

**Pili trianguli et canaliculi as a phenotypic subtype in patients with central centrifugal cicatricial alopecia: A scanning electron microscopy study**



*To the Editor:* Central centrifugal cicatricial alopecia (CCCA) is a scarring alopecia that disproportionately affects black women.<sup>1</sup> The pathophysiology remains poorly understood, although a study found genetic variants of peptidyl arginine deiminase type III (PADI3), an enzyme critical for normal formation of hair shafts, in approximately 25% of patients with CCCA.<sup>2</sup> PADI3 is 1 of 3 genes implicated in the pathogenesis of uncombable hair syndrome, a condition in which patients note dry, brittle hair that has difficulty lying flat, rendering it uncombable.<sup>3</sup> This is due to triangular or heart-shaped cross-sections of the hair shafts with longitudinal grooving along the length, also termed *pili triangular et canaliculi* (PTEC).<sup>3,4</sup> Although PADI3 mutations have been observed in both uncombable hair syndrome and CCCA, the role of hair shaft changes in CCCA remains unclear. Our study aimed to investigate hair shaft characteristics such as cross-sectional shape and longitudinal grooving, using scanning electron microscopy (SEM), in patients with and without CCCA.

This study was approved by the institutional review board. Black women ages 25 to 60 years with L'Oréal worldwide diversity of hair curliness VI through VIII and without chemical alterations (perms/relaxers or texturizers) were recruited in the dermatologic clinic.<sup>5</sup> Hair strands were obtained from the vertex and occipital scalp by using a gentle pull technique. Each strand was sectioned and mounted onto a SEM stub with the cross-section visible. Imaging was performed using an LEO/Zeiss 1530 Field-Emission SEM (Carl Zeiss, Oberkochen, Germany) operating at 1 kV. The overall appearance, cross-sectional shape, and presence of longitudinal grooves were observed. Measurements of shape descriptors (circularity, aspect ratio, and round) were generated for cross-sectional shape using FIJI\* image analysis. A *t* test with unequal variance (2-tailed analysis with  $\alpha = .05$ ) was used to compare shape descriptor means between the CCCA and unaffected groups. Statistical analysis was performed using STATA IC 16.0 (Stata Corp, College Station, TX).

Seventeen individuals, 9 with CCCA and 8 control patients, were sampled. The average ages were 54.2 years and 49.4 years in the CCCA and control

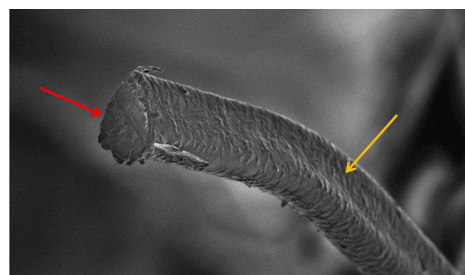
**Table I.** Statistical comparison for age and shape descriptors of cross-sectional shape in CCCA versus control hair shafts

Variable	CCCA mean (SD) (n = 9)	Control mean (SD) (n = 8)	P value
Age, y	54.2 (8.8)	49.4 (14.0)	.4168
Vertex scalp*			
Circularity	0.8613 (0.05)	0.8604 (0.05)	.9702
Aspect ratio	1.7506 (0.27)	1.7418 (0.28)	.9487
Round	0.5860 (0.11)	0.5860 (0.09)	>.9999
Occipital scalp*			
Circularity	0.8669 (0.05)	0.8710 (0.06)	.8829
Aspect ratio	1.6688 (0.22)	1.7515 (0.37)	.5897
Round	0.6086 (0.08)	0.5976 (0.15)	.8578

No statistical significance is observed when comparing mean values for shape descriptors (circularity, aspect ratio, round) between CCCA and control patients.

CCCA, Central centrifugal cicatricial alopecia; SD, standard deviation.

\*Circularity:  $(4\pi \times \text{area})/\text{perimeter}$ . Aspect ratio: major axis/minor axis. Round:  $(4 \times \text{area})/(\pi \times \text{major axis})^2$ .



**Fig 1.** Occipital hair shaft of a patient with CCCA with atypical features. The hair shaft was sampled from the occipital scalp of a patient with CCCA with a triangular-shaped cross-section (*red arrow*) and longitudinal groove (*yellow arrow*) noted along the length; this is consistent with features for *pili trianguli et canaliculi*. CCCA, Central centrifugal cicatricial alopecia.

groups, respectively ( $P = .4168$ ). All control and most CCCA hair shafts from the vertex and occipital scalp appeared oval on cross-section. There was no statistically significant difference in shape descriptor measures when comparing the CCCA and control groups (Table I). One patient with CCCA had longitudinal grooving along the length of both the vertex and occipital shaft, with observable triangular cross-sectional shape in the occipital strand (Fig 1).

Although most cases of CCCA did not feature hair shaft changes consistent with PTEC, a patient exhibited features in both the vertex and occiput. To the authors' knowledge, this is the first report documenting the presence of atypical shaft features

in a black patient with a history of CCCA. We suspect that these alterations in the shaft are not responsible for most cases of CCCA, but, possibly, a unique subset of patients with CCCA may harbor hair shaft abnormalities, placing them at risk for developing the disease. Limitations of this study include sampling of patients from a single institution. Future studies will aim to further identify a link between PADI3 mutations and PTEC in patients with CCCA. Identifying characteristics of this subset of patients with CCCA may help differentiate their clinical course and treatment.

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