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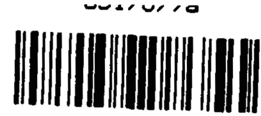

Delayed management of fracture of the lateral humeral condyle in children

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Thirty-nine displaced fractures of the lateral humeral condyle in children were followed for an average of 5 (2–5) years. The results were evaluated from functional and cosmetic aspects. Patients treated within 2 weeks by open reduction and internal fixation did well. Those operated on after 6 weeks did not do better than nonoperated on cases. Complications included cubitus varus and valgus deformities, osteonecrosis, nonunion and malunion, and loss of motion. We recommend that patients presenting late be left alone and any sequelae evaluated at a late stage.

In Malaysia, children are often taken to indigenous bone setters (Malay "bomoh" or Chinese "sinseh") before being brought to the hospital, sometimes several weeks after the injury. Untreated cases of lateral condylar fracture seen years later are asymptomatic and without functional disability. This raises the question whether delayed surgery is worthwhile. We have evaluated the results of late operation of lateral humeral condyle fractures in comparison with those managed without surgery.

Patients and methods

Forty-five children with a displaced fracture of the lateral condyle of the humerus were seen between 1971 and 1980. Thirty-nine had complete records and radiographs and were included in this retrospective study. Undisplaced fractures were not included. The condylar fragment was displaced laterally in all the cases and also was found to be rotated in 24 out of 30 operated on cases. The ages of the patients ranged from 2 years to 14 years. Twenty-seven were boys and 12 were girls. The follow-up period ranged from 2 to 15 years, median 6 years. Fourteen children were operated on within 2 weeks of injury (Group I), 8 were seen between 3 and 6 weeks (Group II), and a further 8 children presented between 6 weeks and 6 months after injury (Group III). These 30 cases were treated by surgery. Group IV comprised 9 children who were seen more than 6 months after the initial injury and were not operated on.

Surgery, when undertaken, was by the standard lateral approach of Boyd (1971). The joint and the condylar fragment were cleared of all fibrous tissue and callus, care being taken not to disturb the extensor muscle attachment from the fragment that maintains its vascular supply. The condyle was then replaced in correct alignment and transfixed with two Kirschner wires, except in 1 case where only one wire was used. The wires usually crossed the physis. In Case 28 a single compression screw was used. A posterior plaster slab, with the elbow at a right angle and the forearm in midprone position, was worn from 4 to 6 weeks. The wires were then removed and active mobilization of the elbow commenced.

At follow-up, all the patients were examined for motion, function and deformity. Neurologic examination for motor or sensory loss and muscle wasting was carried out. Standard anteroposterior and lateral radiographs of the elbow were taken. The carrying angle was measured clinically and also radiographically according to Keats et al. (1966).

A clinical score was awarded to each case according to a point system based on function and

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Table 1. Scoring system for the outcome of fractures of the lateral humeral condyle in children

Function		Carrying angle (degrees)	Score points, each column
Pain or weakness	Range of movement (degrees)		
Nil	0–140	valgus 7–10	3
Occasional	> 15–125	valgus < 20 varus < 0	2
After heavy work	> 30–110	valgus 20–30 varus 0–15	1
With normal activity Motor or sensory loss	< 30–110	valgus > 30 varus > 15	0

Functional grading (points): excellent 6, good 5, fair 4, poor < 4.
Overall grading (points): excellent 9, good 7–8, fair 5–6, poor < 5.

Table 2. Outcome of fractures of lateral humeral condyle

A	B	C	D	E	F	G	H
1	2/F/L	6	5–135	–	–	G	G
2	5/M/L	4	0–145	–	f	E	E
3	10/M/R	2	0–150	–	–	E	E
4	2/F/R	3	0–130	–	val 17	G	G
5	5/F/L	6	0–140	–	–	E	E
6	10/F/L	6	0–140	–	–	E	E
7	4/M/L	11	0–145	–	f	E	E
8	10/M/L	6	10–135	–	–	G	G
9	14/F/L	4	0–130	p	var 12	F	F
10	2/M/L	6	0–145	–	f	E	E
11	3/M/R	10	10–135	–	–	G	G
12	5/M/L	8	5–145	–	–	G	G
13	9/M/R	2	0–150	–	–	E	E
14	2/M/R	5	5–145	–	f	G	G
15	8/M/L	5	15–120	p	av, val 15	F	F
16	6/M/L	7	5–140	–	–	G	G
17	9/F/L	6	10–145	–	f	G	G
18	13/M/R	3	0–150	–	var 15	E	F
19	7/M/L	2	5–135	–	–	G	G
20	8/M/R	4	10–140	p	var 10	F	F

A	B	C	D	E	F	G	H
21	5/F/R	3	5–145	–	f	G	G
22	3/M/R	3	0–145	–	f, var 15	E	F
23	9/M/R	3	5–135	–	var 25	G	F
24	13/M/R	5	25–145	–	av, val 20	F	P
25	5/M/L	6	10–130	–	n, val 30	G	F
26	6/F/R	7	0–140	–	var 10	E	G
27	5/M/R	3	10–110	p, g	var 15	P	P
28	5/M/L	8	15–130	p, g	av, val 15	P	P
29	7/F/L	6	10–140	–	var 15	G	F
30	4/M/L	4	20–110	–	var 20	F	P
31	5/M/R	10	5–130	p	val 25	F	F
32	7/M/L	15	0–145	–	n, val 35	E	F
33	6/F/R	12	5–145	–	n, val 32	G	F
34	4/F/R	9	30–135	–	n, val 22	P	P
35	10/M/L	13	15–110	–	n, val 25	P	P
36	9/M/L	15	20–120	–	n, val 30	P	P
37	6/F/R	13	0–145	–	val 17	E	G
38	5/M/L	11	5–145	–	n, val 27	G	F
39	3/M/R	8	15–130	–	val 18	F	F

A case number; B age/sex/side; C years follow-up; D Range of movement in degrees; E complaints: p occasional pain, g weak grip; F radiographic abnormality: av avascular necrosis, f fish-tail deformity, n nonunion, var varus, val valgus; G functional grading; H overall grading: E excellent, G good, F fair, P poor (Table 1).
Cases 1–14 treated by open reduction and wire fixation within 2 weeks of injury.
Cases 15–22 treated within 3–6 weeks, and Cases 23–30 treated within 7–26 weeks.
Cases 31–39 nonoperated on: Cases 31, 36, 39 posterior slab, Cases 32, 34, 35, 38 treated by Sinseh, Cases 33 and 37 by Bomoh.

Table 3. Outcome of fractures of the lateral humeral condyle in children. Grading according to Table 1

		Function				Overall			
Group[a]	n	Excellent	Good	Fair	Poor	Excellent	Good	Fair	Poor
I	14	7	6	1	0	7	6	1	0
II	8	2	4	2	0	0	4	4	0
III	8	1	3	2	2	0	1	3	4
IV	9	2	2	2	3	0	1	5	3

[a] Group I operated on within 3 weeks.
II operated on within 6 weeks.
III operated on more than 6 weeks after injury.
IV Not operated on.

appearance (Table 1). For functional grading, pain on activity, presence of any neurologic deficit, e.g., weakness, wasting or sensory loss, and a decrease in the range of movement were considered. In overall grading, any deformity due to alteration in carrying angle was also taken into account. Results were analyzed for each group (Table 2).

Results

Group I

Of the 14 children operated on within 3 weeks of injury, both functional and overall results were excellent in 7, good in 6, and fair in 1 (Table 2). There was no poor result.

Nine of the children were operated on within 48 hours of the injury, and all of them had excellent or good results. One patient (Case 4) developed a 10° increase in carrying angle, because the pins holding the fragment had poor purchase of the proximal humerus and had become loose. Four of the 5 children operated on after 40 hours, but within 2 weeks, had a good result. The exception was Case 9, where the single pin used for fixation failed to keep the capitellar fragment in place, resulting in 12° loss of the carrying angle, mild restriction of movement, and occasional pain. A fish-tail deformity was seen on radiographs in four of the elbows (Figure 1), but was found to be of no clinical significance. This radiographic defect is produced from an abnormal fusion, with loss of the ossific link between the trochlear and capitellar centers, with a resultant deficiency of the lateral lip of the trochlea (Wadsworth 1972).

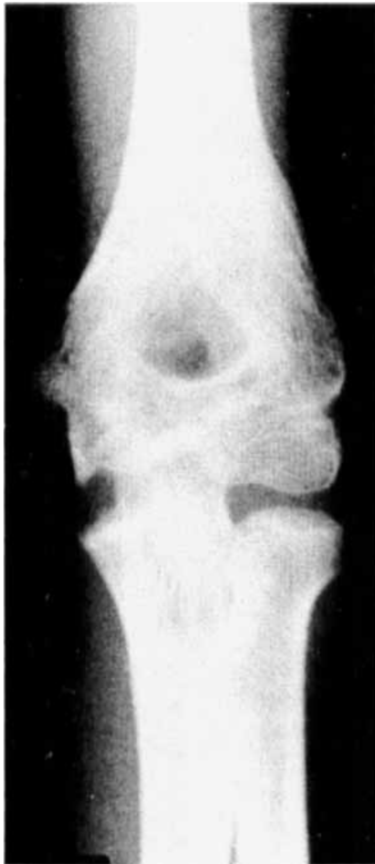

Figure 1

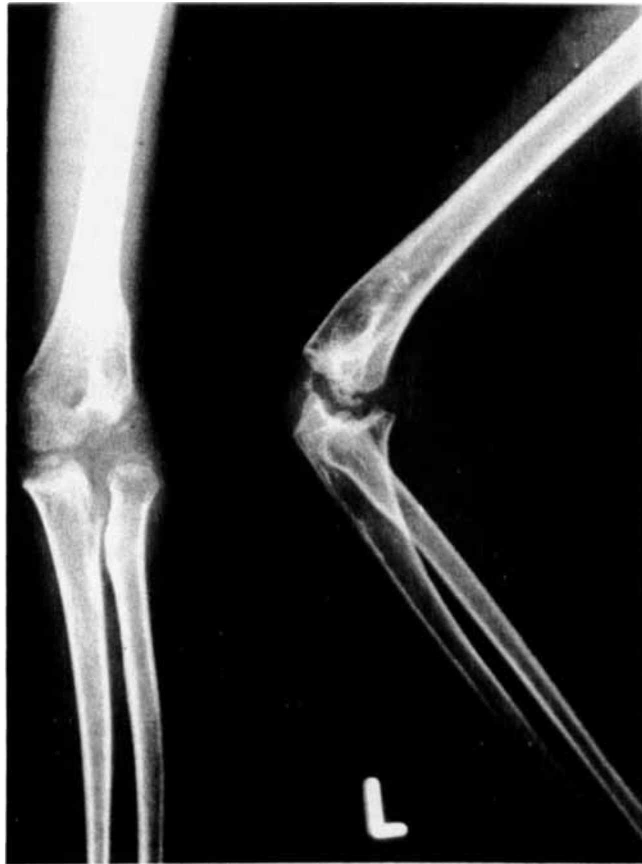

Figure 2

Figure 1. Case 10. "Fish-tail" deformity in a 9-year-old boy. When 2 years old, he had immediate open reduction of a lateral humeral condylar fracture.

Figure 2. Case 15. An 8-year-old boy operated on 4 weeks after sustaining a fracture of the lateral condyle. Radiographs 1 year later show necrosis and cubitus valgus of 15°.

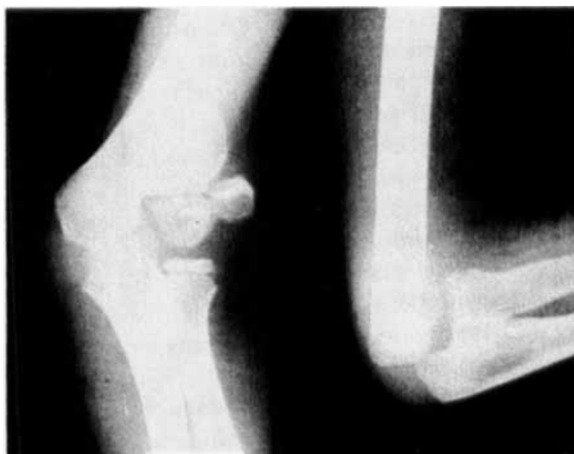

Figure 3

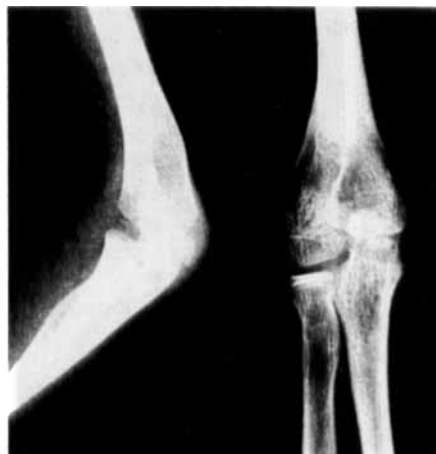

Figure 4

Figure 3. Case 25. A 5-year-old boy operated on 3 months after sustaining a fracture of the left lateral condyle. Radiographs at the age of 9 show nonunion and 30° valgus deformity.

Figure 4. Case 20. A 10° varus deformity of the right elbow in a 12-year-old boy with an enlarged capitulum. Three years earlier, internal fixation was done 6 weeks after injury.

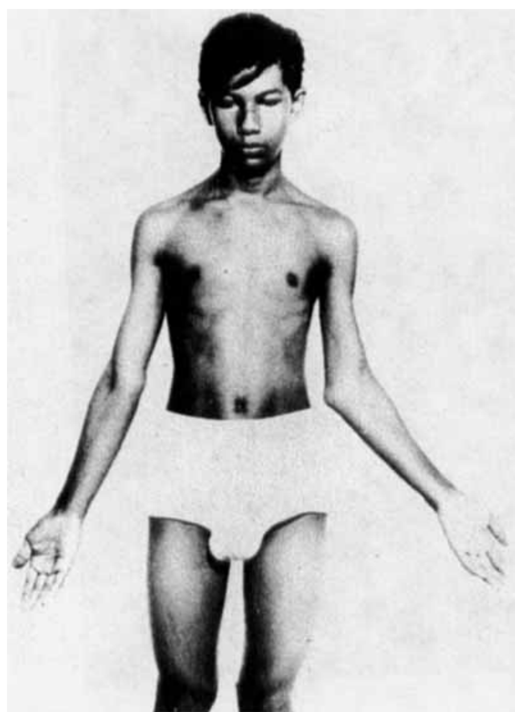

Figure 5. Case 38. A 16-year-old boy with 27° cubitus valgus and minimal restriction of movement. At the age of 5, fracture of the left humeral condyle was treated by a Chinese bone setter (Sinseh).

Group II

Eight cases were operated on 3–6 weeks after injury (Table 2). Functional results were graded as excellent in 2 with full range of movement, good in 4 with mild restriction, and fair in 2 who complained of occasional pain. In 3 cases fish-tail deformity of the lower end of the humerus was noted in radiographs. In one elbow (Case 15, Figure 2) the carrying angle had increased due to necrosis of the condylar fragment, and cubitus varus developed in 3 children owing to malunion or subsequent overgrowth of the capitellar ossific center (Figure 4). Overall grading was thus good in 4 cases, fair in the other 4, and excellent in none.

Group III

Eight children were operated on more than 6 weeks after injury. Only 1 had excellent function (Case 26), although she had a varus angle of 10°; this girl when seen 9 months after operation appeared to have nonunion, but when recalled 7 years later for this assessment, the condyle had united. Three children had mild restriction of motion. The rest, with further restriction of elbow motion or with pain or weakness, were graded fair to poor. All eight elbows had abnormal carrying angles, and overall assessment gave only 1 good result.

In 3 cases condylar fragments had either undergone necrosis or remained ununited (Figure 3) leading to an increased carrying angle. Malunion in the other 5 cases led to cubitus varus.

Group IV

In this group of 9 unoperated on cases, 6 were initially treated by indigenous bone setters and the other 3 were treated with plaster immobilization at district hospitals. The patients' only complaint at follow-up was deformity of the affected elbow (Figure 5). Functionally, 2 cases were found to be excellent without restriction of motion and another 2 had minimal restrictions. The condylar fragments had, however, remained ununited in 7, and all 9 had a cubitus valgus deformity. Overall grading was thus good in only 1, and the rest were fair to poor.

Statistics

In the Fisher exact probability test, there was a significant difference in the overall grading between Groups I and II ($P = 0.037$), but the difference in the functional grade was not significant. The overall grading of Groups I and II combined differed from Group III ($P = 0.003$) and from Groups III and IV combined ($P = 0.00005$). The functional results of the combined Groups I and II were marginally better than those of Group III ($P = 0.053$) and clearly better than those in Groups III and IV ($P = 0.010$).

Discussion

There is unanimity of opinion on the need of open reduction and internal fixation of the displaced fracture when seen early (Salter 1970, Wadsworth 1972, Jacob 1975). This is also confirmed by the excellent to good result in Group I of our study.

However, management of these fractures when presenting late is controversial. Wilson (1936) and Böhler (1966) stated that open reduction should be done for all late neglected cases. Speed and Macey (1933) recommended surgery even in cases of established malunion on nonunion. Others have found delayed open reduction unsatisfactory (Rohl 1953, Blount 1954, Maylahn and Fahey 1958, Hardacre et al. 1971, Smith 1972, Wadsworth 1972, Jacob et al. 1975). Most of these reports do not clearly mention the time of surgery in the late cases and do not compare results in patients treated early and late. Jacob et al. (1975), however, found that 7 patients operated on more than 3 weeks after injury did no better than 6 patients who received no treatment at all.

In the proper evaluation of results, the function of the elbow is much more relevant than is appearance. Range of motion in children improves with time, but deformity may worsen depending upon the age at which these injuries occur. Accurate measurement of the carrying angle is difficult when the elbow cannot be fully extended. Our patients were willing to accept a deformity provided they had satisfactory function. Finally, deformity, if necessary, can be corrected by a supracondylar osteotomy.

We feel the grading used by Hardacre et al. (1971) is unsatisfactory because patients with conspicuous alteration in their carrying angle can have a good functional range of elbow motion. Further, the authors do not specify what is a satisfactory functional range. According to Morrey (1985), for most activities the full potential of the elbow is not needed or used, loss of terminal flexion being more disabling than the same degree of loss of extension. Ogilvie (1930) stated that the elbow was designed for use between 10° and 110° of flexion. Carstam (1950) placed the greatest clinical relevance in an arc of motion of 30° to 120°. According to the functional scoring system of So et al. (1985), a loss of motion exceeding 20° gives an unsatisfactory result. We accepted a loss of less than 15° as good, between 15° and 30° as fair, and a loss exceeding 30° as a poor result.

Loss of the carrying angle to neutral is barely noticeable, whereas cubitus varus exceeding 15° is conspicuous. Based on these observations, we adopted a functional scoring system (Table 1) taking into account the presence of pain, weakness, and range of motion. Overall grading is obtained when elbow deformity is also considered.

It is our experience that delayed surgery is a difficult undertaking. Reorientation of the condylar fragment becomes difficult; extensive dissection to free the fragment from adhesions not only damages the articular cartilage, but also jeopardizes its delicate vascular supply leading to necrosis and cubitus valgus, seen in 3 of the operated on cases (Figure 2). Incomplete or inaccurate reduction results in malunion and

cubitus varus deformity. We think that extensive surgery in some cases may account for subsequent increased vascularity and enlargement of the capitellar ossific center aggravating the varus deformity (Figure 4). Varus from an enlarged lateral condyle has been noted before (Holst Nielsen et al. 1974).

It was interesting to note that untreated cases always resulted in a valgus deformity (Figure 5) due to nonunion of the displaced and rotated condylar fragment. However, cubitus valgus, unless excessive, is more acceptable and less disfiguring than the cubitus varus or gun-stock deformity resulting from malunion after delayed surgery.

None of the patients in our series had ulnar nerve palsy, possibly because our follow-up was not long enough. Gay and Love (1947) found the average age of onset of ulnar neuropathy after an elbow injury is 38 years, and the average interval between injury and onset of symptoms is 22 years.

We recommend that children who present more than 6 weeks after sustaining a fracture of the lateral humeral condyle be left alone until skeletal maturity, at which time they should be reassessed for their cosmetic status, and if the deformity is significant a supracondylar osteotomy should be carried out.

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