Transbrachioradialis Approach to the Radial Tunnel: An Anatomic Study of 5 Potential Compression Sites

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Abstract

Background: Recent anatomic studies have failed to demonstrate a single utilitarian approach to intraoperative identification and surgical release of all 5 potential sites of posterior interosseous nerve (PIN) compression in the radial tunnel. This study examines if a single incision brachioradialis-splitting approach without the use of additional anatomic windows is capable of adequately exposing the entire length of the radial tunnel, including all 5 sites of PIN compression to allow for adequate release. **Methods:** Ten fresh frozen cadaver forearms (6 female, 4 male) were dissected utilizing a curvilinear 7 cm incision over the brachioradialis. The muscle belly was split via simple blunt retraction, exposing the radial tunnel. The PIN was identified and mobilized at 5 compression sites: radiocapitellar joint (RCJ), radial recurrent vessels (Leash of Henry), fibrous medioproximal edge of extensor carpe radialis brevis, arcade of Frohse, and distal edge of supinator. **Results:** The PIN was identified and effectively released in all specimens without difficulty from this single approach. All 5 sites of compression were visible and accessible through the brachioradialis-split approach. Specifically, there was no difficulty in identifying and releasing the PIN at the distal edge of supinator. **Conclusions:** Radial tunnel syndrome is defined as PIN compression within the radial tunnel spanning from the fibrous RCJ to the distal edge of the supinator. A single brachioradialis-splitting approach is adequate for complete visualization and release of all compression sites of the radial tunnel. Utilizing this technique allows for surgical access and ease as well as minimizing necessity for additional windows or multiple incisions.

Keywords: transbrachioradialis, radial tunnel syndrome, elbow, decompression, anatomy

Background

Radial tunnel syndrome is defined as posterior interosseous nerve (PIN) compression within the radial tunnel spanning from the fibrous radiocapitellar joint (RCJ) to the distal edge of the supinator. The radial tunnel is 5 cm long and has defined anatomic borders.¹ The brachioradialis (BR) muscle forms both the roof and a portion of the lateral wall, with contributions from the mobile wad extensor carpi radialis brevis (ECRB). The floor of the tunnel is the superficial belly of supinator and the radial shaft.^{1,2,7} Radial tunnel syndrome is classically described as having 5 areas of potential PIN compression: Fibrous tissue anterior to the RCJ, fibrous tendinous origin of ECRB, radial recurrent vessels (leash of Henry), arcade of Frohse, and the more recently described distal edge of the supinator.^{1,5}

Recent anatomic studies have failed to demonstrate a single utilitarian approach to intraoperative identification and surgical release of all 5 potential sites of compression through a single incision without the use of additional

anatomic windows.⁶ At our institution, we routinely utilize the BR-split approach classically described by Lister et al for surgical treatment of refractory radial tunnel syndrome.¹ The purpose of our study was to confirm, through cadaver dissection, that the entirety of the radial tunnel could be both exposed and subsequently released via one BR-split approach without the use of additional anatomic windows.

Methods

Ten fresh frozen cadaver arms (6 female, 4 male) from 10 separate cadavers were dissected utilizing a curvilinear incision measuring approximately 7 cm over the BR muscle

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Figure 1. Transbrachioradialis approach utilizing blunt retraction of brachioradialis muscle and direct visualization of the arcade of Frohse.

Figure 2. Blunt elevation of proximal supinator edge.

belly as originally described by Lister et al.¹ All specimens were inspected prior to dissection to ensure there was no preexisting trauma or obvious anatomic deformity. The

Figure 3. Posterior interosseous nerve after release of the arcade of Frohse.

proximal extent of the incision was located just proximal to the radial head and 3 cm lateral to the bicipital tendon.¹ Dissection was performed sharply through skin, then bluntly after reaching BR muscle fascia. BR muscle belly was then bluntly split using retractors (Figure 1). This blunt dissection was carried down until the PIN was visible within the radial tunnel. In all specimens, this approach identified the PIN at the proximal edge of supinator muscle (Figures 2 and 3). Retractors were moved proximally to identify the anterior portion of the RCJ, the radial recurrent vessels, fibrous edge of ECRB, and then distally to expose the distal extent of the supinator muscle belly (PIN) (Figure 4). Identification and mobilization of the PIN was assessed in all specimens and confirmed by a fellowship-trained upper extremity surgeon. Careful sharp dissection of the supinator muscle belly was performed in all forearms in attempt to visualize the PIN as it entered the dorsal forearm (Figure 5). After the supinator was transected, a photograph was taken of the muscle belly reflected away from the nerve as it exited the radial tunnel (Figure 5).

Results

The PIN was identified at 5 sites of compression in all specimens without difficulty from a single approach. All 5 sites of compression were visible and accessible through the BR-split approach. In all specimens, the first site of compression identified was the arcade of Frohse and the adjacent and slightly proximal radial leash of Henry. The PIN was followed proximally and distally and mobilized at any sites

Figure 4. Deep dissection showing sectioned supinator (asterisk) with underlying posterior interosseous (solid line), radial recurrent vessels proximally (arrow), and medial portion of extensor carpi radialis brevis (arrowhead). Note the proximal (asterisk) and distal edges of supinator (plus sign) are clearly visible.

of compression. With no more dissection aside from initial incision, proximal and distal borders of the radial tunnel were visualized by adjusting blunt retractors. Specifically, there was no difficulty in identifying and releasing the PIN at the distal edge of supinator. Figure 5 shows the distal extent of the supinator muscle being elevated off the radial shaft with the PIN traversing the muscle belly. The average length of incision for all dissections was 70 ± 6 mm. In addition to the radial tunnel exposure, the sensory branch of the radial nerve was identified in 8 specimens.

Discussion

Radial tunnel syndrome is a condition that is frequently seen in laboring populations. Quick recovery from surgery and the potential for pain relief are often of paramount concern

Figure 5. Deep dissection showing supinator reflected off the radial shaft and exit point of posterior interosseous nerve (asterisk).

for these patients. At our institution, we have utilized the trans-BR approach for radial tunnel releases. According to the Lister et al description, this approach afforded access to the 4 compressive sites of the PIN.¹ Subsequent studies showed that there was an additional distal compression site from the distal supinator muscle belly at the exit point for PIN to the dorsal forearm. Together these 5 anatomic sites have been studied extensively, and there are several approaches that have been described for radial tunnel release.^{3,5} A recent cadaveric study by Urch et al (2015) concluded that it was not possible to visualize the entirety of the radial tunnel through one approach. However, it is important to note that the BR-split approach was excluded from their study due to its similarity to the anterior approach. Approaches included in that study were anterior, anterolateral, and posterior.^{2,6} Despite similarities between the anterior and BR-split approach, they were unable to identify the distal extent of the supinator which was easily identifiable in our study.

Given our results of excellent visualization of the PIN traversing the supinator, utilizing an approach that is slightly lateral to the volar Henry approach, allows access to the distal lateral extent of the supinator as it traverses the radial shaft. This allows for adequate release of the PIN at this compression site. This approach also does not compromise access to proximal compression sites as shown in the above figures. Variable PIN anatomy has been described regarding muscular

branches that perforate the supinator muscle belly within the radial tunnel.⁴ We did not encounter these variants likely due to a small sample size. However, we presume our approach would not endanger these branches given the wide visibility of this exposure. One additional limitation of our study is that it was performed in cadavers with smaller forearm musculature. It is possible that in a well-muscled individual, a longer incision with wider exposure may be necessary.

In conclusion, based on our anatomic study, a single BR-split approach is adequate for complete visualization and release of all compression sites of the radial tunnel. Utilizing this technique allows for surgical access and ease as well as minimizing necessity for additional windows or multiple incisions. This single incision approach decreases potential patient recovery complications as well as operative time while addressing all anatomic constraints of the PIN.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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