Operative treatment of proximal humeral fractures in children: Indications and results

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ABSTRACT

Background: In most children proximal humeral fractures are treated non-operatively with generally good results. This review discusses the indications of operative treatment and assesses the treatment results. **Materials and Methods:** The charts of 20 patients (14 girls; mean age: 12.3± 2.8 years; range: 7-16 years) with proximal humeral fractures who were operated on at our institution were reviewed from 1992 to 2002. **Results:** There were five metaphyseal fractures and 15 physeal injuries which were angulated according to Neer-Horowitz score as grade III in four cases and grade IV in 16 cases with a mean angulation of 47.8±39.1 degrees (range: 6-148 degrees). Associated lesions comprised open fracture and head trauma in two cases each. Patients with associated injuries were operated on primarily and the 16 others by secondary intention. All but one were reduced via an anterior approach with internal fixation. They were assessed for clinical and radiological healing at a mean follow up of 3.6 years ranging from 1.2 to 7.8 years. **Conclusion:** Based on our study, surgical option is indicated for severely displaced and unstable fractures in older children and adolescents.

Key words: Children, humeral fractures, operation

INTRODUCTION

Proximal humeral fractures account for only 1% of all fractures in children and 3 to 6% of all epiphyseal injuries.[1] As in most fractures in children, they are treated non-operatively with generally good results. The surgical option, usually limited to open and irreducible fractures, tends to be extended to other clinical circumstances and has become a matter of controversy over the years. Currently, the surgical option constitutes 10 to 15% of the treatment options.[2,3] This study discusses the indications and methods of surgical treatment based on a 10-year experience of 20 cases, and compares our results with the literature.

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MATERIALS AND METHODS

This was a retrospective study of patients operated on for proximal humeral fractures at the Department of Paediatric Surgery, CHU de Yopougon, Abidjan, Côte d'Ivoire, from 1992 to 2002. Their records were investigated for clinical data, surgical indications and treatment results.

RESULTS

There were 20 patients, 14 girls and six boys; their mean age was 12.3 ± 2.8 years (range = 7-16 years).

Table 1 summarises the clinical findings. There were five metaphyseal and 15 physeal fractures. Based on the Salter-Harris[4] classification, we identified five type I and 10 type II injuries. The magnitude of displacement was grade III in four patients and grade IV in 16 patients according to the Neer-Horowitz[5] grading score (mean angulation 47.8 ± 39.1 degrees ; range: 6-148 degrees).

Associated lesions included open injuries and head injury in two patients each. Patients with these complications were operated on primarily but the 16 others were operated by secondary intention. Surgery in those with head injury was delayed for 2-3 weeks due to their critical condition.

Indications for secondary surgery in the 16 patients without open injury or head injury were irreducibility in three cases and re-displacement in 13. Open reduction was required in two of three cases of irreducibility to relieve shoulder dislocation prior to obtaining reduction; the remaining patient had an interposed biceps tendon. Thirteen patients with re-displaced fracture with a mean additional angulation of 25 degrees required open reduction and internal fixation.

Open reduction was via a deltopectoral approach with internal fixation (ORIF) using K-wires fixation in 18

Table 1: Summaries of demographic and clinical data

Case no.	Age (years)	Sex	Type	SH[1]	NH[2]	Treatment	Results
1	10	F	PF	I	4	ORIF	Excellent
2	11	F	PF	II	4	ORIF	Excellent
3*	12	F	MF	-	3	ORIF	Excellent
4	15	F	PF	II	4	ORIF	Good
5	15	M	PF	I	4	ORIF	Good
6	10	F	PF	II	4	ORIF	Excellent
7**	15	M	MF	-	3	ORIF	Excellent
8	14	F	PF	II	4	ORIF	Excellent
9	12	M	MF	-	3	ORIF	Excellent
10	11	M	PF	I	4	ORIF	Excellent
11*	7	F	MF	-	4	-	Excellent
12	15	M	PF	I	4	ORIF	Good
13	15	F	PF	I	4	ORIF	Good
14	8	M	PF	II	4	ORIF	Excellent
15	12	F	PF	II	4	ORIF	Excellent
16	13	F	PF	II	4	ORIF	Excellent
17	13	F	PF	II	4	CRIF	Excellent
18**	14	F	MF	-	4	ORIF	Excellent
19	7	F	PF	II	4	ORIF	Excellent
20	16	M	PF	II	4	ORIF	Excellent

PF: Physeal fracture; MF: Metaphyseal fracture; [1]Salter - Harris classification. [2]Neer - Horowitz grading score

(*) Open injury; (**) Brain trauma

patients and intramedullary nailing in one [Figure 1]. One patient could not have ORIF because of sepsis caused by late referral.

The mean surgery time was 9.6 days and healing duration averaged 48.65 days (range = 38-69 days). Postoperatively, all were immobilised using a Mayo clinic sling until union, at which time pins were removed. They were assessed for fracture healing, radiologic and functional results. We adjudged the result excellent if shoulder function was similar to the normal side, good if the function was normal with radiologic imperfections and fair when both were abnormal. Patients were assessed clinically and radiophysically at 3 months, 6 months and annually thereafter.

The follow up period averaged 3.6 years (range = 1.2 to 7.8 years). At follow up, excellent and good results were achieved in all the patients and all were painfree. Three girls developed marked keloids and two patients had minor valgus deformity without clinical significance. Neither physeal arrest nor avascular necrosis was observed.

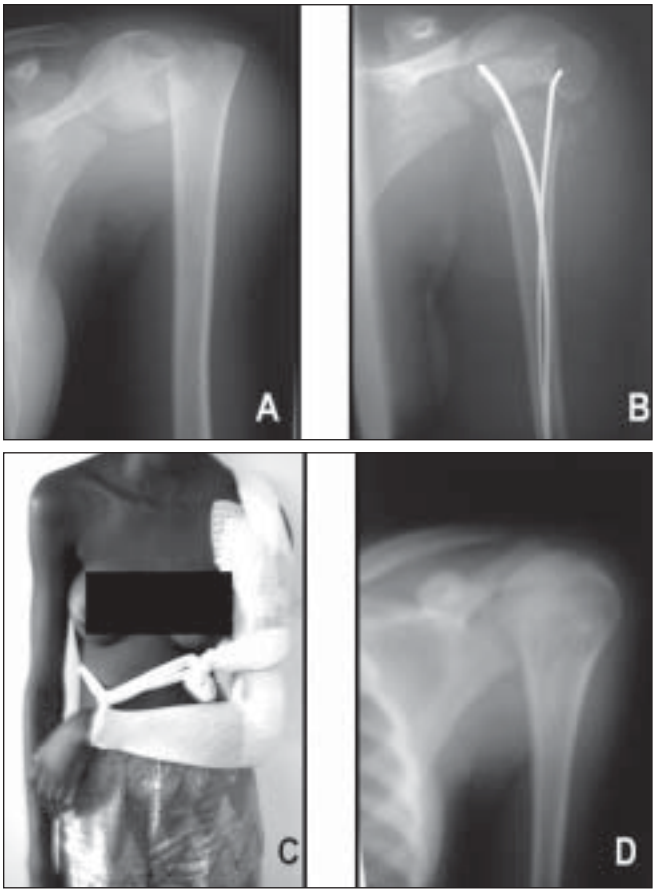


Figure 1: (A) A Salter-Harris type II fracture of the proximal humerus in a 13-year-old girl (B). A Retrograde intra medullary nailing was performed by open reduction through a deltopectoral way (C). This photograph shows the use of a Mayo clinic sling (D). Solid union was achieved three months after injury in the same patient

DISCUSSION

Most proximal humeral fractures in children are treated non-operatively with good results because the great remodelling potential in this area obviates imperfections of reduction.[1,2] Thus, surgical options are limited to open and irreducible fractures, and those

with neurovascular damage. Surgical intervention in unstable fractures and polytraumatised cases is controversial.[2,6]

In our series, interposed biceps tendon and associated shoulder dislocation necessitated surgical intervention, although Kohler[7] and Chapuis[8] reported successful closed reductions in such instances. However, their patients had prompt reduction, whereas in ours, acute swelling due to late referral prevented adequate reduction. We chose to fix each case to avoid any further displacement after the swelling had resolved. In the same way, we pinned one opened patient at débridement stage although this usually does not require internal fixation. We opted for primary surgery in head injured cases, to aid nursing and critical care.[6]

In dealing with displaced fractures, three main factors dictate treatment options: the patient's age, degree of displacement and stability of fracture. Most surgical indications of our series are related to older children with unstable fractures. In terms of age, surgical options are mainly required in older children.[1-3] Half of our patients were aged 13 and above; the poor remodelling ability at this age justifies a more aggressive treatment. David *et al*.[2] in a recent study reported that these fractures are overtreated since good results were achieved irrespective of age, fracture type and treatment. Thus it appears that the degree of displacement (marked angulation), rather than age alone, is the main determinant of the surgical option.

In this series, all were Neer grade III/IV with a high frequency of re-displacement. The relationship between degree of displacement and fracture stability favoured surgical treatment in this study. Beringer *et al*.[3] reported only nine surgical indications among 48 markedly displaced physeal injuries. Clément *et al*.[9] believed that any physeal angulation >20° would correct because of expected adequate remodelling. This implies repetitive manipulative trials whose effects on the growth plate must be questioned. We agree with Bright *et al*.[10] that no more than two trials are ideal for avoiding iatrogenic physeal damage.

On the whole, surgical decision should result from careful analysis taking into account many factors. The choice between surgical approaches and the use of closed reduction and internal fixation (CRIF) in children is critical. In our series, all were openly reduced with internal fixation since we did not yet have good knowledge of CRIF at the time of the study. Currently, elastic intramedullary nailing appears to be better than percutaneous pinning for a more rapid recovery of the shoulder motion.[11] Since we just began to apply this way of fixation, no inference can be deduced from this yet [Figure 1].

Satisfactory outcome was achieved in all patients and no variation from standard healing duration. Also, no functional impairment was observed in the two patients who had developed a minor valgus deformity. Dobbs *et al*.[12] reported good results in a series of Neer grade III/IV proximal humeral physeal fractures. Contrary to the report by Kohler *et al*.[7] none of our patients developed physeal arrests.

Based on this study, surgical treatment is a safe alternative for severely displaced and unstable fractures of the proximal humerus in older children with minimal remodelling potential.

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Source of Support: Nil, **Conflict of Interest:** None declared.