

11, 4, 1998 10

The Journal of the Korean Society of Fractures
Vol.11, No.4, October, 1998

= Abstract =

Results of cross pinning fixation for supracondylar fracture of the humerus in children - considering adequate reduction and instability -

Jong-Hun Jee, M.D., Bong-Soon Chang, M.D. *, Seung-Baik Kang, M.D. **,
Choong-Hee Won, M.D. and Eui Seong Choi, M.D.

Department of Orthopaedic Surgery, Chungbuk National University Hospital, Cheongju, Korea,

Department of Orthopaedic Surgery, Seoul National University Hospital, Seoul, Korea,*

*Department of Orthopaedic Surgery, Seoul City Boramae Hospital, Seoul, Korea***

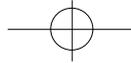
The supracondylar fracture of the humerus is the most common fracture of the elbow in children. New trends of treatment is that if satisfactory reduction is achieved by manual reduction, medial and lateral cross percutaneous pin fixation is better than others for stable fixation. Among many complications, cubitus varus deformity most commonly results from inaccurate reduction and failure in maintenance of fixation. The obliquity of the fracture, together with internal rotation, causes angular deformity. The angulation and coronal rotation, or tilting of distal fragment, often cause the deformity and limitation of motion of elbow. The forty-two Gartland type , supracondylar fractures of the humerus were treated by closed

:
62 (361-711)

Tel : (0431) 269 - 6072 Fax : (0431) 274 - 8719

* 1996 40
* 1995



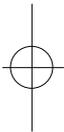


reduction or open reduction with percutaneous pinning or internal fixation from May 1993 to December 1995. The results were as follows;

1. The frequency of difference above 5° in Baumann's angle was relatively high if fracture line is oblique on lateral roentgenogram or medial column comminution is present, that means unstable reduction.
2. In average, 2.7 pins were needed for reduction and maintenance of stability at this time.
3. Even though a few degree of rotation(5mm), translation(2-4mm) and angulation(5-10°) were present at immediate reduction, carrying angle and Baumann's angle of follow-up period were often remained about the similar values compared with healthy side.

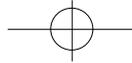
If acceptable intraoperative carrying angle was achieved and a few degree of rotation, translation and angulation were permitted after reduction, varus deformity and limitation of motion of elbow were rarely caused. So repeating forceful manual reduction for anatomical reduction must be avoided because the final results may become progressively remodelled to normal.

Key Words : supracondylar fracture, reduction, cross pin fixation



가 1)
 , Volkmann , , 1993 3 1995 12
 , , , , 1 가가
 . 44 가
 가 Kirschner 가 6 , 가 38 ,
 가 , 가 36 (86%), 가 6 (12%) 가
 , , 1 6 10 9
 . 5 7 .
 , , 2.3 (1-9)
 , 가 가 .
 가 .

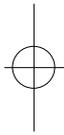




2)
 , 1 3 1 4
 Gartland¹⁰⁾
 , 90-100 °
 , 1.6mm 가 ,
 (smooth) K- 가
 Baumann
 , 4
 , 3 , Baumann
 30^{d4)} 가
 , 가
 가
 1) , 가
 Gartland¹⁰⁾ 42 1
 , 2 8 , 3 36 , 28 가
 3A , 8 가
 3B (Table 1). 가 가
 Flynn⁸⁾ (Table 2,3)
 27 (61%), 11 (25%), 6 (14%)
 (38)
 가
 Baumann 가 2 ,
 가 4 .
 가 5 ,
 가 4
 5mm , 10 °
 , 5mm (beak of
 fracture site) Baumann
 가 5 ° .
 3-5
 , 80-90 ° ,
 3
 ,
 4-5 .

Table 1. Classification of supracondylar fracture of the humerus in children by Gartland¹⁰⁾

Type	Number
I : Undisplaced	0
II : Displaced fx But with post. cortex intact	8
II : Displaced fx with no cortical contact	
IIIA : posteromedial	28
IIIB : posterolateral	8
Total	44



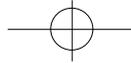


Table 2. Grading system for result of treatment (by Modified Flynn et. al⁸⁾)

Result Rating	Cosmetic factor (change in carrying angle)	Functional factor (motion loss)
Satisfactory	Excellent	0-5 °
	Good	6-10 °
	Fair	11-15 °
Unsatisfactory	Poor	>15 °

Table 3. Results according to the grading system of Flynn. et al.

	Closed reduction & percutaneous pinning	Open reduction & internal fixation	
Excellent	24	3	27
Good	9	2	11
Fair	5	1	6
Poor	0	0	0
Total	38	6	44

Table 4. The difference in number of pins between Gartland type

Gartland type	2pin	3pin
II	4	4
IIIA	15	13
IIIB	3	5
Total	22	22

Table 5. The relationship between pin number with the shape of fracture

* OR : odd ratio, † Fx : fracture

‡ MCC : medial column comminution

$$X^2_{Trend}=7.161 (P=0.007)$$

	2pin	3pin	OR*
simple transverse fx †	9	2	1.0
oblique fx †	4	6	3.60
MCC ‡	5	4	7.50
oblique fx + MCC ‡	4	10	1.25
Total	22	22	

Table 6. The relationship of number of pin after post reduction

	2pin	3pin
Anatomical reduction	6	3
Translation	7	4
Rotation	1	3
Translation + Rotation	6	8
AP*angulation +Trans. or Rotat.	2	4
Total	22	22

*AP:anteroposterior

Table 7. The relationship of Baumann's angle difference after post. reduction within a few degree of rotation, translation and angulation

	Baumann's angle diff.>5
Anatomical reduction	2/9(22%)
Translation	4/11(36%)
Rotation	0/2(0%)
Translation + Rotation	5/11(36%)
AP*angulation +Trans. or Rotat.	2/6(33%)
Total	13/42(31%)

*AP:anteroposterior

15 ° 가 10-15 °

2)

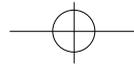
가 31

2.67

가 11 2.27

2

가



3) Gartland (Table 6, P>0.05), Gartland 가 (Table 4) 2 3, Baumann 5° 가 . (Table 7, P>0.05). , Baumann

4) 가 가 가 1), 가 가 가 1 (가 가 가 1), (Table 5, P<0.05), 1 4 , Gartland III B K- 1

5) Baumann 5° 가 , Baumann 25° , 36° . 3 Baumann 21° ; 22° , 가 1 Baumann 20° ;



Fig 1. Radiographs of four year old female with Gartland type B supracondylar fracture of the humerus (A) preoperative radiographs, (B) radiographs of immediate postoperative state shows 25° of Baumann's angle and 36° of carrying angle, and (C) radiographs of 1 year after operation shows 20° of Baumann's angle and 15° of carrying angle. According to Flynn's grading system, excellent result was obtained.



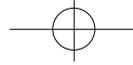
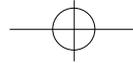


Fig 2. Radiographs of five year old male with Gartland type A supracondylar fracture of the left humerus (A) preoperative radiographs, (B) radiographs of intraoperative state shows 31° of Baumann's angle and 20° of carrying angle, and (C) radiographs of 1 year after operation shows 22° of Baumann's angle and 15° of carrying angle. According to Flynn's grading system, excellent result was obtained.



Fig 3. Radiographs of six year old male with Gartland type B supracondylar fracture of the left humerus (A) preoperative radiographs, using olecranon pin traction (B) radiographs of postoperative 4 weeks shows 20° of Baumann's angle and 18° of carrying angle and we saw remodelling process of fracture with extuberant callus (C) radiographs of 1 year 6 months after operation shows 15° of Baumann's angle and 11° of carrying angle. According to Flynn's grading system, excellent result was obtained.

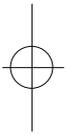


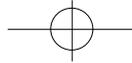
15 (Baumann 8 ° 10) 4 가
 (remodelling) , Flynn 8)
 가 Flynn 8)
 (Fig 1-A,B,C). (Fig 3-A,B,C).

2
 5 , Gartland III A
 1 , 2 90
 가 2mm 가 98% , 가
 3mm 가 가
 가 가
 20 ° Baumann 31 ° , ,
 8 Baumann 20 ° 23 ° 가 가
 가 (30 ° 110)
 Baumann 22 ° 15 (가
 Baumann 20 ° 14)
 Flynn 8)
 (Fig 2-A,B,C).

3
 6 (Power drill)
 (wire reamer) 가
 90 가

Gartland¹⁰⁾ III B
 1 K-
 가 1
 20 ° Baumann
 31 ° , 가 ,
 3mm 가
 2mm 가 4
 18 ° Baumann 20 ° ,
 11 ° Baumann 15 ° ,
 (7 ° Baumann 22) .
 가 Wilkins¹⁸⁾ Herzenberg ¹¹⁾
 30 ° ,

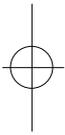


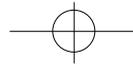


가
 , Zions¹⁹⁾
 (torsional strength)가 , Vahvanen¹⁷⁾ Flynn⁸⁾
 5) , .
 2 3 , Pirone¹⁵⁾ , Arino⁶⁾
 가 Flynn⁸⁾ 가
 , Wilkins¹⁸⁾
 (medial buttress) 가 .
 가 (molding)
 가 , ,
 1 가 가
 , Baumann
 1993 3 1995 12
 (5mm) (2-4 mm) , 1 가
 . Arino⁶⁾ Flynn⁸⁾ 가 44
 .
 가 , 가
 4 , , 가
 , 가²³⁾
 , Baumann
 가
 , 가

REFERENCES

Baumann^{4,7)} 가^{13,14,18)} 1) , , :
 . French⁹⁾ , Smith²²⁾ K-
 , 28:2161-2167, 1993.





- 2) , , , , , :
 , 28:774-780, 1993.
- 3) , , , , :
 , 30:1404-1407, 1995.
- 4) , , , , . :
 Baumann
 , 29:1658-1665, 1994.
- 5) , , , :
 , 30:694-701, 1995.
- 6) **Arino VL, Lluch EE and Ramirez AM** : Percutaneous fixation of supracondylar fractures of the humerus in children. *J Bone Joint Surg*, 59-A:914-916, 1977.
- 7) **Baumann E** : Beitrage zur kenntnis der fraktufren am elbogengelnk. *Bruns Beitr Klin Chir*, 146:115, 1929.
- 8) **Flynn J, Matthews J and Benoit R** : Blind pinning of displaced supracondylar fractures of the humerus in children. Sixteen years experience with long-term follow up. *J Bone Joint Surg*, 56-A:263, 1974.
- 9) **French PR I** : Varus deformity of the elbow following supracondylar fracture of the humerus in children. *Lancet*, 2:439-411, 1959.
- 10) **Gartland JJ** : Management of supracondylar fractures of the humerus in children. *Surg Gynecol Obstet*, 109:145, 1959.
- 11) **Hertzenberg JE, Koreska J and Rang ML** : Biomechanical testing of pin fixation in pediatric supracondylar elbow. presented at the 55th annual meeting of the American Academy of Orthopaedic Surgeons. Atlanta, February 5, 1988.
- 12) **Ippolito E** : Supracondylar fractures of the humerus in children. *J Bone Joint Surg*, 68-A:333-344, 1986.
- 13) **Kallio PE, Foster BK and Paterson DC** : Difficult supracondylar elbow fractures in children : Analysis of percutaneous pinning technique. *J Ped Orthop*, 12:11-15, 1992.
- 14) **Labelle H, Bunnell WP, Duhaime M and Poitras B** : Cubitus varus deformity following supracondylar fractures of the humerus in children. *J Ped Orthop*, 2:539-546, 1982.
- 15) **Pirone AM, Eraham HK and Krajbich JI** : Management of displaced extension-type supracondylar fractures of the humerus in children. *J Bone Joint Surg*, 70-A:641-650, 1988.
- 16) **Smith L** : Deformity following supracondylar fractures of the humerus in children. *J Bone Joint Surg*, 42-A:235-252, 1960.
- 17) **Vahvanen V and Alto K** : Supracondylar fractures of the humerus in children. A long term follow up study of 107 cases. *Acta Orthop Scand*, 49:225-233, 1978.
- 18) **Wilkins KE** : The operative management of supracondylar fractures. *Orthop Clin North Am*, 21(2):269-289, 1990.
- 19) **Zionts LE** : Torsional strength of pin configurations used to fix supracondylar fractures of the humerus in children. *J Bone Joint Surg*, 76-A:253-256, 1994.

