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= Abstract =

## Treatment of Infected Nonunion of the Femur

Jung Ryul Kim, M.D. and Byung Yun Hwang, M.D.

*Department of Orthopedic Surgery, College of medicine,  
Chonbuk National University Hospital, Chonju, Korea*

The pupose of this study was to analyze influences on the bony union, to evaluate results and to consider effective methods of the treatment of infected nonunited fracture of the femur. Seventeen patients who had infected nonunited fracture of the femur were managed from January 1989 to January 1996. We reviewed the results according to the method of treatment. Fixation were judged to be unstable in all of patients who had undergone primary internal fixation so that we treated them with radical debridement of soft tissue and necrotic bone. The bacterial cultures usually revealed a mixed infection and the organisms cultured from the infected fracture site were, in order of frequency, Staphylococcus aureus, Escherichia coli, Streptococcus, Pseudomonas, and Enterococcus. At the time of final evaluation, functional results according to criteria of Sanders-Swiontkowski-Helfet were excellent in three, good in five, fair in four, and poor in five. The average motion of the knee joint ranged from 6.7° (0-20°) of extension to 75.5° (50-130°) of flexion. The five patients had shortening of affected limb (mean  $1.8 \pm 0.2$  cm).

Effective treatment of the infected non-union should be achieved not only bony union but also bacteriological and clinical remission of infection with subsequent closure of the wound and

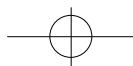
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634-18 (561-180)

Tel : (0652) 250-1760

Fax : (0652) 271-6538

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physical rehabilitation of the patient. Rigid internal fixation at the site of non-union can provide fracture healing as well as eradicate infection by improving the biologic environment.

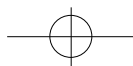
**Key Words** :Femur, Infected nonunion, Treatment

가 , 3 -A2 , 3 -B3 (Table 1).

**Table 1.** Primary Treatment

|                    | Open fracture | Closed fracture |
|--------------------|---------------|-----------------|
| Plate & screws     | 1             | 9               |
| Intramedullay nail | 3             | 1               |
| External fixation  | 3             |                 |
| Total              | 7             | 10              |

가 , 3.5 , , 가, C- 가 , 14 , 3 , Judet 13) , , 77 43 , 14 , 3 , 10 , 7 , Gustillo-Anderson 1 1 , 2 1 , 3 -A 2 , 3 -B 3 가 10 (58.8%), , 4 (23.6%), 3 (17.6%) , 11 (64.8%), 3 (17.6%), 3 (17.6%) , 10 9 , 1 , 14 , torsion wedge 1 , 8 , 5 .



, Escherichia coli, Streptococcus, Pseudomonas, Enterococcus (Table 2). 13, 1, 2, 4

**Table 2.** Bacterial Isolation from the patients with infected nonunion

|                       | Number of Patients |
|-----------------------|--------------------|
| Staphylococcus Aureus | 17                 |
| E. coli               | 4                  |
| Streptococcus         | 3                  |
| Pseudomonas           | 2                  |
| Enterococcus          | 1                  |
| Total isolates        | 27                 |

1 . Gustillo-Anderson

3 -b 3, 2, 1

(Table 3).

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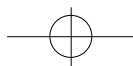
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**Table 3.** Treatment of infected nonunion

| Primary Treatment       | Secondary treatment                            | Number of patients |
|-------------------------|--|--------------------|
| Plates & screws<br>(10) | stable osteosynthesis with plate               | 4                  |
|                         | uniframe external fixator                      | 2                  |
|                         | plate fixation after uniframe external fixator | 1                  |
|                         | Ilizarov external fixator                      | 3                  |
| IM nailing<br>(4)       | larger diameter medullary nail                 | 2                  |
|                         | uniframe external fixator                      | 1                  |
|                         | Ilizarov external fixator                      | 1                  |
| Uniframe EF<br>(3)      | stable osteosynthesis with plate               | 2                  |
|                         | Ilizarov external fixator                      | 1                  |
| Total                   |  | 17                 |

**Table 4.** Analysis of cases

| Case No. | Age/sex | Treatment      | F/U ROM of the knee joint |            | Functional outcome |
|----------|---------|----------------|---------------------------|------------|--------------------|
|          |         |                | Extension(°)              | Flexion(°) |                    |
| 1        | 22/F    | P*             | 0                         | 120        | excellent          |
| 2        | 68/M    | U              | 10                        | 50         | poor               |
| 3        | 77/F    | I <sup>§</sup> | 10                        | 50         | poor               |
| 4        | 40/M    | P*             | 0                         | 120        | excellent          |
| 5        | 25/F    | P*             | 0                         | 80         | good               |
| 6        | 35/M    | U              | 0                         | 50         | fair               |
| 7        | 21/M    | I <sup>§</sup> | 0                         | 130        | excellent          |
| 8        | 41/M    | P, U           | 20                        | 50         | fair               |
| 9        | 43/M    | I <sup>§</sup> | 10                        | 50         | fair               |
| 10       | 39/M    | IM             | 0                         | 85         | good               |
| 11       | 50/M    | P*             | 0                         | 120        | excellent          |
| 12       | 61/M    | I <sup>§</sup> | 20                        | 50         | poor               |
| 13       | 37/M    | U              | 20                        | 50         | poor               |
| 14       | 30/M    | P*             | 0                         | 90         | good               |
| 15       | 47/M    | P*             | 20                        | 50         | poor               |
| 16       | 38/M    | I <sup>§</sup> | 5                         | 50         | fair               |
| 17       | 58/M    | IM             | 0                         | 90         | good               |

\* P: stable osteosynthesis with plate

U: uniframe external fixator

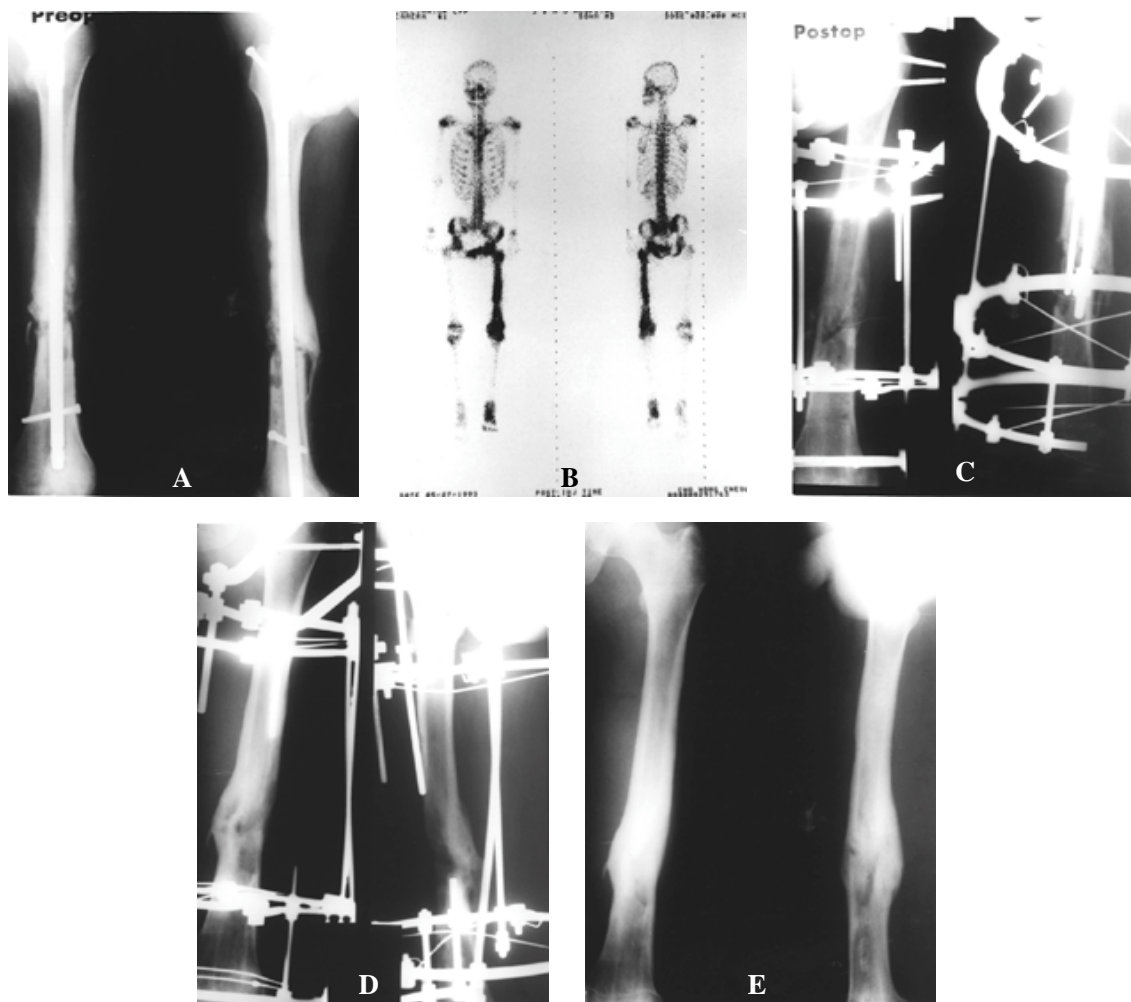
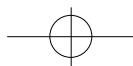
IM: intramedullary nail

§ Ilizarov external fixator

P,U: plate fixation after uniframe external fixator

(50-130 9, 6.7 9(0-20.)) 5 , , , Gustilo<sup>4,5)</sup> 가  
 2 cm .  
 가 , , ,  
 Sanders 9) 가 3 ,  
 5 , 4 , 5 8 , , ,  
 (47%) (Table 4).

가 , , , , Bacitracin- Polymixin 2,000ml 3,000ml 0.1%  
 , 가 , 10,000ml 5,000ml ,  
 , 1  
 2  
 2,14) . , 3-5



**Fig 1.** A 21-year-old male sustained closed fracture of left femur by traffic accident. Open interlocking intramedullary nailing was done at local clinic. The patient was referred to our department at postop. 3months due to active, draining osteomyelitis.

A. Preoperative X-ray showed osteolysis and periosteal reaction.

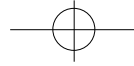
B. Preoperative bone scan showed increased activity in the entire femur.

C. Postoperative X-ray after extensive debridement, irrigation, sequestrectomy and external fixation with Ilizarov apparatus.

D. Follow-up study at six months after the operation showed complete eradication of infection and bony union.

E. Follow-up X-ray at 12 months after the operation showed complete consolidation of the fracture site.

5,8),  
1 3 , 가  
3,8,11) Wiggins  
Nelson<sup>15)</sup> Wahling<sup>12)</sup> 14



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, 10 3 2 가 , , 4 3 , ,

Gustilo<sup>5)</sup>

1).

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Stephane<sup>10)</sup>

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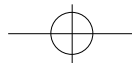
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