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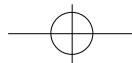
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 , , 9,10) 17 가 .
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 Gustilo Anderson 1)
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 2), (Table 3),
 (Table 4), (Table 5)
 (divergency) (Table 6)
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Table 1. Type of fractures

Types of fracture	Total No of cases	*Union time(wk)	Delayed union	Nonunion	Angulation	Shortening	Proximal migration	Nail breakage
Transverse	2	19						
Oblique	3	17.7			1			
Spiral	6	18.3						
Unicortical comm.	13	17.8	1					
Bicortical comm.	5	18.3	1	1	1			
Segmental	6	21	1	2	3			1
Total	35		2	2	5	1	1	1

* : mean union time of cases excluding nonunion

comm. : comminuted

**Table 2.** Level of fractures

Types of fracture	Total No of cases	*Union time(wk)	Delayed union	Nonunion	Angulation	Shortening	Proximal migration	Nail breakage
Proximal	2	26.5	1					
Middle	17	17.6			2	1	1	
Distal	10	17.3						
Segmental	6	21	1	2	3			1
Total	35		2	2	5	1	1	1

* : mean union time of cases excluding nonunion

Table 3. Type of open fractures

Types of fracture	Total No of cases	*Union time(wk)	Delayed union	Nonunion	Angulation	Shortening	Proximal migration	Nail breakage
Closed	26	18.9	2	1	4			1
Open								
Type I	4	17.3		1	1	1	1	
Type II	5	17						
Type III	0							
Total	35		2	2	5	1	1	1

* : mean union time of cases excluding nonunion

Table 4. Number of nails

Number	Total No of cases	*Union time(wk)	Delayed union	Nonunion	Angulation	Shortening	Proximal migration	Nail breakage
2	23	18.2	1	2	4	1	1	1
3	10	19.2	1		1			
4	2	18						
Total	35		2	2	5	1	1	1

* : mean union time of cases excluding nonunion

Table 5. Length of nails

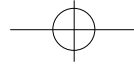
Length	Total No of cases	*Union time(wk)	Delayed union	Nonunion	Angulation	Shortening	Proximal migration	Nail breakage
Short	19	19.1	2	1	5	1	1	
Adequate	16	17.7		1				1
Total	35		2	2	5	1	1	1

* : mean union time of cases excluding nonunion

Table 6. Divergency and direction of nails

Divergency & direction	Total No of cases	*Union time(wk)	Delayed union	Nonunion	Angulation	Shortening	Proximal migration	Nail breakage
Adequate	16	17.1		2				1
Inadequate	19	19.5	2		5	1	1	
Total	35		2	2	5	1	1	1

* : mean union time of cases excluding nonunion



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35 26 (74.3%)
 (Fig. 1) 9 (25.7%) 가
 . 2 33
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Fig 1. Radiographs of right tibia of 55-year-old woman show bridging callus with good alignment. Three nails were inserted and the length and the divergency of nails were adequate.

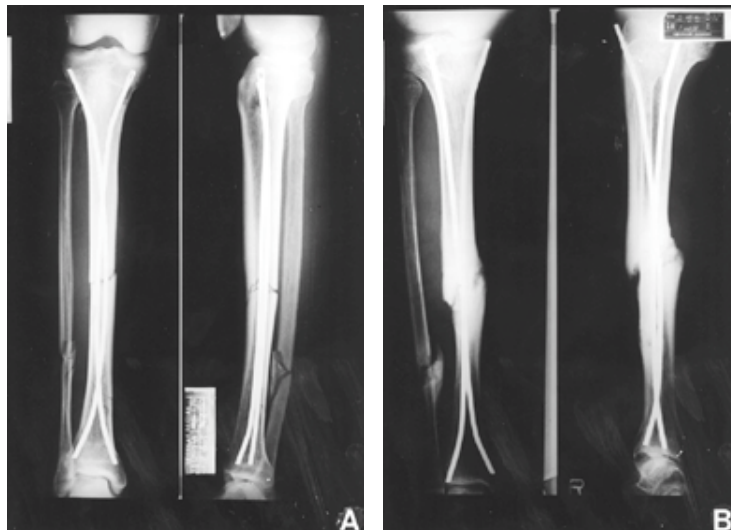


Fig 2. Radiographs of 57-year-old man with a segmental fracture in the middle and distal third of right tibia.

- A:** Postoperative radiographs showing well reduced fracture with two nails of adequate length and divergency.
- B:** Follow up radiographs at 17 months. Anterolateral shifting of proximal fragment with breakage of one nail. Note nonunion with widened fracture gap at mid-shaft fracture site. Two nails were not sufficient to stabilize the fracture fragments.

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(Fig. 3).

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(Fig. 4A-4B).

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(Fig. 2A-2B).

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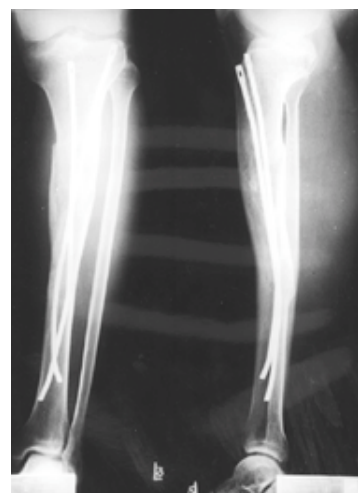


Fig 3. Follow up radiographs of 20-year-old man with segmental comminuted fracture of left tibia show 11 degrees of posterior angulation and 10 degrees of varus deformity. Adding to few number of two nails, short length, improper antero-postero-anterior direction and insufficient divergency of nails might be the causes of angular deformity.



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16), 가 , 가
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 18.5
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 , 가 21 19
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 2,3,6,7,10,13) 26.5 가
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 가 2 (5.8%) , 3 (8.6%)
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 Pankovich 10)
 19 가 가 가
 5 (26.3%)
 가 16
 1 가

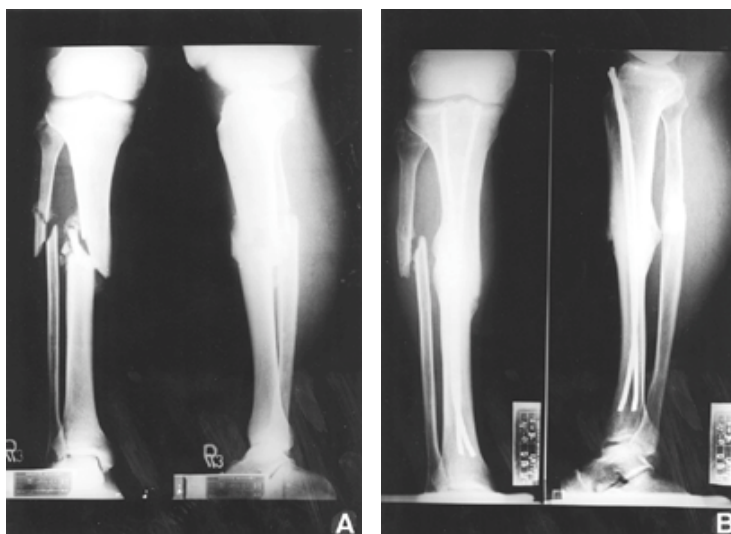
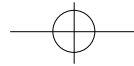


Fig 4. Radiographs of 57-year-old man with fractures in middle third of left tibia and fibula.
A : Severely comminuted unstable fractures on admission films.
B : Follow up radiographs at 18 months after operation reveal bony union, 2.5 cm shortening with protrusion of proximal end of nails, which irritated overlying soft tissue. Note only two nails with short length were used. Divergency and direction of nails were also inadequate.



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6 3 (50%),

5 1 (20%)

24 1 (4.2%)

17 2 (11.8%)

18 15

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10 7 3

6 4 (66.7%) 10

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(Fig. 5).

2 23 4 (17.4%)

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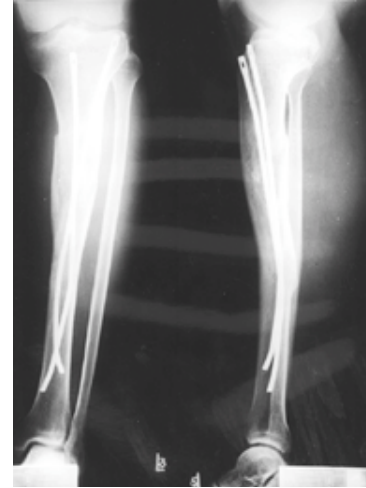


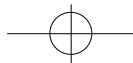
Fig 5. Healed segmental comminuted fractures in distal third of left tibia and fibula show 15 degrees of posterior angulation and 11 degrees of valgus angulation. Medial two nails, one of which was inserted into medial malleolus, could not prevent the development of valgus deformity, suggesting that flexible intramedullary nailing did not provide the sufficient stability in such an unstable segmental fracture.



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 35 9 (25.7%) 가
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Abstract

Ender Nailing of Tibial Shaft Fractures

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Purpose : Though Ender nailing in tibial shaft fractures is a good method of treatment, there were several reports about complications such as angulation or shortening. Most of those complications were associated with improper surgical technique and might be avoidable. So, we analyzed the results of tibial Ender nailing in view of the complications and their contributing factors.

Material and Method : Thirty-five tibial shaft fractures were treated with Ender nailing and followed up for 12 to 51 months. We evaluated the bony union, angulation, shortening, proximal migration of nail and infection, and analyzed the results in association with the type and the location of fractures, the number and the length of nails and the divergency of distal tip of nails.

Results : Average bony union time was 18.5 weeks and there were 2 delayed unions, 2 nonunions, 5 angulations, 1 shortening, 3 soft tissue irritations by proximal tips of nails, 1 proximal migrations of nails and one nail breakage. Most of them were associated with technical faults such as few number, short length or insufficient divergency of nails. According to the type of fractures, the highest rate of complications was seen in segmental fractures.

Conclusion : Performed by proper surgical technique based on detailed fracture analysis, most of the complications of Ender nailing for tibial shaft fractures might be avoidable. Therefore, Ender nailing is one of the useful alternatives for tibial shaft fractures.

Key Words : Tibial shaft fracture, Ender nailing, Complication