

# Classification of Pediatric Supracondylar Fractures: Comparison between the Gartland and the Lagrange & Rigault Classifications

## *Clasificaciones de las fracturas supracondíleas en edad pediátrica: comparación de las clasificaciones de Gartland y Lagrange & Rigault*

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### Abstract

**Background** The supracondylar fracture of the humerus is one of the most common fractures in pediatric age. Many classifications were proposed, with Gartland being the most widely used one and Lagrange and Rigault (L&R) the most used in French-speaking countries.

**Objectives** The goal of this study was to compare the Wilkins-modified Gartland classification with the L&R classification in terms of reproducibility.

**Methods** Three observers with similar training levels classified 35 fractures according to both classifications twice to evaluate both intra and interobserver variation.

**Results** The mean intraobserver variation was 0.78 and 0.77 for Gartland and L&R classifications, respectively, and the mean interobserver variation was 0.55 and 0.62 for Gartland and L&R classifications, respectively.

**Conclusions** Both classifications reveal adequate to usage in clinical and investigational practices, which is consistent with the literature.

### Keywords

- ▶ humeral fractures
- ▶ classification

### Resumen

**Introducción:** La fractura supracondílea del húmero es una de las fracturas más comunes en la edad pediátrica. Varias clasificaciones han sido propuestas, siendo la de Gartland la usada de forma mas amplia y la de Lagrange and Rigault (L&R) la más usada en países de habla francesa.

**Objetivo:** Comparar la clasificación de Gartland modificada por Wilkins con la clasificación de L&R en términos de reproducibilidad.

**Material y Método:** tres observadores, con el mismo nivel de entrenamiento, clasificaron 35 fracturas de acuerdo a las dos clasificaciones en dos ocasiones para evaluar tanto la variación intra como inter observador.

**Resultados:** La variabilidad media intraobservador fue de 0.78 y 0,77 para la de Gartland y L&R respectivamente. La variabilidad media interobservador fue 0.66 y 0.62 para la de Gartland y L&R respectivamente.

**Conclusiones:** Las dos clasificaciones son adecuadas para el uso en la práctica clínica e investigación, lo que es consistente con la literatura.

### Palabras clave

- ▶ fractura de húmero
- ▶ clasificaciones

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## Introduction

The supracondylar fracture of the humerus is one of the most common fractures in pediatric age, with extension-type fracture being responsible for about two thirds of pediatric trauma around the elbow.<sup>1,2</sup> These fractures were known as the “misunderstood fracture,” due to common complications as Volkmann contracture and bone deformity.<sup>3</sup>

The distinction between flexion and extension types is somehow linear, with most problems rising when subdividing extension type injuries.<sup>2</sup>

The first classification for supracondylar fractures was described by Felsenreich, in 1931, and was based on fracture displacement.<sup>4</sup> However, it was Gartland who created the first widely used classification, in 1959.<sup>2,3</sup>

The Gartland classification divided extension-type fractures in three types: type I, nondisplaced; type II, moderately displaced; and type III, severely displaced.<sup>3</sup>

This classification was then modified by Wilkins, in 1984, to include the lack or presence of a rotational component in type II fractures.<sup>2,5</sup>

In 2006, Leitch et al added a fourth type to the Wilkins classification to include fractures with multidirectional instability.<sup>6</sup>

Another classification was described in 1962 by Lagrange and Rigault (L&R), which became the most used classification in France and other French-speaking countries.<sup>7</sup> This classification divides fractures in five types. The first three are similar to Gartland, and the fourth is similar to Leitch. It then includes a fifth type of fracture classified as metaphyseal or high supracondylar.<sup>2</sup>

The purpose of all these classification systems is to guide the treatment, to help defining a prognosis for the fractures and to standardize medical communication in both clinics and investigations. To achieve these goals, a classification needs to be simple and easy to use, and a high agreement between intra and interobservers must exist.<sup>2,8-10</sup>

Nowadays, most pediatric trauma textbooks rely on the modified Gartland classification to guide the treatment.<sup>5</sup>

The aim of this work was to compare the Gartland classification modified by Wilkins with the L&R classification in terms of intra and interobserver variation.

The fourth type of Leitch was not included in the Gartland classification as it considers clinical parameters that cannot be inferred by radiographic evaluation alone.

Classifications help the scientific community to achieve consensus when discussing clinical cases and allow treatment orientations. The establishment of a reproducible classification can help in the homogenization of studies and might simplify residents' and general doctors learning curve in terms of treatment guidelines, mainly in small centers, where there is a lack of pediatric orthopedic surgeons.

## Material and Methods

A total of 35 elbow radiographs (both anteroposterior [AP] and lateral) were retrospectively obtained from the database of our center. These were obtained by searching the database for supracondylar fractures in children with both AP and lateral incidences obtained on the initial evaluation without previous reduction. The 35 most recent cases fulfilling these criteria were selected.

Three observers, with similar training levels (3 junior consultants with 7 years of training and experience in the evaluation of pediatric trauma), were asked to classify each radiograph using both classifications. Each observer had access to a diagram explaining both classifications (►Table 1). A description of the classifications can be found in ►Table 1.

The observers were then asked to classify the exact same radiographs 15 days later, so that intraobserver variation could be determined.

The statistical analysis was performed in the SPSS.23 for Mac (IBM Corp., Armonk, NY, USA) using the Cohen kappa coefficient, which was interpreted according to the standards proposed by Landis and Koch (►Table 2).<sup>11</sup> The kappa value measures the proportion of concordant answers, considering the expected proportion related to chance. It varies between 0 and 1, with 0 meaning complete disagreement and 1 total agreement.

Light's kappa variant was used to access interobserver variation.<sup>12</sup>

## Results

Thirty-five radiographs of 35 children were reviewed. The mean age at the time of fracture was 6.2 years, and 54.3% of the sample are males.

**Table 1** Classification description<sup>2</sup>

Wilkins-modified Gartland classification	Lagrange at Rigault classification
<p><b>Type I:</b> undisplaced or minimally displaced fracture</p> <p><b>Type II:</b> obvious fracture with displacement. The posterior cortex remains intact but the anterior humeral line passes anterior to the capitellum. The anterior cortex is disrupted but the posterior cortex is still intact.</p> <p><b>A:</b> without rotation</p> <p><b>B:</b> with rotation</p> <p><b>Type III:</b> displaced fracture without an intact cortex; with either posteromedial or posterolateral displacement.</p>	<p><b>Type I:</b> undisplaced fractures</p> <p><b>Type II:</b> involve both cortices but with little or no displacement.</p> <p><b>Type III:</b> displaced fractures in which there is some contact between the proximal and distal fragments.</p> <p><b>Type IV:</b> severely displaced fractures with no contact between the proximal and distal fragments.</p> <p><b>Type V:</b> meta-diaphyseal fractures (high supracondylar fractures)</p>

**Table 2** Interobserver variation

Pairs of observers	Gartland		L&R	
	observation 1	observation 2	observation 1	observation 2
O1/O2	0.575	0.574	0.648	0.604
O1/O3	0.595	0.492	0.602	0.526
O2/O3	0.519	0.553	0.646	0.676
Mean	0.563	0.540	0.632	0.602
	0.55		0.62	

Abbreviations: L&R, Lagrange & Rigault.

**Table 3** Intraobserver variation

	Observer 1	Observer 2	Observer 3	Mean
Gartland	0.877	0.880	0.596	0.78
L&R	0.917	0.881	0.521	0.77

Abbreviations: L&R, Lagrange & Rigault.

**Table 4** Interpretation of the kappa statistic according to Landis and Koch<sup>11</sup>

Value of Kappa	Interpretation
< 0.21	Very poor
0.21–0.40	Poor
0.41–0.60	Fair
0.61–0.80	Good
0.81–1.00	Very good

The mean interobserver variation was 0.55 and 0.62 for the Gartland classification and the L&R classification, respectively (► **Table 2**).

The mean intraobserver variation was 0.78 and 0.77 for the Gartland classification and the L&R classification, respectively (► **Table 3**).

According to Landis and Koch<sup>11</sup> (► **Table 4**), both classifications reach full intraobserver agreement, but only the L&R classification reaches full interobserver agreement, with the Gartland classification showing only moderate agreement.

## Discussion

Classifications are intended to facilitate communication between clinicians and investigators, as well as guiding the treatment. To serve these purposes, they must be reproducible.

In the present study, the interobserver variation obtained for the modified Gartland classification is similar to that found in literature. Mallo et al<sup>13</sup> showed a kappa of 0.52; Heal et al<sup>14</sup> of 0.54, and Barton et al<sup>15</sup> a slightly better score of 0.74.

Regarding intraobserver variation, the results obtained are also comparable to those described in the literature. Mallo et al<sup>13</sup> achieved a kappa of 0.723; Heal et al<sup>14</sup> of 0.77, and

Barton et al<sup>15</sup> of 0.84, when comparing the radiographs with a 2-week interval and of 0.81 with a 9-month interval.

The classification of L&R is much less studied, which reflects the comparatively wider use of the Gartland classification. Nevertheless, the results obtained are similar to those of de Gheldere et al,<sup>16</sup> who obtained an intra and interobserver variation of 0.76 and 0.69, respectively.

Limitations to this study may be the small sample size and the use of radiographs that sometimes failed to be adequate anteroposterior and lateral acquisitions, mainly due to pain elicited while manipulating the upper limb. On the other hand, it approaches clinical practice, as most radiographs obtained in the acute setting lack perfect acquisition.

Additionally, the use of the Wilkins-modified Gartland classification may increase classification difficulty, leading to underestimated results.

## Conclusions

As it is well known, the quality of a classification is given by its intra and interobserver reliability.

Through this analysis, it is possible to conclude that both classifications show a similar intra and interobserver variation and both are adequate for usage in clinical and investigational practices. Nevertheless, the L&R classification shows a trend to better interobserver correlation, but larger studies are needed to confirm this hypothesis.

### Conflicts of Interest

Authors declare no conflict of interest.

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