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Original Research Article

Analysis of the results of ipsilateral hip and shaft femur fractures treated with reconstruction-type intramedullary nail or various plate combinations

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ABSTRACT

Background: Ipsilateral femoral shaft and hip fractures are commonly encountered following high energy trauma. Despite many treatment methods, controversy exists regarding the optimal management of these fractures. This study was planned to compare reconstruction-type intramedullary nailing and various plate combinations on the fracture healing and functional outcome in patients with these fractures.
Methods: 25 patients with ipsilateral femoral shaft and hip fractures were operated by one of the two modalities - cancellous lag screws or dynamic hip screw for fracture hip and compression plate fixation for fracture shaft of the femur (Group I, 13 patients) and Reconstruction-type intramedullary nailing alone (Group II, 12 patients) - depending on surgeon's preference. The functional results of the patients were assessed with the system used by Friedman and Wyman. Radiological and functional assessment was done by an independent evaluator blinded to the surgical procedure.
Results: The mean age was 33.6±4.03 in group I and 35.3±4.04 years in group II (p=0.70). The average follow up was 15 months. The average union time for femoral neck fracture was 15.75±0.89 and 16.48±1.40 (p=0.36) weeks and for fracture shaft was 19.27±1.18 and 20.06±1.16 (p=0.15) in group I and group II respectively. 10 patients (76.9%) in group I and 9 (75%) in group II showed good functional results. Two patients needed re-operation in group I and one patient in group II.
Conclusions: Ipsilateral femoral shaft and hip fractures can be treated satisfactorily either with nailing alone or various plate combinations with similar outcome.

Keywords: Ipsilateral hip, Femoral shaft fracture, Reconstruction-type intramedullary nail, Cancellous screw, Dynamic hip screw, Plate

INTRODUCTION

Ipsilateral hip and shaft femur fractures are uncommon pattern of injuries and these fractures account for 2.5-9% of femur fractures.[1-3] Most are encountered in high-energy trauma like road traffic injuries and fall from height.[1,3-6] Victims are usually young, with multiple associated injuries.[3,4,7,8] The treatment of ipsilateral hip and shaft femur fractures is technically difficult and challenging and there are many surgical options for management of these fractures. Treatment options include:

- Reconstruction-type of intramedullary nail.[7-15]
- Various plate-screw combinations-including a dynamic hip screw (DHS) and long side plate combination, a hip screw with a short side plate for the neck and separate plate for the shaft or cancellous screws for femoral neck and a plate for the shaft.[13,14,16]
- Retrograde intramedullary nail of the shaft and screw fixation of the neck.[17-19]
- Antegrade femoral nailing of the shaft with separate screws adjacent to the nail for fixation of neck ('miss-a-nail' technique).[20,21]

Each method has its own merits and demerits. The purpose of our study was to compare the radiological and functional outcome of ipsilateral hip and shaft femur fractures treated by using two different methods, i.e., reconstruction-type intramedullary nail and plate-screw combinations.

METHODS

The study was a retrospective and prospective observational study that included all patients who have undergone surgery for ipsilateral hip and shaft femur fractures between April 2012 and September 2014. Patients have been recruited into the study after obtaining their informed consent. All adult patients between 20-60 years age group with ipsilateral hip and shaft femur fractures were included in the study and those with pathologic fractures, compound fractures > Gustilo-Anderson grade II, post radiation fractures, age <20 years and >60 years were excluded from the study.

Table 1: Fracture classification.

Intra-capsular hip fractures	**18**
Sub-capital	01
Trans-cervical	03
Basi-cervical	14
Extra-capsular hip fractures	**07**
Boyd and Griffin Type I	05
Boyd and Griffin Type II	02
Winquist Hansen's classification: fracture shaft femur	
Type I	03
Type II	04
Type III	10
Type IV	08

All injuries were incurred due to a high energy trauma; 21 patients were injured due to road traffic injuries and 4 due to other causes fall from height, firm injury. Eighteen patients had other associated life threatening injuries - blunt injury abdomen, head injury, chest injury. Twenty patients had other associated fractures in the upper and lower extremities. Proximal femoral fractures were divided into intracapsular and extracapsular fractures. Depending on their anatomical location, intracapsular fractures were divided into transcervical, basicervical, and subcapital fractures and the extracapsular fractures were classified according to Boyd and Griffin. Femoral shaft fractures were classified according to the Winquist and Hansen classification system (Table 1). Twenty three fractures closed and two were open.

Based on the surgical intervention the patients had undergone according to surgeon preference, the patients were grouped into two groups - Group I included patients who underwent cancellous screws or DHS for fixation of hip fracture and dynamic compression plating (DCP) for fixation of fracture shaft femur and group II included patients who underwent reconstruction-type intramedullary nail for fixation of both the fractures. Group I had 13 patients with mean age of 37.53±4.73 years and group II had 12 patients with mean age of 38.25±6.52 years.

Patients were followed at monthly intervals up to six months, then at three monthly intervals up to one year, and then every six months up to the last follow-up. The follow-up study included both clinical and radiological evaluations. Progressive weight bearing was allowed after the appearance of callus on radiographs. Union was defined as painless full weight bearing on the affected limb with the presence of radiologic consolidation of fracture in both antero-posterior and lateral views and delayed union as a fracture that was not united even after 24 weeks .The functional results of the patients were assessed with the scoring system used by Friedman and Wyman.[2]

Both the groups were compared in terms of mean age, mean delay in surgery, mean duration of surgery, mean blood loss, mean radiation exposure, average union time for femoral neck fracture, and average union time for femoral shaft fracture, the radiological and functional outcome, the complications and the need for re-operations. Radiological and functional outcome assessment was done by an independent evaluator blinded to the surgical procedure.

Statistical analysis

The baseline demographic characteristics are expressed as mean±SD. Unpaired t-test is used to compare demographic and other efficacy variables and chi square test is used to establish association between Friedman-Wyman score between two groups.

RESULTS

A total of 25 cases of neck and shaft fractures were operated by plate combinations and reconstruction type nail surgeries in one year. All the patients were males and the baseline demographic characteristics of patients and results are given in Table 2. The age, duration of neck fracture and follow up duration was similar in both the groups. An unpaired t-test revealed no preoperative

significant differences between groups I and II with respect to the patient's age.

Group I

In this group (n=13), operations were performed within a mean of 6.1 days (range, 2-11 days) following trauma. Various plate-screw combinations were used: DHS long plate in 3 patients, lag screws and DCP in 8, lag screws and low-contact dynamic compression plate in one, and lag screws and locking compression plate in one patient. All patients were operated using a closed technique for fractured neck, if the fracture was undisplaced and open reduction of the fracture if it was displaced. Open reduction of the fracture femur was done later taking care to avoid devascularization of fragments and periosteum stripping. In few cases, especially when the femur fracture was uncomminuted, first fracture femur was fixed in lateral position and later the hip fracture was fixed on fracture table.

Table 2: Analysis of data.

characteristic	Plate combinations (n=13)	Reconstruction type nail (n=12)	P-value
Age (years)	37.53±4.73	38.25±6.52	0.75
Duration of surgery (minutes)	128.07±13.15	149±13.95	P <0.01
Blood loss (ml)	637.69±100.34	183.33±34.46	P <0.01
Radiation exposure (minutes)	2.16±0.84	5.75±0.89	P <0.01
Follow up (weeks)	58.46±15.32	52±13.88	0.28
Union time for neck fracture (weeks)	15.75±0.89	16.48±1.40	0.13
Union time for shaft fracture (weeks)	19.27±1.18	20.06±1.16	0.12
Weight bearing (weeks)	18.84±1.77	18.16±1.26	0.28

The average operation time (skin incision to skin closure) was 128.07±13.15 min, mean blood loss was 637.69±100.34 ml, mean radiation exposure was 2.16±0.84 min, average union time for femoral neck fracture was 15.75±0.89 weeks, and average union time for femoral shaft fracture was 19.27±1.18 weeks (Table 2). There were complications - two cases of delayed union and one case non-union at fracture shaft femur (Figure 5a). There was need for re-operations - bone grafting alone in two cases and redo-plating plus bone grafting in one case. Patients were followed up for a mean of 16±2.5 months. Neither osteonecrosis of femoral head nor proximal fracture non-union was observed. There were 10 (76.9%) good, 2 (15.3%) fair and one (7.6%) poor functional outcome.

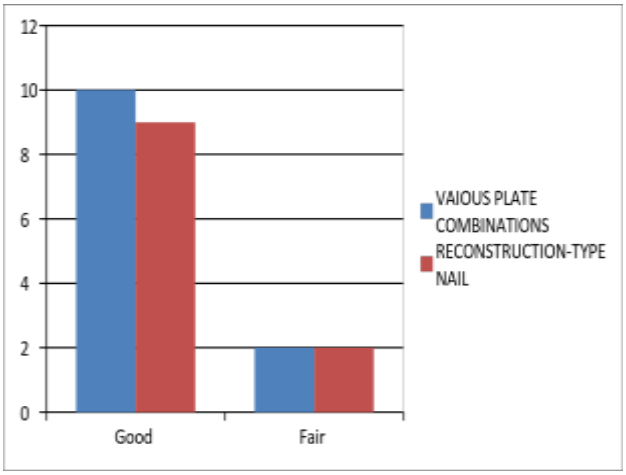

Figure 1: Comparison of union of shaft fracture and weight bearing (in weeks) in two groups.

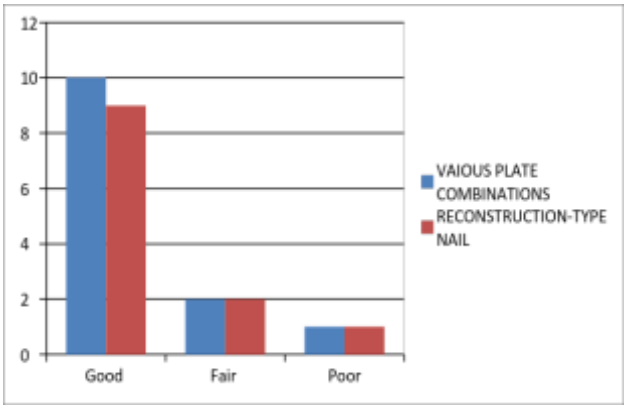

Figure 2: Distribution of Friedman-Wyman scores in both the groups

Figure 3A: Case example of a group I patient showing preoperative.

Figure 3B: Case example of a group I patient showing immediate postoperative radiographs.

Figure 3C: Case example of a group I patient showing) last follow-up radiograph showing union of the fractures.

Group II

In this group (n=12) operations were performed within a mean of 5.2 days (range, 2-10 days) following trauma under image intensifier control. Both femoral neck and shaft fractures were operated using closed techniques in most patients; we faced technical difficulties during the operations in four patients and two patients required open reduction of the shaft fracture. The average time of operation was 149±13.95 min, mean blood loss was 183.33±34.46 ml, mean radiation exposure was 5.75±0.89 min, average union time for femoral neck fracture 16.48±1.40 weeks, and average union time for femoral shaft fracture was 20.06±1.16 weeks (Table 2).

There were complications - superior cervical screw cut out in one case (Figure 5b) which was managed with removal of the screw and miss-a-nail cancellous screw fixation of fracture neck, one case of delayed union at fracture shaft femur and in another case posterior angulation at femur fracture. There was need for re-operations - bone grafting in one case. Patients were followed up for a mean of 15±2.5 months. Neither osteonecrosis of femoral head nor proximal fracture non-union was observed. There were 9 (75%) good, 2 (16.6%) fair and one (8.3%) poor functional outcome.

Figure 4A: Case example of a 30 year old Group II patient showing preoperative.

Figure 4B: Case example of a 30 year old group II patient showing postoperative follow-up radiographs.

Although the duration of surgery and radiation exposure was more in reconstruction type of surgery, the amount of blood loss was significantly lower than in the other modality. One case of non-union and one case of delayed union were seen in plate combination, but the mean duration of healing of shaft fracture and weight bearing was similar in both the types of surgeries (Table 2, Figure 1). The test of association of Friedman-Wyman

score for good score between two types of surgeries for fracture neck and shaft showed no significant difference. The distribution of scores in both the modalities of surgery is shown in Figure 2.

Figure 5A: Case examples of complications nonunion at 6 month follow-up.

Figure 5B: Case examples of complications superior screw cutout.

DISCUSSION

Ipsilateral hip and femoral shaft fractures are common following high energy trauma and these complex fractures constitute 2.5-9% of femur fractures.[1,2,4] Victims are usually young with multiple associated injuries which included fracture pelvis, contralateral fracture shaft of femur, fracture tibia, head injury, abdominal injury, and pulmonary contusion.[2-4] Operations were performed within 2-11 days following trauma. The timing of operative fixation was often dictated by the patient's status as a multiple trauma victim with injuries to other extremities and other systems.

Despite many treatment methods, controversy exists regarding the optimal management of these fractures. Though recent literature shows favourable results with the use of a single implant i.e., reconstruction type of intramedullary nail, we are of the opinion that treating these combination of fractures with two separate devices (plate-screw combinations) does have a role.[7-15] In this study we compared the outcome of ipsilateral hip and shaft femur fractures treated with reconstruction-type intramedullary nailing and various plate combinations on the fracture healing and functional outcome in patients. Very few authors have compared these two methods of fixation.[13,14] Femoral neck fracture is unrecognized in the initial examination of 19-31% of patients.[3,9] However, we did not observe any missed femoral neck fractures, probably because of our standard protocol of roentgenographic evaluation of the pelvis and both hips in all femoral shaft fractures. Femoral neck fractures were most often basilar in our series as was observed by several other authors.[1,3] The rate of avascular necrosis of the femoral head was ranged from 1.2 to 5 % with the highest reported in patients who underwent reconstruction type of nailing.[22] However, none of the cases in our study developed this complication.

In terms of the average union time for fracture neck and the average union time for fracture shaft of femur, the mean age of the patients, the mean delay in surgery, complications and functional outcome of both the treatment groups the results showed no statistical difference (p value > 0.05). However, in terms of the mean duration of surgery, mean radiation exposure, the patients treated with recon-type intramedullary nail showed a statistically significant higher value in comparison to the patients treated with various plate combinations ($p < 0.05$). (Table 2) In terms of mean blood loss, number of transfusions, size of incision, wound healing problems, the patients treated with Recon-nail had better results in comparison to the patients treated with various plate combinations ($p < 0.05$).

The main limitation of our study was that it was not a randomised control study and there was potential for bias, because the surgeon could not be blinded with respect to the method used. The choice of implant was dictated primarily by the fracture pattern and the surgeon's familiarity with the chosen treatment method. In this study, the bias was tried to minimize by an independent evaluator of the results blinded for the surgical procedure. However, it could not be completely eliminated as the choice of the implant was based on the surgeon's preference and expertise.

Reconstruction-type intramedullary nail should not be preferred in displaced femoral neck fractures, because of

difficulties in reducing the fracture and difficulty in maintaining the reduction during reaming and nail insertion. Stable anatomic reduction is the key for union of fracture neck of femur in this complex fracture pattern.

Both of the treatment methods used in our study achieved satisfactory functional outcome. Functional outcome is affected largely by other injuries as these fractures are associated with polytrauma. A reconstruction-type intramedullary nail is advantageous in terms of possible closed antegrade nailing with minimal incision, reduced blood loss and biological fixation of both fractures with single implant. Fixation with plates for the shaft and screws or DHS for the hip is easy from a technical perspective especially if the femoral shaft fracture is uncomminuted, which is not the usual case in these combination of fractures. In case of uncomminuted shaft femur fractures, we have observed that plating of the femoral shaft fracture first in a lateral position gives anatomic reduction and converts the combination into a simple hip fracture which may then be treated with cancellous screws or DHS on a fracture table. Reconstruction-type intramedullary is a good option for undisplaced or minimally displaced fractures at hip and marked comminution at the shaft femur fracture site but in patients with marked displacement at hip fracture, fixation with plates for the shaft fracture and screws or DHS for the hip should be preferred. We have not used cancellous screws and retrograde femoral nailing in any of our cases which was preferred by some authors.[17-19]

CONCLUSION

Our results indicate that ipsilateral hip and femoral shaft fractures can be treated satisfactorily either with recon-nailing alone or various plate combinations with similar radiological and functional outcome. The functional outcome is affected largely by other injuries as these fractures are associated with multiple injuries. The management of these complex fractures with recon-nailing had significantly prolonged operative time, intra operative exposure to radiation during fluoroscopy but had less blood loss and allowed early post-operative weight bearing when compared to those managed with various plate combinations.

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