

Severely Displaced Supracondylar Fracture in Children: Conservative Versus Surgical Treatment

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Abstract

Background: Supracondylar fractures are usually seen in children, it is 10% of all pediatric fractures. The distal fragment may be displaced either posteriorly or anteriorly. Posterior (extension) type is the commonest type (95%) of cases suggests hyperextension injury.

Aim: the aims of this study is to compare the results of conservative versus surgical treatment in severely displaced supracondylar fracture of humerus in children and to compare the results of posterior and lateral surgical approaches.

Patients and Method: Forty six children with severely displaced posterior supracondylar fractures (Wilkins type IIB and III) were studied prospectively over 12 month's duration (Sep.2005-Sep.2006) in Al-Basra teaching hospital. Thirty five (76%) of patients were presented early (≤ 8 hrs.), while the other 11(24%) cases were received late (> 8 hrs.). Closed reduction was done for all cases & it succeeded in 14(30%) cases only, while the other 32(70%) required open reduction through posterior approach mainly (23/32) and via lateral approach in the other (9/32). Crossed 2 K-wires, two lateral K-wires or Steinman pin through olecranon were the three modalities of fixations. Approach and way of fixation been selected according to surgeon preferences.

Results: Among the complications recorded in this study joint stiffness lies on the top of the list, it affects 18 cases (39%) 16 cases treated surgically (12 by posterior approach and 4 by lateral approach) and 2 cases treated conservatively. The second common complication was malunion in the form of cubitus varus deformity which occur in 6 cases (13%) 4 treated conservatively and other 2 cases treated by posterior approach and fixation by Steinman pin through the olecranon process. In those treated by surgery complications were more in association with posterior approach.

Conclusions: In ideal situations when fluoroscopy is available closed reduction and percutaneous fixation by multiple k-wires is good method of management. As the results and the rate of complications of early and late reduction are the same so there is no need for urgent reduction as long as there is no vascular compromise. The favorable approach was the lateral as it shows fewer complications in comparison with posterior one.

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الخلاصة

الخلفية: يعتبر كسر اعلى اللقمتين لعظم العضد من الكسور الشائعة لدى الاطفال حيث تبلغ نسبته ١٠% بين الكسور التي تصيب الاطفال اتجاه نزوح الجزء البعيد للكسر يكون اما خلفي وهو الاكثر شيوعا (٩٥%) او امامي.

اهداف البحث:

- مقارنة بين نتائج معالجة الكسر بالطريقة التحفظية والجراحية.
- مقارنة نتائج التداخل الجراحي من الجهة الخلفية والجهة الجانبية.

المرضى وطريقة العمل: تم اجراء الدراسة على ٤٦ طفل مصاب بكسر اعلى اللقمتين لعظم العضد شديدة النزوح ومن النوع الخلفي (ولكنز IIB,III على مدى ١٢ شهرا) (٢٠٠٥-٢٠٠٦ ايلول) في قسم جراحة العظام بمستشفى البصرة العام. خمسة وثلاثون مريضا (٧٦%) من مجمل المرضى قد تم معابنتهم بوقت مبكر (اقل من ٨ ساعات) بعد الاصابة بينما تم معابنة الاحد عشر مريضا الباقين (٢٤%) بعد مرور اكثر من ٨ ساعات. تم اجراء عملية تعديل الكسر لجميع المرضى بالطريقة المغلقة (التحفظية) تحت تاثير التخدير العام وقد نجحت في ١٤ مريض (٣٠%) فقط بينما احتاج ٣٢ مريض (٧٠%) الى تداخل جراحي لتعديل وتثبيت الكسر من خلال الجرح الخلفي في ٣٢/٢٣ مريضا والجرح الجانبي في ٣٢/٩ مريضا. تم تثبيت الكسر باستخدام اسلاك بشكل صليبي او سلكين من الجانب او باستخدام دبوس ستايمن من خلال النهاية العلوية لعظم الزند ومفصل المرفق. تم اختيار طريقة التثبيت مكان الجرح حسب اختيار الجراحين المعالجين.

النتائج: من بين المضاعفات الاكثر شيوعا والمسجلة في نتائج هذا البحث هو حصول تيبس حركة مفصل المرفق قد حصلت في ١٨ حالة مرضية (٣٨%)، ١٦ حالة قد عولجت جراحيا (١٢ جرح خلفي و٤ جرح جانبي) وفي المريضين الاخيرين حصلت بعد العلاج التحفظي. وجاء التئام الكسر بشكل مشوه وبشكل تقوس المرفق للداخل بالمرتبة الثانية من بين المضاعفات حيث حصلت في ٦ حالات (١٣%) ٤ منها عولجت تحفظيا و٢ حالة عولجت جراحيا من خلال الجرح الخلفي وتثبتت بدبوس ستايمن خلال المرفق.

الاستنتاجات: في الظروف المثالية مع توفر جهاز الفلوروسكوب تعتبر طريقة تعديل الكسر وتثبيته من خلال الجلد باسلاك-ك بدون جرح افضل الطرق العلاجية. لم يلاحظ اي فرق في نتائج علاج المرضى المعابنين مبكرا او بعد ٨ ساعات من الاصابة واستدل من ذلك عدم الحاجة لاجراء تعديل الكسر بشكل طارئ طالما لا تصاحبه علامات عدم كفاءة التروية بسبب ضرر بالشرايين. اجراء الجراحة خلال الجرح الجانبي هي افضل من تلك خلال الجرح الخلفي حيث سجلت اقل نسبة من بين المضاعفات.

Introduction

Supracondylar fracture is among the commonest fractures in children, it is 10% of all pediatric fractures. Posterior (extension) type is the commonest type (95%) of cases suggests hyperextension injury [1, 2]. The incidence peaks at 7 years why? That is the age when children reach their maximum ligamentous laxity (cubitus recurvatum), when a child falls on their extended upper extremity and as the extended extremity attempts to break the fall the olecranon is forced deep into it's fossa causes the humerus to fail in the very thin, weak metaphyseal supracondylar area [3]. The posterior type is classified according to severity of displacement (Wilkin 1984) into type I undisplaced, type IIA angulated fracture, IIB more severely angulated and malrotated, type III fracture: fragment completely displaced which subclassified into posteromedial and

posterolateral they differ in the following aspects:

- 1-nerve and vessel injured
- 2-surgical approach
- 3-rate of complications

The rate of complication is greater with the posterolateral fractures and higher risk of (1) vascular injuries and (2) irreducibility [4].

With the posteromedial fracture the radial nerve is more vulnerable to injury [4]. After closed reduction obtain hyperflexion of the elbow with hyperpronation to lock the distal fragment to the proximal fragment, if unable to obtain full flexion you have to stop, as there may be interposed tissue between the fragments. Using a cast alone for post reduction produces the poorest results when compared with other methods [5,6]. A recent study has demonstrated that asymptomatic pressure of > 30 mm.Hg may occur in the deep volar forearm compartment, even when

the elbow is flexed to just above 90 degrees, for this reasons, some surgeons advocate stabilizing all type II and III fractures by percutaneous pin fixation [7].

Using medial and lateral cross pins has advantages (1) being most stable construct, (2) post operatively, one is able to fully extend elbow to visualize coronal alignment, but it has one disadvantage that is ulnar nerve injury more likely which can be minimized by making an incision directly over the medial epicondyle and insertion of the pin under direct vision in addition a nerve stimulator can also be used to localize the nerve. Using 2 lateral pins is easy to apply and almost no risk of nerve injury, the disadvantage of this method it has poor rotational stability which can be enhanced by separating the pins and adding a third pin [8, 9]. The "pucker sign" which may indicate irreducibility, the proximal spike may be disimpaled by performing the "milking" maneuver; the brachialis is milked distally past the impaled fragment [10].

In the irreducible fractures, the preferred surgical approach is that one which increases the ability to visualize the interposed vital structures, for posterolateral fracture anteromedial incision is favored to visualize the median nerve and brachial artery, for posteromedial fracture an anterolateral incision is used to visualize the radial nerve[11,12].

The posterior Triceps splitting approach is easy one and allows direct visualization of fracture site but it injures virgin tissue with inability to visualize anterior artery and nerve. The primary purpose of an open reduction is to remove the interposed structures which facilitate a closed reduction and a percutaneous pinning. The most tissues preventing an anatomical reduction is the periosteum which tears proximally and remains attached distally and evidenced on x-ray as gap in the fracture [11,12].

For late appearing fractures with radiological signs of healing, wait policy is more wise than repeating the closed reduction or do open reduction as remodeling can change things in addition to the risk of myositis ossificans is high after doing a late open reduction[13].

The displacement pattern of the distal fragment is the main factor determines which nerve is most likely to be injured with type III fracture, with posteromedial extension fracture the radial nerve is most commonly injured, With the posterolateral extension fracture pattern the median nerve is most commonly injured, with complete motor and sensory median nerve deficit with the lack of sensation in the forearm compartment may mask the pain of a developing compartment syndrome [13,14].

With the flexion fracture pattern the ulnar nerve is commonly injured. The two major categories of vascular complications are:

1. Direct (incidence 5%)
2. Indirect (incidence <1%)

The fracture pattern that has the highest incidence of vascular injuries is posterolateral. The major indirect vascular complication is compartment syndrome. Oxymeter does not adequately assure against that a compartment is not present as it measures only skin oxygenation, not muscle blood flow. Functional evaluation is better than technology in evaluation the adequacy of muscle blood flow which involves the presence or absence of pain in the muscles and the quality of forearm muscle function. If a patient has the clinical findings of a compartment syndrome, initiation the treatment for a compartment syndrome without the need for measuring compartment pressure [13, 14].

In general the malunion deformities are grouped into (1) angulation (2) translocation (3) rotation. Translocation usually remodels but angulation remodels very little if any. The angulation in the coronal plane manifest

clinically as cubitus varus and as hyperextension in the sagittal plane which may result in loss of elbow flexion it is usually of no clinical or functional significance [15].

Patient and Method

Forty six children with severely displaced posterior supracondylar fractures (Wilkins type IIB and III) were studied prospectively over 12 month's duration (Sep.2005-Sep.2006) in Al-Basra teaching hospital .All those patients who presented early(≤ 8 hrs.) with mild swelling were treated by closed reduction under general anesthesia ,while those who presented late (> 8 hrs.) with severe swelling were treated according to associated ischemic signs, if there is no ischemia the reduction postponed until edema subside using Dunlop traction for 5-7 days. If there is signs of ischemia immediate trial of closed reduction and rechecking of vascularity of the limb, if no improvement following reduction, vascular consultation is mandatory. If closed reduction failed then an open reduction became mandatory through posterior (tongue or splitting) or lateral approaches. Crossed 2 K-wires, two lateral K-wires or Steinman pin through olecranon were the three modalities of fixations been used according to surgeon preferences. In those treated by posterior approach, tongue flap used in 8 of them and fixation by 2 crossed K-wires, while the other 15 cases splitting of triceps tendon were adequate and fixation by 2 crossed K-wires in 12, 2 lateral K-wires in one and Steinman pin through the olecranon process in two cases. In remaining 9 cases open reduction were done through lateral approach and fixation by 2 lateral K-wires (surgery done by different surgeons).Post reduction x-ray was requested for all cases and repeated after one week in those treated conservatively to check for any

displacement, k-wires were removed 6-8 weeks but splint kept for 8 weeks then physiotherapy was started.

Results

Thirty patients (65%) were male and 16(35%) were female mainly in those aged ≥ 5 years [36(78.2 %)]. The fracture affecting non dominant hand in the majority of cases [28(60.9%)] .RTA was the cause in only 2 cases (4.4%) while fall on an outstretched hand (FOSH) was the main mechanism of injury. Open fracture happen in 2 cases only (4.4%).Thirty five (76%) of patients were presented early (≤ 8 hrs.), while the other 11(24%) cases were received late (> 8 hrs.). Closed reduction was done for all cases & it succeeded in 14(30%) cases only, while the other 32(70%) required open reduction through posterior approach mainly (23/32) and via lateral approach in the other (9/32) cases.

Among the complications recorded in this study as shown in tables (1) , joint stiffness lies on the top of the list, it affect 18 cases (39%) (16 cases treated surgically and 2 cases treated conservatively) it is more common in association with posterior approach (table2). The second common complication was malunion in the form of cubitus varus deformity which occur in 6 cases (13%) (4 treated conservatively and other 2 cases treated by fixation by Steinman pin through the olecranon process via posterior approach. Nerve injuries occur in 3 (6.5%) cases treated by operation 2 through posterior and 1 through lateral approaches; brachial artery compression recorded in 2 cases (4.3%) exposing to conservative treatment. Infection happen in only one case (2%) treated by surgery. Compartment syndrome not recorded in this stud.

From table (2) complications are more with posterior approach than lateral one.

Table (1): Complications of different methods of treatment.

Complication	Posterior approach		Lateral approach	conservative	Total
	Tongue	Splitting			
Stiffness	6	6	4	2	18
Malunion	-	2	-	4	6
Nerve injury	1	1	1	-	3
Brachial a. injury	-	-	-	2	2
Infection	1	-	-	-	1

Table (2): Complications of different surgical approaches.

	Lateral approach#	Posterior approach*
Stiffness	4(44.4%)	12(52.17%)
Malunion	-	2(8.69%)
Nerve injury	1(11.11%)	2(8.69%)
Infection	-	1(4.35%)
Brachial artery injury	-	-

9 cases out of 32 patients were treated surgically

*23 cases out of 32 patients were treated surgically

Discussion

The age and sex distribution among our cases was agreed with the results of Alburger [3]. As this study show no reasonable differences between early and late management which supported by Layenger *et al*[4], the fractures have not need to be reduced in the middle of the night, as long as there is no evidence of any vascular compromise. Several studies have demonstrated that a delay of 6-8 hours in reducing these fractures does not increase the incidence of complications or unsatisfactory results [16, 17, 18]. Closed reduction with splint or cast immobilization has traditionally been recommended for displaced supracondylar fractures, but loss of reduction and the necessity of repeated manipulations have been frequently reported to cause elbow stiffness and physeal damage. Our results goes with Pirone *et al* [19] who reported that closed reduction and casting of displaced fractures resulted in a lower percentage of good results and higher percentages of early and late complications compared with

skeletal traction, percutaneous pinning, and open reduction; they recommended cast treatment only for undisplaced fractures. As noted by Terry [20], closed reduction is difficult not only to achieve, but also to maintain because of the thinness of bone of the distal humerus between the coronoid and olecranon, where most supracondylar fractures occur. For this reason, many authors have described percutaneous pinning techniques, and these techniques have become the treatment of choice for most supracondylar fractures. Swenson [21] and Casiano [22] used two crossed pins. Arino *et al* [23] recommended two lateral pins, and Foster and Paterson [24] used two lateral "divergent" pins, whereas Haddad *et al* [25] used two pins laterally and one medially. In our locality the shortage of availability of image intensifier make percutaneous pinning a bit difficult so that open reduction and internal fixation of supracondylar fractures are indicated when closed reduction is unsatisfactory which supported by Ohew *et al* (11). In a type III displaced fracture with

no cortical contact and completely detached periosteum, and with the fracture fragment "puckering" or even penetrating the skin (open fracture), a satisfactory closed reduction may not be possible. If, after one or two attempts at closed reduction with the child under general anesthesia, the fragments cannot be reduced and held by percutaneous pinning, open reduction and internal fixation are indicated [26,27,28,29].

According to Rasool and Naidoo [30] manipulation should be avoided in displaced type III posterolateral supracondylar fractures with neurovascular deficit if clinical evidence indicates that the fracture fragment has buttonholed through the brachialis muscle, since the neurovascular bundle may be trapped in the fracture site.

If open reduction and internal fixation are to be carried out, they should be performed after the swelling has decreased but not later than 5 days after injury, since the possibility of myositis ossificans apparently increases after that time which also recommended by Lal *et al* (13). Some prefer a lateral approach; others have used posterior, medial, anterolateral, and antecubital approaches. Kekomäki *et al* [31], using an antecubital approach, as well as Danielsson and Petterson[32], using a medial approach, described good results using open reduction and internal fixation of severely displaced fractures that could not be reduced or had significant vascular embarrassment. They also recommended fasciotomy at the same time. Gruber and Hudson [33] treated 31 difficult fractures with open reduction and internal fixation and obtained satisfactory results even in the most severe fractures. We found that the favorable approach was the lateral as it shows fewer complications in comparison with posterior one.

The most dreaded complication is Volkmann's ischemic contracture; the most lasting complication is cubitus varus. The

order of frequency of the complications those are associated with Supracondylar fractures:

1. nerve injury
2. vascular injury
3. malunion
4. myositis ossificans
5. Avascular necrosis

The overall incidences of nerve injuries associated with supracondylar fractures is 7.7 % [14] in comparison to our results (6.5%).

The most common nerve involved is the median nerve in particular the anterior interosseous nerve which manifest by lack of thumb and index finger flexion but no sensory loss. The most common complication associated with this nerve is failure to recognize the dysfunction in the initial examination. The reason behind the vulnerability of this nerve to injury is the passage of it under a thick fibrous arch of the deep head of the pronator teres in the proximal forearm [14].

Conclusion

In ideal situations when fluoroscopy is available closed reduction and percutaneous fixation by multiple k-wires is good method of management. As the results and the rate of complications of early and late reduction are same so there is no need for urgent reduction as long as there is no vascular compromise. The favorable approach was the lateral as it shows fewer complications in comparison with posterior one.

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