

## STUDY OF OUTCOME FOLLOWING NAIL DYNAMIZATION FOR TREATING DELAYED HEALING FEMORAL SHAFT FRACTURES

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**ABSTRACT: BACKGROUND:** Dynamisation of a previously interlocked intramedullary nail is believed to stimulate an osteogenic response and accelerate union due to increased load across the fracture site.

**OBJECTIVE:** This retrospective study evaluated the role of dynamization of interlocking nails to treat the delayed healing femoral fractures.

**MATERIAL AND METHODS:** Eighteen static femoral interlocking nails were dynamized after 4 months (Range 3-6 months) because of poor fracture healing. The clinical and radiographic healing processes were recorded. All the cases were followed up to monitor the progress of fracture healing till their end results in the form of union or non-union.

**RESULTS:** The time between interlocking nailing and nail dynamization was ranging between 3 to 6 (Mean 4 months). After the dynamization cases were followed for at least 6 months (Range, 4-8 months) twelve patients (66.6%) achieved a solid union, within a union period of 5.4 months (Range, 3-8 months) after dynamization. One patient achieved union with more than 2 cm of femoral shortening.

**CONCLUSION:** Not all cases achieve union after dynamization. It should be reserved for delayed healing axially stable fractures.

**KEYWORDS:** Femoral Shaft Fracture, Delayed Union, Dynamization.

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**INTRODUCTION:** Intramedullary nailing was introduced in the treatment of femoral shaft fractures resulting in excellent union.<sup>1</sup> Interlocking nailing provides more rotational stability for fixation of the fracture. Closed intramedullary nailing is a recent treatment for femoral shaft fractures.<sup>2,3</sup> Repair of fractures involves a sequence of dynamic events, which ultimately restores the integrity of the bone and its biomechanical properties.<sup>4</sup> In some cases healing is compromised leading to delayed union or nonunion. It is estimated that 10% of the fractures, which occur annually will require further surgical procedures because of impaired healing.<sup>5</sup> Einhorn reported definitions for nonunion and delayed union that move beyond a simple time line describing nonunion as the cessation of all healing processes and union has not occurred.

He further defines delayed union as a continuation of healing processes, but union has not occurred in the expected time, and the outcome is uncertain.<sup>6</sup> Dynamization of a previously interlocked intramedullary nail is a simple method for treating femoral shaft fractures (FSF) in patients with delayed healing after intramedullary nailing and is believed to stimulate an osteogenic response due to increased load across the fracture site. In this study, we retrospectively investigated the effects of dynamization of static interlocking nails to promote union in FSF patients with delayed healing and the adverse effects of dynamization.

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**METHOD:** Eighteen consecutive acute FSF patients with static locking intramedullary nails who developed delayed union and subsequently underwent dynamization were recruited between August 2011 and April 2015. The indication for the dynamization was the persistence of gap or absence of bridging callus at the fracture site after 3 months of statically locked intramedullary femoral nailing. Exclusion criteria were established non-union, dynamization after 6 months of nailing, infection at the fracture site and severely unstable fracture patterns that had tendency to develop unacceptable shortening and deformity.

Fourteen patients were male and 4 were female with a mean age of 34 years. Sixteen cases were due to road side accidents and 2 were due to falls from a height. Eleven cases had open fractures and 7 had closed ones. The fractures were located at the middle 1/3 in 10 cases and at the distal 1/3 in 8. According to the Winquist-Hansen classification, there were 5, 3, 7 and 3 types I, II, III and IV fractures, respectively. Reamed nails were used for 16 fractures and unreamed nails were used for 2. All the cases of delayed union had been nailed in static mode initially and underwent later dynamization by removing interlocking bolts away from the fracture site. All the cases were followed up to monitor the progress of fracture healing till their end results in the form of union or non-union.

**RESULT:** The time between interlocking nailing and nail dynamization was ranging between 3 to 6 (Mean 4 months). Complete union (Within 6 months after dynamization) was achieved in 9 patients without significant femoral shortening. One patient with unstable fracture pattern united with significant femur shortening (>20mm). Two cases took longer than 6 months (7<sup>th</sup> and 8<sup>th</sup> post-dynamization months) to achieve complete union.

In the remaining 6 cases non-union developed. Thus 12 of the 18 cases (66.6%) achieved union after the dynamization.

**DISCUSSION:** Several textbooks have proposed definitions for delayed healing based upon time 3–4 months for delayed union and 6–8 months for non-union.<sup>7</sup> Non-union of the femoral shaft is usually defined as a failure to achieve clinical union at 6–12 months following fixation or if there is no healing progress during the last 3 months or an implant failure is obvious.<sup>8-11</sup> Dynamization of a static interlocking nail offers a theoretically sound and minimally invasive treatment option for the management of delayed and non-union. Although, it has also been credited with accelerating the rate of union in delayed unions,<sup>12-14</sup> dynamization, or dynamic interlocking nailing, has also been blamed for causing loss of reduction and shortening in comminuted femoral shaft fractures.<sup>15-16</sup>

Furthermore, benefits of dynamization and the timing of it is still very controversial.<sup>17-19</sup> In our study 12 of 18 (66.6%) patients with delayed union achieved complete union after the nail dynamization. In a similar study Wu,<sup>11</sup> reported a 58% union rate after dynamization, performed 6 months on average after the initial procedure. More than 2 cm of femoral shortening was noted in 21% of these patients. Basomallick and Bandopadhyay,<sup>20</sup> in a prospective randomized comparative study found that although dynamization after open interlocking nailing significantly shortens the mean time to union, there are no significant differences between the union rates in the dynamized and non-dynamized groups.

In the present study, the fractures were dynamized between 3 and 6 months postoperatively, since it was felt that dynamization 6 to 8 months after operation may be too late and by that time all biological efforts to achieve union would have exhausted. In the present study, six patients with delayed union did not respond with dynamization. The possible factors affected the union would be compound and comminuted nature of most of them. According to Boyd et al.<sup>21</sup> the following local factors should be taken under consideration for non-union of long bones: Open fractures, infection, segmental fractures with impaired blood supply to the middle fragment, comminuted fractures due to severe trauma, insecurely fixed osteosynthesis, ill-advised open reduction, and distraction by traction.

In our study it was observed that dynamization alone provided only a 66% chance of bone union and duration of achieving union varied from within 6 months, in most of cases to more than 6 months in some. It was also observed that most of patients that achieved union had some distraction at the fracture site and were dynamized early without waiting much, whereas most of those who landed up with non-union had high velocity bone and soft tissue injuries.

**CONCLUSION:** In my experience, however, not all cases achieve union after dynamization. It should be reserved for delayed healing axially stable fractures without significant angular deformity, particularly if they are statically locked in distraction.

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Fig. 1



Fig. 2



Fig. 3