TREATMENT OF FOREARM FRACTURES IN CHILDREN AND ADOLESCENTS

ALEXANDRE PEDRO NICOLINI, BRUNO JANNARELLI, MARIO HENRIQUE LOBÃO GONÇALVES, FRANCESCO CAMARA BLUMETTI, EIFFEL TSUYOSHI DOBASHI, AKIRA ISHIDA

ABSTRACT

Objective: The treatment and the angular deviations tolerated in diaphyseal forearm fractures in children evoke divergent opinions in literature. In view of this controversy, we idealized this study to evaluate the preferred treatment methods for this injury, during the 39th Brazilian Congress on Orthopedics and Traumatology. Methods: A total 759 questionnaires were answered (13% of total entrants). We addressed the general aspects of the study sample to obtain a profile of the orthopedic surgeons questioned. Results: Two clinical subjects were presented, aged 12 (CASE 1) and 5 years old (CASE 2), along with radiographs depicting forearm diaphyseal fractures of these patients. Data was gathered and submitted to statistical analysis. The overall preferred treatment in CASE 1 was closed reduction and fixation with Kirschner wires (26%), while in case 2 it was closed reduction followed by plaster cast (46%). Conclusion: Among orthopedic surgeons less than 30 years old, the choice for less invasive treatments and greater acceptance of angular values prevailed in both cases. The traumatologists accepted lower angular values and tended towards more invasive treatments, particularly for CASE 2. On the other hand, the pediatric orthopedic surgeon prefers less invasive treatments and accepts greater angular deviations.

Keywords: Treatment. Fractures; Forearm; Child.

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INTRODUCTION

Forearm fractures are the most prevalent in childhood and adolescence and correspond to between 30% and 50% of all lesions that affect the immature skeleton.

According to literature, adequate closed reduction maintained with effective plaster cast immobilization prevails as the best therapeutic option, particularly in patients under 10 years of age, due to the notable potential for bone remodeling.[1,2] Although this method is applied to most fractures, a preoccupying rate of complications is reported, including: loss of reduction (7 to 13 %),[1,3-5] particularly in the two first weeks after trauma; defective consolidation and consequent function limitation of the affected limb.[3]

The guidelines of the surgical treatment still give rise to discussion, as the choice of patient, type of fracture, indication of operating method, availability of synthesis materials and experience of the surgeon should be carefully considered. Surgical treatments are classically indicated for: exposed fractures; association with neurovascular lesion; floating elbow; pathological fractures; angular deviation above 20°; failure of closed treatment; and when approaching skeletal maturity.[6] However, we verified a tendency for the choice of operating methods in the last 15 years, where the use of intramedullary Kirschner wires corresponds to the main osteosynthesis option[1,2,4-13] and, more recently, titanium elastic nails.[8,14,15] This rational technique offers potentially good results according to international literature.[1-5,7,8,11] The controversy relating to the therapeutic option is particularly pronounced in borderline situations. As there are no national studies demonstrating the therapeutic approach of orthopedists toward diaphyseal forearm fractures, we prepared this study aiming to evaluate 2 distinct clinical situations. Through a questionnaire, we intend to demonstrate the therapeutic options chosen for each case and to evaluate how much deviation is tolerated for the treatment indication.

MATERIAL AND METHODS

This work was initially sent for examination by the Institutional Review Board (IRB) of our institution and was approved. We prepared a questionnaire that was applied to the participants of the 39th Brazilian Orthopedics and Traumatology Congress, at random, without obligation and without identification. Foreigners, residents, undergraduates and professionals from other areas

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Department of Orthopedics and Traumatology of Universidade Federal de São Paulo (UNIFESP) – Brazil

Study conducted in the Department of Orthopedics and Traumatology of Universidade Federal de São Paulo- Escola Paulista de Medicina (UNIFESP- EPM)
Mailing Address: Rua: Borges Lagoa, 783 - São Paulo - SP - Brazil - CEP.: 04038-032 – E-mail: apnicolini@uol.com.br

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that took part in the survey were disregarded for the study purposes. We obtained a significant sample, with 759 orthopedists, which corresponded to 13.8% of the 5500 participants of the 39th Brazilian Orthopedics and Traumatology Congress. The questionnaire was composed of two parts (Figure 1):

1st – Information on the interviewee: age; gender; nationality (city/state); medical specialty; orthopedic sub-specialty; whether he or she is a member of any education and training service; estimate of fractures treated per month; how he or she obtains scientific updates; which implants are available in his or her service.

2nd – Presentation of two clinical cases of patients with deviated simple trait fractures of the two bones of the forearm, the first in a 12-year-old and the other in a 5-year-old individual.

a. The interviewee evaluated had access to the x-ray photos, in the anterior and lateral positions of the fractured forearm, with the respective ages of the patients; the therapeutic possibilities should be distinguished among the following options: plaster cast immobilization without reduction; closed reduction followed by immobilization; or open reduction.
b. To maintain the reduction, they opted among: fixation with Kirschner wires, titanium elastic nail or plate and screws.
c. With regard to the tolerable angulation to indicate the conservative treatment for fractures in anterior-posterior and lateral planes, these marked one of the options: no angulation is acceptable; up to 5º; 5º to 10º; 10º to 15º; or higher than 15º.

For statistical purposes, we distributed the ages in the following age groups: under 30 years; 31 to 40 years; 41 to 50 years; and over 50 years. The cities of origin were grouped according to the geographical regions (Southeast, Northeast, South, Midwest and North). As regards the title of specialist, we divided the interviewees into the following categories: no title, with title up to 5 years; from 5 to 10 years; and over 10 years.

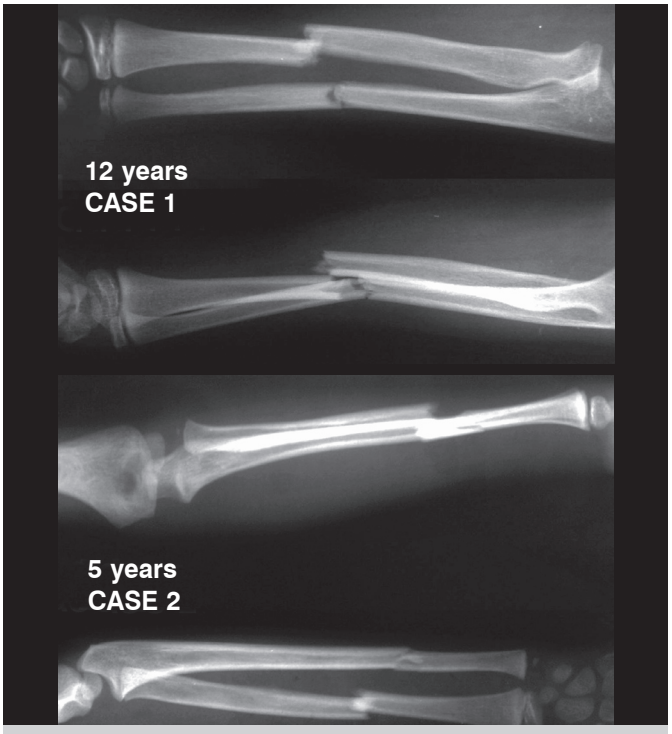

Figure 1 – *Cases presented*

Initially all the variables were analyzed descriptively. For the qualitative variables we calculated the absolute and relative frequencies. Thus our sample consists of 95% male and 5% female individuals, with predominance of participants in the age bracket between 31 and 40 years (32%), and with 64% coming from the southeast region. In relation to age we observed: 25.29% individuals under 30 years of age, 20.95% between 41 and 50 and 20.82% over 50. As regards nationality, 14.36% are from the Northeast region, 10.41% from the Southern region, 5.93% from the Midwest region and 5.4% from the Northern region. As regards the title of specialist, 34% obtained their title more than 10 years ago, 22.92% up to 5 years ago and 15.94% from 5 to 10 years ago, while 25.3% reported not having a title. Distribution in relation to orthopedic subspecialties was as follows: knee (15%), trauma (11%), hand (9%), pediatric (9%), foot and ankle (4.22%), spine (2.51%), sports (1.84%), shoulder and elbow (5.27%), osteometabolic (1.45%), hip (4.48%), external fixer (1.84%), and tumor (0.93%), while 28.98% do not work in orthopedic subspecialties and 4.61% marked more than one option. Of the total interviewees, 53% work in services accredited by the Brazilian Society of Orthopedics and Traumatology for education and training of residents. As regards the estimated number of treated forearm fractures, 46% deal with more than 5 cases monthly, 24% from 1 to 2 cases, 24% from 3 to 5 cases; and 4.74% do not treat this ailment. The knowledge update sources verified are: conferences (71%), books (63%), magazines (60%), courses (51%) and the Internet (52%). As regards osteosynthesis materials available in their services of origin, 98% have access to Kirschner wires and 95% to the plates and screws, while only 46% have access to the titanium nails.

RESULTS

The results obtained for CASE 1, considering the type of treatment among the interviewees, are set out in Table 1, according to the therapeutic methods, absolute frequency and respective percentages (%). The data relating to the anterior-posterior and varus/valgus deviations are expressed in Tables 2 and 3.

The results obtained for CASE 2 considering the type of treatment among the interviewees are set out in Table 4 according to the therapeutic methods, absolute frequency and respective percentage (%). The data relating to the anterior-posterior and varus/valgus deviations are expressed in Tables 5 and 6.

The statistical analysis was carried out by a professional specialized in this area. The chi-squared test[1] and Fisher's exact test[1] were used to test homogeneity among proportions, and the significance level was 5%. In this manner, separating the sample into age groups and subspecialties, we obtained the following results.

Statistical analysis for CASE 1

Between 20 and 30 years of age, the main therapeutic choice is closed reduction and fixation with Kirchner wires (35.94%). In the age brackets between 41 and 50 years and over 50, there is a predilection for open reduction and fixation with Kirschner wires, corresponding respectively to 30.19% and 27.22% of the sample. Between the ages of 31 and 40 years, two kinds of therapy (open reduction followed by fixation with plates and screws and closed reduction associated with fixation with Kirschner wires) obtained 24.8%.

Distinguishing by subspecialty, traumatologists demonstrate a preference for open reduction and fixation with Kirschner wires (26.58%), while pediatric orthopedists opt for closed reduction

Table 1 – *Distribution of absolute frequency and percentage (%) of orthopedists in relation to the therapeutic option for Case 1.*

TREATMENT OPTIONS	ABSOLUTE FREQUENCY	PERCENTAGE (%)
Plaster cast immobilization without reduction	6	0.79
Open Reduction + Fixation with Kirschner wires	167	22.00
Open Reduction + Fixation with titanium nail	64	8.43
Open Reduction + Fixation with plate and screws	163	21.48
Closed Reduction + Fixation with Kirschner wires	198	26.09
Closed Reduction + Fixation with titanium nail	59	7.77
Closed Reduction + plaster	102	13.44

Table 2 – *Distribution of the absolute frequency and percentage (%) of orthopedists in relation to acceptance of the anterior-posterior angular deviation for indication of treatment in Case 1.*

ANTERIOR-POSTERIOR DEVIATION	ABSOLUTE FREQUENCY	PERCENTAGE (%)
0º	145	19.10
UP TO 5º	254	33.46
5 TO 10º	277	36.50
10 TO 15º	83	10.94
> 15º	0	0.00

Table 3 – *Distribution of the absolute frequency and percentage (%) of orthopedists in relation to acceptance of the varus/valgus angular deviation for indication of treatment in Case 1.*

VARUS/VALGUS DEVIATION	ABSOLUTE FREQUENCY	PERCENTAGE (%)
0º	274	36.10
UP TO 5º	297	39.13
5 TO 10º	148	19.50
10 TO 15º	38	5.00
> 15º	2	0.27

Table 4 – *Distribution of the absolute frequency and percentage (%) of orthopedists in relation to the therapeutic option in Case 2.*

TREATMENT OPTIONS	ABSOLUTE FREQUENCY	PERCENTAGE (%)
Plaster cast immobilization without reduction	75	9.88
Closed Reduction + plaster cast immobilization	349	45.98
Closed Reduction + Fixation with Kirschner wires	169	22.27
Closed Reduction + Fixation with titanium nail	26	3.42
Open Reduction + Fixation with Kirschner wire	106	13.97
Open Reduction + Fixation with titanium nail	21	2.77
Open Reduction + Fixation with plate and screws	13	1.71

Table 5 – *Distribution of the absolute frequency and percentage (%) of orthopedists in relation to acceptance of the anterior-posterior angular deviation for indication of treatment in Case 2.*

ANTERIOR-POSTERIOR DEVIATION	ABSOLUTE FREQUENCY	PERCENTAGE (%)
0º	53	6.98
UP TO 5º	157	20.68
5 TO 10º	294	38.74
10 TO 15º	163	21.48
> 15º	92	12.12

Table 6 – *Distribution of the absolute frequency and percentage (%) of orthopedists in relation to acceptance of the varus/valgus angular deviation for indication of treatment in Case 2.*

VARUS/VALGUS DEVIATION	ABSOLUTE FREQUENCY	PERCENTAGE (%)
0º	134	17.65
UP TO 5º	257	33.86
5 TO 10º	215	28.33
10 TO 15º	94	12.38
> 15º	59	7.78

associated with Kirschner wires (25.71%). In the other subspecialties considered as a whole, the prevalent treatment is open reduction and stabilization with plates and screws (24.36%).

We observed acceptance of anterior-posterior deviation (AP) from 5º to 10º according to the grouping in age brackets: 20 to 30 years (43.75%); 31 to 40 years (39.2%); and over 50 years (34.81%). The age group from 41 to 50 years accepts deviations up to 5º (36.48%). Only traumatologists differ from the other orthopedists, accepting AP deviations < 5º (43.04%). The pediatric orthopedists and the others accept AP deviations between 5º and 10º in 38.57% and 36.92% respectively. The acceptance of varus/valgus (VV) deviation among orthopedists from 20 to 30 years of age was: < 5º (34.9%) and 5º to 10º (33.33%). Between the ages of 31 and 40 years, most accept deviations < 5º (40.8%) or do not accept deviation (35.2%). Between the ages of 41 and 50 years, most do not accept deviation (47.8%) or accept it up to 5º (35.85%). Over the age of 50 years, 44.94% accept up to 5º of angulation and 36.71% do not accept deviations. Considering orthopedic subspecialties there was a dichotomy: the majority of orthopedists without subspecialty and those specialized in trauma do not accept VV deviations (37.73% and 51.9%); pediatric orthopedists and other specialists accept up to 5º of angulation (51.43% and 42.31%).

Statistical analysis for CASE 2

Most of the interviewees opt for treatment with plaster cast immobilization preceded by closed reduction, regardless of the surgeon's length of experience: 20 to 30 years (60.42%), 31 to 40 years (42.4%), 41 to 50 years (33.96%) and > 50 years (46.2%). There is also statistical significance through treatment with closed reduction and fixation with Kirschner wires in the age groups 31 to 40 (24.8%) and 41 to 50 years (29.56%).

In the division by specialties, the majority opts for closed reduction followed by plaster cast application: pediatric orthopedists (55.71%), traumatologists (41.77%), no subspecialty (47.73%) and others (44.10%).

Acceptance of the AP deviation is uniform, with predominance <10º at all ages. Only the youngest group had a significant portion (31.77%) accepting deviations between 10º and 15º. For the AP deviation irrespective of the subspecialty of the interviewee, most accept angulation between 5º and 10º. Only the pediatric orthopedists accept deviations > 15º (27.14%). As regards VV deviations, the lower age brackets (20 to 30 and 31 to 40 years) tolerate deviations between 5º and 10º (32.29% and 32.8% respectively), while the most experienced (between 41 and 50 and over 50 years) accept up to 5º (40.88% and 43.67% respectively). Most trauma specialists do not accept VV deviations (34.18%); while pediatric orthopedists (38.57%) and the others (38.72%) tolerate deviations up to 5º.

DISCUSSION

The treatment of forearm fractures in childhood still gives rise to controversy among authors even though the therapeutic systematization is based on the countless papers published in orthopedic literature. In a survey conducted in the Medline database (2000 to 2008) we found 180 articles related to the prevention, diagnosis and treatment of this condition. Nevertheless, there are no scientific elements that demonstrate the training profile of Brazilian orthopedists with regard to the treatment of it. We found only 2 papers with a similar proposal,[2,10] whose studies were carried out at centers with characteristics that differ from the Brazilian situation.

Technically, the method of choice for the stabilization of diaphyseal forearm fractures in childhood depends mainly on the degree of initial deviation and on the patient's age.[4] The aim is always to restore the function of the affected limb within orthopedic precepts of alignment and stability, regardless of the therapeutic method chosen.

The closed treatment of this fracture has been applied since time immemorial, and its principles are still maintained today for the majority of fractures in children under the age of 8-10 years,[3,6,15] as the high potential for bone remodeling in this age bracket is helpful to the therapeutics.[4]

In this study, we observed that most of the orthopedists evaluated opt for closed reduction followed by the application of a plaster cast as seen in CASE 2, in which the patient is 5 years old. In CASE 1, on the other hand, there is preference for closed reduction and percutaneous fixation with Kirschner wires. Generally speaking, this data corroborates what it is heralded by most authors in relation to the therapeutics.[4,16,17]

For both cases, the majority considered varus/valgus deviation $> 5^{o}$ and anterior-posterior deviation $> 10^{o}$ unacceptable. There is no consensus the regarding the acceptable limits by the orthogonal evaluation of angulations by x-rays. Many consider that deviations $< 20^{o}$ have remodeling potential under the age of 8 - 10 years. Nowadays, there is a tendency for acceptance of lower deviations, particularly over the age of 9 years, where angulations above 10^{o} are habitually not tolerated due to the proximity of skeletal maturity and the diminishment of the bone remodeling potential of deviations.

In our survey we observed considerable variability in the choice of treatment method and in the angulation accepted to indicate the therapeutics among the different groups of orthopedists evaluated. The younger ones indicate less invasive treatments, preferring closed reduction for both situations presented, and accept greater deviations. In our opinion, it is possible that this fact reflects the recent change of osteosynthesis concepts where we sought adequate alignment considering the preservation of the biological aspect following the opinion of most studies published in the last few years that defend the techniques of indirect reduction and percutaneous fixation.[3,8,9,14,15]

As regards subspecialties, we noticed that the pediatric orthopedists indicate less invasive treatments regardless of the case. It is the only group in which there is predominance of the indication of immobilization without reduction for CASE 2. In this subspecialty there is acceptance of greater angular deviations for CASE 2 than in the other groups evaluated. We also verified that the traumatologists accept lower angular deviations regardless of the case presented. Those belonging to the other subspecialties indicate the more aggressive treatments for CASE 1, preferring osteosynthesis with plates and screws preceded by open reduction.

We believe that the pediatric orthopedist, more used to applying the concepts involved in the process and the remodeling capacity of immature bone, more frequently indicates the less invasive treatment for forearm fractures, expecting this to lead to the spontaneous correction of angular deviations.

In view of the data obtained, we observed that there is no homogeneity of conduct among Brazilian orthopedists, in spite of the general treatment guidelines defended by international literature.[1,3-5,7,8,11] It is possible that factors such as: change of osteosynthesis concepts, improvement of anesthetic techniques, technical knowledge and personal experience of the assistant physician, play a crucial role in the characterization of heterogeneity observed in our sample.

CONCLUSION

The treatment of forearm fractures continues controversial and determines a difference of opinion among Brazilian orthopedists. Statistically, younger physicians and those specialized in Pediatric Orthopedics, accept a greater angular deviation to indicate the conservative treatment and apply the less invasive therapeutics.

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