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## Original article

## Outcome of bone marrow instillation at fracture site in intracapsular fracture of femoral neck treated by head preserving surgery

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## ABSTRACT

**Purpose:** The aim of present study is to evaluate the outcome of bone marrow instillation at the fracture site in fracture of intracapsular neck femur treated by head preserving surgery.

**Methods:** This study included 32 patients of age group 18–50 years with closed fracture of intracapsular neck femur. Patients were randomized into two groups as per the plan generated via [www.randomization.com](http://www.randomization.com). The two groups were Group A (control), in which the fracture of intracapsular neck femur was treated by closed reduction and cannulated cancellous screw fixation, and Group B (intervention), in which additional percutaneous autologous bone marrow aspirate instillation at fracture site was done along with cannulated cancellous screw fixation. Postoperatively the union at fracture site and avascular necrosis of the femoral head were assessed on serial plain radiographs at final follow-up. Functional outcome was evaluated by Harris hip score.

**Results:** The average follow-up was 19.6 months. Twelve patients in each group had union and 4 patients had signs of nonunion. One patient from each group had avascular necrosis of the femoral head. The average Harris hip score at final follow-up in Group A was 80.50 and in Group B was 75.73, which was found to be not significant.

**Conclusion:** There is no significant role of adding on bone marrow aspirate instillation at the fracture site in cases of fresh fracture of intracapsular neck femur treated by head preserving surgery in terms of accelerating the bone healing and reducing the incidence of femoral head necrosis.

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## Introduction

Femoral neck fracture remains the unsolved problem in terms of union rate and avascular necrosis (AVN). Lu-Yao et al.<sup>1</sup> in his meta-analysis reported nonunion rate of 23%–37% and AVN rate of 11%–19%. In current literature various treatment modalities are available to treat fracture of intracapsular neck femur (ICNF). This includes 2/3/4 cannulated cancellous screw (CCS), sliding hip screw with or without derotation screw, valgus osteotomy and muscle pedicle bone grafting procedure. All have varied indications, limitations and overall outcomes.<sup>2</sup> The factors that influenced the union rate are posterior comminution, vertical fracture line, injury-surgery duration, etc.<sup>3–5</sup>

There has been scanty literature available using bone marrow aspirate at the fracture site in fresh fracture of ICNF.<sup>6</sup> However, autologous bone marrow has been used to enhance osteogenesis in long bone diaphyseal fractures and was found effective in stimulating bony union in delayed and nonunion cases treated by plating/intramedullary nailing/external fixation.<sup>7</sup> Therefore in this study we have involved the two groups of patients of fresh fracture of ICNF in young adults (18–50 years) undergone close reduction and CCS fixation. The study group was additionally being subjected with autologous bone marrow aspirate instillation at fracture site<sup>6</sup> through capsule of the hip joint and was assessed for the role of bone marrow in fracture union of ICNF and AVN of the femoral head.

## Materials and methods

Thirty two patients who fulfilled the inclusion criteria were included in this study and were operated upon during the period of

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December 2011 to April 2013. Inclusion criteria were: patients of 18–50 years old and either sex with closed, traumatic fracture of ICNF injury duration <3 weeks. Patients with polytrauma, ipsilateral fracture of shaft femur, open injury, pathological fracture, patient on oral/injectable steroids, clinically detectable major illness, fracture of neck femur not suitable for CCS fixation, and patients not willing to give consent/participate in the study were excluded from the study. All patients fulfilling the inclusion criteria of the study were included after taking informed consent in writing. After clinical assessment and appropriate stabilization of the patient, an X-ray of anteroposterior (AP) and lateral views of bilateral hip and AP view of involved hip in 20° internal rotation were taken for documentation of fractures. The fracture was classified according to Garden Classification<sup>2,8</sup> into stable (Garden type I and II) and unstable (Garden type III and IV) fractures. The patients were randomized into two groups as per the plan generated via [www.randomization.com](http://www.randomization.com). The two groups were: Group A (control): fracture of ICNF treated by closed reduction and CCS fixation; Group B (intervention): fracture of ICNF treated by closed reduction and CCS fixation with percutaneous autologous bone marrow aspirate instillation at fracture site. Under suitable anaesthesia, the patients were taken for closed reduction on a fracture table. Closed reduction was attempted under image intensifier control. Garden's alignment index was used for assessment of adequacy of reduction.<sup>9,10</sup> After obtaining satisfactory closed reduction, the fracture of neck femur was fixed internally with 3 CCS as per standard technique.<sup>9,10</sup> In Group B additionally 6–8 ml of autologous bone marrow was aspirated from the ipsilateral iliac crest (Fig. 1). At the end of osteosynthesis, the affected hip joint was first aspirated by a wide bore needle (16 gauge) to prevent the raise in intracapsular tamponade. Then the bone marrow was injected intracapsularly through the same needle under the image intensifier control (Fig. 2). Patients were allowed to sit in bed on the 1st day after



Fig. 1. Aspiration of bone marrow from ipsilateral iliac crest using bone marrow needle (Group B).

surgery. Toe touch nonweight bearing with two crutch walking was allowed as long pain was tolerated. Patients were followed up clinically at 2 weeks, and then every 6 week till union at fracture site occurred and thereafter at every 6 months. Radiological assessment of the fracture was done by serial AP view in 20° internal rotation and lateral view taken at each follow-up. They were examined for surgical site infection, pain on VAS scale, hip range of motion and limb length discrepancy if any. The mean follow-up period was 19.6 months (range 16–28 months). Fracture union was assessed on plain radiograph and was taken as positive if fracture line becomes indistinct/not appreciable and there is no sclerosis at fracture margins. Early loss of reduction was assessed by change in Garden alignment index, neck shaft angle and implant back out. AVN of femoral head was assessed on plain radiograph at final follow-up. The function of the operated hip was evaluated by Harris hip scoring system at the final follow-up.

## Results

A total of 32 patients who met the inclusion criteria were operated upon during the study duration. Two patients from Group A were lost to follow up after 11 months; the rest were followed up for mean follow-up period of 19.6 months (range 16–28 months). There were 25 males (79%) and 7 females (21%) in the study population. The mean age of the patients was 39.5 years (range 18–50 years). Eighteen patients had fracture due to fall from height, 13 following road traffic accidents and one due to physical assault. Eleven patients had Garden type III and 3 patients had Garden type IV fractures in Group A; while Group B had 8 Garden type III and 6 had Garden type IV fractures and rest of the patients had Garden type II in both groups. There was no statistically significant difference in both groups in terms of Garden classification (fracture subtypes, Fig. 3). The mean duration of injury to surgery was 5 days in Group A and 8 days in Group B.

In both groups, union was seen in 12 patients out of 16 with mean union time of 29 weeks (24–36 weeks) in Group A and 32 weeks in Group B (24–36 weeks, Fig. 4). There was no statistically significant difference in both groups in terms of union time ( $p = 0.739$ ).

Nonunion was seen in 4 patients in each group. One patient out of 4 nonunion cases in Group B had undergone implant failure at 12 weeks of follow-up and was reoperated upon with Valgus osteotomy using double angle osteotomy blade plate. Subsequent follow-up of 12 months showed no signs of union and patient had developed implant failure with AVN changes in femoral head. Thus underwent total hip replacement (THR) subsequently.

One patient from each group had developed AVN of the femoral head. Group A patient was Garden type IV and had closed reduction at 6th day after injury, and had AVN at 18 months of follow-up. The patient was having good functional outcome and he was able to squat and sit cross legged and was able to manage his daily living activities with mild pain. Patient was not willing for any intervention. The other patient from Group B was Garden type III and developed implant failure at 12 weeks thus went for Valgus osteotomy procedure, and then developed nonunion with AVN changes in femoral head at 12 months of follow-up and finally underwent THR. The average Harris hip score at final follow-up in Group A was 80.50 and in Group B was 75.73, which was found to be not significant. In both groups there was no surgical site infection in any of the patient during postoperative follow-up.

The proportion of nonunion and AVN was compared between the two groups using a relative risk, which was 1.0667 and its 95% confidence interval was  $\pm 0.16001$ , ranging between 0.9067 and 1.2267 using the software of [www.easycalculation.com](http://www.easycalculation.com). Therefore there is no significance of association with the type of treatment.

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