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\* 2002

가  
 ,  
 4,11,13,14,17,23)  
 3.5-mm DCP  
 LC-DCP, 3.5-mm , 1/3  
 2% 2,14,22)  
 1/3 2,5,24,25)  
 , 3.5-mm  
 1,4,5,12,14,20)  
 10,14,25) 21)  
 2,6,20) 4,13,14,17)  
 1997 1 2001 12 1/3

**Table 1.** Data on Patients

| Case | Sex | Age (yr) | Cause of Fx. * | Initial Treatment | Symptom <sup>†</sup> | Nonunion          |               | Surgery <sup>§</sup> | Results    |               |
|------|-----|----------|----------------|-------------------|----------------------|-------------------|---------------|----------------------|------------|---------------|
|      |     |          |                |                   |                      | Type <sup>‡</sup> | Duration (mo) |                      | Union (wk) | Complication  |
| 1    | M   | 62       | Cultivator A   | None              | Pain                 | AT                | 6             | RC/IBG               | 8.5        | None          |
| 2    | M   | 37       | Automobile A   | Fig-of-8          | False motion         | AT                | 4             | RC/IBG               | 10.5       | None          |
| 3    | M   | 17       | Bicycle A      | Fig-of-8          | Both                 | HT                | 10            | RC/IBG               | 9          | None          |
| 4    | M   | 36       | Bicycle A      | Fig-of-8          | Pain                 | AT                | 8             | RC/IBG               | 10         | None          |
| 5    | M   | 47       | Cultivator A   | Fig-of-8          | Both                 | HT                | 11            | RC/IBG               | 10         | None          |
| 6    | F   | 31       | Fall           | Fig-of-8          | False motion         | AT                | 15            | RC/IBG               | 15         | None          |
| 7    | M   | 30       | Bicycle A      | Fig-of-8          | Both                 | HT                | 4             | RC/IBG               | 10.5       | None          |
| 8    | M   | 62       | Motorcycle A   | Fig-of-8          | False motion         | HT                | 4             | RC/IBG               | 10         | None          |
| 9    | M   | 20       | Sports injury  | None              | Pain                 | HT                | 3             | RC/IBG               | 10         | None          |
| 10   | M   | 53       | Automobile A   | Fig-of-8          | Pain                 | AT                | 4             | RC/IBG               | 12         | Shoulder pain |
| 11   | M   | 19       | Motorcycle A   | IM pinning        | Pain                 | AT                | 3             | RC/IBG               | 9          | None          |
| 12   | F   | 39       | Automobile A   | Fig-of-8          | False motion         | AT                | 5             | RC/IBG               | 10.5       | None          |
| 13   | M   | 60       | Automobile A   | Fig-of-8          | Pain                 | AT                | 3             | RC/IBG               | 9          | Shoulder pain |
| 14   | F   | 50       | Automobile A   | Fig-of-8          | Pain                 | AT                | 4             | RC/IBG               | 11         | None          |
| 15   | M   | 35       | Fall           | Plating           | Pain                 | HT                | 14            | RC/BG-C              | 11         | None          |
| 16   | M   | 53       | Automobile A   | Sling             | Both                 | AT                | 3             | RC/IBG               | 11         | Shoulder pain |

\*A = accident, <sup>†</sup>Both = pain and false motion, <sup>‡</sup>AT = atrophic, HT = hypertrophic,

<sup>§</sup>RC = reconstruction plate, IBG = iliac bone graft, BG-C = bone graft with callus

mm, 3.5-12

가 가 16

(Table 1).

가 13, 가 3, 17

62 40.6 가

8 가, 가 3,

가 2, 가 2, 1

. 1, Gustilo-Anderson

II

2 14

7 가

7, 14

(1 cm) 가 1, (1~2.5 cm) 가

11, (2.5 cm) 가 2

가 11,

가 1,

가 2,

가 2

2 1/3

Steinmann

가

(Fig. 1).

10 6

가 8, 가 가 4,

가 가 4, 가

7 2 . 2

가

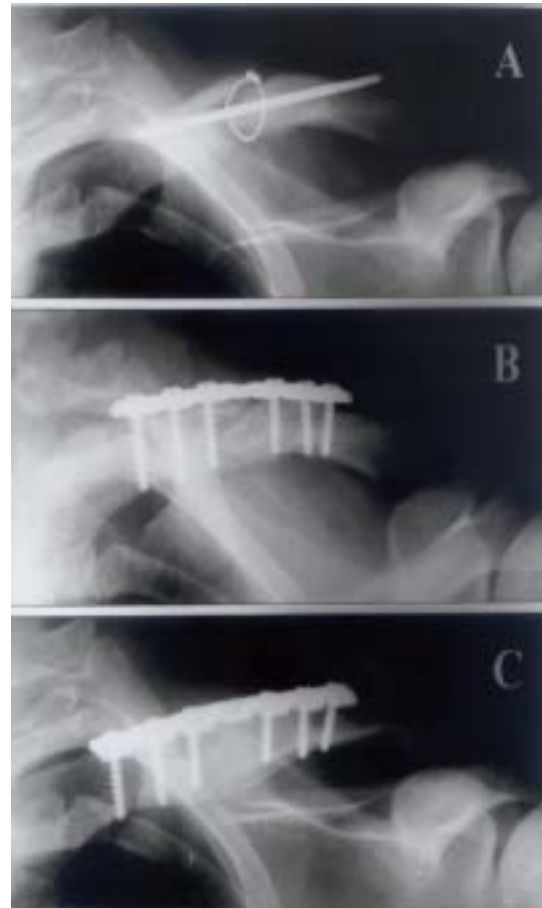
( 1, 14).

가 1

( 10).

3

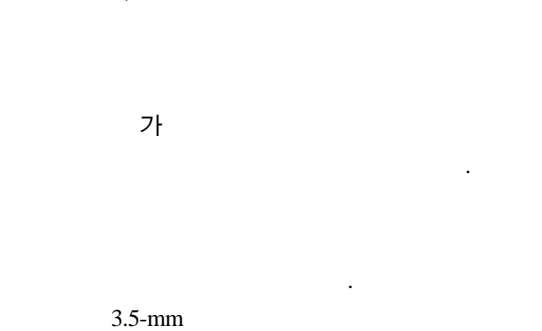
15 6.5 . 3.5-mm

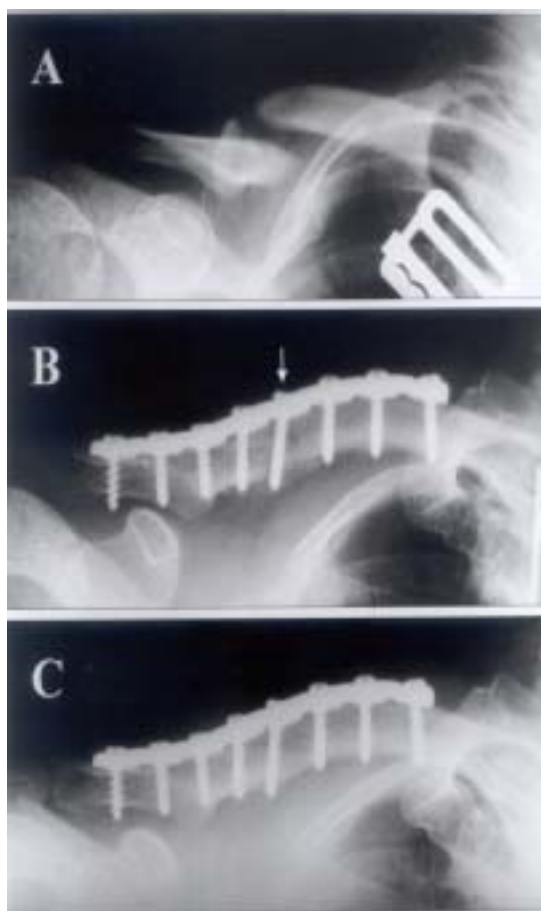


**Fig. 1A.** Anteroposterior radiograph shows an atrophic nonunion of the midshaft of the clavicle due to loss of fixation, though the fracture was fixed with a Steinmann pin and a cerclage wire.

**1B.** Postoperative radiograph shows fixation with a 7-hole, 3.5-mm reconstruction plate and screws and bone-graft.

**1C.** Follow-up radiograph 6 months after operation shows solid union of the ununited fracture (Case 11).





**Fig. 2A.** Anteroposterior radiograph shows an atrophic nonunion of the midshaft of the clavicle.  
**2B.** Postoperative radiograph shows fixation with a 8-hole, 3.5-mm reconstruction plate and screws, a lag screw fixation through the plate ( ), and bone-graft.  
**2C.** Follow-up radiograph 6 months after operation shows solid union of the ununited fracture without complications (Case 14).

3~4  
 가 4  
 (Fig. 2).

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1~1.5 cm  
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1/3 가 . 가 7  
 , 7  
 2% 2,14,22) , 1 6  
 1/3 . 3  
 (pectoral girdle)  
 4  
 14,18,20,25) , 3  
 , 가  
 10,25) . 12 4  
 15 , 가 1,4,5,12,14,20) .  
 1 , 10,14,25) 21) ,  
 Steinmann 2,6,20) , 4,13,14,17) .  
 1 ,  
 2 4  
 3 가 5,10,14,25) .  
 ,  
 , , , 1/3 , . Schuind 21) 20  
 , 5,6,10, 2  
 20,25) . Rowe<sup>18)</sup> .  
 0.8% , 3.7% K-  
 가 , Steinmann , Knowles , Hagie  
 Rush  
 가 . Boehme 2)  
 가 21 , Hagie  
 가 20 (95%)  
 5,10,16,20) . Poigenfürst 16)  
 122 5 Langer line  
 , 가 가 ,  
 가 load-sharing device  
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 , 2,6,7,9,10,18,24) . Capi-  
 cotto 6) 14 2  
 가 2 , 2 8  
 12

(85%)

Wilkins Johnston<sup>25)</sup>  
4 2

가 , 가  
가

가

5,10,14,17), AO<sup>19)</sup>

2,5,8,10,14),

Manske Szabo<sup>14)</sup>

10

10

, Kloen<sup>13)</sup> 12 3.6

15

1~1.5 cm

, Boyer Axelrod<sup>4)</sup> 7

6~12

1

3.5-mm DCP LC-DCP

3.5-mm , 1/3

3

9

. DCP LC-

10,11,14)

DCP

가<sup>8)</sup>

4,8,19)

1/3

3~5)

4,8,13) Böstman<sup>3)</sup>

가

3.5-mm

AO/ASIF DCP 55 3.5-mm

46

1/3

2

, Boyer Axelrod<sup>4)</sup>

3.5-mm LC-DCP

7

5,10,13) Jupiter

Leffert<sup>10)</sup>

Kloen<sup>13)</sup>

가

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**Abstract****The Operative Treatment of Nonunions of Midshaft Clavicular Fractures  
- Reconstruction Plate Fixation and Bone Grafting -**

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**Purpose:** The purpose of this study is to present our experience with open reduction, 3.5-mm reconstruction plate fixation, bone-grafting, and postoperative early mobilization for nonunions of midshaft clavicular fractures.

**Materials and Methods:** Sixteen patients were treated operatively for nonunions of the midshaft of the clavicle from 1997 to 2001. Ten nonunions were atrophic and six were hypertrophic. Nonunion had been present for an average of 6.5 months. The operative technique included removing the fibrous tissue from the nonunion site and opening the medullary canal, reduction of the fracture and fixation with a 3.5-mm reconstruction plate, and bone-grafting. Postoperative mobilization started within one week.

**Results:** The average duration of follow-up was 22.0 months. All fractures were united in an average of 10.0 weeks. All patients had full range of motion of the ipsilateral shoulder, but 3 out of 6 patients who were more than 50 years old complained occasional pain in the ipsilateral shoulder at the final follow-up examination. There were no major complications of postoperative infection, metal failure of the plate, loss of fixation, nonunion, and refracture after removal of the implant.

**Conclusion:** The technique of open reduction, reconstruction plate fixation, and bone-grafting is a safe and reliable method to allow early rehabilitation by stable fixation and to predict a high rate of union for nonunions of midshaft clavicular fractures.

**Key Words:** Clavicle, Nonunion, Reconstruction plate

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