Section: DVL

Original Research Article

NAILFOLD DERMOSCOPIC CHANGES IN CONNECTIVE TISSUE DISORDERS

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ABSTRACT

Background: Nailfold dermoscopy is a non-invasive bedside tool for assessing microvascular abnormalities in connective tissue disorders (CTDs). Although widely adopted in Western literature, data on its diagnostic value among Indian patients remain sparse, limiting its routine application in early disease detection and monitoring. The objective is to evaluate nailfold dermoscopic patterns in patients with CTDs and correlate them with clinical features, disease duration, serological markers, and systemic involvement to enhance diagnostic precision and guide management.

Materials and Methods: A cross-sectional observational study was conducted on 45 patients with clinically and serologically confirmed CTDs over 18 months. Nailfold dermoscopy was performed to assess capillary morphology. Correlations with systemic findings, autoantibody profiles, and treatment responses were analyzed. Capillary changes were classified using Cutolo's staging criteria. Statistical analysis included Chi-square and t-tests ($p<0.05$ as significant).

Results: Systemic sclerosis showed the most severe microvascular changes, including reduced capillary density and late patterns. Significant associations were found between dermoscopic abnormalities and Raynaud's phenomenon, sclerodactyly, disease duration, HRCT abnormalities, and ANA patterns. Cyclophosphamide showed superior treatment response compared to methotrexate.

Conclusion: Nailfold dermoscopy is a reliable, non-invasive method to detect, monitor, and stratify microvascular involvement in CTDs.

Keywords: Nailfold dermoscopy; Connective tissue diseases; Systemic sclerosis; Capillary dropout; Raynaud phenomenon; Autoimmune rheumatic diseases.

INTRODUCTION

Nailfold dermoscopy is a non-invasive, point-of-care imaging tool used to assess microvascular changes in connective tissue disorders (CTDs) such as systemic sclerosis (SSc), systemic lupus erythematosus (SLE), dermatomyositis (DM), mixed connective tissue disease (MCTD), and rheumatoid arthritis (RA).[1,2] While often compared to nailfold capillaroscopy, dermoscopy offers portability and real-time assessment, albeit at lower magnification (~10x), making it suitable for clinical screening, especially in resource-limited settings.[1] Characteristic dermoscopic features in CTDs include dilated capillary loops, bushy capillaries, microhemorrhages, avascular zones, and capillary dropouts.[2,3] These findings correlate with disease activity, systemic involvement, and therapeutic

response. For instance, in SSc, a "scleroderma pattern" has been described and classified into early, active, and late stages, with increasing capillary loss and neoangiogenesis reflecting disease progression.[4,5] Similar scleroderma-like patterns are also observed in MCTD, DM, and overlap syndromes.[6] Although nailfold capillaroscopy is well-documented in the literature, dermoscopic evaluation has gained momentum as a simpler, cost-effective alternative. In Indian populations, however, data on dermoscopic patterns in CTDs remain sparse, limiting its diagnostic and prognostic application in clinical practice.

The purpose of the study is to assess nailfold dermoscopic patterns in connective tissue disorders and establish their correlation with clinical manifestations, aiming to facilitate early detection and personalized management in Indian patients.

MATERIALS AND METHODS

The cross-sectional observational study was conducted over a period of 18 months at the Department of Dermatology, Venereology, and Leprosy, Shri Mahant Indresh Hospital, Dehradun—a tertiary care center serving a diverse urban and semi-urban population of Uttarakhand. The study aimed to evaluate nailfold dermoscopic changes in patients diagnosed with connective tissue disorders (CTDs) and correlate them with systemic and cutaneous manifestations. Ethical clearance was obtained from the Institutional Ethical Committee, and informed consent was taken in both English and Hindi from all participants prior to enrollment.

Patients attending the dermatology outpatient department with confirmed diagnoses of CTDs—based on standard clinical and serological criteria—were included. Those with coexisting distal digit dermatoses such as eczema, onychomycosis, or psoriatic nail changes, or those unwilling to consent, were excluded. The sample size was calculated using Cochran's formula, considering a 3% prevalence rate and 5% allowable error, resulting in a minimum required sample of 45, determined via Statulator software.

Detailed clinical history was obtained, including demographic details, disease duration, symptoms, family history, and treatment response. Systemic complaints suggestive of organ involvement—such as Raynaud's phenomenon, joint pain, myopathy, respiratory symptoms, gastrointestinal disturbances, and cardiovascular manifestations—were carefully documented. Nailfold dermoscopy was performed using a dermatoscope with magnification ranging from 10× to 200× to assess capillary morphology, density, hemorrhages, avascular areas, and vascular architecture. Capillary features were categorized based on the Cutolo classification into Early, Active, and Late patterns. All dermoscopic images were captured digitally and evaluated independently in a blinded manner to ensure accuracy and reduce observer bias.

To correlate dermoscopic findings with systemic disease, all patients underwent appropriate investigations including ANA profiling, specific autoantibodies (anti-dsDNA, anti-Scl-70, anti-U1 RNP, anti-Jo-1), rheumatoid factor, CRP, ESR, and renal function tests. Where indicated, additional assessments such as pulmonary function testing, HRCT chest, echocardiography, ECG, barium swallow, and 24-hour urinary protein were performed. Skin biopsies were obtained in patients with suspicious cutaneous lesions. A pilot study was conducted to validate the methodology and refine data collection tools. All clinical and investigation data were recorded using structured case forms. Statistical analysis was carried out using SPSS version 22, employing descriptive statistics for baseline variables and Chi-square or t-tests for inferential analysis. A p-value of <0.05 was considered statistically significant.

RESULTS

Our study of 45 patients showed a female predominance (60%) and most were aged 31–50 years (55.6%). Secondary or higher education (55.6%) and middle to lower socioeconomic status were common, with significant associations for both ($p=0.03$, $p<0.01$). Systemic sclerosis was the most frequent CTD (33.3%, $p=0.02$), followed by SLE and RA.

Table 1: Nailfold Capillary Patterns and Capillary Density Across Connective Tissue Disorders

Diagnosis	Early Pattern (%)	Active Pattern (%)	Late Pattern (%)	Capillary Density (Mean ± SD)
Systemic Sclerosis (SSc)	60.0	33.3	6.7	4.2 ± 1.1
Systemic Lupus Erythematosus (SLE)	33.3	41.7	25.0	6.8 ± 1.5
Rheumatoid Arthritis (RA)	20.0	30.0	50.0	5.3 ± 1.3

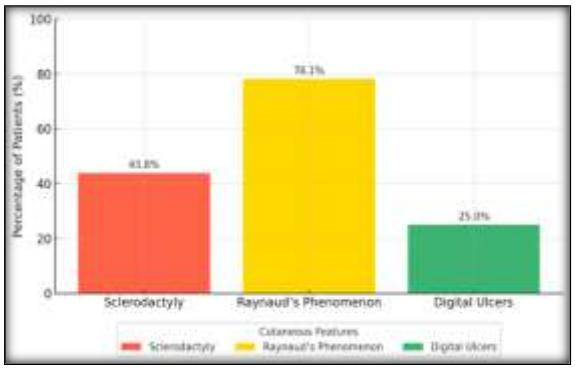

Figure 1: Cutaneous vs. Capillaroscopic Changes

In [Table 1], the predominance of early capillary patterns in systemic sclerosis and late-stage changes in rheumatoid arthritis highlights distinct microvascular involvement across CTDs, with systemic sclerosis showing the lowest capillary density, reflecting severe vasculopathy.

[Figure 1] shows that Raynaud's phenomenon (78.1%) is most frequently associated with abnormal capillaroscopy, followed by sclerodactyly (43.8%) and digital ulcers (25.0%), with each showing a statistically significant correlation.

Giant capillaries were more frequently seen in patients with disease duration less than 5 years, while avascular areas were significantly higher in those with longer disease duration, indicating progression of vascular injury over time, as shown in [Table 2].

Homogeneous ANA patterns were significantly associated with abnormal capillaroscopic findings, suggesting their potential as immunological markers of microvascular involvement in CTDs, as shown in [Table 3].

Table 2: Capillary Morphology vs. Disease Duration

Morphology	<5 Years (n=20)	≥5 Years (n=25)	p-value
Giant Capillaries	12 (60.0%)	8 (32.0%)	0.03
Avascular Areas	5 (25.0%)	15 (60.0%)	<0.01

Table 3: ANA Positivity vs. Capillaroscopy

ANA Pattern	Abnormal Capillaroscopy (n=32)	Normal (n=13)	p-value
Homogeneous	18 (56.2%)	4 (30.8%)	0.04
Speckled	10 (31.2%)	6 (46.2%)	0.12

[Figure 2] shows that microhemorrhages were observed in 60.0% of early-stage disease cases compared to only 22.2% in late-stage disease, indicating a significant association with early vascular damage.

The presence of capillary dropout was strongly associated with HRCT-detected lung abnormalities, while cyclophosphamide showed a better capillaroscopic response compared to methotrexate, indicating therapeutic efficacy in reversing microvascular changes, as shown in [Table 4].

High interobserver agreement in assessing giant capillaries (κ = 0.82) and avascular areas (κ = 0.75) supports the reliability and reproducibility of nailfold dermoscopy in evaluating microvascular changes in CTDs, as shown in [Table 5].

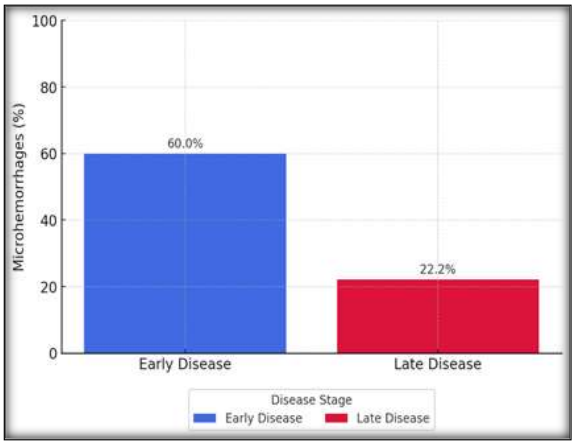

Figure 2: Microhemorrhages.

Table 4: HRCT Abnormalities and Treatment Response Based on Capillaroscopic Findings

Parameters		Frequency (n)	Percentage (%)	p-value
HRCT Abnormalities	Capillary Dropout Present, (n=20)	14	70.0%	<0.01
	Capillary Dropout Absent, (n=25)	6	24.0%	
Capillaroscopic Improvement with	Cyclophosphamide (n=11)	8	72.7%	0.04
	Methotrexate (n=12)	5	41.7%	

Table 5: Interobserver Variability (Methodology Validation)

Parameter	Observer 1 vs. 2 (Kappa Score)	p-value
Giant Capillaries	0.82	<0.01
Avascular Areas	0.75	

DISCUSSION

In this study on nailfold dermoscopic changes in connective tissue disorders (CTDs), significant microvascular abnormalities were observed, with systemic sclerosis (SSc) being the most prevalent diagnosis (33.3%)—a finding consistent with Eldeeb et al. and Jeelani et al., who similarly reported SSc as the dominant CTD with typical scleroderma patterns.[7,8] Early capillaroscopic patterns (giant

capillaries) were most frequent in SSc (60.0%) and showed significant association (p=0.04), mirroring observations by Alessandrini et al. and Bhakuni et al. Late capillary dropout was most marked in rheumatoid arthritis (50.0%, p<0.01), an unusual but previously noted trend in Rajaei et al., suggesting overlooked microangiopathy in chronic RA cases.[9-11] Capillary density was significantly lower in SSc (4.2 ± 1.1 capillaries/mm, p<0.01), aligning with Bhakuni et al. and Caramaschi et al., both of whom associated capillary rarefaction with late scleroderma pattern and internal organ involvement.[10,12] SLE patients showed moderate capillary density loss (6.8 ± 1.5/mm), consistent with Nagy and Czirjak, while RA had a non-significant reduction, echoing findings by Lee et al.[13,14]

Microvascular changes also correlated with disease duration. Giant capillaries predominated in disease <5 years (60.0%), while avascular areas increased in disease ≥5 years (60.0%, p<0.01), supporting Caramaschi et al. and Cutolo et al,[12,15] who described this morphological shift as a hallmark of disease progression. Microhemorrhages, significantly more common in early disease (60.0%, p=0.02), were similarly reported in early-phase dermatomyositis by Manfredi et al.[16]

Abnormal capillaroscopic features showed strong associations with clinical signs like Raynaud's (78.1%, p<0.01) and sclerodactyly (43.8%, p=0.02), reinforcing Cutolo et al. and Sato et al.'s emphasis on Raynaud's as a predictor of early vascular damage.[15,17] Capillary dropout was significantly linked to HRCT-proven pulmonary fibrosis (70.0%, p<0.01), as described by Ingegnoli et al. and Sato et al.[6,17]

Treatment response analysis revealed superior vascular improvement with cyclophosphamide (72.7%, p=0.04) compared to methotrexate (41.7%), reflecting results from Manfredi et al. and Parker, who reported vascular regression following aggressive immunosuppression.[16,18]

Socioeconomic factors strongly influenced outcomes. Delayed diagnosis and poor treatment adherence were significantly higher among lower socioeconomic groups, as supported by Ghannem et al. and Desai & Nayak.[19,20] Finally, interobserver reliability was high (Kappa = 0.82 for giant capillaries), validating the methodological robustness of nailfold dermoscopy as emphasized by Alessandrini et al. and Bergman et al.[9,21]

CONCLUSION

We concluded that nailfold dermoscopy is a simple yet effective tool for detecting vascular changes in connective tissue disorders. It aids in early diagnosis, reflects disease severity, and monitors treatment response, especially in systemic sclerosis. Its bedside utility makes it highly suitable for routine clinical practice, offering valuable insights into microvascular pathology across various autoimmune conditions.

Limitations: The limitations of the study include its single-center design, limited sample size, and lack of follow-up. Rare CTD subtypes were underrepresented, limiting subgroup analysis. The absence of capillaroscopic validation may have restricted deeper morphological comparisons. Despite this, the findings remain clinically meaningful and highlight the diagnostic potential of nailfold dermoscopy.

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