



# Scaphoid Angulation and the Cortical Ring Sign



Richard C Rooney<sup>1\*</sup> and Dupreez Smith<sup>2</sup>

<sup>1</sup>Seattle Regenerative Medicine Center, USA

<sup>2</sup>Medical Student, Royal College of Surgeons, Ireland

\*Corresponding author: Richard C Rooney, Seattle Regenerative Medicine Center, USA

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## Abstract

The cortical ring sign often associated with scaphoid fractures and scapho-lunate dissociations is due to flexion of all or part of the scaphoid. This study examined the X-rays and CT scans of 81 patients to determine how much flexion leads to the appearance of the ring sign. In this study, the average amount of flexion that produced the ring sign was 69.1 degrees. Consequently, a cortical ring sign indicates scaphoid flexion, all or in part, compared to radiographs without that amount of flexion.

## Introduction

The 'cortical ring sign' is a radiographic finding described in mandibular fractures and scapho-lunate dissociation's [1,2]. Palmar flexion of the scaphoid or distal scaphoid fragment (Figure 1) lends to a tubular appearance or ring that represents the scaphoid cortex (Figure 2). It is often associated with scaphoid fractures but there

is little orthopaedic literature that addresses the 'ring' sign and the scaphoid fractures per se. Although it is often referred to in practice it is poorly studied and scarcely written about [1-4]. We studied the association between the amount of scaphoid fracture angulation on CT scanning and frequency of the 'ring sign' on X-rays.



Figure 1



**Figure 2**

## Materials and Methods

All patients with scaphoid fractures at a US Army hospital over a 4-year period that had a CT scan through the longitudinal axis of the scaphoid and plain radiographs were evaluated for the appearance of the 'cortical ring sign'. The angulation of the scaphoid fracture was measured through the longitudinal axis in the sagittal plane. The angulation was determined in relation to the proximal fracture fragment as well as the axis of the radius. The radiographs were then evaluated for the presence of a cortical ring sign.

## Results

103 patients' radiographic files were evaluated and 81 were found to have a CT scan in the longitudinal axis of the scaphoid with associated plain radiographs that were performed within one week of the CT scan. 39 patients' radiographs were noted to have the ring sign and 42 were noted to not have the appearance of the ring sign. The average measured intra-scaphoid angulation on the CT scan of the group with a ring sign was 58.1 degrees of palmar flexion. The average measured angulation between the distal scaphoid fragment and the axis of the radius was 81.3 degrees. The

average measured intra-scaphoid angulation of the CT scan of the group with no ring sign was 49.9 degrees of palmar flexion. The angulation between the scaphoid distal fragment and axis of the radius was 69.1 degrees of palmar flexion. Simple t-test analysis of the intra-scaphoid angulation showed a significantly greater

intra-scaphoid angulation in the ring sign patients (mean=58.1 degrees, standard deviation=16.19) vs the non-ring-sign patients (mean=49.9 degrees, standard deviation=8.40) with  $t(0.025)$  for 95% CI=2.0118.

## Discussion

Scaphoid fractures are one of the most troublesome injuries about the wrist. The propensity for suboptimal outcomes with these injuries should make the treating physician particularly suspicious when dealing with wrist injuries that may involve the scaphoid. Radiographic determination of displacement and angulation of scaphoid fractures is quite difficult at times. A 'cortical ring sign' should alert the physician to seek out a fracture of the scaphoid or ligamentous injury to the scapho-lunate interosseous ligament until proven otherwise.

The 'ring sign' has been described previously for SLIL injury [1]. It is typically the result of palmar flexion of the scaphoid after its link to the lunate has been disrupted. As the scaphoid takes on a more flexed posture, its appearance on radiographs appears to shorten and the cortical density of the waist of the scaphoid is viewed parallel to its surface giving the appearance of a ring.

If the injury is to the scaphoid itself, the volar flexion of the distal fragment begins to assume a similar radiographic appearance. The radiograph reveals a shortened scaphoid and the cortical density is viewed 'end on' as a 'ring'.

At some critical point of volar flexion, the scaphoid will assume a ring density on X-ray. This will be determined by the angle of the X-ray tube, the angle of the scaphoid and the shape of the scaphoid. While it is impossible to determine the exact angular relationship between x-ray tube and scaphoid or the exact same shape of each scaphoid, we have assumed this and have minimized any inconsistencies that we could to determine the critical level of palmar flexion. Considering that the group of patients that had ring sign and those that did not had different angles, the critical amount of flexion must be extrapolated between the two measurements. This critical amount of flexion in relation to the x-ray tube is between 69 and 81 degrees.

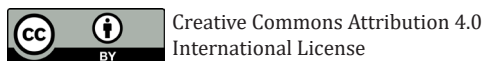
### Conclusion

The cortical ring sign is commonly seen in scaphoid fractures as well as scapho-lunate dissociation. Previously its relationship to

the amount of palmar flexion has not been quantified. This study helps to delineate that relationship between a subjective finding such as the ring sign and its objective measurement.

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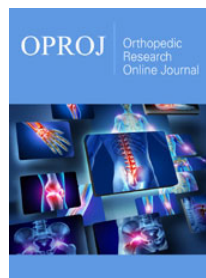
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