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= Abstract =

Use of Interlocking Intramedullary Nail in Treatment of Delayed Union or Nonunion of the Long Bone Fractures

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Of the several nonoperative and operative options described for the treatment of delayed union and nonunion of the long bone, interlocking nailing with reaming offers the effect of internal splint, autogenous bone graft and early return to a normal way of life. The purpose of this study is to evaluate the usefulness and complication of intramedullary(IM) nailing with reaming by retrospective method.

We treated 34 patients with delayed union or nonunion of the tibia, femur, and humerus by interlocking nailing with reaming between January 1992 and December 1996.

The results were as follows ;

1. Of the 34 cases, there were 13 tibia fracture, 17 femur fracture, 4 humerus fracture. Half of them were ununited and another half were delayed in fracture healing.
2. Previous methods of treatment were conservative treatment in 2 cases, external fixator in 2, plate & screws fixation in 8, Ender nail in 2, Küntscher nail in 2 and interlocking nail in 7 among 24 cases of closed fracture and external fixator in 8 and interlocking nail in 2 among

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10 cases of open fracture.

3. Twenty-five patients were treated with closed nailing and 9 were treated with open nailing. Iliac bone graft was performed at 3 cases and fibulotomy was performed at 1 case.
4. Union was obtained in 33 cases and 1 case needed additional bone grafting to achieve union.
5. Postoperative complications were one nonunion, two entry site pain, one screw breakage, one heterotopic ossification, and one postoperative infection.

Interlocking nailing with reaming was associated with a high union rate(97%) in our series. The authors believe that IM nailing with reaming is a useful option for treatment of delayed or nonunion of the long bone fracture.

Key Words : Long bone, Delayed union or nonunion, Interlocking nailing, Reamed.

34

가 , 9 3

가 11),

4 17),

19),

internal splint 8),

bone dust 가 가 2,9),

1.

가 34 24 (70.6%), 10 (29.4%)

9,15) 14 77

38.5 20 -40 가 82% 가

5,7)

2.

34 13 , 17 , 4

17 , 17

24 11 , 13 ,

10 6 , 4

(Table 1).

(hypervascular) 21 , (avascular) 13

(Table 2).

8 (23%), 6

(17%), 5 (15%), 11 (32%),

4 (12%) . 10

1992 1 1996 12 1 2

6 2 3 8 가



Table 1. Site and type of initial fractures

Type\Site	Tibia	Femur	Humerus	Total
Delayed union	4/4*	5/1	2/1	11/6
Nonunion	3/2	9/2	1/-	13/4
Total	7/6	14/3	3/1	24/10

* : Closed / Open

Table 2. Type of delayed union and nonunion

Type \ Site	Tibia	Femur	Humerus	Total
Hypervascular	8	11	2	21
Avascular	5	6	2	13

Table 3. Previous methods of treatment

Tx.(Fx. type)\Site	Tibia	Femur	Humerus	Total
Conservative	1/-*	-	1/-	2/-
Ext. fixator	3/6	-/1	-/1	3/8
Plate and screws	-	6/-	2/-	8/-
Ender nail	1/-	1/-	-	2/-
K ntscher nail	1/-	1/-	-	2/-
Interlocking nail	1/-	6/2	-	7/2

* : Closed / Open

Table 4. Postoperative period of the formation of bridging callus according to previous treatment

Treatment Union time(mos.)	Conserv	Plate & screw	Ext. fixator	Ender or K ntscher	Interlocking nail	Total (No.)
2	1	1	-	-	2	4
3	-	2	2	2	3	9
4	1	4	5	2	2	14
5			-		1	1
6			2		1	3
7			1			1
8-			1			1
Avg.(mos.)	3.6 ± 0.8	4.0 ± 1.7	4.4 ± 2.1	3.8 ± 0.7	3.7 ± 1.2	3.8 ± 1.4

Gustilo & Anderson I 3 , II 3 , III 4 . 25 (74%), 4 (11%), 가 3 (9%), 2 (6%) .

3.

2 , 3 , 8 , Ender 2 , Küntscher 2 , Interlocking 7 8 , Interlocking 2

(Table 3).

가 3 ,

1 가 .

2

, 5 , 2 3 .

3

2

1

.

2 ,

2 ,

1 ,

2

, 1 , 1

4.

5.4 ,

3.8 ,



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16.5 , 가
 12.2 . provocation test
 4.8 , 14.7 .¹⁹⁾ 34 33
 (97%)
 5. Interlocking 1 가
 8 1 6
 2 6
 가
 가
 3.6±0.8 , 4.0±1.7 ,
 4.4±2.1 , Ender Küntscher 3.8±0.7
 , 2 , 9 , , Interlocking 3.7±1.2 1
 5.5 . Ender , 33 3.8±1.4
 Küntscher (Table 4).
 3.6±1.2 ,
 6. 4.0±1.5
 34 9 1 ,
 6 2 , 1 , 1 ,
 2 , 2 1
 1 1
 가 가 6
 1 ,
 1 1
 3 가
 1
 AO nail 4 , Russel-Taylor nail 9 , Seidal nail 1.
 1 , AIM nail 1 , Grosse-Kempf nail 19 30
 reaming 7 12 3 ,
 , 1
 ,
 가 가 4 가
 가 (Fig 1).

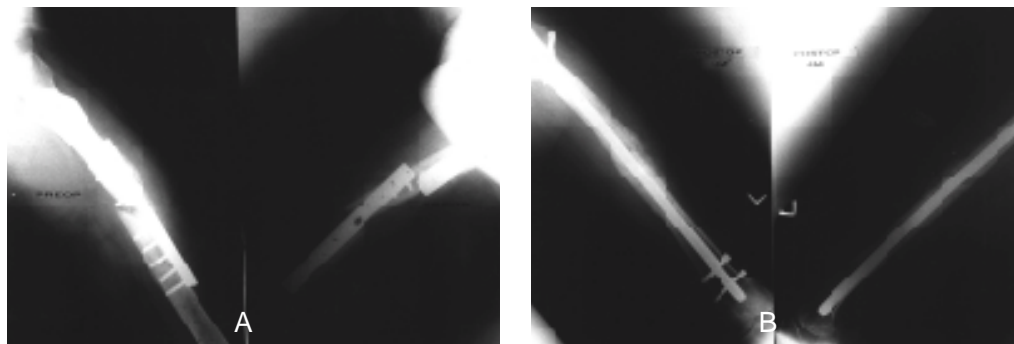


Fig 1. A 30 year-old woman with nonunion of femur shaft

A. Preoperative fixation state with plate and screw

B. Radiograph at 4 months after IM nailing shows bridging callus at the fracture site

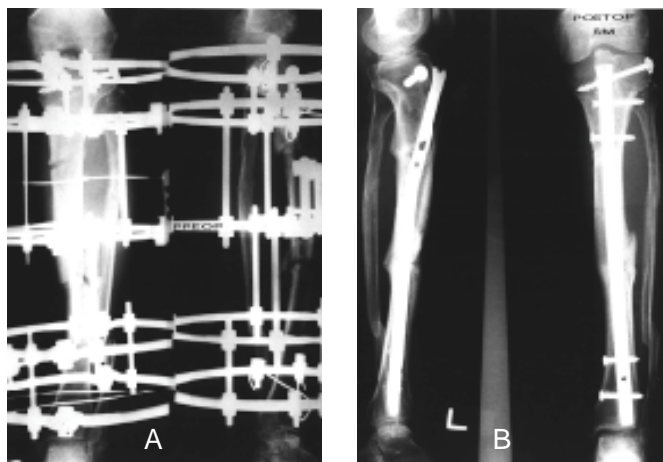


Fig 2. A 45 year-old man with delayed union of segmental fracture at tibia

A. Preoperative state with Ilizarov external fixator

B. Radiograph at 6 months after conversion to IM nailing shows bridging callus at the fracture site.

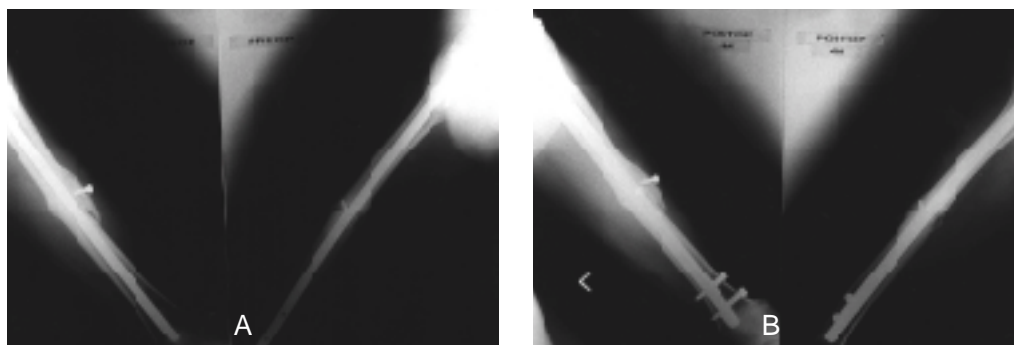
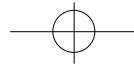


Fig 3. A 39 year-old man with hypertrophic nonunion of femur shaft

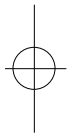
A. Preoperative IM nailed state

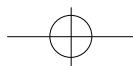
B. Radiograph at 4 months after changing to another nail shows bridging callus at the fracture site



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2. ,
45 ,
Ilizarov 4 , 가
, 가2 5,7) 가 .
.
, 6
(Fig 2). 가 , Kessler
Hallfeldt⁹⁾ 2/3
3. , 가
39 ,
5 8 1
21 , 7 가
4.0 ± 1.7
4 (Fig 3). 가 (t-test, P >
0.05).
가
가 13
가 가 3.7
(t-test, P > 0.05).
.
load sharing effect가 ,
가가 가 가 8,19)
가
3,16) 가
bone dust 가 3 2
5,19) , 1 , 2
가 가 2,9) 1
가 3
,
(telescoping) 가 8) 2 ,
가 2)
가
2
가 2
가 9,15), 2cm, 3cm





19),

Rommens¹⁸⁾ 가 70

8 12 65 , Maurer¹²⁾ 92% 15%

71% , Healy⁶⁾ 67%

. Johnson Simpson⁷⁾ 가

47가 , , , ,

. (1) 가 (2) 가 가

ring sequestrum 가 ,

(3) 3 (4) 5.5 가

1 2 4 1 ,

가 6 가

3 ESR, CRP 가

2).

Klemm¹⁰⁾ 89.5%, 1992 1

62.5% , Miller¹⁴⁾ 1996 12 ,

19 18 (95%) 3 8 34

, Gustilo⁵⁾ .

. Freeland⁴⁾ Meyer¹³⁾ 1. 34 13 , 17

17 4 17 ,

skin coverage 2. 2 ,

11 , 8 , Ender Küntscher

4 , Interlocking 9 .

3 2 3. 25 , 9

pin tract , 5 가 3 ,

1 .

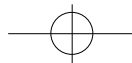
4. 1 33

(97%) 가

3 가 , 3.8 .

1 5. 1 , 2 ,





1 , 1 , 1 .

,
97%

. 가

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