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Assessment of medial elbow laxity by gravity stress radiography: comparison of valgus stress radiography with gravity and a Telos stress device

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Background: Valgus instability was reported to be higher with the elbow in 60° of flexion, rather than in 30° of flexion, although there are no studies using valgus stress radiography by gravity (gravity radiography) with the elbow in 60° of flexion.

Methods: Fifty-seven patients with medial elbow pain participated. For both elbows, valgus stress radiography by use of a Telos device (Telos radiography) and gravity radiography, with the elbow in 60° of flexion, were performed for the assessment of medial elbow laxity. In both radiographs, the medial elbow joint space (MJS) on the affected side was compared with that on the opposite side, and the increase in the MJS on the affected side was assessed.

Results: For the Telos radiographs, the mean MJS was 4.7 mm on the affected side and 4.0 mm on the opposite side, with the mean increase in the MJS on the affected side being 0.7 mm. For the gravity radiographs, the mean MJS was 5.0 mm on the affected side and 4.2 mm on the opposite side, with the mean increase in the MJS on the affected side being 0.8 mm. There were significant correlations between the Telos and gravity radiographs in the MJS on the affected side, the MJS on the opposite side, and the increase in the MJS on the affected side (respectively, $P < .0001$). There was also a high level of intraobserver and interobserver reliability for the assessment of the gravity radiographs.

Conclusions: Gravity radiography is useful for assessment of medial elbow laxity, similar to Telos radiography.

Level of evidence: Level I, Diagnostic Study.

Keywords: Assessment; elbow; laxity; valgus stress; radiography; gravity

Valgus stress radiography, conducted manually,[7] with a Telos device,[2-4,10,11,13] or by gravity,[5-7,9,12,15] has been reported as a quantitative means for the assessment of medial elbow laxity. Stress radiography with a Telos device (Telos stress radiography; Telos Arzt- und Krankenhausbedarf GmbH, Hungen, Germany) has been widely used as a quantitative tool to assess medial elbow laxity in throwing athletes, such as baseball players, because Telos stress radiography has an advantage in being able to assess laxity under uniform conditions.[2-4,10,11,13] Valgus stress radiography by gravity (gravity stress radiography) is able to assess laxity without any special equipment, under uniform

Institutional review board approval was obtained before the start of this study, and informed consent was obtained from the subjects.

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conditions, and has also been widely used for the assessment of medial elbow laxity.[5-7,12,15] In previous studies, two different techniques for gravity stress radiography have been reported, in which subjects for both techniques were placed supine on a table with the shoulder at 90° of abduction and 90° of external rotation and the elbow at 15° to 30° of flexion.[5,7,9,15] The first technique, however, involves only gravity of the forearm,[7,9] whereas the second involves not only gravity of the forearm but also a weight attached to the wrist.[5,15] However, the intraobserver and interobserver reliabilities of these valgus stress radiography techniques have not yet been assessed, and little is known about which is better at assessing elbow laxity.

Both Telos stress radiography and gravity stress radiography have been performed extensively with the elbow in 15° to 30° of flexion.[3-5,7,9,11-13,15] However, Søjbjerg et al[14] reported that in normal cadaveric elbows, transection of the medial collateral ligament caused valgus instability with a mean maximum of 20.2° in 60° of flexion. This result suggests that valgus instability is higher with the elbow in 60° of flexion than in 30° of flexion. Therefore, we have performed Telos and gravity stress radiography with the elbow in 60° of flexion. The aim of this study was to address the efficacy of gravity stress radiography for assessment of medial elbow laxity.

Methods

This is a prospective cohort study of diagnostic tests to assess medial elbow laxity. Fifty-seven athletes with medial elbow pain participated. There were 55 men and 2 women, aged between 10 and 29 years (mean, 18.1 years). The types of sports played by the subjects were baseball in 49, tennis in 2, basketball in 2, judo in 2, cycling in 1, and badminton in 1. The reason for onset of elbow pain was chronic overload of the medial collateral ligament in 54 subjects and acute traumatic events in 3 (judo, 2; cycling, 1). Forty-seven subjects had right elbow pain, 9 had left elbow pain, and 1 had bilateral pain. The diagnosis of medial elbow pain was ulnar neuritis in 30 subjects, medial collateral ligament injury in 25, osteochondritis dissecans of the capitellum in 8, medial epicondyle injury in 4, posterior elbow injury in 4, and ulnar sublime tubercle avulsion fracture in 1. For both elbows, valgus stress radiography was performed with a Telos device and gravity to assess medial elbow laxity.

Anteroposterior radiographs of both elbows were taken with a standard radiographic unit. For Telos stress radiography (Telos GA-IIE stress device; Telos, Weiterstadt, Germany), the subjects sat on a chair with the shoulder in 60° of abduction, the elbow in 60° of flexion, and the forearm in a neutral position; 60° of elbow flexion was confirmed with use of a polystyrene foam triangular frame set at the correct angle. Anteroposterior radiographs were obtained while a force of 50 N was applied to the lateral aspect of the elbow (Fig. 1). The valgus force was applied with a screw-threaded shaft that allowed a gradual increase in stress. For gravity stress radiography, subjects were placed supine on a table with the shoulder in 90° of abduction, the elbow in 60° of flexion, and the forearm in a neutral position. Similar to Telos stress radiography, the elbow was confirmed to be flexed at 60° with use of a polystyrene foam frame. Anteroposterior radiographs were obtained with the gravity stress being applied to the elbow (Fig. 2). Another polystyrene foam frame was placed under the upper arm, just proximal to the elbow, so the valgus force was easily applied with the stress from gravity. In both the Telos and gravity stress radiographs, the shortest distance between the most distal point on the curved contour of the medial epicondyle and the ulnar coronoid process was measured, and this was considered to be the medial elbow joint space (MJS) (Fig. 3). For the measurement of the MJS, anteroposterior radiographs by both Telos and gravity stress radiography were enlarged with electronic software (Vox-Base; J-Mac System, Sapporo, Japan) to obtain accurate MJS measurements to the 0.01-mm unit. For both the Telos and gravity stress radiographs, the MJS on the affected side was compared with that on the opposite side, and the increase in the MJS on the affected side was determined.

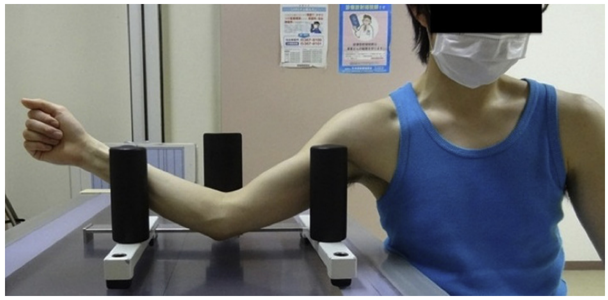

Figure 1 Photograph depicting the technique associated with Telos stress radiography. Subjects sat on a chair with the shoulder in 60° of abduction, the elbow in 60° of flexion, and the forearm in a neutral position. Anteroposterior radiographs were obtained with a force of 50 N applied to the lateral aspect of the elbow.

An orthopedic clinician with more than 10 years of experience (examiner A [M.H.]) measured the MJS on both the Telos and gravity stress radiographs. We investigated the correlation of the MJS between these 2 techniques by comparing the MJS from the Telos stress radiographs with that from the gravity stress radiographs. To investigate the correlation of MJS between the Telos and gravity stress radiographs, a statistical analysis of the data was carried out by the Pearson correlation coefficient and Student t test. A correlation coefficient of ± 0.4 to ± 1.0 and a significance level of $P < .05$ were considered to be significant.

To determine the intraobserver reliability of using Telos and gravity stress radiography, examiner A also measured the MJS again approximately 3 months after the first measurement. Furthermore, to investigate the interobserver reliability of using Telos and gravity stress radiography, another orthopedic clinician (examiner B [M.M.]) measured the MJS with both methods. We evaluated the intraobserver and interobserver reliability of MJS measurements with these two methods by an intraclass correlation coefficient. A coefficient of 0.8 or more was considered to be significant.[1] The analysis of intraobserver and interobserver reliability was performed with Microsoft Excel for Windows version 2002 (Microsoft, Redmond, WA, USA).

Results

The Telos stress radiographs showed that the mean MJS was 4.7 ± 0.9 mm (range, 3.3-8.1 mm) on the affected side and 4.0