




Available online at
 ScienceDirect
www.sciencedirect.com

Elsevier Masson France
 EM|consulte
www.em-consulte.com



ORIGINAL ARTICLE

Reliability of the Lagrange and Rigault classification system of supracondylar humerus extension fractures in children

A. de Gheldere^{a,*}, M. Legname^a, M. Leyder^a, G. Mezzadri^b, P.-L. Docquier^c

^a Brabois Children's Hospital, Nancy Teaching Medical Center, Pediatric Orthopaedic Surgery Department, rue du Morvan, 54500 Vandœuvre-lès-Nancy, France

^b Mothers Children's Hospital Lyon Teaching Medical Center, Pediatric Orthopaedic Surgery Department, 59, boulevard Pinel 69677 Bron, France

^c Saint-Luc Academic Hospitals, Orthopaedic Surgery Department, 10, avenue Hippocrate, 1200 Bruxelles, Belgium

Accepted: 8 March 2010

KEYWORDS

Supracondylar fractures;
Lagrange and Rigault classification;
Reliability;
Intra and interobserver reliability comparison

Summary

Introduction: The Lagrange and Rigault classification was designed to describe extension-type supracondylar fractures of the humerus. It can also help in treatment decision-making.

Hypothesis: The reliability of this classification has not yet been proven. The goal of this study was to assess this system's intra- and interobserver reliability.

Methods: One hundred supracondylar fracture radiographs were randomly retrieved and reviewed by five different observers on two occasions in a different order. The kappa index was used to calculate the intra- and interobserver reliability.

Results: Intraobserver reliability was 0.76 and interobserver reliability was 0.69.

Discussion: The study shows good intra- and interobserver reliability. The Lagrange and Rigault classification has similar reliability to other supracondylar fracture classifications.

© 2010 Elsevier Masson SAS. All rights reserved.

Introduction

Extension-type supracondylar fractures are the most frequent elbow fractures in children [1,2]. The classification proposed by Lagrange and Rigault in 1962 to describe this fracture [3] remains the most widely used in France and in most French-speaking countries. It is based on the amount of displacement of the distal fragment. Originally composed

* Corresponding author. 14, rue de la chapelle, 1367 Ramillies, Belgium. Tel.: +32 472 37 12 36.

E-mail address: digheldria@gmail.com (A. de Gheldere).

of five stages, the fifth is now infrequently used.

This classification also assists in making the decision on the type of treatment to apply depending on the stage. Orthopaedic teams vary widely in terms of indications for the various stages [4]. Stage I (undisplaced fracture) responds well to orthopaedic treatment with a long arm cast. Stage II is treated with the Blount method [5] or surgically. Stage III fractures can sometimes be treated with the Blount method, but most surgeons prefer osteosynthesis, as in stage IV. Stage V is rarer, but less stable given the more proximal location of the fracture line [6]. It requires surgical stabilization [6].

The quality of the classification system resides in its intra- and interobserver reliability. Yet the reliability of the Lagrange and Rigault classification has never been evaluated. The objective of this study was to measure the intra- and interobserver reliability of this classification so as to validate its continued use.

Material and methods

One hundred randomly selected radiographic files of extension-type supracondylar fractures were obtained retrospectively from two different hospitals. Each radiographic file included an AP and a lateral X-ray. The images were taken in emergency situations with the consequential disadvantages in terms of image quality.

Five different observers (two orthopaedic surgeons, one senior registrar, and two junior registrars) participated in the study. The first three observers had more than 6 years of experience. Each observer had a diagram outlining the Lagrange and Rigault classification (Fig. 1). The 100 radiographic files of the fracture were provided to each observer, who classified them according to their stage (I, II, III, IV, or V). After a minimum 15 days, the same files

Table 1 Interpretation of the kappa statistic according to Landis and Koch [8].

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

were submitted in a different order to the same observers, who classified them once again. Each classification was made without knowledge of the responses of the other observers or the responses given the first time by the same observer.

Intra- and interobserver reliability was calculated using SPSS.15.0 for Windows (SPSS Inc., Chicago, IL, USA). The kappa value measures the proportion of the number of times the observers gave the same response, modified to take into account random concordances. This variable measures the proportion of responses for which the observers are in agreement, taking into account the proportion related to chance [7]. The maximum kappa value (1.00) indicates perfect agreement between two observers. The minimum kappa value (0) represents agreement between two observers entirely due to chance [8]. Table 1 shows the reliability value of the kappa variable as described by Landis and Koch [8].

Results

The kappa values are summarized in Table 2. The mean kappa index of intraobserver reliability was 0.76. For the three most experienced observers, the proportion of X-rays that were classified identically during the two evaluations

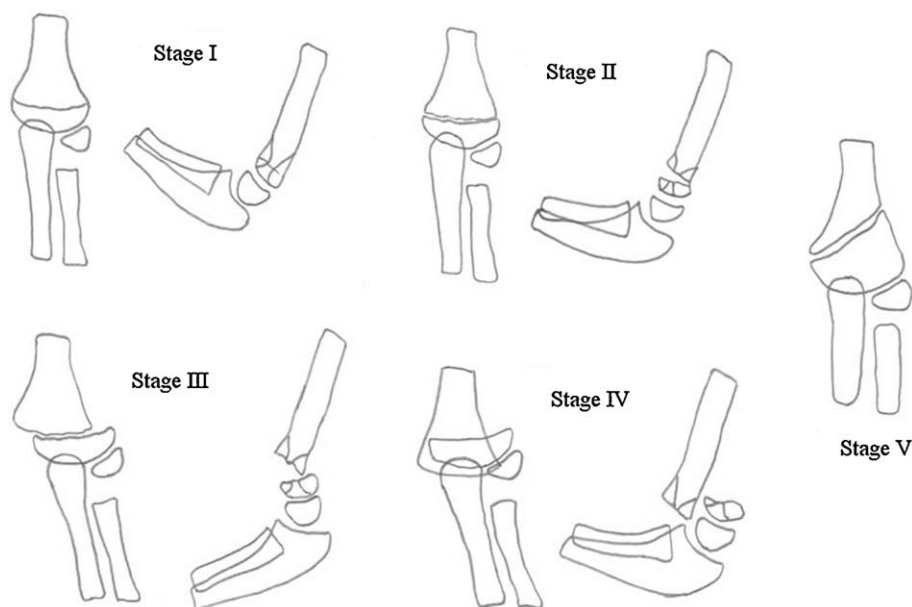


Figure 1 Diagram outlining the Lagrange and Rigault classification. Stage I: undisplaced fractures, only the anterior cortex is disrupted; stage II: fractures involving both corticals, no or little displacement; stage III: fractures with substantial displacement; stage IV: substantial displacement fractures with no contact between bone fragments; stage V: metaphyseal-diaphyseal fractures.

Table 2 Kappa values expressing intra- and interobserver reliability (a=first observation; b=second observation; bold = intraobserver reliability).

	Obs 1.b	Obs 2.b	Obs 3.b	Obs 4.b	Obs 5.b
Obs 1.a	0.695	–	–	–	–
Obs 2.a	0.665	0.777	–	–	–
Obs 3.a	0.632	0.686	0.730	–	–
Obs 4.a	0.667	0.749	0.633	0.747	–
Obs 5.a	0.675	0.731	0.644	0.776	0.827

Table 3 Comparison of studies reporting intra- and interobserver reliability for different fracture classification systems.

Study	Fracture site	Classification	Interobserver κ	Intraobserver κ
Thomsen et al. [14]	Ankle	Lauge-Hansen	0.49 and 0.60	0.60–0.70
Thomsen et al. [14]	Ankle	Weber	0.58 and 0.56	0.60–0.76
Sidor et al. [15]	Shoulder	Neer	0.48 and 0.52	0.66
Siebenrock and Gerber [16]	Shoulder	Neer	0.40	0.66
Barton et al. [9]	Elbow	Gartland	0.74	0.84
Heal et al. [17]	Elbow	Modified Gartland	0.54	0.77
Our study	Elbow	Lagrange-Rigault	0.69	0.76

Table 4 Rate of agreement between observers (%).

Total agreement	Series 1 (%)	Series 2 (%)
All five observers	51	54
At least four observers	85	79
At least three observers	100	99

was 84%. For the last two, less experienced observers, it was 82%. This difference was not significant.

The mean kappa index of interobserver reliability was 0.69. Agreement was perfect between the five observers in only 51% of the cases in the first assessment and in 54% of the cases in the second. Agreement is therefore independent of the clinician's experience.

Discussion

The evaluations were carried out 15 days apart for each of the observers. For Barton et al. [9], this time lapse did not influence intraobserver reliability. The intraobserver reliability calculated can be qualified as "good" for four observers and very good for the fifth. The mean kappa index for intraobserver reliability (0.76) was higher than or comparable to other classification systems used in orthopaedics (Table 3).

Interobserver reliability was good between all the observers participating in the present study. The mean kappa index for interobserver reliability (0.69) was lower than the intraobserver reliability, as in most other classification systems. However, the percentage of agreement in the results of the different observers remains fairly low (Table 4).

Differentiating between stages 3 and 4 was the source of most of the disagreements, followed by differentiating between stages 1 and 2, and finally between stages 2 and 3. This may be due to the problems obtaining good-quality

images when cases presented severe displacement, with pain. In these cases it is difficult to determine whether contact remains between the fragments. The absence of a difference between experienced and unexperienced observers proves that the classification is easy to assimilate.

The Lagrange and Rigault classification is therefore as reliable as the Gartland classification described in 1959 [10], which has been modified several times over the years and is sometimes a source of more confusion than precision. Initially described in three stages [10], each of the stages is now subdivided into subgroups [11,12] and a fourth stage was described for intraoperative observations [13].

It is therefore easier to use the Lagrange and Rigault classification in daily practice. However, it shows that the facility of reduction and stability of fractures cannot be assessed with this system. It should remain within its descriptive limits allowing the orthopaedic surgeon to orient treatment without dictating it.

Conflict of interest statement

None.

References

- [1] Cheng JC, Ng BK, Ying SY, Lam PK. A 10-year study of the changes in the pattern and treatment of 6493 fractures. *J Pediatr Orthop* 1999;19:344–50.
- [2] Omid R, Choi PD, Skaggs DL. Supracondylar humeral fractures in children. *J Bone Joint Surg Am* 2008;90:1121–32.
- [3] Lagrange J, Rigault P. Les fractures de l'extrémité inférieure de l'humérus de l'enfant. *Rev Chir Orthop* 1962;48:334–414.
- [4] Akakpo-Numado GK, Mal-Lawane M, Belouadah M, Kabore B, Lefort G, Daoud S. Management of Lagrange and Rigault stage IV extension type supracondylar fracture of the humerus in children. *Rev Chir Orthop* 2005;91:664–70.
- [5] Blount WP. Fractures in children. *Postgrad Med* 1954;16:209–16.

- [6] Fayssoux RS, Stankovits L, Domzalski ME, Guille JT. Fractures of the distal humeral metaphyseal-diaphyseal junction in children. *J Pediatr Orthop* 2008;28:142–6.
- [7] Petrie A. Statistics in orthopaedic papers. *J Bone Joint Surg Br* 2006;88:1121–36.
- [8] Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977;33:159–74.
- [9] Barton KL, Kaminsky CK, Green DW, Shean CJ, Kautz SM, Skaggs DL. Reliability of a modified Gartland classification of supracondylar humerus fractures. *J Pediatr Orthop* 2001;21:27–31.
- [10] Gartland JJ. Management of supracondylar fractures of the humerus in children. *Surg Gynecol Obstet* 1959;109:145–54.
- [11] Beaty JH, Kasser JR. Supracondylar fractures of the distal humerus. In: Rockwood Jr CA, Wilkins KE, editors. *Fractures in children*, 3. Philadelphia: PA: LB Lippincott; 2001. p. 563–624.
- [12] Mubarak SJ, Davids JR. Closed reduction and percutaneous pinning of supracondylar fractures of the distal humerus in the child. *Master techniques in orthopaedic surgery—the elbow* 1994:p. 37.
- [13] Leitch KK, Kay RM, Femino JD, Tolo VT, Storer SK, Skaggs DL. Treatment of multidirectionally unstable supracondylar humeral fractures in children: a modified Gartland type-IV fracture. *J Bone Joint Surg Am* 2006;88:980–5.
- [14] Thomsen NO, Overgaard S, Olsen LH, et al. Observer variation in the radiographic classification of ankle fractures. *J Bone Joint Surg Br* 1991;73:676–8.
- [15] Sidor ML, Zuckerman JD, Lyon T, et al. The Neer classification system for proximal humerus fractures: assessment of inter-observer reliability and intraobserver reproducibility. *J Bone Joint Surg Am* 1993;75:1745–50.
- [16] Siebenrock KA, Gerber C. The reproducibility of classification of fractures of the proximal end of the humerus. *J Bone Joint Surg Am* 1993;75:1751–5.
- [17] Heal J, Bould M, Livingstone J, Blewitt N, Blom AW. Reproducibility of the Gartland classification for supracondylar humeral fractures in children. *J Orthop Surg* 2007;15:12–4.