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Prospective study of effect of quality of reduction of intertrochanteric fractures on functional outcome

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Abstract
Objective: To assess the importance of quality of reduction on the functional outcome of patients treated with proximal femoral nail for unstable intertrochanteric fractures of the proximal femur.
Patients and Methods: 20 patients diagnosed with unstable intertrochanteric fractures between January to November 2017 were included in this study after ethical clearance was obtained from the institute. Patients that were mobile and were cognitively sound were included in the study. Boyd and Griffin classification was used for classifying the fractures. All were treated with short PFN and based on the postoperative reduction were categorized into three groups using modified Baumgartner's criteria for assessing quality of reduction into good, satisfactory and poor. Assessment of functional outcome using Harris Hip score was done at 2nd, 3rd, 6th and 12th month follow up. At the end of the follow up Baumgartner's criteria were correlated to the functional outcome.
Results: We found that all patients who had poor reductions (2 of 2) ended up with complications of fracture healing while those with good (11) and satisfactory (7) reduction criteria had none.
The functional score in patients with good reduction was at a mean of 95.4, those with satisfactory reduction at 81.6 and in those having poor reduction at 68.75. This translated to; poor reduction resulting in poor functional outcome (HHS), satisfactory reduction resulting in fair to good outcome (HHS) and a good reduction resulting in excellent outcome (HHS).
Conclusion: Aiming at a good to satisfactory reduction either by closed or open means is key in treating unstable intertrochanteric fractures as it helps avoid poor functional outcomes and decreases surgical complications related to fracture healing.

Keywords: Quality, reduction, intertrochanteric fractures, functional outcome

Introduction
The number of patients sustaining intertrochanteric fractures is on the raise in the recent decades [1]. The elderly is the most affected age group and about a third of the affected die within an year of the injury [2]. Life expectancy decreases by 1.8 years moreover, one fifths of the remaining life is dependent on long term care services [3]. Pre fracture functionality is attained in only half those who survive beyond 6 months [4]. Hence, understanding the factors that influence functional outcomes in intertrochanteric fractures is vital.
As per Watson and Jones, intertrochanteric fractures heal but are prone to coxa vara and shortening thus limiting mobility and prolonging recumbency in the primary population it affects, the elderly. Ths, the aim in treating these fractures should be to encourage union with our deformity and at the same time to allow early mobilization with minimal medical complications and technical errors [5, 6]
This necessitates the need to understand the factors that help control fracture healing and prevent complications like varus collapse and shortening.
Lately, many studies have shown that treatment of proximal femoral fractures with intramedullary nails offer biomechanical advantages and end up in lesser complications in comparison to other fixation devices [7-12]

Objective
We hypothesized that reduction of the fracture is an important variable affecting the final functional outcome in surgically treated intertrochanteric fractures. Our aim was to to assess the importance of intraoperative quality of reduction on the functional outcome of patients

treated with proximal femoral nail for unstable intertrochanteric fractures of the proximal femur.

Materials and Methods

A prospective cohort of 20 patients diagnosed with unstable intertrochanteric fractures between January to November 2017 were included in this study. The study was carried out at Raichur institute of Medical Sciences, Raichur. Clearance from ethical committee of the institute was obtained. Boyd and Griffin classification was used for classifying the fractures.

Inclusion criteria:

- Patients having types 2,3 and 4 (Unstable) intertrochanteric fracture.
- Patients that were mobile independently prior to the injury.
- Patients who were cognitively.
- Medically fit for surgical intervention.

Exclusion criteria

- Type 1 intertrochanteric fractures as they were treated with sliding hip screws.
- Unwilling for surgery
- Those with terminal illness and malignancies.
- Polytrauma patients.
- Patients that were bedridden prior to the fall

All cases were operated by a single surgeon. Traction table was used in all cases. All were treated with short PFN under fluoroscopic guidance. Reduction was checked following longitudinal traction, adduction and internal rotation of the limb to such degrees so as to achieve the best reduction as possible on both Anteroposterior and lateral views. Postoperatively based on fracture reduction after cases were categorized into three groups using modified Baumgartner's criteria for assessing quality of reduction into good, satisfactory and poor. In 30% of the cases an open reduction was done. Postoperatively, knee and ankle movements were started from the first postoperative day. All patients were allowed tolerated weight bearing from 2nd to the 10th day. Assessment of functional outcome using Harris Hip score was done at 2nd, 3rd, 6th and 12th month follow up. At the end of the follow up Baumgartner's criteria were correlated to the functional outcome.

Table 1: Modified Baumgaertner criteria: [13]

Modified Baumgaertner Criteria	
Alignment	▪ AP: normal CCD angle or slight valgus ▪ Lateral: < 20 degree angulation
Displacement of Fragments	▪ > 80% overlap ▪ < 5mm shortening
▪ Assessment: ▪ Both criteria met —> Good ▪ One criteria met —> Satisfactory ▪ None of the criteria met —> Poor	

Results

The average age in this study was 61.9 years. 9 men and 11 women comprised the study population. Based on Boyd and Griffin classification 35% were type 2, 40% type 3 and 25% were type 4 fracture patterns. In 6 cases, open reduction had to be done as trials at closed reduction failed. As per modified Baumgartner's quality of reduction criteria it was found to be good in 11 cases, satisfactory in 7 and poor in 2 patients.

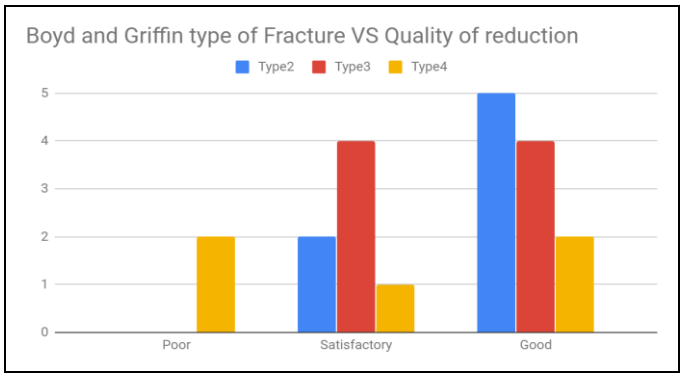
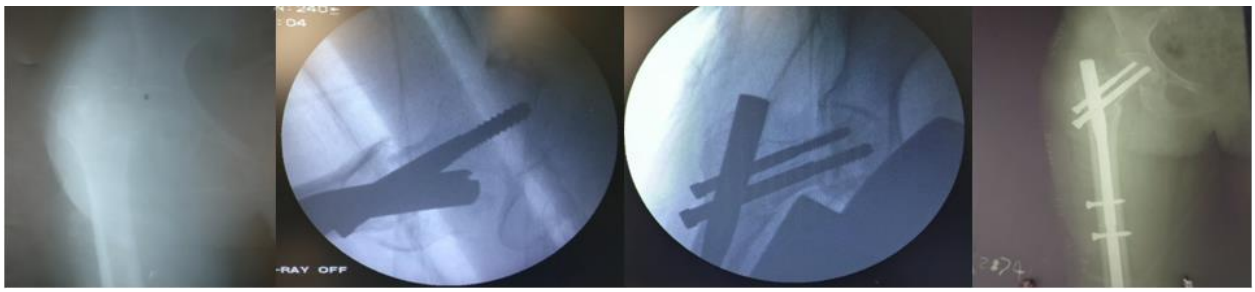


Chart 1: Type of fracture and the quality of reduction. Type 2 and Type 3 fractures produced satisfactory and good reductions while poor reductions were seen with Type 4 fractures.



a) b) c) d)

Fig 1: a) Boyd and Griffin classification type 2 intertrochanteric fracture b) & c) Intraoperative assessment of quality of fracture reduction appears to be good as per Baumgartner's criteria. d) Post operative radiograph at 3rd month follow up

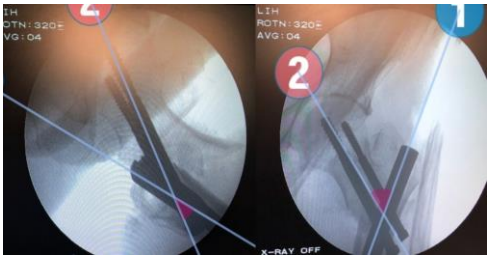


Fig 2: Poor reduction with lateral angulation > 35 degrees, CCD of 120 degrees, displacement with < 80 % contact after final implantation.

We found that all patients who had poor reductions ended up with complications of fracture healing like varus collapse and limb shortening whereas such complications were not encountered in those with satisfactory to good reductions.

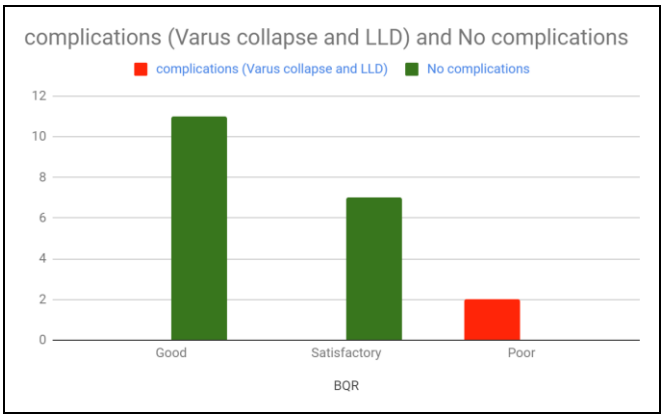


Chart 2: Fracture healing complications at the final follow up were found in cases who were categorized as poor reductions.

The functional score in patients with good reduction was at a mean of 95.4, in those with satisfactory reduction at 81.6 and in those having poor reduction at 68.75 (Chart 3).

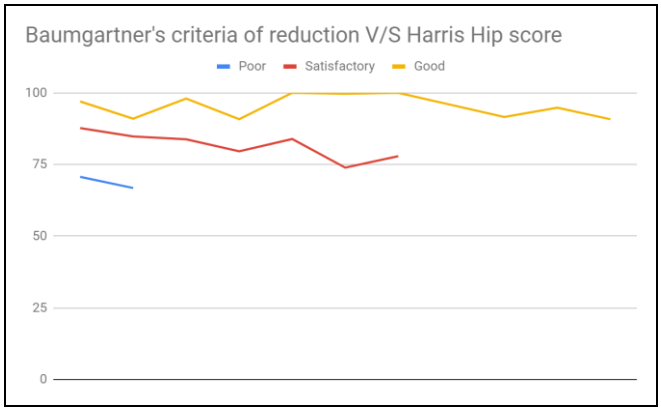


Chart 3: Poor quality of reduction (blue line) producing Harris hip scores between a range of 66 - 71, Satisfactory reduction (red line) produced scores of a range between 73 - 88 while Good reductions (yellow line) produced scores ranging between 90 - 100

This translated to findings where in poor reductions lead to poor functional outcome (HHS), satisfactory reduction resulted in fair to good outcome (HHS) and a good reduction resulted in excellent outcome (HHS) (Chart 4).

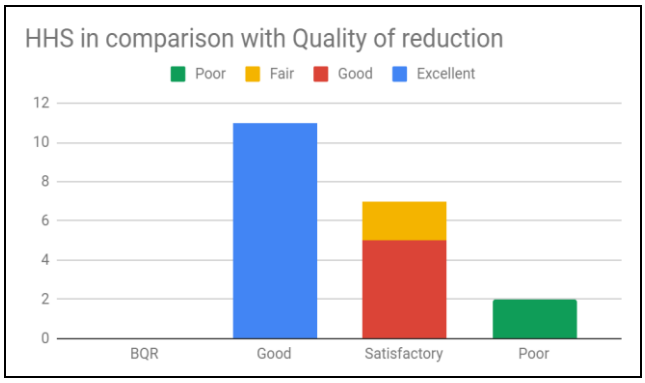


Chart 4: Shows that good reductions produced excellent results, satisfactory reductions produced good and fair functional outcomes while poor reductions produced poor functional outcomes.

Discussion

Reduction of intertrochanteric fractures are a key in the treatment of proximal femoral fractures of the elderly for providing correct treatment and to prevent traumatological complications [7, 8, 14-16] The post injury quality of life of the patient also depends on the quality of treatment. Studies have proven that following these fractures the quality of life of patients that sustain them deteriorates [17, 18] There is a tendency to improve parameters such as mobility, social interaction and general health when reducing the fracture. It should therefore be given enough emphasis by the treating surgeon [19] There is a tendency for these fractures to abduct and flex at the proximal fragment and to undergo varus collapse. In our study 30% of the cases underwent open reduction as recommended by P. Codesido Vilar *et al.* to perform an open reduction of the fracture and get the best possible reduction either with reduction clamps or permanent cerclages [20-26] The procedure of opening the fracture and using cerclage wires hasn't proven to increase postoperative complications [27-30]

This study showed that with increasing complexity of the fracture the possibility of achieving and retaining a good to satisfactory reduction was reduced. In our study both the poor reductions were noted in type 4 fractures.

Also, it was noted that complications like varus collapse and limb shortening were seen in cases who had poor reduction while no such discrepancies or deformities were noted in the fractures that were classified as good or satisfactory reductions.

Functional outcomes also tend to be poor with poor quality of reduction. While good to satisfactory reductions had fair to excellent functional outcomes as measured by Harris Hip Score.

Conclusion

Aiming at a good to satisfactory reduction either by closed or open means is key in treating unstable intertrochanteric fractures as it helps avoid poor functional outcomes and decreases surgical complications related to fracture healing.

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