



Plate fixation of clavicle fractures : A comparative study between Reconstruction Plate and Dynamic Compression Plate

Rizwan SHAHID, Abid MUSHTAQ, Mohammad MAQSOOD

From Lincoln County Hospital, Lincoln, United Kingdom

This study aimed at comparing the results of clavicular fracture fixation with AO Reconstruction (Recon) plate and Dynamic Compression Plate (DCP).

The case notes of 39 patients with 40 acute and chronic clavicular fractures were retrospectively reviewed. The indications for fixation for acute cases comprised open fractures, the presence of sufficient skin tenting to risk skin integrity, neurovascular compromise and severe lateral displacement or comminution. Cases of symptomatic atrophic non-union after at least 12 months conservative management or previous failed 1/3 tubular plate fixation were also included in the study.

In total 24 fractures were fixed with Recon Plate and 16 with DCP. Mean time to union was 4.2 months for the Recon plate group and 5.4 months for the DCP group. Eight of the DCP group complained of plate prominence requiring plate removal.

Recon plates should be used in preference to DCP whenever clavicular fracture fixation is indicated.

Keywords : clavicle fractures ; plate fixation.

fully with one of several conservative methods. Many have residual deformity as either shortening or a lump, yet this results in minimal loss of function, cosmesis and activity level. When symptoms such as pain or limitation of shoulder function do occur, they may be disabling. Studies have shown plate fixation with bone graft as a reliable management method for clavicular fractures (3, 6). The internal fixation provided is usually so secure that early mobilisation can be commenced (7).

In our study the indications for ORIF were symptomatic atrophic non-union, neurovascular compromise, skin tenting, open and severely comminuted fractures. Other indications include a floating shoulder associated with an unstable scapular fracture and poly-trauma when early mobility is desirable (10).

We aimed to compare the results of clavicular fracture fixation with Recon plate and DCP.

INTRODUCTION

Clavicular fractures are common, comprising 5% of all fractures. They involve all age groups and account for up to 44% of all shoulder girdle injuries. They seldom require open reduction and internal fixation (ORIF). Most are treated unevent-

-
- Rizwan Shahid, MD, Senior House Officer.
 - Abid Mushtaq, MD, Senior House Officer.
 - Mohammad Maqsood, Consultant Orthopaedic Surgeon.
Lincoln County Hospital, Lincoln, United Kingdom.
- Correspondence : Mr Rizwan Shahid, 2/1, Rowan House, St Annes Close, Lincoln LN2 5RL, United Kingdom.
E-mail : dr_rizwan@hotmail.com.
© 2007, Acta Orthopædica Belgica.
-

MATERIALS AND METHODS

We retrospectively reviewed the case notes of 39 patients with 40 clavicular fractures who had undergone ORIF at the Diana Princess of Wales hospital over an 8 years period (December 1989 – January 1997).

The indications for fixation for acute cases comprise of open fractures, the presence of sufficient skin tenting to risk skin integrity, neurovascular compromise and severe lateral displacement or comminution. Cases of symptomatic atrophic non-union (the absence of callus formation in the presence of persistent pain and reduced mobility) after at least 12 months conservative management or previous failed 1/3rd tubular plate fixation were also included in the study.

The same surgeon performed all the procedures. Patients were placed in a reclined supine position with a sand bag under the scapula. The fracture was exposed and reduced through an anterior incision at the lower clavicular border. This avoided a scar directly over the clavicle and any potential wound problems. The position was held with lag screws as necessary. The fractures were fixed with either a single AO 3.5 mm titanium Recon plate or AO 3.5 mm DCP of appropriate length and 3.5 mm screws. The plates were contoured and applied along the superior aspect of the clavicle. Plates of 5-12 holes length were used and a minimum of 3 screws inserted into the lateral fragment.

Autogenous bone graft was used in all cases of atrophic non-union, revision procedures and in those deemed as severely comminuted. Where length was required, bone graft was interposed between the refreshed fracture ends ; otherwise it was packed around the fracture site.

The patients were rested in a broad arm sling until the 3rd postoperative day. Gentle passive mobilisation supervised by a physiotherapist was then commenced. All were reviewed as outpatients at 6 weeks, 3 months and at regular intervals thereafter until fracture union, i.e. the restoration of a painless normal range of movement with radiographic evidence of adequate callus formation.

RESULTS

The selected sample of 39 patients comprised 24 men and 15 women with a median age of 31 years (range : 18 to 77). This represents 1.5% of all clavicular fractures treated at the Diana Princess of Wales hospital over the eight years. All patients fulfilling the operative indications underwent

ORIF. Both acute and chronic cases were reviewed. One patient had bilateral clavicular fractures producing 40 cases in total (table I).

There were 11 cases of symptomatic atrophic non-union of greater than 12 months duration. Six cases involved the lateral third and five the middle third of the clavicle. The mean time from injury to operation was 14 months (range : 12 to 20). They all underwent ORIF with bone grafting, 7 with the Recon plate and 4 with DCP.

The 29 acute clavicular fractures were subdivided according to the location of injury. The mean time from injury to operation was 2 days (range : 0 to 5).

The single medial-third clavicular fracture was displaced and was tenting the skin sufficiently to warrant fixation. This was performed with a Recon plate.

There were 3 clavicular fractures of the middle third. One was complicated by skin tenting and was fixed with a Recon plate (fig 1). Two had neurological signs consistent with brachial plexus posterior cord compression. One underwent Recon plate and the other DCP fixation. They both achieved full neurological recovery after the operation.

The remaining 25 clavicular fractures involved the lateral third (fig 2). Five were compound fractures. Two had Recon plate and 3 DCP fixation. A further 5 were revision cases following failure of previous fixation, either single or double-stacked 1/3rd tubular plate (3 and 2 cases respectively). The mean time from injury to re-operation was 10 months (range : 6 to 14). They all underwent ORIF with Recon plate and bone grafting.

There were 15 cases of severely displaced or comminuted fractures of the lateral third of the clavicle. Seven had Recon plate fixation of which 3 were bone grafted and 8 DCP, of which 4 were grafted. One patient had bilateral fractures, both causing tenting of the skin. In this group of 25 lateral third clavicular fractures, 12 underwent bone grafting.

In total 24 fractures were fixed with Recon plate and 16 with DCP. There were no wound complications and within three months, 15 fractures had united leaving the patients symptom free. Mean

Table I. — Summary of results

		No.	SEX	AGE	PLATE	BONE GRAFT	OP TIME DAYS	UNION TIME MONTHS	PLATE REMOVAL MONTHS
ATROPHIC NON-UNION	MID 1/3	1	M	37	RECON	Y	544	7	
		2	F	36	RECON	Y	515	7	
		3	M	24	RECON	Y	372	8	
		4	F	22	DCP	Y	361	10	20
		5	M	27	DCP	Y	380	9	
	LAT 1/3	6	M	24	RECON	Y	378	6	
		7	M	37	RECON	Y	374	8	
		8	F	21	RECON	Y	362	8	
		9	M	42	RECON	Y	422	7	
		10	F	30	DCP	Y	605	9	12
		11	M	33	DCP	Y	394	9	14
MED1/3	12a	F	32	RECON	N	1	4		
MID 1/3	13a	M	28	RECON	N	1	2		
	14b	F	36	RECON	N	0	2		
	15b	M	34	DCP	N	0	4		
LAT 1/3 CLAVICULAR FRACTURE	Compound	16	F	34	RECON	N	1	4	
		17	M	28	RECON	N	0	6	
		18	M	77	DCP	N	1	5	
		19	F	36	DCP	N	2	6	14
		20	M	20	DCP	N	1	6	
	Revision	21c	F	40	RECON	Y	306	4	
		22d	F	41	RECON	Y	247	3	
		23c	M	36	RECON	Y	364	3	
		24d	M	22	RECON	Y	173	2	
		25d	M	28	RECON	Y	183	2	
	Acute	26e	M	27	RECON	Y	3	3	
		27e	F	22	RECON	Y	3	2	
		28f	M	33	RECON	Y	1	3	
		29f	F	36	RECON	N	4	2	
		30e	M	18	RECON	N	5	3	
		31f	F	40	RECON	N	1	2	
		32f	M	50	RECON	N	0	3	
		33f	M	44	DCP	Y	2	3	8
		34e	M	19	DCP	Y	1	5	
		35f	F	18	DCP	N	5	4	9
36f	F	21	DCP	N	4	3	7		
37f	M	22	DCP	N	5	4			
38f	M	24	DCP	N	4	5	12		
39a	M	20	DCP	Y	1	4			
40a	M	20	DCP	Y	1	4			

Footnote :

a : Skin tenting ; b : Neurovascular deficit ; c : Failed double stacked 1/3 tubular plate ; d : Failed single 1/3 tubular plate ; e : Severely comminuted fracture ; f : Severely displaced fracture.



Fig. 1. — a : Multifragmentary fracture of the middle third of the left clavicle. b : Radiograph after open reduction and internal fixation with a Recon plate.



Fig. 2. — a : Fracture of the lateral third of the right clavicle. b : Radiograph 3 months after open reduction and internal fixation with a Recon plate.

time to union was 4.2 months (range : 2 to 8) for the Recon plate group and 5.4 months (range : 3 to 10) for the DCP group. By 12 months all patient had attained a pre-injury level of activity.

Of the 16 patients who had DCP fixation, 8 (50%) complained of plate prominence at 6-month review. They underwent plate removal at a second operation an average of 12 months (range : 7 to 20) post initial surgery. There were no such complaints from the Recon plate group.

DISCUSSION

Both plates provided sufficient rigid fixation to allow fracture healing with or without bone graft (4). The Titanium Recon plate exhibits good tissue tolerance and may be safely left *in situ*. It has a low elastic modulus and can be readily moulded

to conform to the configuration of the fracture and the unique anatomic features of the clavicle. It is also considerably lighter and thinner than the DCP but still able to tolerate the multidirectional mechanical forces across the fracture site. It is well tolerated by the patients (8). There were no reported problems of prominence requiring removal (9). In contrast 50% of the DCPs required removal at a second operation (1).

Recon plates also have a greater number of holes per unit length providing more secure fixation in the lateral fracture fragment. This is of vital importance in lateral-third clavicular fractures which act as a different clinical entity altogether (2).

The mean time to healing was less with the Recon plate, even in cases of atrophic non-union or revision procedures where previous fixation had failed. This may be due to its hexagonal construct

that allows the formation of vascular bridges across the fracture site and thus aids healing, a scenario not dissimilar to the concept of the Low Contact DCP (5). This study well demonstrates the operative versatility possible with the Recon plate.

Allowing for the constraints of a small sample size, we are still able to formulate some conclusions. We recommend that Recon plate should be used in preference to DCP whenever ORIF is indicated with clavicular fractures. Not only is the procedure technically less difficult but also the time to fracture union and return to function is reduced. The need for a second operation to remove the hardware is also avoided. Bone graft is essential in all cases of atrophic non-union.

REFERENCES

1. **Ebraheim NA, Mekhail AO, Darwich M.** Open reduction and internal fixation with bone grafting of clavicular non-union. *J Trauma Injury Inf Crit Care* 1997 ; 42 : 701-704.
2. **Edwards DJ, Kavanagh TG, Flannery MC.** Fractures of the distal clavicle : A case for fixation. *Injury* 1992 ; 23 : 44-46.
3. **Launrsen MB, Dossing KV.** Clavicular non-unions treated with compression plate fixation and cancellous bone grafting : the functional outcome. *J Shoulder Elbow Surg* 1999 ; 8 : 410-413.
4. **Manske DJ, Szabo RM.** The operative treatment of mid-shaft clavicular non-union. *J Bone Joint Surg* 1985 ; 67-A : 1367-1371.
5. **Mullaji AB, Jupiter JB.** Low-contact dynamic compression plating of the clavicle. *Injury* 1994 ; 25 : 41-45.
6. **Olsen BS, Vaesel MT, Sojbjerg JO.** Treatment of mid-shaft clavicular non-union with plate fixation and autologous bone grafting. *J Shoulder Elbow Surg* 1995 ; 4 : 337-344.
7. **Poigenfurst J, Rappold G, Fischer W.** Plating of fresh clavicular fractures : Results of 122 operations. *Injury* 1992 ; 23 : 237-244.
8. **Shen WJ, Liu TJ, Shen YS.** Plate fixation of fresh displaced mid-shaft clavicle fracture. *Injury* 1999 ; 30 : 497-500.
9. **Wentz S, Eberhardt C, Leonhard T.** Reconstruction plate fixation with bone graft for mid-shaft clavicular non-union in semi-professional athletes. *J Orth Sci* 1999 ; 4 : 269-272.
10. **Zenni EJ Jr, Krieg JK, Rosen MJ.** Open reduction and internal fixation of clavicular fractures. *J Bone Joint Surg* 1981 ; 63-A : 147-151.