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ORIGINAL ARTICLE

Hand numbness and carpal tunnel syndrome after volar plating of distal radius fracture

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Abstract We report the incidence of late onset post-operative carpal tunnel syndrome (late carpal tunnel syndrome) and late median nerve neuropathy after volar plating of distal radius fracture by conducting a retrospective study on volar plating for distal radius fracture performed during 2002 to 2006. Two hundred eighty-two volar plating were performed for acute distal radius fracture after exclusion. Post-operative hand numbness occurred in 24 patients of which nine had carpal tunnel syndrome. Thus, the incidence of late carpal tunnel syndrome was 3.2% (9/282). Of the eight (8/24, 33%) patients with post-operative hand numbness that failed to respond to conservative treatment, five had carpal tunnel release and three had neurolysis of median nerve at distal forearm. All had clinical improvement except in one patient. The incidence of late carpal tunnel syndrome after volar plating of distal radius in the present series is similar to the prevalence of carpal tunnel syndrome in general population. The incidence is low compared with other series, regardless of treatment method (conservative treatment, volar or dorsal plating). The outcome of post-operative hand numbness is generally favourable.

Keywords Distal radius fracture · Median nerve neuropathy · Carpal tunnel syndrome · Volar plate · Treatment outcome

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Introduction

Open reduction and internal fixation is becoming more popular with the emphasis on alignment for good functional recovery, and it is more ready to fix unstable fractures. Dorsal plating has high incidence of extensor tendon complications [11], while volar plating has less soft tissue complications. The recent development of locking distal radius plate has increased in open reduction with internal fixation in volar approach. Such volar locking plate is also useful in the treatment of dorsally displaced distal radius fracture and comminuted osteoporotic intra-articular fracture.

The incidence of median nerve complication is of particular concern in volar plating for distal radius fracture. In this study, we report the incidence of hand numbness, carpal tunnel syndrome and outcome of median nerve neuropathy after volar plating of distal radius fracture.

Method and Materials

This is a retrospective review of all volar plating performed for distal radius fracture from January 2002 to December 2006 in two regional hospitals in Hong Kong. The volar distal radius was approached through the sheath of the flexor carpi radialis tendon. Choice of implant (3.5-mm T-shaped locking plate and non-locking plate) depended on fracture pattern. In general, locking plates were use in intra-articular, dorsally displaced fracture or osteoporotic fracture. Non-locking plates were use in extra-articular or volarly displaced fracture. We searched the electronic database using keywords of distal radius fracture, open reduction and internal fixation of radius fracture, carpal tunnel release or neurolysis. We also reviewed all medical notes (hospital and out-patient clinic record), operative records and radiographs. The inclusion criteria were

Table 1 Age and sex breakdown of result.

Age	Volar plating		Late carpal tunnel syndrome			
	Female	Male	Female		Male	
<25	1	9	0	0%	0	0%
25–34	3	4	0	0%	0	0%
35–44	8	16	0	0%	1	6.3%
45–54	42	38	1	2.4%	0	0%
55–64	36	17	3	8.3%	2	11.8%
65–74	56	11	2	3.6%	0	0%
75 or above	37	4	0	0%	0	0%
Total	183	99	6	3.3%	3	3.0%

age 18 or above, distal radius fracture with volar plating performed. The exclusion criteria were pre-existing carpal tunnel syndrome before injury, carpal tunnel release at index operation due to compartment syndrome or as part of surgical approach during open reduction and plating. These patients were having more high-energy trauma, which may cause injury to median nerve.

Patients were reviewed in the specialist out-patient clinic by orthopaedic team members, which ranged from 1 to 5 years. Symptoms of hand numbness, wrist pain, signs of carpal tunnel syndrome such as Phalen's test, Tinel sign and thenar wasting were noted. Results of nerve conduction study are also noted. Union of fracture was assessed by serial radiograph.

All patients that complained of hand numbness were noted. Patient with post-operative hand numbness were divided into two groups. We defined late carpal tunnel syndrome based on symptomatology or electrophysiological study. Patients who had numbness over median nerve territory (radial three and a half digits), and one of the positive signs (Tinel sign, Phalen's test or thenar wasting) of carpal tunnel syndrome, or confirmed by nerve conduction test were included in late carpal tunnel syndrome group. Patients with numbness not in median nerve territory or with forearm involvement were regarded to have late median nerve neuropathy due to scarring over forearm surgical wound.

Statistical analysis was performed by using SPSS software. One-sided Fisher's exact test was used to compare the hand numbness and carpal tunnel syndrome after volar plating with locking plate and non-locking plate.

Result

A total of 300 volar plating of distal radius were performed in the specified period. Eighteen fractures were excluded: one distal radius fracture nonunion, six pre-existing carpal tunnel syndrome before fracture (a patient with bilateral wrist fracture), five primary carpal tunnel release as part of surgical exposure and another six primary carpal tunnel release at the index operation (three for acute carpal tunnel syndrome and three for compartment syndrome). After exclusion, a total of 282 patients were included for analysis of post-operative hand numbness. There were 99 males and 183 females, with age that ranged from 24 to 90. Two hundred sixteen locking plates were performed for intra-articular fracture or osteoporotic fracture. Sixty-six non-locking plates were performed for extra-articular fracture.

Of the 282 patients, 24 had post-operative hand numbness after volar plating. None of these 24 patients have diabetes mellitus, thyroid disorder, renal failure, etc. as risk factor of neuropathy. Within this group, nine patients had late carpal tunnel syndrome, and 15 patients had late median nerve neuropathy. In summary, the incidence of all post-operative hand numbness was 8.5% (24/282), late carpal tunnel syndrome was 3.2% (9/282), and late median nerve neuropathy was 5.3% (15/282). The incidence of late carpal tunnel syndrome in female and male were 3.3% and 3%, respectively. The detail breakdown of age and sex with respect to the late carpal tunnel syndrome is shown in Table 1. The incidence of all post-operative hand numbness in locking plate group was significantly higher ($p<0.05$) than that of the non-locking plate—10.2% (22/216) vs. 3.03% (2/66). The incidence of late carpal tunnel syndrome after volar plating with locking plate was 4.17% (9/216),

Table 2 Summary of operative treatment for late carpal tunnel syndrome.

Sex/ age	Fracture classification (AO)	Onset interval (month)	Presentation	Carpal tunnel release, operative findings	Outcome
F/68	A3	2	Hand numbness and wasting	Scar adhesion	Improved
M/61	C2	2	Hand numbness and weakness, delay NCV	Scar adhesion, carpal tunnel constriction	Improved
M/41	C1	3	Bilateral CTS in NCT	Narrow carpal tunnel	Same
F/60	A3	7	Specific hand numbness	Carpal tunnel constriction	Improved
F/66	C2	2	Specific hand numbness	Carpal tunnel constriction	Improved

Table 3 Summary of operative treatment for late median nerve neuropathy.

Sex/ age	Fracture classification	Onset interval (months)	Presentation	Neurolysis OT findings	Outcome
F/40	C2	2	Wrist numbness	Scar adhesion	Improved
F/57	C2	2	Palm numbness	Scar adhesion	Improved
F/57	A1	7	Wrist numbness	Scar adhesion	Improved

NCV nerve conduction velocity, *NCT* nerve conduction test, *CTS* carpal tunnel syndrome

while no carpal tunnel syndrome was noted in the group of volar plating with non-locking plate; but, this was statistically insignificant ($0.1>p>0.05$).

Of the 24 patients with post-operative hand numbness, 16 (66.7%) patients responded to conservative treatment (splintage, vitamin supplement or regular observation), and eight (33.3%) patients had operations (five had carpal tunnel release and three had neurolysis of median nerve without carpal tunnel release). After operation, seven patients had improvement of symptoms.

Table 4 Incidence of carpal tunnel syndrome in different treatment method of distal radius fracture.

Author	CTS	Sample	CTS incidence (%)
Conservative treatment of distal radius fracture			
Cooney [4]	40	565	7
Stewart [19]	25	209	12
Aro [1]	14	166	8.4
Hove [9]	23	542	4.2
Young [21]	3	25	12
Young [22]	0	50	0
Bienek [3]	12	60	20
Total	117	1617	7
Volar plating of distal radius fracture			
Mehara [13]	4	39	10
Jupiter [12]	6	49	12
Zoubos [23]	0	35	0
Hove [10]	0	31	0
Odumala [15]	17	69	23
Musgrave [14]	2	32	6
Wong [20]	2	30	13
Ruch [17]	2	17	14
Total	33	326	10.1
Dorsal plating of distal radius fracture			
Fawzy [6]			17

LP locking plate, *CTS* carpal tunnel syndrome

Table 5 Prevalence of carpal tunnel syndrome in general population compare with current study.

	General population [2]				Study population
	Pain, numbness or tingling (%)	Clinically certain (%)	Clinically and NCT confirmed (%)	Overall (%)	
Women	17.3	4.6	3.0	4.6	3.3% (6/183)
Men	10.4	2.8	2.1	2.8	3.2% (3/99)
Total	14.4	3.8	2.7	3.8	3.2% (9/282)

For patient with late carpal tunnel syndrome characterised by specific signs and symptoms or nerve conduction study confirmed, four patients responded to conservative treatment (splintage, vitamin supplement or regular observation), and five patients received operative treatment. Intra-operative findings showed carpal tunnel narrowing and constriction of the median nerve. Carpal tunnel release was performed, and all patients had improvement except one patient who had electrophysiological suggestions of bilateral carpal tunnel syndrome on nerve conduction test and inappropriate illness behaviour shown in functional capacity evaluation (Table 2).

For patient with late median nerve neuropathy characterised by numbness over hand with or without forearm involvement, three out of 15 patients received operative treatment. All had scar adhesion over median nerve in forearm region. All improved after neurolysis of median nerve without carpal tunnel release and removal of implant except one patient who had residual numbness over middle finger (Table 3).

Discussion

The incidence of late carpal tunnel syndrome after volar plating reported in our series was 3.2%. In literature, the incidence of carpal tunnel syndrome with conservative treatment for distal radius fracture was reported as 7%, which ranged from 0% to 20% [1, 3, 4, 9, 16, 20, 22, 23] (Table 4). There are few papers in recent literature concerning carpal tunnel syndrome after volar plating of

Table 6 Incidence of all post-operative hand numbness and carpal tunnel syndrome in different plate.

	Locking plate		Non-locking plate		*p* value
All post-operative hand numbness	22	10.2%	2	3.03%	0.049
Carpal tunnel syndrome	9	4.17%	0	0%	0.087
Total	216	66			

distal radius fracture. The average incidence after volar plating was 10.1%, which ranged from 0% to 23% [10, 12–18, 21]. The sample size of these series ranged from 17 to 69, which is much smaller than 282 in our series. The incidence of late carpal tunnel syndrome reported in our series was 3.2%, which is lower than other similar series. The pathophysiology of carpal tunnel syndrome after distal radius fracture has been studied by various authors [5, 7, 8, 19]. Causes include oedema and haematoma from injury, local anaesthetic solution injection, closed reduction and manipulation, flexion position of the wrist and surgical trauma from surgery. Prevalence of carpal tunnel syndrome in general population was reported as 3.8% [2]. The incidence of late carpal tunnel syndrome after volar plating reported in our series was 3.2%. Thus, the incidence of late carpal tunnel syndrome after volar plating is similar to general population reported (Table 5).

In our study, there is a statistically significant higher incidence of post-operative hand numbness and a trend of higher incidence of carpal tunnel syndrome after volar plating using locking plate compared with using non-locking plate. This may due to more distal position of locking plate, which are often used in intra-articular fracture. The retraction of tissue when putting this distally placed locking plate can also cause median nerve paresthesia (Table 6).

Besides carpal tunnel syndrome, neuropathy arising from scar adhesion of median nerve at the surgical wound will also cause post-operative hand numbness. The outcome of operative treatment for carpal tunnel syndrome or median nerve neuropathy from scar adhesion is generally favourable.

The limitations of the current study are as follows. It is not a prospective randomised control study. The operation and follow-up assessment was performed by different surgeons, and the interval of follow-up was not standardised. Outcome measurement is mainly based on patient symptomatology, and not all patients have electrophysical assessment.

Conclusion

The result from our study showed that the incidence of late carpal tunnel syndrome after volar plating of distal radius fracture is similar to general population. The incidence is lower than that previously reported in other series of distal radius fracture, regardless of the treatment method (conservative treatment, open reduction and plating). Post-operative hand numbness has a favourable outcome as shown in our study; 66.7% (16/24) patients respond to conservative treatment, and of the eight that required carpal tunnel release or neurolysis of median nerve, only one did not have their symptoms improved.

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