# Course of the Radial Nerve in Relation to the Center of Rotation of the Elbow—The Need for a Rational Safe Zone for Lateral Pin Placement

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**Purpose** To investigate the course and variability of the radial nerve along the lateral humerus in relation to the center of rotation of the elbow joint in the context of lateral pin placement for hinged external fixation.

**Methods** A total of 95 formalin-fixed upper extremities were dissected. The course of the radial nerve along the lateral aspect of the humerus was measured at 3 landmarks with respect to the center of rotation of the elbow. We analyzed the data and the landmark positions correlated with the length of the humerus.

**Results** The measured positions of 3 landmarks of the radial nerve in the lateral aspect of the humerus ranged from 19% to 43% of the length of the humerus and were located, on average, 6.0, 9.7, and 13.5 cm from the lateral center of rotation.

**Conclusions** These data help predict the humeral course of the radial nerve and define a safe zone for pin implantation. However, because of variability in the course of the radial nerve, a safe zone cannot fully ensure prevention of iatrogenic injury to the nerve. The safest method of pin application remains mini-open dissection and visual implantation.

**Clinical relevance** Based on this cadaveric study, it is not possible to define a rational safe zone. The safest method of pin application for dynamic external fixation of the elbow is to perform a mini-open dissection with direct visualization. *(J Hand Surg Am. 2014;39(6):1136–1140.* 

**Key words** Radial nerve, center of rotation, dynamic fixator, iatrogenic injury, elbow.

HINGED EXTERNAL FIXATORS of the elbow assist in healing reconstructed ligaments or bony structures[1–4] and facilitate joint distraction after open or arthroscopic arthrolysis.[5–7] Hinged and rigid fixators customarily are fixed to the humeral and ulnar shafts by pins. When humeral pins are placed on the lateral aspect of the arm, the radial nerve is at risk of injury.[2,4,8,9] Several studies have analyzed the course of the radial nerve along the humerus and tried to define safe zones.[10–14] However, radial nerve injury can occur despite adherence to recommended safe zones.

A radiologically identifiable landmark allows reproducible measurements, and when applying hinged external fixators, the rotational center of the elbow is marked with a K-wire after radiological identification.

The middle third of the humeral shaft is about 2.4 cm wide in the anteroposterior plane.[15] In clinical practice, fixator pins are rarely inserted into the exact center of the lateral humeral shaft. We therefore

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Received for publication October 28, 2013; accepted in revised form March 17, 2014.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/14/3906-0016$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.03.019

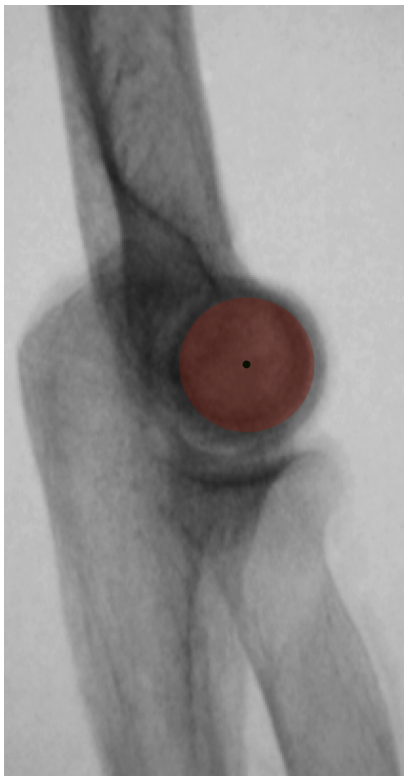

**FIGURE 1:** Identification of the rotational center of the elbow at the distal humerus by the use of fluoroscopy.

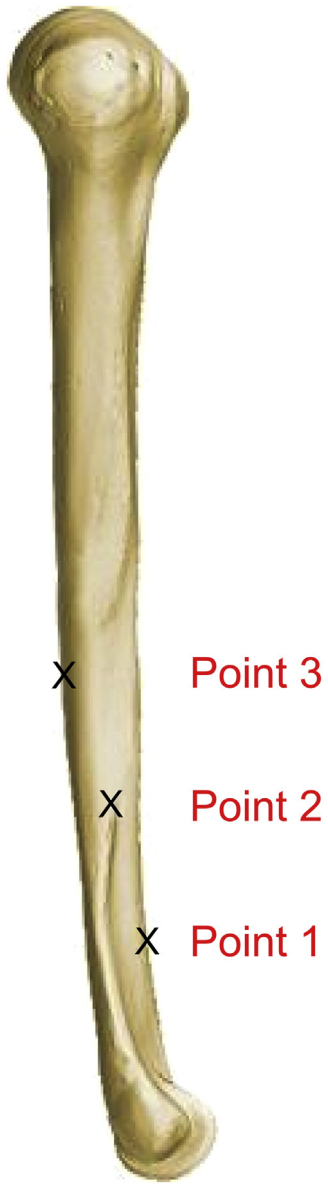


**FIGURE 2:** The 3 anatomic landmarks used to mark the course of the radial nerve. Point 1: the radial nerve crossing the anterior aspect of the humeral shaft (lateral view); point 2: the radial nerve crossing the lateral center of the humeral shaft; point 3: the radial nerve crossing the posterior aspect of the humeral shaft (its exit from the radial groove).

believe it is important to analyze the course of the radial nerve with respect to the entire lateral aspect of the humerus, not only at the center of the shaft, because the nerve also can be injured in a more anterior or posterior region.

The aims of this study were to investigate the course of the radial nerve in relation to the rotational center of the elbow and to statistically evaluate variability in its course to examine the possibility of establishing a reliable safe zone for the lateral humeral placement of fixator pins.

## MATERIALS AND METHODS

### Specimens and dissection

A total of 95 embalmed upper extremities (48 left side and 51 right side) of 99 voluntary body donors (54 female and 45 male; average age, 83 y) were available for experimental study after disarticulation at the shoulder joint. We excluded 4 specimens from analysis because of preexisting lesions or degenerative changes that did not allow full elbow extension. This left 95 specimens for study.

After removal of the skin and the subcutaneous fatty layer, and beginning at the proximal humerus, the radial nerve was displayed in the radial groove along with its passage through the lateral intermuscular septum. We followed its course to its entry in the forearm, and took care to display the nerve under the covering muscles without changing its natural course.

To identify the rotational center of the elbow, each of the 95 specimens was fluoroscopically oriented such that the condyles projected exactly over each other and a harmonic circular aspect was achieved. The center of the circle, representing the rotational center of the elbow, was marked with a K-wire (Fig. 1).