



NAILFOLD CAPILLAROSCOPY IN DARK SKINNED INDIVIDUALS : A DIAGNOSTIC CHALLENGE WORTH EXPLORING?

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ABSTRACT **Background** - Nailfold capillaroscopy is a non-invasive diagnostic tool used to evaluate microvascular changes. While it is widely recognized for its utility in assessing disease severity and progression, its application in dark-skinned individuals remains underexplored. Melanin in skin can pose challenges in visualization and interpretation, potentially leading to underdiagnosis or misdiagnosis of microvasculopathy in dark skinned populations. **Aims and Objectives** - This study aims to evaluate the effectiveness and challenges of nail fold capillaroscopy in detecting microvascular abnormalities in dark-skinned individuals. **Materials and Methods** - A cross-sectional study was done among 100 patients presenting to dermatology OPD and nail fold capillaroscopy was done. The patients were divided into group A with dermatological disorders with known microvascular changes and group B with dermatological disorders without any known microvascular changes. **Results** - Capillaries were visible in 33% of total patients. Among group A patients, the capillaries were visible in 88% of Fitzpatrick type 4, 48% of type 5 patients. Among group B patients, the capillaries were visible in 38% of Fitzpatrick type 4 and only 4% of skin type 5 patients. None of the patients with Fitzpatrick skin type 6 showed visible capillaries in either of the groups. Even when visible, the majority of the capillaries were unevaluable due to the hindrance by the skin pigmentation. Findings revealed significant differences in capillary visibility and pattern recognition between Fitzpatrick skin type 4, 5, 6 individuals in both the groups. **Conclusion** - This study concludes that the capillary visibility, pattern recognition and appreciation of abnormalities in the morphological pattern of capillaries decreased sequentially in the Fitzpatrick skin type 4, 5 and 6. The nailfold capillaroscopy remains a valuable tool for assessing microvasculature in dark-skinned individuals, but melanin in skin and the amount of pigmentation significantly influences the visualization of the nailfold capillaries.

KEYWORDS : Nailfold capillaroscopy, skin of color, connective tissue disorders

INTRODUCTION

Nailfold capillaroscopy is a non-invasive diagnostic imaging technique used to evaluate microvascular changes in the nail fold capillaries. The translucency and decreased cell thickness in the nail folds has made it possible for the in vivo assessment of the capillaries in this region. Melanin in dark skinned individuals can pose challenges in nail fold capillaroscopy as it hinders the visualization and interpretation of the morphological patterns of the capillaries in nail fold. This can potentially lead to underdiagnosis or misdiagnosis of microvasculopathy in dark skinned populations. Large scaled studies of nailfold capillaroscopic findings in white skinned populations with Fitzpatrick skin type 1,2,3 have documented morphological abnormalities in the nail fold capillaries in dermatological disorders. The majority of the Indian population come under Fitzpatrick skin type 4 and 5, but the application of nail fold capillaroscopy in dark-skinned individuals of Fitzpatrick skin type 4,5,6 has remained underexplored. This study aims to evaluate the effectiveness and challenges of nail fold capillaroscopy in detecting microvascular abnormalities in dark-skinned individuals.

METHODS:

A cross-sectional study was done from December 2024 to May 2025 among 100 patients attending DVL OPD of a tertiary care hospital in South India. Patients aged ≥ 18 years who were willing to participate in the study were included in the study. Patients with infections and eczema involving nail fold and those aged < 18 years and > 80 years, pregnant and lactating women and smokers were excluded from the study.

The Institutional Ethics Committee approval was obtained.

An informed consent was obtained from every patient and thorough history related to dermatological disease, caffeine intake upto 6 hours prior to examination was noted and clinical examination including the Fitzpatrick skin type assessment was performed. The patients were

seated comfortably with hands kept at the level of heart and given a rest period of 15-20 mins in a room with normal ambient temperature for acclimatization¹ and the nailfold capillaries were then examined with a hand held polarized dermatoscope of 10x magnification. A qualitative assessment of the nailfold capillaries were done by assessing the morphological patterns of the nail fold capillaries of each finger and the images were captured with a 50 MP mobile camera.

Based on the clinical examination, the participants were grouped into 2 categories. The group A included patients with dermatological diagnosis with known microvascular changes i.e., psoriasis and connective tissue disorders like systemic sclerosis, systemic lupus erythematosus, dermatomyositis. The group B included patients with all other dermatological disorders without any known microvascular changes. The nail fold capillaroscopy findings were analyzed based on Cutolo et al^{2,3,4} study and categorized based on the criteria laid by EULAR studies⁵ and compared between each group. The visibility of the capillaries was assessed among each Fitzpatrick skin types within the study groups and with Standard Fitzpatrick skin types 1, 2, 3 from previous studies.

The abnormal nail fold capillary definitions used in our study are as follows⁶:

- Tortuous capillaries - capillary limb curled but not crossing over
- Meandering capillaries - limbs crossed upon themselves several times
- Dilated and giant capillaries - width of the capillary > 2 times or > 10 times the normal, respectively
- Neo-angiogenesis /bushy capillaries - small, multiple buds originating from the distal loop
- Microhemorrhages - small punctate bleeds around the nail fold capillaries
- Capillary dropouts, avascular areas - absence of two or more adjacent capillaries from the distal-most row
- Receding capillaries - capillaries laying slightly proximal to the

distal most loops but has not dropped out yet

- Bizarre capillaries - atypical morphology not conforming to the predefined morphologies

The data collected was tabulated and analyzed using MS Excel IBM SPSS 21 version.

RESULTS

There were a total 100 cases in our study, which had 45 patients in group A and 55 patients in group B. All patients were of Fitzpatrick type 4,5,6 in our study. In group A, 17 patients were of Fitzpatrick skin type 4, 19 patients were of skin type 5 and 9 patients were of skin type 6. In group B, 21, 24, and 10 patients were of Fitzpatrick skin type 4,5 and 6 respectively.

The Nail Fold Capillaroscopy findings were categorized into Visible Nail Fold Capillaries (NFC) and Invisible Nail Fold Capillaries. The visible NFC were subdivided based on the morphological patterns observed⁵.

- Normal NFC - normal or non-specific pattern (defined as hairpin, crossing or tortuous)
- Abnormal NFC - abnormal pattern (not hairpin, not tortuous and not crossing)
- Unevaluable NFC - whenever unable to classify between normal and abnormal

Table 1: Visualization Of Nailfold Capillaries Among Various Fitzpatrick Skin Types In Our Study

Groups	Visible NFC			Invisible NFC	Total
	Normal NFC	Abnormal NFC	Unevaluable NFC		
Group A	4 (9%)	8 (18%)	12 (26%)	21 (47%)	45 (100%)
Fitzpatrick type 4	4 (24%)	5 (29%)	6 (35%)	2 (12%)	17 (100%)
Fitzpatrick type 5	0	3 (16%)	6 (32%)	10 (52%)	19 (100%)
Fitzpatrick type 6	0	0	0	9 (100%)	9 (100%)
Group B	3 (5%)	0	6 (11%)	46 (84%)	55 (100%)
Fitzpatrick type 4	2 (9%)	0	6 (29%)	13 (62%)	21 (100%)
Fitzpatrick type 5	1 (4%)	0	0	23 (96%)	24 (100%)
Fitzpatrick type 6	0	0	0	10 (100%)	10 (100%)

33% of the total participants showed visible capillaries in their nail fold and in 77% of participants the capillaries were invisible. Table 1 shows the capillaroscopy findings in groups A and B among the Fitzpatrick skin types 4, 5, 6 patients.

In group A, the observed abnormalities in the morphology of nail fold capillaries were dilated capillaries (75%), disorganization of capillary distribution (70%), tortuosity (55%), receding capillaries (50%), capillary dropouts (46%), avascular areas (40%), microhaemorrhage (52%) and giant capillaries (35%) (Figure 1).

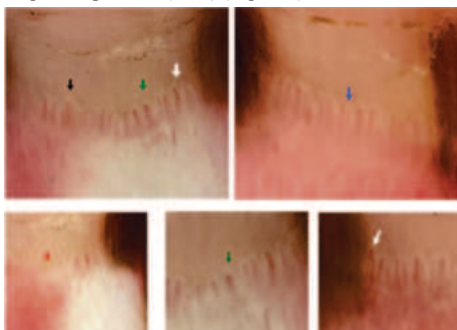


Figure 1: Nailfold capillaroscopy findings observed in our study - Ramified capillaries (black arrow), Giant capillaries (green arrows), Tortuous capillaries (white arrows), Receding capillaries (blue arrow), Capillary dropouts and avascular areas (red arrow)

Subgrouping within group A showed us that the capillaries were visible in 88% (n=15) of patients of Fitzpatrick skin type 4, 48% (n=9) of

Fitzpatrick type 5 patients. This difference in the visualization of capillaries is statistically significant with a p value <0.05. Even among Fitzpatrick type 4 patients, though 88% (n=15) patients showed visible capillaries, the majority 35% (n=6) among them were unevaluable. Among Fitzpatrick type 5 patients, in 32% (n=6) of patients, capillaries were barely visible but the morphological pattern of the capillaries still could not be appreciated and hence were unevaluable. Capillaries were invisible in 100% (n=9) patients of Fitzpatrick skin type 6 in group A.

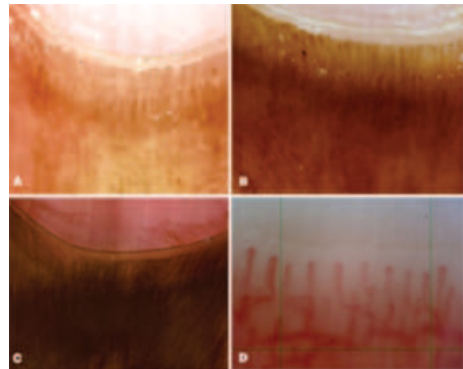


Figure 2: Nailfold capillaroscopy images obtained in our study in (a) Fitzpatrick type 4 (b) Fitzpatrick skin type 5 (c) Fitzpatrick skin type 6 in comparison with (d) images obtained in Sandy et al⁷ study with skin type 1,2,3

It could be noticed that the capillary visibility, pattern recognition and appreciation of abnormalities in the morphological pattern of capillaries decreased sequentially in the Fitzpatrick skin type 4, 5 and 6 (Figure 2). Nail fold capillaroscopy images from other studies done among the population with predominant Fitzpatrick skin type 1,2 and 3 (Sandy et al⁷) were compared with the images obtained in our study with predominant Fitzpatrick skin type 4, 5 and 6 individuals (Figure 2d). The capillaries were more clearly visible in the former with better appreciation of the morphological characteristics of the capillaries than the latter.

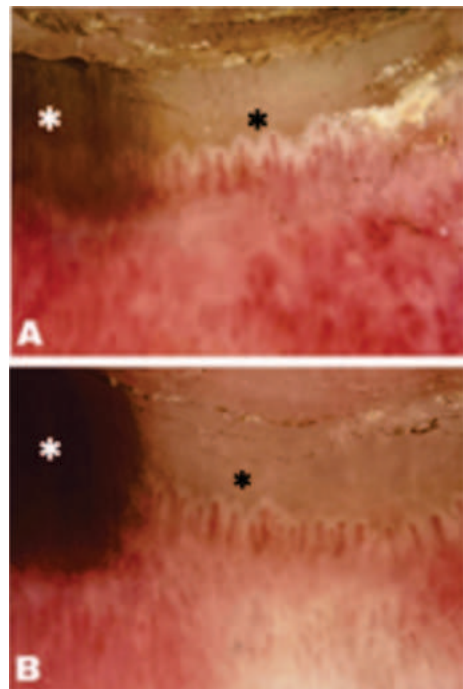


Figure 3: Comparison of visualization of nailfold capillaries in normally pigmented areas (white stars) and depigmented patches (black stars) in a patient with discoid lupus erythematosus

In a patient with known discoid lupus erythematosus in group A, a focal depigmented patch over the dorsum of the distal digits revealed striking differences in the visibility of vessels and its morphological abnormalities due to the varied skin pigmentation (Figure 3). The appreciation of the nail fold capillaries markedly decreased in the adjacent pigmented areas.

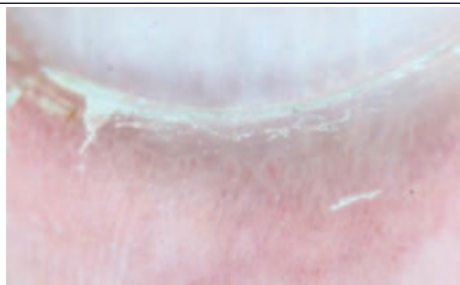


Figure 4: Visualization of nailfold capillaries in an acral vitiligo patient

In group B, only 16% (n=9) patients showed visible nailfold capillaries. Among these 9 patients, the detailed morphological patterns were unevaluable in 11% (n=6) patients. It was interesting to note that, the 5% (n=3) patients with normal NFC had acral vitiligo. The focal depigmentation in their proximal nail folds had enabled the better visualization of the morphological pattern and hence were inferred as 'normal' capillaries (Figure 4). These patients also exhibited the normal physiological variations of capillary morphology. In all other group B patients, the pigment in nail fold hindered the visibility of normal morphological variants. Capillaries were invisible in 100% (n=10) patients of Fitzpatrick skin type 6 in group B.

Of the 33% (n=33) patients in our study with visible capillaries, only 45% (n=15) were categorized as normal or abnormal capillaries. The majority 55% (n=18) of them, showed visible capillaries which were unevaluable.

DISCUSSION

Capillaroscopy is a non-invasive imaging technique for in vivo assessment of microcirculation¹⁸. It can be used to diagnose and assess disease severity and to monitor the progression of the disease and helps in predicting the risk of development of complications in dermatological disorders including psoriasis and connective tissue disorders like systemic sclerosis, systemic lupus erythematosus, dermatomyositis^{5,10}.

Equipments which can be used for nail fold capillaroscopy are ophthalmoscope, light stereo microscope, dermatoscope, and video dermatoscope¹¹. Video capillaroscopy is expensive, but easy and allows 200x magnification with a high resolution monitor and digital software for image analysis. Hand held dermatoscopes are simple, quick and inexpensive alternatives¹² and hence most commonly used for nailfold capillaroscopy assessment in dermatology clinics.

Fitzpatrick skin phototyping classifies skin into 6 types based on the amount of melanin and sun reactivity¹³. In our study conducted in a population with predominant Fitzpatrick skin types 4, 5 and 6, the nailfold capillaroscopic examination was helpful in recognizing the active, early and late scleroderma patterns observed in the systemic sclerosis patients and the dilated capillaries observed in the psoriasis patients among Group A participants. But statistically significant differences in the visibility of the morphological patterns of the capillaries could be noted between Fitzpatrick skin types 4 (88%) and 5 (48%). The same was observed among the Group B patients where the capillaries were visible only in Fitzpatrick type 4. None of the patients with Fitzpatrick skin type 6 in either of the groups showed any visible capillaries.

Most studies have shown normal physiological variations in the morphological patterns of the nail fold capillaries in healthy controls. The most common qualitative capillary changes in healthy controls were tortuosity (64%), meandering capillary (94%), micro-hemorrhages (25%), and capillary dilation (19%)^{6,14}. In our study, these physiological morphological changes were noted only in 3 participants which were tortuosity and capillary dilatation.

Both the groups A and B in our study included patients with a focal depigmentation in the nail fold either as an atrophic patch due to discoid lupus erythematosus in group A or as an acral vitiligo patch in group B. The clearly visible vessels on the depigmented patches sheds us light on how significantly presence of melanin in the skin influences the capillary visibility. The sequential decrease in the visualization of vessels with increasing skin pigmentation in skin types 5 and 6 shows that the amount of melanin also holds significant impact in the nailfold capillary examination.

A study by Andrade et al¹⁵ including population from various ethnic groups also has showed generalized decrease in the visibility of capillaries in non-white group compared to the white group, making the recognition of morphological anomalies more difficult, but not impossible. This correlates with the findings noted in our study.

A study by C Bairwa et al¹⁶ also compared the nail fold capillaroscopic findings across skin phototypes and concluded that the main factor determining the visualization of nail fold capillaroscopy was pigmentation of skin and Sandy et al concluded that the visualization correlates with the degree of skin pigmentation. The same has been established in our study.

Ahmed et al¹⁷ study found that the nailfold capillaroscopy findings were comparable between skin type 3 and 4 but significantly decreased with skin type 5 and 6. And hence concluded that an increase in skin pigmentation significantly hampered the visualization of NFC.

This questions the relevance of using the same diagnostic parameters for all the skin types without considering the ethnic variability in skin in terms of pigmentation.

CONCLUSION

Nail fold capillaroscopy remains a valuable tool for assessing microvasculature in dark-skinned individuals. But the capillary visibility, pattern recognition and appreciation of abnormalities in the morphological pattern of capillaries decreased sequentially in the Fitzpatrick skin type 4, 5 and 6. The amount of melanin pigment in the skin of color, significantly influences the visualization of nail fold capillaries. Therefore, improved guidelines and training is required to enable appropriate evaluation of nail fold capillaries in dark skinned individuals. This would ensure equitable diagnostic outcomes across diverse populations. Further research should focus on standardizing capillaroscopy protocols for dark-skinned patients to enhance the clinical utility of this diagnostic modality. The study also underscores the need for modified protocols tailored to darker skin tones to enhance diagnostic accuracy.

Limitations of Our Study: Device Used

Conflict of Interest: Nil

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