, venous thrombosis, infection). The Device allows for controlled collapse at the fracture site without a change in the neck shaft angle. Hence it does not alter the bio-mechanics at the hip. Therefore the incidence of coxavara is low. The fixation is rigid even in the osteoporotic bone because of innovative truncated thread design of the lag screw. The incidence of femoral head penetration due to absorption and collapse at fracture site is low even in an osteoporotic bone because of rounded tip design of lag screw and a provision for its telescopy. After insertion the implant is flush with the bone unlike the two-piece nail and plate which protrudes into the soft tissue thereby making the patient demand for early implant extraction. Patients treated with this device have recovered early with painless hip movements.

In conclusion, most of the patients were young males who most often are the sole bread-winners of an Indian family. Hence there is an absolute need for anatomical reduction, early mobilisation and faster rehabilitation. All these are possible with a Dynamic Hip Screw which will enable the patient to return to work at an earlier date. Hence we feel that Dynamic Hip Screw is an ideal implant for surgical management of Trochanteric Fractures.

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