

# Digital Periarterial Sympathectomy for Severe Ischemia of Raynaud's Syndrome

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## Introduction

Digital ischemia in the upper extremity, with ulceration and gangrene due to primary or secondary Raynaud's phenomenon, may be a difficult problem for the hand surgeon to solve. Ischemic pain, numbness, cold intolerance and disabling symptoms of the hands may be the early manifestations of the Raynaud's phenomenon, but patients are usually referred to hand surgeons in later stages of the disease, when they have developed refractory ulcers and necroses at the fingers.

Many conventional therapies have been used. Behavioral therapy such as cessation of smoking, avoidance of cold exposure, avoidance of caffeinated beverages, use of gloves (preferably mittens) and biofeedback therapy are important initial interventions.<sup>1,2</sup> A variety of vasodilating and antiplatelet agents such as calcium channel blockers, a2 adrenergic antagonists, warfarin, plasminogen activator or iloprost, a prostacyclin analog have shown promising effectiveness in reducing morbidity.<sup>3-6</sup> Medical treatment is ineffective in many severe cases, causing partial or total loss of the finger. In cases refractory to medical treatment, cervical sympathectomy has been used with either poor long-term results, as pre-ganglionic sectioning does not remove all the sympathetic stimulation to the hand, or unpleasant side effects such as postoperative compensatory hyperhidrosis.<sup>7-10</sup> The results for digital artery sympathectomy have been much more successful than those for cervical sympathectomy. Digital sympathectomy, first described by Flatt, involves stripping the adventitial layer from the affected common and proper digital arteries. Digital sympathectomy may be the only alternative to amputation when medical therapy has failed.<sup>11</sup>

The aim of this study is to evaluate the effect of peripheral periarterial sympathectomy on digital ulceration, severity of ischemic pain and cold intolerance of the digits in patients suffering from Raynaud's syndrome.

## Materials and Methods

A retrospective analysis of all digital artery sympathectomy performed in our Hand Surgery Clinic between February 1998 and May 2004 was performed. Five patients representing 16 affected digits underwent peripheral periarterial sympathectomy for severe Raynaud's phenomenon. Three of them were females and 2 were males, and their ages ranged from 28 to 60 years (average age, 42 yrs). Four of the patients were heavy smokers (one and a half pack per day, for an average of 15 years of smoking). All the patients showed chronic ischemia with worsening ischemic pain, especially during their work, cold intolerance and numbness (Table 1). Progressive ulcer formation was present in three patients. There were three ulcers in the middle finger (Figure 1), 3 in the ring, 1 in the small, and 1 in the index finger. Gangrene on the middle and ring fingers was developed in one patient (Figure 2). Preoperative conservative treatment included pharmacological agents, such as calcium channel blockers, angiotensin converting-enzyme inhibitors, serotonin receptors antagonists, and behavioral modifications such as cessation of smoking, avoidance of caffeinated beverages, and avoidance of cold exposure and use of gloves. Diagnosis was based on a history of repeated or vibrational injuries, the number of attacks, blood dyscrasia, drug use, smoking, and the degree of incapacitation. Patients were also evaluated for capillary refill, skin integrity, and the presence or absence of ulcers or necrotic areas, peripheral pulses and an Allen test. Preoperative blockade was used in two patients, with lack of response and progression of ischemic symptoms. Doppler studies were performed in 2 patients and showed good pulsations to the distal tufts of their fingers. Conventional angiography was employed for the evaluation of digital ischemia to all patients (Figure 3). Cold stress testing, as recommended by Wilgis,<sup>12</sup> was not used in this study.

The etiology of the digital ischemia was Raynaud's phenomenon secondary to collagen disease (scleroderma) in 4 patients and Raynaud's disease in one patient (Table 1). One patient had undergone sympathectomy with incomplete response and a recurrent ulceration after initial healing. That patient also underwent a repeat sympathectomy.

Under axillary block anesthesia and after exsanguinations of the affected limb, a zigzag type incision was

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**Table 1.**  
**Patients Data**

Patient	Age/Sex	Diagnosis	Smoker	Preoperative Status	Preoperative Treatment
1	28/female	Raynaud's disease	yes	multiple ulcers	nifedipine
2	39/male	scleroderma	yes	multiple ulcers	nifedipine
3	60/female	scleroderma	no	multiple ulcers	warfarin
4	45/female	scleroderma	yes	gangrene	nifedipine,captoprile
5	38/male	scleroderma	yes	multiple ulcers	nifedipine

made at the base of the affected finger extending into the palm. The incision was extended distally to the crease of the proximal phalanx. Under operating microscope, the common digital artery was first separated from the adjacent digital nerve and then stripped of the adventitia from the superficial arch distally, as the artery advanced into the proximal phalanx (Figures 4A and 4B).

The patients were asked to complete a questionnaire where they scored digital pain pre- and post-surgery, complications of surgery and the overall impact of surgery. Disability of the upper extremity was measured with the Disabilities of the Arm, Shoulder and Hand Questionnaire.<sup>13</sup> The postoperative rehabilitation program included recommendation for immediate mobilization and continuation of drug use. The follow-up time averaged 45 months (range 24–80).

## Results

All the patients, who represented 16 digits, healed sufficiently with sustained reperfusion, limited loss of tissue and healing of the ulcerations (Table 2). The average time for ulcer healing was 5 weeks (range, 3 to 6 weeks). There was no recurrent ulcer during the follow-up period (range, 24 to 80 months). One patient suffered minor wound infection that responded to oral antibiotics. All the patients returned to their daily activities with clear improvement of the symptoms and their function. Mean pain score (0 = no pain, 1 = mild pain, 2 = moderate pain, 3 = severe pain) fell from 3.6 before surgery to 2.9 after surgery. The overall improvement following surgery was scored from 0 to 3 (0 = no improvement, 1 = slight improvement, 2 = moderate improvement, 3 = great improvement). The mean score was 1.90. The mean score of the DASH questionnaire was a 17 out of a possible maximum of 100 points. Preoperative blockade was used in two patients with a lack of response and progression of ischemic symptoms, suggesting that the response to preoperative sympathetic blockade was not predictive of the response to digital sympathectomy. In all cases there was immediate postoperative change as reperfusion was immediately established.



Figure 1. Patient with an ulcer in the middle finger.

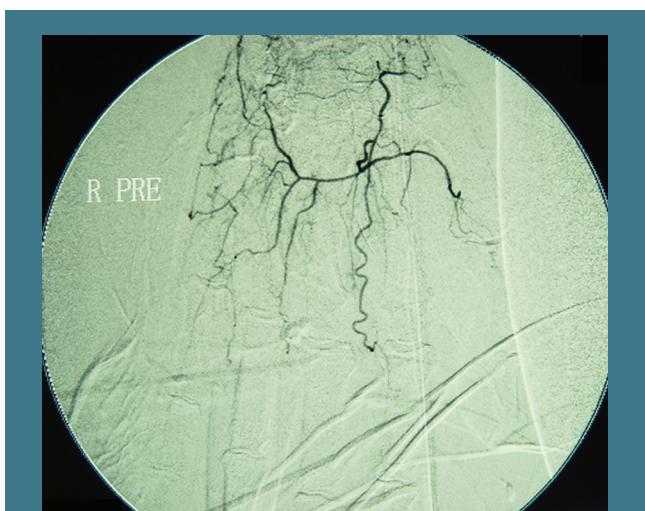


Figure 2. Gangrene on the middle and the ring finger was developed in one patient.

## Discussion

Raynaud's phenomenon is a vasospastic disorder of the hand that is characterized by ischemic pain, cold intolerance, numbness, disabling symptoms of the hands (especially dysfunction of fine movements), and phasic tricolor change of the skin (pallor, cyanosis, and erythema). Syndrome attacks are caused by exposure of

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**Figure 3.** Angiography for the evaluation of digital ischemia.

the hands or the whole body to cold temperature and emotional stresses. Patients suffering from a severe form of Raynaud's phenomenon may develop critical digital ischemia, with ulceration and gangrene at the fingertips. Although medical treatment with calcium channel blockers and other vasodilators is now widely used in this disease, it is unsuccessful in many cases and the results of the cervical sympathectomy have been generally disappointing.

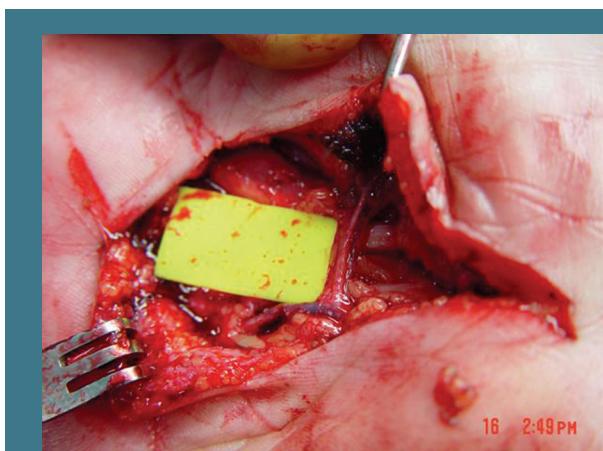
In cases of severe ischemia where the digit is at risk for tissue loss, adventitial stripping may be the treatment of choice. In 1980, Flatt first reported a successful digital artery sympathectomy for the treatment of Raynaud's phenomenon.<sup>11</sup> On the largest cohort of patients, Wilgis has reported a modified technique with increased length of adventitial stripping of the proper

digital artery or of the common digital artery from 4 mm to 2 cm.<sup>12,14</sup> El-Gammal and Blair advocated a more extensive approach by stripping the adventitia from the ulnar and radial arteries at the wrist.<sup>15</sup>

Koman et al found a significant improvement in the response to cold stress testing without significant increase of the digital temperature after distal peripheral sympathectomy, including adventitial stripping of the radial and ulnar arteries, for a distance of 2 cm.<sup>10</sup> That indicates an increase in nutritional blood flow and sufficient improvement of cutaneous perfusion without effect to the thermoregulatory counterparts of the vessels. The increased nutritional blood flow relieves pain and cold intolerance and improves the ulcer healing.

In this study, adventitial stripping for a length of 1 to 2 cm of the common digital artery from the superficial arch to the dividing point between the proper digital arteries was sufficient to achieve adequate circulation to heal the ulcers in all 16 digits. Although total flow was not significantly increased after the surgery, as was shown by the temperature, periarterial sympathectomy increased nutritional flow in the patients with combined vasospastic vessels and occlusive injury. Despite progressive ischemia in nonoperated digits, sustained improvement for the operated digits was noted. Our long-term results are similar to those of several previous works.<sup>10,16-18</sup> The average time to ulcer healing was not longer than what has been previously reported.

For most of our patients reperfusion was established intraoperatively, suggesting that both sympathetic denervation and decompression of the ischemic vessels from the fibrotic adventitia are important. Our observations are similar to those of Yee, who has proposed this dual cause of vessel constriction.<sup>19</sup> The narrowing of the vessel lumen is often a combination of sympathetic activity and external compression caused



**Figures 4a and 4b.** A z type incision was made at the affected fingers. Under operating microscope, the common digital artery was stripped of the adventitia from the superficial arch distally as the artery advanced into the proximal phalanx.

**Table 2.**  
**Results of Digital Artery Sympathectomy**

Patient	Digits at risk	Time to healing	Follow-up	Postoperative results
1	index, ring, middle fingers	3 weeks	12 months	perfusion maintained ulcers healed
2	small finger	4 weeks	28 months	ulcers healed
3	middle finger	6 weeks	36 months	ulcers healed
4	middle and ring finger	8 weeks	44 months	ulcers healed, cold intolerance
5	ring finger	4 weeks	60 months	perfusion maintained ulcers healed

by a thickened adventitia or contraction of the tissues surrounding the arteries. Perfusion of the hand is determined by a sufficient pressure gradient that is achieved by increasing the luminal diameter with sympathectomy and decompression. Thus, a high, increased pressure gradient in the arteries and enhanced collateral circulation via the cutaneous vessels may benefit the ischemic digits.

Repeat sympathectomy on the digital artery was performed in one patient because of a recurrent ulcer 13 months after the initial adventitial stripping. In the literature, recurrent ulcerations or vasospastic attacks and how these were treated, is mentioned once before.<sup>17</sup> In two of our patients a sympathetic nerve blockade was performed with no clinical response, but adventitial sympathectomy was effective to those patients. Although a sympathetic nerve blockade is considered to be diagnostic or prognostic, the lack of response to preoperative nerve blockade is not predictive to postoperative outcomes.<sup>14,20</sup> Although digital artery sympathectomy is effective in preventing amputation, it is technically demanding and is highly dependent on surgical skills. In most series, postoperative and intermediate follow-up has shown good clinical results. However, it is possible that after long time periods, periarterial fibrosis and digital ischemia may recur.

Digital artery sympathectomy is an effective technique for diminution of pain, healing of ulcers and preservations of the digits in patients with chronic digital ischemia. Continued smoking cessation, cold avoidance and pharmacologic therapy also play a significant role in the prevention of the Raynaud's phenomenon.

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