

Anatomical Study of the Surgical Approaches to the Radial Tunnel

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Purpose To provide a cadaveric analysis of 3 surgical approaches (anterior, anterolateral, posterior) used for decompression of the posterior interosseous nerve within the radial tunnel. The aim of the study was to determine whether the number of compression sites visualized and safely released differed between approaches. We hypothesized that no single approach is adequate for visualization of all key compression sites.

Methods Thirty fresh-frozen cadaveric specimens were used to perform 10 anterior, 10 anterolateral, and 10 posterior approaches to the radial tunnel. For each approach, key anatomical structures and the 5 documented anatomical sites of nerve compression that were clearly visualized within the surgical exposure were recorded. The portion of the supinator that was directly visualized in each approach was released. A second window was then created to expose the remaining uncut portion of the supinator. Measurements were taken from each specimen.

Results Statistical analysis demonstrated that the anterior and anterolateral approaches were best for visualizing the fibrous bands of the radial head, the leash of Henry, the origin of the extensor carpi radialis brevis, and the arcade of Frohse. The posterior approach was best for visualizing the distal border of the supinator. The relative uncut supinator distance varied with approach. The anterior approach left a larger relative uncut portion than the posterior approach.

Conclusions No single approach was adequate for complete visualization and release of all compression points of the radial tunnel. In cases of radial tunnel release, complete visualization of the posterior interosseous nerve compression sites is best achieved through multiple windows. (*J Hand Surg Am.* 2015;40(7):1416–1420. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Therapeutic IV.

Key words Anatomy, radial tunnel, nerve compression, radial nerve, posterior interosseous nerve.

RADIAL TUNNEL SYNDROME (RTS) is classically defined as compression of the posterior interosseous nerve (PIN) within the radial tunnel.^{1–3} The radial tunnel is a 5-cm-long potential space along

the anterior aspect of the proximal radius, originating at the radiocapitellar joint (RCJ) and running distally between the deep and the superficial heads of the supinator.⁴ Through numerous anatomical and clinical studies, various compression sites have been identified, including the fibrous bands proximal to the radial head, the leash of Henry, the extensor carpi radialis brevis (ECRB), the arcade of Frohse, and the supinator superficial head, ending with the distal edge of the supinator.^{4–8} The arcade of Frohse may be the primary site of PIN compression in RTS; however, the remaining 4 sites also may play key roles in the syndrome.^{4,9} The 3 pathognomonic signs of RTS are pain over the radial tunnel, pain during resisted extension of the middle finger, and pain during resisted supination.^{4,5} The first

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Received for publication November 5, 2014; accepted in revised form March 3, 2015.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/15/4007-0020\$36.00/0
<http://dx.doi.org/10.1016/j.jhssa.2015.03.009>

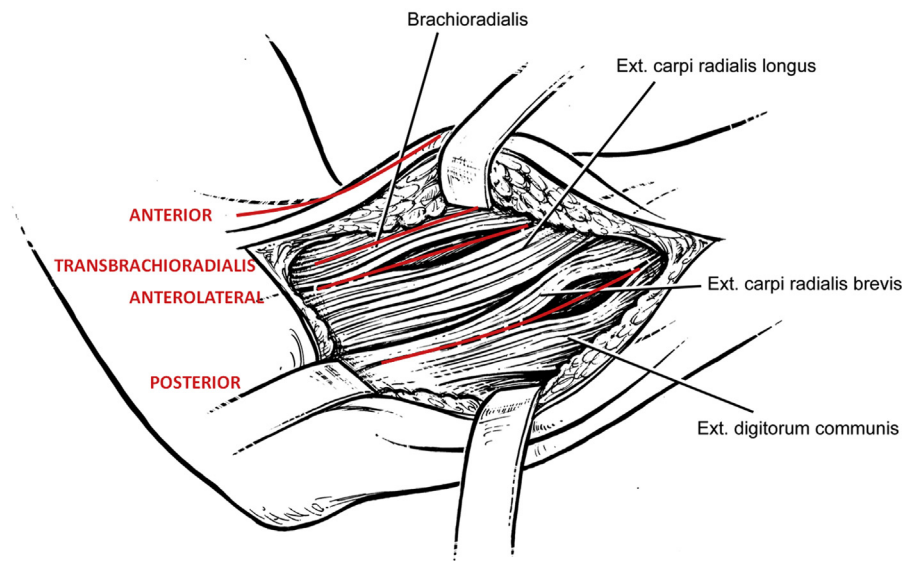


FIGURE 1: Four classic approaches to the radial tunnel.

line of treatment of RTS is nonsurgical and includes rest, activity modification, anti-inflammatories, and corticosteroid injections.^{4,8} In certain patients who are refractory to nonsurgical management, surgical exploration and release of the nerve may be indicated.

Unfortunately, prior clinical series documenting the efficacy of surgical release have shown only moderate success in patient outcomes, with some studies reporting good or excellent results from 50% to 95% of patients.^{5,8,10–13} This is partly due to the inherent difficulty in identifying an isolated RTS.^{1,3,13} In cases in which the appropriate diagnosis is made, inadequate visualization and release of the nerve within the tunnel may play a role in unsatisfactory outcomes. Four different approaches to the radial tunnel have been described. These include the anterior, the anterolateral, the transbrachioradialis, and the posterior approaches.^{1,8} The purpose of our study was to perform 3 approaches (anterior, anterolateral, and posterior) used for surgical release of the PIN and evaluate the effectiveness of each in exposure and decompression of the PIN within the radial tunnel.

METHODS

Cadaveric dissection

A total of 30 fresh-frozen cadaveric arms (4 female, 26 male; average age, 64 y) with no previous trauma, surgery, or obvious abnormality was used for dissection. One of 3 approaches (anterior, anterolateral, and posterior) was randomly performed on the 30 specimens for a total of 10 times per approach. The approaches were as described by Mackinnon and

Novak¹ (Fig. 1). The transbrachioradialis approach was omitted from the study owing to its similarity to the anterior approach. The radial tunnel begins at the RCJ and terminates at the distal aspect of the supinator. The floor of the tunnel is the anterior surface of the radiocapitellar joint proximally and the deep head of the supinator distally. The roof is marked by a fibrofatty layer between the brachialis and the brachioradialis proximally, then the medial edge of the ECRB, and finally the superficial head of the supinator.^{1,9} This definition spans all documented areas of possible nerve compression, including the fibrous bands proximal to the radial head, the leash of Henry, the insertion of the ECRB, the arcade of Frohse, and the superficial head of the supinator including the distal edge of the supinator.

The anterior approach created a window between the brachioradialis and the brachialis and biceps tendons with the forearm supinated. The dissection was carried down to visualize the RCJ, the motor branch to the ECRB, and the superficial radial nerve. The RCJ was marked with an 18-gauge needle that was inserted into the joint. The distance from the needle to the arcade of Frohse (the entry point of the PIN into the supinator) was measured using a 15-cm stainless steel ruler. All measurements were made jointly by 2 investigators (E.Y.U. and Z.M.). This measurement, denoted as the distance between the RCJ and the arcade of Frohse, would later be used to derive the total length of the radial tunnel as it runs from the radial head to the distal edge of the supinator. Direct visualization of key anatomical landmarks and possible compression sites was noted.

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