



# Superficial Radial Neuropathy due to Anatomic Variation: A Case Report

해부학적 변이로 인한 표재성 요골 신경병증: 증례 보고

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Superficial radial neuropathy is a purely sensory neuropathy, usually caused by nerve entrapment in the distal forearm. We report a case of superficial radial neuropathy caused by the anomalous course of the superficial radial nerve, which was found to be spirally encircling the brachioradialis tendon in the distal forearm. To the best of our knowledge, this is the first report of an anatomical variant of the superficial radial nerve that causes neuropathy.

**Index terms** Ultrasound; Superficial Radial Nerve; Anatomic Variants

## INTRODUCTION

The superficial radial nerve (SRN) is the terminal sensory branch of the radial nerve that runs along the radial side of the forearm, passes under the brachioradialis tendon, and penetrates the deep fascia. It is located near the lateral aspect of the radial artery in the mid-third of the forearm.

The SRN innervates two-thirds of the skin in the dorsal region of the hand, including the proximal portions of the thumb and the adjacent 1.5 or 2.5 fingers (1). The nerve emerges 8–9 cm above the radial styloid and bifurcates 4–5 cm above it. The medial branch provides sensory innervation to the ulnar half of the dorsum of the thumb, index, middle fingers, and radial half of the ring fingers. The lateral branch provides sensory innervation to the dorsal thumb.

The SRN can be compressed at various anatomical sites along its path in the forearm, causing superficial radial neuropathy known as Wartenberg syndrome. Patients with Wartenberg syndrome complain of pain and paresthesia along the dorsum of the distal forearm, thumb, and index finger, which can mimic de Quervain's tenosynovitis (2).

To the best of our knowledge, few studies have reported compression of the SRN by anatomical variants (3). Here, we report a case of superficial radial neuropathy caused

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by a variant pathway of the SRN, which was found to be spirally encircling the brachioradialis tendon in the distal forearm.

## CASE REPORT

A 52-year-old female presented with tingling and pain in the dorsum of the right first finger and the radial aspect of the distal forearm. She denied any history of trauma or hands-intensive exercise. She first noticed the symptoms one month prior, shortly after waking up in the morning. On physical examination, palpation of the radial aspect of the patient's right forearm worsened radicular pain in the first finger. However, no muscle weakness was noted during the physical examination.

Radiological examinations were performed to evaluate the cause of the patient's symptoms. Initial right-hand series radiographs showed no obvious abnormalities. A wrist ultrasound was performed by a musculoskeletal radiologist.

A transverse ultrasound scan of the distal third of the forearm, where the patient complained of pain (Fig. 1A), showed that the SRN lay beneath the brachioradialis and on the radial side of the radial artery. As the transducer was moved towards the wrist, the SRN shifted ulnarly, emerging between the brachioradialis and extensor carpi radialis and lying in the subcutaneous layer. The SRN then turned radially over the brachioradialis tendon and traveled downward while resting on the radial side of the brachioradialis tendon (Supplementary Video in the online-only Data Supplement). In summary, the SRN traveled distally in a spiral pattern around the brachioradialis tendon (Fig. 1B). When this region was touched with the transducer, the patient complained of a tingling sensation in the thumb and radial aspect of the distal forearm. To accurately assess the nerve thickness or echogenicity, the asymptomatic contralateral side of the distal forearm was examined using ultrasonography (Fig. 1C). Scanning revealed that the SRN encircled the brachioradialis tendon of the left distal forearm spirally. When bilateral nerves were compared, the right SRN at the encirclement point was thicker and more hypoechoic than that of the left SRN.

The patient underwent electromyography and nerve conduction studies. Based on these findings, right superficial radial neuropathy was suspected. The tingling and pain in the dorsum of the right first finger could be explained by compressive superficial radial neuropathy due to a variant pathway. The patient was treated with oral nonsteroidal anti-inflammatory drugs, and the pain improved after taking the medication for 2 weeks.

This study was approved by the Institutional Review Board of our institution, which waived the requirement for informed consent (IRB No. 2022-10-027).

## DISCUSSION

The patient presented with pain and tingling in the dorsum of the right first finger and the radial aspect of the distal forearm. Ultrasonography of the right forearm revealed that the SRN, spirally wrapped around the brachioradialis tendon, was thickened and hypoechogenic. Thus, the anatomical variant-associated superficial radial neuropathy was responsible for these symptoms.

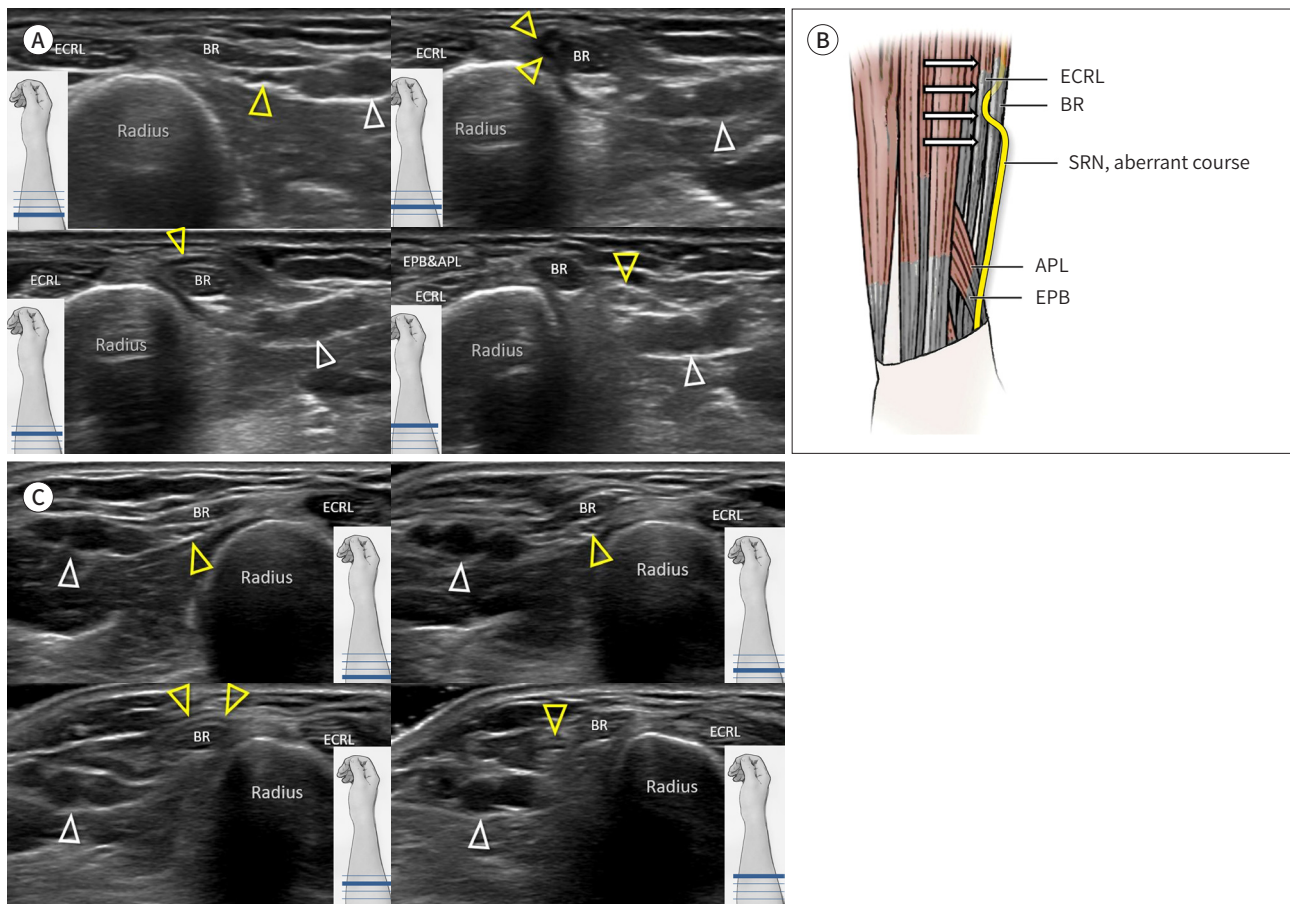
**Fig. 1.** Compressive superficial radial neuropathy due to an aberrant nerve pathway in a 52-year-old female.

**A.** Serial transverse ultrasound scans at the distal one-third of the symptomatic right forearm show the unusual pathway of the SRN (yellow open arrowheads). In the most proximal ultrasound image (left-upper), the SRN is placed below the BR tendon. The radial artery (white open arrowheads) is noted radial to the SRN. On scanning more distally (right-upper), the SRN travels toward the ulnar side, emerging between the BR and ECRL tendon and lying in the subcutaneous layer. Subsequently, the SRN turns radially (left-lower) and goes distally at the radial side of the BR (right-lower) along with the axis of the BR tendon. When the SRN is partially encircled in the BR tendon, it is swollen and hypoechoic, and the patient complained of tenderness at the site of thickening.

**B.** The schematic image shows the aberrant course of the SRN spiraling around the BR tendon in the distal forearm. From the top, the first, second, third, and fourth arrows correspond to the left-upper, right-upper, left-lower, and right-lower images, respectively, in (A) and (C).

**C.** Serial transverse ultrasound scans at the distal one-third of the asymptomatic left forearm also show an unusual pathway of the SRN (yellow open arrowheads), which partially encircles the BR. However, the left SRN has normal echogenicity and thickness in the gray-scale ultrasound image. The radial artery (white open arrowheads) is noted radial to the SRN.

APL = abductor pollicis longus, BR = brachioradialis, ECRL = extensor carpi radialis longus, EPB = extensor pollicis brevis, SRN = superficial radial nerve



Patients with superficial radial neuropathy typically complain of pain, paresthesia, and sensory disturbances along the dorsal distal forearm extending into the dorsal first web space and thumb. Upon examination, paresthesia is often observed on the dorsum of the hand. Common causes of this syndrome are compression, traction, trauma, and repetitive occupational pronation-extension reflexes. The initial treatment is often nonsurgical; however, surgical decompression of the superficial branches of the radial nerve can yield good results (4).

The differential diagnoses for superficial radial neuropathy included de Quervain's disease and intersection syndrome. Ultrasonography helps differentiate superficial radial neuropathy

thy from de Quervain's disease and intersection syndrome. De Quervain's disease is characterized by tenosynovitis and tendinitis of the first extensor compartment just above the radial styloid (abductor pollicis longus and extensor pollicis brevis). The larger abductor pollicis longus and smaller extensor pollicis brevis tendons were affected because they passed through a fibro-osseous tunnel on the radial side of the anatomical snuff box. This condition may have been caused by repetitive microtrauma, leading to increased friction and inflammation. Imaging features include edema and fluid in the first extensor compartment, often with loss of tendon definition and hypertrophy. Ultrasonography is useful for detecting changes, such as edema and thickening of the synovial membrane. Intersection syndrome is an inflammatory condition that occurs at the crossing point of the first and second extensor compartments (i.e., the extensor carpi radialis longus and brevis tendons). This condition can be attributed to direct trauma to the second extensor compartment. Ultrasonography revealed peritendinous edema surrounding the second and first extensor compartments in concentric circles, beginning at the intersection point 4–8 cm proximal to Lister's tubercle and extending proximally (5).

High-resolution ultrasonography can detect unusual morphological changes in superficial radial neuropathy and distinguish it from other differential diagnoses. Ultrasonography in patients with superficial radial neuropathy may show nerve compression or soft tissue changes manifesting as abnormal heterogeneous hypoechogenicity of the SRN (4).

Several cadaveric studies have investigated the anatomy and anatomical variants of the SRN. Ikiz and Uçerler (6) reported that in 48 specimens, the SRN emerged subcutaneously at a mean distance of 9.2 cm and branched at a mean distance of 4.9 cm proximal to the styloid process of the radius. They also reported three representative patterns of SRN branching distributions. Beldner et al. (7) described the anatomical features that differentiate the SRN from the lateral antebrachial cutaneous nerve after dividing the region into proximal and distal zones at the intersection of the extensor carpi radialis longus, brevis, and abductor pollicis longus. The SRN appeared subcutaneously and ran distally in 37 cadaveric forearms, with an average distance of 9 cm above the radial styloid. In a study of 19 arms by Park et al. (8), the SRN was found to penetrate the fascia to emerge on the surface 8.4 cm proximal to the radial styloid, followed by division into medial and lateral branches 4.85 cm proximal to the radial styloid in all arms. Consistent with the findings of these previous studies, the SRN in our case emerged subcutaneously around the distal one-third of the forearm, approximately 8–9 cm proximal to the wrist joint. However, the bifurcation of the SRN has not yet been completely examined.

Reports on the anatomical variations of the SRN are few. Lindau and Wax (9) reported a cadaveric anatomical variant in which the superficial branch of the radial nerve did not run under the brachioradialis tendon in the proximal arm and superficially innervated the muscle. Murphy and Blair (3) reported on a 28-year-old female exhibiting signs and symptoms consistent with SRN compression due to an anatomical variant of the SRN, which had a proximal intramuscular course and appeared between the two lobes of the brachioradialis tendon located 6 cm above the radial styloid. However, the variant course of SRN observed in the present study has not been previously reported.

One limitation of this case is that the anatomical variance was not confirmed operatively

because the patient's symptoms improved with conservative treatment alone. However, we believe that ultrasonography is an excellent method for determining the cause of these symptoms.

In summary, we describe a rare case of compressive superficial radial neuropathy due to an aberrant pathway, with the SRN encircling the brachioradialis muscle, which has not been previously reported.

### Supplementary Materials

The online-only Data Supplement is available with this article at <http://doi.org/10.3348/jksr.2023.0037>.

### Supplementary Video Legend

Video 1. Proximal to distal ultrasound scans of the symptomatic right forearm.

### Author Contributions

Conceptualization, C.H.J.; data curation, C.H.J.; formal analysis, C.H.J.; methodology, C.H.J.; resources, C.H.J.; visualization, C.H.J.; writing—original draft, C.C.; and writing—review & editing, C.H.J.

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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## 해부학적 변이로 인한 표재성 요골 신경병증: 증례 보고

최창원 · 추혜정\*

표재성 요골 신경 병증은 일반적으로 원위 팔뚝의 신경 포획으로 인해 발생하는 순수 감각 신경 병증이다. 저자들은 원위부 팔뚝의 상완요골근 힘줄을 나선형으로 둘러싸고 있는 표재성 요골 신경의 비정상적인 주행으로 인한 표재성 요골 신경 병증 증례를 보고하고자 한다. 저자들이 검토한바로는 이것은 신경 병증을 유발하는 표재성 요골 신경의 최초의 초음파 영상 증례 보고이다.

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