Role of Gravity Varus Stress Dynamic CT in Assessment of Isolated Coronoid Fractures

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Introduction

Isolated coronoid fractures (ICFs) without evidence of a radial head fracture should raise suspicion for varus posteromedial rotatory instability (VPMRI). In many cases, there is no obvious subluxation/dislocation of the elbow on the initial injury. However, VPMRI injuries have been associated with disruption of the lateral collateral ligament (LCL) as well as other soft tissue structures such as the posterior/anterior bundles of the medial collateral ligament (MCL), and the common extensor origin. These injuries can lead to rapid post-traumatic arthritis from repeated joint incongruity when inappropriately treated. Appropriate assessment of associated instability would provide valuable information to guide treatment of these coronoid fractures. The aim of this study was to look at the role of a dynamic gravity varus stress CT protocol in the assessment of dynamic instability in ICFs.

Material & Methods

A novel dynamic gravity varus stress CT protocol was utilized to identify potential instability of ICFs preoperatively. To perform this dynamic CT protocol, a bolster was placed under the arm allowing the elbow and forearm to hang freely and provided a gravitational varus force on the elbow (Figure 1). The patients were asked to pronate their forearm and extend their elbows to a degree that they were comfortable. Axial, sagittal, and coronal images were evaluated for signs of instability assessing for asymmetry of ulnohumeral and/or radiocapitellar joints (Figure 2). These findings of instability on CT were correlated with clinical assessment of elbow instability and/or intraoperative assessment of instability under fluoroscopic guidance to determine the positive predictive value (PPV) and false negative rate (FNR) of this dynamic CT protocol for demonstrating associated instability. The analysis was compared to a separate cohort of patients who underwent a standard static preoperative CT protocol.

Results

30 patients with an ICF underwent this dynamic gravity varus stress CT protocol at an academic institution and were retrospectively reviewed (mean age 44±16 years). Fractures evaluated included five O'Driscoll tip subtype 2 fractures, 22 O'Driscoll anteromedial subtype 2 fractures, and three O'Driscoll anteromedial subtype 3 fractures. The PPV and the FNR of the gravity varus stress CT for the presence of instability were 88% and 12% respectively (Table 1).

This was compared to a cohort of 35 patients with an ICF with standard static preoperative CT protocol (mean age 38±15 years). Nine patients had evidence of subluxation/dislocation on the initial radiographs. The CT scan of these 9 patients did not show any evidence of instability on any of the axial, coronal, or sagittal planes which were taken with the elbow in 86°±7° of flexion and 7/9 were in a splint. Fractures evaluated included one O'Driscoll tip subtype 2 fractures, two O'Driscoll anteromedial subtype 1 fractures, 28 O'Driscoll anteromedial subtype 2 fractures, and 4 O'Driscoll anteromedial subtype 3 fractures. The PPV and the FNR of the standard static CT for the presences of instability were 100%, and 86% respectively (Table 1).

Discussion

Clinically significant instability was present in 57% of cases in the dynamic CT group and 60% of cases in the static CT group. There was a high FNR to identify the associated instability with the standard CT protocol. The proposed dynamic gravity varus stress CT significantly decreases the FNR demonstrating the associated instability with excellent PPV. This dynamic CT protocol may aid in appropriate decision making for the management of ICFs. It may also avoid the need to perform examination under anaesthesia which saves valuable operating resources and provides information about stability of the elbow in the presence of dynamic elbow stabilizers which are not maintained under anaesthesia.

Figure 1: patient positioning for the dynamic gravity varus stress CT protocol

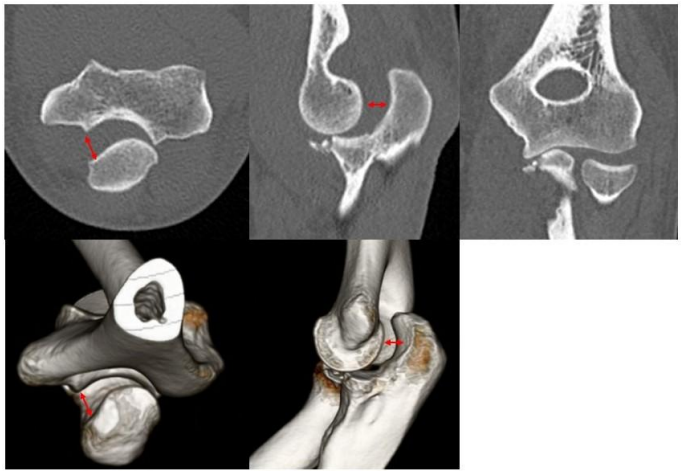

Figure 2: axial 2D/3D, sagittal 2D/3D, coronal 2D images showing typical instability demonstrated by the dynamic gravity varus stress CT protocol

Table 1: Diagnostic Accuracy Table for dynamic and static CT

Dynamic CT		Evidence of Instability on dynamic gravity varus stress CT	
		Yes	No
Evidence of Instability on Clinical Assessment or EUA	Yes	15	2
	No	2	11
Static CT		Evidence of Instability on standard static CT	
		Yes	No
Evidence of Instability on Clinical Assessment or EUA	Yes	3	18
	No	0	14