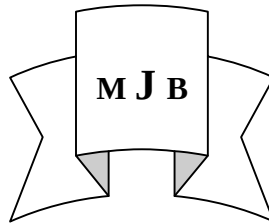


Pediatric Humeral Supracondylar Fracture (phscf) Type III: One Month Delay? Later Corrective Osteotomy or Orif Rightaway

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Abstract

The commonest treatment of displaced PHSCF is closed reduction and percutaneous pinning within 24 hours- 7th day, after that ORIF usually required. The purpose of this study was to review the author's experience in treating 17 children delayed for 3 – 6.5 weeks by ORIF that otherwise left for later corrective osteotomy. patient age, sex, mechanism of injury, time and cause of delay, classification of fracture, associated neurovascular injury, preoperative procedures, and complications were noted. All fractures were treated by OR from posterior approach and fixed with 2 crossed K-wires from medial and lateral condyles. Wires were removed at 4-5 weeks. Range of motion and carrying angle were measured at follow up. A less common fracture type affecting older children was presented, consisting of supra and inter condylar fracture requiring usually ORIF and may affect elbow motion, and suggested to be the 5th type in Gartland's classification. *Conclusion:* it is worth to attempt ORIF for late presenting displaced PHSCF even 3-6 weeks after injury. Otherwise the resulting cubitus varus will impose functional, psychological, and cosmetic impairments demanding later corrective osteotomy with much more complications and lower rate of success.

الخلاصة

العلاج الأكثر شيوعاً لحالات كسر فوق المذبرين للعضد عند الأطفال هو الإرجاع المغلق والتثبيت من خلال الجلد بالاسلاك خلال 24 ساعة - 7 أيام من الإصابة، بعدها العلاج عادة بإجراء عملية إرجاع مفتوح وتثبيت داخلي للكسر. الهدف من البحث هو دراسة حالات 17 طفل مصاب متأخر عن العلاج لفترة 3 - 6.5 أسبوع قد أجريت لهم عملية إرجاع مفتوح وتثبيت بالوإيرات ألتي بدونها عادة يترك المصاب لعملية قص عظم بعد سنوات لتعديل الانحراف. تمت ملاحظة: العمر، الجنس، سبب الإصابة، فترة التأخر، سبب التأخر، تصنيف الكسر، إصابة الأوعية الدموية والأعصاب، إجراءات العلاج السابقة والمضاعفات. كل الأطفال اجري لهم إرجاع مفتوح وتثبيت بوإيرات متعكسة أزيلت بعد 4-5 أسابيع. تم قياس مقدار الحركة وزاوية الحمل للمرفق. تم عرض حالة كسر غير شائعة تتألف من نفس الكسر مع كسر المذبرين تصيب الأطفال الأكبر سناً وتعالج بنفس الطريقة، نقترح جعلها النوع الخامس لتصنيف جارتلاند. الاستنتاج: إجراء عملية الإرجاع المفتوح والتثبيت ولو بعد فترة 3-6 أسابيع تستحق المحاولة تجنباً لانحراف المرفق المصحوب بخلل وظيفي و شكلي ونفسي يتطلب عملية تعديل مليئة بالمضاعفات ونسبة نجاح واطئة.

Introduction

Supracondylar humeral fracture (SCHF) is the most common elbow injury in children accounting for up to 70% of all

injuries around elbow joint[1,2]. The mechanism of injury in 98% is falling on outstretched hand, driving the olecranon into olecranon fossa causing the extension type of fracture.

In 2% the fracture is of flexion type caused by direct fall on the olecranon [3,4,5]. *Gartland's* classification: I – undisplaced $\pm$ medial and/ or lateral column impaction; II – displaced with some cortical contact $\pm$ rotation and/ or angulations; III – completely displaced[5,6].

Treatment: type I – with no column collapse – splint for 3 weeks with close observation of radiological reduction. Type II & III – require closed reduction(to restore the normal carrying angle guided by contralateral Baumann's angle) and pin fixation[7]. Open reduction and percutaneous pinning (ORIF) is indicated when closed reduction can't be achieved, when fracture is open, or when vascular compromise is present[6,7,8].

Techniques of K- wiring include: crossed medial and lateral wires(gives the most stable fixation against redisplacement) [9]; 2 medial parallel K- wires (may injure ulnar nerve); 2 lateral parallel K-wires(weak fixation); 2 crossed lateral K- wires(more stable + less ulnar nerve injury)[10]. To avoid injuring ulnar nerve, some use mini medial incision[7,9].

Complications: vascular injury, compartment syndrome, nerve injury(radial, median and ulnar), and *cubitus varus*: usually caused by inadequate or inability to maintain reduction[5,6,11].

The most commonly used criteria for cosmetic and functional outcome assessment are those of Flynn[12]:

Result	Cosmetic factor carrying angle loss	Functional factor loss of motion
excellent	0 – 5	0 – 5
good	6 – 10	6 – 10
fair	11 – 15	11 – 15
poor	> 15	> 15

Patient with poor outcome(noticeable cosmetically) can be corrected by lower humerus closing lateral wedge osteotomy with internal or external fixation[13]. The goal is coronal plane deformity correction, though hyperextension and rotational deformity are also present. Complications of this operation: nerve palsy, infection, loss of fixation, reoperation and inadequate correction⁴. The overall complication rate is 33%[13]. Other procedures with lower success rates: medial opening wedge osteotomy with grafting, stepcut osteotomy, dome

osteotomy, and multiplanar osteotomy[14].

Materials and Methods

Between May 2005 – December 2007, seventeen children with late presenting HSCF type III were admitted to the Orthopedic department in Al-Hilla teaching general hospital, Iraq. There were (65%) 11/17 boys and (35%) 6/17 girls, table-1. Their age ranged from 9 months – 12 years, with a mean of 5 years 7 months. All fractures were Gartland type III (94% extension, and 6% flexion type). Both right and

left sides were almost equally affected. Mechanism of injury: 82% (14/17) were due to fall on outstretched hands during running or fall from low height like a table , whereas 18% (3/17) were caused by direct force like road accident. All fractures were closed except one opened from within.

Delay time: ranged from 20 – 46 days, with a mean of 33 days. The cause of delay was either missed injury or neglect. Those with missed injury 3/17 (18%) were one unconscious and 2 with multiple injuries. Those neglected were either due to parent neglect in 11/17(65%), or general practitioner neglect in 3/17 (18%). Most of children were not having previous surgery except one ORIF with loss of reduction, and 4 having been manipulated and splinted with or without anesthesia. No patient found to have vascular compromise. While 2/17 (12%) were found having radial nerve injury, one of them was recovering.

All children were operated on within 2-3 days of their late presentation: in supine position with elastic tourniquet applied, through the posterior approach, the ulnar nerve identified and protected, then division of triceps tendon in reversed V incision, exposure of fracture site and cleaning from callus especially medial and lateral column and olecranon fossa to be used as a guide for reduction, which sometimes needed some bone ends trimming to achieve reduction. Then fixation by 2 crossed K – wires from medial and lateral condyles; closure over radycavag drain; posterior slab, release of tourniquet and assessing limb viability, the radial pulse may lag 1/2

an hour. Follow up at 2 weeks for stitches removal and radiological confirmation of reduction. At 4 – 5 weeks, K – wires removed and starting of active elbow exercise, then follow up every month for a minimum of 4 months where most patients regained good ,though not full, range of elbow movements for final assessment according to Flynn's criteria.

Results

Of the 17 children, three were lost from final assessment, the remaining 14 had the following results: 65%(9/14) had excellent outcome functionally and cosmetically; 21% (3/14) had good cosmetic results, while 14% (2/14) had good functional results. Fair cosmetic and functional outcome was seen in 14% (2/14). No poor cosmetic result seen, while only one child had poor functional outcome who was the oldest one in the study(12 year) with severe injury(SCF + intercondylar fracture), hence, the suggestion to consider this type as type V , the fourth one being considered by others as unstable neither in flexion nor in extension.

The overall result: all children had satisfactory outcome cosmetically, and 93%(13/14) had satisfactory functional results.

Complications seen include: pin tract infection in 11%(2/14); excessive granulation tissue around pin site in 30%(5/14); neither bone infection nor iatrogenic nerve injury was seen. No significant varus deformity(>15 degree loss of carrying angle) was seen.

Results of ORIF for late presenting PHSCF III according to Flynn's criteria at 4th month follow up.

Result	Functional			Cosmetic		
	Motion loss	No.	%	Carrying angle loss	No.	%
excellent	0-5	9/14	65%	0-5	9/14	65%
Good	6-10	3/14	21%	6-10	3/14	21%
Fair	11-15	1/14	7%	11-15	2/14	14%
Poor	> 15	1/14	7%	> 15	0/14	0%

Discussion

PHSCF is a common injury; in our hospital, we daily see at least 3 – 5 cases of significant elbow injury in the accident department and outpatient clinic, and at least one case of ORIF for SCF every 2 – 3 days in the orthopedic theater. However, the importance of this fracture comes from its potential complications that range from vascular injury to nerve injury, severe swelling, forearm compartment syndrome, difficulty in assessing subtle radiological fracture displacement which may end with varus deformity.

In this hospital, the policy in the management of displaced PHSCF is early ORIF because we don't have the facility of X – ray screen in the theater. However, we have usually excellent results that might be related to the following reasons:

- 1 – open reduction is always superior to closed reduction (regarding perfect cortical apposition).
- 2 – using 2 crossed mediolateral K wires is mechanically more stable than parallel wires or crossed wires from one side [9,10].
- 3 – ulnar nerve identification and protection.

By this, we could guarantee perfect stable reduction, though the drawback of OR, as said, is the possible elbow stiffness and myositis ossificance,

both of them, virtually, I haven't seen in a ten years period.

Regarding the late presenting PHSCF, most our colleague would leave such fracture without interference if the delay > 2 – 3 weeks depending on later osteotomy which is a demanding procedure requiring special skill, by then I tried treating such delayed cases whenever I could distinguish radiologically between the original bone ends and their surrounding callus. The operation, although seems difficult, but it is really an easy one once you peel off the rough callus from the smooth shiny cortical bone of the medial and lateral column. The cleaning of olecranon fossa from callus and fat is essential for more confirmation of reduction.

A real difficulty I have seen was that with cases of SCF + intercondylar fracture (deceptively appearing as a crack on x-ray). Of them I have seen one late presenting and few early presenting. These cases require transverse K- wire to hold the condyles, then crossed wires holding them to the humerus medial and lateral columns. The reduction is a gain guided by restoration of the circular outline of the olecranon fossa. This type of severe injury is usually seen in older children (equivalent to adult injury) and may be added as type V in Gartland's

classification, the fourth one being that described by Leitch as multidirectionally unstable SCF neither in flexion nor in extension[15].

By reviewing the most recent available literatures, non have mentioned about treatment of such delayed PHSCF, the most delayed fractures treated were < 21 days delay and were treated by lateral traction with bad results[16]. The other report was treating late presenting PHSCF(<12 days with a mean of 4 days) by ORIF for those delayed more than 7 days, with 88% satisfactory result [17]. Obviously, it is unwise to compare our results with these two studies. However, we'll compare with other studies treating their PHSCF within 24 hours of injury and with studies treating cubitus varus deformity.

Most of the published results reported: 5 – 12 % iatrogenic nerve injury, though, most recovered spontaneously [1- 8, 12, 17,18-26]; and 5 – 10 % cubitus varus deformity requiring correction due either to poor reduction or loss of reduction[3-5,7,9,11,13-15,17,18,20,22-33]. If one applied these percentages here, the result would be: at least 5 – 12 cases of cubitus varus and iatrogenic nerve injury in only our hospital every year!. Whereas, our results showed 100% satisfactory cosmetic outcome and 93% satisfactory functional outcome at the fourth month follow up hoping for possible better motion improvement even a year later. No study reported myositis ossificance or severe restriction of elbow joint movements following PHSCF. Neither iatrogenic nerve

injury, nor significant varus deformity were seen in this study.

Conclusion

Late presenting PHSCF type III more than 3 – 6 weeks, usually left untreated for later corrective osteotomy; according to our results, it is much better cosmetically and functionally to proceed with ORIF than waiting for less predictable procedures.

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Table 1 Late presenting PHSCF III : seventeen patients

No.	Age	Sex	Side	Mech. Of injury	Fracture type	Previous procedures	Time of delay	Cause of delay	complication
1	4 yr.	♂	Lt.	fall	Ext. III closed	—	24 days	neglect	Ex. Gran.
2	2.5 yr	♀	Lt.	RTA	Flx. III closed	—	42 days	missed	
3	10 yr	♂	Rt.	fall	Ext. III closed	—	46 days	neglect	Pin tract infec.
4	9 mon.	♂	Lt.	fall	Ext. III closed	MUA	33 days	neglect	---
5	12 yr.	♀	Rt.	RTA	Ext. III open	MUA	37 days	Missed unconscious	Ex. Gran. + pin tract inf.
6	7 yr.	♂	Rt.	RTA	Ext. III closed	---	24 days	missed multiple inj.	---
7	6 yr.	♂	Rt.	Fall	Ext. III closed	Prev. pinnig	28 days	Neglect	---
8	5 yr.	♂	Lt.	Fall	Ex. III closed	---	36 days	Neglect	---
9	11 yr.	♀	Rt.	Fall	Ext. III closed	---	40 days	Missed	---
10	3.5 yr	♂	Lt.	Fall	Ext. III closed	MUA	27 days	Neglect	Pin tract inf.
11	7 yr.	♂	Lt.	Fall	Ext. III closed	---	39 days	Neglect	---
12	4.5 yr	♀	Lt.	Fall	Ext. III closed	---	22 days	Missed	Ex. Gran.
13	5 yr.	♂	Rt.	Fall	Ext. III closed	---	36 days	Missed	Ex. Gran.
14	1.5 yr	♂	Lt.	Fall	Ext. III closed	MUA	43 days	Missed	---
15	9 yr.	♂	Rt.	Fall	Ext. III closed	---	30 days	Missed	---
16	3.5 yr	♀	Lt.	Fall	Ext. III closed	---	25 days	Missed	Ex. Gran.
17	3 yr.	♀	Rt.	Fall	Ext. III closed	---	28 days	Missed	---