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Original article

Total wrist denervation: Retrospective study of 39 wrists with 56 months' follow-up

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ABSTRACT

Introduction: The objective of this study was to analyze patient satisfaction after total wrist denervation.
Hypothesis: Total wrist denervation provides reliable and durable results.
Material and method: A single-center multi-surgeon retrospective study included a cohort of 39 wrists. Mean age was 58 years. The dominant side was operated on in two-thirds of cases. SLAC wrist and SNAC wrist accounted for 41% of etiologies. All patients were seen again in consultation and were evaluated for pain, strength, mobility and limb function. Failure was defined as any reoperation.
Results: Mean follow-up was 56 months, with no loss to follow-up. Pain improved in 79.5% of cases. Median DASH score was 27.27. Strength on Jamar® dynamometer improved from 60% to 75% compared to the contralateral side ($p = 0.012$). Range of motion improved by 5° ($p = 0.052$). At last follow-up, 31% of patients showed aggravation of radiological osteoarthritis. There were 4 revision procedures (total wrist fusion), and 4 complications.
Discussion: The present results were comparable to those in the literature in terms of satisfaction, functional scores and number of complications and revision procedures. Total wrist denervation is a reliable and reproducible surgical technique in terms of pain relief preservation of function in painful osteoarthritic wrists. It thus has an essential place in the therapeutic algorithm of patients presenting with chronic pain in a wrist that is still mobile, whatever the initial etiology.
Level of evidence: IV, Retrospective cohort.

1. Introduction

Wrist denervation is one of the surgical techniques used in the palliative management of chronic painful wrists [1,2]. Wilhelm [3] first described this technique. Denervation can be partial or total, isolated or associated to other procedures. Since Wilhelm, several authors have been interested in this technique [4–12], with results ranging from 62.5% to 89% improvement for isolated total wrist denervation (TWD). The present study analyzed medium-term results for a dual-approach TWD technique. The hypothesis was that isolated TWD provides reliable and durable results. The primary endpoint was pain assessment. Secondary endpoints comprised strength and range of motion (RoM), activity, overall satisfaction, and number of revision surgeries.

2. Material and method

2.1. Population

A single-center multi-surgeon retrospective cohort study included all TWDs carried out in our department from January 1, 2000 to January 1, 2017. Inclusion criteria comprised chronic painful wrist managed by isolated TWD, with a minimum 12 months' follow-up. Preoperative data were retrieved from the hospital's medical information department database.

There were 38 patients for 39 wrists. Mean age was 58 years (range, 20 to 81 years). The male/female sex ratio was 2:1 (12 women, 26 men). The dominant side was involved in 66.67% of cases. A total of 55.26% of patients were manual workers. Preoperative etiologies comprised 41% scaphoid non-union advanced collapse (SNAC) or scapholunate advanced collapse (SLAC), 9 inflammatory diseases, 6 distal radius fractures, 5 osteonecroses (4 Kienbock, 1 Preiser), 2 Madelung diseases and 1 history of infection (Table 1).

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Table 1
Preoperative demographics.

		Gender		Side		Dominant side involvement	Manual worker
Series	Age(year)	Women	Men	Left	Right		
$n = 39$	58	12	26	17	22	26	21

Etiologies

SNAC	SLAC	Kienböck	Trauma	Rheum	Chc	Infection	Preiser	Still	Pso art	Madelung
5	11	4	6	3	4	1	1	1	1	2

SNAC: scaphoid non-union advanced collapse; SLAC: scapholunate advanced collapse; Trauma: peri-lunar carpal dislocation, radius joint fracture; Rheum: rheumatoid arthritis; Chc: chondrocalcinosis; Pso art: psoriatic arthritis.

2.2. Operative technique

The princeps technique was that of Wilhelm [13], as revised by Dubert et al. [14], then by Berger [15]. Only two incisions were made.

The first step was palmar, using a 5–6 cm Henry approach. The comitant veins of the radial artery (branches of the lateral cutaneous nerve of the forearm) were dissected and electro-resected, followed by electrocoagulation of the supra-aponeurotic vertical tracti of the lateral edge and of the distal part of the pronator quadratus which was roughened over 1 cm opposite the radiocarpal joint. Finally, the anterior interosseous nerve was resected, and the palmar cutaneous branch of the median nerve was dissected and its deep attachments were released.

The second step was dorsal, via a straight 6 cm incision centered on the Lister tubercle. The fourth compartment of the extensors was opened at its proximal part to electro-resect the posterior interosseous nerve over 3 cm. Then the radial edge was dissected and raised, with the radial nerve branches. Electro-resection was performed close to the extensor apparatus and retinaculum of all fibrous tracti, followed by dissection of the ulnar edge to electrocoagulate the articular branches from the dorsal cutaneous branch of the ulnar nerve. The top of the second and third interosseous spaces (muscular terminal branches of the ulnar nerve) was scarified. Through the same incision, at the top of the first commissure, electrocoagulation of the vein and dorsal articular nerve of the first interosseous space was performed.

2.3. Methods

All patients were seen again in routine consultation between September 2017 and February 2018, with assessment of Quick-DASH score [16], mean pain during the previous week on visual analog scale (VAS), strength on Jamar® dynamometer [17], and joint RoM on goniometry. Progression of osteoarthritis was assessed by comparing the preoperative radiological images with those of the last consultation or reoperation [18].

The statistical analysis used Mann-Whitney and Student tests on BiostaTGV©, with a significance threshold of $p \leq 0.05$.

3. Results

3.1. Global results

Mean follow-up was 56 ± 32 months, with no loss to follow-up.

Mean time to return to work after TWD was 88 days; 21 patients returned to the same job, 4 had adaptation of working hours or work-post, 3 changed jobs, 3 did not return to work, and 7 were retired.

Eighty-seven percent of patients would recommend the procedure.

Table 2
Results on pain, grip strength and range of motion.

Pain

VAS	Wrist	
VAS = 0	13	33%
1 < VAS ≤ 3	19	49%
4 < VAS ≤ 6	5	13%
VAS > 6	2	5%

Strength of Jamar®

Preoperative	Postoperative	
60.54%	75.88%	$p = 0.012$

Range of motion

	Preoperative	Postoperative	
FE	74°	83°	$p = 0.254$
PS	163°	168°	$p = 0.052$

FE: flexion-extension; PS: pronation-supination.

3.2. Clinical results

Pain improved in 79.50% of patients, at rest and during exercise. At last follow-up, 13 wrists were pain-free (VAS = 0), 19 slightly painful (0 < VAS ≤ 3), 5 moderately painful (3 < VAS ≤ 6) and 2 were still rated VAS > 6. Mean time to stabilized VAS was 2 months 3 weeks. Thirty patients (79%) considered their results stable at 56 months. In all, 30.77% of symptomatic patients had pain in the dorsal side of the base of the thumb.

At last follow-up, mean DASH score was 27.27/100 (range, 0–93.18).

Grip strength on Jamar® increased from a mean 60.54% to 75.88% compared to the healthy side ($p = 0.012$).

Flexion/extension range increased in 59% of cases and decreased in 13%, with overall average increase from 74° to 83° ($p = 0.254$). Pronation-supination range was unchanged in 69% of cases, and improved in 25%, with overall average increase from 163° to 168° ($p = 0.052$) (Table 2).

3.3. X-Ray results

At last follow-up, 12 wrists (31%) showed worsening of osteoarthritis. No correlation was found between clinical and radiological results (Fig. 1).

3.4. Complications and revision surgeries

There were 4 postoperative complications: 1 complex regional pain syndrome (CRPS), 1 radial neuroma and 2 superficial scar infections. At 50 months, the patient with CRPS had still not returned to work and still had chronic pain. The patients with immediate postoperative superficial infection had no further

Fig. 1. Progression of osteoarthritis over 5 years. At last follow-up, this patient's VAS score was 1, and DASH score 27.27. A. SCAC 1. B. SCAC 3 according to Romano's classification (SCAC: scaphoid chondrocalcinosis advanced collapse).

Table 3
Results of 10 isolated total wrist denervations.

Authors	Number of TWDs	Follow-up(months)	Results(% improvement)	Reoperation
Rostlund (1980)	9	24	89%	0%
Foucher (1998)	50	60	74%	–
Rothe (2006)	32	76	62.50%	–
Schweizer (2006)	71	113	67%	12.90%
Braga-Silva (2011)	49	72	79%	–
Hohendorff (2012)	61	120	73%	7 fusions
Simon (2012)	27	77	81%	2 fusions
Delcaux (2017)	33	41	75%	2 fusions
Fuschberger (2017)	124	146	67.70%	–
Our series	39	56	79.50%	4 fusions

complications. The patient who developed radial nerve neuroma was successfully managed by simple neurolysis.

There were 4 revisions by total wrist fusion: 3 for persistence or recurrence of pain, and 1 for fracture of the distal radius complicating an SLAC wrist; 2 of these patients showed chondrocalcinosis, 1 SLAC wrist and 1 Madelung's disease. Mean time to revision was 35 months (range, 12 to 75 months).

Table 4
Comparison of postoperative Quick-DASH scores.

Quick-DASH score	
Schweizer et al. (2006)	26 (0–88)
Rothe et al. (2006)	17.1
Simon et al. (2012)	30.4 (22–60)
Delcaux et al. (2017)	23 (5–70)
Our series	27.27 (0–93.18)

4. Discussion

With 39 wrists undergoing isolated TWD, the present series was large [4–12]. However, it involved some limitations.

Seven preoperative Quick-DASH scores and five Jamar® grip strength ratings were missing. In addition, there was wide scatter in follow-up, ranging from 12 to 112 months.

We did not perform a local anesthetic injection test. However, there are no formal guidelines concerning this test preoperatively [19–22].

Previous series of isolated TWD found improvement in pain in a mean 75% of cases (range, 62.5–89%) (Table 3). The present 79.50% improvement was thus in agreement with previous studies. Pain at rest and during exercise resolved (VAS < 3) in 32 wrists. Time to symptom improvement was 2 months 3 weeks, compared to 16 months for Foucher et al. [21] and 3 months 3 weeks for Simon et al. [10]. Pain relief was lasting for 79% of patients, in agreement with Buck-Gramcko et al. [23] and Lanz and Lehmann [24]. Age did not influence these results, in agreement with Foucher et al. [21]. There was no gender difference, unlike for Fuchsberger et al. [12], who reported significantly greater pain relief after TWD in women than in men ($p = 0.038$).

Mean DASH score was 27.27/100 (range, 0–93.18), comparable to previous reports [6,7,10,21] (Table 4). Unlike Schweizer et al. [7] and Buck-Gramcko et al. [23], who observed better results in SNAC wrist, we did not find a link between Quick-DASH score and osteoarthritis etiology.

At 56 months' follow-up, grip strength on Jamar® was significantly greater on the healthy than on the operated side (29 versus 23) ($p = 0.032$). Contrary to Foucher et al. [21], we observed significant improvement in strength after TWD, from a mean 60.54% to 75.88% compared to the healthy side ($p = 0.012$).

There was no significant difference in progression of RoM, although 59% of wrists showed improvement. These results are to be qualified by the possible measurement error attributed to goniometry. In the literature, Simon et al. [10] found 50% and Lanz and Lehmann [24] 51% improvement in RoM, whereas Rothe et al. [6] reported 8.1% loss of flexion and extension after TWD.

Radiographically, one-third of cases showed increased osteoarthritis area, compared to half of cases for Simon et al. [10], and 1 in 4 for Foucher et al. [5]. As in all previous studies we had no cases of Charcot arthropathy.

With 4 total fusion revision procedures (10%), the present results were comparable to the literature range of 6–13% and confirm that TWD can allow fusion to be postponed [7,9–11].

Anatomical studies by Dubert et al. [14] showed that TWD could be performed with three incisions (dorsal, palmar and opposite the first interosseous space). Then Berger et al. [15] proposed making only one posterior incision. After work by Van de Pol et al. [25] on capsular and periosteal innervation of the wrist, Delcaux et al. [11] proposed performing TWD with two incisions (palmar and dorsal), with 75% satisfactory results at 41 months. The present results confirm that this two-incision technique is effective. However, in 8 patients with VAS > 1 (30.77%), the pain was located in the territory of the articular nerve of the first interosseous space. This type of pain may be related to poorer exposure and to electrocoagulation rather than to resection of the vein and dorsal articular nerve of the first interosseous space.

5. Conclusion

Total wrist denervation is a reliable and reproducible surgical technique for pain relief and preservation of wrist function in painful osteoarthritis. It thus has an essential place in the therapeutic algorithm for chronic pain in a wrist that remains mobile, whatever the initial etiology.

Disclosure of interest

The authors declare that they have no competing interest.

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Contribution

Baptiste Picart is the main author of the article, Clément Laborie helped to the achievement of the article.

Mélanie Malherbe was the study director.

Christophe Hulet is the Head of the department.

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