Variability in Foveal Morphology in Albinism Assessed with SD-OCT

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Summary
Albinism is typically characterized by foveal hypoplasia, though recent data have demonstrated variability in the degree of hypoplasia.5 To date, it has not been possible to link this morphological variation to the underlying genetics of albinism. Here we sought to quantify foveal morphology in individuals with albinism and compare this to an extensive normal population using newly developed metrics of foveal pit morphology.

Normal Variation in Foveal Pit Morphology
We recruited 139 individuals with normal vision (71 male, 68 female; mean age = 27 yrs). Volume and linear SD-OCT images of the macula were obtained using Cirrus HD-OCT (Carl Zeiss Meditec, Dublin, CA). The foveal pit depth, diameter, and volume were measured using commercially available software (Biophtigen, Inc., Research Triangle Park, NC). Custom Matlab (Carl Zeiss Meditec, Dublin, CA) and/or the Bioptigen SD-OCT software was used to derive estimates of foveal pit depth, diameter, and volume. The lateral scale of SD-OCT images was corrected for individual differences in axial length to improve the accuracy of foveal pit measurements. Pit depth ranged from 0.024 to 0.177 mm, diameter ranged from 1.07 to 2.65 mm, and volume ranged from 0.024 to 0.21 mm3. Shown are exemplars from our population.6

Albinism Patient Population
We recruited 23 individuals with albinism (14 male, 9 female; mean age = 25 yrs), 7 of whom were recruited at the National Conference of the National Organization for Albinism and Hypopigmentation (NOAH). Note the mean (± SD) axial length 24.90 ± 0.17 mm. Phenotype was based on clinical diagnosis, molecular results are pending.

We observed wide variation in foveal pit morphology in our albinism patients. One individual (JC_6821) had a pit with near normal morphology (depth = 0.028 mm, diameter = 1.58 mm, volume = 0.019 mm3). The remaining subjects were subjectively classified in having increased macular thickness (“mounding”) with a subtle foveal depression (n=9), mounding with no pit (n=7), and planar macular thickness (n=7). Phenotypes were based on clinical diagnosis, molecular results are pending.

Variation in Foveal Pit Morphology in Albinism

We are now examining the relationship between foveal morphology and foveal cone specialization. We have found that even in the absence of a foveal pit, the cone density at the foveal center (B) is increased in albinism compared to normal. The increase in cone density at the foveal center is likely due to increased cone loss at the periphery, which is consistent with previous findings in albinism. The results of this study suggest that foveal morphology may be a useful indicator of cone loss in albinism.

Assessing Foveal Cone Specialization in Albinism: Outer Segment Layer

The second aspect of foveal cone specialization we can examine is cone mosaic topography, given the well-described increase in cone density at the foveal center. Preliminary results (below) confirm that even in the absence of a foveal pit, substantial cone packing can occur. One participant, peak foveal cone density is 71,031 cones/mm2 while density at −4 degrees inferior is 14,980 cones/mm2. Scale bar = 100 µm, asterisk indicates location of peak cone density.

Conclusions
The spectrum of foveal morphology in albinism is greater than previously thought, in some cases overlapping with normal foveal pit morphology. The ability to accurately characterize foveal and foveal cone topography represents an important step in separating out retinal versus cortical contributions to visual deficits in albinism.

References