



Reliability testing of two classification systems for osteoarthritis and post-traumatic arthritis of the elbow

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Hypothesis and background: The severity of elbow arthritis is one of many factors that surgeons must evaluate when considering treatment options for a given patient. Elbow surgeons have historically used the Broberg and Morrey (BM) and Hastings and Rettig (HR) classification systems to radiographically stage the severity of post-traumatic arthritis (PTA) and primary osteoarthritis (OA). We proposed to compare the intraobserver and interobserver reliability between systems for patients with either PTA or OA.

Methods: The radiographs of 45 patients were evaluated at least 2 weeks apart by 6 evaluators of different levels of training. Intraobserver and interobserver reliability were calculated by Spearman correlation coefficients with 95% confidence intervals. Agreement was considered almost perfect for coefficients >0.80 and substantial for coefficients of 0.61 to 0.80.

Results: In patients with both PTA and OA, intraobserver reliability and interobserver reliability were substantial, with no difference between classification systems. There were no significant differences in intraobserver or interobserver reliability between attending physicians and trainees for either classification system (all $P > .10$). The presence of fracture implants did not affect reliability in the BM system but did substantially worsen reliability in the HR system (intraobserver $P = .04$ and interobserver $P = .001$).

Conclusions: The BM and HR classifications both showed substantial intraobserver and interobserver reliability for PTA and OA. Training level differences did not affect reliability for either system. Both trainees and fellowship-trained surgeons may easily and reliably apply each classification system to the evaluation of primary elbow OA and PTA, although the HR system was less reliable in the presence of fracture implants.

Level of evidence: Level III, Diagnostic Study.

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Although fractures of the elbow joint represent only 6% of fractures in adults, they occur in patients of all ages,¹² and radiographic evidence of post-traumatic arthritis (PTA) is common.¹¹ Primary osteoarthritis (OA) of the elbow accounts for 1% to 2% of all patients presenting with



Figure 1 Broberg and Morrey classification of elbow arthritis. (A) Grade 1: slight joint space narrowing with minimal osteophyte formation. (B) Grade 2: moderate joint space narrowing with moderate osteophyte formation. (C) Grade 3: severe degenerative change with gross destruction of the joint.



Figure 2 Hasting and Rettig classification of elbow arthritis. (A) Class I: degeneration in the margins of the ulnotrochlear joint with the presence of coronoid and olecranon spurring; absence of degenerative changes within the radiocapitellar joint. (B) Class II: class I with mild joint space narrowing within the radiocapitellar joint, without subluxation of the radial head. (C) Class III: class II with radiocapitellar subluxation.

degenerative arthritis¹⁶ and is most common in middle-aged, male laborers.^{13,15,17} Many treatment options exist for elbow arthritis,¹⁷ and appropriate treatment for individual patients is based on a multitude of factors, including the severity of disease.

PTA is commonly graded according to the system proposed by Broberg and Morrey (BM), based on osteophyte formation and joint space narrowing.³ Primary OA usually is graded according to the system proposed by Hastings and Rettig (HR), based on the presence of subluxation and involvement of the radiocapitellar joint.¹⁵ Previous work has demonstrated fair reliability of the BM system in grading of patients with PTA,¹⁰ but the reliability of the HR system has not been examined. Further, these 2 systems have not been compared in the same cohort of patients.

The purpose of this investigation was to evaluate the intraobserver and interobserver reliability of the BM and HR systems in patients with PTA and OA. We also sought to determine the effect that level of training of the observers had on the reliability of both systems. We hypothesized that both systems would prove reliable in grading of both types of elbow arthritis and that more senior observers would be more reliable than trainees.

Materials and methods

This is an agreement study of 2 classification systems for elbow OA and PTA in a group of nonconsecutive patients. After receiving approval from our Institutional Review Board, we used *Current Procedural Terminology* codes to identify 45 patients who were seen for elbow arthritis, excluding inflammatory conditions, at our institution. Best-quality anteroposterior and lateral radiographs from each patient were de-identified, and all radiographs were reoriented to represent right elbows to improve consistency. The original characterizations for both the BM³ (Fig. 1) and HR¹⁵ (Fig. 2) classifications were included in the beginning of the file for reference by the evaluators. The films were then electronically distributed to the 6 evaluators (3 attending orthopedic surgeons with fellowship training in upper extremity surgery [B.M.M., F.M.A., and T.W.T.] and 3 orthopedic trainees [M.H.A., J.B.S., and S.T.O.]). Each evaluator classified the radiographs according to both systems after an interval of at least 2 weeks, a period used in other reliability studies in upper extremity surgery.^{2,7}

Of the 45 patients, 19 had PTA and 26 had primary OA. In the patients with PTA, the initial injuries included 7 radial head or neck fractures, 4 intercondylar distal humeral fractures, 2 elbow dislocations, 2 olecranon fracture-dislocations, 1 Monteggia fracture-dislocation, and 1 capitellar fracture. We were unable to definitively ascertain the initial injury in 2 patients because of the time that had passed between the injury and presentation to our institution. Four patients who had a previous radial head excision

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