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Original Research Article

Irreducibility in Trochanteric Hip Fractures: An Observational Study

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Conflict of interest: Nil

Abstract

Aim: To understand X Ray features and Surgical Management of trochanteric hip fractures not reducible by the standard closed reduction methods.

Methods: During a 3-year period (from October 2018 until October 2021), 140 patients with trochanteric hip fractures were treated at our Institute. A retrospective observational review study was undertaken to understand which of these fractures were not reducible by the standard closed reduction methods and required open reduction. These fractures were assessed for X Ray features suggesting irreducibility, intra operative surgical findings & reduction methods, and complications, if any.

Results: Sixteen patients had fractures not reducible by standard closed reduction methods and underwent open reduction. These fractures could be grouped into 3 types. One, in which proximal fragment was found locked below the shaft (3 cases), second where the posteromedial fragment was stuck at the fracture site (4 cases) and third where the proximal fracture fragment was flexed due to lesser trochanter (9 cases).

Conclusion: Trochanteric hip fractures, which are not reduced by the standard closed reduction methods can be understood by special X Ray features. These special X Ray features can warn the Orthopaedician about any possible difficulty in achieving closed reduction. Hence, they can be aware of any need of open reduction in such patients beforehand thereby helping in planning the perioperative course better.

Keywords: Pertrochanteric hip fracture, Irreducible, Computed tomography.

Introduction:

Trochanteric hip fractures are a common case surgically treated by Orthopaedicians. Most of these fractures are reducible by standard closed reduction methods. Whitman's method and lead better method are the standard methods usually deployed, though other methods are also there including Massie, Mc Elevenny, Deyerle, Smith Peterson and Flynn methods. Sometimes, fracture configurations are not reducible by the standard closed reduction methods and need open reduction. The purpose of this study was to recognize such fractures with their special X Ray features, their causes and their operative management.[1-5]

Materials and Methods:

Duration & Place of study: Between October 2018 till October 2021, 140 trochanteric hip fractures were treated at Department of Orthopaedics Bundelkhand Medical College, Sagar (M.P.)

Type of study:

A retrospective review study

Inclusion criteria:

Trochanteric hip fractures in adults (age>18yrs) that were treated at our Institute, these fractures were not reducible by the standard closed reduction methods and required open reduction. Surgical approach, anatomic features preventing closed reduction, intraoperative reduction methods and the implants were used. X Rays of these patients were compared with reducible trochanteric fractures. 16 patients had fractures not reducible by the standard closed reduction methods and required open reduction. These fractures could be grouped into 3 types.

Exclusion criteria:

Unfit for anesthesia, skeletal immaturity, pathological fractures, compound fractures, polytrauma, known alcohol or drug dependency, inability to participate in the study, neuromuscular disorder & Inflammatory arthritis. Patients participating in other clinical trials of a drug or device were also excluded. Pathological and prosthetic hip fractures were excluded from the study.

Methodology:

A retrospective review was done to determine which of these fractures were not reducible by the standard closed reduction methods and required open reduction. Retrieved data included patient's age, mechanism of injury, and X Rays. The Confirmation of open reduction was made from the operative records.

Surgical Procedure:

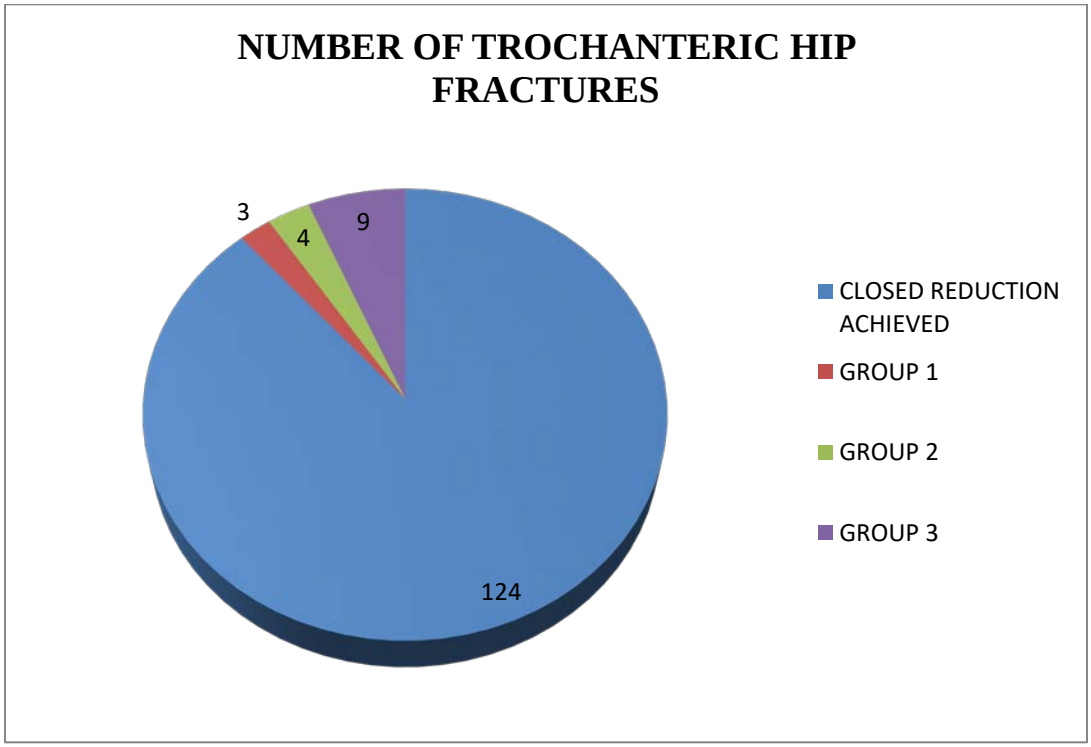
Group 1 The first variant was seen in 3 patients. All patients were females with an average age of 30 years (range 22–38 years). This fracture was classified as A.O.31-A1 fracture. They had similar X ray findings with an overriding shaft fragment with the lesser trochanter attached. Patients were operated on fracture table. Closed reduction was unsuccessful, hence open reduction was undertaken. Standard lateral incision was made. Vastus lateralis was split. Levering out the sunken proximal fragment was not possible. Hence, incision was extended proximally similar to Watson Jones approach. Interval between the tensor fascia lata and the vastus lateralis was used to reach the proximal fragment with reduced traction. The iliopsoas tendon was found preventing the proximal fragment from being pulled anteriorly. So, illiopsoas tendon was partially released in all three patients. The proximal fragment was levered out with either a schanz pin inserted into femoral neck or a hohmann retractor. The fracture was fixed using dynamic hip screw (DHS) in all cases.

Group 2 The second variant was seen in 4 patients. There were 2 women and 2 men with an average age of 60 years (range 50–70 years). All patients suffered from a trivial fall. These fractures were classified as A.O.31-A2 fractures. X Rays showed an overlap between the shaft and the posteromedial fragment. This posteromedial fragment caused the proximal fragment to displace anterior. This prevented closed reduction by the standard reduction manoeuvre of traction and internal rotation. Hence, open reduction was needed. The posteromedial fragment was removed from the fracture site, by a bone lever or a by a Kocher's forceps. Stable reduction was achieved after this and the fractures were fixed using DHS.

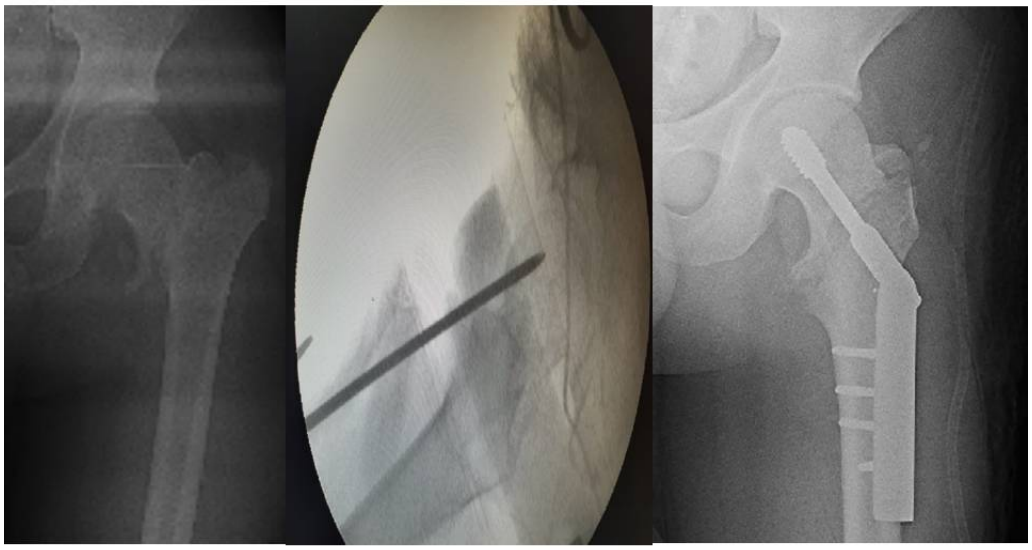
Group 3 The third variant was seen in 9 patients. There were 4 women and 5 men with an average age of 73 years (range 65–85 years). All these patients had a trivial fall. These fractures were classified as A.O.31-A2 fractures. The X Rays showed a long medial beak on the flexed proximal fragment. A lateral incision was made at the level of the flexed proximal fragment and the reduction was achieved by either a bone clamp or a bone lever to achieve anterior cortex continuity. The fracture was fixed by using a dynamic hip screw (DHS) or a Proximal Femoral Nail (PFN).

Follow up Standard postoperative and follow up care was given. 12 of 16 patients had 6 months follow up. One patient in group 4 expired before a follow up of 6 months due to unrelated causes. One patient in group 3 and 2 patients in group 4 were lost to follow up after surgery. In remaining patients, all fractures had healed at 6 months.

Observation Chart:



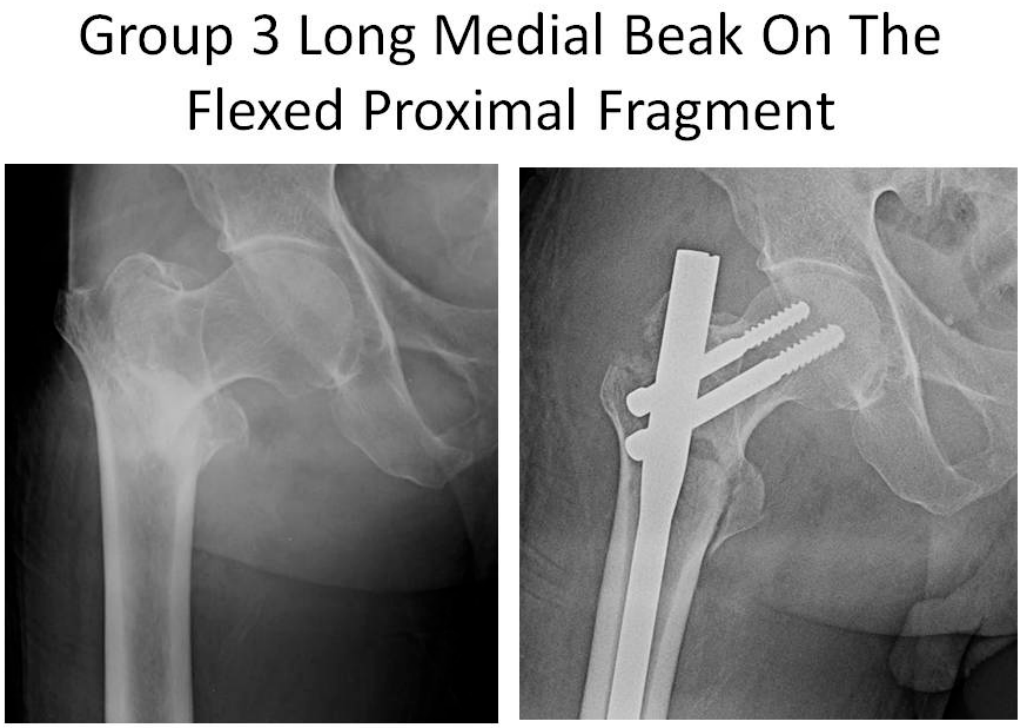
Group 1 Overriding Shaft Fragment With The Lesser Trochanter Attached



Group 1 The first variant was seen in 3 patients. All patients were females with an average age of 30 years (range 22–38 years).

Group 2 Overlap Between The Shaft And The Posteromedial Fragment

Group 2 The second variant was seen in 4 patients. There were 2 women and 2 men with an average age of 60 years (range 50–70 years)



Group 3 The third variant was seen in 9 patients. There were 4 women and 5 men with an average age of 73 years (range 65–85 years)

Results:

Sixteen patients had fractures not reducible by standard closed reduction methods and underwent open reduction. These fractures could be grouped into 3 types. One, in which proximal fragment was found locked below the shaft (3 cases), second where the posteromedial fragment was stuck at the fracture site (4 cases) and third where the proximal fracture fragment was flexed due to lesser trochanter (9 cases).

Statistical Analysis:

The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or Fisher's exact test was used. To compare the quantitative outcome measures, independent t test was used. If data was not following normal distribution, Mann Whitney U test was used. SPSS version 22 software was used to analyse the collected data. p value of <0.05 was considered to be statistically significant.

Discussion:

In a similar review of 212 trochanteric fractures between August 2011 and December 2013, 24 fractures (11.3%) were not amenable to closed reduction. These fractures could be divided into 3 types. The first was seen in relatively younger age group, involved high-energy trauma and was classified as A.O. 31-A1 fractures. The other two types were seen in a relatively older age group, sustained low-energy trauma and were classified as A.O. 31-A2 fractures. [1-4]

We reduced all fractures on the fracture table. The proximal fragment remains below

the shaft fragment, which is further medialised by the pull of the illiopsoas. Pulling up the shaft laterally and releasing the illiopsoas tendon were the most helpful steps for reduction of this fracture. Once this is achieved, the proximal fragment was levered back by using a bone lever or a Schanz screw.

The second variant involved an A.O.31-A2 trochanteric fracture with entrapped posteromedial fragment at the fracture site. This causes anterior displacement of the head and neck fragment, which could only be reduced after the entrapped posteromedial fragment was delivered.

The third variant involved an A.O.31-A2 trochanteric fracture with an anteriorly displaced proximal fragment and a separate lesser trochanter. The cause of irreducibility is that the proximal fragment is free to move in the sagittal plane. The lesser trochanter fragment causes an anterior displacement of the proximal fragment while itself it gets flexed by the pull of the illiopsoas. Chin described a series of sagittally unstable trochanteric fractures. They used a 4.2 mm stienmann pin to push the anterior cortex downward. With the pin in situ, the fractures were fixed by intramedullary device. Carr described the use of a percutaneously inserted Jocker elevator to reduce the anterior cortex. We reduced these fractures using a bone clamp or a bone lever through a lateral incision. Orthopaedicians might hesitate to give this lateral incision while using PFN and consequently insert the nail in an unreduced fracture. [3,4]

At our institute A.O.31-A1 fractures are treated with a DHS, while A.O.31-A2 fractures are treated with either a DHS or an intramedullary implant depending on the Orthopaedician's preference. Given the fact that a reduction must be obtained prior to definitive stabilisation in trochanteric fractures, the reduction methods described by the authors can be used with either a DHS or an intramedullary implant. [6-9]

The aim of the study by Ikuta Y et al was to clarify the relationship between the preoperative radiographic classification of trochanteric fractures and the success/failure of closed reduction. Identification of irreducible fractures would be important to proceed promptly to direct reduction.The position of the proximal fragment, relative to the shaft on lateral view, and the fracture pattern of the lesser and greater trochanters were predictive of the feasibility of obtaining a successful closed reduction. These criteria identified success/failure of closed reduction in 99.3% of cases.Their findings should be useful for identifying patients in whom closed reduction would be suitable and for avoiding ineffectual manipulation in unsuitable patients.[10]

Hao YL et al in a similar study gave predictors and reduction techniques for irreducible reverse intertrochanteric fractures. This study aimed to summarize the displacement patterns of irreducible reverse intertrochanteric fractures and corresponding reduction techniques, and explore predictors of irreducibility.A high proportion of reverse intertrochanteric fractures are not amenable to closed reduction. Predictors of irreducibility include a medially displaced femoral shaft relative to the head-neck fragment on the AP view, a displaced lesser trochanter, and a displaced lateral femoral wall. These patients warrant special consideration in terms of recognition and management. [11]

Fang KB et al studied treatment of irreducible femoral intertrochanteric fractures using a wire-guided device. The operation time, blood loss, visual analogue scale scores, angulation, reduction, neck-shaft angle, re-displacement, limb length discrepancy, and

union time were then recorded and analyzed to determine the efficiency of the wire introducer technique. Conclusion was that the minimally invasive wire guide achieved a similar effect to that of open reduction in the treatment of intertrochanteric fractures with difficult reduction. Moreover, the minimally invasive wire introducer is a good technology that accurately guides the wire during reduction. Indeed, it is an effective technique and achieves good clinical outcomes in restoration of irreducible femoral intertrochanteric fractures.[12]

Moehring HD et al did a retrospective study which revealed that four of 112 patients had intertrochanteric fractures that were irreducible by the usual closed manipulation and traction techniques at the time of surgery. Each of these patients' preoperative radiographs showed a fracture line that bisected the lesser trochanter and was relatively uncomminuted. Although longitudinal traction and appropriate closed manipulation provide acceptable reduction for most intertrochanteric fractures, the few with the described fracture pattern may require open reduction with removal of interposed soft tissue to achieve satisfactory alignment.[13]

Said GZ et al deviced a technique for open reduction in an irreducible variant of intertrochanteric fractures.Five cases of intertrochanteric fractures needed open reduction after failed closed reduction techniques. In all cases the shaft fragment included the lesser trochanter, and there was a long spike on the head–neck fragment. So they deviced a three-step technique, which was applied for open reduction in these unusual cases. With the patient supine on a standard operating table, the fracture site was exposed. The limb was placed in full adduction and external rotation to slacken the iliopsoas tendon. A Hohmann retractor was then passed medial to the shaft and behind the fractured surface of the sunken femoral neck, levering it anteriorly. Traction in abduction and internal rotation was applied to complete the reduction. Additional iliopsoas tenotomy was performed in two patients. All cases were fixed with a dynamic hip screw[DHS] and all fractures united uneventfully.[14]

Sharma G et al studied pertrochanteric fractures (AO/OTA 31-A1 and A2) not amenable to closed reduction.A retrospective review was undertaken to determine which of these fractures were not reducible via the routine closed reduction manoeuvres and required some form of open reduction. These fractures were assessed for radiographic markers of irreducibility, surgical findings, reduction techniques, and perioperative complications.24 such cases were studied, where the proximal fragment is locked underneath the shaft fragment (3 cases), bisected lesser trochanter with a locked proximal fragment (3 cases), irreducibility due to entrapped posteromedial fragment at the fracture site (6 cases) and a variant where the proximal fragment is flexed passively by the underlying lesser trochanter (12 cases).It was concluded that pertrochanteric fractures, which are not amenable to closed reduction, are uncommon, but are heralded by unique radiographic features. These patients warrant special consideration in terms of recognition and management. The specific radiographic markers should alert the surgeon to this injury pattern and its related difficulty encountered during closed reduction. Once reduction is achieved, however, these fractures follow an uneventful course.[15]

We encountered 3 variants of trochanteric fractures, which were not reducible by closed reduction. If a high index of suspicion is maintained and the Orthopaedician is aware of these irreducible variants, it is possible to predict irreducibility on standard X Rays

based on certain special X Ray features. Awareness of these fracture types would allow Orthopaedicians to be better prepared for fracture reduction and would reduce unnecessary attempts at closed reduction.

Conclusion:

Trochanteric fractures irreducible by closed reduction possess special X Ray features. Features on an AP X Ray which should alert the Orthopaedician of irreducibility while treating an 31-A1 fracture include an overriding shaft fragment with the lesser trochanter attached to it. These types are more likely to be seen in young patients with high-energy trauma. Likewise, features on an AP X Ray, which should alert the Orthopaedician of irreducibility while treating an 31-A2 fracture, include an overlap between the shaft fragment and the large posteromedial fragment, and an end-on appearance of the proximal fragment (flexed proximal fragment) with an underlying lesser trochanter fragment. These types are usually seen in older patients with low-energy trauma.

Declarations:

Funding: None

Availability of data and material: Department of Orthopaedics Bundelkhand Medical College, Sagar (M.P.)

Code availability: Not applicable

Consent to participate: Consent taken

Ethical Consideration: There are no ethical conflicts related to this study.

Consent for publication: Consent taken

What this Study Add to Existing Knowledge:

Trochanteric hip fractures, which are not reduced by the standard closed reduction methods can be understood by special X Ray features. These special X Ray features can warn the Orthopaedician about any possible difficulty in achieving closed reduction. Hence they can be aware of any need of open reduction in such patients beforehand there by helping in planning the perioperative course better.

Limitations of Our Study:

This study had certain limitations. The percentage of patients with irreducibility may not be a correct representation as our centre is primarily a referral centre. Although this is a limitation, it did give us the opportunity to witness these types in a relatively short period. Second, this was a retrospective review, relying on operative records and X Rays retrieved from the picture archiving and communication system. The causes of irreducibilty and difficulties encountered may not always be mentioned in the records.

Contribution by Different Authors:

First and Corresponding author:

Dr. Gaurav Agarwal D Ortho, Dnb (Ortho.) Assistant Professor Department of Orthopaedics Bundelkhand Medical College, Sagar (M.P.) Data collection and statistical analysis

Second author: Dr. Raghvendra Choubey MS (Ortho.) Associate Professor, Department of Orthopaedics Bundelkhand Medical College, Sagar (M.P.) Data collection and statistical analysis

Third author: Dr Roopa Agrawal MD (Paediatrics) Assistant Professor Department of Paediatrics Bundelkhand Medical College, Sagar (M.P.) Statistical Analysis,References and Discussion

Fourth author: Dr. Rajesh Kumar Jain MS (Ortho)Professor & Head of Department of Orthopaedics Bundelkhand Medical College, Sagar (M.P.) Concept and Guidance

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