Original Article
African Journal of Paediatric Surgery
Vol. 3 (2); Jul - Dec 2006

Traumatic physeal injuries Retrospective study on 113 cases at Yopougon teaching hospital (Abidjan)

Blessures traumatisantes de l'épiphyse - étude rétrospective de 113 cas au centre hospitalo-universitaire de Yopougon (Abidjan)

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Abstract

Background: African data on physeal injuries are lacking; the current study aimed to describe their anatomic patterns; to discuss treatment options; and to analyze results of treatment.

Patients and Methods: From 2000-2004, a cohort of 113 physeal injuries (76 boys; mean age: 11.5±2.9 years; range: 5-15) was reviewed for demographic and clinical data at our institution. Injuries were classified according to Salter-Harris (SH). In first intention, we treated closely Salter-Harris type 1-2, and surgically the other types and failures of initial reduction. Patients were assessed for union and complications rates at a followup averaged 1.2±0.8 years.

Results: The main injury cause was car accident (56.6%); radial (29.2%) and femoral (28.3%) distal sites were mostly involved; Salter-Harris type 2 predominated (68.1%). Closed reduction was successful in 97 patients (27 SH1, 70 SH2); surgery is indicated in 16 patients of whom 7 (5 SH3, 2 SH4) by primary intention, and 8 (1 SH1, 7 SH2) secondarily. The mean healing index was 59.8 days (upper limb: 44.4; lower limb: 75.3). Late complications (6.2%) included 3 growth disturbances, 2 stiff knees, 1 painful and 1 stiff ankle. Growth disturbance was statistically correlated to age of patients ($p>0.05$) but not to fracture site ($p<0.05$, Fischer exact test).

Conclusion: This series supports that Salter-Harris type 1-2 should be treated closely in first intention while surgical indications should be reserved for Salter-Harris articular types.

Key-words: Physeal injuries , trauma , children.

Résumé

Arrière-plan : Il manque des données africaines sur les blessures de l'épiphyse; la présente étude a eu l'intention d'en décrire les modèles anatomiques; de discuter des options de traitement; et d'analyser les résultats du traitement. ***Malades & méthodes:*** De 2000 à 2004, nous avons revu à notre établissement 113 blessures de l'épiphyse (76 garçons; âge moyen: 11.5±2.9 années; gamme: 5-15) pour en tirer des données démographiques et cliniques. Les blessures ont été classées selon le système Salter-Harris (SH). Dans un premier temps, nous avons traité attentivement les catégories 1-2 du type Salter-Harris et nous avons recouru à la chirurgie pour les autres types et ceux qui avaient échoué à la réduction initiale. Les malades ont été évalués pour la fusion et les complications. Les taux au suivi étaient, en moyenne, de 1.2±0.8 années. ***Résultats:*** La cause principale de la blessure était l'accident de voiture (56.6%); impliquant surtout les côtés radial (29.2%) et fémoral (28.3%) du distal. La deuxième catégorie du type Salter-Harris était prédominante (68,1%). La réduction fermée a réussi chez 97 malades (27 SH1, 70 SH2); la chirurgie a été recommandée pour 16 malades, parmi lesquels 7 (5 SH3, 2 SH4) étaient par intention primaire, et 8 (1 SH1, 7 SH2) secondairement. L'index curatif moyen était de 59,8 jours (membre supérieur: 44.4; membre inférieur: 75.3). Parmi les complications ultérieures, (6.2%), on compte 3 perturbations de la croissance, 2 genoux raides, une cheville douloureuse et raide. La perturbation de la croissance correspond statistiquement à l'âge des malades ($p>0.05$) mais non pas à l'endroit de la fracture ($p <0.05$, épreuve exacte de Fischer). ***Conclusion:*** Cette série supporte que la catégorie 1-2 du type Salter-Harris soit traitée attentivement initialement alors que les indications chirurgicales devraient être réservées pour les types articulaires de la maladie Salter-Harris. ***Mots-clés:*** Blessures de l'épiphyse - traumatisme - enfants.

Introduction

The physis or growth plate provides bone longitudinal growing, but also defines a weak cleavage plane between epiphysis and metaphysis making possible fractures separations that have been well described by the Salter-Harris

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classification.[1] These physeal fractures can lead to angular deviations and length discrepancies. Their treatment is currently discussed regarding the use of closed versus open means. Although this topic has been extensively studied through the literature, the lack of African data justifies this investigation.

Methods

This study included all children aged within 15 years admitted for traumatic physeal injuries of limbs at paediatric surgery unit of Yopougon teaching hospital (Abidjan, Côte d'Ivoire). A retrospective review of 1873 children who sustained fractures in the period January 2000 to December 2004 was performed at our institution.

We enrolled 113 consecutive physeal injured children with a regular followup from initial injury until fracture union. We defined acute traumatic physeal injuries as those resulting from trauma = 24 hours. Physeal injuries of other nature and apophyseal injuries were excluded. Due to their particular locations, proximal femoral and distal humeral sites were not included in this study. The original x-rays and complete case records were investigated for demographics and clinical data that's included injury mechanism, fracture type, treatment required and outcomes. The physeal injuries were classified according to Salter-harris2 (SH) on the basis of AP and lateral plain x-rays. Closed treatment was indicated for SH1-SH2 injuries in primary intention; it has consisted in reduction under C-arm x-rays followed by a molded plaster. Surgical treatment was indicated for SH3-SH4 injuries and after failure of closed attempt; we used parallel screws or crossed K-wires fixations either openly or percutaneously. Patients were followed clinically and radiophically until fracture union and thereafter at 6 months intervals with follow-up averaged 1.2 ± 0.8 years (range, 0.73.5 years). We used the Fischer's exact test for statistical comparisons.

Results

During the study period, 113 of 1873 patients have fit the inclusion criteria, that's accounting for 6.1% of all bone fractures; there were 76 boys and 37 girls (ratio, 2:1); the mean age was 11.5 ± 2.9 years

Table 1: Anatomic Distribution of major physeal injuries

Fracture site	Proximal	Distal	Total (%)
Radius	1	32	33 (29.2)
Femur	0	32	32 (28.2)
Tibia	0	24	24 (21.2)
Humerus	8	0	8 (7.1)
Fibula	0	10	10 (8.8)
Ulna	0	6	6 (5.3)
Total (%)	9 (7.9)	104 (92.1)	113 (100)

Table 1: Anatomic Distribution of major physeal injuries

SH* Pattern	Surgical Care	Orthopedic Care	Total (%)
Type I	1	27	28 (24.8)
Type II	7	70	77 (68.1)
Type III	6	0	6 (5.3)
Type IV	2	0	2 (1.7)
Type V	0	0	0 (0)
Total (%)	16 (14.1)	97 (85.8)	113 (100)

with a peak incidence in the 12-to-15 year age group (fig.1); the physeal injuries were caused by motor vehicle accident (56.6%), recreational activities (19.5%), high fall (16.8%), sport activities (6.2%) and others (0.9%); the injured children were pupils (65%), pedestrians (89%), passengers (6.3%) or motorcyclists (4.7%); the mechanism of injury was indirect (54.8%), direct (13.3%) and unknown in 31.9% of cases.

Repartition of physeal injuries according to anatomic site is shown in table I. We noted a predominant occurrence at the lower limb (58.4%). The end of bone was affected in majority of cases (92.1%). Distribution of physeal fractures regarding their Salter-Harris1 patterns is resumed in table II. Salter-Harris type 2 was predominant (68.1%), but type 5 was not recognized. Associated lesions were present in 26.5% of cases with 7 open fractures, 13 head-injured patients, 6 thoracic and 4 abdominal blunts.

Ninety seven (86.4%) patients (27 SH1, 70 SH2) were treated closely, and 16 surgically (13.6%) with screws fixation for 5 femoral (2 SH2, 2 SH3 and 1 SH4) and 4 tibial SH3 injuries; K-wire fixation was used in 5 humeral SH2 and 1 femoral SH1 injuries;

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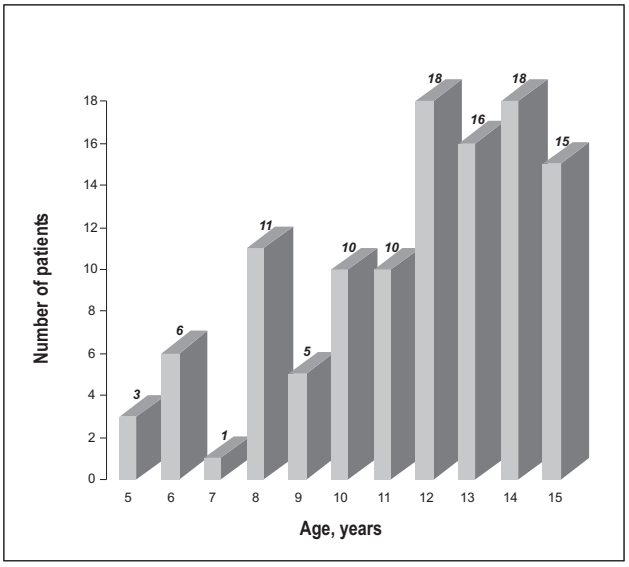


Fig. 1: Distribution of physeal injuries according to age

year-old boy with SH4 injury and have required a corrective surgery. The age of patient at injury time was significantly correlated to growth disturbance occurrence (p=0.88), but no statistical relation was found between fracture site and the risk of growth disturbance (p=0.17; Fischer exact test).

Discussion

Physeal injuries accounted for 6.1% of all bone fractures, that differs from the current reportedly rates of 15 to 20%, from two main series by the Petersons[2] (1972) and Mizuta[3] (1987) which are now>20 years old. Their incidence is poorly cited due to the lack of studies that given an overall view as compared with those by anatomic locations. However, this ratio has not varied much over the years if we refer to the rate of 17.9% from Kawamoto 2006 recent study.[4] Thus, care must be taken in interpreting ours since it may not undervalue the true incidence. Otherwise, the peak incidence between age 12 and 15 supports the hypothesis of growth plate weakness at the onset of puberty as suggested by Bright[5] experimental studies. Lastly, the high rate of male in our series may result from their high propensity for increased activity level.

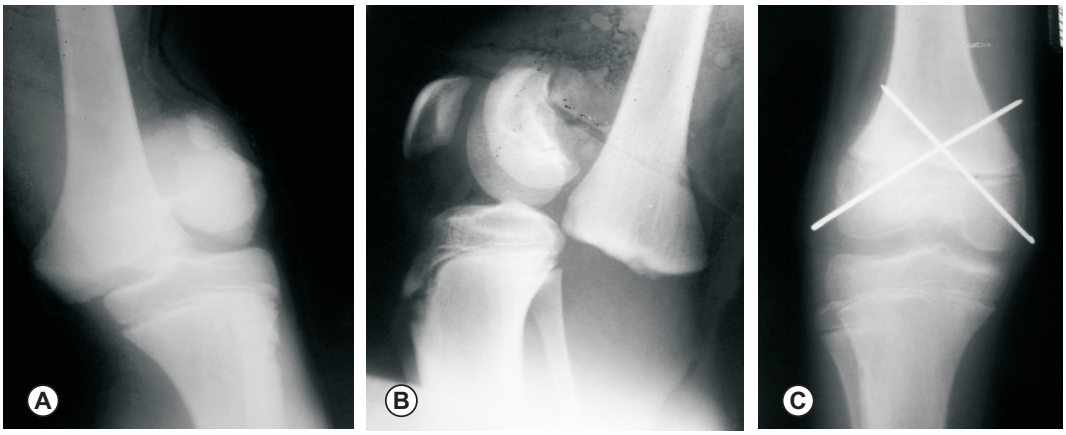


Fig.2: a) A 12 year-old-girl suffered a SH1 injury of the end of femur by motor vehicle accident; b) Lateral x-rays view showed the posterior displacement of distal fragment in the same patient; c) This unstable fracture was stabilized with percutaneous K-wires fixation after loss of reduction.

both fixations were used in 1 tibial SH4 injury (table II). The mean healing index was 59.8 days, running for 44.4 days (range, 28 -70) at the upper limb to 75.3 days (range, 40-103) at the lower. Seven patients (6.2%) had developed complications that included 3 growth disturbances (2.6%), 2 stiff knees, 1 painful and 1 stiff ankle. A 12-year-old boy with SH3 injury showed a varus deformity of 5 degrees due to medial physeal arrest; a SH3 injury yielded complete physeal arrest with leg-length discrepancy of 1.5 centimetres in a 6-year-old girl; both valgus deformity of 20 degrees and length discrepancy of 3.5 centimetres appeared in a 12-

On anatomic viewpoint, the distribution of physeal injuries in our study is similar to others series in which the end of the radius was also the most in-volved extre-mity.[2,3] However, in some series physeal injuries predominated at the upper limb that differs from ours in which the lower limb was more affected with prevalent location at distal femur. This may result from their high rate of sport injuries versus motor vehicle accident in ours3,4. Concerning the Salter-Harris' classification, type 2

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injury was the most common type as unanimously observed.[1,2,4]

Regarding treatment, with 86.4% of successful closed treatment, it was sufficiently efficient to make surgical means questionable in Salter-Harris types I-II. To our opinion, only unstable and irreducible fractures should require surgery either to prevent the iatrogenic effect of repeated closed attempts or to look for anatomic reduction. In this way, we have to pin percutaneously one unstable femoral SHI (fig.2); we have also to remove interposed periostum in 2 femoral SH II for gaining anatomic reduction since a residual gap can lead to premature physeal closure6. Two open injuries of 5 humeral SH II were pinned at debride-ment time; in two of them who were near skeletal maturity, we also chose pin fixation due to the remaining poor potential of remodelling; at last, we have to remove an interposed biceps tendon prior pinning in the remainder.[7] Current treatment of Salter-Harris types III-IV is less discussed regarding the use of closed versus open means, since most of authors consider surgery as the best way to restore physis and articular continuities.[8] This double threat of treatment has dictated our choice for a systematic open reduction for Salter-Harris articular types even if this does not guarantee avoiding further complications as seen in one patient of our series.

No specific variation was noted in healing duration as compared standard union times with ours. However, our complications rate (6.2%) was lower than those previously cited (15 - 40%) in which a high rate of growth arrest namely at distal femur was outlined.[9] Nevertheless, we did not find correlation between growth arrest rate and the femoral site in our series ($p<0.05$). This low rate may result from the relative shortness of our follow-up as physeal arrest may be delayed for 6 months or longer even until completion of growth plate. Conversely, we found a significant correlation between age of patient at injury time and growth disturbance ($p>0.05$). Furthermore, even if osseous bridging can be expected by looking for migration of the Harris-Park lines, in practical viewpoint it was difficult to make an early diagnosis of physeal bridging based only on plain x-rays. Nowadays, magnetic resonance imaging is the most effective way in revealing presence, location and extends of physeal bridge.[10] Since this equipment was not at our disposal for this series, procedures of osseous bridge excision can not be carried out.[11] Therefore, we could go no further than the old standard for treatment of these lesions which recommends corrective osteotomy if the limb developed an angular deformity and lengthening procedures if the limb became short.

Traumatic physeal injuries are more likely to involve male adolescent and anatomic distal sites, and be a SH II injury. Salter-Harris types I-II should be treated closely in primary intention, when other types should be operated for achieving an anatomic reduction. Early diagnosis and adequate treatment of physeal bridge can prevent deformities and further aggressive corrections.

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