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Complications after Open Reduction and Internal Fixation of Olecranon Fractures: Elderly vs Young

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Abstract

Background

Although tension band wiring (TBW) is used commonly for simple olecranon fractures, we often encounter redisplacements in the elderly. We hypothesized that elderly patients have more complications after olecranon fracture operations than young patients. Therefore, we compared outcomes of these procedures including complications in young and elderly patients.

Methods

We retrospectively investigated outcomes including complications of 31 patients aged ≧65 years and 40<65 years who underwent olecranon fracture operations at two hospitals. Average follow-up was 10 months. Complications included redisplacement (fracture site displaced ≧2 mm), non-union and infection. We statistically compared the outcomes of TBW (simple TBW and ring pin) and locking plate between elderly and young patients.

Results

Redisplacement occurred in 21 elderly patients (67%), 2 of whom (6%) had huge displacements resulting in nonunion. The postoperative redisplacement rate using TBW in the elderly was significantly higher than that in young patients (71% vs 27%, $p<0.001$). The postoperative redisplacement rate using locking plate in the elderly was not significantly higher than in young patients (33% vs 10%, $p=0.07$). There was no statistically significant difference in redisplacement rate and distance among simple TBW, ring pin and locking plate. We confirmed no deep infections, but only superficial infection in one patient in each group.

Conclusions

Elderly patients had more complications after olecranon fractures, including redisplacement rate and distance, especially when TBW was used. However, there were no statistically significant differences in redisplacement rate and distance among the implants.

Key Words: Fracture: Olecranon; Complication; Elderly patient; Osteoporosis; Displacement

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Introduction

With an increasingly aging society, fracture fixation modalities for patients with osteoporotic bone are changing. Although tension band wiring (TBW) is used commonly for simple olecranon fractures, some reports recommend plate or suture anchor fixation for highly comminuted fractures in the elderly. Complications such as redisplacement, infection and non-union may lead the loss of function and some cases may relate in the mortalities of the elderly[1-4]. We report outcomes including complications of olecranon fractures in the elderly compared to those of young patients. We hypothesized that elderly patients have more complications after surgical operations of olecranon fractures than young patients.

Methods

We received institutional review board approval for this study. We used electronic medical charts to identify 96 patients who underwent surgery for olecranon fractures between January 2011 and December 2016 at our hospital and another related hospital. All charts were reviewed in 71 patients (37 men, 34 women). We divided the patients into two groups, Group O aged ≧65 years (31 patients) and Group Y aged <65 years (40 patients). Average age at surgery was 58 years (range, 15-95). Minimum follow-up period was 6 months postoperatively. We excluded patients who showed no range of motion (ROM) data at the final follow-up. The right and left sides were affected in 21 and 50 patients, respectively. Average follow-up period was 10 months (range, 6-17). According to the Mayo classification[5], one patient had Type Ⅰ, 27 Type ⅡA, 38 Type ⅡB, and five Type ⅢB fractures. All patients with Types Ⅰ and ⅡA fractures were treated with TBW. Types ⅡB and ⅢB fractures were treated with locking plate in 13 patients and TBW in 30 patients (Table 1). Simple TBW, ring pin (TBW with eyelet preventing wire backout), and three kinds of locking plates were used. Although we usually chose locking plates for highly comminuted fractures, the implants were chosen according to the operators' preference. We usually used splint for 1 or 2 weeks after surgery. Redisplacement was defined when the fracture site was displaced ≧2 mm postoperatively on a plain X-ray examination[6]. Redisplacement distance was defined as the gap between fracture fragments, and we calculated the average values of redisplacement cases.

We investigated complications including redisplacement rate and distance as primary outcomes. We statistically compared the outcomes of TBW and locking plate between groups O and Y. Furthermore, we statistically compared the outcomes of TBW only for simple fractures (Type Ⅰ and ⅡA). We also investigated the redisplacement rate and distance statistically for three different implants (TBW, ring pin, and locking plate). Secondary outcomes were active ROM of the elbow at final follow-up and other complications, such as non-union, implant irritation, reoperation and infection. Statistical analyses were performed with Fisher's exact test, Mann–Whitney U test and Kruskal-Wallis test. All statistical analyses were performed with EZR, which is for R. More precisely, it is a modified version of R commander designed to add statistical functions frequently used in biostatistics. $P<0.05$ was considered statistically significant.

Results

Demographic data were not statistically significantly different between the groups. Follow-up was longer in group Y (Tables 1 and 2). Redisplacement rates in cases using TBW were 71% in group O and 27% in group Y ($p<0.001$). Redisplacement rates in cases using TBW for simple fracture were

Table 1. Mayo classification

	≧65 y	<65 y	Total
Type Ⅰ	0 (0%)	1 (2.5%)	1
Type Ⅱ A	15 (48.4%)	12 (30%)	27
Type Ⅱ B	14 (45.2%)	24 (60%)	38
Type Ⅲ B	2 (6.5%)	3 (7.5%)	5
			* p=0.384

TBW (simple TBW and TBW with eyelet)

	≧65 y	<65 y	Total
Type Ⅰ	0 (0%)	1 (3.3%)	1
Type Ⅱ A	15 (53.6%)	12 (40%)	27
Type Ⅱ B	12 (42.9%)	15 (50%)	27
Type Ⅲ B	1 (3.6%)	2 (6.7%)	3
			* p=0.618

Locking plate

	≧65 y	<65 y	Total
Type Ⅰ	0 (0%)	0 (0%)	0
Type Ⅱ A	0 (0%)	0 (0%)	0
Type Ⅱ B	2 (66.6%)	9 (90%)	11
Type Ⅲ B	1 (33.3%)	1 (10%)	2
			* p=0.423

* Fisher's exact test. TBW, tension band wiring.

Table 2. Demographic data, follow-up period, complications and ROM

		Group O	Group Y	p value
Sex	Male	19	15	* 0.058
	Female	12	25	
Affected side	Right	10	29	* 0.794
	Left	21	11	
Implant	TBW	14	16	* 0.252
	Ring pin	14	14	
	Plate	3	10	
Follow-up		8 M	10 M	** 0.02
Rediplacement rate		64%	23%	* <0.001
Rediplacement distance		3 mm	2 mm	** 0.16
ROM	flexion	140°	140°	** 0.285
	extension	8°	10°	** 0.04
non-union		2	0	
irritation		1	0	
reoperation		3	1	
infection		1	1	

* Fisher's exact test, ** Mann-Whitney U test. M, month; ROM, range of motion; and TBW, tension band wiring.

66% in group O and 23% in group Y (p=0.03). Redisplacement rate in cases using locking plate was not significantly different between group O and Y (Table 3).

Displacement occurred on an average of 1.9 weeks after surgery. Redisplacement distance in cases using TBW was 4.8 mm in group O and 3.3 mm in group Y (p=0.281), and redisplacement distance in cases using TBW for simple fracture was 5.1 mm in group O and 2 mm in group Y (p=0.019) (Table 3). Redisplacement rate and distance were not significantly different among TBW, ring pin, and locking plate (Table 4). Although ROMs of flexion were not significantly different between the groups, ROMs of extension in group O were significantly worse than those in group Y (Table 2).

Two patients in group O had huge displacements resulting in non-union without reoperation. Reoperation was not possible in one because of multiple general diseases, while the other refused reoperation. Redisplacement occurred in 2 cases of plate fixation and 28 cases of TBW. Reoperation was performed for three patients in group O and one in group Y. We confirmed no deep infections, but only superficial infection in one patient in each group (both recovered with use of oral antibacterial agents).

Two cases of complications after surgical operations are presented. Patient 1 is an 84-year-old woman sustained a Type ⅡA fracture fixed using TBW. Wire back-out from the bone fragment occurred at 1 month postoperatively. Reoperation was performed because of skin irritation. The wire back-out reocurred, but we delayed removal of the implant after bony union was confirmed. ROM at last follow-up was −15° extension and 110° flexion (Fig. 1). Patient 2 is an 86-year-old man sustained a Type ⅡB fracture fixed using a locking plate (VA-LCP® OLECRANON PLATE 2.7/3.5). Because of poor capturing of the proximal locking screw to the bone fragment, redisplacement occurred at 1 week

Table 3. Displacement rate and distance

		Group O	Group Y	p value
TBW (simple TBW and ring pin)				
Displacement	rate	71%	27%	*<0.001
	distance	3 mm	2 mm	**0.281
TBW for simple fracture (Type Ⅰ and ⅡA)				
Displacement	rate	66%	23%	*0.03
	distance	3.5 mm	2 mm	**0.019
Locking plate				
Displacement	rate	33%	10%	*0.073

*Fisher's exact test, **Mann-Whitney U test. TBW, tension band wiring.

Table 4. Redisplacement rate and distance by each implant

Displacement	Group	TBW	Ring pin	Plate	p value
Rate	O	9 (64%)	11 (79%)	1 (33%)	*0.29
	Y	5 (31%)	3 (21%)	1 (10%)	*0.51
Distance	O	4.0 mm	2.0 mm	20 mm	**0.09
	Y	2.0 mm	2.0 mm	2.0 mm	**0.33

*Fisher's exact test, **Kruskal-Wallis test. TBW, tension band wiring.

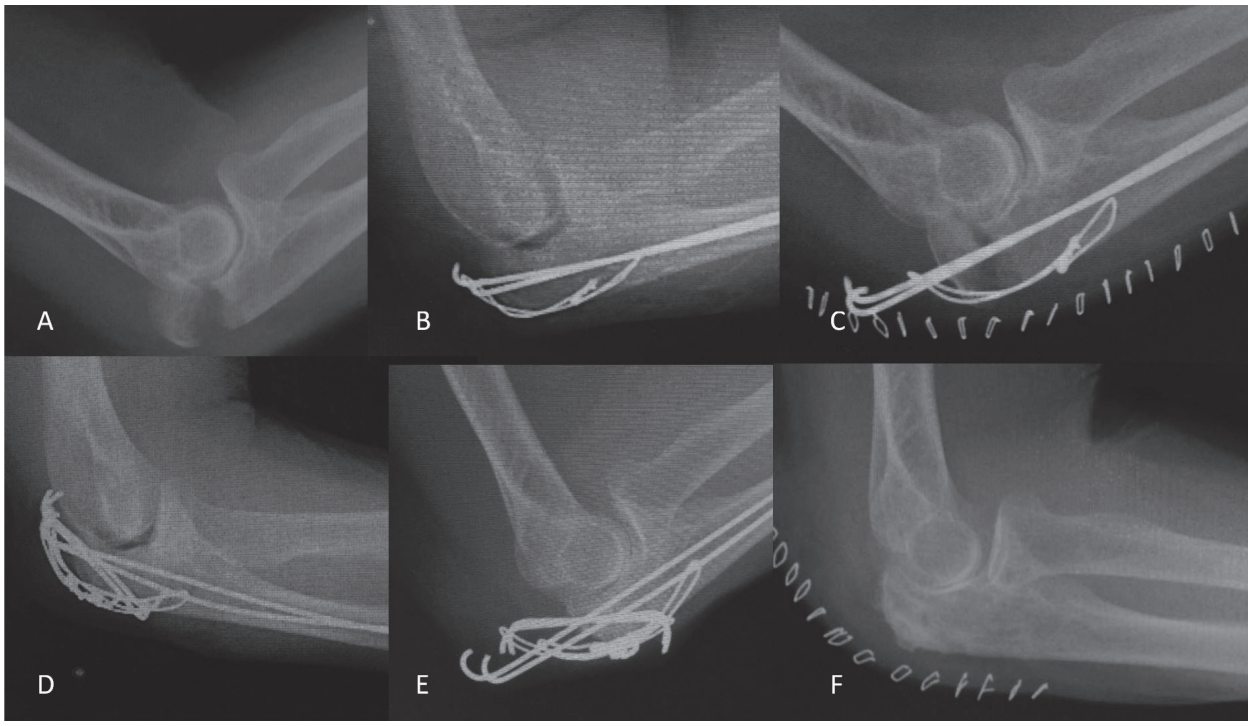

Figure 1. An 84-year-old elderly female with type ⅡA fracture. A, Preoperative X-ray. B, Immediate postoperative X-ray. C, One month postoperative X-ray. D, Immediate post-reoperation X-ray. E, Two weeks post-reoperation X-ray. F, Final follow-up X-ray.

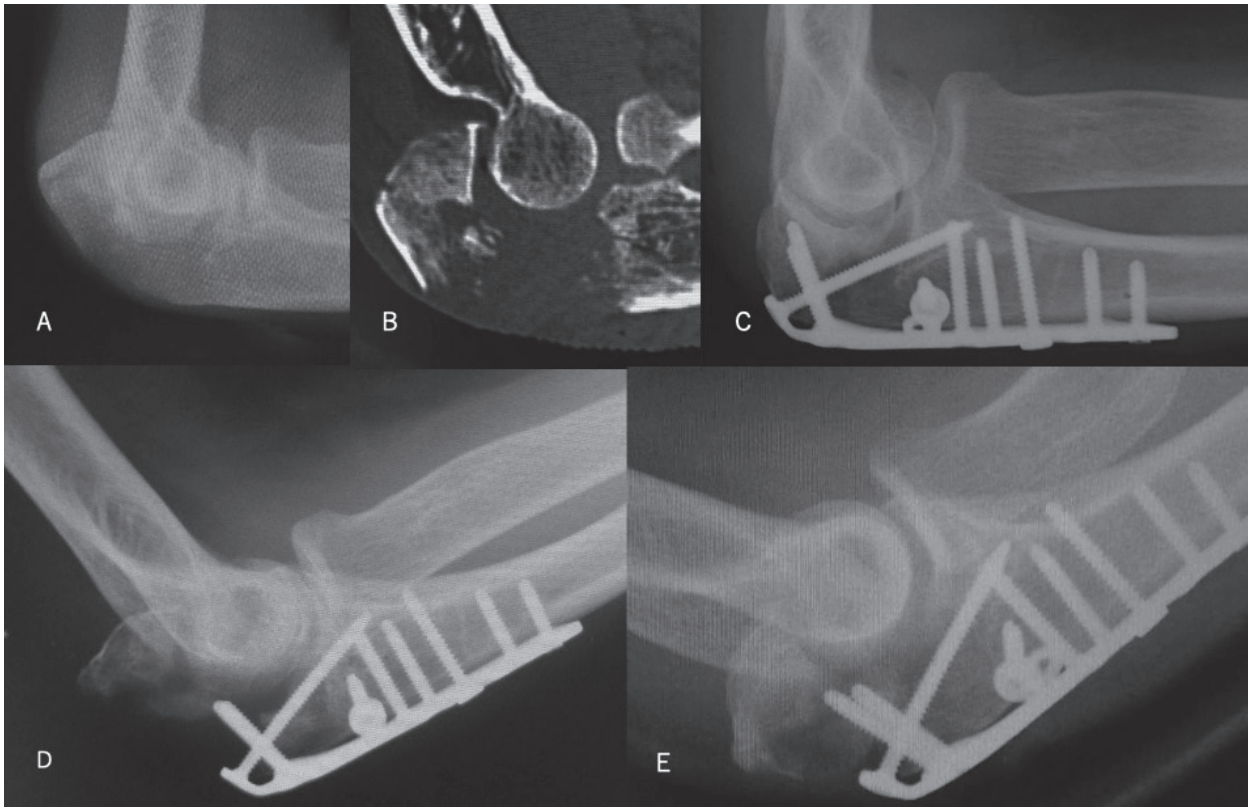

Figure 2. An 86-year-old elderly male with type ⅡB fracture. A and B, Preoperative X-ray and computed tomography. C, Immediately postoperative X-ray. D, One week postoperative X-ray. E, Final follow-up X-ray.

postoperatively. The patient refused reoperation, resulting in non-union. ROM at last follow-up was −15° extension and 145° flexion (Fig. 2).

Discussion

Olecranon fracture is not an osteoporotic fracture[7,8], but we often encounter failures after open reduction and internal fixation in the elderly with olecranon fractures. Several reports have evaluated various implants such as ring pins to prevent wire backout and nails and double plates to achieve rigid fixations. However, to our knowledge no reports compared the distance or rate of redisplacement between each implant. Which implant is best to fix osteoporotic bone has been controversial. Patients with redisplacement resulting in union recover very well, and patients with a huge redisplacement who subsequently underwent reoperation had severe contracture and worse recovery. Otherwise, patients with a huge redisplacement and resulted in non-union gained wide ROMs (Figs. 1 and 2). Whether to perform reoperation should be considered carefully.

According to our results, the redisplacement rate was higher in elderly than young patients. There was a statistically significant difference only in the rates of redisplacement in cases using TBW between in the elderly and young, but there were significant differences in both distance and rate of redisplacement in cases using TBW for simple fractures. And there were no significant differences in distance and rate of redisplacement using locking plate. Wilson et al reported that precontoured plates provide significantly greater compression than TBW in the treatment of transverse fractures of the olecranon[9]. Hume et al reported that plate fixation achieved good functional results more often than TBW in a prospective randomized study. Loss of reduction was more frequent with TBW (53%) than with plate fixation (5%)[10]. Recently, plates with multidirectional locking screws are available for comminuted olecranon fractures. We considered that the locking plate osteosynthesis is an effective and safe tool for comminuted olecranon fractures in the elderly[11-13]. However, we are concerned that surgery time may be longer and the occurrence of complications, such as infection, might be increased.

The main factor of redisplacement seemed to be our technical errors. There was a possibility of inadequate fracture fixations due to insufficient evaluation of preoperative fracture patterns. Some patients experienced immediate postoperative wire loosening. On the other hand, one patient with an ipsilateral trochanteric femoral fracture had redisplacement when she performed gait exercise of the lower extremity, although fracture fixation was strong enough. Jin et al reported that TBW using Kirschner wire with eyelets produced excellent clinical and radiographic outcomes[14]. However, no significant improvement in the post operative pain relief was observed. Similarly, in our results, there were no significant differences in redisplacement rate and distance between TBW and ring pin. Two non-union patients in our study gained wide ROM. Duckworth et al reported that nonoperative functional treatment of displaced olecranon fractures in the elderly (>70 years old) provided good results and a high rate of satisfaction[15]. Gallucci et al also reported similar results in the elderly (average age 76)[16]. Duckworth et al reported no significant difference between groups in a prospective randomized controlled trial comparing nonoperative and operative management for acute isolated displaced fractures of the olecranon in patients aged ≧75 years[17]. The postoperative rehabilitation protocol was free ROM exercise with a sling following 1 week immobilization with a cast or splint. For olecranon fractures in the elderly, in particular for severely comminuted fractures, nonoperative management might be a choice of treatment. Furthermore, operative treatment might not be chosen

in patients with comorbidities and when huge redisplacement occur, we must consider carefully whether to perform a reoperation.

This study has following limitations. At first, the sample size was small. Secondly, several operators chose different kinds of implants and method of fixations. There were many biases in statistical analyses because the fracture types were not unified.

In conclusion, the postoperative redisplacement rates of olecranon fractures using TBW in the elderly were significantly higher than those in young patients. There were no statistically significant differences in redisplacement rate and distance among three different implants.

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References

1. Bateman DK, Barlow JD, VanBeek C, et al. Suture anchor fixation of displaced olecranon fractures in the elderly: a case series and surgical technique. J Shoulder Elbow Surg 2015;24:1090-1097.
2. Cha SM, Shin HD, Kim KC, et al. Fixation of posterior process fractures of the olecranon using a modified suture bridge technique: report of 2 cases. J Hand Surg Am 2014;39:2434-2437.
3. Kiviluoto O, Santavirta S. Fractures of the olecranon: analysis of 37 consecutive cases. Acta Orthop Scand 1978;49:28-31.
4. Morwood MP, Ruch DS, Leversedge FJ, et al. Olecranon fractures with sagittal splits treated with dual fixation. J Hand Surg Am 2015;40:711-715.
5. Ates Y, Atlihan D, Yildirim H. Current concept in the treatment of fractures of the radial hand, the olecranon, and the coronoid. J Bone Joint Surg Am 1996;78:969.
6. Wolfgang G, Burke F, Buch D, et al. Surgical treatment of displaced olecranon fractures by tension band wiring technique. Clin Orthop Relat Res 1987;224:192-204.
7. Cummings SR, Kelsey JL, Nevitt MC, et al. Epidemiology of osteoporosis and osteoporotic fractures. Epidemiol Rev 1985;7:178-208.
8. Cummings SR, Melton LJ. Epidemiology and outcomes of osteoprotic fractures. Lancet 2002;359:1761-1767.
9. Wilson J, Bajwa A, Kamath V, et al. Biomechanical comparison of interfragmentary compression in transverse fractures of the olecranon. J Bone Joint Surg Br 2011;93:245-250.
10. Hume MC, Wiss DA. Olecranon fractures. A clinical and radiographic comparison of tension band wiring and plate fixation. Clin Orthop Relat Res 1992;285:229-235.
11. Edwards SG, Matrin BD, Fu RH, et al. Comparison of olecranon plate fixation in osteoporotic bone: do current technologies and designs make a difference? J Orthop Trauma 2011;25:306-311.
12. Erturer RE, Sever C, Sonmez MM, et al. Results of open reduction and plate osteosynthesis in comminuted fracture of the olecranon. J Shoulder Elbow Surg 2011;20:449-454.
13. Wagner FC, Konstantinidis L, Hohloch N, et al. Biomechanical evaluation of two innovative locking implants for comminuted olecranon fractures under high-cycle loading conditions. Injury 2015;46:985-989.
14. Kim JY, Lee YH, Gong HS, et al. Use of Kirschner wires with eyelets for tension band wiring of olecranon fractures. J Hand Surg Am 2013;38:1762-1767.
15. Duckworth AD, Bugler KE, Clement ND, et al. Nonoperative management of displaced olecranon fractures in low-demand elderly patients. J Bone Joint Surg Am 2014;96:67-72.
16. Gallucci GL, Piuzzi NS, Slullitel PA, et al. Non-surgical functional treatment for displaced olecranon fractures in the elderly. Bone Joint J 2014;96:530-534.
17. Duckworth AD, Clement ND, McEachan JE, et al. Prospective randomised trial of non-operative *versus* operative management of olecranon fractures in the elderly. Bone Joint J 2017;99:964-972.