

REVIEW ARTICLES

Nailfold capillaroscopy in idiopathic inflammatory myopathies

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ABSTRACT

Nailfold videocapillaroscopy (NVC) is a non-invasive technique that enables the evaluation of peripheral microcirculation by visualising nailfold capillaries. Although traditionally used in systemic sclerosis, NVC may also be useful in other systemic autoimmune rheumatic diseases, and particularly idiopathic inflammatory myopathies (IIMs). This review aims to summarise the current evidence on the prevalence of NVC findings in IIMs and their correlation with clinical and serological characteristics, as well as diagnostic, follow-up, and prognostic implications.

Keywords: Idiopathic Inflammatory Myopathy; Nailfold Videocapillaroscopy; Myositis Antibodies; Systemic autoimmune rheumatic diseases.

INTRODUCTION

Nailfold videocapillaroscopy (NVC) is an easily accessible, low-cost, noninvasive technique that enables the direct evaluation of peripheral microcirculation through the visualisation of nailfold capillaries. In systemic autoimmune rheumatic diseases (SARDs), NVC has traditionally been used in the assessment of Raynaud's phenomenon (RP), facilitating the distinction between primary and secondary RP, particularly in association with systemic sclerosis (SSc)¹. In SSc, NVC abnormalities are part of the 2013 classification criteria by the American College of Rheumatology / European League Against Rheumatism, reinforcing its role in this disease². Certain NVC findings, such as altered capillary density, morphology, and dimension, form the basis for defining a capillaroscopic scleroderma pattern³. Although more characteristic of SSc, similar microvascular changes may also be observed in other SARDs, including inflammatory idiopathic myopathies (IIMs)⁴.

IIMs are a heterogeneous group of SARDs primarily characterised by skeletal muscle inflammation and weakness, but frequently involving other organs such

as the skin, joints, and lungs^{5,6}. IIMs are currently classified into six major subgroups: dermatomyositis (DM) (including clinically amyopathic DM), antisynthetase syndrome (ASyS), immune-mediated necrotising myopathy (IMNM), inclusion body myositis (IBM), polymyositis (PM), and overlap myositis (OM)⁷.

Given the possibility of microvascular dysfunction, IIMs may lead to detectable abnormalities on NVC. In 2023, a multicentric Portuguese study reported that 19.1% of IIM patients had some type of capillaroscopic abnormality⁸. Nonetheless, different forms of IIMs may show a higher likelihood of specific capillaroscopic abnormalities, an aspect that is further explored in this work and may suggest different degrees of vasculopathy among subtypes.

In this review, we aim to summarise the current knowledge on the usefulness of NVC in IIMs, highlighting its potential value in disease characterisation and monitoring.

SEARCH STRATEGY

This study was conducted as a narrative review of the literature. A literature search was performed in the MEDLINE database, including articles published up to November 2025, without restrictions on the start date. Publications in English and/or Portuguese were considered. The search strategy used Boolean operators (AND, OR) and combined the following MeSH terms searched in the title and/or abstract: (("nailfold videocapillaroscopy") OR ("capillaroscopy")) AND (("idiopathic inflammatory myopathies") OR ("dermatomyositis") OR ("juvenile dermatomyositis") OR ("antisynthetase syndrome") OR ("polymyositis") OR ("necrotising myop-

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athies”) OR (“overlap myositis”) OR (“inclusion body myositis”). Given the limited available literature on this topic, a broad range of study designs – including systematic reviews, cohort studies, and case series – was considered. Reference lists of selected articles were also screened to identify additional relevant publications not indexed in the database. EndNote software (version 20, Clarivate, Philadelphia, USA) was used for reference management.

Titles and abstracts were screened for relevance, and full-text articles were reviewed when available, with particular attention to the presence of NVC findings across different IIM subtypes. Studies clearly unrelated to IIMs or NVC, articles not published in English or Portuguese, and papers without accessible full-text content were not considered. Study selection and data extraction were performed by a single reviewer.

Information from the included publications was or-

ganised according to IIMs subtypes. For each subtype, data were summarised in relation to the prevalence, definitions, and characteristics of NVC findings, as well as their reported associations with clinical phenotype, autoantibody profiles, and patient prognosis.

PREVALENCE AND TYPES OF NAILFOLD VIDEOCAPILLAROSCOPY FINDINGS IN IDIOPATHIC INFLAMMATORY MYOPATHIES

Dermatomyositis

In DM, NVC abnormalities are common and tendentially more severe than in other forms of IIMs⁹ (Table I). A systematic review published in 2024 found that approximately 65% of DM patients exhibited enlarged capillaries, 57.5% decreased vascularity, 45.1% microhaemorrhages, 31.2% disorganised capillary archi-

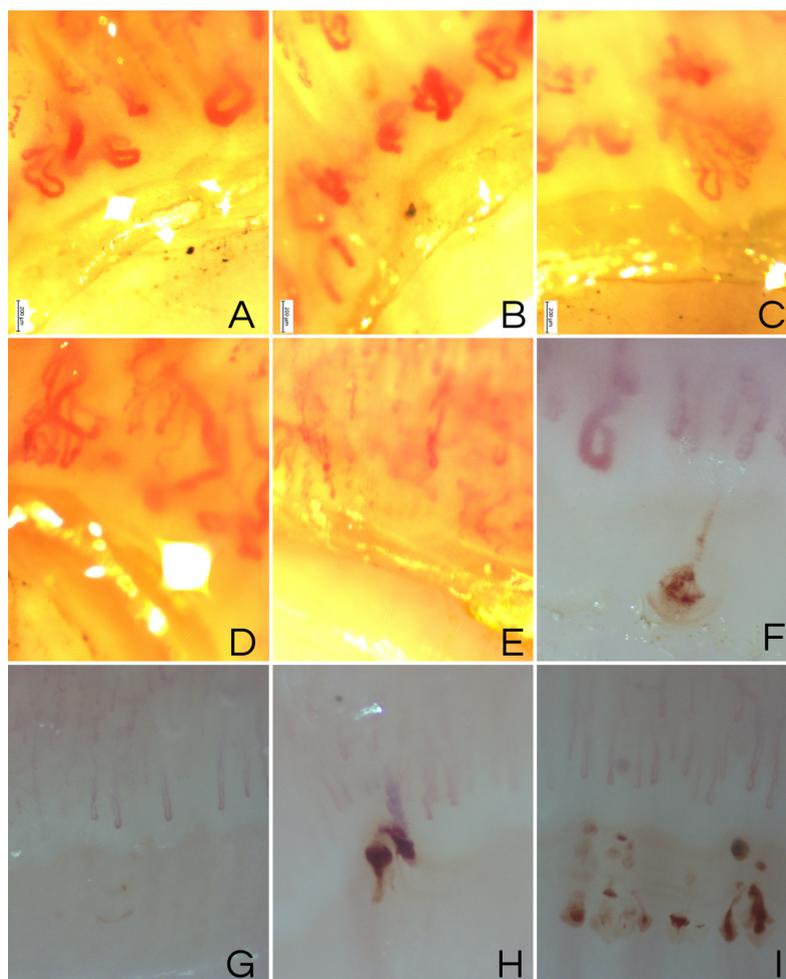


Figure 1. Examples of nailfold videocapillaroscopy findings found in people living with inflammatory idiopathic myopathies, followed at our Myositis Clinic. Images obtained with the ZEISS Stemi 508 stereo microscope, at 200x magnification.

Panels A, B, F: giant capillaries and abnormal capillaries with $>50 \mu\text{m}$. C, D: abnormally shaped capillaries in areas of reduced capillary density, suggesting neoangiogenesis. E: capillary disorganisation. G: reduced capillary density. F, H, I: microhaemorrhages.

texture, and 16.5% neovascularization¹⁰. Of note, this study included data not only from NVC but also from microscopy or dermatoscopy findings.

Regarding NVC patterns, DM may course with a “scleroderma-like” (ScL) pattern, in which mixed microvascular markers of the scleroderma capillary patterns coexist, although not fully fitting the definition for the single early, active, or late scleroderma pattern¹¹. Manfredi et al. found that 69% of DM patients showed a ScL pattern on NVC evaluation; this pattern was not detected in PM patients or controls with primary RP¹². This pattern was observed in 32.7% of DM patients¹³ in the study by Kubo et al., and in 34% in a recent work by Leclair et al.¹⁴

Other NVC patterns can also be found. For instance, Kubo et al. documented a scleroderma pattern in a total of 32.6% of DM patients (19.2% early, 9.6% active, and 3.8% late patterns)¹³. Similarly, in the series by Torres-Ruiz et al., 45.2% of DM patients displayed non-specific abnormalities on NVC, and 51.5% showed a scleroderma capillaroscopic pattern, with the active form being particularly prevalent¹⁵.

Importantly, in DM, NVC alterations may correlate with disease activity, specific myositis autoantibodies, and clinical manifestations, as will be discussed later.

Juvenile Dermatomyositis

In juvenile dermatomyositis (jDM), a scleroderma capillaroscopic pattern is common, reported in more than 80% of patients in a study by Barth et al.¹⁶ Potential abnormalities included capillary loss (36%), dilated capillaries (33%), and microhaemorrhages (28%)¹⁶. Similarly to adult DM, a ScL pattern can also be observed¹⁷.

Antisynthetase Syndrome

NVC abnormalities are also frequent in ASyS. An Italian multicentric study published in 2019, including 190 patients, demonstrated NVC abnormalities in 62.1%, a proportion significantly higher than in healthy controls¹⁸. Giant capillaries (31.1%) and avascular areas (20.5%) were reported exclusively in the ASyS group¹⁸. Other common NVC alterations included ramified capillaries (49.5%) and a ScL pattern (35.3%). Microhaemorrhages, however, were rarer, detected in 23.2% of patients¹⁸.

In line with these findings, Torres-Ruiz et al. reported that 80.7% of analysed ASyS patients exhibited non-specific abnormalities on NVC, while 15.3% presented a scleroderma pattern, namely the active subtype¹⁵.

Immune-Mediated Necrotising Myopathies

In contrast, NVC abnormalities are less frequently reported in IMNM, although most available studies are limited by small cohort sizes. In 2019, Soubrier et al. evaluated NVC changes in a mixed cohort of patients

including DM, ASyS, OM, and IMNM¹⁹. Significant capillaroscopic changes, such as giant capillaries, severe disorganisation, and marked capillary loss, were absent in the IMNM subgroup. Less relevant changes, such as ramified (13.1%) or tortuous capillaries (33.3%), and microhaemorrhages (16.6%), were documented¹⁹. More recently, a study reported that 83.3% of IMNM patients displayed non-specific capillaroscopic abnormalities, with a single patient exhibiting an early scleroderma-like pattern¹⁵.

Inclusion Body Myositis

Data regarding NVC changes in IBM is limited. Available evidence suggests that abnormalities are uncommon, with one study reporting a normal capillaroscopic pattern in 85.8% of patients¹⁵.

Overlap Myositis

OM rarely courses with a normal NVC. In a study by Soubrier et al., several NVC abnormalities were documented, including disorganised architecture (62.5%), giant capillaries (50%), tortuous or ramified capillaries (36.9% and 18.67%, respectively), reduced capillary density, and microhaemorrhages (25%)¹⁹. Torres-Ruiz et al. reported non-specific abnormalities and a scleroderma pattern (mostly the active form) in 50% of patients¹⁵. Apart from myositis, these studies did not specify the other SARD involved, although Soubrier et al. included information on detected autoantibodies¹⁹. A recent study reported that patients with scleromyositis presented more frequently with a non-specific or ScL capillaroscopic pattern¹⁴.

Polymyositis

Similarly, PM rarely presents with a normal NVC. In a study by Manfredi et al., tortuous (52.2%) and enlarged capillaries (17.4%) were observed¹², consistent with the findings of Selva-O’Callaghan et al.²⁰ Rarer findings included ramified capillaries (8.7%), microhaemorrhages (8.7%), and capillary disorganisation (4.3%)¹². Giant capillaries, avascular areas, and a ScL pattern were absent, contrasting with the NVC findings in DM¹². Concerning NVC patterns, non-specific abnormalities tend to be consistently reported^{15, 21, 22}.

CORRELATION BETWEEN NVC ABNORMALITIES AND CLINICAL PHENOTYPE

Microvascular abnormalities identified by NVC in IIMs patients may provide insight into disease phenotype, severity, and organ involvement (Table II). Despite accumulating evidence, results across studies remain heterogeneous and sometimes limited by small cohort sizes. Therefore, conflicting data persist regarding the

TABLE I. Heat map chart representing the main nailfold videocapillaroscopy findings in different studies for the subtypes of idiopathic inflammatory myopathies.

IIMs	Study	N	NYC Findings										Capillaroscopic Patterns						
			Tortuous	Ramified	Giant	Enlarged	Disorganised	Haemorrhages	Neo	Reduced	Avascular	No	NS	Sc	ScL				
DM	Selva-O'Callaghan et al. ²⁰	34	94%	79%		65%		67%		20%									
	Mugii et al. ²⁶	50													74%				
	Manfredi et al. ¹²	29	58.6%	58.6%	65.5%	69%	72.4%	37.9%				31%					69%		
	Manfredi et al. ⁴⁷	29		55.2%	58.6%			41.4%											
	Kubo et al. ¹³	52														32.6%		32.7%	
	Soubrier et al. ¹⁹	17	36%	21.2%	17%		11.8%	29.4%		11.8%	11.8%					0%			
	Johnson et al. ²⁴	15							80%	80%									
	Shenavandeh et al. ²¹	81			46.9%	49.4%			64%	49%	37%	0%	27.2%		72.8%				
	Bogojevic et al. ²²	37			67.6%	75.7%				70.2%		2.7%	16.2%		81.1%				
	Torres-Ruiz et al. ¹⁵	95										3.1%	45.2%		51.5%				
jDM	Leclair et al. ¹⁴	41													17%	37%	12%	34%	
	Xu et al. ³⁴	63			1.7%	41.7%		15.9%											
	Barth et al. ¹⁶	58			9%	33%		28%		41%		36%					84%		
	Shenavandeh et al. ²¹	25			48%	52%		54%				72%	32%	0%	27%	72%			
	Bogojevic et al. ²²	5			20%	80%						80%		0%	20%	80%			
	Bica et al. ²⁸	28			39%	100%		50%				71.4		3.6%	14.2%			82.1%	
	Doğantan et al. ¹⁷	14			21.4%	57.1%		35.7%		50%			21.4%						
	Soubrier et al. ¹⁹	12	41%	20.2%	0.09%		0%						0%				0%		
	ASyS	Sebastiani et al. ¹⁸	190		49.5%				23.2%										35.3%
		Torres-Ruiz et al. ¹⁵	26												3.8%	80.7%	15.3%		
Leclair et al. ¹⁴		16												38%	19%	37%	6%		
Xu et al. ³⁴		26			0%	30.4%			3.8%										

continues on the next page

TABLE I. continuation

IIMs	Study	N	NVC Findings							Capillaroscopic Patterns								
			Tortuous	Ramified	Giant	Enlarged	Disorganised	Haemorrhages	Neo	Reduced	Avascular	No	NS	Sc	ScL			
PM	Selva-O'Callaghan et al. ²⁰	17	88%	64%		24%		6%										
	Manfredi et al. ¹²	23	52.2%	8.7%	0%	17.4%	4.3%	8.7%			0%							0%
	Kubo et al. ¹³	18																5.6%
	Shenavandeh et al. ²¹	19			15.8%	53.7%		43%			16%		11%	47%	42%			
IMNM	Bogojevic et al. ²²	35			2.8%	2.8%				37.1%		48.6%	48.6%	2.9%				
	Torres-Ruiz et al. ¹⁵	2										0%	100%	0%				
IBM	Soubrier et al. ¹⁹	6	33.3%	13.1%	0%		0%				0%							
	Torres-Ruiz et al. ¹⁵	12										8.3%	83.3%	8.3%				
OM	Torres-Ruiz et al. ¹⁵	7										85.8%	14.2%	0%				
	Soubrier et al. ¹⁹	8	36.9%	18.7%	50%		62.5%	25%		25%				75%				
OM	Torres-Ruiz et al. ¹⁵	10										0%	50%	50%				
	Leclaire et al. ¹⁴	24										13%	13%	33%				42%

ASyS: antisynthetase syndrome. Disorganised: disorganised capillaries. DM: dermatomyositis. Enlarged: enlarged/dilated capillaries. Giant: giant capillaries. IBM: inclusion body myositis. IIMs: idiopathic inflammatory myopathies. IMNM: immune-mediated necrotising myopathy. jDM: juvenile dermatomyositis. N: number of patients. Neo: Neovascularisation. No: normal. NS: non-specific. NVC: nailfold videocapillaroscopy. OM: overlap myositis. PM: polymyositis. Ramified: ramified capillaries. Reduced: reduced capillary density. Sc: scleroderma. ScL: scleroderma-like. Tortuous: tortuous capillaries.

strength and specificity of most associations²³.

Disease Duration

The relationship between NVC findings and disease duration has been primarily investigated in DM. Manfredi et al. reported that patients with a disease duration less than six months exhibited lower mean capillary density and frequent giant capillaries, whereas those with longer disease duration more often displayed a ScL capillaroscopic pattern¹². These observations suggested that NVC findings may evolve, reflecting the transition from early inflammatory to chronic microvascular changes^{24, 25}.

Additionally, it seems that adequate disease activity control, based on immunosuppressive therapy, may improve DM microangiopathy. For instance, Kubo et al. demonstrated that a cohort of IIMs patients, including DM and PM, showed that scleroderma-spectrum capillaroscopic abnormalities tended to diminish after one year of immunosuppressive treatment¹³. Consistently, in a study by Mugii et al., involving DM patients, the scores of irregularly enlarged capillaries, microhaemorrhages, and loss of capillaries were significantly reduced after disease stabilization²⁶. The potential regression of NVC findings seems also to be linked to certain autoantibodies, as will be developed later.

Disease Activity

Several studies have examined whether NVC abnormalities correlate with disease activity in IIMs.

In DM, Johnson et al. demonstrated that capillary density was independently associated with disease activity, as measured by the Myositis Intention-to-Treat Activity Index (MITAX)²⁴. Similarly, Mugii et al. found that DM patients with a scleroderma pattern had higher scores on the muscle disease activity visual analogue scale (VAS) and a tendency toward elevated serum creatine kinase (CK) lev-

TABLE II. Main clinical correlations with nailfold videocapillaroscopy findings in idiopathic inflammatory myopathies.

Clinical Domain	IIMs Subtype	Main Findings
Disease Duration	DM	Disease duration < 6 months associated with lower capillary density and giant capillaries ¹² Longer disease duration linked to scleroderma-like patterns ¹²
Disease Activity	DM	Capillary density correlated with MITAX ²⁴ Scleroderma patterns associated with higher muscle VAS and serum CK levels ²⁶ More NVC abnormalities correlated with greater activity on MDAAT/MDI ²⁰ NVC abnormalities potentially resolved after adequate immunosuppressive treatment ^{13, 26}
	jDM	Active disease associated with lower capillary density ¹⁶
	OM	Scleroderma pattern linked to higher global VAS ²¹
	IIMs	Scleroderma patterns associated with certain mucocutaneous manifestations ²²
Cutaneous Involvement	DM	Giant capillaries and avascular areas linked to Gottron's sign ²¹ Haemorrhages associated with Gottron's sign and heliotrope rash ²¹
	jDM	Skin DAS inversely correlated with mean capillary number ²⁸ Giant capillaries linked to higher skin VAS ²⁸
	OM	Scleroderma patterns and other abnormalities (giant loops, avascular areas, haemorrhages) associated with higher skin VAS ²¹
Pulmonary Involvement	IIMs	Scleroderma patterns associated with ILD ²²
	DM	ILD correlated with a greater number of NVC abnormalities ²⁰ In anti-MDA5/ARS IIMs, fatal ILD more frequent if higher microhaemorrhage scores ³¹
	jDM	Weak correlation between capillary density and reduced lung function/airway disease ³²
	ASyS	NVC abnormalities (especially ramified capillaries) more frequent in ILD ¹⁸

ASyS: antisynthetase syndrome. DAS: disease activity score. DM: dermatomyositis. IIMs: idiopathic inflammatory myopathies. ILD: interstitial lung disease. jDM: juvenile dermatomyositis. MDAAT: Myositis Disease Activity Assessment Tool. MDI: Myositis Damage Index. MITAX: Myositis Intention-to-Treat Activity Index. NVC: nailfold videocapillaroscopy. OM: overlap myositis. VAS: visual analogue scale.

els²⁶. In an earlier study, the extent of NVC abnormalities in DM patients correlated with greater disease activity on the Myositis Disease Activity Assessment Tool (MDAAT) and with a higher severity score on the Myositis Damage Index (MDI)²⁰. More recently, Tang et al. reported that greater NVC scores tended to be associated with MITAX in patients with anti-melanoma differentiation-associated protein 5 (MDA5) or anti-aminoacyl-tRNA-synthetase (ARS) antibodies, although this trend did not reach statistical significance, possibly due to a limited sample size⁹. In contrast, Torres-Ruiz et al. found no significant correlation between NVC abnormalities and clinical or laboratory markers of disease activity in a cohort formed by several subtypes of IIMs, including DM¹⁵.

In jDM, Barth et al. observed that active disease, according to the Pediatric Rheumatology International Trials Organization criteria²⁷, was associated with reduced capillary density¹⁶.

Finally, in OM, the presence of a scleroderma capillaroscopic pattern has been linked to higher global VAS scores²¹.

Cutaneous Involvement

Given the prominent cutaneous manifestations of DM

and jDM, several studies have explored correlations between NVC changes and skin disease in these diseases.

In a mixed cohort of IIMs patients, Bogojevic et al. associated the presence of a scleroderma pattern with diverse mucocutaneous features, including Gottron's sign, heliotrope rash, periungual erythema, and RP²².

In DM, dilated or giant capillaries and avascular areas were significantly associated with Gottron's sign, while microhaemorrhages correlated with both Gottron's sign and heliotrope rash²¹.

In jDM, Bica et al. demonstrated an inverse correlation between the skin Disease Activity Score (DAS) and mean capillary number, while higher skin VAS scores were associated with the presence of giant capillaries²⁸. Furthermore, periungual telangiectasias and Gottron's papules were significantly linked to reduced mean capillary density and giant capillaries²⁸. In another study, Smith et al. reported an association between skin DAS and end-row capillary loss²⁹.

In OM, a scleroderma capillaroscopic pattern and other NVC abnormalities, including abnormal shapes, giant capillaries, avascular areas, and haemorrhages, were associated with a higher skin VAS²¹.

These data suggest that cutaneous involvement and

NVC abnormalities frequently coexist, reinforcing the idea that nailfold microvasculature may reflect skin pathology in certain IIM subtypes.

Pulmonary Involvement

Regarding pulmonary involvement, most available evidence pertains to interstitial lung disease (ILD). In fact, given the prognostic relevance of ILD in IIMs, a possible correlation with NVC findings is a key area of interest.

A recently published study found an association between a scleroderma capillaroscopic pattern and the presence of ILD in a cohort of IIMs patients²². Sieiro Santos et al. studied a cohort with several subtypes of IIMs, finding that certain capillary findings, such as avascular zones, low capillary density, and an active scleroderma pattern, acted as predictors of ILD³⁰.

Wakura et al. found that, in patients positive for anti-MDA5 or anti-ARS antibodies, ILD was more lethal in those with higher median scores of microhaemorrhage³¹.

In DM, a study published in 2010 demonstrated that ILD correlated with a higher number of NVC abnormalities²⁰.

In jDM, Barth et al. described a weak correlation between reduced capillary density and reduced lung capacity, reduced diffusion capacity, and airway disease detected on high-resolution computer tomography³².

In ASyS, NVC abnormalities, especially ramified capillaries, were more frequent in patients with ILD¹⁸.

Globally, these findings suggest that capillaroscopic changes may act as a window into pulmonary involvement, particularly as ILD, although their predictive or prognostic utility requires further validation.

Other Organ Involvements

Analysing a cohort with several subtypes of IIMs, Sieiro Santos et al. found an association between dysphagia and low capillary density, avascular zones, and enlarged capillaries on NVC³⁰. Additionally, an international study published in 2023 concluded that NVC abnormalities, specifically enlarged capillaries and capillary loss, tended to be more frequent in IIMs patients with dropped head/bent spine syndrome³³.

Recently, Xu et al. reported a significantly higher incidence of RP in DM patients with abnormal NVC³⁴.

CORRELATIONS BETWEEN MYOSITIS-SPECIFIC AUTOANTIBODIES AND NAILFOLD CAPILLAROSCOPY FINDINGS

Autoimmunity is considered a key mechanism in the pathogenesis of IIMs, and myositis-specific autoantibodies (MSAs) are relevant for diagnosis, clinical phenotyping, and prognosis³⁵⁻³⁷. Increasing evidence suggests that certain MSAs may also correlate with distinct microvascular profiles identifiable by NVC (Table III). Importantly, the lack of large, antibody-stratified studies limits definite conclusions regarding distinct NVC aspects of each MSA.

Anti-MDA5: Severe Microangiopathy

Anti-MDA5 autoantibodies are typically associated with both mild muscle involvement and severe cutaneous and lung manifestations in DM patients³⁶. NVC studies in anti-MDA5-positive patients consistently demonstrate marked microvascular injury, characterised by enlarged capillaries, capillary disorganisation, neoangiogenesis, and microhaemorrhages^{25, 30, 31}. Nota-

TABLE III. Main nailfold videocapillaroscopy findings for distinct myositis-specific antibodies.

Autoantibody	Main NVC Findings
Anti-ARS	Ramified or tortuous capillaries and reduced capillary density ^{18, 31} Non-specific patterns ³⁵
Anti-MDA5	Enlarged capillaries, capillary disorganisation, neoangiogenesis, and microhaemorrhages ^{25, 30, 31} Non-specific or scleroderma (active subtype) patterns ³⁵
Anti-Mi-2	Reduced capillary density ³⁰ Non-specific or scleroderma patterns ³⁵
Anti-NXP2	Enlarged capillaries ³⁰ Non-specific or scleroderma patterns ³⁵
Anti-SAE	Scleroderma patterns ³⁵
Anti-TIF1γ	Enlarged capillaries, capillary rarefaction, and microhaemorrhages ³⁰ Non-specific or scleroderma (active subtype) patterns ³⁵
Anti-SRP	Tortuous and ramified capillaries ³⁰
Anti-HMGCR	Non-specific patterns ³⁵

Anti-ARS: anti-aminoacyl-tRNA-synthetase antibodies. Anti-MDA5: anti-melanoma differentiation-associated protein 5 antibody. Anti-HMGCR: anti-3-hydroxy-3-methylglutaryl-coenzyme A reductase antibody. Anti-NXP2: anti-nuclear matrix protein 2 antibody. Anti-SAE: anti-small ubiquitin-like modifier activating enzyme antibody. Anti-SRP: anti-signal recognition particle antibody. Anti-TIF1γ: anti-transcriptional intermediary factor 1-gamma antibody. NVC: nailfold videocapillaroscopy.

bly, it has been suggested that these abnormalities may be reversible following immunosuppressive therapy²⁵. A normal NVC pattern is rare in anti-MDA5 positive-DM; most patients exhibit non-specific or scleroderma patterns, particularly the active subtype¹⁵. These findings are consistent with a severe microangiopathic process, which appears linked to the pathogenesis of anti-MDA5-DM, involving a type I interferonopathy signature^{38, 39} and activation of type I interferon signaling in blood vessels⁴⁰. Therefore, the endothelial injury observed through NVC may represent a consequence of interferon-mediated vasculopathy, a hallmark of the anti-MDA5-DM phenotype³⁸.

Anti-TIF1 γ : Chronic Capillary Rarefaction

Anti-transcriptional intermediary factor 1-gamma (TIF1 γ) antibodies define a subset of DM often characterised by extensive cutaneous involvement and a higher malignancy risk in adult patients³⁶. The corresponding NVC phenotype is dominated by enlarged capillaries, capillary rarefaction, and microhaemorrhages²⁶. Similar to anti-MDA5 antibodies, anti-TIF1 γ -positive patients often present non-specific or scleroderma patterns on NVC, particularly the active subtype¹⁵.

In a longitudinal analysis by Mugii *et al.*, anti-TIF1 γ -positive patients exhibited persistent capillary rarefaction and enlargement (no definitions provided) throughout follow-up, contrasting with the partial reversibility observed in anti-MDA5-positive patients^{26,41}.

Anti-Mi-2, Anti-NXP2, and Anti-SAE: Subtle Findings

Data regarding the capillaroscopic features of patients with less frequent MSAs remain scarce, and comparative analyses between antibody-defined subgroups are particularly limited.

In DM, anti-Mi-2 is typically associated with the classic cutaneous features, higher serum creatine kinase levels, lower prevalence of ILD and malignancy, and an overall favourable prognosis³⁶. On NVC, both scleroderma patterns and non-specific abnormalities have been observed, and a reduced capillary density is also possible³⁰. Capillary disorganisation has also been described⁴².

Similarly, anti-nuclear matrix protein 2 (NXP2) autoantibody, common in jDM and associated with calcinosis, has been linked to the same NVC patterns, although the available evidence is limited¹⁵. Enlarged capillaries are a possible capillaroscopic finding³⁰.

Anti-small ubiquitin-like modifier activating enzyme (SAE) autoantibody, one of the rarer MSAs in DM³⁶, has also been linked to scleroderma patterns in the cohort analysed by Torres-Ruiz *et al.*¹⁵.

Anti-synthetase Antibodies: Nonspecific Abnormalities and Chronic Vascular Damage

Anti-ARS form a group of autoantibodies directed against an aminoacyl-tRNA synthetase, essential to RNA transcription and protein synthesis⁴³. Presently, this group includes anti-Jo-1 (more common, with an estimated prevalence of 25-30%) and non-Jo-1 antibodies (rarer, individual estimated prevalence <5%) – anti-PL7, anti-PL12, anti-EJ, anti-KS, anti-OJ, anti-Zo, anti-Ha, anti-Ly, and anti-VRS antibodies^{35, 43, 44}.

These autoantibodies are the hallmark of ASyS, characterised by classical clinical manifestations including myositis, fever, inflammatory arthritis, RP, mechanic's hands, and ILD^{6, 45}. Particularly, anti-PL12 positivity was linked to microhaemorrhages, while the detection of anti-Jo1 was related to enlarged capillaries³⁰. Anti-Jo1, anti-PL12, anti-PL12, anti-OJ, and anti-EJ have all been associated with a non-specific capillaroscopic pattern¹⁵. Most available evidence, however, doesn't differentiate between specific anti-ARS antibodies. Ramified or tortuous capillaries, giant capillaries, microhaemorrhages, and reduced capillary density are potential findings^{18,31,41}. These results suggest that microangiopathy is milder in anti-ARS than in pure DM³¹.

Anti-SRP and anti-HMGCR: Mild, Non-Specific Findings

Data on NVC findings in IMNM are also limited, but suggestive of milder abnormalities in comparison with other forms of IIMs. The two major serological subsets are defined by anti-signal recognition particle (SRP) and anti-3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMGCR) autoantibodies³⁶. In a multicenter study by Soubrier *et al.*, IMNM patients exhibited only tortuous and ramified capillaries, having no giant capillaries, major capillary loss, or severe capillary disorganisation¹⁹. In the analysis by Torres-Ruiz *et al.*, including eight anti-HMGCR and five anti-SRP-positive patients, a predominance of non-specific NVC abnormalities was noted¹⁵.

These results suggest that microangiopathy is not as significant in IMNM as in DM, although this concept remains to be validated by further research.

NVC FINDINGS IN IDIOPATHIC INFLAMMATORY MYOPATHIES IN COMPARISON WITH OTHER SYSTEMIC AUTOIMMUNE RHEUMATIC DISEASES

Most comparative studies of NVC abnormalities between IIMs and other SARDs have focused on SS¹¹, although there is also some data emerging from comparative analyses, including a broader spectrum of SARDs⁴⁶.

A large multicenter study published in 2023, com-

prising 1,181 patients with SSc, undifferentiated connective tissue disease (CTD), mixed CTD, DM, systemic lupus erythematosus (SLE), Sjögren's disease, and primary antiphospholipid syndrome (APS), showed that capillary enlargement, microhaemorrhages, and reduced mean capillary density were significantly more frequent in SSc and DM than in other SARDs⁴⁶.

In 2016, Manfredi et al. made a longitudinal evaluation of NVC findings in patients with DM and SSc⁴⁷. At baseline, SSc patients had more giant capillaries and severe capillary loss, whereas ramified capillaries were more frequent in DM⁴⁷. Interestingly, giant-ramified capillaries were almost exclusively observed in patients with DM. During a 30-month follow-up, divergent evolutions were noted. In DM, there was a significant reduction in giant capillaries and a recovery of capillary density, whereas in SSc, capillary loss worsened slightly⁴⁷.

Similarly, Pizzorni et al. reported higher capillary density, ramification, and disorganisation at baseline in DM, especially in patients with shorter disease duration (<1 year); SSc patients displayed more giant capillaries and microhaemorrhages⁴⁸.

Apart from SSc and specific abnormalities such as the “comblake” haemorrhages in APS⁴⁹, NVC findings are nonspecific in most SARDs, justifying the lack of comparative studies with IIMs. Importantly, the microvasculature (and consequently, NVC findings) may also be affected by non-rheumatic comorbidities, such as diabetes mellitus⁵⁰ or hypertension⁵¹.

PROGNOSTIC SIGNIFICANCE OF NVC FINDINGS IN IDIOPATHIC INFLAMMATORY MYOPATHIES

Certain NVC abnormalities seem to have prognostic value in IIMs, although most evidence pertains to DM and jDM.

Wakura et al. reported that DM patients who died due to ILD exhibited higher median microhaemorrhage and neoangiogenesis scores on NVC, suggesting a link between the severity of capillary damage and adverse pulmonary outcomes³¹. Also in DM, patients presenting with abnormal NVC showed a greater likelihood of being managed with triple combination immunosuppressive therapy³⁴.

In jDM, baseline NVC abnormalities have been associated with a higher probability of developing calcinosis during follow-up, emphasising the potential of NVC findings as early indicators of long-term disease damage⁵².

DISCUSSION

Current evidence supports the role of NVC as a valuable tool in the diagnosis, management, and assessment

of IIMs.

Microvascular injury plays a central role in the pathogenesis of IIMs, and NVC provides valuable insight into the microvascular involvement. This is especially relevant for DM, where the deposition of complement on the endothelial wall of endomysial vessels leads to destruction of endothelial cells⁵³. NVC abnormalities are frequent and tendentially more severe in DM, compared to other forms of IIM^{9, 10, 15}, suggesting a special contribution of microangiopathy in its pathogenesis. Severe microvascular alterations may be present early in the course of DM, with partial regression over time – an evolution not typically observed in other SARDs, such as SSc^{13, 47}. Importantly, the identification of ramified giant capillaries at early stages may provide a useful clue for distinguishing DM from SSc⁴⁷.

In line with this thought, DM-associated autoantibodies appear to be more frequently linked to sclerodermic capillaroscopic patterns compared to other MSAs, more often associated with non-specific abnormalities (Table III). This suggests that the serological profile may influence the severity of microvascular involvement, with DM-related autoantibodies reflecting a more pronounced microangiopathy. Such association also supports a potential role of NVC as a complementary tool for phenotypic stratification in IIMs.

Apart from DM, NVC abnormalities are also frequent in other forms of IIMs, including ASyS. Patients with ASyS may present with cutaneous features resembling those of DM^{6, 54}, raising ongoing debate as to whether these individuals should be classified as having ASyS or as a form of overlap with DM. This distinction is particularly relevant when interpreting capillaroscopic findings, as certain abnormalities commonly associated with DM – such as giant capillaries and a ScL pattern – have been reported in ASyS. Heterogeneity in disease definition and classification may partially explain the variability of capillaroscopic findings reported in this population. Possibly, the development of refined classification criteria may help to standardise patient categorization and harmonise the reported capillaroscopic findings across future studies⁵⁵.

NVC also represents a valuable tool in the monitoring of patients with IIMs, given its character as an inexpensive, rapidly performed, widely accessible, and non-invasive examination. Particularly in DM, capillaroscopic abnormalities correlate with disease activity^{20, 24, 26}. Moreover, as previously mentioned, these microvascular changes are not static; they may fluctuate over time and improve with adequate disease control. Consequently, in situations where a flare is suspected – such as in a patient with mild muscle weakness and a modest elevation in creatine kinase –, worsening of capillaroscopic findings may provide additional sup-

portive evidence of a flare, prompting rapid therapeutic adjustment. Furthermore, NVC may also contribute to risk stratification for ILD in IIMs^{22, 30}, serving as an adjunctive tool to identify patients at higher risk of pulmonary involvement, potentially prompting earlier diagnostic evaluation and careful pulmonary monitoring.

Despite the growing interest in the application of NVC in IIMs, several limitations remain, opening the opportunity for future research. First, most available studies are based on small, single-centre cohorts, which restricts statistical power and hinders the generalisability of findings. Future research would benefit from the development of large, multicentric registries that systematically collect detailed and standardised NVC parameters alongside clinical data.

A second challenge relates to the lack of standardisation in NVC image acquisition and interpretation. Considerable variability persists regarding the definition and reporting of capillaroscopic abnormalities, complicating cross-study comparisons, as highlighted in Table IV. The same capillaroscopic finding can be referred to by several definitions, and distinct classification sys-

tems are applied to categorise similar abnormalities across studies. Such heterogeneity complicates the synthesis of evidence and substantially limits the feasibility of meta-analyses with pooled data. Therefore, harmonised definitions and criteria, such as the EULAR-recommended protocols for NVC image acquisition, scoring, and terminology³, are essential to strengthen the robustness and comparative value of future research.

Evidence regarding the association between NVC abnormalities and rare MSAs – such as anti-SAE, anti-NXP2, or anti-HMGCR – also remains limited. It is not yet clear whether the combination of specific NVC abnormalities and MSAs can inform the clinician about prognosis or risk of specific clinical manifestations. Targeted studies or stratified analyses focusing on serological subsets are therefore needed to clarify these potential associations.

Finally, while the prognostic relevance of NVC abnormalities is increasingly recognised in DM, data for other forms of IIMs remain sparse. Prospective studies assessing the evolution of NVC patterns and their association with organ involvement and clinical outcomes

TABLE IV. Nailfold videocapillaroscopy findings and their different definitions across studies.

NVC Findings	Definition Across Studies
Tortuous Capillary	Capillary with a single or multiple crossovers ^{12, 19, 47}
Ramified Capillary	Branching or bushy interconnected capillary, originating from a single capillary ^{12, 18, 19, 30, 47, 48}
Dilated Capillary	Internal capillary diameter between 25-50 μm ^{16, 17} or 20-50 μm ^{9, 10, 17, 21, 28, 46, 49}
Enlarged Capillary	Increase of capillary diameter ≥ 20 and < 50 μm ^{12, 25, 30, 34, 47} Increase of capillary diameter > three times the normal capillary loop diameter for the patient ²³
Giant Capillary	Homogeneously enlarged capillary loop with a diameter ≥ 50 μm ^{12, 16-19, 25, 28, 30, 34, 46-48} Increase of capillary diameter > ten times the normal capillary loop diameter for the patient ²³
Capillary Disorganisation	Loss of capillaries parallelism ¹⁹ Irregular capillary distribution and orientation, along with heterogeneity in the loop shape ³⁰
Low Capillary Density	< 7 capillaries/mm ^{9, 20, 21, 46} < 6 capillaries/mm ¹² $4-6$ capillaries/mm ^{10, 34} < mean minus 2 standard-deviations, calculated from the control group ¹⁶
Capillary Loss	< 7 capillaries/mm ^{28, 30} $< 7-10$ capillaries/mm ¹² Reduction of the number of capillaries ⁴⁶
Capillary Rarefaction	≤ 3 capillaries/mm ^{10, 34}
Avascular Areas	Intercapillary distance > 500 μm ^{12, 18, 19, 21} Two or more capillaries missing, as compared with the areas of low capillary density in the rest of the row ²³ Loss of two consecutive loops of the nail bed ²³

NVC: nailfold videocapillaroscopy; mm: millimeter; μm : micromete

in non-DM IIMs are essential to determine the broader utility of NVC as a prognostic prediction tool for IIMs.

CONCLUSION

NVC provides a valuable window into the microvasculature of people living (or suspected of having) IIMs. Distinct findings may reflect underlying pathophysiology and hold diagnostic, prognostic, and follow-up (disease activity) relevance. Further research, including longitudinal, MSA-stratified studies, will permit the validation of the clinical impact of microvascular changes in IIMs patients.

REFERENCES

- Lambova SN, Müller-Ladner U. Nailfold capillaroscopy in systemic sclerosis - state of the art: The evolving knowledge about capillaroscopic abnormalities in systemic sclerosis. *J Scleroderma Relat Disord*. 2019;4:200-211. <https://doi.org/10.1177/2397198319833486>
- van den Hoogen F, Khanna D, Fransen J, Johnson SR, Baron M, Tyndall A, et al. 2013 classification criteria for systemic sclerosis: an American college of rheumatology/European league against rheumatism collaborative initiative. *Ann Rheum Dis*. 2013;72:1747-1755. <https://doi.org/10.1136/annrheumdis-2013-204424>
- Smith V, Herrick AL, Ingegnoli F, Damjanov N, De Angelis R, Denton CP, et al. Standardisation of nailfold capillaroscopy for the assessment of patients with Raynaud's phenomenon and systemic sclerosis. *Autoimmunity Reviews*. 2020;19:102458. <https://doi.org/10.1016/j.autrev.2020.102458>
- Conticini E, Dourado E, Bottazzi F, Cardelli C, Bruno L, Schmidt J, et al. Idiopathic inflammatory myopathies: one year in review 2023. *Clin Exp Rheumatol*. 2024;42:213-224. <https://doi.org/10.55563/clinexprheumatol/dh5o6c>
- Fattorini F, Conticini E, Dourado E, Bottazzi F, Bruno L, Diomedes M, et al. Idiopathic inflammatory myopathies: one year in review 2024. *Clinical and experimental rheumatology*. 2025;43:167-177. <https://doi.org/10.55563/clinexprheumatol/yizkja>
- Faghihi-Kashani S, Yoshida A, Bozan F, Zanframundo G, Rozza D, Loganathan A, et al. Clinical Characteristics of Anti-Synthetase Syndrome: Analysis From the Classification Criteria for Anti-Synthetase Syndrome Project. *Arthritis Rheumatol*. 2025;77:477-489. <https://doi.org/10.1002/art.43038>
- Lundberg IE, Fujimoto M, Vencovsky J, Aggarwal R, Holmqvist M, Christopher-Stine L, et al. Idiopathic inflammatory myopathies. *Nat Rev Dis Primers*. 2021;7:87. <https://doi.org/10.1038/s41572-021-00321-x>
- Dourado E, Melo AT, Campanilho-Marques R, Bandeira M, Martins P, Fraga V, et al. The idiopathic inflammatory myopathies module of the Rheumatic Diseases Portuguese Register. *ARP Rheumatol*. 2023;2:188-199.
- Tang M, Shi J, Pang Y, Zhou S, Liu J, Wu C, et al. Nailfold videocapillaroscopy findings are associated with IIM subtypes and IFN activation. *Arthritis Research & Therapy*. 2025;27:62. <https://doi.org/10.1186/s13075-025-03532-9>
- Flatley EM, Collins D, Lukowiak TM, Miller JH. Nailfold microscopy in adult-onset dermatomyositis in association with myositis antibodies. *Arch Dermatol Res*. 2024;317:34. <https://doi.org/10.1007/s00403-024-03521-z>
- Piette Y, Reynaert V, Vanhaecke A, Bonroy C, Gutermuth J, Sulli A, et al. Standardised interpretation of capillaroscopy in autoimmune idiopathic inflammatory myopathies: A structured review on behalf of the EULAR study group on microcirculation in Rheumatic Diseases. *Autoimmunity Reviews*. 2022;21:103087. <https://doi.org/10.1016/j.autrev.2022.103087>
- Manfredi A, Sebastiani M, Cassone G, Pipitone N, Giuggioli D, Colaci M, et al. Nailfold capillaroscopic changes in dermatomyositis and polymyositis. *Clinical Rheumatology*. 2015;34:279-284. <https://doi.org/10.1007/s10067-014-2795-8>
- Kubo S, Todoroki Y, Nakayamada S, Nakano K, Satoh M, Nawata A, et al. Significance of nailfold videocapillaroscopy in patients with idiopathic inflammatory myopathies. *Rheumatology*. 2018;58:120-130. <https://doi.org/10.1093/rheumatology/key257>
- Leclair V, Cotton T, Shen HC, Berger C, Troyanov Y, Hudson M, et al. Nailfold videocapillaroscopy abnormalities in autoimmune inflammatory myopathy subsets. *Rheumatology (Oxford)*. 2025. <https://doi.org/10.1093/rheumatology/keaf594>
- Torres-Ruiz J, Pinal-Fernandez I, Selva-O'Callaghan A, Campbell B, Muñoz-Braceras S, Mejía-Dominguez NR, et al. Nailfold capillaroscopy findings of a multicentric multi-ethnic cohort of patients with idiopathic inflammatory myopathies. *Clin Exp Rheumatol*. 2024;42:367-376. <https://doi.org/10.55563/clinexprheumatol/19gudh>
- Barth Z, Witczak BN, Flatø B, Koller A, Sjaastad I, Sanner H. Assessment of Microvascular Abnormalities by Nailfold Capillaroscopy in Juvenile Dermatomyositis After Medium- to Long-Term Followup. *Arthritis Care Res (Hoboken)*. 2018;70:768-776. <https://doi.org/10.1002/acr.23338>
- Doğantan Ş, Taşkın SN, Kisaarslan AP, Poyrazoğlu MH. Nailfold Capillaroscopic Changes in Children with Juvenile Dermatomyositis and Specific Autoantibodies. *Medical Journal of Bakirkoy*. 2025. <https://doi.org/10.4274/BMJ.galenos.2024.2024.3-11>
- Sebastiani M, Triantafyllias K, Manfredi A, González-Gay MA, Palmou-Fontana N, Cassone G, et al. Nailfold Capillaroscopy Characteristics of Antisynthetase Syndrome and Possible Clinical Associations: Results of a Multicenter International Study. *J Rheumatol*. 2019;46:279-284. <https://doi.org/10.3899/jrheum.180355>
- Soubrier C, Segurier J, Di Costanzo M-P, Ebbo M, Bernit E, Jean E, et al. Nailfold videocapillaroscopy alterations in dermatomyositis, antisynthetase syndrome, overlap myositis, and immune-mediated necrotizing myopathy. *Clinical Rheumatology*. 2019;38:3451-3458. <https://doi.org/10.1007/s10067-019-04710-2>
- Selva-O'Callaghan A, Fonollosa-Pla V, Trallero-Araguás E, Martínez-Gómez X, Simeon-Aznar CP, Labrador-Horrillo M, et al., editors. Nailfold capillary microscopy in adults with inflammatory myopathy. *Seminars in arthritis and rheumatism*; 2010: Elsevier. <https://doi.org/10.1016/j.semarthrit.2008.09.003>
- Shenavandeh S, Rashidi F. Nailfold capillaroscopy changes with disease activity in patients with inflammatory myositis including overlap myositis, pure dermatomyositis, and pure polymyositis. *Reumatologia*. 2022;60:42-52. <https://doi.org/10.5114/reum.2022.114109>
- Bogojevic M, Markovic Vlajsavljevic M, Medjedovic R, Strujic E, Pravilovic Lutovac D, Pavlov-Dolijanovic S. Nailfold Capillaroscopy Changes in Patients with Idiopathic Inflammatory Myopathies. *Journal of Clinical Medicine*. 2024;13:5550. <https://doi.org/10.3390/jcm13185550>
- Miozzi R, de Souza FHC, Shinjo SK. Nailfold capillary changes in adult new-onset dermatomyositis: a prospective cross-sectional

- study. *Clinical Rheumatology*. 2019;38:2319-2326. <https://doi.org/10.1007/s10067-019-04537-x>
24. Johnson D, van Eeden C, Moazab N, Redmond D, Phan C, Keeling S, et al. Nailfold Capillaroscopy Abnormalities Correlate With Disease Activity in Adult Dermatomyositis. *Frontiers in Medicine*. 2021;Volume 8 - 2021. <https://doi.org/10.3389/fmed.2021.708432>
 25. Sugimoto T, Mokuda S, Kohno H, Ishitoku M, Araki K, Watanabe H, et al. Nailfold capillaries and myositis-specific antibodies in anti-melanoma differentiation-associated gene 5 antibody-positive dermatomyositis. *Rheumatology*. 2021;61:2006-2015. <https://doi.org/10.1093/rheumatology/keab681>
 26. Mugii N, Hasegawa M, Matsushita T, Hamaguchi Y, Horie S, Yahata T, et al. Association between nail-fold capillary findings and disease activity in dermatomyositis. *Rheumatology*. 2011;50:1091-1098. <https://doi.org/10.1093/rheumatology/keq430>
 27. Lazarevic D, Pistorio A, Palmisani E, Miettunen P, Ravelli A, Pilkington C, et al. The PRINTO criteria for clinically inactive disease in juvenile dermatomyositis. *Ann Rheum Dis*. 2013;72:686-693. <https://doi.org/10.1136/annrheumdis-2012-201483>
 28. Bica PF, Hysa E, Campitiello R, Sulli A, Pizzorni C, Gotelli E, et al. Nailfold videocapillaroscopy in juvenile dermatomyositis: detailed correlations between microvascular abnormalities with clinical and laboratory parameters from an observational retrospective single-center study. *Clinical Rheumatology*. 2025;44:3615-3627. <https://doi.org/10.1007/s10067-025-07561-2>
 29. Smith RL, Sundberg J, Shamiyah E, Dyer A, Pachman LM. Skin involvement in juvenile dermatomyositis is associated with loss of end row nailfold capillary loops. *The Journal of Rheumatology*. 2004;31:1644-1649.
 30. Steiro Santos C, Tandaipan JL, Castillo D, Codes-Mendez H, Martínez-Martínez L, Magallares B, et al. Nailfold videocapillaroscopy findings correlate with lung outcomes in idiopathic inflammatory myopathies-related interstitial lung disease. *Rheumatology*. 2024. <https://doi.org/10.1093/rheumatology/keae669>
 31. Wakura R, Matsuda S, Kotani T, Shoda T, Takeuchi T. The comparison of nailfold videocapillaroscopy findings between anti-melanoma differentiation-associated gene 5 antibody and anti-aminoacyl tRNA synthetase antibody in patients with dermatomyositis complicated by interstitial lung disease. *Sci Rep*. 2020;10:15692. <https://doi.org/10.1038/s41598-020-72752-7>
 32. Barth Z, Schwartz T, Flatø B, Aaløkken TM, Koller A, Lund MB, et al. Association Between Nailfold Capillary Density and Pulmonary and Cardiac Involvement in Medium to Longstanding Juvenile Dermatomyositis. *Arthritis Care Res (Hoboken)*. 2019;71:492-497. <https://doi.org/10.1002/acr.23687>
 33. Pijnenburg L, Giannini M, Bouchard-Marmen M, Arnaud L, Barsotti S, Bellando-Randone S, et al. In inflammatory myopathies, dropped head/bent spine syndrome is associated with scleromyositis: an international case-control study. *RMD Open*. 2023;9:e003081. <https://doi.org/10.1136/rmdopen-2023-003081corr1>
 34. Xu H, Qian J. The role of nailfold video-capillaroscopy in the assessment of dermatomyositis. *Rheumatology (Oxford)*. 2025;64:2987-2994. <https://doi.org/10.1093/rheumatology/keae677>
 35. Wang G, McHugh NJ. An update on myositis autoantibodies and insights into pathogenesis. *Clin Exp Rheumatol*. 2025;43:364-371. <https://doi.org/10.55563/clinexprheumatol/kvj2cy>
 36. Halilu F, Christopher-Stine L. Myositis-specific Antibodies: Overview and Clinical Utilization. *Rheumatol Immunol Res*. 2022;3:1-10. <https://doi.org/10.2478/rir-2022-0001>
 37. Dourado E. Clinical relevance of autoantibodies in idiopathic inflammatory myopathies: an evolving and challenging translational field. *Rheumatology*. 2024;64:913-915. <https://doi.org/10.1093/rheumatology/keae451>
 38. Yoshida T, Nakashima R. Anti- Melanoma Differentiation-Associated Gene 5 Antibody Positive Dermatomyositis: Recent Progress in Pathophysiology and Treatment. *Current Rheumatology Reports*. 2025;27:23. <https://doi.org/10.1007/s11926-025-01188-7>
 39. Castellini C, Scotti C, Navarini L, Fu Q, Qian J, Giacomelli R, et al. The evaluation of type I interferon score in dermatomyositis, a systematic review and a meta-analysis. *Autoimmunity Reviews*. 2024;23:103686. <https://doi.org/10.1016/j.autrev.2024.103686>
 40. Ye Y, Chen Z, Jiang S, Jia F, Li T, Lu X, et al. Single-cell profiling reveals distinct adaptive immune hallmarks in MDA5+ dermatomyositis with therapeutic implications. *Nat Commun*. 2022;13:6458. <https://doi.org/10.1038/s41467-022-34145-4>
 41. Mugii N, Hamaguchi Y, Horii M, Fushida N, Ikeda T, Oishi K, et al. Longitudinal changes in nailfold videocapillaroscopy findings differ by myositis-specific autoantibody in idiopathic inflammatory myopathy. *Rheumatology*. 2022;62:1326-1334. <https://doi.org/10.1093/rheumatology/keac401>
 42. Sieiro Santos C, Tandaipan JL, Mariscal A, Sainz Comas L, Codes H, Moya P, et al. Ab0811 Nailfold Capillaroscopy Findings In Patients With Idiopathic Inflammatory Myopathies And Its Association To Autoantibodies: A Case-Control Study. *Annals of the Rheumatic Diseases*. 2023;82:1618-1619. <https://doi.org/10.1136/annrheumdis-2023-eular.1196>
 43. Patel P, Marinock JM, Ajmeri A, Brent LH. A Review of Antisynthetase Syndrome-Associated Interstitial Lung Disease. *Int J Mol Sci*. 2024;25. <https://doi.org/10.3390/ijms25084453>
 44. Loganathan A, Zanframundo G, Yoshida A, Faghihi-Kashani S, Bauer Ventura I, Dourado E, et al. Agreement between local and central anti-synthetase antibodies detection: results from the Classification Criteria of Anti-Synthetase Syndrome project biobank. *Clin Exp Rheumatol*. 2024;42:277-287. <https://doi.org/10.55563/clinexprheumatol/s14zq8>
 45. Zanframundo G, Dourado E, Bauer-Ventura I, Faghihi-Kashani S, Yoshida A, Loganathan A, et al. The role of multicriteria decision analysis in the development of candidate classification criteria for antisynthetase syndrome: analysis from the CLASS project. *Ann Rheum Dis*. 2025;84:1207-1220. <https://doi.org/10.1016/j.ard.2025.01.050>
 46. Hysa E, Pizzorni C, Sammori S, Gotelli E, Cere A, Schenone C, et al. Microvascular damage in autoimmune connective tissue diseases: a capillaroscopic analysis from 20 years of experience in a EULAR training and research referral centre for imaging. *RMD Open*. 2023;9:e003071. <https://doi.org/10.1136/rmdopen-2023-003071>
 47. Manfredi A, Sebastiani M, Campomori F, Pipitone N, Giuggioli D, Colaci M, et al. Nailfold Videocapillaroscopy Alterations in Dermatomyositis and Systemic Sclerosis: Toward Identification of a Specific Pattern. *The Journal of Rheumatology*. 2016;43:1575-1580. <https://doi.org/10.3899/jrheum.160122>
 48. Pizzorni C, Cutolo M, Sulli A, Ruaro B, Trombetta AC, Ferrari G, et al. Long-term follow-up of nailfold videocapillaroscopic changes in dermatomyositis versus systemic sclerosis patients. *Clinical Rheumatology*. 2018;37:2723-2729. <https://doi.org/10.1007/s10067-018-4211-2>
 49. Ferrari G, Gotelli E, Paolino S, Pesce G, Nanni L, Colombo BM,

- et al. Antiphospholipid antibodies and anticoagulant therapy: capillaroscopic findings. *Arthritis Res Ther.* 2021;23:175. <https://doi.org/10.1186/s13075-021-02551-6>
50. Maldonado G, Guerrero R, Paredes C, Ríos C. Nailfold capillaroscopy in diabetes mellitus. *Microvascular Research.* 2017;112:41-46. <https://doi.org/10.1016/j.mvr.2017.03.001>
51. Mishra A, Grover C, Singal A, Narang S, Das GK. Nailfold capillary changes in newly diagnosed hypertensive patients: An observational analytical study. *Microvascular Research.* 2021;136:104173. <https://doi.org/10.1016/j.mvr.2021.104173>
52. Nozawa T, Bell-Peter A, Marcuz J-A, Whitney K, Vinik O, Shupak R, et al. Early Abnormal Nailfold Capillary Changes Are Predictive of Calcinosis Development in Juvenile Dermatomyositis. *The Journal of Rheumatology.* 2022;49:1250-1255. <https://doi.org/10.3899/jrheum.220249>
53. Dalakas MC. Inflammatory muscle diseases. *N Engl J Med.* 2015;372:1734-1747. <https://doi.org/10.1056/NEJMra1402225>
54. Stone CJ, Faden DF, Xie L, Lim D, Lopes Almeida Gomes L, Werth VP. Overlapping clinical features in anti-synthetase syndrome and dermatomyositis: A case series. *J Am Acad Dermatol.* 2025;92:313-315. <https://doi.org/10.1016/j.jaad.2024.07.1530>
55. Zanframundo G, Faghihi Kashani S, Yoshida A, Dourado E, Bauer Ventura I, Rivero Gallegos D, et al., editors. The Classification Criteria for Anti-Synthetase Syndrome (CLASS) Project. *Arthritis & Rheumatology*; 2024.