A Cadaveric Study Assessing Safety Profile for Using Anterolateral (Proximal, Mid, and Distal) and Posterolateral Portal in Elbow Arthroscopy and Evaluating Variations in the Course of Vital Surrounding Nerves

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INTRODUCTION:

Neurovascular injury is most dreadful complication of elbow arthroscopy most commonly involving radial nerve, ulnar nerve, median nerve and posterior interosseus nerve (PIN), and posterior antebrachial cutanous nerve (PACN). Commonly used portals are anterolateral (AL) portal (Distal, Mid, and Proximal), AM portal, Posterior portal, Posterolateral (PL) portal, and direct lateral portal.

Multiple cadaveric studies have been conducted in past which demonstrated narrow zone of interval between various portals and major neurovascular structures. But, still the literature lacks comparative data of relationship between commonly used the portals and all nerves at risk in same cadaver. Moreover sample size in previous studies was less (5-10 elbows).

Hence, we conducted a cadaveric study on larger sample size with aim to evaluate the safety of anterolateral (distal, mid, proximal) and posterolateral portals in elbow arthroscopy and to evaluate the chances of injury of the radial nerve, PIN, PACN, and ulnar nerve during elbow arthroscopy.

METHODS:

Cadaveric study was conducted on 16 non dissected cadavers (32 elbow specimens) from January 2021 to June 2022. Cadavers were positioned in supine position with elbow flexed 90 degrees. The joint capsule was not distended with any fluid throughout the procedure. Size 4 mm Steinmann pins were used to insert into the respective four portals, namely Distal AL, Mid AL, Proximal AL, and PL portal and distance from different nerve was noted. AL Portal was made 3 cm distal and 1 cm anterior to Lateral epicondyle (LE). Mid AL portal was placed directly anterior to radiocapitellar joint. Proximal AL portal was made 2 cm proximal to LE and just anterior to humerus. PL Portal was made about 1 cm anterior to the midpoint of the tip of olecranon and LE. Distance of Radial nerve, ulnar nerve, PIN, and PACN was noted and digital photographs were captured for record. Mean, SD, p-value, Odds Ratio, and Confidence Interval were calculated for each parameter and P values <0.05 considered significant.

RESULTS:

An equal number of elbow cadaveric specimens were taken for studying the AL (16) and the PL (16) portals. Out of 32 cadaveric elbow specimens, 22 were male and 10 were female. The mean age of cadavers was 56.5± 8.10. The standard AL portal was at an average distance of 7.95 mm from radial nerve, 11.86 mm from PIN, and 13.67 mm from PACN. The proximal AL portal was at an average distance of 12.03 mm from radial nerve, 9.48 mm from the PIN, an average distance of 9.35 mm from PACN. The mid AL portal was at an average distance of 12.31 mm from radial nerve, 12.10 mm from PIN, and 10.48 mm from PACN. The PL portal was at an average distance of 17.98 away from the radial nerve, 17.61 mm from PIN, 28.37 mm from Ulnar nerve, and 21.82 mm from PACN.

The comparison of respective measurements of the distance of Right and Left Steinman pin to various nerves in the two portals is demonstrated in Table. Radial Nerve was closest to the Distal AL portal with the shortest distance being 2.50 mm whereas the PACN was the closest to the Proximal AL portal with the shortest distance of 2.94 mm.

In AL portal, the radial nerve has the highest risk of injury (2.40 %). In the posterolateral portal, the maximum risk of injury lies with the Radial nerve of around 1.44 % followed by PIN with a risk of 0.48 %. PACN and the ulnar nerve were reported safe in our study with no injuries in the PL portal.

DISCUSSION AND CONCLUSION:

We observed a difference of 3-4 mm in the distance of radial nerve from previous studies in which joint was distended. We observed that radial nerve was most prone to injury out of all nerves in AL and PL portals, with highest risk of getting injured in distal AL portal.

No study has yet compared the distances of PIN from the three subdivisions of the AL portals i.e., Proximal AL, mid AL, and standard AL. In our study, we observed that PIN was closest to proximal AL portal. Moreover, no study in literature measured distance of PIN from PL portal which in our study came out to be 17.61 mm, suggesting a safe window. It was also seen that PACN was only injured in AL portals and no injury in the PL portal.

We observed that among the three AL portals, there were lesser injuries in the proximal and mid-AL portals than in the distal AL portal. The proximal AL portals provided the greatest clearance to the neurological structures out of the three AL portals. Furthermore, it was observed that when the number of injuries in the AL (5.28%) and PL (1.92%) portals was compared as a whole, the PL portal was found safer than the AL portals.

After the calculation of distances of various neurovascular structures in two portals (AL, PL) on 32 cadaveric elbow specimens, it can be concluded that though the radial nerve and PIN showed a relatively constant course throughout our

study, it was also found that radial nerve was at a greater risk of injury via distal AL Portal, while the PIN was at greater risk of injury via proximal AL Portal. For the PACN, the risk of injury is greater in the AL portal. No injuries were found in the PL portal with the ulnar nerve.

On an overall basis, the risk of injury in the AL portal is comparatively greater than in the PL portal. Moreover, lateral portals of elbow arthroscopy are relatively safer with reduced risk of ulnar nerve injury in comparison to medial approaches in which ulnar nerve being most commonly injured nerve followed by radial nerve and PIN.

Therefore it can be concluded that for performing a successful elbow arthroscopy the proximal AL and PL portals can be used safely for accessing the anterior and posterior compartment of elbow joint respectively keeping in mind the mean distances of vital structures from each portal.

	AL portal	Mean (SD)	p-value
Radial nerve	Proximal	11.21 (3.54)	Proximal vs Mid: 0.701
	Mid	13.42 (3.05)	Mid vs Distal:0.129
	Distal	8.8 (3.36)	Proximal vs Distal: 0.639
PIN	Proximal	9.13 (2.43)	Proximal vs Mid: 0.051
	Mid	13.11 (2.39)	Mid vs Distal:0.670
	Distal	11.44 (3.83)	Proximal vs Distal: 0.406
PACN	Proximal	9.07 (3.32)	Proximal vs Mid: 0.624
	Mid	10.81 (2.76)	Mid vs Distal:0.388
	Distal	13.13 (2.78)	Proximal vs Distal: 0.624
Ulnar Nerve	NR	-	-

Table-1: Comparison of distance of the vital structure from right Steinmann pin between anterolateral portals. (N = 16)

	AL portal	Mean (SD)	p-value
Radial nerve	Proximal	12.86 (1.85)	Proximal vs Mid: 0.947
	Mid	11.51 (3.74)	Mid vs Distal:0.115
	Distal	7.11 (2.89)	Proximal vs Distal: 0.301
PIN	Proximal	9.83 (2.39)	Proximal vs Mid: 0.923
	Mid	11.09 (3.57)	Mid vs Distal:0.934
	Distal	12.28 (2.42)	Proximal vs Distal: 0.624
PACN nerve	Proximal	9.64 (2.71)	Proximal vs Mid:0.992
	Mid	10.15 (2.15)	Mid vs Distal:0.129
	Distal	14.22 (5.05)	Proximal vs Distal: 0.073
Ulnar nerve	NR	-	-

Table-2: Comparison of distance of the vital structure from left Steinmann pinbetween anterolateral portals. (N = 16)