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= Abstract =

## Augmentative Plate Fixation for Femoral Nonunion after Intramedullary Nailing

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The purpose of this study is to evaluate the efficacy of augmentative plate fixation for the femoral nonunion after intramedullary nailing.

We reviewed eleven femoral nonunion after intramedullary nailing, which were treated with augmentative plate internal fixation. All cases were initially managed with interlocking intramedullary nailing. Five were hypervascular and six were avascular. Leaving the intramedullary nail in situ, an augmentative plate fixation was applied to the fracture site to counter the rotational instability. A simultaneous bone grafting was performed in six avascular nonunion to repair the bony defect. The union time was 8.2 months in average ( 7.8 months in hypervascular and 8.5 months in avascular).

In conclusion, augmentative plating leaving the intramedullary nail in situ is an useful alternative for the treatment of femoral nonunion after intramedullary nailing. The technique is simple and does not require any special instruments. It facilitates an early weight bearing and

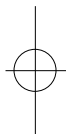
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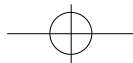
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gives a quick recovery from nonunion.

**Key word** : Femur, Nonunion, Intramedullary nailing, Augmentative plating

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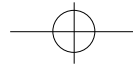
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(Table 1).

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**Table 1.** Data of Cases

Case	Age	Gender	Fracture level	Dynamization	Type of nonunion	Time to nonunion *	Treatment	Union time (months)
1	17	F	middle	+	hypervascular	14	plate	6.7
2	47	F	distal	-	hypervascular	10	plate	8.4
3	40	F	proximal	+	hypervascular	9	plate	7.6
4	20	F	middle	+	avascular	9	plate + BG <sup>†</sup>	7.1
5	38	F	distal	-	avascular	13	plate + BG <sup>†</sup>	11.2
6	54	F	distal	+	avascular	9	plate + BG <sup>†</sup>	7.8
7	21	M	middle	+	hypervascular	10	plate	6.2
8	58	M	middle	+	hypervascular	11	plate	9.8
9	37	M	middle	-	avascular	9	plate + BG <sup>†</sup>	10.3
10	42	M	distal	+	avascular	10	plate + BG <sup>†</sup>	8.1
11	33	M	proximal	+	avascular	10	plate + BG <sup>†</sup>	6.4

\* Elapsed time from trauma to diagnosis of nonunion(months)

† bone graft

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(Figure 2).

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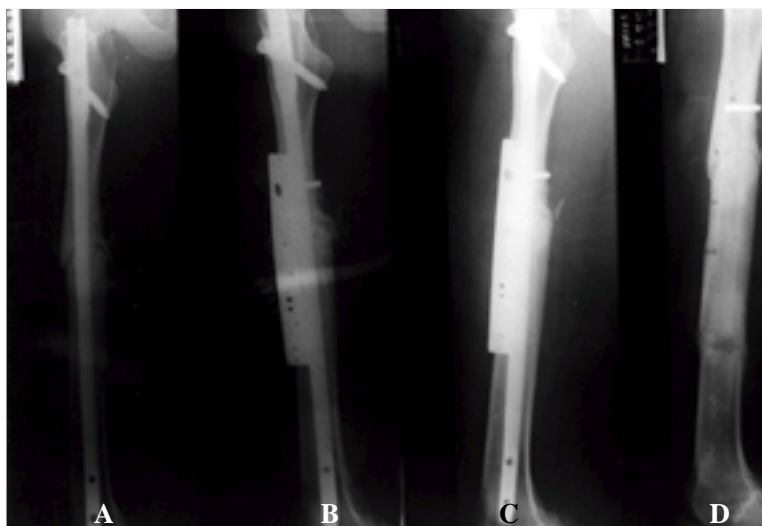
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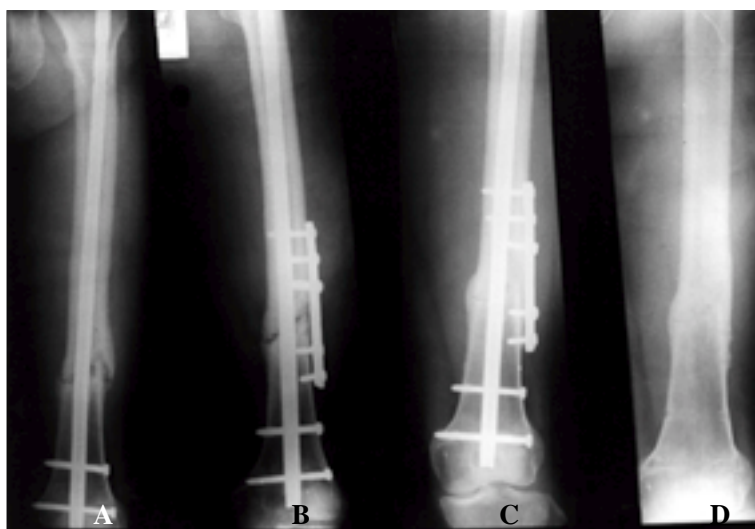
(Figure 4).



**Fig 1A.** Radiograph taken at 14 months after intramedullary nailing for femoral shaft fracture, shows hypertrophic nonunion.

**1B.** Augmentative plate fixation was applied to the fracture site to counter the rotational instability leaving the intramedullary nail in situ.

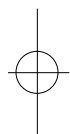
**1C, D.** At 6.7 months after re-operation, radiograph shows bone union.



**Fig 2A.** Radiograph taken at 10 months after intramedullary nailing shows hypertrophic nonunion.

**2B.** Augmentative plate fixation was applied to the fracture site to counter the rotational instability.

**2C, D.** At 8.4 months after re-operation, radiograph shows bone union.



Wolinsky<sup>13)</sup>

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Weresh<sup>12)</sup>  
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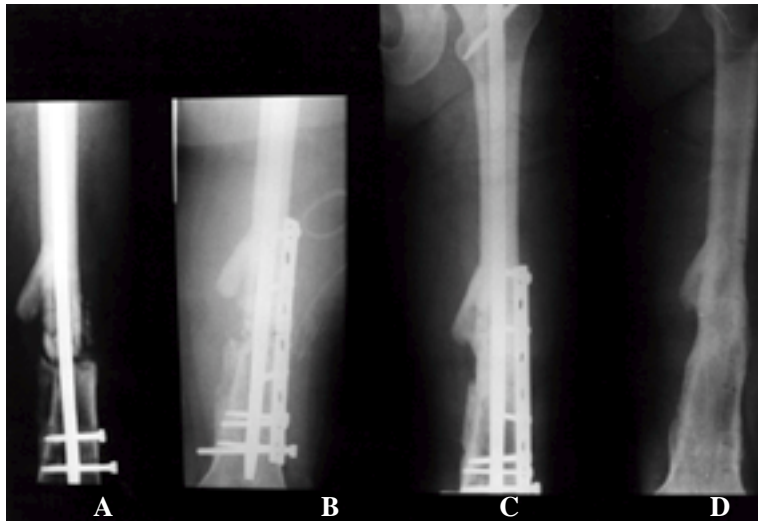
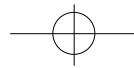
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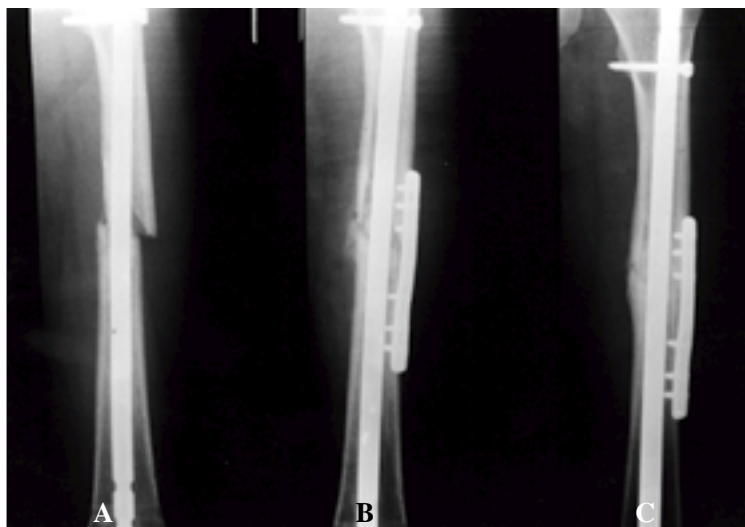




**Fig 3A.** Radiograph taken at 13 months after intramedullary nailing shows atrophic nonunion.

**3B.** Augmentative plate fixation was applied to the fracture site and simultaneous bone grafting was performed.

**3C, D.** At 11.2 months after re-operation, radiograph shows bone union.



**Fig 4A.** Radiograph taken at 9 months after intramedullary nailing shows atrophic nonunion.

**4B.** Augmentative plate fixation was applied to the fracture site and simultaneous bone grafting was performed.

**4C.** At 7.1 months after re-operation, radiograph shows bone union.

Grosse<sup>4)</sup> Miller<sup>8)</sup>

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Weber Brunner<sup>11)</sup>

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Allgower<sup>1)</sup>

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## REFERENCES

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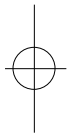
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- 1) **Allgower M and Spiegel PG** : Internal fixation of fractures. *Clin Orthop*, 138:26-29, 1979.
- 2) **Chun CH, Kim SS, Kim DC and Yoo HJ** : The treatment of nonunion of femoral fractures with an interlocking nailing. *J Korean Fracture Assoc*, 8;497-504, 1995.
- 3) **Clancey GJ, Winquist RA and Hansen ST** : Nonunion of the tibia with Kuntscher intramedullary nailing. *Clin Orthop*, 167:191-195, 1982.
- 4) **Grosse A** : Aseptic pseudoarthrosis of femur and tibia. International Symposium on Recent Advances in Locking Nail, *Hong Kong*, 1992.
- 5) **Hak DJ, Lee SS and Goulet JA** : Success of exchange reamed intramedullary nailing for femoral shaft nonunion or delayed union. *J Orthop Trauma*, 14:178-182, 2000.
- 6) **Kempf I, Grosse A and Rigant P** : The treatment of noninfected pseudoarthrosis of the femur and tibia with locked intramedullary nailing. *Clin Orthop*, 212:142-154, 1986.
- 7) **LaVelle DG** : Delayed union and nonunion of fracture. (cited from Canale ST ed. Campbell 's Operative Orthopaedics. 9th ed. St Louis, *Mosby-Year Book, Inc.* : 2579-2599, 1998).
- 8) **Miller ME, Davis ML, MacClean CR, Davis JG, Smith BL and Humphries JR** : fluroscopic guidance for selected orthopaedic surgical procedures. *J Bone Joint Surg*, 65A:1-4, 1983.
- 9) **Tarr RR and Wiss DA** : The mechanics and biology





- of intramedullary fracture fixation. *Clin Orthop*, 212:10-17, 1986.
- 10) **Ueng SW, Chao EK, Lee SS and Shih CH** : Augmentative plate fixation for the management of femoral nonunion after intramedullary nailing. *J Trauma*, 43:640-644, 1997.
- 11) **Weber BG and Brunner C** : The Treatment of nonunion without electrical stimulation. *Clin Orthop*, 161:24-32, 1981.
- 12) **Weresh MJ, Hakanson R, Stover MD, Sims SH, Kellam JE and Bosse MJ** : Failure of exchange reamed intramedullary nails for ununited femoral shaft fracture. *J Orthop Trauma*, 14:335-338, 2000.
- 13) **Wolinsky PR** : Fracture of the femoral diaphysis, including the subtrochanteric region. (cited from Kellam JF, Fischer TJ, Tornetta III P, Bosse MJ and Harris MB ed. *Orthopaedic Knowledge Update, Trauma 2*. 2nd ed. Rosemont, *American Academy of Orthopaedic Surgeons*:133-146, 2000).
- 14) **Wu CC and Shih CH** : Effect of dynamization of a static interlocking nail on fracture healing. *Can J Surg*, 36:302-306, 1993.

