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Original Article

Cross-sectional study of Gartland II and III humerus supracondylar fracture treatment in childhood: Brazilian orthopedists' opinion☆

Rodrigo Fileto Gavaldão Moreira, Alexandre Yukio Nishimi, Enrico Montorsi Zanon, Thales Santos Rama, Rodrigo Pacheco Lessa Ciofi, Eiffel Tsuyoshi Dobashi*

Hospital IFOR – Rede D'Or, São Bernardo do Campo, SP, Brazil

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ABSTRACT

Objective: This study is aimed at determining, through a cross-sectional study, the preferred therapeutic method in Brazil considering the approach to Gartland type II and III supracondylar humerus fractures during childhood.

Methods: The research project was approved by the Research Ethics Committee of Plataforma Brasil and the material was collected during the 46th Brazilian Orthopedics and Traumatology Congress. A questionnaire was developed to analyze two clinical scenarios about Gartland type II and III fractures.

Results: The sample consisted of 301 questionnaires obtained from 5500 participants of the Congress who met the inclusion and non-inclusion criteria. In case 1, the following was observed: 140 (46.5%) of physicians opted for closed reduction with immobilization and 116 (38.5%) selected closed reduction and osteosynthesis, of whom 82 (70.7%) preferred two crossed Kirschner wires. In case 2, 294 (97.7%) considered that the treatment is urgent, and 225 (74.8%) of the interviewed orthopedists answered that they perform osteosynthesis with two crossed Kirschner wires.

Conclusions: The opinion of orthopedic surgeons in Brazil varies for Gartland type II fractures. Type III fractures have a uniform conduct and they are treated urgently (97.7%). When osteosynthesis is necessary, it was observed that 82 (70.7%) and 225 (74.8%) of the interviewed surgeons opted for fixation with two crossed Kirschner wires.

☆ Study conducted at Hospital IFOR – Rede D'Or, São Bernardo do Campo, SP, Brazil.

* *Corresponding author.*
E-mail: dralexandrenishimi@gmail.com (A.Y. Nishimi).

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Estudo transversal sobre o tratamento das fraturas supracondilianas do úmero na infância dos tipos Gartland II e III: opinião do ortopedista brasileiro

Palavras-chave:
Fraturas do úmero/classificação
Fraturas do úmero/radiografia
Fraturas do úmero/cirurgia

RESUMO

Objetivo: Este trabalho teve como objetivo determinar, num estudo transversal, qual é o método terapêutico preferencial usado no Brasil quando são abordadas as fraturas supracondilianas do úmero na infância dos tipos II e III da classificação de Gartland.

Métodos: O projeto de pesquisa foi aprovado pelo Comitê de Ética em Pesquisa da Plataforma Brasil e o material foi coletado durante o 46° Congresso Brasileiro de Ortopedia e Traumatologia. Elaboramos um questionário para averiguar a conduta nas duas situações clínicas de fraturas do tipo Gartland II e III.

Resultados: A amostra constou de 301 questionários obtidos de 5.500 participantes do Congresso que contemplaram os critérios de inclusão e não inclusão. Para o caso 1 observamos que 140 (46,5%) médicos optam pela redução incruenta e imobilização e 116 (38,5%), pela redução incruenta e osteossíntese, dos quais 82 (70,7%) preferem a osteossíntese com dois fios de Kirschner cruzados. Para o caso 2, 294 (97,7%) entrevistados consideram que essas lesões devam ser abordadas na urgência, na qual 225 (74,8%) fazem a osteossíntese com dois fios de Kirschner cruzados.

Conclusões: A opinião do ortopedista no Brasil varia para as fraturas do tipo II. Para as do tipo III, observamos que existe uma conduta uniforme, pois essas são tratadas na urgência (97,7%). Quando é necessária a osteossíntese, observamos que 82 (70,7%) e 225 (74,8%) dos entrevistados optam pela fixação com dois fios de Kirschner cruzados.

Introduction

Supracondylar humeral fractures during childhood[1,2] account for 50% to 60% of the lesions that occur at the elbow.[2,3] The anatomical reduction of these fractures, associated or not with a stable osteosynthesis, is essential to achieve the best radiographic and functional results. The orthopedic literature presents many discussions as to the difficulty in maintaining an appropriate and stable position between the fractured segments, as imperfection causes anatomical and functional alterations of the affected elbow.[1,4,5]

The therapeutic indication is generally based on the Gartland classification (1959); the treatment of choice for type I fractures is conservative, without the need for reduction. In these cases, an axilopalmar above-elbow cast is used for four weeks. There is no consensus as to the most effective treatment for type II fractures; non-surgical and surgical methods have been mentioned in the literature.[1] When fractures are categorized as type III, the treatment is surgical and based on closed reduction associated with osteosynthesis with Kirschner wires.[4,5] Several wire configurations have been described, and their application is based on the experience of the surgeon. These configurations include one single wire; two crossed wires; two or three divergent side wires; two parallel side wires; two side wires and clamp; and one intramedullary wire and one lateral wire.[4,6]

The use of two crossed Kirschner wires is the most renowned fixation method; the first wire should be inserted into the lateral aspect of the distal humeral fragment and the second, adjacent to the medial epicondyle. Reports in the literature indicate that the medial access is standard for this type of surgery; the procedure is based on maintaining a distance from the ulnar nerve, so that it is positioned far from the path of the synthesis material.[1,7] There are also references for the need of a third wire if any instability is observed.[6]

However, some authors defend an essentially lateral approach. Kirschner wire configurations range from placement in a parallel or divergent manner. It was also observed that the number of devices used varies according to the preference of surgeons.[2,4,5] Some authors argue that biomechanical criteria are the premise for using these methods,[1,6,8] while others state that the risk of injury to the ulnar nerve would be closely related to the placement of a Kirschner wire on the medial side of the involved elbow. Therefore, using only the lateral approach to stabilize the fractures would prevent the risk of injury to the nerve.[7]

Regardless of the fixation method used, radiographic and functional results are generally classified as good; each of the authors in the literature defend their treatment technique when their experience and case series are presented.

Considering medical education in Brazil, despite the fact that great discussions have already been conducted regarding this topic, and also taking into account the frequency and socioeconomic importance of pediatric supracondylar humeral fractures, the treatment by Brazilian orthopedists in the different medical centers is not known.

Therefore, the primary goal of this cross-sectional study was to determine which is the Brazilian orthopedic surgeon's preferred treatment method for supracondylar humeral fractures classified as Gartland types II and III.

Material and methods

This research project was initially submitted to the evaluation and approval of the Research Ethics Committee of the Plataforma Brasil and approved under opinion 1233895.

This was a descriptive observational study conducted during the 46th Brazilian Congress of Orthopedics and Traumatology (Congresso Brasileiro de Ortopedia e Traumatologia [CBOT]), in Rio de Janeiro, from November 19 to 22, 2014.

Initially, the authors developed a questionnaire composed of nine questions (Appendix 1) applied to orthopedists who attended the CBOT in a random manner; participation was voluntary and did not require identification.

The inclusion criteria were:

1. Brazilian citizenship.
2. Physician.
3. Resident physician enrolled in a medical residency program in orthopedics and traumatology.
4. Orthopedist with a specialist degree.

The following exclusion criteria were applied:

1. Physician of another specialty (*e.g.*, physiatrist).
2. Non-medical professional (*e.g.*, physical therapist).
3. Orthopedists from other countries.
4. Incomplete, illegible, or incorrectly filled questionnaires.

The co-authors of this research offered assistance to the participants in order to solve any doubts regarding the questionnaire; the researchers also offered their electronic contact (E-mail).

The questionnaire was composed of two parts (Appendix 1 and Fig. 1). The first part consisted of data on the characteristics of the group to be interviewed, such as gender, age, city/state of origin, orthopedic subspecialty, and estimated number of pediatric supracondylar humeral fractures treated per year.

In the second part, two clinical cases of children with supracondylar fractures classified as Gartland type II and III were presented.

In case 1, radiographs in anteroposterior and lateral views of a pediatric patient with supracondylar humeral fracture classified as Gartland type II was presented.

The treatment options for this case were:

a. Immobilization without reduction.
b. Closed reduction with immobilization in the emergency room.
c. Closed reduction with immobilization in the operating room.
d. Closed reduction with fixation.

If option "d" was selected, the participant should choose the preferred method of stabilization for this type of fracture, among the seven different osteosynthesis options shown in Fig. 1.

In case 2, radiographs in anteroposterior and lateral views of a skeletally immature patient with supracondylar humeral fracture classified as Gartland type III was presented.

The therapeutic options for this situation were: must it be treated as an emergency?, with YES and NO as possible answers.

Regarding the preferred method for stabilizing these lesions, the participant would have to choose one of seven different fixation options shown in Fig. 1.

Sample calculation

To determine the number of participants required for this study, Kappa test values greater than 0.60 were considered, with a significance level of 5% and 80% power. The calculation indicated that, in a universe of 10,000 orthopedists, the minimum sample size required would be 369 participants. Therefore, in the universe of 5500 participants of this event, 203 valid questionnaires should be obtained.

Therefore, the sample consisted of 301 questionnaires that met the predetermined inclusion criteria.

The analysis of the sample showed that the age of the physicians ranged from 25 to 65 years (mean: 37.51, SD: 8.74, median: 35); 279 (92.7%) were males and 22 (7.3%), female.

Table 1 presents the distribution of the 301 participants of this study and their orthopedic subspecialty, indicating the absolute and relative frequencies.

Table 2 shows the distribution of the participants according to their state of origin, indicating the absolute and relative frequencies.

Table 3 presents the distribution of physicians considering the estimated number of supracondylar fractures treated per year. It was observed that 73.1% of physicians treated between one and 20 fractures.

Statistical analysis

It was conducted by a specialized professional.

Initially, all variables were analyzed descriptively. For the quantitative variables, this analysis was conducted by identifying the minimum and maximum values and calculating means, standard deviations, and medians. For the qualitative variables, absolute and relative frequencies were calculated.

Results

Table 4 presents the preferred management and fixation method for case 1. It was observed that 140 (46.5%) physicians chose the closed reduction followed by immobilization at the operating room, while 116 (38.5%) chose closed reduction with fixation. Of these, 82 (70.7%) chose two crossed Kirschner wires as the fixation method.

Regarding case 2, it was observed that 294 (97.7%) of the interviewed considered that the treatment should be performed in the emergency room. Table 5 shows the absolute and relative frequency distribution of the preferred fixation method. Two crossed Kirschner wires was the stabilization method chosen by 225 (74.8%) of the physicians.

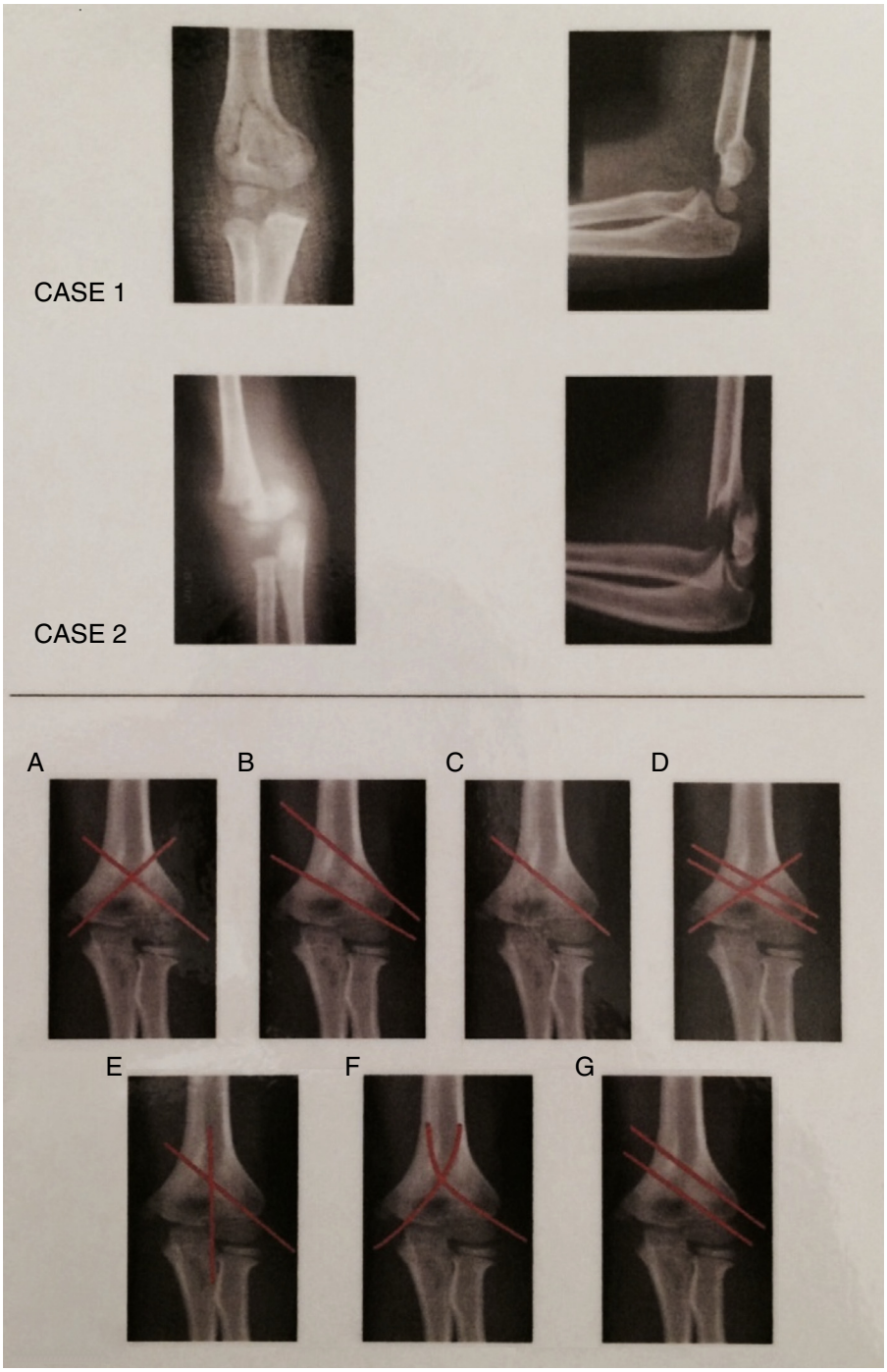

Fig. 1 – Illustration of the two cases presented and the fixation options.

Discussion

The treatment of Gartland type II fractures is quite controversial. Their pattern varies greatly, according to the energy dissipated by the fractured upper limb, since some fractures have rotational or translational components between the fragments.[9]

The authors believe that this understanding would be fundamental so that precise indication of the appropriate closed reduction method can be instituted, as it would be decisive to indicate whether or not osteosynthesis should be used.[3,10,11]

Thus, some type II fractures should be treated surgically. In all fractures, adequate evaluation of the elbow varus is necessary, taking into account the Baumann angle and the medial epicondylar epiphyseal angle.[8,10]

When a posterior medial compression is observed in type II fractures, reduction and a plaster cast can be used. Reduction can first be achieved by extending the elbow and then correcting the deformity in a coronal plane. In some cases,

Table 1 – Distribution of absolute and relative frequency of the interviewed according to their orthopedic subspecialty.

Orthopedic subspecialty	Number	Percentage (%)
General orthopedist	102	33.9
Knee surgery	42	14.0
Traumatology	42	14.0
Resident	26	8.6
Shoulder and elbow surgery	24	8.0
Hip surgery	22	7.3
Spine surgery	10	3.3
Pediatric orthopedics	10	3.3
Foot surgery	9	3.0
Hand surgery	7	2.3
External fixation and reconstruction	5	1.6
Sports traumatology	1	0.3
No information	1	0.3
Total	301	100.0

Table 2 – Distribution of absolute and relative frequency of the interviewed according to their state of origin.

State	Number	Percentage (%)
Amazonas	2	0.7
Bahia	12	4.0
Ceará	12	4.0
Distrito Federal	12	4.0
Espírito Santo	7	2.3
Goiás	6	2.0
Minas Gerais	29	9.6
Mato Grosso do Sul	1	0.3
Mato Grosso	3	1.0
Paraíba	1	0.3
Pernambuco	1	0.3
Paraná	12	4.0
Rio de Janeiro	62	20.6
Rondônia	1	0.3
Rio Grande do Sul	10	3.3
Santa Catarina	16	5.3
São Paulo	113	37.5
No information	1	0.3
Total	301	100.0

Table 3 – Distribution of absolute and relative frequencies of the 301 physicians in relation to the estimated number of supracondylar humeral fractures treated per year.

Number of cases treated per year	Number of respondents	Percentage (%)
I do not operate these fractures	30	10.0
1–10	143	47.5
11–20	77	25.6
21–30	15	5.0
>30	35	11.6
No information	1	0.3
Total	301	100.0

elbow hyperflexion greater than 120° may be required to maintain the reduction.[9,12,13] However, in cases with considerable edema, and significant soft tissue damage, or any vascular impairment, post-reduction instability, percutaneous fixation is paramount.[14,15]

Table 4 – Absolute and relative frequencies of the management and fixation method of choice for case 1.

Variable	Category	*n*	%
Management	Immobilization without reduction	18	6.0
	Closed reduction with immobilization in the emergency room	27	9.0
	Closed reduction with immobilization in the operating room	140	46.5
	Closed reduction with fixation	116	38.5
	None of the options	2	1.7
Fixation method (*n* = 116)	A	82	70.7
	B	23	19.8
	D	6	5.2
	F	1	0.9
	G	2	1.7

Table 5 – Distribution of absolute and relative frequency of the interviewed according to the fixation method for case 2.

Fixation method	Number	Percentage (%)
None of the options	2	0.7
A	225	74.8
B	23	7.6
D	35	11.6
E	2	0.7
F	3	1.0
G	11	3.7
Total	301	100.0

This controversy was also observed in the present study. In the present sample, in the treatment of supracondylar humeral fractures classified as Gartland type II, 140 (46.5%) of the physicians opted for closed reduction followed by cast immobilization. However, for 116 (38.5%), the treatment of choice was closed reduction followed by fixation. Of those who performed osteosynthesis, 82 (70.7%) chose the system with two crossed Kirschner wires.

A biomechanical study analyzed three distinct configurations with Kirschner wires comparing cross pins, parallel lateral pins, and divergent lateral pins. This study demonstrated that the stability provided by the divergent lateral pins was superior to that of the parallel lateral pins and similar to that of the crossed pins.[1–3,8,16] However, when the influence of the torsional forces was assessed, it was observed that the divergent placement of the side entry pins was superior. However, comminuted and unstable fractures require a medial entry pin.

Traditionally, cross-pin configuration has been chosen to stabilize these fractures. Several biomechanical studies presented evidence that this configuration is indeed more stable. Despite the preference for this procedure, some reports indicate a risk of up to 10% of ulnar nerve injury.[7,8,17]

Some authors indicate that the risk of iatrogenic nerve injury would be 1.84 times higher when medial fixation was used. However, the literature also presents systematic reviews

with meta-analysis that indicate a lack of statistical difference regarding this risk when comparing fixation with crossed wires and wires placed on the lateral aspect of the humerus.[15,16]

Surgical injury to the ulnar nerve can occur by direct penetration of the Kirschner wire into this structure, as well as by the friction caused by the surgical drill.[1,7] However, this potential problem is mitigated through a careful surgical management. A small incision centered on the medial epicondyle allows direct placement of the Kirschner wire over the humerus, ensuring that the nerve is not touched.[1,7,9,11]

A peculiar configuration has been reported in the literature, in which a first pin is placed on the lateral side.[1,11,14] In turn, the second pin is introduced through the proximal portion of the lateral cortex of the fracture site and led retrograde toward the other side of the fractured segment. A series of cases using this technique presented good radiographic and functional results, without injury to the ulnar nerve.[15] The biomechanical benefits would be superior to those of crossed wires, except for biomechanical issues.

Identical concern about stability of the different osteosynthesis systems and iatrogenic injury to the ulnar nerve is also observed for Gartland type III fractures.[13,16]

Type III fractures present much higher rates of good results when surgically treated,[16,17] as evidenced in case studies and series, as well as in a systematic review.

In Brazil, a study was conducted on the use of the prospective protocol to evaluate the treatment of supracondylar humeral fractures in children, developed by the Continuing Education Committee of the Brazilian Society of Orthopedics and Traumatology and adopted by the Brazilian Society of Pediatric Orthopedics. The present study demonstrated that, for 294 (97.7%) of the interviewed, Gartland III fractures must be treated as an emergency; for 225 (74.8%) of the physicians interviewed, the preferred fixation method for these fractures was osteosynthesis with two Kirschner wires.

At the authors' institution, 892 supracondylar elbow fractures have been operated on since 1997, and 207 were classified as Gartland type II.

A possible bias of this study is the heterogeneity of the population regarding the surgical experience. Moreover, the functional and radiographic results of the patients were not taken into account.

This matter, although often mentioned in orthopedic literature, still generates much interest among researchers. A PubMed search retrieved 1069 articles on this topic; the authors believe that many studies still need to be conducted on the most diverse nuances regarding this theme.

Conclusion

1. For pediatric supracondylar humeral fractures classified as Gartland type II, 140 (46.5%) of the physicians would opt for closed reduction followed by immobilization in an operating room.
2. For 116 (38.5%), the treatment of choice for these fractures is closed reduction followed by fixation in the operating room. Of these, 82 (70.7%) used two crossed Kirschner wires for fixation.
3. It was observed that, for 294 (97.7%) of the interviewed, Gartland type III fractures must be treated as an emergency.
4. For 225 (74.8%) of the physicians interviewed, the preferred fixation method for these fractures was osteosynthesis with two crossed Kirschner wires.

Conflicts of interest

The authors declare no conflicts of interest.

Appendix 1. Questionnaire on the opinion of Brazilian orthopedists regarding the treatment of pediatric supracondylar fractures classified as Gartland type II and III

1. Age
2. Sex
3. Orthopedic subspecialty
4. State of origin
5. How many cases of supracondylar humeral fracture do you estimate to operate per year?

a. I do not operate these fractures
b. 1–10
c. 11–20
d. 21–30
e. Over 30

6. What would be your treatment of choice in case 1?

a. Immobilization without reduction.
b. Closed reduction with immobilization in the emergency room.
c. Closed reduction with immobilization in the operating room.
d. Closed reduction with fixation.

7. What would be the preferred fixation method for this case?

a. A
b. B
c. C
d. D
e. E
f. F
g. G

8. Do you think that case 2 should be treated as an emergency?

a. YES
b. NO

9. What would be the preferred fixation method for this case?

a. A
b. B
c. C
d. D
e. E
f. F
g. G

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