STUDY TO EVALUATE BLOOD LOSS AFTER REAMING IN INTRAMEDULLARY NAILING OF FRACTURES OF SHAFT OF FEMUR AND FRACTURES OF SHAFT OF TIBIA

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ABSTRACT

BACKGROUND

It is a well-known fact that significant blood loss occurs after long bone reaming in intramedullary nailing. Still, limited research has been done to evaluate the blood loss after specific amount of reaming. In this study, we have tried to evaluate the same.

MATERIALS AND METHODS

It is a combined retrospective and prospective comparative study. Data of 240 patients having isolated shaft of femur fractures (100 cases), isolated shaft of tibia fractures (100 cases) & ipsilateral or contralateral femur + tibia fractures (24 cases), treated with reamed interlocking intramedullary nails and within the age group of 20-60 years was collected. Haemoglobin and PCV values on the day of operation and values after 24 hours after the procedure were noted as parameter for blood loss. Reaming was started from 8.5 mm and done up to chatter sound heard while reaming. Cases with open fractures, patients with blood disorder to whom intra or post-operative blood transfusion was given, were excluded. Fracture union was evaluated from radiographs taken at every 4 weeks' interval.

RESULTS

It was found that post-operative haemoglobin levels were low as compared to pre-operative values, which was statistically significant (p value <0.0001). The loss of haemoglobin was not influenced by factors like age, sex, side. The mean loss of haemoglobin was 2.75 g%. The mean union time was 18.11 weeks.

CONCLUSION

We conclude from the results obtained there is significant correlation between reaming and volume of blood loss. It was observed that as there is increase in diameter of reaming of medullary canal of bone; blood loss also increases proportionately.

KEYWORDS

Reaming, Blood Loss, Femur Fracture, Tibia Fracture, Intramedullary Nailing.

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INTRODUCTION: Diaphyseal fractures of the long bone are the commonest fractures encountered in orthopaedic trauma. Treatment methods include closed reduction and casting, skeletal traction, external fixation, and internal fixation. In which, internal fixation is the preferred treatment method because of better fragment alignment and stabilisation, earlier return of joint function and mobility, and a shorter duration of disability. Internal fixation is mainly achieved by plate fixation and intramedullary nailing. Comparing clinical results from plate fixation and intramedullary nailing, intramedullary nailing is a load-sharing device providing better stability of fractures with lower levels of infection rate and non-union rate than that of infection rate and non-union rate in the plate fixation.[1,2,3]

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Therefore, intramedullary nailing is recommended as the treatment of choice for long bone shaft fractures.[4,5] However, this technique is confined to a well-matched nail and medullary canal. When using a large nail, the isthmus impedes the insertion of the nail and results in either jamming of the nail or an iatrogenic fracture. A small nail makes the insertion easy, but the stiffness of the nail is decreased resulting in nail bending, breakage and migration. In order to avoid these problems, reaming of the intramedullary cavity concept came into consideration. Reaming increases the inner diameter of the medullary canal by removing the inner cortical bone, therefore, a larger diameter nail can be used and provides better stability.

However, reaming can cause several adverse effects in the medullary canal including disturbance of intramedullary circulation, which will lead to additional blood loss postoperatively. Present study is an attempt to evaluate blood loss after reamed intramedullary nailing in form of comparing pre-operative and post-operative haemoglobin and packed cell volume levels between patients with isolated fractures of shaft of femur, isolated fractures of shaft of tibia

and ipsilateral or contralateral femur and tibia fractures. Present study also asses healing at fracture site and its relationship with reaming.

AIMS & OBJECTIVES: To evaluate blood loss after closed reduction & internal fixation using reamed interlocking intramedullary nails in isolated fractures of shaft of femur, isolated fractures of shaft of tibia and ipsilateral or contralateral fractures of shaft of femur & tibia groups. To compare blood loss and preoperative & postoperative haemoglobin & PCV levels between patients with isolated fractures of shaft of femur, in isolated fractures of shaft of tibia, in ipsilateral or contralateral fractures of shaft of femur & tibia. To assess healing at the fracture site and its relation with reaming done during internal fixation.

MATERIALS AND METHODS: This is a combined retrospective and prospective comparative study with sample size of total 224 cases. In which, 100 cases of isolated fractures of femur, 100 cases of isolated fractures of tibia and 24 cases of fractures of femur & tibia.

Inclusion Criteria: Closed fractures involving isolated femur, isolated tibia, ipsilateral or contralateral femur and tibia treated with closed reduction and reamed intramedullary interlocking nailing.

Exclusion Criteria: Closed shaft of femur and tibia fractures but treated with open reduction and internal fixation. Closed reduction and femur and/or tibia nailing procedure in which intraoperative or immediate post-operative blood transfusion was given. Fractures with neurovascular injuries and compound fractures were excluded from study.

Data Collection: Data was collected from the patients attending the orthopaedic department with fractures of shaft of femur, fractures of shaft of tibia and ipsilateral or contralateral shaft of femur & tibia fracture and satisfying the inclusion criteria. Detailed history was taken about age, sex, occupation, mode of injury, past history and associated medical illness. Thorough clinical examination and general condition was assessed. Associated orthopaedic and other systemic injuries were assessed and managed accordingly. Radiographs were taken in 2 planes, AP and lateral including x-ray of ipsilateral hip and knee joints and ankle joints if required.

To maintain hydration of the patient and to maintain blood pressure of the patient, standardised fluid and transfusion procedures were enforced to all three study groups. Fluid therapy consisted of rehydration fluid (normal saline/DNS/RL) according to need of patient were given. Input and output charting of the patient is done from the day of admission till patient was discharged. Height (in cm) & weight (in kg) of the patients were calculated. Haemoglobin percentage (Cyanmethemoglobin method) and packed cell volume (PCV) on the day of operative procedure were noted.

All other routine pre-operative investigations were carried out. After operative procedure, patient was kept nil by mouth for 4-6 hours. Intravenous fluids were given to maintain hydration of the patient. (Average 2 pint Ringer lactate for femur group and 1 pint normal saline for tibia group). Haemoglobin and PCV values were recorded 24 hours post-operatively. Analgesics were given according to the needs of the patient. Postoperative radiographs in AP and lateral view were taken.

Calculation method for evaluating blood loss.[6]
(Haemoglobin balance method was used)

$V_{loss\ total} = 1000 \times Hb_{loss\ total}/Hb_i$

$Hb_{loss\ total} = BV \times (Hb_i - Hb_e) \times 0.001$

In this, $V_{loss\ total}$ (mL): The total volume of RBC loss

$Hb_{loss\ total}$ (g): The loss volume of Hb

Hb_i (g/L): The Hb value before surgery

Hb_e (g/L): The Hb value after surgery;

BV (mL): The patient's blood volume before surgery,

(BV = k1 × H3 + k2 × W + k3)

For males, k1 = 0.3669, k2 = 0.03219, and k3 = 0.6041,

While for females, k1 = 0.3561, k2 = 0.03308, and k3 = 0.1833

(H is height of patient in cm and W is weight of patients in kg)

In this study, totally 72 patients were assessed for healing at fracture site. In which 30 patients were of femur fracture group and 30 patients of tibia fracture group and 12 patients of femur+tibia fracture group. We followed up all these patients and took x-rays of affected limb at every 4 weeks interval.

RESULTS: Average age of the patient in femur group is 42.5 years, in tibia group is 42 years and in femur +tibia group is 36.8 years. That suggests both femur and tibia fractures comparatively occur in younger patients (Table 1). A nearly total male predominance is seen (Femur-61%, Tibia-72%, Femur+Tibia-96%) (Table 2). Right side is more commonly involved than left side (Femur-58%, Tibia-53%, Femur+Tibia-65%). In cases of femur and tibia both bone fractures, ipsilateral side (71%) is more involved than contralateral side (29%).

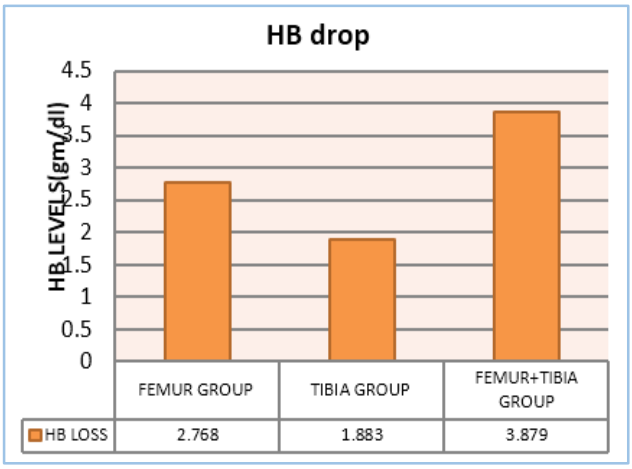
Study Group	Femur Group	Tibia Group	Femur+Tibia Group
Mean Age of patients	42.5 years	42 years	36.8 Years

Table 1: Age Distribution

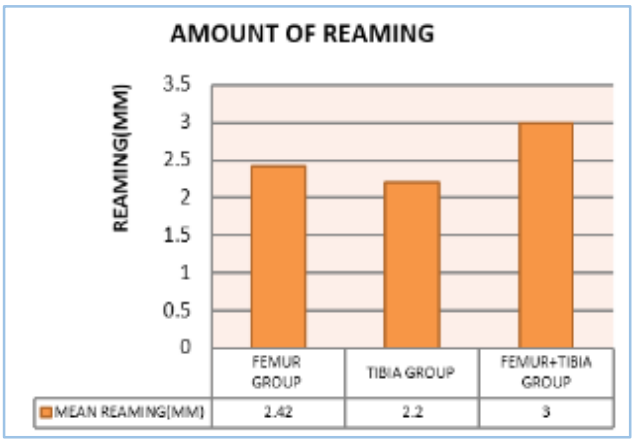
Study Group	Femur Group	Tibia Group	Femur+Tibia Group
Male	61	72	23
Female	39	28	1

Table 2: Sex Distribution

In this study, total average 2.53 mm reaming was done. (Femur average reaming-2.42 mm, tibia average reaming-2.2 mm and femur+ tibia average reaming – 3 mm).

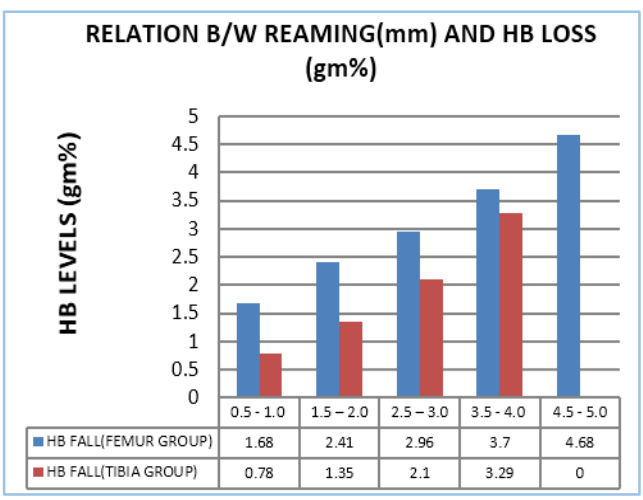


Graph 1



Graph 2

Mean haemoglobin drop in isolated femur group was 2.768 g% (SD=1.538). Mean haemoglobin drop in isolated tibia group was 1.883 g% (SD=1.504). Mean haemoglobin drop in femur and tibia group was 3.879 g% (SD=1.746). In this study, total mean haemoglobin level decreased from 12.97 g/dL (ranges 8 to 17) to 10.11 g/dL (ranges 6- 14.5). Mean PCV loss in isolated femur group is 8.428 % (SD=4.788). Mean PCV loss in isolated tibia group is 6.105% (SD=4.553) and Mean PCV loss in femur and tibia group is 11.746% (SD=5.150).



Graph 3: Relation b/w Reaming & HB loss

Table No. 3 & 4: Mean Union Time & Complication.

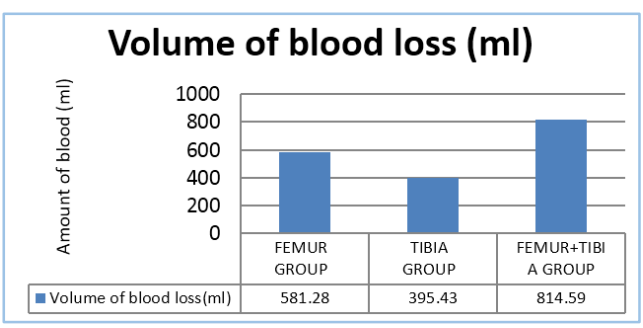
Patient Group	Mean fracture Union Time	SD
Femur Group	18.13 weeks	2.289
Tibia Group	17.46 weeks	2.403
Femur+ Tibia Group	18.75 weeks	1.658

Table 3

Complications	Femur Group	Tibia Group	Femur+Tibia Group
Pulmonary embolism	1	2	0
Infection	2	2	1
Delayed Union	3	3	0
Implant Failure	2	1	0

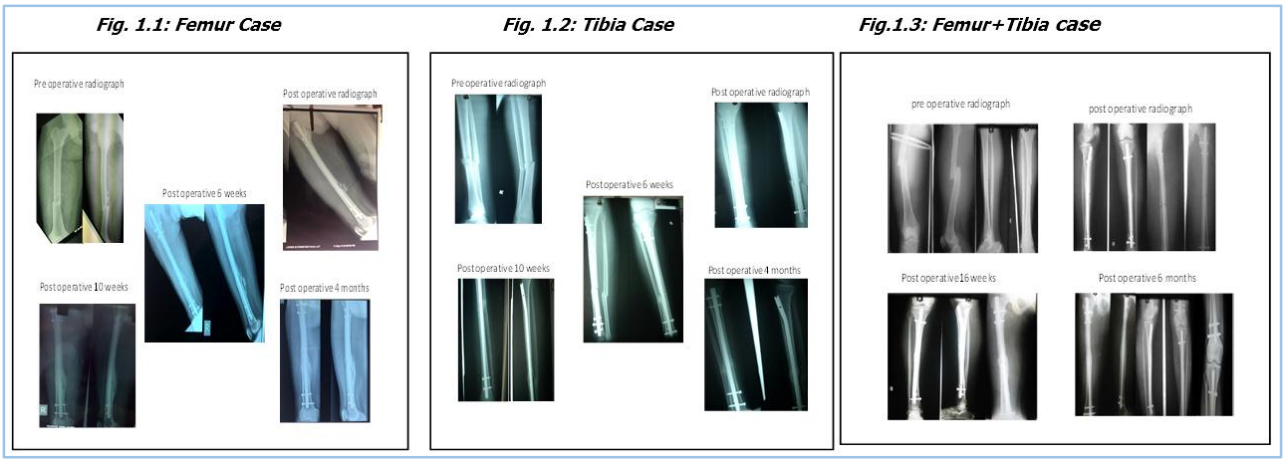
Table 4

There was significant decrease in haemoglobin levels with increased amount of reaming (p value=0.0001). With average 1 mm reaming, there is significant 1 g% haemoglobin level drop seen in our study in both femur and tibia group. But tibia group, there is less amount of haemoglobin drop as compared to femur group.



Graph 4: Volume of Blood Loss (mL)

Mean volume of blood loss in isolated femur group was 581.28 mL (SD=269.30). Mean volume of blood loss in isolated tibia group was 395.43 mL (SD=202.37). Mean volume of blood loss in femur and tibia group was 814.59 mL (SD=196.50). In this study, there were total 3 patients of pulmonary embolism (femur group 1 patient & tibia group 2 patients) in which 2 were managed with critical care and one died after 48 hours of critical care. There were 5 patients of infection (femur group 2 patients & tibia group 2 patients, 1 patient in femur + tibia group), all five patients had superficial infection which was treated with debridement and antibiotic coverage. There were 6 patients with delayed union (femur group 3 patients & tibia group 3 patients). There were incidences of implant loosening in 3 patients (femur group 2 patients & tibia group 1 patient). All three cases had loosening of distal locking screws, they were managed by removal of screws under anaesthesia.



DISCUSSION: We found that fractures of femur were most common in 3rd and 4th decade of life, with mean age of 42.5 years. Fracture of tibia was also most common in 3rd and 4th decade of life, with mean age of 42 years. Fracture of femur and tibia was most common in 2nd and 3rd decade of life, with mean age of 36.8 years. Court–brown et al[6] (1996) in his series shows mean age of 41.5 years. Keating et al[7] (1997) in his study found out mean age of patient is 47 years. Males were predominantly prone to fractures of long bone due to high incidence found in motor vehicular accidents. 61% of femur, 72% of tibia and 96% of femur+tibia of our patients were male. Wiss – Fleming.[8] (1986), male predominance (83.7%) found in his 111 patients series. Alho et al[9] (1991) reported 55% male predominance in 120 patients.

In this study, total average 2.53 mm reaming was done in which, femur average reaming was 2.42 mm, tibia average reaming was 2.2 mm and femur+tibia average reaming was 3 mm. Gannoudis et al[10] in his series of 18 patients shows average reaming of 2.5 mm, which was equal to our study value. Heim et al[11] in his study shows that more amount of reaming, more rise in intramedullary pressure which will lead to more blood loss. In this study, total means haemoglobin level decreased by 2.843 g % and mean PCV value decreased by 8.76%. Shepherd et al[12] (2001) in his series found that after intramedullary reaming, there was significant blood loss of 1.07 g% (278 mL) which was less as compare to our study results. Selvakumar et al[13] (2001) in his series found out total 1.24 g% of blood loss after reamed intramedullary nailing procedures.

Average mean fracture union time in present study is 18.11 weeks. Meta-analysis by Deting et al[14] (2009) shows average union time of 18.45 weeks which is similar to our study group. Court –Brown et al[15] (1996) in his series found out mean union time of 15.4 weeks. Nagraj et al[16] (2000) shows his results with mean union time of 17.3 weeks. Wiss et al shows mean union time 28 weeks, which is more as compared to our study group.

Infection: There were 5 patients of infection (femur group 2 patients & tibia group 2 patients, 1 patient in femur+tibia group), all five patients had superficial infection. Nagaraj et al[16] (2000) had a 2 patients of superficial infection.

Chiu et al[17] in his series of patients, superficial infection was seen in 4 patients. There were 6 patients with delayed union (femur group 3 patients & tibia group 3 patients). Blachut et al[18] had a 7 delayed union cases in his data. Christie et al[19] reported delayed union in 2 patients (i.e. 1.7%) in 117 patients. In our study, there were incidences of implant loosening in 3 patients (femur group 2 patients & tibia group 1 patient). All three cases had loosening/backing out of distal locking screws. Blachut et al[18] in his series shows 2 broken screws and 4 backed out screws. Chiu et al[17] in his study found out 1 case of screw back out.

CONCLUSION: Our study showed that there was significant blood loss (decreased post-operative haemoglobin and PCV levels) after reamed intramedullary nailing in isolated femur, isolated tibia and femur+tibia study groups. In this study, there was statistically significant correlation between amount of reaming and amount of blood loss (decreased post-operative haemoglobin and PCV levels). It is observed that more the amount of reaming, more the amount of blood loss. So before performing the intramedullary nailing procedures, the preparation for blood transfusion should be taken into consideration, even in closed nailing. In our study, it is observed that amount of reaming does not affect fracture healing time; though larger sample size is required to assess relation between reaming and fracture union. The blood loss (decreased post-operative haemoglobin and PCV levels) was not influenced by factors like age, sex, side in all three study groups.

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