

Transhumeral Anterior Radial Nerve Transposition to Simplify Anticipated Future Humeral Reconstruction

David A. Muzykewicz, MD,* Reid A. Abrams, MD*

Anterior transhumeral radial nerve transposition has been described in the treatment of humeral shaft fracture to protect the nerve from implant irritation or callus entrapment. Transposing the radial nerve through a facilitating humeral defect also simplifies revision surgery should nonunion result. Here we describe a surgical technique for anterior transhumeral radial nerve transposition for complex humeral reconstruction when subsequent revision surgery is anticipated. Three cases are used for illustration: (1) revision of a total elbow arthroplasty with periprosthetic fracture; (2) revision of a total elbow arthroplasty after aseptic loosening from an allograft/prosthesis composite; and (3) septic humeral nonunion with substantial bone loss. These 3 patients underwent a total of 16 operations, 6 of which took place after the radial nerve transposition. Transhumeral radial nerve transposition allowed less worrisome dissection during revision surgery despite the multiple previous procedures. We advocate transhumeral radial nerve transposition when the duration and frequency of revisions is uncertain and the anticipated future revision may require a posterior, posterolateral, or anterolateral approach to the humerus. (*J Hand Surg Am.* 2017;42(7):578.e1-e5. Copyright © 2017 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Radial nerve, nerve transposition, humeral reconstruction, total elbow arthroplasty, surgical technique.



THE RADIAL NERVE CAN BE encountered during either the posterior, the posterolateral, or the anterolateral approach to the humeral mid and distal shaft. The concept of transposing this nerve anteriorly/medially through a humeral shaft fracture site prior to fixation has been previously reported to prevent irritation from underlying implants and to

protect the nerve from subsequent entrapment in scar tissue or callus.^{1–3} Cadaver studies have demonstrated that this affords a tension-free environment for the nerve without undue changes in length or the need to sacrifice major branches.^{4,5} We propose that indications for transhumeral anterior radial nerve transposition be extended to other situations of humeral shaft surgery and reconstruction, in which a high likelihood for future revision exists. Two such cases for total elbow arthroplasty (TEA) and 1 for a complicated revision distal humeral reconstruction are described.

SURGICAL ANATOMY

After passing posteriorly through the triangular space (bordered by the teres major, humerus, and long head of the triceps), the radial nerve usually lies closely

From the *Department of Orthopaedic Surgery, University of California at San Diego, San Diego, CA.

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Corresponding author: Reid A. Abrams, MD, Department of Orthopedic Surgery, UC San Diego Health, 350 Dickinson, MC 8894, San Diego, CA 92103; e-mail: raabrams@ucsd.edu.

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adjacent to the humeral shaft, around which it spirals, between the lateral and the medial heads of the triceps. It courses posteriorly, from 20 cm proximal to the medial condyle, medially, to 14 cm proximal to the lateral condyle, laterally.⁶ The triceps branches emanate from the nerve proximally, between the axilla and the spiral groove of the humerus. The next critical branch distally is to the brachioradialis, although there can be more proximal branches to the brachialis, which can be dually innervated with the more significant contribution from the musculocutaneous nerve. Extensile posterior triceps-splitting, posterior, posterolateral, and anterolateral approaches to the humerus for procedures such as primary or revision TEA, or in addressing fractures or nonunions of the distal humerus or humeral shaft can place this nerve at risk. Revision of the humeral component in TEA, for example, has been associated with a 2.7% rate of radial nerve palsy, with only 43% returning nerve function at 7-year follow-up.⁷ Whereas this 2.7% remains relatively low, a certain group of patients, such as those undergoing revision with active infection or inflammatory arthritis, will predictably require multiple such revision surgeries, thus compounding their individual risk for nerve injury. Because the radial nerve is an anterior structure more distally at the elbow, transposing it anteriorly at the midhumeral level, if anything, may shorten its course,⁴ while protecting it from future posterior approaches to the humerus at the time of revisionary surgery.

INDICATIONS

Transhumeral anterior radial nerve transposition is well established for fracture treatment when local nerve irritation over implants and potential revision surgery for nonunion are anticipated. Our illustrative cases of periprosthetic TEA fractures, aseptic TEA loosening, and chronic septic nonunion with bone loss demonstrate the utility of extending indications for anterior radial nerve transposition to other complex revisions and reconstructions. In our series, each of the 3 patients did require further revision after their transposition procedure: a total of 6 posttransposition surgeries. Unfortunately, given the complexity of care in these cases, the need for such revision was predictable. In such cases, where there is a gap in the humerus (via implant/allograft removal, periprosthetic fracture, or nonunion), we advocate the radial nerve be transposed anteriorly through this window to facilitate less worrisome dissection at the time of future surgery. In the face of distorted

anatomy and an already complex revision surgery, knowing that the radial nerve is out of the way reduces operative time and surgeon anxiety that would be associated with dissecting the nerve out of mature noncompliant scar tissue.

SURGICAL TECHNIQUE

The radial nerve is most easily found in the interval between the brachialis and the brachioradialis at about the junction of the middle and distal thirds of the upper arm. It is then carefully dissected proximally and posteriorly, preserving branches to the brachioradialis and radial wrist extensor muscles. As dissection proceeds proximally, the nerve passes underneath the triceps, which can be mobilized or split longitudinally. Dissection progresses proximally and medial to the humerus. Once the nerve is liberated, it is protected while the humeral defect is initially defined and mobilized depending on the pathology. The nerve is then passed anterior to the humerus through the defect and the ensuing reconstruction proceeds, maintaining the nerve anteriorly.

CONTRAINDICATIONS

We have not encountered any contraindications in our short series.

PEARLS AND PITFALLS

- Anterior radial nerve transposition can be considered when repairing or reconstructing any humeral shaft gap.
- Anticipate the high likelihood of revision surgery in the infectious, inflammatory, or previously multiply-operated patient. Young patients in whom TEA has been performed, especially where large allografts have been incorporated, or complex reconstructions for infection or nonunion with intercalary bone loss, are likely to require revision.
- Be sure to adequately mobilize the nerve proximally and distally prior to transposition, while maintaining the integrity of its major branches.
- List the transhumeral anterior radial nerve transposition in the “Procedures” heading of the operative report, in addition to later in the body, to best communicate the resulting anatomical variation, should care of the patient be transferred to another surgeon.

CASE ILLUSTRATIONS

Case 1 is a 42-year-old woman with rheumatoid arthritis who 8 years after right TEA sustained a periprosthetic olecranon fracture. Of note, she also

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