

가

< >

:

: 1995 1 2000 12

1

가 21

가 .

3 6

가 1mm, 1~2mm, 2~3mm, 3mm 4

A, B, C, D

가 Anderson

Mayo modified wrist score

: A 11 (52.3%), B 5 (23.8%), C 4 (19.0%), D 1 (4.8%)

Anderson Excellent 11 (52.3%), Good 7 (33.3%), Fair 3 (14.3%)

2mm

Excellent 11 Good 5

Mayo Modified Wrist Score

2mm

75.15 2mm

61.15

:

, 2mm

: , , , 가

:

633-165

TEL : 051-890-6129, FAX : 051-892-6619

*

2002

28

가 4),

1995 1 2000 12
21

1,6,7,13,23),

5,8,9,12,20)

가

1995 1 2000 12

가

Table 1. The complete data upon the fracture of both bones of forearm and functional outcomes

Case	Sex/ Age	Cause*	Type †	Location	Difference of length (mm)	Complication	Grip strength (%)	Anderson's classification	Mayo Modified Wrist Score
1	M/34	T.A.	T/T	Distal	0.5		98	Excellent	85
2	M/30	T.A.	O/T	Middle	0.3		95	Excellent	80
3	M/22	Fall	O/O	Proximal	2.3	Delayed	74	Fair	60
4	M/35	T.A.	C/T	Middle	1.1		90	Good	65
5	M/30	Machinery	C/T	Middle	0.5		86	Good	75
6	F/26	Fall	T/C	Middle	0.1		88	Excellent	75
7	M/31	T.A.	O/O	Middle	2.2		78	Good	65
8	M/34	Fall	O/T	Middle	1.3		92	Excellent	75
9	M/33	Direct	T/T	Middle	0.1		95	Excellent	90
10	F/68	T.A.	T/T	Middle	0.1		93	Excellent	80
11	M/35	T.A.	T/T	Middle	1.0		77	Excellent	70
12	M/18	T.A.	C/C	Distal	2.8	Delayed	62	Fair	55
13	M/65	Fall	S/O	Distal	1.3		80	Good	65
14	M/39	T.A.	T/T	Distal	1.0		75	Excellent	75
15	F/65	T.A.	T/S	Middle	1.7	Delayed	85	Good	65
16	F/60	Direct	T/T	Middle	0.1		68	Excellent	75
17	F/58	T.A.	C/T	Middle	2.3		93	Good	65
18	M/41	Fall	T/O	Middle	0		83	Good	75
19	F/18	T.A.	O/T	Proximal	1.5		92	Excellent	75
20	F/39	Fall	T/T	Middle	0		98	Excellent	85
21	F/22	T.A.	T/T	Middle	5.0	Malunion	56	Fair	55

* Cause of Injury ; T.A : Traffic Accident, Fall : Fall from Heights, Direct : Direct blow, Machinery : Machinery injury

† Type of Fracture ; T : Transverse, O : Oblique, C : Comminuted, S : Segmental the type of radius fracture/the type of ulnar fracture

Table 2. Anderson 's classification of wrist function

Excellent	Loss < 10 degree in flexion-extension Loss < 25% in pronation-supination
Good	Loss < 20 degree in flexion-extension Loss < 50% in pronation-supination
Fair	Loss > 30 degree in flexion-extension Loss > 50% in pronation-supination
Poor	Nonunion with of without loss of range of motion

, 21 , 21
(Colles) ,
Monteggia

21 88 21
30 가7 , 31 40 가8
가
가13 , 가8 가
가12 (57.1%) 가
6 (28.6%), 가 2 (9.5%),
1 (4.8%) .

Table 3. Mayo Modified Wrist Score

Category	Score(points)	Findings
Pain	25	None
	20	Mild
	15	Moderate
	0	Severe
Function	25	Able to return to employment
	20	Restricted employment
	0	Unable to work due to pain
Pronation-Supination in degrees	25	>170
	15	141 to 169
	10	101 to 140
	5	61 to 100
	0	<60
Grip strength (% of normal side)	25	95 to 100
	15	75 to 94
	10	50 to 74
	5	25 to 49
	0	0 to 24

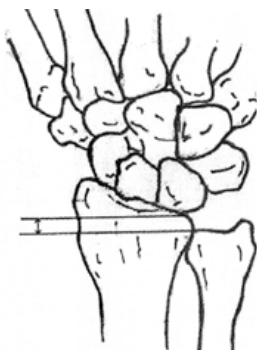


Fig. 1-A. schematic diagram for measurement of length difference of radius and ulnar at wrist joint



Fig. 2. A 22 years old female patient. Transverse fractures at distal 1/3 of both bones of forearm were noticed. A butterfly segment was founded at fracture site of ulna.

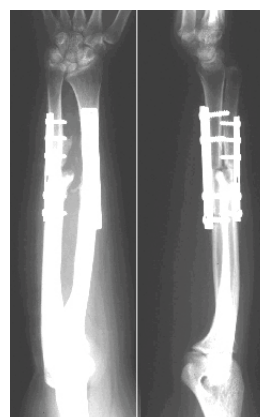


Fig. 3. At postoperative 6 months, malunion was found after operative treatment using compression plate in the fracture of both bones of forearm. Length difference more than 5mm was noticed due to radial shortening and dorsal dislocation of ulna was seen at distal radioulnar joint.

가			
가			
6			
percentage			
가	Anderson	2)(Table 2)	Mayo
Modified Wrist Score ⁴⁾ (Table 3)			
21 17			
, 65.3 ± 1.7%, 66.8			
± 1.5%, 0.5 ± 0.7%, 135.4 ±			
1.2%, 73.0 ± 4.1%,			
75.3 ± 1.9%			
가 1mm A, 1~2mm			
B, 2~3mm C 3mm			
D, A 11 (52.3%), B 5			
(23.8%), C 4 (19.0%), D 1 (4.8%)			
가 Anderson			
가, Excellent 11 (52.3%), Good 7			

(33.3%), Fair 3 (14.3%)	가	A 8 가
Excellent, 3	Good	가, B
3	Excellent, 2	Good, C
2	Good, 2	Fair D 1
Fair 가		2mm
A B	Excellent 11	
Good 5		
80%		14 (66.7%),
50% 80%	6 (28.6%)	,

1 50% 가
Mayo Modified Wrist Score A 5mm
77.3 , B 73 , C 가
63.3, D 59 , (Figure 3). Sauve-Kapandji
2mm A, B 2mm C, D (Figure 4) 6 20.
3 , 1 Anderson Good Mayo Modified Wrist Score 75
가
2,7,22,29)
22
(Figure 2), 가
(
,) ,
가 ,
4
(Figure 3). 6
30.
60., 0. 60.,
20., 56% . Anderson
Fair Mayo Modified Wrist Score 55 .



Fig. 4. A reconstructive operation was done by Sauve-Kapanji procedure : distal radioulnar arthrodesis and distal ulnar pseudoarthrosis.

가
Anderson Good Mayo Modified Wrist Score 75
가
2,7,22,29)
Sarmiento^{26,27)}, Charnley⁷⁾
functional brace
가 “8”
Patrick¹⁸⁾
4
X-
Sage²³⁾
30.
60., 0. 60.,
20., 56% . Anderson
Fair Mayo Modified Wrist Score 55 .
Anderson²⁾
가
Sargent²⁵⁾
2) , 3) , 4)
가

11,14,19).
 가 ,
 . Anderson^{2,3)} ,
 , enchondral phase 6 가 1 .
 가 enchondral ,
 phase ,
 Anderson²⁾ .
 97.3% 85% ,
 , wrist score
 가
 . 70%
 70% .
 가 , , 가
 가 2mm 가 .
 28) .
 , 가
 , 가
 10) 가 2mm 가 .
 16,21). 10 가 , ,
 20 , 가
 30% 가 .
 가 16, 21) ,
 Evan 's .
 tuberosity view technique¹⁰⁾ ,
 ,
 11,15,19). 2mm

REFERENCES

- 1) **Ahn BM, Chung YK, Lee CJ, Chang IY**: Treatment of Diaphyseal Fractures of the Forearm Bones. J. Korean Orthop Assoc, 15-2 : 288-295, 1980.
- 2) **Anderson LD, Sick TD, Tooms RE, Park WI**: Compression-plate fixation in Acute Diaphyseal Fractures of the Radius and Ulna. J. Bone and Joint Surg., 57-A : 287-296, 1975.
- 3) **Anderson LD**: Compression plate fixation and the effect of different types of internal fixation on fracture healing. J. Bone and Joint Surg., 47-A : 191-208, 1965.
- 4) **Bradway JK, Amadio PC, Cooney WP**: Open reduction and internal fixation of displaced, comminuted intra-articular fractures of the distal end of the radius. J. Bone and Joint Surg., 71-A : 839-847, 1989.
- 5) **Burwell HN, Charnley AD**: Treatment of Forearm Fractures in Adults with Particular Reference to Plate Fixation. J. Bone and Joint Surg., 46-B : 404-425, 1964.
- 6) **Caden JG**: Internal Fixation of Fractures of the Forearm. J. Bone and Joint Surg., 43-A : 1115-1121, 1961.
- 7) **Charnley JC**: The Closed Treatment and Common Fractures. 3rd Ed. p. 112-123, Baltimore, Williams and Wilkins, 1975.
- 8) **Choi CU, Jeong SY, Moon U, Yim SJ, Yoon SR, Rah SK**: Clinical Comparison in Intramedullary Fixation to Plate Fixation on Treatment of the Both Forearm Bone Fractures. J. Korean Society of Fractures, 8-4 : 893-901, 1995.
- 9) **Dodge HS, Cady GW**: Treatment of Fractures of the Radius and Ulna with Compression Plates. J. Bone and Joint Surg., 54-A : 1167-1172, 1972.
- 10) **Evans EM**: Rotational deformity in the treatment of fracture of both bones of the forearm. J. Bone and Joint Surg., 27 : 373-379, 1945.
- 11) **Fernandez DL**: Correction of Post-traumatic wrist deformity in adults by osteotomy, bone grafting, and internal fixation. J. Bone and Joint Surg., 64-A : 1164-1178, 1982.
- 12) **Grace TG, Evermann JR**: Forearm Fractures, Treatment by rigid fixation with early motion. J. Bone and Joint Surg., 62-A : 433-438, 1980.
- 13) **Hughstone JC**: Fractures of the Distal Radius Shaft. Mistakes in Management. J. Bone and Joint Surg., 39-A : 249-264, 1956.
- 14) **Jerry LK, Jesse BJ**: Intra-articular fractures of the distal end of the radius in young adults. J. Bone and Joint Surg., 68-A : 647-659, 1986.
- 15) **Kazuki K, Kusunoki M, Shimazu A**: Pressure distribution in the radiocarpal joint measured with a densitometer designed for pressure sensitive film. J. Hand Surg., 16-A : 401, 1991.
- 16) **Matthews LS, Kaufer H**: The effect on supination-pronation of angular malalignment of fractures of both bones of the forearm. J. Bone and Joint Surg., 64-A : 14-17, 1982.
- 17) **Muller ME, Allgower M, Willenegger H**: Technique of internal fixation of fractures. New York, Springer-Verlag, 1965.
- 18) **Patrick J**: A study of supination and pronation with especial reference of the treatment of forearm fractures. J. Bone and Joint Surg., 28 : 737-748, 1946.
- 19) **Patte GA, Thompson GH**: Anterior and posterior marginal fracture dislocations of the distal radius. Clin Orthop, 231 : 183-195, 1975.
- 20) **Petrie D, Tile M**: Fractures of Radius and Ulna of End Result Study Following the Use of Compression Plates. J. Bone and Joint Surg., 54-B : 762-788, 1972.
- 21) **Rang M**: Children's fractures. pp. 124-140, Philadelphia, J. B. Lippincott Co., 1976.
- 22) **Rockwood CA, Green DP**: Fractures, 1st Ed., 441-483, Philadelphia, J.B. Lippincott company., 1975.
- 23) **Sage FP**: Fractures of the Shafts and Distal Ends of the Radius and Ulna. ICL., 20 : 91-115, 1971.
- 24) **Sage FP**: Medullary fixation of fractures of the

-
- forearm. J. Bone and Joint Surg., 41-A : 1489-1516, 1959.
- 25) **Sargent JP, Teipner WA**: Treatment of forearm shaft fractures by double-plating. A preliminary report J. Bone and Joint Surg., 47-A : 1475-1490, 1965.
- 26) **Sarmiento, Augusto**: Cooper JS, Sinclair WF: Forearm fractures. Early functional bracing. A preliminary report. J. Bone and Joint Surg., 57-A : 297-304, 1975.
- 27) **Sarmiento, Augusto**: Kinman PB: Hurphy RB: Treatment of ulnar fractures by functional bracing. J. Bone and Joint Surg., 58-A : 1104-1107, 1976.
- 28) **Smith JEM**: Internal fixation in the treatment of fractures of the shafts of the radius and ulna in adults. J. Bone and Joint Surg., 41-B : 122-131, 1959.
- 29) **Watson-Jones B**: Fractures and Joint Injuries. Vol. 1. Ed. 4. Edinburgh, E. & S. Livingstone, 1952.

Abstract

Functional Evaluation of Wrist According to Changes of Length after Operation in Fracture of Both Bones of Forearm

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Purpose : To evaluate the relationship between the length changes of both forearm bones and function of wrist. To know permitted length discrepancy for good wrist function after operation in fracture of both bones of forearm

Materials and methods : From Jan. 1995 to Dec. 2000, 21 cases were followed over 1 year, were treated with compression plate and screws due to fracture of both bones of forearm in our hospital. Mean duration of follow-up was 3 years 6 months. The postoperative length difference was compared to preoperative or unaffected side in roentgenography. Four groups were defined to A, B, C and D by postoperative length difference ; 1mm, 1 ~ 2mm, 2 ~ 3mm, and >3mm for comparison. The function of wrist joint was evaluated with the Anderson 's classification and Mayo modified wrist score.

Result : Group A were 11 cases(52.3%), B 5 cases(23.8%), C 4 cases(19.0%) and D 1 case(4.8%). By the Anderson 's classification, the number of Excellent were 11 cases(52.3%), Good 7(33.3%), Fair 3(14.3%). In the group of the length difference lesser than 2mm, the number of Excellent were 11, and Good 5. The Mayo modified wrist score was 75.15 in the group of the length difference lesser than 2mm, that was higher than 61.15 in the group of more than 2mm.

Conclusion : To obtain a good wrist function after operative treatment of fracture of both bones of forearm the length discrepancy of both bones should be lesser than 2mm.

Key words : forearm bones fracture, length difference, wrist function

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