



Osteochondritis dissecans of the humeral capitellum: reliability of four classification systems using radiographs and computed tomography

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Background: The radiographic appearance of osteochondritis dissecans (OCD) of the humeral capitellum varies according to the stage of the lesion. It is important to evaluate the stage of OCD lesion carefully to guide treatment. We compared the interobserver reliability of currently used classification systems for OCD of the humeral capitellum to identify the most reliable classification system.

Methods: Thirty-two musculoskeletal radiologists and orthopaedic surgeons specialized in elbow surgery from several countries evaluated anteroposterior and lateral radiographs and corresponding computed tomography (CT) scans of 22 patients to classify the stage of OCD of the humeral capitellum according to the classification systems developed by (1) Minami, (2) Berndt and Harty, (3) Ferkel and Sgaglione, and (4) Anderson on a Web-based study platform including a Digital Imaging and Communications in Medicine viewer. Magnetic resonance imaging was not evaluated as part of this study. We measured agreement among observers using the Siegel and Castellan multirater κ .

Results: All OCD classification systems, except for Berndt and Harty, which had poor agreement among observers ($\kappa = 0.20$), had fair interobserver agreement: κ was 0.27 for the Minami, 0.23 for Anderson, and 0.22 for Ferkel and Sgaglione classifications. The Minami Classification was significantly more reliable than the other classifications ($P < .001$).

Conclusions: The Minami Classification was the most reliable for classifying different stages of OCD of the humeral capitellum. However, it is unclear whether radiographic evidence of OCD of the humeral

This study was approved by the Institutional Review Board of Orthotrauma Research Center Amsterdam for the use of anonymous radiographs and computed tomography scans.

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capitellum, as categorized by the Minami Classification, guides treatment in clinical practice as a result of this fair agreement.

Level of evidence: Basic Science Study, Development or Validation of Outcomes Instruments/Classification Systems.

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The prevalence of osteochondritis dissecans (OCD) of the humeral capitellum is highest among adolescent athletes who have played throwing sports, such as baseball, since childhood.^{4,7,38} Repetitive compression and shear forces to an immature capitellum that is vulnerable for vascular changes are believed to be etiologic factors associated with this type of “overuse” injury.^{7,19,26,38,46} The radiographic appearance of OCD of the humeral capitellum varies according to the stage of the lesion.^{4,7,26,46} In general, OCD of the humeral capitellum should be treated conservatively, unless there are loose bodies, mechanical symptoms, or failure of conservative treatment.^{7,22,24,33,38}

Several staging systems are used for OCD of the knee and ankle to guide treatment.^{9,25} These classifications for capitellar OCDs are less frequently used and their reliability is unknown. Evaluating the stage of OCD lesions is important to guide treatment and optimize outcome.²³ Radiographs are most commonly used for diagnosing OCD of the humeral capitellum; however, early stages could be missed.^{4,38} Computed tomography (CT) may be indicated to depict osseous details and to determine the size of the lesion.^{20,30,38}

This study evaluated the reliability of the most commonly used OCD classification systems for the humeral capitellum on radiographs and CT scans. Magnetic resonance imaging (MRI) was not evaluated in this study. We hypothesized that the Minami,³⁴ Berndt and Harty,² Ferkel and Sgaglione,¹³ and Anderson¹ classification systems would be equally reliable for classification of OCD of the humeral capitellum.

Materials and methods

This was an interobserver study to evaluate the reliability of the most commonly used OCD classification systems for the humeral capitellum on radiographs and CT scans.

We invited orthopedic surgeons and musculoskeletal radiologists specialized in orthopedic elbow pathology from several countries to an online survey to evaluate radiographs and CTs of patients intraoperatively diagnosed with an OCD of the humeral capitellum between January 2013 and June 2014 by one of the senior authors (D.E.). Nine control patients without cartilage abnormalities of the humeral capitellum were diagnosed with (posteromedial) elbow impingement.⁴¹

Anterior-posterior and lateral radiographs of the elbow, as well as sagittal, axial, and coronal CTs of the elbow were available for

each patient. Patients with previous surgery of the elbow were excluded. We asked observers to classify OCDs of the humeral capitellum on radiographs and CT scans according to the most commonly used staging systems. In addition, observers had to determine the position of the lesion on the humeral capitellum.

Study design

A total of 80 orthopedic surgeons and musculoskeletal radiologists specialized in elbow pathology, members of the Science of Variation group (<http://www.scienceofvariationgroup.nl>) and the Shoulder & Elbow Platform, logged onto the Web site (<http://www.shoulderelbowplatform.com>) after receiving an invitation e-mail that included a short study description. Observers evaluated radiographs and 2-dimensional (2D) CT scans using a built-in Digital Imaging and Communications in Medicine viewer and were able to adjust brightness, contrast, and window leveling. They were able to scroll through the 2D-CT scans in transverse, sagittal, and coronal planes.

An independent research fellow not involved in patients' care blinded all radiographs and CTs and uploaded the Digital Imaging and Communications in Medicine files of blinded radiographs to the Web site. After observers logged on to the Web site, we asked them to provide demographic and professional information: (1) sex, (2) location of practice (Europe, USA, or other), (3) years in practice (0-5, 6-10, 11-15, or >16 years), and (4) involvement in resident or fellow training (yes or no). Observers subsequently classified radiographs of 22 cases according to the Minami,³⁹ the Berndt and Harty,³ the Ferkel and Sgaglione,¹³ and the Anderson classification systems¹ (Appendix I). After assessing the classification, we asked observers to indicate where the OCD was located in the coronal plane (lateral, medial, or middle) and in the sagittal plane (anterior, middle, or posterior) of the humeral capitellum.

Thirty-two of the 80 observers (40%) completed the survey. All questions related to 1 case had to be completed to continue with the next case. The observers completed the study at their own pace, in their own time, and on various computers, if necessary.

Statistical analysis

Post hoc power analysis revealed that a minimum sample of 22 cases evaluated by a minimum of 32 observers would provide 80% power ($\alpha = 0.05$, $\beta = 0.20$) in a 2-sample Z test to detect a clinically significant difference of 1 categorical rating of $\kappa = 0.20$.¹⁴

We calculated the agreement among the observers using the Siegel and Castellan multirater κ , a commonly used statistic to describe chance-corrected agreement in various intraobserver and interobserver studies.^{6,8,29,37} A value of 0.01 to 0.20 indicates poor agreement; 0.21 to 0.40, fair agreement; 0.41 to 0.60, moderate

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