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ORIGINAL STUDY

Plate osteosynthesis of simple forearm fractures : LCP versus DC plates

Charles Tjerk STEVENS, Henk Jan TEN DUIS

From the University Medical Centre Groningen, the Netherlands

The aim of this study was to compare the time to radiological bony union of simple A-type fractures of the forearm, treated with either a locking compression plate (LCP) or a dynamic compression plate (DCP). For each fracture, the relation between the use of compression and radiological healing time was studied.

Nine fractures were treated with LCP and 10 fractures with DC plates. The mean time to definite radiological bony union in the LCP group was 33 weeks and in the DCP group 22 weeks. Compression was used in 7 fractures in the DCP group and in 3 fractures in the LCP group. The compressed fractures, irrespective of the type of plate, healed 10 weeks faster than the non-compressed fractures.

Time to definite radiological bony union of simple A-type fractures does not depend on the type of plate used, but on the application of axial or interfragmentary compression.

Keywords : forearm fracture ; plate fixation ; locking compression plate ; dynamic compression plate.

INTRODUCTION

Anatomical reduction and internal fixation with a dynamic compression (DC) plate is the preferred treatment of simple shaft fractures of the forearm. Primary bony union without callus formation is the expected outcome.

While DC-plating is advocated in the treatment of simple diaphyseal fractures, its use in multifragmentary fractures and in osteoporotic bone may become problematic, due to early plate loosening. Instability and disturbed healing then often result (*3,7,14*). The problem was addressed by the development of angularly stable implants, conceived by Reinhold in France in 1933 (*11*). In 1987 AO introduced the Point Contact-fixator (PC-fix). Since 2001, AO has advocated the locking compression plate (LCP). This plate concept offers the choice of angularly stable screw fixation or dynamic compression at each single screw hole - the combination hole (fig 1). This enables the surgeon to use the LCP either as an internal fixator, preserving the soft tissue under the plate, or as a standard Dynamic Compression Plate. In DC plating mechanical stability is obtained by friction between plate and underlying bone (fig 2). The indication for the appropriate use of the LCP should be based on the recognition and full understanding of the separate basic principles inherent in

■ Charles Tjerk Stevens, MD, Surgeon.

■ Henk Jan ten Duis, MD, Ph D, Surgeon, Professor and head of the department.

Department of Traumatology, University Medical Centre Groningen, the Netherlands.

Correspondence : Charles Tjerk Stevens, Department of Traumatology, University Medical Centre Groningen P.O. Box 30.001, 9700 RB Groningen, the Netherlands.

E-mail : c.t.stevens@chir.umcg.nl

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Fig. 1. — The Locking Compression Plate with the combination hole which allows use for anglestable as well as compression fracture treatment.

Fig. 2. — The Dynamic Compression plate.

its design. Simple transverse fractures require stable fixation by axial compression, unstable multifragmentary fractures should be allowed to heal by callus, as a result of the relative stability of an internal fixator. This is virtually universally agreed.

There is much interest in promoting the use of these new angular stable plate techniques, having the additional advantage to allow minimal invasive surgery. In clinical practice, however, it is difficult to strictly follow manufacturer's recommendations for using these plates. In simple diaphyseal fractures the use of LCP as an internal fixator, without axial compression may delay union (fig 3). The aim of this study was to compare usage and conformity of LCP and DC plates to their design objectives in osteosynthesis of simple fractures of the forearm bones and to describe the incidence of union and non-union.

MATERIAL AND METHODS

Patients with a diaphyseal fracture of the forearm, type - A according to the Müller AO/ASIF classification (*9*) and treated between January 1999 and October 2004 at the University Medical Centre, Groningen with a DCP or LCP were selected for this study. Patients who underwent further treatment in other hospitals, or who died from other injuries were excluded. Nine fractures were treated by LCP osteosynthesis and 10 fractures with a DC plate. The distribution of Müller-AO/ASIF fracture types is shown in table I. There were 4 women and 11 men. Their ages ranged from 8-50 years (median : 29 years, mean : 27 years, SD : 14.4 years). Each group included one open Gustilo grade 1 fracture.

Fig. 3. — Inappropriate use of angle stability in a forearm fracture treated with the LCP.

Table I. — Distribution of the LCP and DC plates according to the Müller AO/ASIF classification and the distribution of compression

	LCP	DC	Total
A1	1	3	4
A2	2	0	2
A3	6	7	9
Compression	3	7	10
No compression	6	3	9

Radiographs were made 3, 6 and 12 weeks after the operation and later every 3 months until definite bony union. The surgical records were searched for the use of axial compression via the screw holes. The radiographs were studied by two investigators and for each fracture the use of compression and the consolidation time were

Table II. — Mean time to definite bone union in weeks

	LCP	DC	Total group
Compression	32	17	22
No compression	34	31	33
Whole group	33	22	

Table III. — Mean time to definite bony union (in weeks) in the LCP and DC plate groups, with compression, and LCP and DC plate groups without compression

Compression	22 (13-67)
No compression	32 (9-72)

noted. The endpoint was the time to radiographic consolidation. Radiological consolidation time of the fracture was defined as the time elapsed since the operation and the transformation of the primary radiolucent callus, by a process of endochondral ossification, to mature lamellar bone forming a continuous and dense external bridge across the fracture line (*5*). The callus had to be uniformly ossified approaching the density of normal bone (*12*).

RESULTS

No neurological or vascular injury was seen before or after operation. No infection was seen in either group. No non-unions were observed.

In the LCP group the mean time to bony union was 33 weeks (range : 11 to 72, SD : 24), whereas in the DC plate group it was 22 weeks (range : 9 to 63, SD : 15.8). In the LCP group 3 fractures were treated with compression and in the DC plate group 7 fractures were compressed. In both groups all fractures which had been compressed, healed in a mean of 22 weeks (range : 13 to 67, SD : 17.9). All fractures without compression healed in a mean of 32 weeks (range : 9 to 72, SD : 22.8). In tables II and III the distribution of the mean consolidation times for DC plates and LCP, with or without compression, is displayed.

DISCUSSION

Several authors have reported union rates of 91-98% in A-type forearm fractures with DC plates which is accordance with our results (100% union) (*1,2,5,8,14,15*). The reported mean consolidation time after DC plating varies from 12 weeks (range : 8 to 29) in closed fractures, to 13 weeks (range : 8 to 20) in open fractures, including all fracture types (*2,8*). In two reports of fracture treatment using the angularly stable PC-Fix, bony union was reached in all fractures after a mean of 18 weeks (range : 8 to 40) in closed fractures, and 20 weeks in open fractures (range : 12 to 40) (*3,6*). The longer radiological healing time is probably due to the interval between radiological controls.

The important point in simple transverse or short oblique diaphyseal forearm fractures is the use of interfragmentary compression. The stability of the fixation determines the speed of primary bone healing in A-type fractures (*1,4,10,13*).

In the study presented we observed no non-unions. When we compared the consolidation time in the DCP and LCP groups, we observed an 11 week difference in favour of the DCP group. We believe that axial compression was the main factor contributing to healing time. When we re-analysed the groups in terms of compression versus non-compression, we found that compression shortened the time to definite bony union by 10 weeks.

CONCLUSION

Based on the results we conclude that the difference in healing time in simple A-type forearm fractures does not depend on the type of plate used, but on its proper use. As axial compression seems to be important in these fractures, the LCP would seem to offer little, if any, technical advantage over the standard DCP.

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