

Partial Wrist Denervation: The Evidence Behind a Small Fix for Big Problems

Michael T. Milone, MD,* Christopher S. Klifto, MD,† Louis W. Catalano III, MD*

Wrist denervation addresses symptomatic wrist pain without the morbidity and complication profile of more extensive surgical procedures aimed to correct the underlying pathology. The concept of wrist denervation is not new, but its practical application has been modified over the past 50 years. A variety of techniques have been described for various indications, with generally good results. In the United States, a simple, single incision partial denervation consisting of neurectomies of the anterior and posterior interosseous nerves is most commonly performed. Although data on this procedure are limited, most patients are satisfied with pain relief in the short term. There is no evidence that partial denervation procedures alter proprioception of the wrist, and this procedure shows promise as a good option for palliating pain without prolonged postoperative immobilization or leave from work. Preoperative injections do not seem to correlate well with postoperative results. Future studies are needed to assess the duration of relief and possible acceleration of underlying pathology. (*J Hand Surg Am.* 2018;43(3):272–277. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Anterior interosseous nerve, arthritis, denervation, nerve, posterior interosseous nerve.

INTRODUCTION

Wrist denervation describes neurectomies of terminal sensory fibers of peripheral nerves that innervate the wrist capsule and or ligaments.¹ Although popular internationally,^{1–3} complete joint denervation is not commonly undertaken in the United States, where partial isolated denervation of the wrist through neurectomies of the anterior interosseous (AIN) and posterior interosseous nerves (PIN) is more routinely performed.⁴

The advantage of wrist denervation is that it offers pain relief while avoiding stiffness, postoperative immobilization, and other complications associated

with arthrodesis procedures.^{4,5} An unsuccessful neurectomy also does not preclude subsequent alternative treatment. For this reason, partial and total neurectomies have been described for the treatment of a variety of wrist pathologies including post-traumatic, degenerative, and inflammatory.

HISTORY OF TOTAL WRIST DENERVATION

The concept of wrist denervation is not new. In 1862, John Hilton⁶ put forth Hilton's law, which states that nerves crossing a joint innervate that joint. However, it was not until the 1940s and 1950s that surgeons first reported surgical denervation of the hip, knee, shoulder, and ankle joints.⁵ In January, 1959, Albrecht Wilhelm⁵ initially described the technique of a total wrist joint denervation performed in a 30-year-old German patient with arthritis associated with a scaphoid nonunion. Wilhelm's complete wrist denervation involves 5 skin incisions, 2 of which require epifascial mobilizations, to gain access to 10 terminal nerve branches (Table 1). Many international surgeons reported on modifications of Wilhelm's procedure,^{7,8} and although a definitive

From the *Department of Orthopedics, NYU Langone Orthopedic Hospital, New York, NY; and the †Department of Orthopaedic Surgery, Duke University Medical Center, Durham, NC.

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Corresponding author: Michael T. Milone, MD, NYU Langone Orthopedic Hospital, 14th Floor, 301 East 17th Street, New York, NY 10003; e-mail: michael.t.milone@gmail.com.

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TABLE 1. Wrist Innervation

Branch	Nerve	Terminal Innervation
Median	Anterior interosseous	Volar radiocarpal joint, volar radiocarpal ligaments, carpal tunnel floor, distal radioulnar joint
	Palmar cutaneous branch	Transverse carpal ligament adjacent to scaphoid tubercle
Radial	Posterior interosseous	Dorsal radiocarpal joint, intercarpal joints, second to fourth CMC joints
	Superficial branch	Radiocarpal joint (10%)
	Articular branch of first interosseous space	First to second CMC joints (95%)
	Posterior antebrachial cutaneous	Radiocarpal joint (5%)
Ulnar	First articular branch	Pisotriquetral joint (55%)
	Deep branch perforators	Volar second to fifth CMC joints, distal intercarpal, and midcarpal joints
	Dorsal sensory branch	Ulnar carpus, ulnocarpal complex (70%), fourth to fifth CMC joints
Other	Lateral antebrachial cutaneous	Radial radiocarpal joint, radial intercarpal joints, first CMC joint
	Medial antebrachial cutaneous	Ulnocarpal complex (10%)

CMC, carpometacarpal.

Derived from anatomic findings of Fukumoto¹⁰ in 20 specimens. Percentages report occurrence if less than 100%. All nerves except first articular branch of the ulnar are neurotized by Wilhelm's⁵ total denervation technique.

technique has not been established, results have been mostly favorable.²

RATIONALE FOR PARTIAL DENERVATION

Despite its international record, total wrist denervation is technically demanding, requires multiple incisions, and may result in the loss of protective proprioception.⁴ It is not routinely performed in the United States, where surgeons have advocated for partial denervation procedures focusing on the PIN and AIN.^{4,8} Although inherently incomplete, such a partial denervation is supported by anatomical studies highlighting the relative contributions of these nerves.^{1,9}

The PIN is the main innervator dorsally, because it has been consistently shown to send fibers into the central two-thirds of the wrist.^{1,10,11} Although anterior wrist innervation is less dominated by the AIN,^{11,12} Van de Pol¹ reported that the AIN is the most important contributor to volar wrist innervation because it innervates volar periosteum at its capsule and ligament insertions.

In addition to being a technically relatively simple surgery supported by anatomic findings, an isolated AIN and PIN neurectomy affords the attractive option of a single-needle diagnostic nerve block, which is easy to perform in the office. Moreover, the patient may favor a procedure with quick recovery and immediate unrestricted activity to minimize work leave.^{7,8,13,14}

PARTIAL DENERVATION TECHNIQUE

Berger⁴ first formally defined the technique for a single-incision combined AIN and PIN neurectomy in 1998. He described a 3- to 4-cm longitudinal dorsal incision overlying the plane between the radius and ulna one finger-breadth proximal to the ulnar head. The PIN is identified overlying the interosseous membrane after dissection between the extensor digitorum communis and extensor indicis proprius. The AIN is identified after longitudinally incising the interosseous membrane. Both the PIN and AIN are neurectomized by sharply resecting 2 cm of nerve. Other surgeons have advocated for slightly more complex 2-incision approaches to access additional nerves.^{1,8,15}

RESULTS OF PARTIAL DENERVATION

Unlike complete or extensive denervations, almost all published results of partial AIN and or PIN neurectomies were performed in the United States (Table 2).^{1-3,12,16-18} In 1984 and 1985, Dellon et al¹⁶ and Dellon,¹⁷ respectively, reported good short-term results of isolated AIN or PIN neurectomy. However, those studies were limited by short follow-up and heterogeneous indications. In 1995, Ferreres² retrospectively reviewed 30 patients who underwent an isolated PIN neurectomy. Although the study found that pain improved initially and that radiographs did not deteriorate, two-thirds of patients had pain recur with activity

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