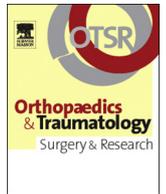




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Original article

Comparison of the inter- and intra-observer reproducibility of the Crowe, Hartofilakidis and modified Cochin classification systems for the diagnosis of developmental dysplasia of the hip



A. Clavé^a, L. Kerboul^b, T. Musset^c, X. Flecher^d, D. Hutten^e, C. Lefèvre^a,
 F. Gaucher^f, E. Stindel^{a,*}, The French Hip & Knee Society (SFHG)^g

^a Service de chirurgie orthopédique et traumatologique, faculté de médecine, université de Bretagne-Occidentale, hôpital de la Cavale-Blanche, CHRU de Brest, boulevard Tanguy-Prigent, 29200 Brest, France

^b Centre médico-chirurgical Paris V, 36, boulevard Saint-Marcel, 75005 Paris, France

^c Clinique mutualiste de la Porte-de-L'Orient, 3, rue Robert-de-La-Croix, 56324 L'Orient, France

^d Institut du mouvement et de l'appareil locomoteur, faculté de médecine, université d'Aix-Marseille, hôpital Sainte Marguerite, Marseille, France

^e Service de chirurgie orthopédique, réparatrice et traumatologique, faculté de médecine Rennes, université de Rennes, hôpital Sud, CHRU de Rennes, 16, boulevard de Bulgarie, 35203 Rennes, France

^f Service de chirurgie orthopédique, Hôtel-Dieu-de-Pont-l'Abbé, rue Signor, 29120 Pont-l'Abbé, France

^g 56, rue Boissonnade, 75014 Paris, France

ARTICLE INFO

Article history:

Accepted 22 July 2014

Keywords:

Hip
 Dysplasia
 Classification
 Congenital hip disease

ABSTRACT

Introduction: Developmental dysplasia of the hip (DDH) leads to multiple treatment challenges during adulthood. Surgical treatment is mainly based on radiographic evaluation of the anatomical alterations. Several classification systems have been described in the published English scientific literature, but the French Cochin classification has not been used very much. Its primary advantage lies in its ability to intricately describe the DDH alterations with a large number of grades. We hypothesized that the inter- and intra-observer reproducibility of the SOFCOT-modified Cochin classification system was equal to that of the Crowe and Hartofilakidis classifications.

Material and methods: Five French orthopaedic surgeons who were DDH experts classified 94 A/P pelvis radiographs (179 hips) using the Crowe (Cr), Hartofilakidis (Ha) and modified Cochin (Co) systems. This evaluation was repeated a second time one month later. The intra-observer reproducibility was determined with weighted Kappa and concordance coefficients. The inter-observer reproducibility was performed by calculating the multirater Kappa coefficient on each of the two data series.

Results: For the intra-observer reliability, the average weighed concordance coefficients (95% CI) were 88.62–94.52 for Cr, 89.43–93.80 for Ha and 92.14–95.71 for Co. The average weighed Kappa coefficients (95% CI) were 0.70–0.85 for Cr, 0.67–0.82 for Ha and 0.75–0.83 for Co. For the inter-observer reliability, the Kappa for each assessment round was 0.57 and 0.48 for Cr, 0.43 and 0.44 for Ha, and 0.43 and 0.37 for Co.

Discussion: The intra- and inter-observer reliability for the modified Cochin classification system is the same as the one for the Crowe and Hartofilakidis classifications. The theoretical advantage of this classification system should be confirmed by comparing the findings with intra-operative anatomical observations.

Level of proof, type of study: IV.

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* Corresponding author. Service de chirurgie orthopédique et traumatologique, faculté de médecine, université de Bretagne-Occidentale, hôpital de la Cavale-Blanche, CHRU de Brest, boulevard Tanguy-Prigent, 29200 Brest, France.
 Tel.: +33 02 98 34 72 72.

E-mail address: eric.stindel@univ-brest.fr (E. Stindel).

1. Introduction

Development dysplasia of the hip (DDH) in adults, which is becoming less prevalent because of better prevention [1], is a condition where treatment requires complex surgery. The surgical treatment must take into account the combination of muscular and bone (femur, acetabulum) abnormalities [2–5]. Pre-operative



Fig. 1. Cochin Classification (SOFCOT modified).

evaluation of these alterations is a key component when defining the treatment strategy. This will help the surgeon anticipate the intra-operative challenges and potential complications, determine which implants to use and to a lesser degree, predict the expected outcome [2,3,6–8]. This evaluation uses radiographic classification systems that define groups of typical alterations. These are either objective (based on measuring a radiographic index) or subjective (based on evaluating descriptive anatomical elements). The Crowe (objective) and Hartofilakidis (subjective) classification systems are used most commonly in published English-language scientific publications. Although the reproducibility of these classifications has been validated [9–11], their ability to predict surgical problems has been questioned by many authors [7,12,13]. Alternative classification systems include the one proposed and evaluated by Gaston et al. in 2009 [14] and the one published by Kerboul back in 1987 [2,15,16]. The latter has also been called the Cochin classification. Its five-level version was modified by the SOFCOT (French Society of Orthopaedic and Trauma Surgery) in 2012, but its reproducibility has never been evaluated nor compared to the commonly-used Crowe and Hartofilakidis classifications.

We hypothesized that the inter- and intra-observer reproducibility of the SOFCOT-modified Cochin classification system was equal to that of the Crowe and Hartofilakidis classifications.

2. Material and methods

The radiography databases from five French hospitals were used to select a group of standing A/P pelvis views. Radiographs were eligible to be selected if they were from adult patients with hip dysplasia that had never been surgically treated. The following inclusion and exclusion criteria were used.

Inclusion criteria:

- radiographs with signs of DDH as defined by Crowe on at least one hip.

Exclusion criteria:

- radiographs with no signs of DDH;
- radiographs that do not show the entire pelvis (anterosuperior iliac spines to ischium);
- radiographs not taken in full frontal view (defined as asymmetry of the iliac crests and obturator foramen and/or coccyx projection that is not centred relative to the pubic symphysis).

To avoid recall bias, the sequence in which the radiographs were analysed was randomly set by making up two reading lists (list A and list B).

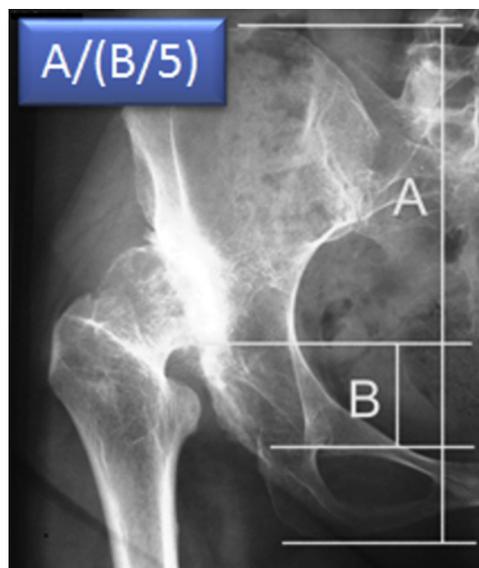


Fig. 2. Crowe Classification.

All of the following documents were saved to DVD and sent to five French orthopaedic surgeons throughout France who are DDH experts (R1, R2, R3, R4, R5):

- reading list A;
- digitized version of the radiographs;
- description of the three classification systems (Cr, Ha, Co) – (Figs. 1–3 and Tables 1 and 2);
- sheet used for standardized recording of the grades.

Each analysable hip was classified in the three classification systems (Cr, Ha, Co) by each of the five surgeons in the order shown in list A. The recording sheets were frozen and then the same method reapplied 30 days later using list B. The classification results were combined into a single file for statistical analysis (STATA 12.1, Stat-aCorp, 4905 Lakeway Drive, Texas, USA).

The intra-observer reproducibility was evaluated by calculating two weighed coefficients: concordance and Kappa (as defined by

Table 1
Crowe classification.

Grade	Description
I	$R < 0.1$
II	$0.1 < R < 0.15$
III	$0.16 < R < 0.2$
IV	$R > 0.2$

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