Introduction: The femoral shaft fractures in adults are preferably treated with closed intramedullary nailing. Closed reduction is a critical component of the procedure and at times can be difficult and technically challenging resulting in increased operative time. Moreover, fluoroscopy is used extensively to achieve closed reduction which increases the intraoperative radiation exposure. A small diameter nail in the proximal fragment or 8 mm straight reamer into the proximal fragment and a Schanz pin as percutaneous skeletal joystick in either of the fragments have been used to assist closed reduction. However, simultaneous use of a cannulated reamer in proximal fragment as intramedullary joystick and Schanz screw in the distal fragment as percutaneous joystick has never been reported earlier. Moreover, the quantitative impact of these techniques on success of closed reduction and reduction of radiation exposure and operative time has rarely been documented. The purpose of this study was to compare prospectively the duration of nailing procedure; number of radiation exposures or images required for closed reduction in patients operated with a cannulated reamer in the proximal fragment or with simultaneous use of a cannulated reamer in the proximal fragment and a Schanz screw in the distal fragment versus those operated without it.

Materials & methods: In a prospective study from March 2006 to December 2008, sixty patients with femoral diaphyseal fractures treated by locked intramedullary nailing were randomized in two groups. All patients gave the informed consent prior being included into the study. The study was authorized by the local ethical committee. As per AO classification type A fractures were 8 & 8; type B9 & 11; and 13 & 11 fractures were type C in group I & II, respectively. In group I fracture reduction was performed under fluoroscopy with a cannulated reamer in the proximal fragment or with simultaneous use of a cannulated reamer in the proximal fragment and a Schanz screw in the distal fragment. Patients in group II had fracture reduction under fluoroscopy alone.

Results: Closed reduction was achieved in 29 patients in group I and 26 patients in group II. Open reduction was required in one patient in group I (type C2 fracture) and four patients in group II (one type A fracture, one type B and two type C2 fractures). The use of cannulated reamer in the proximal fragment alone achieved closed reduction in 12 patients in group I. Schanz screw was used in the distal fragment or intact intermediate fragment in 18 patients in group I. The guide wire insertion time, time for nail insertion and its distal locking, total operative time, and total fluoroscopic time were 26.57, 27.93, 68.03, and 0.19 minutes in group I; compared with 30.87, 27.83, 69.93 and 0.24 minutes in group II, respectively. The average number of images taken to achieve guide wire insertion, for nail insertion and its locking, and for the complete procedure in group I, respectively was 12.33, 25.93 and 37.6 compared with 22.1, 26.17 and 48.27, respectively in group II. Nonunion developed in one patient in group I and two patients in group II. Open exchange nailing using a large diameter nail with bone grafting from ipsilateral iliac crest was required to achieve union in these patients. No patient had fracture or infection at interlocking screw and Schanz screw sites. No cases of deep infection, avascular necrosis of femoral head, iatrogenic neurovascular injury, and fibrosis or quadriceps contracture were observed. Limb length shortening (range, 1-2.5 cm) was detected in one patient in group I and in two patients in group II. Angular (>5 degrees) or rotatory malalignment (>15 degrees) was observed in one patient in group I and 4 patients in group II.

Comparison of groups I and II

No significant difference could be detected between groups I and II with respect to gender (P =0.1), type of fracture (P =0.92), need for open reduction (P =0.35), nonunion (P =1.0), and limb malalignment (P =0.35). An unpaired t-test did not reveal significant differences between groups I and II with respect to the patient’s age (P =0.39), the average time for nail insertion and its distal locking (P =0.94), the average total operative time (P =0.35), and the average number of images taken during nail insertion and its distal locking (P =0.39). The guide wire insertion time was significantly less in group I in comparison to group II (P =0.001). The number of images taken for closed reduction and guide wire insertion was less in group I versus group II. This decrease in radiation by 44% is statistically extremely significant at P <0.0001. The average total number of images required during the complete procedure and average total fluoroscopic time were less in group I versus group II. (statistically extremely significant at P <0.0001).

Discussion: Numerous techniques and devices have been proposed to aid closed reduction. Fracture table generates longitudinal traction to achieve closed reduction and maintains the reduction during the operative fixation. Shezaz et al (Injury 2005) reported use of a mounted external supporting device that can be controlled in both anterior-posterior and lateral planes to eliminate the deforming forces of thigh muscles. McFerran and Johnson (J Orthop Trauma 1992) reported the use of a femoral distractor to aid in obtaining and holding a reduction. Shewring et al (Injury 1991) reported the use of an F-clamp to facilitate reduction and reduce exposure of the operator to radiation. A small bend at the end of guide wire can be used to assist with passage of guide wire into the distal fragment. A small diameter nail in the proximal fragment or 8 mm straight reamer into the proximal fragment and a Schanz pin as percutaneous skeletal joystick in either of the fragments have been reported to aid closed reduction of the diaphyseal fractures. Ball spike pusher can also be used to achieve closed reduction and are applied to the bone through stab incisions like Schanz pins, thus respecting the fracture biology.

Ionizing radiation has no safe threshold of exposure below which it cannot be shown to have adverse effects. Moreover, long term effects of this radiation exposure are unknown. Therefore every effort must be made to keep radiation exposure to minimum. Use of cannulated reamer in the proximal fragment and Schanz pin in the distal fragment achieved closed reduction of the fracture with 44% decreased exposure to radiation in group I as compared to the group II. This decrease is extremely significant statistically (P <0.0001). Moreover, the technique consumes less time for insertion of the guide wire as reflected by statistically significant difference of the average guide wire insertion time. The present technique does not prolong the total operative time as the average total operative time was comparable in both groups (statistically insignificant). The technique utilizes readily available instruments and is not technically demanding.

The use of cannulated reamer in the proximal fragment alone achieved closed reduction in 40% patients in group I in the present study. The addition of the Schanz screw in the distal fragment achieved closed reduction 96.6% patients in group I in comparison to 82.3% patients in group II in the present study. We believe that simultaneous use of cannulated reamer in proximal fragment as intramedullary joystick and Schanz screw in the distal fragment as percutaneous joystick further facilitates closed reduction of the fracture and insertion of the guide wire. The unicortical nature of the Schanz pin allows for passage of the guide wire. Use of Schanz screw offers the advantage of maintaining a closed soft tissue sleeve around the fracture, can be used with or without a fracture table, and allows for excellent control of the fracture fragments, using equipment that is readily available. Another use of the technique is avoidance of angular malalignment as only one patient in group I had angular malalignment (3.3%) in the present series. Russel et al (J Orthop Trauma 2008) also reported a similar technique that uses a percutaneous cannulated channel reamer over a guide pin, termed as minimally invasive nail insertion technique (MINIT) to avoid malreduction in proximal shaft fractures and reported malalignment in 5.2% when the MINIT was used and in 26% of the fractures treated without the use of MINIT. Schanz screw can bend during skeletal manipulation. The surgeon should check the bending of the screw during operation to avoid its breakage inside the bone. The limitations of the present study include small number of patients in the series and potential for user bias because the surgeon could not be blinded with respect to the method used for closed reduction.

Conclusion: The use of cannulated reamer in proximal fragment as intramedullary joystick and Schanz screw in the distal fragment as percutaneous joystick facilitates closed reduction of the fracture during closed intramedullary femoral nailing with statistically significant reduction in guide wire insertion time and total operative time. Intramedullary joystick in the proximal fragment should preferably be used in all patients and the surgeon should keep a low threshold for percutaneous Schanz screw in the distal fragment.