FOREARM ROTATION AFFECTS VALGUS LAXITY OF THE ELBOW WHEN UPPER EXTREMITIES MUSCULATURE IS LEFT INTACT

+*Lee, T Q; +McGarry, M H; +Shin, S; +Han, S; +Safran, M R

+*Orthopaedic Biomechanics Laboratory
VA Healthcare System, Long Beach, CA and University of California, Irvine

INTRODUCTION: Accurately diagnosing the presence and degree of ulnar collateral ligament (UCL) injury is often difficult, even for experienced clinicians. Valgus laxity of the elbow is difficult to confirm clinically with various reports recommending examination in pronation, supination and neutral rotation and varying degrees of elbow flexion. There have been no studies performed assessing valgus laxity with the UCL intact and cut in varying degrees of flexion and rotation with the entire upper extremity musculature intact. The purpose of this study was to determine the effect of forearm rotation and elbow flexion on valgus laxity.

METHODS: Twelve fresh frozen cadaveric upper extremities with no radiographic evidence of arthritis, previous fracture or surgery of the elbow were used. The entire upper extremity was used to maintain the origins and insertions of all muscles that cross the elbow that may provide passive stability. The thawed arms were held in a custom instrumented elbow laxity testing device that permits the measurement of varus/valgus laxity of the elbow while applying a pre-specified valgus torque. (Figure 1) Valgus laxity was measured using a Microscribe digitizing system. Using a muscle splitting approach to limit injury to other structures and maintain their effect on elbow stability, the anterior band (AB) of the anterior oblique ligament (AOL) and the posterior band (PB) of the AOL were sectioned randomly and sequentially. Valgus laxity was directly measured (in degrees) in the forearm pronation (P), supination (S) and neutral rotation (N) at 30, 50, and 70 degrees of elbow flexion using 1 Nm and 2 Nm valgus torque with the ligament intact (Int), joint vented (Vent), and fully defined (Def). Follow-up testing involved cutting the anterior or posterior half of the AOL (Half), and following complete sectioning of the AOL (Full). ANOVA was used for statistical analysis with p<0.05 set for statistical significance.

RESULTS: In all cases, N forearm rotation had more valgus angular displacement than P for all degrees of elbow flexion with the ligament intact, AB transected and complete cutting of the AOL at 1 and 2 Nm of torque (p<0.05). With the PB only cut, N had more angular displacement at 30° flexion with 1Nm torque, and at 30° and 70° with 2Nm force (p<0.05). N forearm rotation revealed more valgus displacement than S in all degrees of elbow flexion with the AOL intact and completely transected at 2 Nm (p<0.05), while at 1Nm of torque, NR resulted in more displacement than S at 30° and 50° for both intact and complete AOL transection (p<0.05). With the AB only cut, NR resulted in more displacement than S at all degrees of elbow flexion and both torque forces (except 50° with 1 Nm force) and with the PB only cut, (p<0.05) N forearm rotation resulted in a similar pattern when compared with P (p>0.05). Supination resulted in more forearm valgus displacement as compared with P at 30° and 50° of elbow flexion with an intact ligament at both 1Nm and 2Nm torque (p<0.05), however, there was no difference at either force when the AOL was completely cut (p>0.05). With the AB cut at 30° of flexion with 1Nm force and at 50° of flexion with 2Nm force S resulted in more valgus displacement than P (p<0.05), otherwise there was no statistically significant difference between P and S at any other degree of flexion and no difference at any degree of elbow flexion with AB only or PB only cut (p>0.05). At 1Nm of force, 30° of flexion resulted in more valgus angular displacement than 50° with AOL cut and in S, (p<0.05) while more displacement was noted with complete AOL transection in N at 70° (p<0.05). There was no statistical difference in valgus displacement with flexion angle at 2 Nm testing (p>0.05). There was no difference in cutting the PB or AB first in testing (p<0.05). (Figures 2 and 3) In all cases, 2 Nm force resulted in more displacement than 1 Nm force (p<0.05), and fully transected AOL resulted in more angular displacement than the intact ligament (p<0.05).

DISCUSSION: The results of this study confirm the importance of forearm rotation in the assessment of valgus laxity of the elbow. Neutral rotation is the best position to examine the elbow for valgus laxity. The results from this study most likely differ from previous published data because the entire upper extremity was used and all musculature and their insertions were maintained. Although the muscles are not activated, they contribute to stability by passive muscle length and bulk effects.

Figure 1: Photograph showing the custom elbow laxity testing device.

![Figure 1](image)

Figure 2: Histograms showing valgus laxity with AB transected first.

![Figure 2](image)

Figure 3: Histograms showing valgus laxity with PB transected first.


**Department of Orthopaedic Surgery, University of California, San Francisco"