



ELSEVIER

ORIGINAL ARTICLE

The contribution of the posterolateral capsule to elbow joint stability: a cadaveric biomechanical investigation

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Background: Elbow posterolateral rotatory instability occurs after an injury to the lateral collateral ligament complex (LCLC) in isolation or in association with an osteochondral fracture of the posterolateral margin of the capitellum (Osborne-Cotterill lesion [OCL]). The contribution to elbow stability of the posterolateral capsule, attached to this lesion, is unknown. This study quantified the displacement of the radial head on simulated posterior draw with sectioning of the posterior capsule (a simulated OCL) or LCLC.

Methods: Biomechanical testing of the elbow was performed in 8 upper limb cadavers. With the elbow 0°, 30°, 60°, and 90° degrees of flexion, posterior displacement of the radius was measured at increments of a load of 5 N up to 50 N. A simulated OCL and LCLC injury was then performed.

Results: A simulated OCL results in significantly more displacement of the radial head compared with the intact elbow at 30° to 60° of elbow flexion. LCLC resection confers significantly more displacement. An OCL after LCLC resection does not create further displacement.

Conclusions: The degree of radial head displacement is greater after a simulated OCL at 30° to 60° of flexion compared with the intact elbow with the same load but not as great as seen with sectioning of the LCLC. This study suggests that the posterior capsule attaching to the back of the capitellum is important to elbow stability and should be identified as the Osborne-Cotterill ligament. Clinical studies are required to determine the importance of these biomechanical findings.

Level of evidence: Basic Science Study; Biomechanics

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Keywords: Elbow; instability; lateral collateral ligament complex; capsule; trauma; reconstruction

Ethical committee permission was not required for this Basic Science Study.

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Posterolateral rotatory instability of the elbow is a term described by O'Driscoll et al⁹ that occurs due to post-traumatic or iatrogenic failure of the lateral collateral ligament complex (LCLC).^{8,10,11} This can lead to recurrent elbow instability, during which the ulna and radius rotate externally and then posteriorly with the forearm in a valgus position.

In 1966, Osborne and Cotterill¹² described a case series of 8 patients with recurrent elbow dislocation ascribed to a failure of the posterolateral ligamentous and capsular structures. They identified “an osteochondral fracture in the posterolateral margin of the capitellum” as a key component of this condition. Jeon et al³ later termed this abnormality an Osborne-Cotterill lesion (OCL) and described a shear or avulsion fracture of the posterolateral capsular component from the capitellum and lateral condyle readily seen on radiographs.³

Although the contribution of an intact LCLC to elbow stability is well recognized, the contribution of the posterolateral capsule has not been studied biomechanically. This report describes a cadaveric study that assessed the contribution of a simulated OCL to radial head stability on simulated posterior draw.

In this study we examined the contribution of the posterolateral ligamentous and capsular structures to posterior radial head stability. We compared the measured posterior displacement of the radial head with load throughout the range of flexion of the elbow between the intact state and the elbow with an isolated OCL, isolated LCLC complex release, and a combined release. We hypothesized that an isolated OCL results in elbow instability in the form of posterior displacement of the radial head compared with an intact elbow.

Materials and methods

Biomechanical testing of the elbow was performed in 8 upper limb fresh frozen cadavers (3 right and 5 left limbs; age range, 54-79 years) consisting of the glenohumeral joint to the hand. The

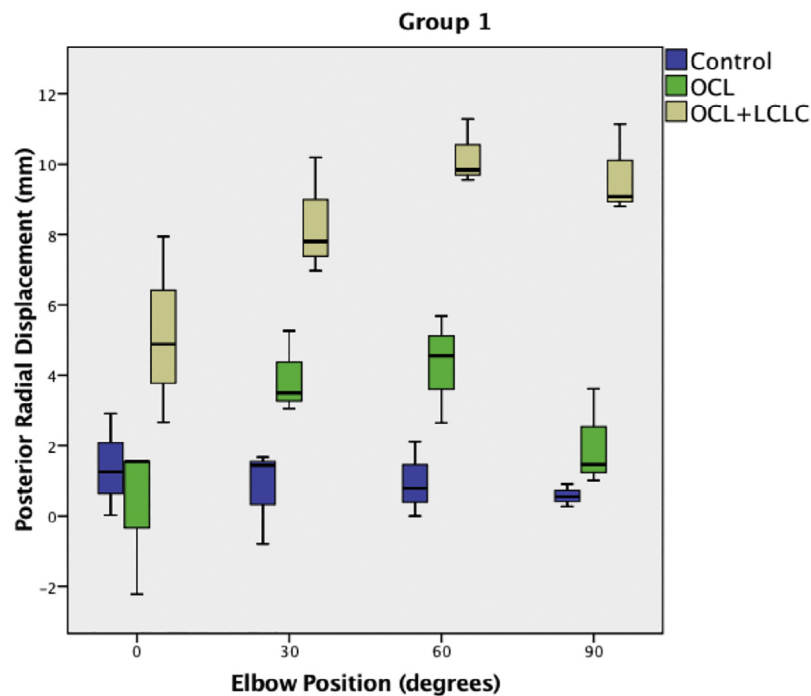


Figure 1 A multivariate box-and-whisker plot of posterior radial displacement at the maximum load (D_{max} , mm) at 0°, 30°, 60° and 90° of elbow flexion of the normal (*control*) elbow and after isolated Osborne-Cotterill lesion (*OCL*) and OCL + lateral collateral ligament complex (*LCLC*) resection (group 1). The *horizontal line* in the middle of each box indicates the median, the *top and bottom borders* of the box mark the 75th and 25th percentiles, respectively, and the *whiskers* indicate the standard deviation.

Table 1 Statistical results of analysis of variance of displacement at maximum load between elbow position and ligament conditions for group 1

Variable	Elbow flexion (°)	Control	OCL	OCL + LCLC	ANOVA P	Control vs. OCL	Control vs. OCL + LCLC	OCL vs. OCL + LCLC
		Mean (SD)	Mean (SD)	Mean (SD)		P	P	P
Group 1 (D_{max} , mm)	0	1.05 (1.13)	0.30 (2.18)	5.16 (2.65)	.0173	NS	<.05	<.05
	30	1.12 (1.23)	3.94 (1.17)	8.32 (1.67)	.0001	<.05	<.01	<.01
	60	0.97 (1.07)	4.29 (1.54)	10.22 (0.93)	.0002	<.05	<.01	<.01
	90	1.47 (1.05)	2.03 (1.39)	9.67 (1.28)	<.0001	NS	<.01	<.01

OCL, Osborne-Cotterill lesion; LCLC, lateral collateral ligament complex; SD, standard deviation; ANOVA, analysis of variance; D_{max} , displacement at maximum load; NS, nonsignificant result.

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