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Sarmiento osteotomy with plate and screw fixation for comminuted/unstable inter-trochanteric fracture femur

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Abstract
Comminuted inter-trochanteric fractures are unstable and treated with conventional anatomic reduction and internal Fixation stability may not be restored due to significant cortical defect present postero-medially. Several surgical methods of treatment for comminuted and unstable inter-trochanteric fracture is described. In this study we performed oblique valgus osteotomy (Augusto Sarmiento) technique in fixing unstable comminuted inter-trochanteric fractures using a short Smith Petersen (SP Nail) and Mclaughlin plate system has been used to achieve union.
Materials and Methods: A prospective study was carried out on 20 hips of 20 patients are treated with oblique valgus osteotomy (Augusto Sarmiento) technique and fixed with short Smith Petersen Nail and Mclaughlin Plate was used, the patients were evaluated at a mean of 10 months to 62 months average (26 months) for union, leg equalisation, clinical outcomes.
Results: Mean time of union was 12.5 +_ (range 10 – 22 weeks). NO intra-operative instability of the osteotomy site was encountered.
Conclusions: Comminuted unstable inter -trochanteric fracture treated by valgus osteotomy (Sarmiento technique) and medial displacement of the distal fragment with accurate approximation of the medial cortex of the two major fragments greatly enhances the efficiency of fixation.

Keywords: Unstable Inter-trochanteric fractures, Medial displacement, valgus osteotomy, Sarmiento technique, MESH terms trochanter, Osteotomy, comminution

Introduction
Fractures of the Inter-trochanteric region is one of the commonest injuries occurring in the elderly age group. Several studies have suggested that incidence of fractures of the inter-trochanteric region are increasing, these fractures are associated with substantial morbidity and mortality.
An intertrochanteric fracture should be classified functionally as stable and unstable (comminuted along the postero-medial aspect).
Comminuted inter-trochanteric fractures are unstable and treated with conventional anatomic reduction and internal fixation stability may not be restored due to the significant cortical defect present postero-medially. This leads to several complications, like penetration of nail into the Acetabulum, bending or breaking of nail or sometimes nail cuts out of the head and neck.
Main objective of surgical treatment of comminuted and unstable inter-trochanteric fracture is to establish the continuity of the bone along the medial aspect of the femoral neck, trochanter, and proximal shaft of femur to restore stability, without medial and postero-cortical contact of head and neck fragment will tend to be unstable migrating into varus and retroversion.
It is now universally agreed that the inter-trochanteric fracture is best treated by internal fixation. Probably this outlines the importance of considering surgery in every patient of trochanteric fractures. Union is not a problem inter-trochanteric fracture because of the abundant cancellous bones, broad fracture surface and good blood supply.
The objective of internal fixation in inter-trochanteric fractures is to achieve early mobilisation and rehabilitation and thereby preventing the undesirable complications of prolonged immobilisation.

Augusto Sarmiento reported on unstable inter-trochanteric fracture treated with valgus osteotomy and medialisation of the fracture fragments using in I- Beam Nail plate.

Inter-trochanteric fractures frequently require prolonged periods of incapacitation and are often complicated by various deformities because of loss of fixation by the internal fixation device therefore emphasis must be placed on obtaining bony stability at the fracture sight and to depend on the internal Osteosynthesis mainly as a supporting structure. Osteotomies that create stable situation have a definite place on the management of comminuted and unstable inter-trochanteric fractures. When properly carried out the oblique valgus osteotomy by (Sarmiento technique) produces a stable situation by approximating cortical surfaces and reducing instability by changing the vertical inclination of the fracture into a more horizontal and stable one and fixing the fracture segments with the nail and plate device.

Materials and Methods

The study consisted of 22 patients who underwent surgery of these, 2 patients were lost for follow up and were excluded from the study. Thus 20 patients with the follow up of 10 to 62 months are included in this prospective study.

The indication was comminuted unstable inter-trochanteric fracture. Oblique valgus osteotomy (Sarmeinto technique) was used medialisation of the fracture fragment was done and fracture fixed with short SP nail and McLaughlin plate and screws.

Operative Procedure

The patient was put in supine position over the Watson Jones fracture table the affected limb is kept in 15- 20 degrees of abduction and the foot is fixed to the foot piece in 10 degrees of internal rotation. Portable X-ray along with C arm image intensifier was used whenever necessary. A standard lateral incision with its proximal end curves slightly forwards. The bone was exposed by reflecting the split vastus lateralis on either side. With double gloved index finger both medial and posterior cortex and lesser trochanter fragment were palpated.

No attempt is made to reduce the fracture. An oblique osteotomy of the distal fragment is made beginning proximally and laterally slightly below the flare of the greater trochanter and extending distally, medially to a point approximately 1 cm below the apex of the fracture. Prior to osteotomy drill holes are made through distal fragment with special care being taken to drill through the medial cortex of bone to prevent its shattering as the osteotomy is completed with a sharp osteotome. Once the osteotomy is completed the resulting wedge-shaped fragment is retracted laterally to expose the medullary canal of the proximal fragment. The guide wire is driven into the proximal end of the femur parallel to the anterior cortex and at approximately 90 degrees to the plain of fracture surface. In patients in whom the plane of fractures is more vertical the wire should be inclined distally so that the inferior angle of entry of the guide wire with respect to the plane of fracture is less than 90 degrees. The distance of point of entry from the medial cortex must be equal to medial to lateral width of the osteotomised surface of the distal fragment. However, to allow for the width of the nail, the guide wire was placed 0.5cm higher than the measured point of insertion.

Once after placement of guide wire, position of the guide wires was checked on antero-posterior and lateral X-ray images. Later a short S.P. nail of 5.5-6cm is driven over the guide wire into the formal head. It was seen that the tip of the nail falls short of at least 1 to 1.5cm to the articular surface of head of femur, adequate placement of the nail is confirmed again with Image intensifier. Then the side plate (Mclaughlin) of 135 degree was fixed to the nail with side bolt. Bolt is tightened with the screwdriver.

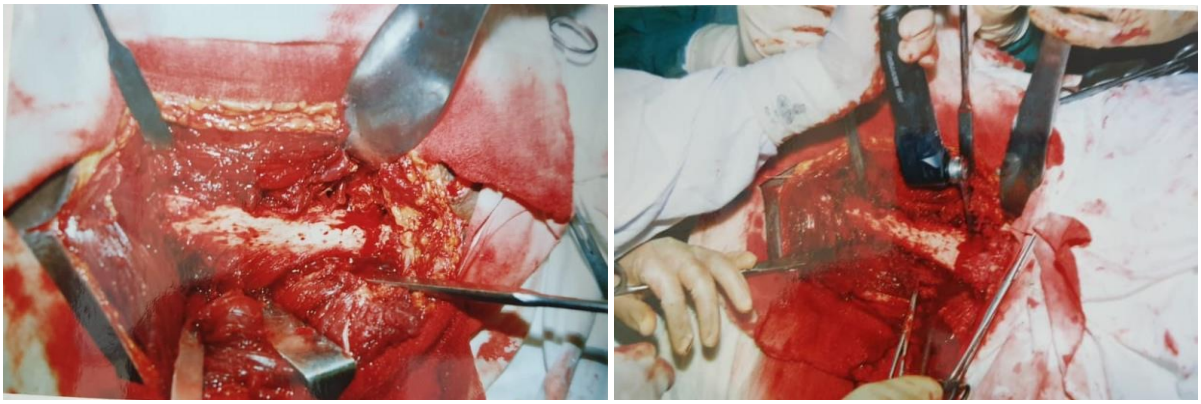
Since the distance between the medial cortex of the proximal fragment and the entrance site of the nail is identical to the medial to lateral width of the osteotomized surface of the distal fragment, later the abduction of the distal fragment is done so that shaft of femur (distal fragment) come in contact with the plate.

In fracture with extensive damage to the postero-medial cortex of the femur the contact surface may be too small to provide adequate stability. Any bone on lateral, proximal portion of the distal fragment which interferes with the proper contact of the metallic plate and the lateral surface of the femoral shaft may be removed with a rongeur.

Once the fragments have been approximated the plate portion of the nail is fixed to the shaft with 4 or 6 screws. Internal rotation of the distal fragment during the entire surgical procedure is necessary because during the insertion of the nail the proximal fragment is lifted and therefore internally rotated.

If a similar degree of internal rotation is not given to the distal fragment, there will be an external rotation deformity of the limb. No attempt is made to approximate the greater trochanter to the femur. Non-union of the loose trochanter has not resulted from this practice.

Check X-ray images were taken before closure. If the procedure is satisfactory the wound was irrigated and closed in layers. Plaster of Paris de-rotation boot was applied to the operated limb.



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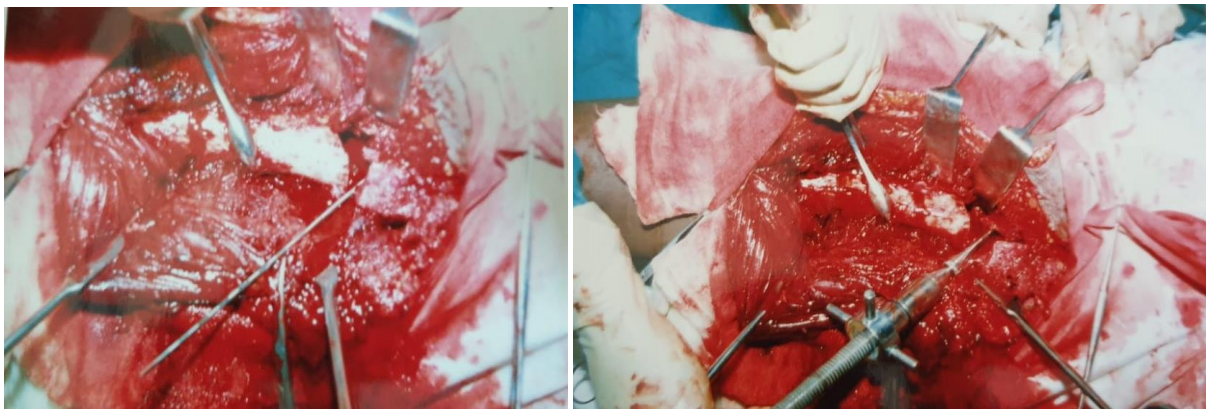

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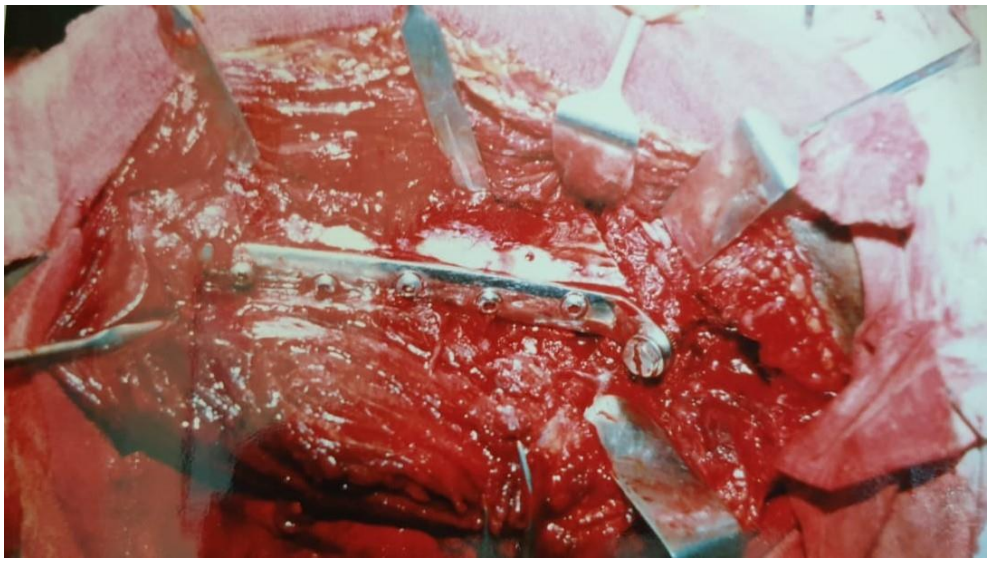

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Fig 1: Per-operative photographs showing (a) the fracture site exposed (b) Valgus osteotomy performed (c) Guide wire inserted (d) SP Nail passed into proximal fragment (e) SP Nail and McLaughlin Plate in situ.

Evaluation

Mohanty and Chacko 1984 [29] criteria was used for evaluation of the results

1. pain
2. deformity
3. daily activities
4. ability to squat and sit crossed legged
5. walking distance
6. range of knee movements

As excellent good, fair, poor.

Table 1: showing criteria for Evaluation.

		Excellent	Good	Fair	Poor
1	Pain	No pain	Negligible	Pain cannot be ignored demands relief occasionally	Pain interferes with activities demands treatment all the time
2	Deformity	No deformity	Varus less than 15 degree, shortening less than 1 cm.	Varus less than 15-30 degree, shortening more than 1 inch.	Severe deformity
3	Daily activities	Normal, back to pre-accident status	Minimal, restriction limited to out -door activities only.	Previously active confirmed to house since accident.	Confirmed to bed since accident
4	Ability to squat and sit cross legged	Can do without difficulty	Minimal restriction with minimal pain	Partially restricted	Not possible
5	Walking distance	More than 1 km same as before accident.	Between ½ to 1 km less than before the accident	Less than ½ km	Not able to walk without aid
6	Range of knee movement	Free & painless	Extremes are restricted with minimal pain	Cannot flex more than 90 degrees, swelling and effusion may be present	Less than 45 degree of flexion present. Swelling and effusion present.

The degree of union was Radiologically assessed, quantifying the union of cortices bridged by bone. Intra- operative stability of the fracture sight was defined as obvious movement of the osteotomy line after fixation with short (McLaughlin) plate and SP nail.

De-rotation boot removed at the end of 3 weeks patient was allowed non-bearing walking with axillary crutches at the end of 3 weeks. Partial weight bearing was allowed at the end of 8 weeks and full weight bearing at the end of 3 months. At each visit the patient was examined for shortening of the limb, deformity of the affected Hip, gait, ability to squat and sit crossed legged, range of movements, Radiological evaluation

of the Hip.

Leg length discrepancy of the patients were measured pre and post operatively by measurement from the ASIS to the tip of the medial malleolus. Postoperative leg length difference was determined using X-rays. For the determination of the leg length difference, it was aimed to achieve an agreement between the measurement with a tape measure and by the radiographic method.

Table 1: Clinical details of the patients

Variable's	participants
Age (year)	55.5 (35-76 years)
Follow up (months)	26months (10-62)
Gender (%)	
Male	17 (85)
Female	3(15)
Fracture side (%)	
Right	12(60)
Left	8(40)
Mode of injury (%)	
Road traffic accident	12(60)
Accidental fall	8(40)

Results

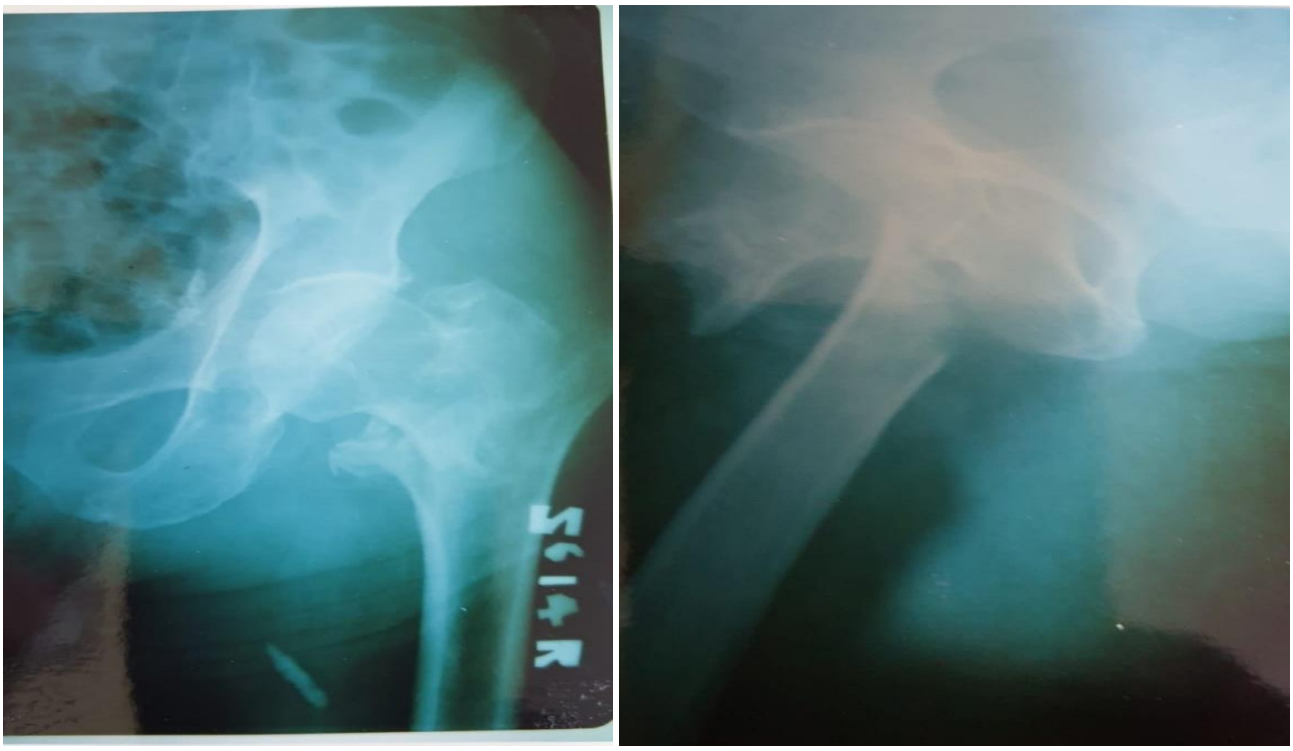
Demographic findings of the patients were evaluated on Mohanty and Chacko 1984 [29] criteria (excellent, good, fair, poor) was used for evaluation of the results.

1. Pain
2. Deformity
3. Daily activities
4. Ability to squat and sit crossed legged
5. Walking distance
6. range of knee movements.

No patient was lost in follow up, the patients were evaluated at a mean of 26 months (range: 10-62 months). Patient's fractures were healed after fixation of the osteotomy site with short McLaughlin plate and SP nail, adequate stability was achieved at the fracture /osteotomy site. Mean time of union was 12.5 weeks (range10-22 weeks).

Inter observer reliability results regarding the clinical leg length (anterior superior iliac spine) and radiological measurements for all subjects were excellent. The average leg length of the patient was 145.5 +_ 5.3cm (range between 130-158cm). The average femoral shortening was 3+_0.6cm (range 2-4.5cm). Pre-operative leg length discrepancy was 3.8+_1.4cm (range 2-8cm) post-operative leg length discrepancy was 1.2+_0.6cm (0-2.5cm).

There were no neurological deficits in the patient's union of fracture occurred on the average period of 12.5 weeks with a range of (10-22) weeks. One patient had superficial infection of the wound, after culture and sensitivity suitable antibiotics were administered wound healed without complications. In 2 patients varus deformity was seen optimal nail placement was between 10 and 25 mm from the articular cartilage. In our series tip of the nail was between 6-20mm from the margin of articular cartilage. Single placement was the rule in all cases, the final position was accepted.



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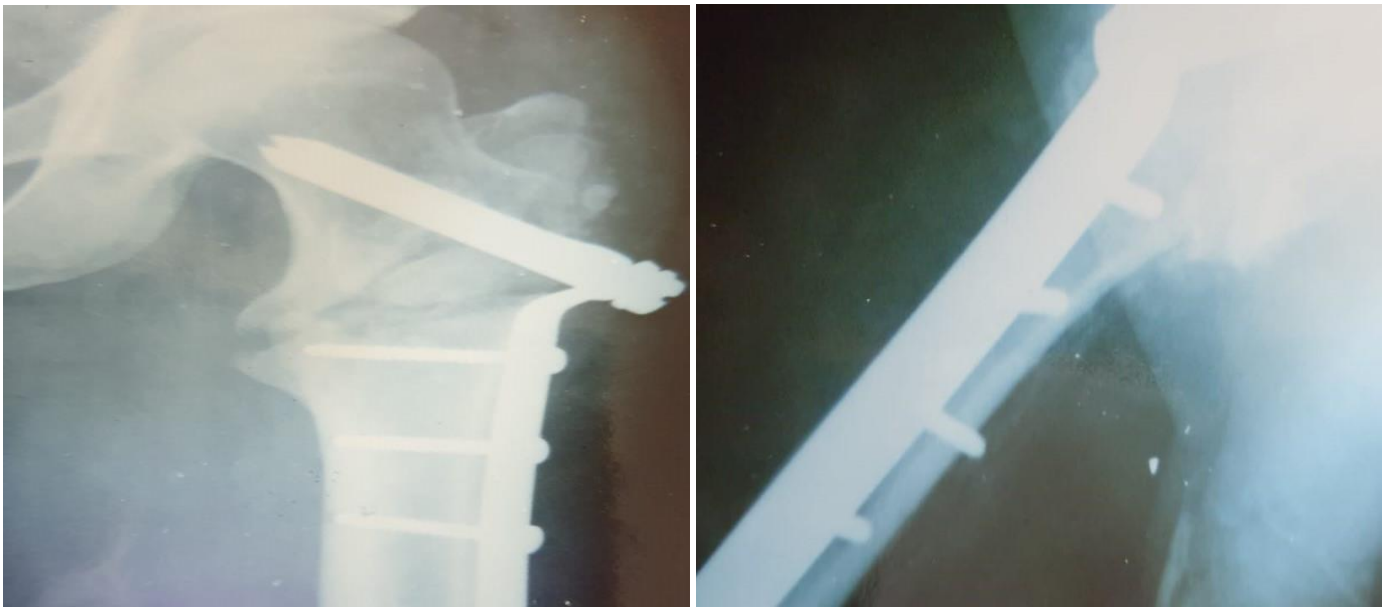

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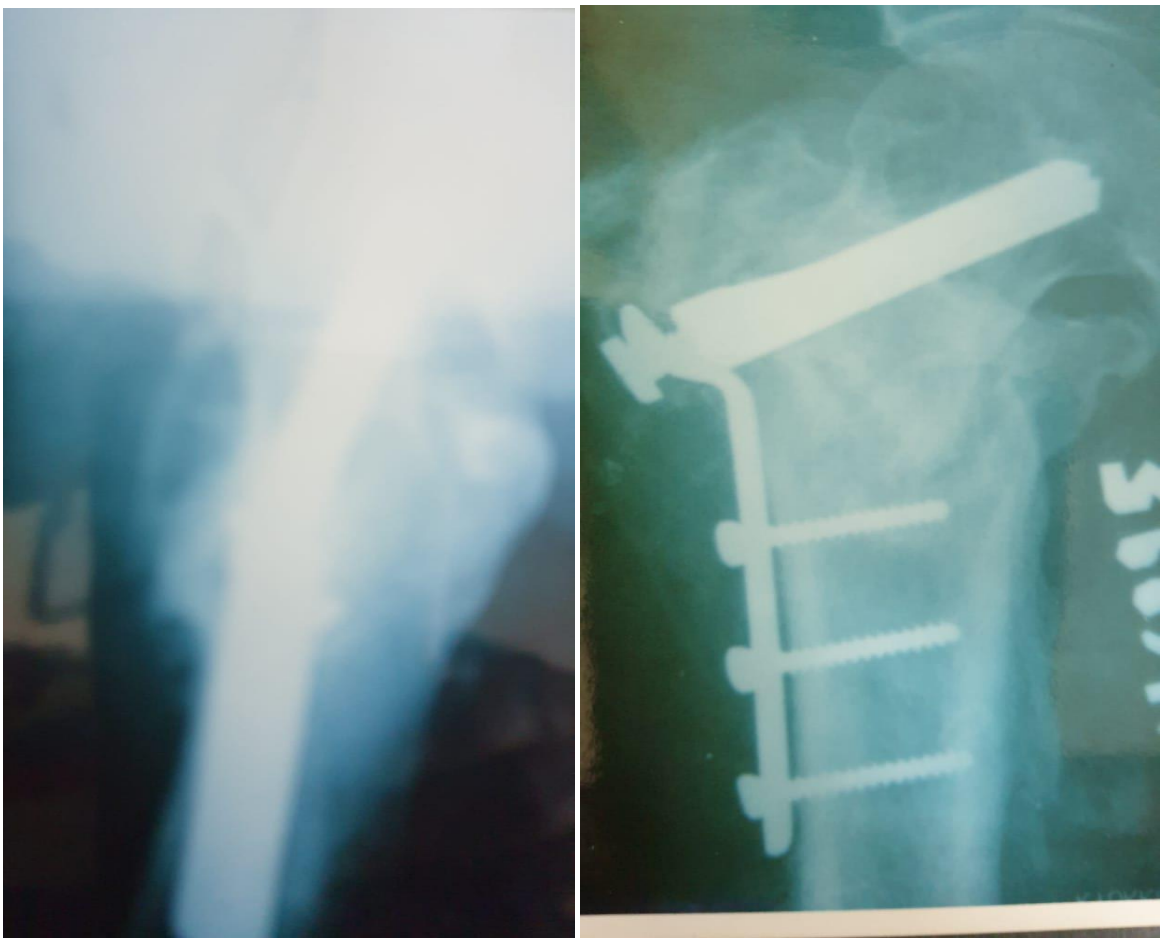

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Fig 2(a): Pre-op AP & Lat views showing the fracture (b) Post -Op AP & Lat view showing implant in-situ. (c) Pre-Op Lat view & Post-Op Ap view showing the Implant in-situ.

Discussion

This study was done in a crowded Government medical college hospital (VIMS) Bellary. This study includes 20 patients with comminuted inter-trochanteric and unstable fractures treated with Sarmiento valgus osteotomy and fixation with short S.P nail and McLaughlin plate system. This study is aimed at analysing the results of operative treatment of these fracture with valgus osteotomy and fixation with above system.

It is universally accepted that surgical treatment of inter trochanteric fractures is to achieve early mobilization and rehabilitation and thereby overcome the complications of prolonged immobilization like hypostatic pneumonia, deep vein thrombosis, bed sore, pulmonary embolism, senile psychosis.

Comminuted and unstable inter-trochanteric fracture is due to a gap in the postero- medial segment comprising the lesser trochanter and a portion of the calcar femorale, it is

impossible to obtain a rigid internal fixation of the fracture, when this type of fracture is treated conventionally with screw and plate, complications like varus deformity, implant may bend, cut out of the proximal fragment or may penetrate the hip joint. The screw may become loose or may break at the plate screw junction. Comminuted and unstable inter-trochanteric fractures form 21-83% (Wolf Gang 1982/ Edmonson 1980) [42] of total inter-trochanteric fractures. In 1970 Augusto Sarmiento has devised a method of valgus osteotomy and medial displacement of the femoral shaft for the comminuted unstable inter-trochanteric fractures. This converts an unstable fracture into a stable one.

Dimon and Hughston have devised a method of transverse osteotomy of the distal fragment and medialization. The spike of proximal segment is pushed into medullary canal of distal fragment, Jewett nail was used for fixation. Complication of Jewett nail is penetrating the hip join is known, also proximal fragment goes for excessive valgus position. The higher instance in elderly age group can be described by fact that the bones are osteoporotic and the Hip joint being a major weight bearing joint is subject to sudden and abnormal stresses. The space between the bony trabeculae are enlarged and filled with fat and calcar femorale is atrophied hence trochanteric fracture is more common in elderly age group. In our series average age was 55 years and youngest patient was 35 years oldest was 76 years. Sarmiento reported average age was 78 years ranging from 41 to 98 years.

Various authors have found females to be more prone for these fractures to Sarmiento series out of 100 cases 69 females and 31 males were reported. Diamond and Hughston reported 53 % males in their series. Ohri, Hatim and RC Gupta reported a male predominance in their series. In our series 85% are males and 15% are females.

Victor Frankel by his experiments has come to a conclusion that older bones absorbed approximately 25% less energy than the energy absorbed by young bones. He concluded that over-loading of bone occurs because of lack of inhibitory impulses to the muscles during a fall. In our series 8 patients sustained fractures due to accidental fall, 12 patients sustained fracture due to road traffic accident.

From our study of 20 cases, it is apparent that most of the fractures were preventable, but for little care taken by the patients or the attendants. The surroundings should be free of potential danger for the aged, such as slippery floors, scattered toys, stray animals, poor lighting etc.

In Cleveland series 16.4% of the patients had bi-lateral trochanteric fractures. In our study right side was involved in 12 patients and left side in 8 patients. In none of our cases Bilateral-trochanteric fractures were observed. Wade and Campbell (1959) [8], Ohri and Hatim (1959), RC Gupta (1974) [16] have reported the highest number of fractures on the right hip in their series.

Advantage of operating early on the patients is that of early mobilization. But a delay of few days also allows the fracture haematoma to start resolving and associated injuries and diseases can be treated. The patient is also more mentally prepared for the operation and post-operative management. In our series average time between admission and operation was 11.5 days ranging from 4-17days. During this period patients were investigated refer to physician for medical fitness, general condition of the patient was improved before undergoing surgery.

According to August Sarmiento surgical treatment is the choice for comminuted and unstable inter-trochanteric fracture for the following reasons:

For early ambulation of the patient

To achieve good functional results

Valgus osteotomy and medialization for comminuted and unstable inter-trochanteric fracture to prevent complications which arises if treated conventionally.

Further Sarmiento stressed the need for accurate reduction of the fracture. Improper reduction of the fracture fragments leads to varus deformity or migration of nail out of the neck or into the acetabulum irrespective of whichever the implant has been used in fixation.

Our study was done in a Government Medical College hospital where in all the patients treated were poor and cannot afford even for basic treatment.

Hence the best available system that was present in our hospital (SP Nail/McLaughlin Plate) system was used. This system has adequate strength to bear the stresses, easy to Pass the nail into proximal fragment, can be fixed easily to Mclaughlin plate, bending of the nail is rare, 135 degrees Mclaughlin plate is used, advantage of using this plate is easy to apply causing minimal damage to the femoral cortex/ cold bending of nail is avoided a large stock of nail plate of varying length and angle is unnecessary.

In our series some of the osteoporotic patient's rigid immobilisation was not possible, partial weight bearing with crutches was allowed keeping the above said factor into consideration on an average of 8.5 weeks with a range of 5-15 weeks.

In our study union of fracture occurred in an average of 12.5 weeks ranging from (10-22 weeks). All fractures united well, because the osteotomy is done below the surface of the fracture, shortening of the extremity would be anticipated, (shortening of less than one inch was seen in 6 cases). However, the valgus positioning of the proximal fragment compensates for the loss of length of the extremity.

In this study the following observations were made comminuted unstable inter-trochanteric fractures treated by valgus osteotomy and medial displacement of the distal fragment with accurate approximation of the medial cortex of the 2 major fragments greatly enhances the efficiency of fixation.

By valgus osteotomy change in the plain of fracture to a more horizontal one increases the stability of reduction and reduces the shearing stresses to which more vertical fractures are subjected. Sarmiento technique provides sufficient stability of the fracture site to make early rehabilitation possible. In the present setup and prevailing conditions in a crowded government teaching hospital though our study consisted of only 20 cases we found that Sarmiento technique is excellent, and the implants used in treating comminuted unstable inter-trochanteric fracture are satisfactory.

Conclusion

Inter-trochanteric fracture Femur is a common injury in the elderly persons and occurs due to accidental fall/Road traffic accidents. Increased incidence of Inter-trochanteric fracture in the elderly people calls for prophylactic care pertaining to these patients, as these fractures are more common in Male patients. These fractures treated by Valgus osteotomy and medial displacement of the distal fragment (Sarmiento Technique) with accurate approximation of the medial cortex of two major fragments greatly enhances the efficiency of fixation. By Valgus osteotomy change in the plane of fracture to a more horizontal one increases the stability of reduction and reduces the shearing stresses to which more vertical fractures are subjected. Sarmiento Technique provides sufficient stability of the fracture site to make early

rehabilitation possible.

In a crowded government teaching Hospital, I have found that Sarmiento technique is excellent in treating comminuted and unstable intertrochanteric fractures. This technique is being further continued in this Institution as it proved to be excellent in treating these fractures of Femur.

Conflicts of Interest

There are no conflicts of interest

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