

Incidence of Posterior Interosseous Nerve Trauma During Creation of the 3-4 Wrist Arthroscopy Portal in Cadavers

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Purpose: To describe histologic evidence of nerve trauma during the creation and use of the 3-4 portal. **Methods:** Fourteen fresh-frozen cadaveric wrists were mounted on a custom-built frame that simulated a wrist arthroscopy traction tower. After the 3-4 portal was created in the usual manner, the skin was dissected off to identify possible trauma to the posterior interosseous nerve (PIN). Specimens were categorized into those where there was clearly no trauma to the PIN and those where trauma was possible. In the cases where trauma was possible, we harvested the PIN with a cuff of the proximal edge of the portal and examined the cross-sectional histology of the most distal sections for the presence of neural tissue. **Results:** There was clearly no trauma to the PIN in 3 of the wrists during the creation of the 3-4 portal. In the remaining 11 wrists with possible trauma to the PIN, we identified axonal tissue on histologic examination at the proximal edge of the 3-4 portal in 7 of these specimens. In summary, 50% (7 of 14) of our specimens had visual and histologic evidence of trauma to the PIN. **Conclusions:** Based on the findings of this study, there may be more instances of trauma to the PIN during routine wrist arthroscopy than have been previously reported. **Clinical Relevance:** Findings suggest that transection or injury to this nerve may not lead to any clinical sequelae. However, if there is an instance where a patient has persistent, otherwise unexplained, dorsal wrist pain after a wrist arthroscopy procedure, iatrogenic neuroma of the PIN may be responsible and should be considered.

The 3-4 portal (between the third and fourth dorsal extensor compartments) is one of the most important portals that is typically established first and used as the viewing portal for diagnostic arthroscopy of the radiocarpal and ulnocarpal joints.¹ Many structures have been reported to be injured during wrist

arthroscopy, including nerves, tendons, and articular cartilage.²

To help wrist arthroscopists minimize iatrogenic injury to these structures during the procedure, many authors have carried out cadaveric studies to highlight the relevant anatomy as well as suggest ways to prevent them.³⁻¹⁴ Interestingly, a clinical case report of PIN injury predates any cadaveric study that has reported this risk. In that case report, del Pinal et al.¹⁵ described how the posterior interosseous nerve (PIN) was found to have been avulsed at the level of the 3-4 portal after the procedure was converted from an arthroscopic assessment to an open procedure to treat the scapholunate injury discovered on arthroscopy. In fact, a similar situation occurred in the practice of the senior author (J.Y.) of this study which motivated the performance of this study.

The purpose of this study was to describe histologic evidence of nerve trauma during the creation and use of the 3-4 portal. Our hypothesis was that the incidence of mechanical trauma to the PIN is likely higher than has been previously reported during this step in wrist arthroscopy.

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Methods

Establishing the 3-4 Portal

Fourteen fresh-frozen cadaveric upper limbs that were harvested at the level of the midforearm were obtained from a nonprofit organization that supplies tissue for research (Restore Life USA, Elizabethton, TN). The specimens were inspected and excluded if there were any signs of previous wrist injury or surgery. Wrists that were deemed normal on inspection were included, and each of these specimens was mounted on a custom-built frame that simulates a wrist arthroscopy traction tower (Fig 1). The 3-4 portal was established by creating a 5-mm longitudinal skin incision approximately 10 mm directly distal to the Lister tubercle at the level of the radiocarpal joint, making sure to avoid the extensor pollicis longus radially and extensor digitorum communis ulnarly.¹ A curved hemostat was then used for blunt dissection down to the dorsal wrist capsule and a blunt arthrotomy was made with the same instrument to enter the radiocarpal joint. A single surgeon (A.C.) with 5 years of wrist arthroscopy experience established all of these portals.

Identification of Injured Structures

After establishing the 3-4 portal, the skin was carefully dissected off each cadaveric specimen in the subcutaneous plane superficial to the cutaneous nerves. Extensor tendons, the superficial radial nerve, and the PIN were examined under loupe magnification ($\times 2.5$) by one of the authors (A.C.) and trauma to them was recorded. In the case of the PIN, we categorized specimens into those where there was clearly no visual trauma to the PIN and those where trauma was possible. We defined possible trauma as the situation when the PIN was judged visually to be transected at the proximal edge of the 3-4 portal (Fig 2). For the group where there was no clear trauma, that is, the PIN was not transected at the 3-4 portal, we recorded the distance of the ulnar edge of the portal from the course of the PIN using a digital caliper with an accuracy of 0.01 mm.

Histologic Confirmation

In the cases where trauma to the PIN was possible, we harvested the PIN with a cuff of the proximal edge of the portal (Fig 3). All specimens were fixed in 4% paraformaldehyde (Electron Microscopy Science, Hatfield, PA) with phosphate-buffered saline solution (pH 7.4) at 4°C and refrigerated overnight. The tissues were then immersed in 15% sucrose (Sigma-Aldrich, St. Louis, MO) followed by 20% sucrose in phosphate-buffered saline for 2 hours at room temperature and in 30% sucrose in phosphate-buffered saline at 4°C overnight. Next, the specimens were placed successively in 30%, 50%, and 90% optimal cutting temperature compound



Fig 1. Cadaveric right wrist specimen mounted on an arthroscopy tower. Note that the 3-4 portal (dotted sphere) was established 1 cm distal to the Lister tubercle (*).

(Sakura Finetek, Torrance, CA) for 30 minutes each. Thereafter, the tissues were embedded in 100% optimal cutting temperature and frozen immediately with liquid nitrogen. The tissues were then sectioned at 70- μ m thicknesses using a cryostat (Leica, Bannockburn, IL). The sections were stained with hematoxylin and eosin, and the images taken with the EVOS XL Core microscope (Thermo Fisher Scientific, Waltham, MA). One of the authors (W.L.), who was not involved in the dissection and harvest of the cadaveric specimens, examined the cross-sectional histology (at $\times 40$ magnification) of the most distal sections, 350 μ m from proximal edge of the 3-4 portals, for axons (Fig 4) and recorded their presence or absence. Trauma to the PIN was declared when neural tissue was present on histologic examination of these cross sections.

Results

None of the 14 wrist specimens were excluded. In 3 of 14 wrists, there was clearly no trauma to the PIN during the creation of the 3-4 portal. In these specimens, the 3-4 portal was 1 to 2 mm radial from the course of the PIN (Table 1). In the remaining wrists with possible trauma to the PIN, we identified axonal tissue on histologic examination at the proximal edge of the 3-4 portal in 7 of 11 of these specimens. There was no

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