

# INTRAMEDULLARY NAILING OF THE FEMUR BY CLOSED AND OPEN TECHNIQUE - A COMPARATIVE STUDY.

N.Lasanianos, G.Mouzopoulos, E.Morakis, G.Nikolaras,  
V.Fotopoulos, M.Kaminaris, I.Georgilas, N.Tsutseos

1<sup>st</sup> Orthopaedic Department of “Evangelismos” General Hospital , Athens - Greece



## BACKGROUND

One of the great advantages of intramedullary nailing is the preservation of the posttraumatic haematoma around the fracture area since this promotes the earlier callus formation and diminishes the chance of non-union.

## AIM

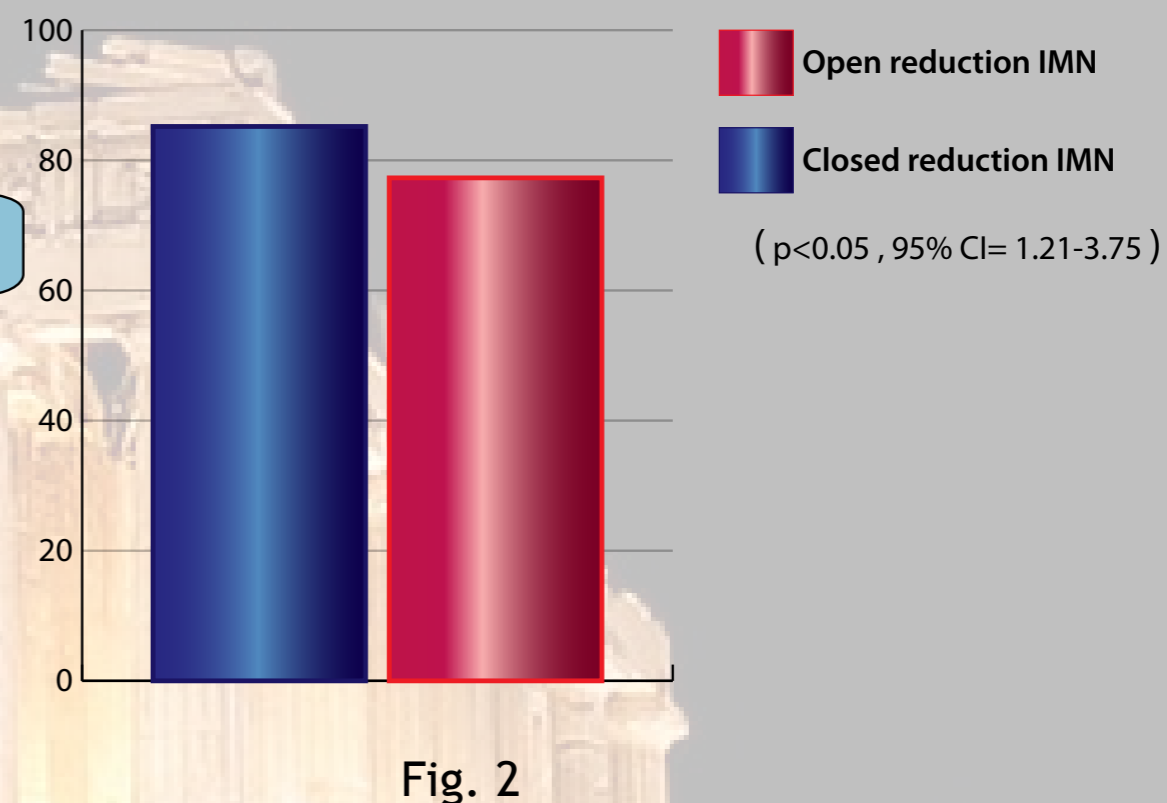
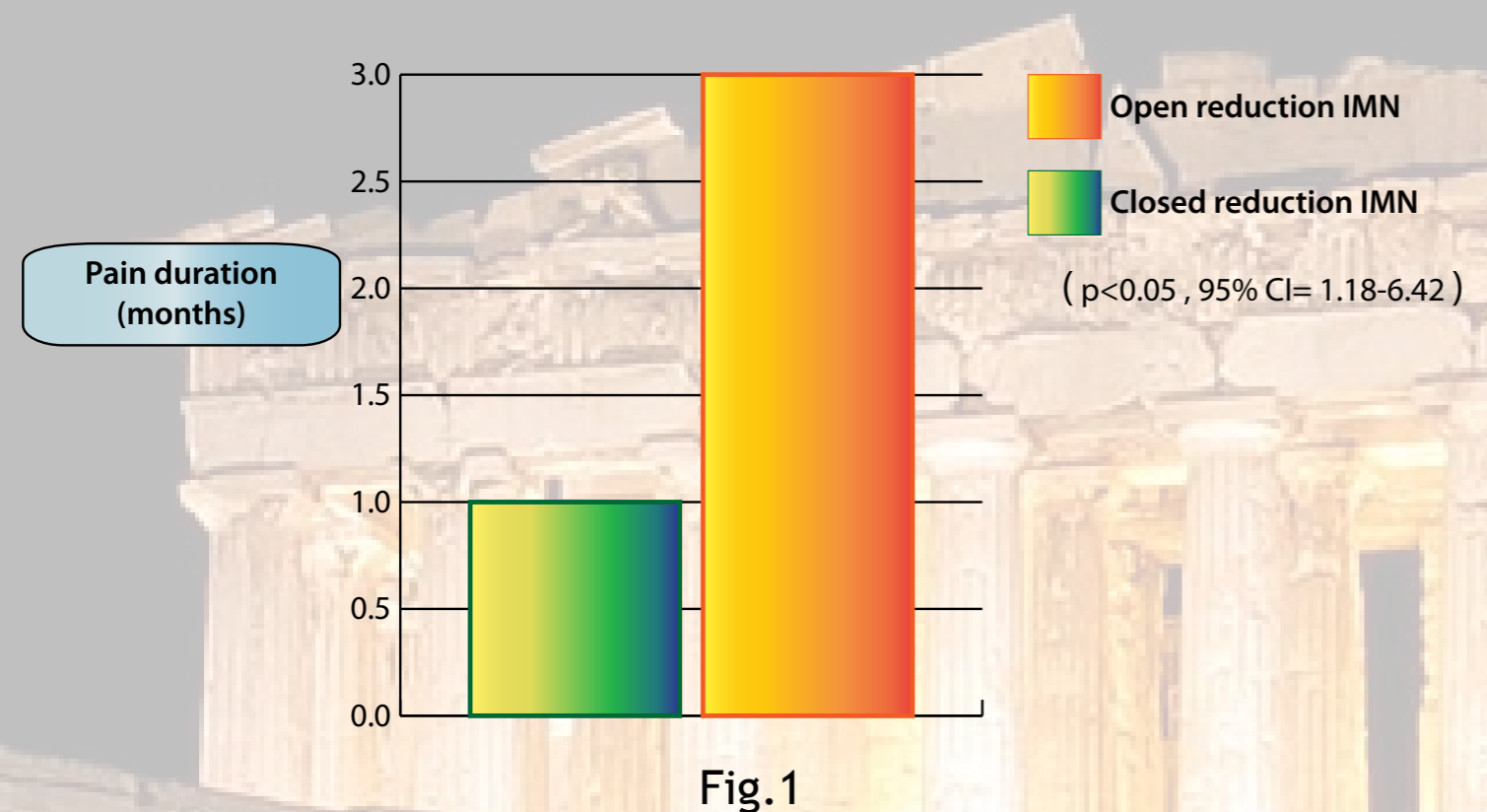
In this retrospective study we examine the postoperative results of Intramedullary Nailing (IMN) in two groups of patients with closed midshaft femur fractures. We try to point out if open reduction at the level of the fracture and thus partial or full drainage of the post-traumatic haematoma seriously deteriorates the post-surgery rehabilitation and mobilization.

## METHODS & MATERIAL

The first group (closed IMN) consisted of 25 patients and the second one (open reduction) consisted of 13 patients. In both groups reamed IMN was performed. The first group underwent typical closed femur IMN. At the patients of the second group skin and fascia incisions were performed at the level of the fracture. This was done in order to facilitate the reamer guide wire promotion through the fracture level by open reduction. Suturing of the incision was performed before the reaming process. The two groups were similar with respect to important preoperative variables such as age, fracture classification and coexisting diseases and injuries. Both groups underwent similar antibiotic therapy. The following outcomes were calculated: Length of hospital stay post-operatively, leg shortening, non-union, postoperative inflammation, range of hip & knee motion, persistent pain, time elapsed until full callus formation. At the final follow up all patients were evaluated by the SF36 questionnaire. Statistical analysis was evaluated with SPSS

## RESULTS

Length of hospital stay and postoperative inflammation were similar in both groups ( $p > 0.05$ ,  $95\%CI = 0.89-1.82$ ). More specifically no postoperative inflammation occurred in any patient of both groups. Malunion concerning leg shortening of more than 1 cm and angulation of more than 5 degrees occurred in two cases in closed nailing. Non-union was not observed in any group whereas full callus formation was achieved at a mean time of 7,5 months for the closed nailing group and 11 months in the open nailing group. Range of hip and knee motion was statistically significant deteriorated ( $p < 0.05$ ,  $95\%CI = 2.78-3.35$ ) in patients whose fractures were openly reduced. Pain elicited with movement was more persistent in the openly reduced group with a mean duration of 3 months postoperatively whereas the mean duration in the closed group was just 1 month ( $p < 0.05$ ,  $95\%CI = 1.18-6.42$ ) (Fig. 1). Better SF-36 scores were achieved by patients of the first group ( $p < 0.05$ ,  $95\%CI = 1.21-3.75$ ) (Fig. 2)



## DISCUSSION

Intramedullary nailing is the treatment of choice for all midshaft femoral fractures. One of the advantages of IMN is the preservation of post injury haematoma around the fracture site. Bone fracture initiates a series of molecular pathways that commence with haematoma formation and an inflammatory cascade that regulates mesenchymal stem cells activity leading to fracture healing and the reestablishment of skeletal integrity. Thus the haematoma preservation that is secured by fully closed intramedullary nailing techniques is essential for early and strong callus formation. On the other hand open reduction should be taken into account in difficult cases where reduction cannot be accomplished in a proper surgical time. In such a case the useful perfracture hematoma has to be sacrificed for the shake of the protracted surgical stress a patient or a surgeon may undergo or the excessive radiological aggravation.

## CONCLUSION

Closed nailing of femoral fractures ensures a shorter duration of union as well as better range of hip and knee motion and a shorter period of movement elicited pain postoperatively. The persistent pain in open reductions as well as the reduced range of motion is suggested to be correlated with scar formation and inogenesis of the soft tissue (skin, muscles & fascia) because of the incision made at the fracture level. Nevertheless, in closed method, care should be taken to malalignment or shortening while locking the nail. Postoperative inflammation or non-unions did not differ between the two groups in our study, although in the literature they seem to be relevant with open nailing.

Table 1: Characteristics of the closed IMN group

|             | Hospital staying (days) | Leg shortening | Mal-union              | Non-union | Deep infection | HIP ROM (final follow-up)         | Knee ROM (final follow-up) | Pain duration (months) | Callus formation (months) | Full weight bearing (months) | SF-36       |
|-------------|-------------------------|----------------|------------------------|-----------|----------------|-----------------------------------|----------------------------|------------------------|---------------------------|------------------------------|-------------|
| 1           | 6                       | -              | -                      | -         | -              | 45° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 8                         | 7.5                          | 85          |
| 2           | 5                       | -              | -                      | -         | -              | 40° - 20° - 135° - 30°            | 0° - 135°                  | 1.5                    | 6                         | 6.5                          | 83          |
| 3           | 6                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 1                      | 8                         | 7.5                          | 87          |
| 4           | 7                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 0.5                    | 7                         | 8.5                          | 82          |
| 5           | 8                       | >1 cm          | -                      | -         | -              | 35° - 10° - 100° - 15°            | 0° - 130°                  | 1                      | 6                         | 10                           | 80          |
| 6           | 5                       | -              | -                      | -         | -              | 40° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 7                         | 7.5                          | 86          |
| 7           | 6                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 1                      | 6                         | 6.5                          | 85          |
| 8           | 5                       | -              | -                      | -         | -              | 45° - 20° - 130° - 25°            | 0° - 140°                  | 1                      | 9                         | 7                            | 83          |
| 9           | 6                       | -              | -                      | -         | -              | 40° - 20° - 125° - 20°            | 0° - 140°                  | 1.5                    | 6                         | 7                            | 90          |
| 10          | 5                       | -              | -                      | -         | -              | 35° - 15° - 130° - 20°            | 0° - 135°                  | 2                      | 7                         | 8                            | 84          |
| 11          | 7                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 1                      | 9                         | 9                            | 85          |
| 12          | 5                       | -              | -                      | -         | -              | 40° - 20° - 135° - 30°            | 0° - 140°                  | 1                      | 8                         | 8.5                          | 92          |
| 13          | 6                       | -              | Angulation > 5 degrees | -         | -              | 30° - 10° - 110° - 25°            | 0° - 120°                  | 1                      | 9                         | 11                           | 78          |
| 14          | 7                       | -              | -                      | -         | -              | 45° - 20° - 130° - 30°            | 0° - 140°                  | 0.5                    | 9                         | 5.5                          | 87          |
| 15          | 7                       | -              | -                      | -         | -              | 40° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 8                         | 7                            | 84          |
| 16          | 7                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 1                      | 7                         | 7                            | 93          |
| 17          | 6                       | -              | -                      | -         | -              | 45° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 9                         | 8                            | 82          |
| 18          | 4                       | -              | -                      | -         | -              | 45° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 6                         | 7                            | 86          |
| 19          | 5                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 0.5                    | 8                         | 9                            | 82          |
| 20          | 6                       | -              | -                      | -         | -              | 40° - 15° - 130° - 25°            | 0° - 135°                  | 1.5                    | 6                         | 7.5                          | 88          |
| 21          | 6                       | -              | -                      | -         | -              | 45° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 8                         | 6.5                          | 85          |
| 22          | 6                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 0.5                    | 7                         | 7                            | 83          |
| 23          | 5                       | -              | -                      | -         | -              | 45° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 8                         | 8                            | 90          |
| 24          | 5                       | -              | -                      | -         | -              | 45° - 20° - 135° - 30°            | 0° - 140°                  | 0.5                    | 8                         | 7                            | 80          |
| 25          | 6                       | -              | -                      | -         | -              | 40° - 20° - 130° - 30°            | 0° - 140°                  | 1                      | 7                         | 8                            | 90          |
| <b>Mean</b> | <b>5.88</b>             |                |                        |           |                | <b>42° - 19.5° - 129.5° - 28°</b> | <b>0° - 138.2°</b>         | <b>1</b>               | <b>7.5</b>                | <b>7.68</b>                  | <b>85,2</b> |

Table 2: Characteristics of the open IMN group

|             | Hospital staying (days) | Leg shortening | Mal-union | Non-union | Deep infection | HIP ROM (final follow-up)            | Knee ROM (final follow-up) | Pain duration (months) | Callus formation | Full weight bearing (months) | SF-36       |
|-------------|-------------------------|----------------|-----------|-----------|----------------|--------------------------------------|----------------------------|------------------------|------------------|------------------------------|-------------|
| 1           | 6                       | -              | -         | -         | -              | 35° - 15° - 130° - 25°               | 0° - 135°                  | 4                      | 9                | 8.5                          | 73          |
| 2           | 7                       | -              | -         | -         | -              | 40° - 15° - 130° - 30°               | 0° - 135°                  | 3                      | 11               | 11                           | 78          |
| 3           | 6                       | -              | -         | -         | -              | 45° - 15° - 135° - 30°               | 0° - 140°                  | 4                      | 12               | 8.5                          | 76          |
| 4           | 6                       | -              | -         | -         | -              | 30° - 15° - 130° - 20°               | 0° - 140°                  | 3                      | 10               | 8.5                          | 72          |
| 5           | 6                       | -              | -         | -         | -              | 30° - 15° - 130° - 25°               | 0° - 140°                  | 3                      | 12               | 10                           | 74          |
| 6           | 5                       | -              | -         | -         | -              | 45° - 20° - 135° - 30°               | 0° - 140°                  | 2                      | 9                | 9                            | 80          |
| 7           | 6                       | -              | -         | -         | -              | 35° - 20° - 130° - 25°               | 0° - 140°                  | 3                      | 10               | 9                            | 72          |
| 8           | 7                       | -              | -         | -         | -              | 30° - 15° - 125° - 20°               | 0° - 130°                  | 3                      | 12               | 10                           | 78          |
| 9           | 7                       | -              | -         | -         | -              | 35° - 15° - 130° - 25°               | 0° - 125°                  | 3                      | 12               | 10.5                         | 78          |
| 10          | 7                       | -              | -         | -         | -              | 40° - 15° - 135° - 25°               | 0° - 140°                  | 2                      | 12               | 11                           | 86          |
| 11          | 6                       | -              | -         | -         | -              | 40° - 15° - 125° - 25°               | 0° - 140°                  | 3                      | 10               | 8                            | 82          |
| 12          | 6                       | -              | -         | -         | -              | 35° - 15° - 130° - 25°               | 0° - 140°                  | 4                      | 12               | 10.5                         | 80          |
| 13          | 5                       | -              | -         | -         | -              | 30° - 10° - 125° - 25°               | 0° - 135°                  | 2                      | 11               | 10.5                         | 76          |
| <b>Mean</b> | <b>6.15</b>             |                |           |           |                | <b>36.15° - 15.3° - 130° - 25.4°</b> | <b>0° - 136.9°</b>         | <b>3</b>               | <b>11</b>        | <b>9.6</b>                   | <b>77,3</b> |

## LITERATURE

1. M.Gharehdaghi, H.Rahimi, M.Bahari, J.Afzali. A prospective study of closed and open reamed intraadullary ailing of 136 femoral shaft fractures in adults. JRMS. 2007;12(1):16-20
2. Bielby R, Jones E, McGonagle D. The role of mesenchymal stem cells in maintenance and repair of bone. PMID: 17383482
3. Kapp W, Lindsey RW, Noble PC, Rudersdorf T, Henry P. Long-term residual musculoskeletal deficits after femoral shaft fractures treated with intramedullary nailing. J Trauma 2000; 49(3):446-449.
4. Winquist RA, Hansen ST, Jr., Clawson DK. Closed intramedullary nailing of femoral fractures. A report of five hundred and twenty cases. 1984. J Bone Joint Surg Am 2001; 83-A(12):1912.
5. Kyle RF, Schaffhausen JM, Bechtold JE. Biomechanical characteristics of interlocking femoral nails in the treatment of complex femoral fractures. Clin Orthop Relat Res 1991;(267):169-173.
6. Ricci WM, Bellabarba C, Lewis R, Evanoff B, Herscovici D, Dipasquale T et al. Angular malalignment after intramedullary nailing of femoral shaft fractures. J Orthop Trauma 2001; 15(2):90-95.