International Journal of Surgery and Surgical Research
www.surgeryjournals.net
Online ISSN: 2664-9179, Print ISSN: 2664-9160
Received: 06-11-2023, Accepted: 22-11-2023, Published: 07-12-2023
Volume 5, Issue 1, 2023, Page No. 20-23

Short and medium term following of osteosynthesis of closed diaphyseal fractures in child: Preliminary results and epidemiological profile in two Black African Countries

Hermann Victoire Feigoudozoui[1*], Théodore Mempanou[2], Jodine Raïssa Djieutcheu Tchokotcheu[3], Mukwelle Karla Acha[4], Joslanie Mba Noumi Nyansi[5]

[1] Department of Pediatric Surgery, University Hospital of Treichville, Abidjan, Ivory Coast
[2] Department of Epidemiology, University of Maryland School of Medicine, United State of America
[3] Integrated Center of Health and Social Services of West Montérégie, Québec, Canada
[4] General Hospital of Yaoundé, Yaoundé, Cameroun
[5] MedStar Southern Maryland Hospital Center, Maryland, United State of America

Abstract
Aim: To describe the clinical evolution and the epidemiological profile of long bone fractures in child.
Patients and Method: This was a five-year retrospective study of closed fractures of long bones in children aged 9, 7 years on average. 74 fractures were synthesized by guying or screwing. The results were evaluated according to Osthern and Tscherne and parental satisfaction by an individual investigation form.
Results: The following operations were marked by complications such as infection (17%), implant migration (18%), nonunion (10%) and vicious callous (4%). According to the assessment criteria, 32% were excellent, 47% were good and 20% were bad. 20% of parents were very satisfied, 62% were satisfied and 17% were disappointed with the results of the management.
Conclusion: Osteosynthesis in common pediatric trauma are only indicated if the capabilities of remodeling of a callous are insufficient. Osteosynthesis should not be the first choice in children therapeutic arsenal of fractures.

Keywords: Africa, children, fracture, long bone, osteosynthesis

Introduction

More than thirty per cent of children suffer at least one fracture before the age of 17 [1]. Open or closed fractures of the long bones in young children are not uncommon. Closed fractures with a stable line are preferably treated orthopedically [2, 3, 4]. Unstable fractures are usually treated surgically [5]. The most widely used osteosynthesis for diaphyseal fractures of the long bones in children is stable elastic centromedullary nailing (SECN) [4, 6]. Surgical treatment is often associated with complications, the most common of which are infection, pseudarthrosis and malunion [6 - 8]. The risk of post-operative complications is increased in poor conditions in developing countries. The aim of this study is to describe the clinical course of osteosynthesis and the epidemiological profile of closed diaphyseal fractures in children.

Patients and Method

Between January 2017 and December 2021, in Ivory Coast and Cameroun, a single-center retrospective study was conducted on 91 children with a mean age of 9.7 years (Extremes: 4 and 16). Seventeen children were lost to follow-up. 74 cases were retained and collated, including 43 boys and 31 girls with a sex ratio of 1.4. Open fractures, pathological fractures, children under 4 years of age and orthopedically treated fractures were not included. Children over 10 years of age were in the majority. The circumstances of occurrence were predominantly play accidents. The right side was the dominant side. There was no bilaterality. The most common fractures were those of the femur, humerus, and tibia. The average time to treatment was 4.7 days (Extremes: 1 and 62). Osteosynthesis by pin or screw plate was indicated either immediately or after failure of orthopaedic treatment. Most of indications were for closed SECN. More than half of the fractures had healed. The mean follow-up was 6 months (extremes: 1 and 9 months). The criteria of Osthern and Tscherne [2] were used to assess clinical and functional outcomes. Parental satisfaction was obtained by means of an individual questionnaire. The data were processed and analyzed using Epi Info software. The significance threshold was set <0.05.

Results

At a mean follow-up of 6 months, 74 fractures had been synthesised using SECN or a screw-retained plate, 66 of which were consolidated. The mean post-operative hospital stay was 11.3 days (Extremes: 2 and 32). The socio-demographic data for the epidemiological profile are shown in Table I. 38 (51%) osteosyntheses developed complications, details of which are given in Tables II, III and IV. According to the Osthern and Tscherne evaluation criteria, 24 (32%) outcomes were excellent, 35 (47%) were good, and 15 (20%) poor. Finally, 15 (20%) parents were very satisfied, 46 (62%) were satisfied and 13 (17%) were disappointed with the outcome.

Table 1: Epidemiological characteristics of the series.

Data	n (%)
Age	
< 6 years	8 (10%)
6 – 10 years	29 (39%)
>10 years	37 (50)
Gender	
Female	31 (41%)
Male	43 (58%)
Circumstance of occurence	
Play accident	47 (63%)
Traffic road accident	27 (36%)
Side	
Dominant side	50 (67%)
Non dominant side	24 (32%)
The bone	
Humerus	23 (31%)
Forearm	9 (12%)
Hand phalanx	1 (1%)
Femur	26 (35%)
Tibia	14 (18%)
Foot phalanx	1 (1%)
Consolidation	
Union	66 (89%)
Nonunion	8 (10%)

Table 2: Breakdown of fractures by surgical indication.

Bone	Screwed plate	SECN	Total
Humerus	-	23	23
Forearm	-	9	9
Hand phalanx	-	1	1
Femur	23	3	26
Tibia	3	11	14
Foot phalanx	-	1	1
Total	19	55	74

SECN: stable elastic centromedullary nailing.

Table 3: Distribution of fractures according to post-operative complications.

Bone	Infection	Material migration	Nonunion	Vicious callus	Total
Humerus	-	4	2	-	3
Forearm	-	5	-	-	
Hand phalanx	-	-	-	-	-
Femur	5	5	4	2	
Tibia	7	-	2	1	
Foot phalanx	1	-	-	-	
Total	13	14	8	3	38

Table 4: Correlation between surgical indications and post-operative complications.

Bone	Infection	Material migration	Nonunion	Vicious callus	Total
SECN	2	13	0	2	17
Screwed plate	11	1	8	1	21
Total	13	14	8	3	38

SECN: stable elastic centromedullary nailing.
p = 0,000389

Discussion

In general, authors believe that orthopaedic treatment is the treatment of choice for fractures in children [2, 3, 4]. However, in this study, the problem concerned diaphyseal fractures. Orthopaedic treatment is sometimes difficult to achieve because of genuine instability or irreducibility. This justifies recourse to surgery. Osteosynthesis thus has its place in the treatment of fractures in children. It must be minimally invasive, respecting the rules of osteosynthesis and periosteal consolidation in children.

The predominant proportions concerning male gender, age over 10 years and play accident are like other studies [2, 4, 9, 10]. Boys are more mobile and boisterous than girls and are exposed to accidents of all kinds. The age group over 10 is the most mobile and reckless in childhood, and therefore exposed to accidents in everyday life. The dominant side has an interest in the occurrence of complications.

Stable elastic Centro medullary pinning: post-operative course

In children, the use of pins for osteosynthesis is frequent and less invasive for the growth plate. We believe that it remains the reference technique for the treatment of diaphyseal fractures in children. Table IV shows that post-operatively, of the 17 fractures synthesised by SECN, there were two cases of infection, 13 cases of pin migration and two cases of malunion. These complications were linked to the parents' failure to follow post-operative instructions. In addition to infection (n=3), Yaokreh et al found three cases of skin irritation and two cases of joint stiffness in 26 fractures treated by SECN [9]. However, the frequency of post-operative complications of SECN remains low [4, 11, 12]. Infection remains the main complication of surgical treatment in children in precarious environments [4]. In high-

performance facilities, post-operative infection is rare or non-existent. This was the case for Lascombes et al who, in a sample of 100 fractures treated by SECN, did not encounter any postoperative infectious complications [6].

Screw-retained plate: post-operative course

The screw plate has very limited indications in the treatment of fractures in children. It is used less and less and is in the process of being abandoned [3]. The use of screw plates can destroy the fracture hematoma and compromise the anatomical integrity of the periosteum. It is used for certain fractures of the femur, humerus, and radius in order to obtain perfect anatomical reduction and, above all, to allow early mobilisation. Screw-plate osteosynthesis has been used to achieve complete consolidation of highly displaced fractures without complication [5].

Table IV shows that half of all screw-plate osteosyntheses resulted in post-operative infection. This finding reinforces the argument that infection is the main complication of osteosynthesis in children [4].

A screw-retained plate should always be removed within eight to twelve months post-operatively [4]. This is to avoid the plate becoming embedded in the cortical bone, leading to recurrent fracture, as in the case of Feigoudozoui et al, where the plate was removed after 21 years post-operatively [3].

Other complications

Osteosynthesis using pins has been associated with fewer complications than screw plates. Malunion is favored by inadequate orthopaedic treatment (insufficiently molded plaster with excess cotton, imperfect reduction, etc.) [8]. Vicious calluses are the result of orthopaedic treatment [4]. In this study, we found a small proportion (n=3) of malunion (Table IV) which had not resulted in lower limb length inequality (LLLI).

Another post-operative complication of diaphyseal fractures, which is not uncommon in the literature, is LLLI. We did not find any in this study, as the surgical technique was rigorous and performed by an experienced team. In addition, LLLI is the preserve of orthopaedic treatment [4]. Ndour et al believe that LLLI is exclusive to diaphyseal fractures (whatever the treatment); either by hypergrowth or by malunion with or without angulation [4]. They also believe that LLLI is the main sequela of femur fractures in children [4].

Pseudarthrosis is a complication that is rarely encountered in children [6, 13]. This is shown in Table IV. Like other authors, we have noted that pseudarthrosis is favored by loss of bone substance or common fractures [6]. Furthermore, Lascombes et al noted that delays and defects in consolidation were observed exclusively in diaphyseal fractures and none of these complications were observed in metaphyseal fractures [6].

According to the Osthern and Tsherne criteria, 24 outcomes were excellent, 35 were good and 15 were poor. Using the same criteria, Abiome et al found 37 excellent outcomes and 5 good outcomes [2]. We deduce that, unlike us, they did not obtain poor outcomes. This comparison could be explained by differences in the quality of the work and the assessment of the criteria.

Finally, in our study, 20% of the parents were very satisfied with the care provided, 62% were satisfied and 17% were disappointed. These were subjective figures that enabled us to assess the efficiency of our services.

Conclusion

It must always be remembered that any orthopaedic treatment leads to faster and safer consolidation than any osteotomy. Osteosynthesis in routine pediatric traumatology is only indicated if the remodeling capacity of a callus is insufficient. Osteosynthesis in children produces good outcomes. Post-operative complications are almost always present, often encouraged by a precarious environment. Complications are most often induced by screw plates. The preferred surgical treatment for closed diaphyseal fractures should now be SECN. In all cases, regular clinical and radiological monitoring is essential for early diagnosis of complications. In addition, further studies with a considerable sample size need to be undertaken to better define the limits between surgical and orthopaedic treatment of diaphyseal fractures in children.

Conflicts of interest

The authors declare no conflicts of interest.

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