Title **ANATOMICAL INSIGHTS INTO THE POSTERIOR INTEROSSEOUS NERVE. IMPLICATIONS FOR PROXIMAL FOREARM SURGICAL APPROACHES.**

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Abstract

Introduction: The posterior interosseous nerve (PIN) is at risk of injury when surgical procedures are undertaken in the proximal forearm. Moreover, the use of retractors to allow adequate exposure of the radial head and neck could lead to compression or traction injuries of the PIN. Extensive exposure of the proximal radius is required in cases of fractures of the proximal radius, trauma, and in certain conditions of the elbow.Incisions in radial head fractures are placed over the radial head and knowledge of the relationship of the PIN to the radial head is important in such cases. In addition, decompression procedures undertaken for PIN in cases of its entrapment require the exact localization of PIN. The aim of the present study was to determine the relationship of the PIN to adjacent anatomical landmarks, which can be used to prevent iatrogenic injury to the nerve.

Material and Methods: Forty upper extremities were used for this study. The landmarks used to measure the required parameters were intercondylar reference point, styloid process of ulna, proximal and distal borders of superficial layer of supinator muscle, and head of radius. The number of trunks of PIN and the innervation pattern of supinator muscle were studied.

Results: The mean values and standard deviations of the measurements obtained were determined. There was no statistical difference of data between right and left sides.

Discussion: The data obtained in the study will be of use to surgeons and orthopedicians during interventional procedures on the proximal part of radius and in decompression procedures of the PIN.

Introduction:

The posterior interosseous nerve (PIN) is vulnerable to injury during surgical exposures of the radial head and neck, due to the closeness of the nerve to the proximal radius and the absence of clear intermuscular planes.[1-3] Moreover, the use of retractors to allow adequate exposure of the radial head and neck could lead to compression or traction injuries of the PIN. [4] Extensive exposure of the proximal radius is required in cases of fractures of the proximal radius, trauma, and in certain conditions of the elbow.[5] Incisions in radialhead fractures are placed over the radial head and knowledge of the relationship of the PIN to the radial head is important in such cases. In addition, decompression procedures undertaken for PIN in cases of its entrapment require the exact localization of

PIN.[6,7]

The radial nerve passes from the posterior to the anterior compartment, after piercing the lateral intermuscular septum in the lateral part of the distal arm. Here, it divides into its two terminal divisions-the superficial branch and the deep branch or the PIN. The PIN descends, passing over the anterior aspect of the elbow joint, and travels deep to the proximal border of the superficial layer of supinator muscle (arcade of Frohse). It passes between the superficial and deep layers of the supinator and after exiting from the supinator muscle gives branches to the muscles of the extensor compartment of the forearm. It travels posterior to the interosseous membrane and anterior to the extensor pollicis longus muscle onto the dorsum of the carpus, where it sends filaments to the ligaments and articulations of the dorsal carpus.[8]

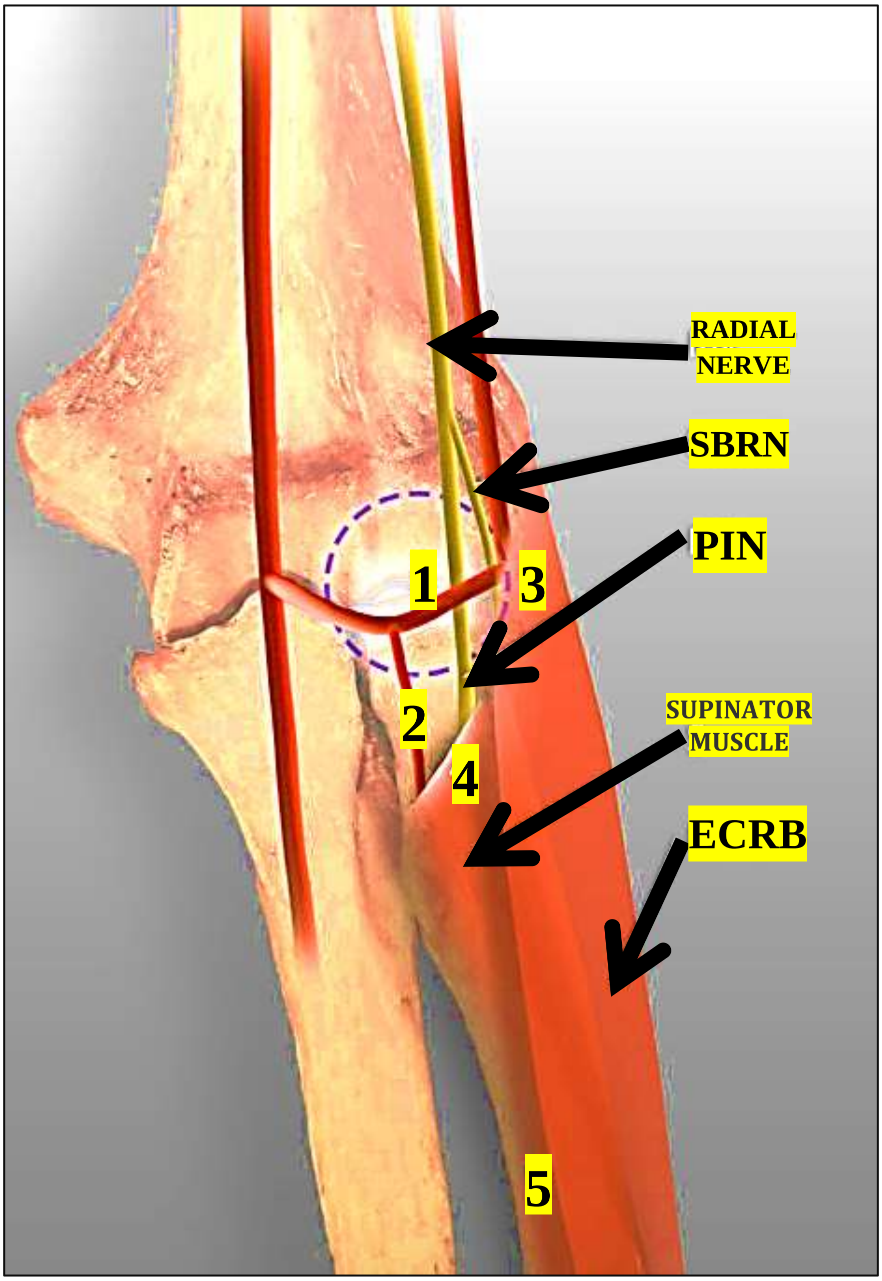
Little information can be found in the literature regarding the relationships of the posterior interosseous nerve (PIN) while it traverses the supinator muscle. Because compression syndromes may involve this nerve at this site and researchers have investigated using branches of the PIN to the supinator for neurotization procedures, the authors' aim was to elucidate information about this anatomy. PIN syndrome, while not common in the general population, is considered the most prevalent compressive neuropathy affecting the radial nerve (RN) and the third most common neuropathy associated with the brachial plexus branches, following carpal tunnel and cubital tunnel syndromes. Studies have shown varying incidence rates, with Weitbrecht and Navickine identifying radial tunnel syndrome (RTS) in only 1% of patients with confirmed forearm entrapment syndromes. Latinovic et al. estimated the annual incidence of RN entrapment to be 2.97 among men and 1.42 among women per 100,000 persons, with a surgery ratio of 0.5 for men and 0.8 for women per 100,000 persons. Incidence tends to peak in middle age before declining.

The entrapment of the PIN can occur at five primary sites. The first is the floor of the radial tunnel, where fibrous tissue from the radial head fuses with surrounding muscles, potentially leading to compression. The second point is at the radial neck, where compression may occur due to hypertrophy of the recurrent radial vessels, known as the leash of Henry. The third site is the tendinous medial margin of the extensor carpi radialis brevis, which can blend with surrounding structures and cause entrapment. The fourth location is the proximal margin of the supinator muscle's superficial head, known as the arcade of Frohse, which can also lead to compression. Lastly, the distal border of the supinator muscle can also be a site of entrapment, with variations observed between muscular and tendinous structures. Understanding these points of entrapment is crucial for diagnosing and treating PIN syndrome effectively. [9]

Aims & Objectives Of the study:

The aim of the present study was to determine the distances of the PIN to certain adjacent landmarks that can be used intraoperatively to locate the nerve and prevent iatrogenic injury during the proximal dissection of the radius. The pattern of innervation of supinator was studied, as it is essential for effective regional anesthetic block and for harvesting the motor branches for nerve transfer procedures

FIGURE 1 : There are five basic points of PIN entrapment .



Material and Methods:

The study conducted was observational and spanned a duration of 2 years. It involved dissection of forty embalmed upper limbs from 28 male and 12 female adult cadavers, with ages at death ranging from 40 to 90 years (mean 75 years). All upper limbs were devoid of scars, trauma, or deformities and were maintained in a midprone position during dissection. The research was carried out by the Department of Anatomy, Government Medical College, Ongole, following approval from the Institutional Review Board. During dissection, a vertical incision was made from 5 cm proximal to the interepicondylar line to the wrist, and a fasciocutaneous flap was excised from the lower third of the arm to the middle of the forearm. The radial nerve and its main branches were dissected from the lateral

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intermuscular septum of the arm to the distal arcade of the supinator muscle. The proximal and distal borders of the superficial layer of the supinator were identified, and the PIN was carefully dissected out. Measurements, including distances from the interepicondylar reference point and styloid process of the ulna to the exit of the PIN from the supinator, and the distance from the origin of the PIN to the proximal border of the superficial layer of the supinator (arcade of Frohse), were taken using a measuring tape. Additional measurements included the length of the forearm, distance from the lateral epicondyle to the entry of the PIN at the arcade of Frohse, distances from the radial head to the entry and exit of the PIN from the supinator, and distances from the radial head to the proximal and distal borders of the superficial layer of the supinator. The study also delineated the number of PIN trunks, length of the PIN within the supinator, and branches to the supinator. Data were analyzed using paired t-test and SPSS version 26.0 software.

Results:

The PIN was consistently identified in all 40 embalmed cadaveric forearms. Table 1 displays the distances of the PIN from significant adjacent anatomical landmarks, including the midpoint of the interepicondylar line (interepicondylar reference point), ulnar styloid process, radial head, and proximal border of the superficial layer of the supinator (arcade of Frohse). Surgeons can predict the borders of the supinator preoperatively for cases of PIN entrapment by considering distances from the radial head to the proximal and distal borders of the superficial layer of the supinator. There were no statistically significant differences between sides. Table 2 presents the distance between the tip of the lateral epicondyle and the proximal border of the superficial layer of the supinator muscle (distance AF) alongside mean forearm lengths. The "ratio AF" was calculated by dividing distance AF by forearm length and offers a means to predict distance AF based on forearm length. Most commonly, the PIN entered the supinator as a double trunk, with 23% entering as a single trunk and 77% as a double trunk (Table 2). The course of the PIN and whether it supplied branches to the supinator before entering the muscle or afterward were observed and documented in Table 3. The length of the PIN within the supinator averaged 48.2 ± 9.1 mm. Additionally, the average number of total branches supplying the supinator was found to be 6.4 ± 1.2, with 3.1 ± 1.1 radial branches and 3.5 ± 1.2 ulnar branches. The exit types of the PIN, whether proximal or at the distal border of the supinator, are outlined in Table 4.

Table 1: Parameters measured in the study in relation to the posterior interosseous nerve

	Mean±SD (mm)	Range (mm)
Distance from inter epicondylar reference point to exit of PIN from supinator	88±12	67‐109
Distance between styloid process of the ulna and exit of PIN from supinator	176 ±15	154‐205

Distance between origin of PIN and proximal border of superficial layer of supinator (arcade of Frohse)	31 ±16	25‑50
Distance between PIN entry at proximal border of superficial layer of supinator (arcade of Frohse) and radial head	25 ±5	11‑37
Distance between PIN exit point from supinator and radial head	68 ± 8	47‑85
Distance between radial head and proximal border of superficial layer of supinator (arcade of Frohse)	25.2 ±6.2	12‑37
Distance between radial head and distal border of superficial layer of supinator	83.2 ± 9	59‑100

(‑): Proximal to interepicondylar line. PIN: Posterior interosseous nerve, SD: Standard deviation

The table presents anatomical measurements related to the posterior interosseous nerve (PIN) and surrounding structures. Key values include an average distance of 88 mm from the interepicondylar reference point to the PIN exit from the supinator, and 176 mm from the styloid process of the ulna to the PIN exit. Additionally, the mean distance from the PIN origin to the superficial layer of the supinator (arcade of Frohse) is 31 mm, and from the PIN entry to the radial head is 25 mm. The PIN exit point from the supinator to the radial head averages at 68 mm. These measurements aid in understanding forearm anatomy, crucial for surgical planning and clinical assessments involving the PIN.

Table 2: Forearm length and distance AF

Parameter		**Mean distance±SD (mm)**	
	Total	**Males**	**Females**
Distance between the tip of lateral epicondyle and proximal border of superficial layer of supinator muscle (distance AF)	59 ±8 (50 ‑74)	61±10	56.2 ±9.0

Forearm length	250 ± 17	264 ± 16	241 ±13
Ratio AF (distance AF/forearm length)	0.25 ±0.02	0.22±0.01	0.20 ±0.03
SD: Standard deviation, AF: Arcade of Frohse			

The table provides anatomical measurements related to the distance between the tip of the lateral epicondyle and the proximal border of the superficial layer of the supinator muscle (distance AF), forearm length, and the ratio of distance AF to forearm length. Overall, the mean distance between these points is 59 ± 8 mm, with males having a slightly greater mean distance (61 ± 10 mm) compared to females (56.2 ± 9.0 mm). Forearm length averages at 250 ± 17 mm, with males having a longer forearm length (264 ± 16 mm) than females (241 ± 13 mm). The ratio of distance AF to forearm length (Ratio AF) is 0.25 ± 0.02, with males having a higher ratio (0.22 ± 0.01) compared to females (0.20 ± 0.03). These measurements offer insights into forearm anatomy and sexual dimorphism, which are essential for various clinical assessments and surgical interventions involving the supinator muscle and surrounding structures.

Table 3: Trunks of posterior interosseous nerve and pattern of innervation of supinator muscle

Parameter	Total, *n* (%)	Right, *n* (%)	Left, *n* (%)
Single trunk	9 (23)	7 (35)	2 (10)
Double trunk	30 (77)	13 (65)	18 (90)
PIN supplied supinator before entry into the muscle	12 (30)	4 (20)	8 (40)
PIN supplied supinator as it travelled between its superficial and deep layers	28 (70)	16 (28)	12 (60)
PIN: Posterior interosseous nerve			

The table illustrates the distribution of variations in the posterior interosseous nerve (PIN) regarding its trunk configuration and supply pattern to the supinator muscle. Among the total sample, 23% exhibit a single trunk configuration, with 35% on the right side and 10% on the left side. In contrast, 77% show a double trunk configuration, comprising 65% on the right side and 90% on the left side. Regarding PIN supply to the supinator muscle, 30% of cases indicate the PIN supplying the muscle before entering it, with 20% on the right side and 40% on the left side. On the other hand, in 70% of cases, the PIN supplies the supinator as it travels between its superficial and deep layers, with 28% on the right side and 60% on the left side. These findings offer insights into the variations in PIN anatomy and distribution, which are pertinent for clinical assessments and surgical considerations involving the forearm.

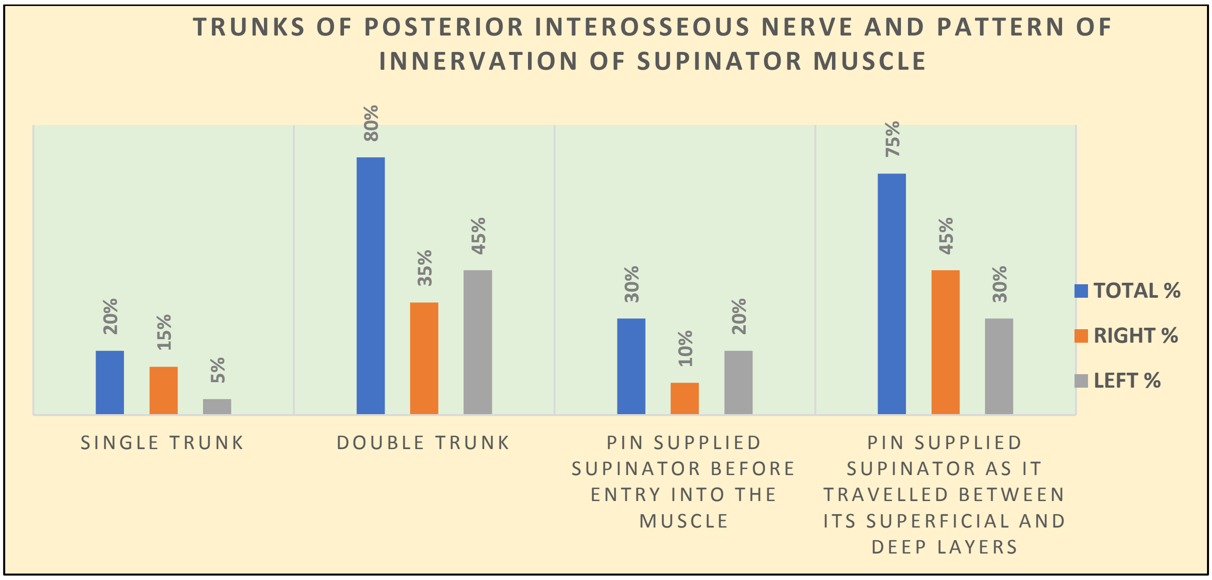

FIGURE 1 : Trunks of posterior interosseous nerve and pattern of innervation of supinator muscle.

Table 4: Type of exit of posterior interosseous nerve from supinator

Parameter	**Total, *n* (%)**	**Right, *n* (%)**	**Left, *n* (%)**
PIN exited proximal to the distal border of the superficial layer of supinator	37 (92.5)	18 (90)	19 (95)
PIN exited at the distal border of the superficial layer of supinator	3 (7.5)	2 (10)	1 (5)
PIN: Posterior interosseous nerve			

The table outlines the distribution of the posterior interosseous nerve (PIN) exit locations relative to the superficial layer of the supinator muscle. Among the total sample, 92.5% exhibit PIN exiting proximal to the distal border of the superficial layer of the supinator, with 90% on the right side and 95% on the left side. In contrast, 7.5% of cases show PIN exiting at the distal border of the superficial layer of the supinator, comprising 10% on the right side and 5% on the left side. These findings provide insights into the variations in PIN anatomy, specifically its exit points relative to the supinator muscle, which are crucial for clinical assessments and surgical interventions involving the forearm.

Table 5: Studies showing the distances between the posterior interosseous nerve and adjacent landmarks (mm)

	Duquin *et al.*[24]	**Present study (2018)**
Distance from interepicondylar reference point to exit of PIN from supinator	90.21±1 5.61	88±12
	Thomas *et al.*[2]	Present study (2018)
Distance between PIN and proximal border of	36±7	31 ±16

superficial layer of supinator(arcade of frohse)		
	Tubbs *et al.*[10]	Present study (2018)
Distance between ulnar styloid process and exit of PIN from supinator	180	176 ±15
	Hazani *et al.*[6]	Present study (2018)
Distance between PIN entry at the proximal border of superficial layer of supinator (arcade of frohse) and radial head	35	25 ±5
Distance between PIN exit point from supinator and radial head	74±4	68 ± 8
PIN: Posterior interosseous nerve		

The table juxtaposes measurements from previous studies with those from the present study (2018), focusing on various anatomical parameters concerning the posterior interosseous nerve (PIN). In our investigation, the mean distance from the interepicondylar reference point to the PIN exit from the supinator was found to be 88±12 mm, slightly lower than Duquin et al.'s [11] reported value of 90.21±15.61 mm. Similarly, our study observed a mean distance of 31±16 mm between the PIN and the proximal border of the superficial layer of the supinator, contrasting with Thomas et al.'s measurement of 36±7 mm. Conversely, the present study's measurement of 176 ±15 mm for the distance between the ulnar styloid process and the PIN exit from the supinator aligns closely with Tubbs et al.'s [10] findings of 180 mm. However, there are discrepancies in the distances between the PIN entry at the proximal border of the superficial layer of the supinator and the radial head, as well as the distance between the PIN exit point from the supinator and the radial head, with our study reporting lower values compared to Hazani et al.'s [6] measurements. These variations underscore the importance of considering differences in study methodologies and populations when interpreting anatomical data.

Table 6: Posterior interosseous nerve and the supinator muscle

	Tubbs *et al.*[10]	**Present study (2018)**
PIN entered supinator as single trunk	29	9
PIN entered supinator as double trunks	23	31
Distance between division of the radial nerve and proximal border of superficial layer of supinator (cm)	2.2	3.1
Length of PIN within supinator (cm)	4	4.8
Average number of branches of PIN to the supinator	2.5	6.65

PIN exited proximal to the distal border of supinator	10	37
PIN exited at the distal border of supinator	42	3
PIN: Posterior interosseous nerve		

The table presents a comparison between data from Tubbs et al. and the present study (2018) regarding various aspects of the posterior interosseous nerve (PIN) as it relates to the supinator muscle. Tubbs et al. reported that 29 cases involved the PIN entering the supinator as a single trunk, whereas in the present study, this occurred in only 9 cases. Conversely, the present study observed more cases of the PIN entering the supinator as double trunks, with 31 cases compared to Tubbs et al.'s [10]23 cases. Additionally, the distance between the division of the radial nerve and the proximal border of the superficial layer of the supinator was shorter in Tubbs et al.'s study (2.2 cm) compared to the present study (3.1 cm). The length of the PIN within the supinator was similar between the two studies, with Tubbs et al. reporting 4 cm and the present study measuring 4.8 cm on average. However, there was a notable difference in the average number of branches of the PIN to the supinator, with Tubbs et al. [10] reporting 2.5 branches and the present study observing 6.65 branches on average. Regarding the exit point of the PIN from the supinator, Tubbs et al. documented 10 cases where the PIN exited proximal to the distal border of the supinator, while the present study found 37 such cases. Conversely, Tubbs et al. reported 42 cases of the PIN exiting at the distal border of the supinator, whereas the present study observed only 3 such cases. These comparisons highlight variations in PIN anatomy and distribution, emphasizing the importance of considering different studies' findings in understanding forearm anatomy and clinical implications involving the PIN.

Discussion

There are many studies describing the course and branches of the PIN to the muscles of the forearm. Palsies of the PIN can develop after an unreduced radial head dislocation, associated with proximal ulnar fractures, and with anterolateral dislocations of the radial head. Injury to the PIN is a major potential complication of surgery involving the proximal radius.[12-15] The posterolateral or Kocher approach, (Kocher, 1911), and the Thompson approach, are two approaches used by surgeons for the proximal radius but these interventions seem to place the PIN at risk ofinjury. In addition, repair undertaken for the ruptureof the distal biceps tendon can jeopardise the safety of the PIN. Injury to the PIN is a known complication in elbow arthroscopy.Hence, it is imperative to visualize and protect the PIN while performing surgical interventions on the proximal radius.

Other causes of paralysis of PIN include neuromas, schwannomas,traumatic aneurysms of the posterior interosseous artery,neurofibromas,and ganglion cysts. Understanding the anatomical relationship between the supinator muscle and the PIN is important to limit the surgical morbidity when interventions are undertaken in that area. [16-19]

Our study provides crucial anatomical measurements concerning the posterior interosseous nerve (PIN) and its adjacent structures. Among the key findings, we observed an average distance of 88 mm from the interepicondylar reference point to the PIN exit from the supinator, and 176 mm from the ulnar styloid process to the PIN exit. Furthermore, the mean distance from the PIN origin to the superficial layer of the supinator (arcade of Frohse) was measured at 31 mm, while the distance from the PIN entry to the radial head averaged 25 mm. The PIN exit point from the supinator to the radial head was found to have an average distance of 68 mm. These precise measurements provide valuable insights into forearm anatomy, serving as essential reference points for surgical planning and clinical evaluations concerning the PIN. The table 2 outlines variations in the posterior interosseous nerve (PIN) trunk configuration and supply to the supinator muscle. It reveals that 23% have a single trunk, predominantly on the right side (35%) compared to the left (10%), while 77% exhibit a double trunk, with varying prevalences between sides (65% on the right, 90% on the left). PIN supply patterns also vary, with 30% supplying the muscle before entry (20% right, 40% left), and 70% supplying within its layers (28% right, 60% left). These findings highlight the diverse anatomy of the PIN, crucial for clinical and surgical considerations in forearm procedures.

Table 5 presents a comparison across studies on locating the posterior interosseous nerve (PIN) intraoperatively using specific anatomical landmarks. Calfee et al. [20]noted that the PIN crossed the radius approximately 4.2 cm distal to the radiocapitellar joint in neutral rotation, increasing to 5.6 cm during pronation and decreasing to 3.2 cm during supination. Hohenberger et al. [21] found a shorter distance between the tip of the radial head and the PIN's exit point from the supinator during maximum supination compared to pronation. In our study, we observed this distance to be 69.45 ± 8.86 mm in the midprone position. High-resolution ultrasound and magnetic resonance imaging aid in assessing posttraumatic radial nerve or PIN palsy. Seradge et al. highlighted the significance of understanding PIN trunks and branches within the supinator muscle during decompressive or neurotization procedures. Tubbs et al. [22] examined PIN branching patterns to the supinator, while Abrams et al. reported a mean of 3.9 ± 1.4 branches to the supinator, akin to our findings. The number of PIN trunks, its length within the supinator, branches to the muscle, and exit are crucial for anesthetists performing regional blocks of the PIN for surgical exploration near the supinator muscle.

High-resolution ultrasound is beneficial for promptly assessing the nerve in cases of posttraumatic radial nerve or PIN palsy. Affected nerve segments are identifiable through decreased echogenicity, alterations in caliber, or discontinuity of the nerve. Magnetic resonance imaging aids in discerning soft-tissue details and lesion characterization. Understanding the trunks and branches of the PIN as it traverses the supinator muscle is valuable for neurosurgeons during decompressive or neurotization procedures. Seradge et al. documented a case where the PIN bifurcated, with one half exiting at the distal border of the supinator and the other half proximal to it, necessitating decompression of both for symptom alleviation. Knowledge of the number of PIN trunks, its length within the supinator, branches to the muscle, and exit points is crucial for anesthetists performing regional blocks of the PIN for surgical exploration in the supinator muscle region. In

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a study conducted by Tubbs et al., [22] 52 cadaveric limbs were dissected to examine the branching patterns of the posterior interosseous nerve (PIN) within the supinator muscle. The findings revealed two main patterns: on 29 sides, the PIN entered the muscle as a single nerve, branching into two to four smaller branches medially. On 23 sides, it entered as two equal-sized branches originating from the radial nerve, with the medial branch terminating on the muscle and the lateral one traversing through it, sometimes giving off additional branches. The average length of the PIN within the muscle was 4 cm, with branch diameters ranging from 0.8 to 1.1 mm. Notably, in some cases, the PIN exited the muscle before its distal end, and in rare instances, muscle fibers pierced the nerve. Understanding these variations in PIN anatomy within the supinator muscle could prove beneficial for neurosurgeons during procedures like decompression or neurotization.

Waitzenegger et al. [23] reported a novel case of motor paralysis of the posterior interosseous nerve (PIN) characterized by rapid onset in a 62-year-old man with a history of distal biceps rupture. Remarkably, the paralysis occurred two years post-injury, coinciding with hypertrophy of the short supinator muscle. The patient had initially received conservative treatment for the biceps rupture due to age and low functional demands. Upon operative intervention, the deep branch of the radial nerve was found compressed within the arcade of Frohse. Following release, the patient experienced complete symptom resolution within five months. This case highlights the potential risk of PIN compression in individuals with unrepaired distal biceps ruptures, particularly those engaged in active pursuits.

Hohenberger et al. [21] conducted a study aimed at evaluating the entrance and exit points of the posterior interosseous nerve (PIN) into the supinator muscle in detail. Dissecting 100 upper extremities, they depicted these points and measured the distances from the tip of the radial head (RH) to these points. They observed variations in the borders of the arcade of Frohse (AF), with 54 cases exhibiting a muscular border and 46 showing a tendinous version. The mean interval between PIN entry into the supinator and the RH tip was 28.9 mm, while the mean interval between PIN exit and the RH tip was 64.2 mm. Notably, they found that approximately one-third of patients might also experience entrapment at the exit point of the PIN. These findings underscore the importance of considering variations in PIN anatomy during surgical interventions for PIN syndrome.

Anania et al. [24]present a case study and review the literature on spontaneous posterior interosseous nerve (PIN) palsy, focusing on cases of entrapment distal to the arcade of Frohse. They identified seven cases of distal entrapment, with lesions being the primary cause in 58.7% of cases and entrapment in 20.65%. The pathology was found to be located at the elbow in 33.7% of cases, at the arcade of Frohse in 28.26%, and at the supinator canal in 10.33%. Interestingly, entrapment occurred predominantly at the arcade of Frohse (64.45%), followed by proximal (20%) and distal (15.55%) locations. Their findings underscore the rarity of PIN distal entrapment, emphasizing the need for further investigation when radiological images at the arcade of Frohse fail to reveal any entrapment.

Qin et al. [25] reported a case study of a 35-year-old male automobile mechanic presenting with progressive weakness in finger extension and forearm supination, indicative of posterior interosseous nerve (PIN) entrapment syndrome. Musculoskeletal ultrasound identified the entrapment point at the inlet of the Frohse arch and the outlet of the supinator muscle. Utilizing ultrasound-guided nerve hydrodissection, they successfully treated the entrapment, leading to significant improvement in symptoms, particularly in dorsiflexion weakness of the right hand. This case underscores the efficacy of ultrasound-guided hydrodissection as a therapeutic approach for PIN entrapment syndrome, offering promising clinical outcomes and future applications.

Calfee et al. [20]conducted a cadaveric study to quantify the impact of simulated fractures on the posterior interosseous nerve (PIN). They analyzed 20 upper extremities, recording the distance between the radiocapitellar joint and the point where the PIN crosses the radius axis in different forearm positions. In their study, Calfee et al. observed that the posterior interosseous nerve (PIN) crossed the radius at an average distance of 4.2 cm distal to the radiocapitellar joint in a neutral forearm rotation. This distance increased to 5.6 cm in pronation and decreased to 3.2 cm in supination. Notably, these changes were statistically significant ($p < 0.01$). Additionally, they found that radial length correlated with these measurements, indicating that forearm rotation influences the position of the PIN relative to the radius.Furthermore, the study investigated the effects of simulated fractures on PIN position. Diaphyseal osteotomy of the radius markedly decreased the effect of forearm rotation on PIN position, reducing the change in nerve position from supination to pronation from 2.13 ± 0.8 cm to 0.24 ± 0.2 cm ($p = 0.001$). On the other hand, radial head excision resulted in proximal migration of both the radius and the PIN in all forearm positions. This suggests that forearm pronation has minimal effect on PIN position following diaphyseal osteotomy, while proximal migration of the radius leads to corresponding proximal migration of the PIN in cases of simulated Essex-Lopresti lesions.These results underscore the importance of considering forearm rotation and fracture patterns when assessing PIN position and the necessity of visualizing and protecting the PIN during surgical exposure of the traumatized proximal radius.

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 Kaplan [26] and the 2.2 cm of motion reported by Diliberti et al. [27] 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). [27] 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 joint.

In their study, Qin et al.[25] presented the case of a 35-year-old male automobile mechanic who experienced progressively worsening symptoms indicative of posterior interosseous nerve (PIN) entrapment syndrome. Despite initially experiencing only slight weakness in finger extension, the symptoms escalated over two years, culminating in finger drop and supination weakness in the right forearm. Neural electrophysiological examination confirmed partial PIN injury of the right radius. Through musculoskeletal ultrasound examination, PIN entrapment was localized at the inlet of the Frohse arch and the outlet of the supinator muscle, leading to the diagnosis of PIN entrapment syndrome. Following treatment with ultrasound-guided nerve hydrodissection targeting the entrapment site, significant improvement in dorsiflexion weakness of the right hand was observed compared to pre-treatment conditions. This case underscores the efficacy of ultrasound-guided hydrodissection as a therapeutic intervention for PIN entrapment syndrome, offering promising outcomes for patients experiencing similar symptoms.

The function of the hand is impaired in lesions of the lower brachial plexus. In C7 – T1 injuries, there is the absence of finger flexion and intrinsic muscle control, as well as thumb and finger extension. Since the supinator is innervated by the upper roots of the brachial plexus, it is unaffected in lower brachial plexus palsy.[28,29] The motor branches supplying supinator muscle could be transferred directly to the PIN, without using a nerve graft, resulting in a fair return of finger and thumb extension. The clinical diagnosis of posterior interosseous nerve (PIN) entrapment syndrome primarily relies on recognizing its characteristic symptoms. However, due to similarities with other conditions regarding etiology, clinical presentation, and signs, misdiagnosis and missed diagnoses are common occurrences. Conventional imaging methods often fail to provide continuous and dynamic visualization of peripheral nerves, especially smaller branches, leading to diagnostic inaccuracies. Even electrophysiological examinations, considered the gold standard for nerve entrapment diagnosis, may struggle to precisely locate nerve compression sites. In the case described, electrophysiological testing indicated PIN injury, prompting further evaluation with ultrasound. This comprehensive approach, including observation and measurement of PIN morphology, aids in accurate diagnosis and treatment planning, highlighting the importance of multimodal assessment in PIN entrapment syndrome cases.

Conclusion

The findings in the present study have documented many potentially useful anatomic landmarks for locating the PIN that can be used intraoperatively during the surgical management of fractures of the proximal radius to avoid iatrogenic injuries. Decompressive procedures undertaken for entrapment neuropathies require intimate knowledge of PIN anatomy. In addition, the findings on the branching pattern of PIN to supinator muscle may be useful when considering transfer of these branches to PIN for restoration of hand function.

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