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— Abstract —

The Results of Surgical Treatment of Comminuted Fractures of Distal humerus

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Purpose: To report the results of surgical treatment of comminuted fractures of distal humerus and to identify factors that affect the results.

Materials and Methods: Thirty-two patients who were treated with open reduction and internal fixation for comminuted fracture of distal humerus were enrolled. According to the AO classification, A2.3 was 1 case, A3.2, 2 cases, A3.3, 8 cases, B1.3, 1 case, B2.3, 1 case, C2.2, 5 cases, C2.3, 4 cases, C3.2, 3 cases and C3.3, 7 cases. As fixation technique, 17 cases were fixed by double plates, 4 cases by only K-wires, 4 cases by only screws, 3 cases by K-wires and screws and 4 cases by one plate and screws. The mean age at the time of the operation was 49 years(range, 19~77 years). The mean follow-up period was 16 months(range, 8~51 months).

Results: At the last follow-up, the mean maximum flexion was 116.4 (range, 85~140 °) and the mean loss of terminal extension was 11.8 (range, 0~40 °). The average Mayo elbow performance score was 91.4(range, 55~100). Overall 29 cases(91%) showed good to excellent results. The mean range of motion of extraarticular and intraarticular fracture group was 105 (range, 65~140 °) and 104 (range, 55~140 °), respectively. The average elbow score of both groups was 93(range, 70~100) and 90.7(range, 55~100). Over 90% showed more than good results. 30 cases(94%) showed complete bony union but two cases, nonunion. One case of the nonunion cases underwent replating with bone graft as revision surgery and total elbow arthroplasty was performed in the other case. At the last follow-up, 27 patients(84.4%) showed subjective satisfaction.

Conclusion: Open reduction and internal fixation with appropriate surgical technique for comminuted fractures of distal humerus showed good results, which were not affected by age at the time of operation, fixation methods and anterior transposition of the ulnar nerve. Transolecranon approach may be considered as good choice for intraarticular comminuted fractures of distal humerus.

Key Words: Distal humerus, Comminuted fracture, Open reduction and internal fixation

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49 (19~77)

가 3 , 가 29 , 12 ,

1% 20 가 6

5,9) , 가 23 , 가 3

가 . AO A2.3

가 가 1 , A3.2 2 , A3.3 8 , B1.3 1 ,

가 B2.3 1 , C2.2 5 , C2.3 4 , C3.2 3

7,13,14,19,26) 20 , C3.3 7 . 31

1 Gustil⁸⁾

1 , ,

가 , 5.5 (1~13

가

3,15,16)) ,

20 , 가

11 (A2.3 1 , A3.2 2 , A3.3 8)

1,2,4,6,12,18,19,21,29) , 21 (B1.3 1

가 , B2.3 1 , C2.2 5 , C2.3 4 , C3.2 3 ,

가 C3.3 7) ,

(extra-articular fracture)

(partial or complete

articular fracture)

1995 12 2004 9

가 17 (Fig. 1), K-

32 가 4 ,



Fig. 1. 37-year-old female patient with intercondylar fracture of distal humerus. (A) Preoperative radiographs showed displaced fracture extending from the groove on the articular surface of the trochlea, proximally between the condyles, and then dividing obliquely across the shaft. (B) Postoperative radiographs revealed that anatomical reduction and secure fixation was achieved with dual plate fixation using two one-third tubular plates.

가 4 , K- 가 3 Mann-Whitney test
 , 1 가 4 95%
 ,
 . 6
 가 9 104.6°
 . (55 ~ 140 °) (Fig. 2).
 116.4 °(85 ~ 140 °)
 C2.2 4 , C2.3 2 , C3.2 3 , C3.3 6 11.8°(0 ~ 40°) (Fig. 3). Cassebaum²⁾
 (complete articu- 가 9
 lar fracture) . 16 (28.1%), 가 14 (43.8%), 가 3
 (8 ~ 51) , 가 (9.4%), 6 (18.7%)
 가 23 (71.9%) (Table 1).
 Mayo 가 ²²⁾ , Mayo 가 91.4 (55-
 . 100) 가 22 (68.7%), 가 7
 (21.9%), 가 2 (6.3%), 1
 (AO A) (3.1%) , 29 (90.6%)
 (AO B, C) (Table 2).
 , ,
 . 117°(90 ~ 140°)
 가 12°(0 ~ 40°) 105°

Table 1. Cassebaum's classification for elbow range of motion

Classification	Range of motion	No. of cases
Very good	Flexion>130 °, Extension deficit<15 °	9 (28.1%)
Good	Flexion>120 °, Extension deficit<40 °	14 (43.8%)
Fair	Flexion>110 °, any extension deficit	3 (9.4%)
Poor	Flexion<110 °	6 (18.7%)

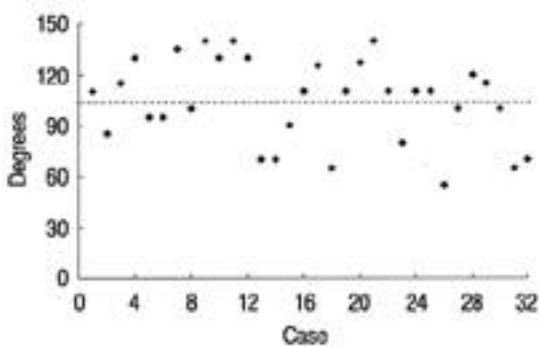


Fig. 2. Total range of motion at the last follow-up.

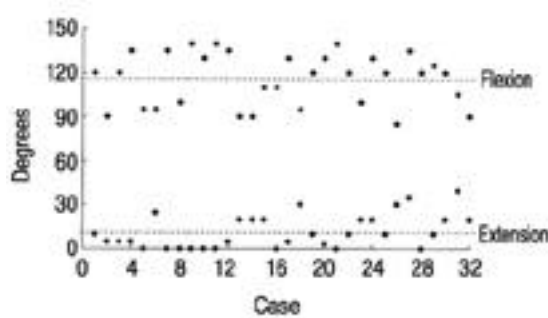


Fig. 3. Average maximum flexion and average lack of terminal extension at the last follow-up.

(65 ~ 140°) 8 (72.7%)
 . Mayo 가 가
 93 (70 ~ 100) 10 (90.9%) 111 (55 ~ 140°) , K- 가
 117 (100 ~ 135°), 가
 122 (95 ~ 140°), K- 가
 , 가 85°
 116 (85 ~ 140°), 12 (0 ~ 35°) 114 (85-140°) (P=0.130).
 104 (55 ~ 140°) 15 (71.4%)
 . Mayo
 가 90.7 (55 ~ 100) 가 89 (65 ~ 110°) , K-
 19 (90.5%) 가 80°, 가 70°, K-
 가 78 (65 ~ 90°),
 50 111° 1 가 113 (100 ~
 (70 ~ 135°) , 50 100° 130°
 (65 ~ 140°) (P=0.464), 94 (65 ~ 130°) (P=0.118).
 109.2 (55 ~ 140°), 100 (65 ~ 140°) 가
 (P=0.273). 가 86
 , K- 가 100 ,
 가 50 가 93 , K-
 92 , 50 가 95
 93 (P=0.70), 96
 91 , 90 (P=1.0). (P=0.135),
 가 가 92 , K-
 가 95 , 가 90 ,

Table 2. Mayo elbow performance score

Function	Point	Definition (points)	No. of Elbows	Mean Score
Pain	45	None (45)	24 (75%)	41.25
		Mild (30)	8 (25%)	
		Moderate (15)		
		Severe (0)		
Motion	20	Arc >100°(20)	21 (66%)	18.28
		Arc 50°~100°(15)	11 (34%)	
		Arc <50°(5)		
Stability	10	Stable (10)	32 (100%)	10
		Moderate instability (5)		
		Gross instability (0)		
Function	25	Comb hair (5)	28 (87.5%)	21.87
		Feed (5)	31 (96.8%)	
		hygiene (5)	27 (84.3%)	
		Shirt (5)	28 (87.5%)	
		Shoe (5)	26 (81.2%)	
Total	100			91.4

Classification : excellent >90, good 75-89, fair 60-74, poor <60

K- 가 73 , ^{20,23,28)} John
1 가 96 ¹²⁾ 49
89 2%
(P=0.940). 85%

가 Kinik ¹⁵⁾
46 2%
, 87.5%
가 , 77.5%

Jupiter ¹¹⁾
104 °(55 ~ 140 °), 106 ° 13 92.3%
(65 ~ 130°) (P=0.969),
가 93 , 90 (P=0.967). 가 111.9°
1985 1989 , Helfet ⁹⁾

가 가 75%
30 (93.8%) 115°
2 1 2

, 1 (6.2%)
104.6°
4 (12.5%) 가 23 (71.9%)
Mayo 가 ²²⁾

3 가 29 (90.6%)
2 1 23
84.4% (AO 1

A3.3) Gustilð ⁸⁾
2 ~ 10%
가 ^{1,13,15,17,26,30)}

가 ^{25,28)}
가 ⁸⁾

가 ³¹⁾
가 1
가 ⁵⁾ 71
(AO B2.3)

가 K-
가
^{5,13)} 20
가

가

24)

가 가 108°, 94°, 98°

86

Jupiter ¹¹⁾ 57 34 70 9 8

가

, Pereles ²⁷⁾

71 18 12

Jarkko ¹⁰⁾

18

40

100%

Jupiter ¹¹⁾

가

, 50
가 20%

가

³⁾ Jarkko ¹⁰⁾

50

50

가

가

가

4

가

^{13,28)}

, 3 (75%)가

가

가

가

가

가

^{6,13,20)} Jarkko ¹⁰⁾

66.7%

가 33.3%

(partial or complete articular fracture)

가

REFERENCES

- 1) **Caja VL, Moroni A and Vendemia V:** Surgical treatment of bicondylar fractures of the distal humerus. *Injury*, 25: 433-438, 1994.
- 2) **Cassebaum WH:** Open reduction of T and Y fractures of the lower end of the humerus. *J Trauma*, 9: 915-925, 1969.
- 3) **Cooney III WP:** Contractures of the Elbow. In Morrey BE (ed). *The Elbow and Its Disorders*. Ed 2. Philadelphia, *WB Saunders*, 464-475, 1993.
- 4) **Eralp L, Kocaoglu M and Sar C:** Surgical treatment of distal intraarticular humeral fractures in adults. *Int Orthop*, 25: 46-50, 2001.
- 5) **Evans EM:** Supracondylar Y fractures of the humerus. *J Bone Joint Surg*, 35-B: 371-375, 1953.
- 6) **Gabel GT, Hanson G and Bennett JB:** Intra-articular fractures of the distal humerus in the adult. *Clin Orthop*, 216: 99-108, 1987.
- 7) **Gupta R and Khanchandani:** Intercondylar fractures of the distal humerus in adults: a critical analysis of 55 cases. *Injury*, 33: 511-515, 2002.
- 8) **Gustilo RB:** Open fracture. In *Fractures and dislocation*. St. Louis, C.V. *Mosby*, 1993.
- 9) **Helfet DL and Schmeling GJ:** Bicondylar intraarticular fractures of the distal humerus in adults. *Clin Orthop*, 292: 26-36, 1993.
- 10) **Jarkko P and Jan-Magnus B:** Operative treatment of type C intercondylar fractures of the distal humerus: Results after a mean follow-up of 2 years in a series of 18 patients. *J Shoulder Elbow Surg*, 11: 48-52, 2002.
- 11) **Jupiter JB and Morrey BF:** Fractures of the distal humerus in adults. In: Lampert R, ed. *The Elbow and Its Disorders*, 3rd ed. Philadelphia: W. B. *Saunders*, 293-329, 2000.
- 12) **John H, Rosso R and Neff U:** Operative treatment of distal humeral fractures in the elderly. *J Bone Joint Surg*, 76-B: 793-796, 1994.
- 13) **Jupiter JB, Neff U, Holzach P and Allgower M:** Intercondylar fractures of the humerus: an operative approach. *J Bone Joint Surg*, 67-A: 226-239, 1985.
- 14) **Kaushal L, Rai J and Singh SPP:** Comminuted intra-articular fractures of the distal humerus. *Int Orthop (SICOT)*, 18: 276-279, 1994.
- 15) **Kinik H, Atalar H and Mergen E:** Management of distal humerus fractures in adults. *Arch Ortho. Trauma Sur*, 119: 467-469, 1999.
- 16) **Kino Y:** Reconstruction of 2 cases with distal humeral defect. *J Jpn Elbow Soc*, 4: 53-54, 1997.
- 17) **Kundel K, Braun W and Wieberneit J:** Intra-articular distal humerus fractures: Factors affecting functional outcome. *Clin Orthop*, 332: 200-208, 1996.
- 18) **Low CK, Wong DH and Toh CL:** A retrospective study on elbow function after internal fixation of intercondylar fracture of adult humerus. *Ann Acad Med Singapore*, 26: 168-171, 1997.
- 19) **McKee MD, Wilson TL and Winston L:** Functional outcome following surgical treatment of intra-articular distal humeral fractures through a posterior approach. *J Bone Joint Surg*, 82-A: 1701-1707, 2000.
- 20) **McKee MD and Jupiter JB:** Trauma to the adult elbow and fractures of the distal humerus. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, eds. *Skeletal Trauma: Fracture, Dislocations, Ligamentous Injuries*, Vol. 2. Philadelphia: W. B. *Saunders*; 1455-1522, 1998.
- 21) **Morrey BF:** Fractures of the distal humerus: Role of elbow replacement. *Orthop Clin North Am*, 31: 145-154, 2000.
- 22) **Morrey BF, An KN:** Functional evaluation of the elbow. In: Lampert R, ed. *The Elbow and Its Disorders*, 3rd ed. Philadelphia, London, New York, St. Louis, Sydney, Toronto: W. B. *Saunders*, 74-83, 2000.
- 23) **Muller ME, Allgower M and Schneider R:** *Manual of Internal Fixation: Techniques Recommended by the AO Group*, 2nd ed. New York: *Springer*; 71-87, 1979.
- 24) **Micahel H and Albert P:** Treatment of distal humerus fracture in the elderly. *Clin. Orthop*, 425: 55-63, 2004.
- 25) **O'Driscoll SW, Sanchez-Sotelo J and Torchia ME:** Management of the smashed distal humerus. *Orthop Clin North Am*, 33: 19-33, 2002.
- 26) **Papaoiannou N, Babis GCh and Kalavritinos J:** Operative treatment of type C intra-articular

- fractures of the distal humerus: the role of stability achieved at surgery on final outcome. *Injury*, 26: 169-173, 1995.
- 27) **Pereles TR, Koval KJ and Gallagher M**: Open reduction and internal fixation of the distal humerus: Functional outcome in the elderly. *J Trauma*, 43: 578-584, 1997.
- 28) **Ring D and Jupiter JB**: Fractures of the distal humerus. *Orthop Clin North Am*, 31: 103-113, 2000.
- 29) **Safran O, Mosheiff R, Segal D and Liebergall M**: Surgical treatment of intercondylar fractures of the humerus in adults. *Am J Orthop*, 28: 659-662, 1999.
- 30) **Sodergard J, Sandelin J and Bostman O**: Post-operative complications of distal humeral fractures: 27/96 adults followed up for 6 (2-10) years. *Acta Orthop Scand*, 63: 85-89, 1992.
- 31) **Waddel JP and Hatch J**: Supracondylar fracture of the humerus: the results of surgical treatment. *J trauma*, 28: 1615-1621, 1988.