CLINICAL MANAGEMENT extra

# Advances in Upper Extremity Scleroderma Wound Care

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**Joshua M. Cohen, MD** • Resident Physician • New York University School of Medicine • Hansjörg Wyss Department of Plastic Surgery • NYU Langone Health • New York, New York
**Rachel A. Sibley, MD** • Resident Physician • New York University School of Medicine • Department of Internal Medicine • NYU Langone Health • New York, New York
**Ernest S. Chiu, MD, FACS** • Associate Professor • Hansjörg Wyss Department of Plastic Surgery • NYU Langone Health • New York, New York
**Sheel Sharma, MD** • Clinical Associate Professor • Hansjörg Wyss Department of Plastic Surgery • NYU Langone Health • New York, New York

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## GENERAL PURPOSE:

**To provide information about the pathophysiology, diagnosis, and treatment options for systemic sclerosis.**

## TARGET AUDIENCE:

**This continuing education activity is intended for physicians, physician assistants, nurse practitioners, and nurses with an interest in skin and wound care.**

## LEARNING OBJECTIVES/OUTCOMES:

**After participating in this educational activity, the participant should be better able to:**

**1. Describe the pathophysiology, signs, symptoms, and diagnosis of systemic sclerosis.**

**2. Outline the evidence-based medical and surgical management of systemic sclerosis.**

## ABSTRACT

**OBJECTIVE:** To perform a targeted review of systemic sclerosis, including epidemiology, pathophysiology, diagnosis, signs and symptoms, and medical and surgical management of upper extremity manifestations.

**DATA SOURCES AND STUDY SELECTION:** An electronic literature review was conducted using PubMed for all publication dates through October 2017. Searches were performed using combinations of terms including "systemic sclerosis," "scleroderma," "management," "upper extremity," "hypercalcinosis," "Raynaud's phenomenon," "sympathectomy," and "digital ulcers." Only full-length articles written in English that discussed the management of upper extremity scleroderma were used.

**DATA EXTRACTION AND SYNTHESIS:** The epidemiology, pathophysiology, diagnosis, upper extremity manifestations, and medical and surgical management of systemic sclerosis were reviewed. The case described in this article reports the utility of microsurgical interventions in the treatment of medically refractory upper extremity systemic sclerosis.

**CONCLUSIONS:** Systemic sclerosis is a rare rheumatologic disease that greatly impacts quality of life. Medical management is the mainstay of treatment, propelling an improvement in the dismal 10-year cumulative survival rate from 54% in the 1970s to 66% in the 1990s. However, the pathophysiology of this disease is still poorly understood, and when medical management fails and the disease inevitably progresses, surgical approaches are critical.



**KEYWORDS:** calcinosis, hand, Raynaud syndrome, scleroderma, systemic sclerosis, upper extremity

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## INTRODUCTION

Scleroderma (otherwise known as systemic sclerosis) is a rheumatologic disease characterized by dysregulated collagen deposition in skin and internal organs, autoantibody production, and microvascular damage.[1] It is rare, with an estimated incidence in the United States of 1 or 2 cases per 100,000 persons and a prevalence of 5 to 30 cases per 100,000 persons. Females are more commonly affected than males (4:1), and both African Americans and Native Americans are affected earlier and more severely than others. The average peak age of onset is between the third and fifth decades of life.[2]

Although it is challenging to determine the familial risk of a rare disease, one study looking at scleroderma in twins found an overall 5% concordance rate, unchanged between monozygotic and dizygotic twins.[3] Also of note, 36% of patients with scleroderma have an immediate family member with an autoimmune condition, and multiple genetic risk factors have been implicated in the susceptibility and severity of the disease. Specifically, one study reported that human leukocyte antigen markers are independent risk factors for the development of scleroderma renal crisis.[4] Interestingly, environmental factors have also been implicated in development of the disease, including exposure to silica, organic solvents, and industrial fumes. In addition, those with a history of cytomegalovirus infection, parvovirus B19 infection, *Helicobacter pylori* infection, or a history of childbearing (because of microchimerisms) have an increased risk of the disease.[5]

Although scleroderma is deadly, survival rates have improved significantly over the past 50 years. In a large Pittsburgh cohort study, the 10-year cumulative survival rate increased from 54% in the 1970s to 66% in the 1990s.[6] This improvement was most likely attributable to earlier diagnosis and newer treatment options. As patients now live longer with scleroderma, external manifestations have time to become more apparent. Specifically, upper extremity impairment is practically universal in scleroderma patients and can significantly affect activities of daily living (ADLs).[7] Therefore, this article focuses on the medical and surgical management of upper extremity scleroderma.

## METHODS

An electronic literature review was conducted using PubMed to review the epidemiology, pathophysiology, diagnosis, upper extremity symptoms, and treatment modalities of upper extremity systemic sclerosis. Searches were performed through October 2017 using combinations of terms including "systemic sclerosis," "scleroderma," "management," "upper extremity," "hypercalcinosis," "Raynaud's phenomenon," "sympathectomy," and "digital ulcers." Only full-length articles written in English that discussed the management of upper extremity scleroderma were included.

## PATHOPHYSIOLOGY

The underlying pathophysiology of scleroderma is complex and not yet fully elucidated. First, there is likely an autoimmune-mediated vascular injury that leads to an exuberant production of chemokines and eventual activation of B cells, T cells, and macrophages. B cells produce various autoantibodies including anticentromere, antitopoisomerase I (Scl-70), and anti-RNA polymerase III antibodies.[5,8] The autoantibody that is most predominant is useful in classifying patients in terms of phenotypic diagnosis and also prognosis, but their exact role in the pathogenesis of scleroderma is still an active field of research. T cells and macrophages, on the other hand, produce profibrotic

cytokines including transforming growth factor β (TGF-β), interleukin 6 (IL-6), and IL-13. Fibroblasts are transformed into myofibroblasts, resulting in excessive extracellular matrix production, producing the hallmark of the disease: tissue fibrosis.[9,10]

## DIAGNOSIS

Along with these variations on a molecular level, the clinical presentation of scleroderma can also vary significantly between patients. As a result, the American College of Rheumatology and European League Against Rheumatism developed new diagnostic criteria in 2013.[11] The criteria do not apply to patients with skin thickening excluding the fingers or patients with a scleroderma-like disorder that better fits their symptoms. Aside from these exceptions, patients must score a minimum of nine points across eight different categories in order to be definitively diagnosed with the disease. Among the categories, there is only one where nine points are awarded in full. This category is the clinical finding of bilateral skin thickening of the fingers extending proximally to the metacarpophalangeal joints. This is therefore the only clinical finding sufficient for diagnosis.

Of the seven remaining categories, two have multiple subitems, or manifestations: skin thickening and fingertip lesions. When a patient exhibits more than one subitem of a single category, the score for the category will be the higher score of the two subitems. For example, skin thickening that does not extend proximal to the metacarpophalangeal joints is divided into two subitems. The patient may exhibit skin thickening involving only the proximal one-third of the digit (between the metacarpophalangeal joint and the proximal interphalangeal joint), awarded four points, or the patient may have puffy fingers, awarded two points. If the patient manifests both, the patient will receive four points.

The remaining five categories are telangiectasias, abnormal nailfold capillaries, Raynaud phenomenon (RP), pulmonary arterial hypertension or interstitial lung disease, and the presence of relevant autoantibodies (anticentromere, Scl-70, or anti-RNA polymerase III). The maximum total score is 19.[11]

Once definitively diagnosed, scleroderma patients are clinically divided into two major phenotypic variants: diffuse cutaneous disease, affecting one-third of patients, and limited cutaneous disease, affecting the remaining two-thirds. The diffuse form is defined by skin thickening along all extremity surfaces with significant internal organ involvement. The limited cutaneous form, on the other hand, is characterized by skin thickening of the extremities only distal to the elbows and knees, with minimal internal organ involvement. A common subtype of the limited cutaneous form is a constellation of calcinosis, RP, esophageal dysfunction, sclerodactyly, and telangiectasias (CREST).[2]

## UPPER EXTREMITY MANIFESTATIONS

### Raynaud Phenomenon and Secondary Ischemic Complications

Affecting 90% of patients, RP is one of the most common clinical signs of scleroderma. It is also one of the first manifestations of the disease, preceding the onset of diffuse cutaneous scleroderma by 1 year, and proceeding limited cutaneous disease onset by approximately 10 years. It is specifically associated with the Scl-70 autoantibody.[1,12]

From a pathophysiologic standpoint, constitutive up-regulation of adrenergic alpha $a_2$ receptors leads to vasospasm of digital arteries and thermoregulatory cutaneous arterioles in the setting of cold or stress.[12,13] Clinically, activation of these receptors causes a patient's fingers to become white during initial vasospasm. Prolonged receptor activation and vessel vasospasm result in blue (cyanotic) coloring of the fingers, and finally, the patient's fingers return to a red color after reperfusion. While RP is not an entity limited to scleroderma, these patients demonstrate more severe ischemic complications, including abnormal nailfold capillaries, digital pitting, and ischemic ulcerations of the distal phalanges. These ulcers are at increased risk of bacterial infection, which can progress to gangrene and ultimately autoamputation.[1,14]

### Skin Changes

Despite the prevalence of RP and its manifestation early in the course of scleroderma, the major clinical hallmark of the disease is actually skin fibrosis, affecting more than 90% of patients. In fact, the new diagnostic criteria state that "skin thickening of the fingers of both hands extending proximal to the metacarpophalangeal joints" is sufficient evidence to diagnose scleroderma.[10,11]

For most patients, this fibrosis initially manifests as shinier skin and nonpitting edema distal to the wrists. This phase is subsequently followed by induration, skin thickening of the fingers (sclerodactyly), and atrophy of underlying tissues. As the disease progresses, severe flexion contractures may develop in the extremities, and the dermis can become so bound down on the patient's hands that the distal cuff of his/her digits start to resorb, called acrolysis.

Beyond involvement of the hands and wrists, the trunk, face, and the rest of the arms can also be involved, largely depending on the disease variant. When the face is affected, specifically in those with diffuse cutaneous form, patients present with characteristic Mauskopf facies ("mouse head" in German), beak-like nose, expressionless face (due to reduced mobility and oral aperture), and thinning of the lips.[14,15]

Overall, given that the extent of fibrosis depends on the variant, duration, and overall severity of the disease, clinicians

can use multiple tools to quantify degree of skin thickness. The modified Rodnan skin score (mRSS) is one of the most commonly used tools. It divides the body into 17 anatomical regions, scored from 0 to 3 (from normal to severe skin thickening). The maximum and most severe score that can be obtained is 51.[16] Ultrasonography and durometry, a measurement of skin hardness, have also been used to assess skin fibrosis; however, the mRSS is both quicker and easier.[17]

Finally, 25% of scleroderma patients also suffer from calcinosis cutis, calcium deposits in the skin that begin as small, hard, discrete nodules and eventually enlarge over time. They can become extremely disfiguring.[5,10]

## Musculoskeletal Symptoms

Musculoskeletal manifestations of scleroderma are frequent, occurring in approximately 65% of cases.[10] Patients initially experience arthritis and myositis from inflammation. The arthritis is often further exacerbated by decreased mobility of the joints secondary to skin contracture (as described previously). Later in the course of the disease, fibrosis of tendon sheaths and fascia can produce palpable, and occasionally audible, tendon friction rubs—another example of how the duration of systemic sclerosis directly affects its clinical manifestations over time.[1,10]

## Internal Organ Involvement

Finally, although this article focuses on scleroderma's upper extremity manifestations, it is important to briefly summarize the internal organ involvement. First, the gastrointestinal tract is a major target of the disease. Gastrointestinal involvement typically begins with telangiectasias of the tongue and lips that can fracture and bleed. Esophageal involvement is widespread, occurring in 90% of patients with limited cutaneous disease and 80% of patients with diffuse cutaneous disease.[18] Manifestations of esophageal involvement include gastroesophageal reflux disease and decreased esophageal motility secondary to fibrosis. In fact, dysmotility and overall decreased peristalsis can occur throughout the length of the gastrointestinal tract, leading to pseudo-obstruction and bacterial overgrowth.[1,18]

Scleroderma lung disease is another prominent feature of internal organ involvement. It can present in two forms: pulmonary hypertension, a vasculopathic manifestation, and interstitial lung disease, a fibrotic manifestation.[19]

Third, cardiovascular manifestations are prominent and problematic because excessive collagen deposition in the cardiac conduction system can lead to dysrhythmias or heart block. Cardiomyopathies and pericarditis have also been associated with scleroderma.[20]

Finally, a rare but deadly complication is scleroderma renal crisis, characterized by anuric acute renal failure and malignant hypertension. It is possible to support patients through a renal crisis with angiotensin-converting enzyme inhibitors and dialysis; however, the current 5-year survival rate is only 65%.[21]

# MEDICAL MANAGEMENT

The medical management of scleroderma is a rapidly changing field given the advent of immunomodulatory and biologic agents (Table 1). This section will highlight the mainstays of treatment for each manifestation mentioned previously and will also discuss medications in clinical trials.

## Raynaud Phenomenon and Digital Ulcers

The first-line management of RP is lifestyle modification. Because RP is a vasospastic event, it is important that patients are educated to avoid vasoconstrictive stimuli, including cold, stress, nicotine, or any vasoconstrictive medications. Therefore, patients should wear gloves in cold environments, be counseled on the importance of smoking cessation, and be given a list of commonly used vasoconstrictive medications to avoid.[12,13,22]

If lifestyle modifications fail, a long-acting calcium-channel blocker (CCB) (dihydropyridine) such as nifedipine or amlodipine can be prescribed. This pharmacologic choice is well supported by the literature; a meta-analysis of seven randomized controlled trials (RCTs) looking at CCB for primary RP found a significant improvement in symptoms with CCB use.[23] Angiotensin II receptor blockers and angiotensin-converting enzyme inhibitors can also be used; however, the evidence for their efficacy is lacking in comparison with CCBs.[22] Of course, one concern is patients who cannot tolerate CCBs because of already low (or borderline) blood pressures. In these patients, selective serotonin reuptake inhibitors such as fluoxetine have been shown to decrease frequency of RP attacks.[24] For more advanced cases of RP, physicians can resort to phosphodiesterase type 5 (PDE-5) inhibitors. One meta-analysis looking at seven double-blind RCTs stated that PDE-5 inhibitors decreased frequency and duration of RP attacks compared with other commonly used medications.[25]

Despite these treatment options, RP is still frequently complicated by digital ulcers. A meta-analysis looking at 31 RCTs to assess the benefit of medical management in healing and preventing ulcers identified PDE-5 inhibitors as a pharmacologic agent associated with improvement of ulcers. It also revealed bosentan and intravenous iloprost as agents that prevent new ulcers.[26] While there is little evidence for the use of other agents, some patients with RP complicated by digital ulcers have also been prescribed antiplatelet therapy, topical nitroglycerin, and even nonselective PDE inhibitors such as pentoxifylline.[7]

A procedural approach to RP and secondary digital ulcers is also possible. Specifically, case reports have been published on the use of botulinum toxin type A (Btx-A) injection into the

**Table 1.**
**EVIDENCE-BASED MEDICAL MANAGEMENT OF UPPER EXTREMITY SCLERODERMA**

| Manifestation | Medical Management | Level of Evidence | References |
|---|---|---|---|
| All manifestations | Lifestyle modifications | N/A | |
| Raynaud Phenomenon | CCB (dihydropyridines) | I | 23 |
| | SSRI (fluoxetine) | II | 24 |
| | PDE-5 Inhibitors | I | 25 |
| Digital Ulcers | PDE-5 Inhibitors (improvement in ulcers) | I | 26 |
| | Bosentan (prevention) | I | 26 |
| | Intravenous iloprost (prevention) | I | 26 |
| | Botulinum toxin type A (clinical improvement) | II | 27–29 |
| Skin Fibrosis | Methotrexate | I | 30–33 |
| | Cyclophosphamide | I | 30–33 |
| | Mycophenolate mofetil | II | 34 |
| | Tocilizumab (anti-IL-6 receptor ab) | in phase III trial | 35 |
| | Rituximab (anti-CD20 ab) | II | 36 |
| | Fresolimumab (anti-TGF-β ab) | II | 37 |
| Calcinosis | CCB | III | 7, 38 |
| | Colchicine | III | 7, 38 |
| | Warfarin | III | 7, 38 |
| | Rituximab | III | 7, 38 |

Abbreviations: ab, antibodies; CCB, calcium channel blockers; IL, interleukin; PDE, phosphodiesterase; SSRI, selective serotonin reuptake inhibitor; TGF, transforming growth factor

perivascular space of affected digits. The Btx-A is thought to locally improve blood flow by inhibiting sympathetic vasoconstriction.[27,28] This approach is still controversial; a recent RCT of Btx-A injection in 40 patients (25 with limited scleroderma and 15 with diffuse scleroderma) found that while patients reported subjective symptom improvement, Doppler imaging of blood flow did not show a benefit of Btx-A treatment.[29]

## Skin Fibrosis

For skin fibrosis, the mainstay of medical management is immunomodulatory drugs. The choice of which immunomodulator to prescribe is a complex one (largely made by the patient's primary rheumatologist); organ involvement and individual presentation affect the ultimate decision. However, this article only presents therapeutic options designed for treating skin thickness alone supported by level III evidence or better.

First, methotrexate and cyclophosphamide are both efficacious in decreasing skin thickness, as measured by mRSS quantification according to multiple RCTs.[30–33] Mycophenolate mofetil was also shown to be efficacious in decreasing skin thickness in patients with scleroderma.[34]

Beyond these three medications, the future of medical management for skin fibrosis in scleroderma depends on a firmer understanding of the underlying pathophysiology of the disease. Currently in clinical trials are monoclonal antibodies against three targets: IL-6, CD-20, and TGF-β. The faSScinate study was a phase 2 RCT looking at the anti–IL-6 receptor antibody tocilizumab. faSScinate found that after a 24-week administration period skin thickness improved in patients with a duration of disease less than 5 years and elevated IL-6–related inflammatory markers.[35] The global phase 3 trial of tocilizumab is ongoing.

CD20 has also been a popular target of multiple RCTs, given the current understanding that B cells are critical in the autoimmune nature of scleroderma. Specifically, rituximab, a well-known anti-CD20 antibody, has been used in multiple small RCTs. Each small study demonstrated positive results, allowing the interpretation that in totality B-cell targeting can improve fibrosis, vasculopathy, and autoimmunity of this disease.[36]

Finally, TGF-β is thought to be a critical cytokine in the development of skin fibrosis, prompting a 2015 phase 2 clinical trial of an anti–TGF-β antibody called fresolimumab. In this study, the mRSS was significantly improved in patients treated with

**Table 2.**
**EVIDENCE-BASED SURGICAL MANAGEMENT OF UPPER EXTREMITY SCLERODERMA**

| Manifestation | Surgical Procedure | Level of Evidence | References |
|---|---|---|---|
| Raynaud phenomenon and digital ulcers | Digital sympathectomy | II | 40–43 |
| Skin fibrosis and contractures | Arthroplasty, skin grafts, free flaps | III–V | 7, 39, 44–45 |
| Calcinosis | $CO_2$ laser vaporization/shock wave lithotripsy | III–IV | 38 |
| | Surgical excision/debulking | IV–V | 38, 46–47 |

fresolimumab as compared with control subjects, and these patients also experienced a decrease in TGF-β–regulated biomarker genes, overall confirming the role of TGF-β in the pathogenesis of skin fibrosis.[37]

Although clinical trials are ongoing, these monoclonal antibodies represent a promising future for treatment and secondary prevention of skin fibrosis in systemic sclerosis.

## Calcinosis Cutis and Musculoskeletal Symptoms

Calcinosis cutis, which is potentially disfiguring and severe, is managed similarly to RP and skin fibrosis. Lifestyle modifications are first line, with additional symptomatic treatment of pain and infection secondary to calcinosis. Although multiple reviews have listed pharmacologic treatments for calcinosis cutis, including CCBs, colchicine, warfarin, and rituximab, evidence for these agents is inconsistent and weak.[7,38] If calcinosis cutis is debilitating and medical management fails, surgical intervention is required (see following section).

Finally, medical management of the musculoskeletal manifestations of scleroderma follows the treatment guidelines for rheumatoid arthritis patients. Corticosteroids (≤10 mg daily) and/or methotrexate are used for inflammatory arthritis and tenosynovitis.[7]

# SURGICAL MANAGEMENT

## Raynaud Phenomenon and Digital Ulcers

As scleroderma progresses and ADLs become impaired, surgical management becomes critical (Table 2).[39] For RP, sympathectomy destroys sympathetic nerves by stripping the adventitia of arteries in the distal extremities, thereby preventing sympathetic vasoconstriction. Patients can undergo sympathectomy of the ulnar and radial arteries, as well as digital arteries.[40,41] A 2003 systematic review of 16 studies found that digital sympathectomy was effective in some; however, 14% of patients still ultimately required amputation, and 18% of patients experienced ulcer recurrence.[42] A more recent retrospective analysis of 17 patients (26 affected hands) who underwent peripheral sympathectomy found that pain improved in more than 90% of affected hands, and 100% of digital ulcers were healing with recurrence in only two patients. Minor complications of the sympathectomies included infection and wound breakdown (seen in 25% of affected hands, with none requiring further surgical intervention).[43] This is compared with past practices of cervical and endoscopic thoracic sympathectomies where adverse events were much more severe, including compensatory hyperhidrosis, Horner syndrome, and chest wall paresthesias.[40]

## Skin Fibrosis and Secondary Joint Contractures

For skin fibrosis and secondary joint contractures, surgical treatment includes arthroplasty, arthrodesis, skin grafts, and free

**Figure 1.**
**RIGHT HAND SCLERODACTYLY AND PALLOR OF THE THIRD DIGIT ON INITIAL PRESENTATION**

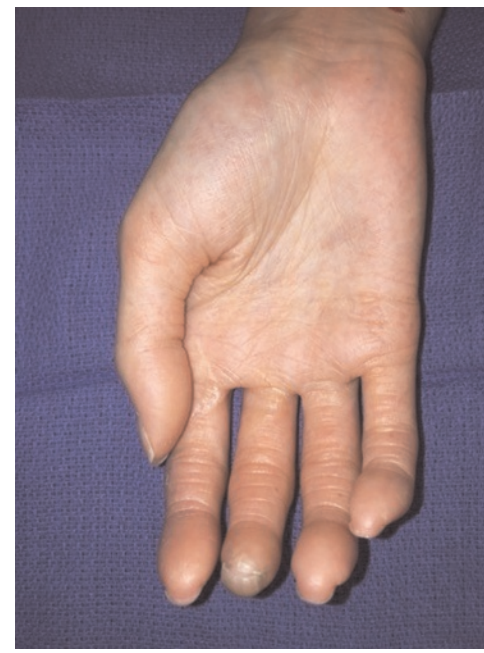
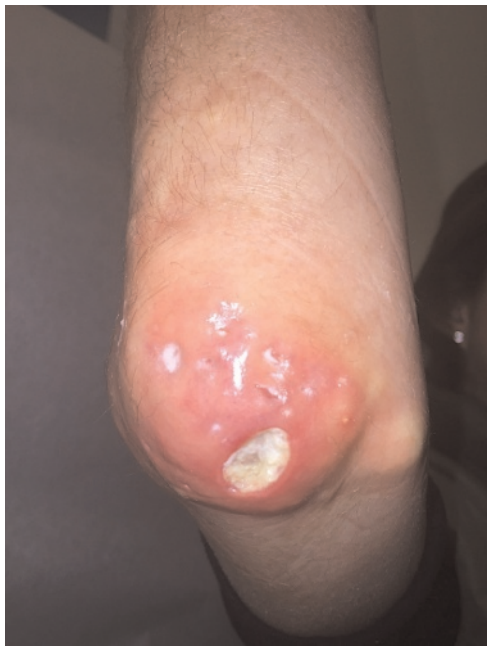


**Figure 2.**
**HYPERCALCINOSIS CUTIS OF THE RIGHT ELBOW ON INITIAL PRESENTATION, WITH VISIBLE SINUS**



flaps.[7,39] A systematic review of hand surgery in scleroderma patients found that arthrodesis can improve distal and proximal interphalangeal joint function and decrease frequency of skin ulceration, although severe contractures of the interphalangeal joints are unlikely to regain full range of motion.[44] Free flap reconstruction and skin grafts can be used to replace larger areas of fibrotic and contracted skin. A review of 32 free flaps in patients with collagen vascular disorders found that there was no increased risk of thrombotic events, and thus these patients should be eligible to undergo microvascular reconstruction.[45]

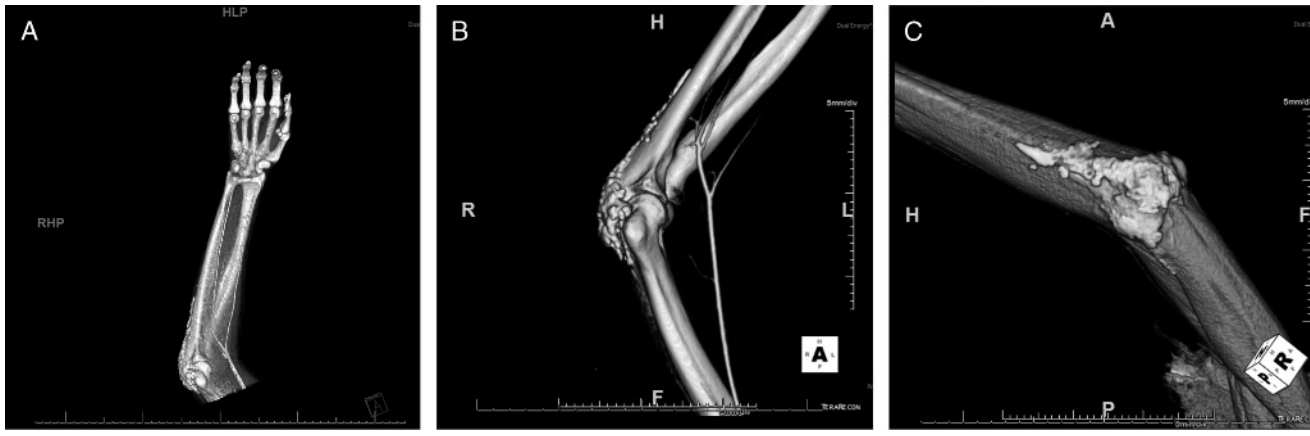
## Calcinosis Cutis

Finally, because evidence for pharmacologic treatments of calcinosis cutis is inconsistent and weak,[7,38] severe calcinosis is most commonly treated with surgical intervention. Carbon dioxide laser vaporization and extracorporeal shock wave lithotripsy are effective methods at reducing pain and decreasing median area of calcinosis.[38] For larger calcium deposits, surgical debulking and excision are used. A 2013 retrospective analysis of calcinosis debulking by a high-speed micro-burr found that although complete resolution is not achieved, there is a high degree of patient satisfaction with the procedure.[38,46] In a retrospective study of 78 patients with calcinosis cutis attributable to autoimmune disease, complete removal and absence of recurrence was achieved in 72% of patients (8 of 11) who underwent surgical excision.[47]

## CASE REPORT

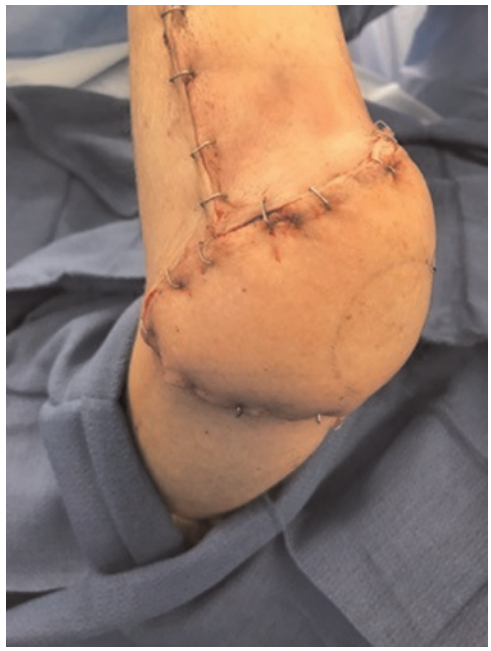
The patient is a 37-year-old right-hand–dominant woman with limited cutaneous systemic sclerosis (CREST subtype) diagnosed in 2013 whose course was previously complicated by interstitial lung disease. Two years after diagnosis, the patient noted RP of the left fifth digit and subsequently underwent a digital sympathectomy at an outside hospital with initial resolution of her symptoms. One year later, in 2016, the patient presented for

**Figure 3.**
**THREE-DIMENSIONAL VOLUME RENDERED AND MAXIMUM INTENSITY PROJECTION COMPUTED TOMOGRAPHY ANGIOGRAPHIC RECONSTRUCTION IMAGES OF HYPERCALCINOSIS CUTIS OF THE RIGHT ELBOW ON PRESENTATION**




A, Posterior to anterior view. B, Lateral view demonstrating bifurcation of the brachial artery with no evidence of occlusion or stenosis. C, Posterior view.

**Figure 4.**
**POSTOPERATIVE IMAGE OF THE ANTEROLATERAL THIGH FLAP OF THE RIGHT ELBOW**



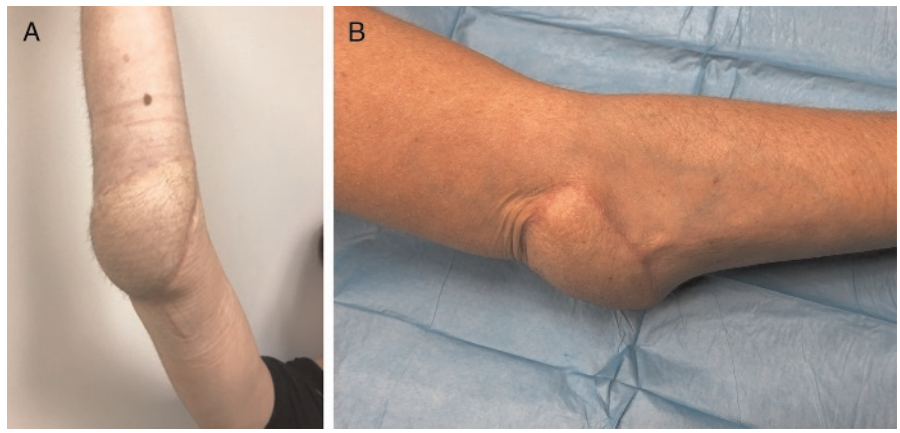
treatment of now bilateral RP (right worse than left, given prior left digital sympathectomy; Figure 1), as well as calcinosis cutis of the right elbow (Figure 2) that had been progressing for 3 years with occasional drainage and 40 degrees of contracture.

Her medication regimen at the time of presentation included mycophenolate mofetil (1500 mg daily), nifedipine extended release (30 mg daily), naproxen (500 mg twice a day), and prednisone (10 mg daily). The patient denied use of tobacco.

Her physical examination at that time was remarkable for significant sclerodactyly of the bilateral hands, pallor of the right third digit (Figure 1), and a volar scar contracture on the left fifth digit. The patient also had a 10 × 7-cm area of hypercalcinosis of the right elbow with multiple visible sinuses (Figure 2). Although she also reported a history of recurrent cellulitis and wound discharge of this area, there was no active discharge or surrounding cellulitis at this time. Her complete blood count, basic metabolic panel, and partial thromboplastin time were all within normal limits. An X-ray of the right elbow showed extensive calcification at the dorsal aspect of the elbow with no evidence of periosteal reaction or cortical destruction. A three-dimensional computed tomography angiographic reconstruction of the right elbow confirmed the extensive calcifications and demonstrated patency of the brachial artery bifurcation (Figure 3).

Given the severity of the patient's symptoms and elbow contracture on an optimized medical regimen, the patient was informed about surgical options for treatment of RP and hypercalcinosis. She elected to undergo excision of the hypercalcinosis of the right elbow with reconstruction with an anterolateral thigh flap, as well as right ulnar and radial sympathectomies. The operation included wide excision of the sinuses on the right elbow. There was a large amount of calcium found along the ulnar nerve and around the lateral epicondyle. All the calcium was radically excised around the ulnar nerve, and an ulnar nerve decompression in the cubital tunnel was performed. After excision of all

**Figure 5.**
**ANTEROLATERAL THIGH FLAP OF THE RIGHT ELBOW POSTOPERATION**




A, 2 months postoperation. B, 6 months postoperation.

devitalized skin, the total defect was 7 × 12 cm in diameter. An anterolateral thigh flap was raised on the lateral circumflex artery and vein perforators. At this point, radial and ulnar artery sympathectomies were performed. An anterolateral thigh flap was used to reconstruct the right elbow defect. The flap was debulked, and insetting was carried out with Vicryl sutures (Figure 4).

The patient did well postoperatively. Figure 5 shows the patient's elbow at 2 and 6 months postoperatively. At 2 months, she had excellent range of motion of the elbow with only 10-degree extension lag. At 6 months, she denied recurrence of right-sided RP or secondary ulcerations. Subsequently, she opted to undergo radial and ulnar sympathectomies of the opposite (left) hand.

## CONCLUSIONS

Upper extremity manifestations of systemic sclerosis are practically universal within the disease (regardless of phenotypic variant) and can significantly impair patients' ADLs.[7] Although medical management is first line, surgical management of the disease is also an option. Although the future of this field largely lies in a greater understanding of underlying pathophysiology as well as ongoing clinical trials of three monoclonal antibodies, surgical management remains the primary treatment course when medical management fails.

## PRACTICE PEARLS

- Upper extremity manifestations, including RP leading to digital ulcers, skin fibrosis, and calcinosis cutis, are practically universal in systemic sclerosis and significantly impact patient quality of life.
- Lifestyle changes and medical management are the first-line treatment strategies in upper extremity scleroderma.
- Monoclonal antibodies targeting IL-6, CD-20, and TGF-β are being evaluated in clinical trials and represent the promising future of systemic sclerosis management.
- For refractory upper extremity disease, surgical interventions including (but not limited to) sympathectomy for RP, skin grafts for skin fibrosis, and surgical debulking for severe calcinosis cutis are reasonable and evidenced-based approaches to treatment.

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