Variations in the Anatomic Relations of the Posterior Interosseous Nerve Associated with Proximal Forearm Trauma

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Background: The posterior interosseous nerve is at risk for iatrogenic injury during surgery involving the proximal aspect of the radius. Anatomic relationships of this nerve in skeletally intact cadavers have been defined, but variations associated with osseous and soft-tissue trauma have not been examined. This study quantifies the effect of a simulated diaphyseal fracture of the proximal aspect of the radius and of a radial neck fracture with an Essex-Lopresti injury on the posterior interosseous nerve.

Methods: In twenty unembalmed cadaveric upper extremities, the distance from the radiocapitellar joint to the point where the posterior interosseous nerve crosses the midpoint of the axis of the radius (Thompson approach) was recorded in three forearm positions (supination, neutral, and pronation). Specimens were then treated with either proximal diaphyseal osteotomy ($n = 10$) or radial head excision with simulated Essex-Lopresti injury ($n = 10$), and the position of the nerve in each forearm position was remeasured. We evaluated the effect of the simulated trauma on nerve position and correlated baseline measurements with radial length.

Results: In neutral rotation, the posterior interosseous nerve crossed the radius at a mean of 4.2 cm (range, 2.5 to 6.2 cm) distal to the radiocapitellar joint. In pronation, the distance increased to 5.6 cm (range, 3.1 to 7.4 cm) ($p < 0.01$). Supination decreased that distance to 3.2 cm (range, 1.7 to 4.5 cm) ($p < 0.01$). Radial length correlated with each of these measurements ($r > 0.50$, $p = 0.01$). Diaphyseal osteotomy of the radius markedly decreased the effect of forearm rotation, as the change in nerve position from supination to pronation decreased from 2.13 ± 0.8 cm to 0.24 ± 0.2 cm ($p = 0.001$). Proximal migration of the radius following radial head excision was accompanied by similar magnitudes of proximal nerve migration in all forearm positions.

Conclusions: Forearm pronation has minimal effect on posterior interosseous nerve position within the surgical window following a displaced diaphyseal osteotomy of the proximal aspect of the radius. The nerve migrates proximally toward the capitellum with proximal migration of the radius in all forearm positions following a simulated Essex-Lopresti lesion. Visualization and protection of the posterior interosseous nerve is recommended when operatively exposing the traumatized proximal aspect of the radius.

The posterior interosseous nerve is at risk for iatrogenic injury during both the surgical approach to, and the application of internal fixation to, the proximal aspect of the radius. Although a volar approach to the radius is preferred for many injuries, anatomic constraints such as the limited periphery of the nonarticular portion of the radial head approach

for hardware placement and the volar biceps insertion often necessitate a dorsal exposure of the traumatized proximal aspect of the radius.

The existing literature offers discordant recommendations regarding the necessity of formal isolation of the posterior interosseous nerve during surgical exposure of the

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proximal aspect of the radius. Safe distances for dissection, within which exposure does not require visualization of the posterior interosseous nerve, have been reported to be as much as 4 cm distal to the radiocapitellar joint¹, as much as 5 cm distal to the lateral epicondyle², or proximal to the distal extent of the bicipital tuberosity³. Other investigators have recommended identifying and protecting this nerve in all cases⁴.

Whether the surgeon approaches the dorsal aspect of the radius and retracts the posterior interosseous nerve within a cuff of reflected supinator muscle or directly visualizes the nerve, a working knowledge of its location is useful. To this end, investigators have conducted numerous cadaveric investigations to determine the longitudinal and cross-sectional anatomic relationships of the posterior interosseous nerve. The location of the posterior interosseous nerve relative to osseous and soft-tissue landmarks^{1,3,5,6}, and the effects of forearm rotation on the posterior interosseous nerve^{1,2,4,5}, have been studied in skeletally intact specimens.

Although previous studies have evaluated the position of the posterior interosseous nerve relative to landmarks likely to be preserved despite trauma to the proximal aspect of the radius (e.g., the articular surface of the capitellum), there have been no prior studies that have examined the posterior interosseous nerve in a model of simulated proximal forearm trauma^{1,4-7}, to our knowledge. This study was designed to quantify the effect of a simulated diaphyseal fracture of the proximal one-third of the radius, and the effect of a radial neck fracture with an Essex-Lopresti injury, on the anatomic relationships of the posterior interosseous nerve. Our hypothesis was that a displaced oste-

otomy of the proximal aspect of the radius would markedly decrease the magnitude of change in the position of the posterior interosseous nerve produced by forearm rotation. Our second hypothesis was that the posterior interosseous nerve would migrate proximally with the radius following replication of an Essex-Lopresti lesion.

Materials and Methods

Twenty fresh-frozen, unembalmed cadaveric upper extremities from eighteen donors (ten female and eight male) were studied. Nine right and eleven left-sided extremities were utilized, with eighteen being unpaired specimens. The mean age at the time of death was eighty-three years (range, sixty-one to ninety-seven years). All specimens were thawed to room temperature before experimentation. No arms had visual evidence of prior elbow surgery or trauma. All forearms retained at least 80° of passive pronation and at least 80° of passive supination (for a total arc of total rotation of $\geq 160^\circ$).

Dissection was performed under loupe magnification (2.5 $\times$). A curvilinear skin incision was made from the lateral border of the distal aspect of the humerus into the dorsal aspect of the forearm. The dorsal fascia was incised from the lateral epicondyle proximally; the incision then extended over the middle portion of the radiocapitellar joint and entered the interval between the extensor carpi radialis brevis and extensor digitorum communis tendons (the Thompson approach). The supinator was visualized, and the posterior interosseous nerve was identified as it entered and exited this muscle. The length of the radius was measured from the radial head to the radial

Fig. 1

Diagram illustrating measurement (blue arrow) from the radiocapitellar joint to the location where the posterior interosseous nerve crosses the midpoint of the axis of the radius within the surgical window. ECRB = extensor carpi radialis brevis tendon, and EDC = extensor digitorum communis tendon.

Fig. 2

Photograph showing the posterior interosseous nerve entering (left arrow) and exiting (right arrow) the supinator. A small incision in the supinator, guided by the overlying suture, identifies the nerve crossing the midpoint of the axis of the radius.

styloid. A 22-gauge needle was used to mark the radiocapitellar joint. Both the distance that the posterior interosseous nerve coursed within the supinator and the distance from the radiocapitellar joint to the exit of the posterior interosseous nerve from the supinator in neutral forearm rotation were measured. All measurements were made with a sliding caliper to the nearest 0.1 mm (General Tools 4-Way Dial Caliper; General Tools and Instruments, New York, NY). The elbow was maintained in 90° of flexion throughout the investigation.

In all twenty extremities, the distance from the radiocapitellar joint to the location where the posterior interosseous nerve crossed the midpoint of the axis of the radius was mea-

sured in supination, neutral, and pronation. As we utilized a dorsal Thompson approach, the long axis of the radius was consistently defined from the vantage point of the lateral aspect of the elbow through the interval between the extensor carpi radialis brevis and extensor digitorum communis tendons. As a result of testing through a range of forearm rotations, the visible surface of the radius within the surgical field ranged from the lateral surface (in supination) to the dorsal or posterior surface (in neutral or pronation). For clarity, the text will refer only to the midpoint of the long axis of the radius as the location at which the posterior interosseous nerve crossed the axis of the radius within this surgical window (Fig. 1).

Fig. 3

Diagram of the injury model. The green line represents the approximate location of the diaphyseal osteotomy. The red arrows indicate the location of the radial neck osteotomy and division of the stabilizing structures to create the Essex-Lopresti injury model.

Fig. 4-A

Fig. 4-B

Fig. 4-A The radial head is excised, with preservation of the supinator origin (arrowhead = capitellum, star = coronoid process). **Fig. 4-B** The radius (star) is compressed to contact the capitellum (arrow).

A 1.6-mm Kirschner wire was placed into the capitellum at the midline of the radiocapitellar joint with the elbow in 90° of flexion. A size-0 suture was tied from that proximal wire to one of three Kirschner wires that were placed distally to mark the axis of the radius throughout forearm rotation. In neutral forearm rotation, the suture was secured to a 3.2-mm Kirschner wire that was placed through the distal aspect of the radius from posterior to anterior at the Lister tubercle. To mark the axis of the radius in supination and pronation, the suture was

secured to distal 1.6-mm Kirschner wires that were placed into the radial styloid and the ulnar head, respectively. Each distal wire was placed parallel to the proximal capitellar wire. This method was similar to that reported by Lawton et al.¹. Correct wire placement was confirmed before data collection by visually verifying that the suture, when tensioned, indeed marked the axis of the radius. In each forearm position, the supinator was divided in line with its fibers and was minimally spread to identify the proximal margin of the posterior interosseous

nerve as it crossed the midpoint of the axis of the radius (Fig. 2). Clinically, this position represented the location where sharp dissection along the axis of the radius would lacerate the posterior interosseous nerve if the nerve were not identified and retracted. The location of the nerve relative to the supinator (either within or having exited the supinator) was recorded. To minimize iatrogenic changes to its position, the posterior interosseous nerve was not dissected free or grasped.

Ten extremities were selected for diaphyseal osteotomy of the proximal aspect of the radius. Following measurements in the intact state, a transverse osteotomy was performed at the junction of the proximal one-third and distal two-thirds of the radius. This osteotomy was distal to the point where the posterior interosseous nerve crossed the radius in all specimens (Fig. 3). The proximal and distal bone ends were translated manually, with the diaphyseal bone distal to the osteotomy being displaced toward the ulna, by the distance required to eliminate osseous contact. The distances from the radiocapitellar joint to the point where the posterior interosseous nerve crossed the midpoint of the axis of the radius in supination, neutral, and pronation were recorded.

The remaining ten extremities underwent excision of the head of the radius and creation of a simulated Essex-Lopresti lesion (Fig. 3). Following measurements in the intact state, the radiocapitellar joint was accessed via an anterolateral arthrotomy that preserved the lateral collateral ligament complex and the humeral supinator origin (Fig. 4-A). The annular ligament was incised, and a transverse osteotomy was completed through the junction of the neck and head of the radius. The length of excised radial head was recorded (mean, 1.1 cm; range, 0.9 to 1.3 cm). The volar and dorsal radioulnar ligaments of the distal radioulnar joint and the interosseous membrane of the forearm were divided through a volar Henry approach (through the interval between the flexor carpi radialis and the brachioradialis). The Kirschner wire that had been placed through the radius from dorsal to volar at the Lister tubercle was utilized to manually translate the radius proximally until the osteotomized surface of the radial neck directly contacted the articular surface of the capitellum (Fig. 4-B). Osseous contact between the radius and the capitellum was confirmed by direct visualization through the arthrotomy and was held for five seconds in each position of forearm rotation before measurements were taken. The distances from the radiocapitellar joint to the point where the posterior interosseous nerve crossed the radius in supination, neutral, and pronation were recorded according to the methods described above.

On completion of testing, the posterior interosseous nerve was dissected free from the supinator in each specimen. The presence, location, and length of any osseous contact between the posterior interosseous nerve and the radius were recorded.

Statistical Methods

Pearson correlations were utilized to determine the association between radial length and each measurement of the location of the posterior interosseous nerve location in the skeletally intact specimens. Repeated-measures analysis of variance was used to

compare the position of the posterior interosseous nerve among forearm positions (supination, neutral, and pronation). Within the analysis of variance, statistical contrasts were used to test the equivalence of changes in the position of the posterior interosseous nerve when the forearm was positioned in neutral compared with supination and in neutral compared with pronation. We performed an analysis of covariance to determine whether adjusting for bone length would alter our conclusions regarding the change in posterior interosseous nerve position across forearm positions. Unpaired Student *t* tests compared posterior interosseous nerve position and radial length for specimens with and without posterior interosseous nerve contact with the radius.

The paired Student *t* test was used to compare the mean position of the posterior interosseous nerve in each specimen before and after osteotomy. This analysis was performed for each position of forearm rotation. Paired Student *t* tests were also used to compare posterior interosseous nerve position before and after radial head excision with creation of the Essex-Lopresti injury.

The choice of twenty specimens represented a sample of convenience. Data analysis at the conclusion of testing demonstrated significance for each primary outcome. This provided assurance that the number of specimens was adequate and that analysis was not underpowered to detect changes in the posterior interosseous nerve position with forearm rotation or the effect of each traumatic model on the posterior interosseous nerve.

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Results

The mean radial length (and standard deviation) was 23.9 ± 1.9 cm. The posterior interosseous nerve coursed within the supinator for 3.7 ± 0.8 cm. In neutral forearm rotation, the pos-

TABLE I Correlations with Radial Length

Variable	R Value*	P Value
Length of posterior interosseous nerve within supinator	0.31	0.19
Distance from radiocapitellar joint to location where posterior interosseous nerve exited supinator	0.51	0.02
Distance from radiocapitellar joint to posterior interosseous nerve		
Supination	0.55	0.01
Neutral	0.56	0.01
Pronation	0.55	0.01
Total posterior interosseous nerve translation from pronation to supination	0.51†	0.03
*Pearson correlation. †One data point was omitted.

Fig. 5

Diagram illustrating change in the proximal interosseous nerve (PIN) position as a function of forearm rotation. ECRB = extensor carpi radialis brevis tendon, and EDC = extensor digitorum communis tendon.

terior interosseous nerve exited the supinator 5.8 ± 1.0 cm from the radiocapitellar joint. This exit point occurred near the junction of the proximal one-fourth and distal three-fourths of the radius ($24\% \pm 4\%$ of the length of the radius; range, 15% to 28%).

Radial length correlated ($r > 0.50$, $p < 0.05$) with each baseline posterior interosseous nerve measurement except for the distance that the nerve traveled within the supinator (Table I).

In neutral rotation, the posterior interosseous nerve crossed the midpoint of the axis of the radius 4.2 ± 1.0 cm (range, 2.5 to 6.2 cm) distal to the radiocapitellar joint. In pronation, that distance increased to 5.6 ± 1.2 cm (range, 3.1 to 7.4 cm). In supination, the posterior interosseous nerve crossed the radius more proximally, at 3.2 ± 0.8 cm (range, 1.7 to 4.5 cm) distal to the radiocapitellar joint (Fig. 5). The magnitude of change in posterior interosseous nerve position resulting from forearm rotation was correlated with radial bone length (Table I). In eleven of the twenty skeletally intact specimens, the posterior interosseous nerve crossed the radius at, or distal to, its exit from the supinator when measurements were made with the forearm in pronation. The posterior interosseous nerve crossed the midpoint of the axis

of the radius within the substance of the supinator with the forearm in neutral and in supination in all specimens.

Rotating the forearm from supination to neutral and from neutral to pronation significantly ($p < 0.01$) increased the distance from the radiocapitellar joint to the point where the posterior interosseous nerve crossed the radius. When the forearm was rotated from full supination to full pronation, the nerve crossed the radius 2.4 ± 0.8 cm more distally. This change occurred evenly during rotation of the forearm from supination to neutral (1.1 ± 0.4 cm) and from neutral to pronation (1.3 ± 0.7 cm).

Osteotomy of the proximal third of the radius altered the effect of forearm rotation on posterior interosseous nerve position (Table II). Notably, the proximal aspect of the radius demonstrated minimal rotation following osteotomy, and the position of the posterior interosseous nerve was now largely unaffected by forearm rotation from supination to pronation (Fig. 6). The minimal remaining effect on the posterior interosseous nerve occurred only at the extremes of rotation.

Radial head excision and proximal migration of the radius resulted in the posterior interosseous nerve crossing the

TABLE II Effect of Radial Osteotomy on Posterior Interosseous Nerve Translation

Forearm Rotation	Translation* (cm)		
	Intact	Post-Osteotomy	P Value
Supination to neutral	1.00 ± 0.3	0.13 ± 0.2	<0.0001
Neutral to pronation	1.13 ± 0.6	0.11 ± 0.2	0.0003
Total motion (supination to pronation)	2.13 ± 0.8	0.24 ± 0.2	<0.0001

*The values are given as the mean and standard deviation.

Fig. 6

Bar graph illustrating the effect of diaphyseal radial osteotomy on the change in posterior interosseous nerve (PIN) position during forearm rotation. SD = standard deviation.

radius closer to the radiocapitellar joint across all forearm positions (Table III). Furthermore, the posterior interosseous nerve continued to cross more distally as the forearm was increasingly pronated (Fig. 7). The magnitude of change in the position of the posterior interosseous nerve as the forearm rotated from supination to pronation was similar before (2.66 ± 0.7 cm) and after (2.83 ± 0.8 cm) radial head excision. For each forearm position, the distance that the posterior interosseous nerve migrated proximally was similar to the width of the excised radial head (range, 86% to 121%).

Five specimens demonstrated direct posterior interosseous nerve contact with the proximal aspect of the radius. In these cases, the posterior interosseous nerve coursed over the

radius without interposed muscle over a distance that averaged 1.5 cm (range, 1.0 to 2.0 cm). This area of bone contact began consistently at, or distal to, the distal extent of the bicipital tuberosity (range, 0.0 to 1.0 cm). In the specimens in which the posterior interosseous nerve contacted the radius, the length of the radius was significantly shorter (21.9 ± 1.6 cm) as compared with the length in specimens in which the posterior interosseous nerve had underlying muscle throughout its course (24.6 ± 1.5 cm) ($p < 0.01$). We could not demonstrate a difference in the effect on posterior interosseous nerve position produced by forearm rotation from supination to pronation that was attributable to the presence of osseous contact (2.30 ± 0.9 cm compared with 2.42 ± 0.8 cm; $p = 0.77$).

TABLE III Effect of Radial Head Excision and Proximal Radial Migration on Posterior Interosseous Nerve Position

Forearm Position	Distance from Radiocapitellar Joint to Posterior Interosseous Nerve* (cm)			P Value
	Intact	Post-Excision	Change	
Pronation	5.94 ± 1.0	5.01 ± 0.9	-0.93 ± 0.3	<0.0001
Neutral	4.45 ± 1.2	3.11 ± 1.1	-1.34 ± 0.5	<0.0001
Supination	3.28 ± 0.9	2.18 ± 0.7	-1.10 ± 0.3	<0.0001

*The values are given as the mean and standard deviation.

Fig. 7

Bar graph illustrating the effect of proximal radial migration on posterior interosseous nerve (PIN) position across forearm positions. RC = radiocapitellar, and SD = standard deviation.

Discussion

Previous investigations have described the normal structure and course of the posterior interosseous nerve and have elucidated changes in nerve position as a function of forearm rotation^{1,2,4,5}. Notably, these prior measurements were uniformly recorded in skeletally intact specimens¹⁻²¹. While such data are valuable when approaching the posterior interosseous nerve for decompression, their applicability to the traumatized extremity was untested. The present study demonstrates that trauma to the proximal aspect of the radius alters both the position of the posterior interosseous nerve and changes in the posterior interosseous nerve position normally associated with forearm rotation. These data require reassessment of the concept of “safe zones” of dissection and the degree of nerve protection conferred by pronation of the forearm during exposure of the proximal aspect of the radius.

Our measurements in the intact specimens produced results similar to those of several previous investigations. The additional 2.4 cm of distance from the radiocapitellar joint to the posterior interosseous nerve produced by rotating from supination to pronation approximated the 1-in (2.5-cm) change reported by Kaplan⁵ and the 2.2 cm of motion reported by Diliberti et al.⁴. The two extremes in which the posterior interosseous nerve most closely approached the radiocapitellar joint in the skeletally intact state (1.7 and 2.1 cm) represent a finding similar to that reported by Diliberti et al. (2.2 cm)⁴. This is in contradistinction to a recent statement that, regardless of forearm position, the posterior interosseous nerve is not at risk within 4.0 cm of the radiocapitellar joint¹.

The fact that full pronation of the skeletally intact forearm caused the posterior interosseous nerve to cross the radius at or distal to its exit from the supinator in slightly more than half of the specimens raises an important point. The superficial surgical approach through the interval between the extensor carpi radialis brevis and extensor digitorum communis tendons was consistent and unchanged with the position of the forearm. Likewise, deep dissection in the proximal aspect of the radius always requires division of the supinator muscle. Forearm rotation does not in itself change the path of the posterior interosseous nerve; however, forearm rotation does alter the deep tissues that are vulnerable within the surgical field. Despite the stationary humeral origins of the extensor carpi radialis brevis and extensor digitorum communis tendons, pronation brings the most posterior supinator fibers into the window within which the surgeon is working and the posterior interosseous nerve is now coursing relatively more anteriorly. Thus, the actual position of the posterior interosseous nerve within the supinator has remained constant but the nerve does not cross the radius within the field of dissection until a more distal position.

The observation that the posterior interosseous nerve directly contacted the proximal aspect of the radius, without interposed muscle, in 25% of specimens is consistent with the findings of prior studies^{1,20}. Our dissections reproduced the finding of Lawton et al. in that the area of osseous contact was always located in the proximal aspect of the radial diaphysis¹. In contrast to prior descriptions^{13,14,18}, muscle was always interposed between the nerve and the radial neck. We did not find a clinically important change in the effect of forearm rotation

on posterior interosseous nerve position that was attributable to such osseous contact. However, this study was statistically powered to detect a 1.26-cm difference and thus was underpowered when evaluating an observed 0.12-cm difference.

The osteotomy in the proximal third of the radius in this study simulated a completely displaced fracture. The location of the osteotomy was designed to replicate a fracture that would be reasonably treated with a dorsal plating technique while remaining distal to the point at which the posterior interosseous nerve crossed the radius. Our data suggest that, when a dorsal Thompson approach is used for the treatment of a proximal radial fracture, forearm rotation will only minimally affect the position of the posterior interosseous nerve when the bone ends do not engage across a fracture site. Forearm rotation will occur exclusively through rotation of the distal aspect of the radius, whereas the proximal aspect of the radius and the posterior interosseous nerve will remain relatively motionless. In that case, it should not be assumed that changes in forearm rotation will position the posterior interosseous nerve safely away from the surgical field.

Excision of the radial head combined with division of the interosseous membrane and proximal translation of the radius simulated an Essex-Lopresti injury. This model was designed to replicate the most severe case of the associated ligamentous injuries commonly accompanying displaced radial head and neck fractures that require operative stabilization. In this case, the proximal migration of the radius was accompanied by proximal migration of the posterior interosseous nerve. Pronation continued to rotate the posterior interosseous nerve anteriorly such that the nerve was encountered more distally along the radius but the absolute distance from the radiocapitellar joint to the nerve was diminished for all forearm positions. We attribute discrepancies between the width of excised bone and the amount of proximal migration of the nerve in individual specimens to soft-tissue laxity, which allows some variability in the contact point between the radius and the convex capitellum, as well as to mild imperfections in the neck osteotomies.

Previous methods of studying the posterior interosseous nerve have varied. The nerve has been approached volarly^{1,7}, dorsally⁵, and laterally⁴. The nerve has been dissected completely free from surrounding muscle^{4,5}, or has simply been visualized within the supinator¹. We attempted several dissection techniques before conducting this investigation. When the superficial aspect of the supinator was dissected from the posterior interosseous nerve, the nerve was mobile and loosely tensioned such that it was difficult to determine its original position. The muscular interval that was utilized also affected the nerve position. Through the Kocher interval, retracting the extensor mass anteriorly for visualization appeared to displace the posterior interosseous nerve anteriorly. For those reasons, we utilized the Thompson interval as the most direct approach to the posterior interosseous nerve and visualized the nerve with a no-touch technique.

This study had several limitations. First, traumatic injuries entail a range of energy transmission and local soft-tissue disruption. Tearing of the supinator and forearm deformation

following fracture, which would be expected to affect the posterior interosseous nerve, were not replicated. Second, the Thompson approach was utilized in an effort to minimize traction applied to the posterior interosseous nerve during exposure. While this reduced one potential measurement bias, many surgeons will apply fixation to radial head and neck fractures via the Kocher interval. The anterior retraction of the extensor musculature and a relatively more posterior approach to the supinator through the Kocher interval should allow for more distal dissection into the supinator before the posterior interosseous nerve is encountered. Thus, our measurements are presumed to represent a “worst-case” scenario, in which the nerve is encountered in closer proximity to the radiocapitellar joint. Third, the current study only included measurements with the elbow flexed 90°. While it is possible that changes in elbow position could alter the distance of the posterior interosseous nerve from the radiocapitellar joint, the work of Diliberti et al. suggests that elbow extension does not impact this relationship⁴. Additionally, we have focused on the location where the posterior interosseous nerve is at risk for sharp transection at the midpoint of the axis of the radius. The obliquely coursing nerve remains at risk for blunt injury as a result of retraction both proximal and distal to this point as well as at risk for sharp dissection anterior or posterior to the midpoint of the axis of the radius. Finally, a sample of twenty cadaveric extremities may not represent the general population and is likely to miss infrequent variations in both anatomy and patient size. However, the number of specimens utilized was similar to those in previous posterior interosseous nerve investigations and proved sufficient for statistical analysis of the primary outcome measures¹⁻³.

To our knowledge, this is the first examination into the effect of simulated proximal forearm trauma on the posterior interosseous nerve. There are several implications of our findings. Displacement of diaphyseal fractures of the proximal aspect of the radius results in a minimal effect of forearm rotation on posterior interosseous nerve position. Second, proximal translation of the radius in Essex-Lopresti injuries is accompanied by proximal posterior interosseous nerve migration in all forearm positions. We recommend visualization and protection of the posterior interosseous nerve, as opposed to reliance on either previously published safe zones or forearm rotation, when surgically exposing the traumatized proximal radius. ■

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References

1. Lawton JN, Cameron-Donaldson M, Blazar PE, Moore JR. Anatomic considerations regarding the posterior interosseous nerve at the elbow. *J Shoulder Elbow Surg.* 2007;16:502-7.
2. Strachan JC, Ellis BW. Vulnerability of the posterior interosseous nerve during radial head resection. *J Bone Joint Surg Br.* 1971;53:320-3.
3. Witt JD, Kamineni S. The posterior interosseous nerve and the posterolateral approach to the proximal radius. *J Bone Joint Surg Br.* 1998;80:240-2.
4. Diliberti T, Botte MJ, Abrams RA. Anatomical considerations regarding the posterior interosseous nerve during posterolateral approaches to the proximal part of the radius. *J Bone Joint Surg Am.* 2000;82:809-13.
5. Kaplan EB. Surgical approach to the proximal end of the radius and its use in fractures of the head and neck of the radius. *J Bone Joint Surg.* 1941;23:86-92.
6. Strauch RJ, Rosenwasser MP, Glazer PA. Surgical exposure of the dorsal proximal third of the radius: how vulnerable is the posterior interosseous nerve? *J Shoulder Elbow Surg.* 1996;5:342-6.
7. Mekhail AO, Ebraheim NA, Jackson WT, Yeasting RA. Anatomic considerations for the anterior exposure of the proximal portion of the radius. *J Hand Surg Am.* 1996;21:794-801.
8. Ay S, Apaydin N, Acar H, Akinci M, Piskin A, Tekdemir I, Elhan A. Anatomic pattern of the terminal branches of posterior interosseous nerve. *Clin Anat.* 2005;18:290-5.
9. Capener N. The vulnerability of the posterior interosseous nerve of the forearm. A case report and an anatomical study. *J Bone Joint Surg Br.* 1966;48:770-3.
10. Ebraheim NA, Jin F, Pulisetti D, Yeasting RA. Quantitative anatomical study of the posterior interosseous nerve. *Am J Orthop (Belle Mead NJ).* 2000;29:702-4.
11. Elgafy H, Ebraheim NA, Rezcallah AT, Yeasting RA. Posterior interosseous nerve terminal branches. *Clin Orthop Relat Res.* 2000;376:242-51.
12. Fuss FK, Wurzl GH. Radial nerve entrapment at the elbow: surgical anatomy. *J Hand Surg Am.* 1991;16:742-7.
13. Henry AK. Exposures of the long bones and other surgical methods. Bristol: John Wright and Sons; 1927. Complete exposure of the radius; p 9-12.
14. Hopenfeld S, deBoer P, Hutton R. Surgical exposures in orthopaedics; the anatomic approach. 2nd ed. Philadelphia: Lippincott; 1994. The elbow; p 103-15.
15. Missankov AA, Sehgal AK, Mennen U. Variations of the posterior interosseous nerve. *J Hand Surg Br.* 2000;25:281-2.
16. Ozkan M, Bacakoğlu AK, Gül O, Ekin A, Mağden O. Anatomic study of posterior interosseous nerve in the arcade of Frohse. *J Shoulder Elbow Surg.* 1999;8:617-20.
17. Portilla Molina AE, Bour C, Oberlin C, Nzeusseu A, Vanwijck R. The posterior interosseous nerve and the radial tunnel syndrome: an anatomical study. *Int Orthop.* 1998;22:102-6.
18. Prasarthitha T, Liupolvanish P, Rojanakit A. A study of the posterior interosseous nerve (PIN) and the radial tunnel in 30 Thai cadavers. *J Hand Surg Am.* 1993;18:107-12.
19. Spinner M. The arcade of Frohse and its relationship to posterior interosseous nerve paralysis. *J Bone Joint Surg Br.* 1968;50:809-12.
20. The radial nerve -the bare area of the proximal radius. In: Spinner M. Injuries to the major branches of peripheral nerves in the forearm. Philadelphia: WB Saunders; 1972. p 80-90.
21. Thomas SJ, Yakin DE, Parry BR, Lubahn JD. The anatomical relationship between the posterior interosseous nerve and the supinator muscle. *J Hand Surg Am.* 2000;25:936-41.