

Characteristics of Posterior Precortical Vitreous Pockets and Cloquet's Canal in Patients with Myopia by Optical Coherence Tomography

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PURPOSE. To describe the morphological features of posterior precortical vitreous pockets (PPVP) and Cloquet's Canal in patients with myopia using spectral-domain optical coherence tomography (SD OCT).

METHODS. A total of 96 eyes of 51 volunteers (range, 5–18 years) were enrolled in this study, and all individuals underwent OCT (Optovue Inc., Fremont, CA, USA) examinations. From the collected PPVPs images, the widths and heights of the PPVPs were measured, and connections between PPVPs and Cloquet's Canal were identified. The PPVPs widths and heights, width:height ratios and proportions of connections were compared among different age (5–8, 9–14, 15–18 years), axial length (AL; 21–23, 23–25, 25–29 mm) and myopia groups (hyperopia, low to moderate myopia, high myopia); the group data were analyzed to determine their relationship with myopia.

RESULTS. PPVPs were identified in 89 of 96 eyes; 6 eyes were excluded for poor image quality. The PPVPs width was positively correlated with age, especially in the low to moderate myopia group ($F = 7.715$, $P = 0.001$). There was a significant difference in the PPVPs height between the refractive error groups in the 9 to 14 years group ($F = 4.905$, $P = 0.005$). The PPVPs width:height ratio was different among the refractive error groups in the 9 to 14 years group ($F = 3.335$, $P = 0.041$) and among the different age groups in the low to moderate myopia group ($F = 6.077$, $P = 0.004$). A total of 22 eyes (22.4%) were identified as having a connection between the PPVP and Cloquet's Canal. The connections began to increase with AL at 5 to 8 years ($\chi^2 = 7.363$, $P = 0.025$).

CONCLUSIONS. PPVPs existed in most myopia patients from 5 to 18 years old. PPVPs width was positively correlated with age, especially in the low to moderate myopia group. PPVPs height decreased in the 9 to 14 years group with myopia. An imbalance in the horizontal and vertical enlargement of PPVP was the main feature in the 9- to 14-year-old group with myopia. The connections between the PPVP and Cloquet's Canal were associated with AL extension in the 5- to 8-year-old group.

Keywords: posterior precortical vitreous pockets, myopia, Cloquet's Canal

Myopia has become a major public health problem; the population with myopia has been increasing in Asian countries, and 80% to 90% of myopia patients are children.¹ Among them, 10% to 20% belong to the high myopia population.² There is a key period of high myopia formation in children from 11 to 13 years old, resulting in “acquired high myopia.”³ The early development of high myopia can lead to pathological myopia in the future, and the consequent complications of pathological myopia can result in tremendous burdens on individuals and countries.^{1,4}

High myopia and pathological myopia mainly result in lesions at the vitreoretinal interface. Posterior vitreous detachment (PVD) is considered to be the main characteristic of vitreoretinal change, and it has been suggested to be related to macular disease, such as macular hole, retinoschisis, etc.⁵ Partial PVD with posterior precortical vitreous pockets (PPVPs) is considered a precursor of complete PVD.⁶ PPVP was a vitreous lacuna above the macular space in front of the posterior pole with a thin layer of vitreous cortex.⁷ PPVP is

considered to be a liquefied cavity that plays a role in vitreoretinal disease development.^{8,9} Therefore, PPVP changes during the development of myopia may help us understand the mechanism of vitreoretinal lesions in patients with high myopia.

Recently, with the advent of spectral-domain optical coherence tomography (SD-OCT) with a resolution of 12 μm , the structure of the vitreoretinal interface can be clearly observed.¹⁰ In this study, we used this technology to observe the structures of PPVPs and Cloquet's Canal in patients with myopia to analyze the characteristics of the vitreous structures during myopia progression.

MATERIALS AND METHODS

The study included 96 eyes of 51 volunteers (5–18 years) from the Affiliated Eye Hospital of Wenzhou Medical University and was approved by the Institutional Review Board. All the individuals were instructed on the content and purpose of



TABLE 1. Clinical Characteristics of the Study Population

Eye (96 eye)	N (%)	Mean	Median; Range
Age, y	96	9.64 ± 2.97	9; 5 to 18
5 to 8	50 (52.1)	7.64 ± 1.29	8; 5 to 8
9 to 14	34 (35.4)	11.62 ± 1.28	11.5; 9 to 14
15 to 18	12 (12.5)	17.00 ± 1.55	18.0; 15 to 18
Sex			
Male	39 (40.6)		
Female	57 (59.4)		
RE (D)	96	-2.68 ± 3.63	-1.75; -10.75 to +6.75
Hyperopia	13 (13.5)	2.65 ± 2.21	+2.00; +0.25 to +6.75
Low to moderate myopia	65 (67.7)	-2.12 ± 1.45	-1.75; -5.50 to -0.25
High myopia	18 (18.8)	-8.60 ± 1.53	-8.63; -10.75 to -6.00
AL (mm)	96	24.45 ± 1.55	24.26; 21.45 to 28.81
22 to 23	15 (15.6)	22.35 ± 0.49	22.50; 21.45 to 22.83
23 to 25	50 (52.1)	23.91 ± 0.57	23.99; 23.00 to 24.37
25 to 29	31 (32.3)	26.35 ± 0.74	26.18; 25.28 to 28.81

D, diopter.

the study before the examinations. Study subjects with macular disease, amblyopia, cataracts, or glaucoma were excluded from the study. Table 1 shows the basic demographic information of the study participants.

Comprehensive Ophthalmic Examinations

All the subjects underwent complete ophthalmic examinations, including best corrected vision acuity (BCVA), axial length (AL), cycloplegic refraction, color fundus photography, and slit-lamp biomicroscopy examinations. AL was measured by an (IOLMaster; Carl Zeiss, Jena, Germany). The pupil was dilated with cyclopentane before refraction, and the BCVA was measured with Snellen's acuity test. Fundus photography was carried out after cycloplegia using a fundus camera (Retinal Camera CR-DGi; Canon, Japan).

Vitreous Image Acquisition and Analysis

Vitreous images were acquired by OCT (Optovue Inc., Fremont, CA, USA) with 12 μm enhanced high-density line B-scans from different positions. Vertical and horizontal scans through the fovea and optic disk were completed by experienced technicians. Each position included 60 scans that were montaged to produce the final image; only clear images were utilized in the study. All patient examinations were performed in a seated position, and the EVI model was used to highlight the vitreous structure and choroid. The EVI model software (RTVue XR OCT Avanti System, version 2016.1.0; Optovue Inc., Fremont, CA) automatically adjusted the image contrast to obtain clear vitreous structure images.¹⁰

To analyze the vitreous structure, all the images were analyzed by ImageJ (<http://imagej.nih.gov/ij/>; provided in the public domain by the National Institutes of Health [NIH], Bethesda, MD, USA). PPVPs were identified as a boat-shaped empty space above the macula, and Cloquet's Canal were identified as a liquefied space above the optic disc. The widths and heights of the PPVPs were measured by ImageJ (NIH, Bethesda, MD, USA). The width of the PPVP was defined as the longest horizontal distance of the PPVP, and the height of the PPVP was defined as the vertical distance above the macular foveal region. The PPVP width:height ratio was calculated. A defect in the septum was considered a connection between the PPVP and Cloquet's Canal (Fig. 1).

Statistical Analyses

The statistical analyses were carried out with statistics software (IBM SPSS, version 20; IBM Corp., Armonk, NY, USA). The distribution of data was tested for normality with the Kolmogorov-Smirnov test. Means and standard deviations (SDs) were calculated for the normally distributed data, and medians, first quartiles, and third quartiles were calculated for the nonnormally distributed variables. ANOVA was used for the comparisons between groups, and the Tukey-Kramer honestly significant difference (HSD) post hoc test was carried out to adjust for various comparisons between groups. A χ^2 test was used for nonnormally distributed variable comparisons between groups. The relationship between groups was analyzed using the Pearson correlation coefficient test. A value of $P < 0.05$ was considered statistically significant.

RESULTS

Demographic Information of the Study Participants

A total of 96 eyes of 51 volunteers were enrolled in the study (57 female, 39 male). The patients were aged from 5 to 18 years (mean ± SD: 9.64 ± 2.97 years, median, 9 years); 50 eyes (52.1%) ranged from 5 to 8 years (mean ± SD: 7.64 ± 1.29 years, median, 8 years), 34 eyes (35.4%) ranged from 9 to 14 years (mean ± SD: 11.62 ± 1.28 years, median, 11.5 years), and 12 eyes (12.5%) ranged from 15 to 18 years (mean ± SD: 17.00 ± 1.55 years, median, 18 years). The AL ranged from 21.00 to 29.00 mm (mean ± SD: 24.45 ± 1.55 mm; median, 24.26 mm; range, 21.45–28.81 mm); the AL of 15 eyes (15.6%) ranged from 22 to 23 mm (mean ± SD, 22.35 ± 0.49 mm; median, 22.50 mm; range, 21.45–22.83 mm), the AL of 50 eyes (52.1%) ranged from 23 to 25 mm (mean ± SD, 23.91 ± 0.57 mm; median, 23.99 mm; range, 23.99–24.37 mm), and the AL of 31 eyes (32.3%) ranged from 25 to 29 mm (mean ± SD, 26.35 ± 0.74 mm; median, 26.18 mm; range, 25.28–28.81 mm). The refractive error (RE) ranged from -10.75 to +6.75 D (mean ± SD, -2.68 ± 3.63 D; median, -1.75 D); 13 eyes (13.5%) were classified as having hyperopia (mean ± SD, 2.65 ± 2.21 D; median, +2.00 D; range, +0.25 to +6.75 D), 65 eyes (67.7%) were classified as having low to moderate myopia (mean ± SD, -2.12 ± 1.45 D; median, -1.75 D; range, -5.50 to -0.25 D), and 18 eyes (18.8%) were classified as having high

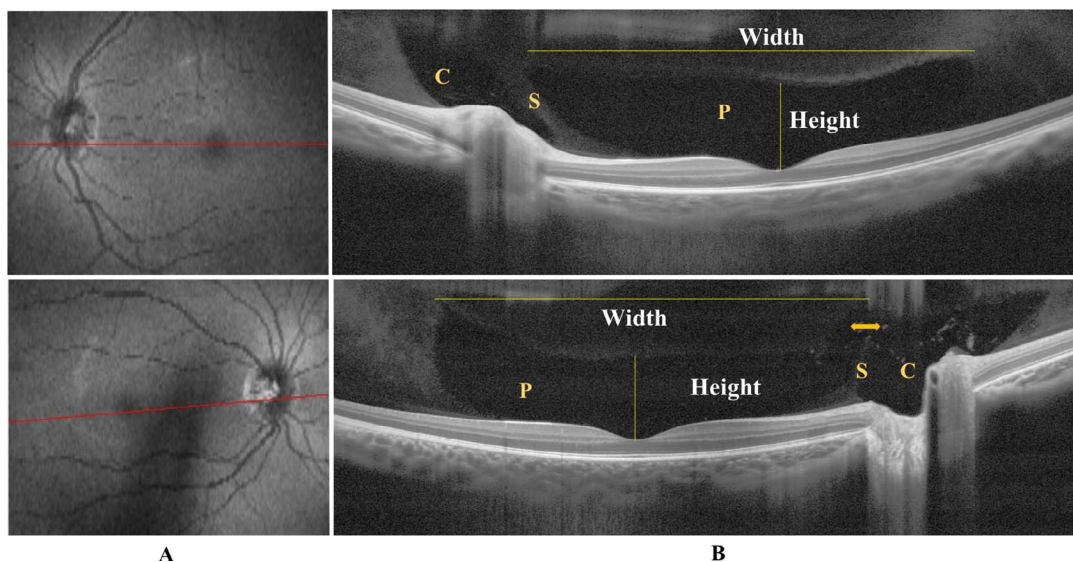


FIGURE 1. The features of PPVPs and Cloquet's Canal on OCT. (A) Shows a fundus photograph; the red lines indicate the scanning positions. (B) shows the vitreous and retinal structures: P is PPVP; C is Cloquet's Canal; S is the septum between the PPVP and Cloquet's Canal; a double arrow indicates the connection between the PPVP and Cloquet's Canal; a yellow line indicates the horizontal and vertical distances of the PPVPs. The width was the maximum horizontal distance, and the height was the vertical distance above the macular foveal region.

myopia (mean \pm SD, -8.60 ± 1.53 D; median, -8.63 D; range, -10.75 to -6.00 D; Table 1).

PPVP Width Increased With Age

A PPVP appeared as a low reflective space in front of macula. PPVPs were not detected in nine eyes, and six eyes were excluded due to poor image quality. There was no clear anterior PPVP contour in one eye. Ages were divided into three groups: 5 to 8 years, 9 to 14 years, and 15 to 18 years. The mean PPVP width was 3.34 ± 0.94 mm, 4.07 ± 1.00 mm, and 3.86 ± 1.44 mm for each age group, respectively, ($F=5.38$, $P=0.006$) as shown in Figure 2A. The PPVP width was positively correlated with age ($Pearson = 0.276$, $P=0.010$), as shown in Figure 2B. Representative B-scan images for each age group are presented in Figure 3.

To further analyze whether the refractive error had an effect on the results, PPVP size was classified based on age and

refractive error, as shown in Table 2. The mean PPVP width was not significantly different between the refractive error groups among the age groups ($F=0.165$, $P=0.849$, $F=2.088$, $P=0.142$, $t=7.215$, $P=0.086$). However, in each refractive error group, the relationship between age and PPVP size was inconsistent. In the hyperopia and high myopia groups, the PPVP width was not significantly different between the age groups ($F=0.200$, $P=0.667$, $F=3.777$, $P=0.051$). In the low to moderate myopia group, the PPVP width increased with age from 5 to 18 years. ($F=7.715$, $P=0.001$).

PPVP Height Decreased With Myopia Degree

The PPVP height was measured above the macular foveal region. The mean PPVP height was 0.64 ± 0.34 mm. The mean PPVP heights were 0.56 ± 0.37 mm, 0.70 ± 0.35 mm, and 0.47 ± 0.16 mm in the hyperopia, low to moderate myopia

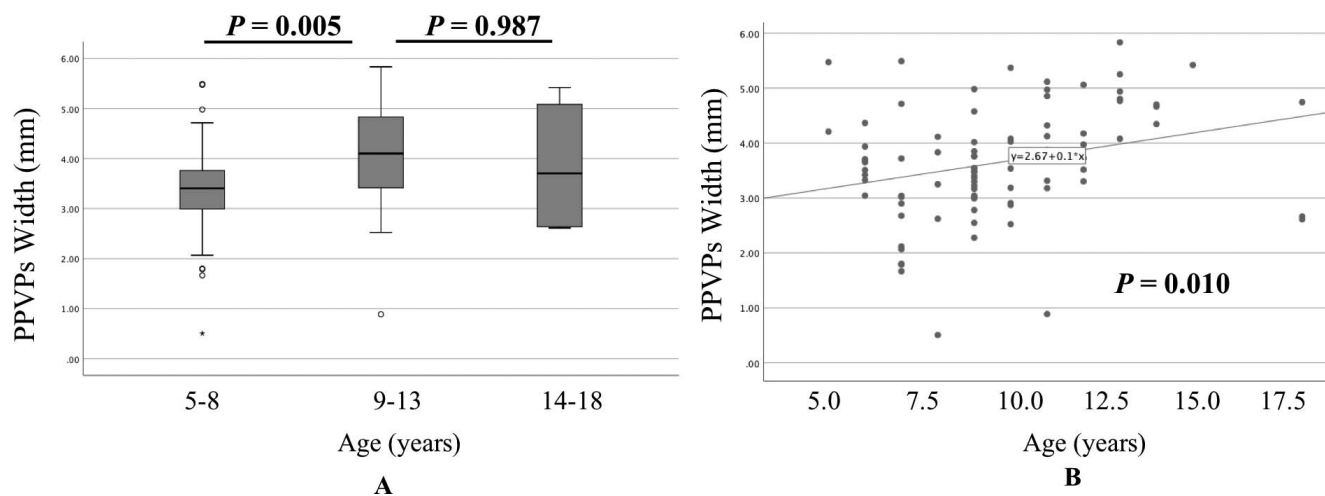


FIGURE 2. The PPVP width varied with age. (A) shows that the PPVP width varied with age. The mean PPVP widths were 3.34 ± 0.94 mm, 4.07 ± 1.00 mm, 3.86 ± 1.44 mm for the age groups (5-8, 9-14, 15-18 years, respectively; $F=5.38$, $P=0.006$) by ANOVA. (B) shows the scatter plot of the PPVP width and age ($P=0.010$).

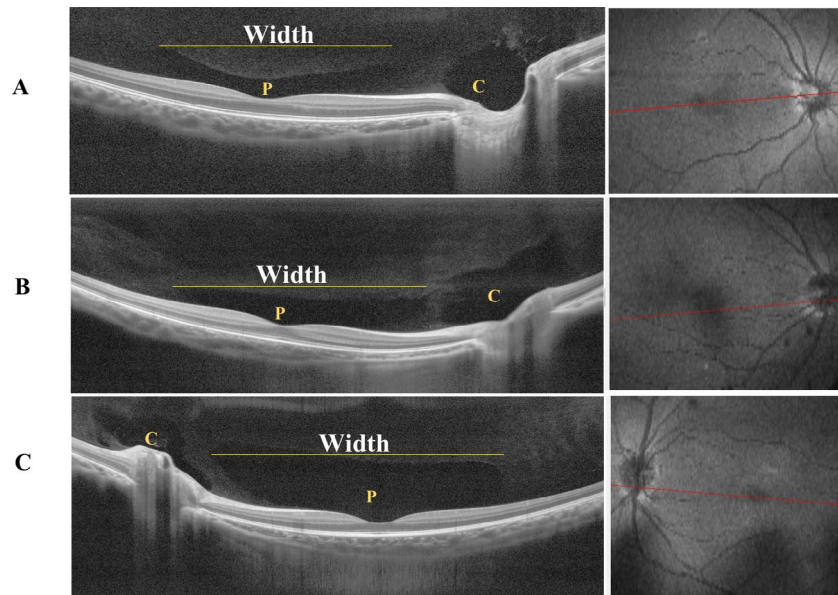


FIGURE 3. Representative B-scans of PPVPs by age. (A) is the B-scan image of a 7-year-old girl; the AL is 23.88 mm, the refractive error is -1.75 DS, and the PPVP width is 2.678 mm. (B) is the image of a 10-year-old boy; the AL is 24.79 mm, the refractive error is -4.00 DS, and the PPVP width is 2.871 mm. (C) An image of a 13-year-old girl; the AL is 23.8 mm, the refractive error is -1.75 DS, and the PPVP width is 4.079 mm.

and high myopia groups, respectively ($F = 3.597$, $P = 0.032$; Fig. 4A).

To further exclude the effect of age on outcomes, we classified outcomes based on age, as shown in Table 2. The results indicated that the greatest effect of the refractive error on the PPVP height was mainly concentrated in the 9 to 14 years age group ($F = 4.905$, $P = 0.015$); the PPVP height in the high myopia group was 0.49 ± 0.18 mm, which was lower than that in the low to moderate myopia group among the 9 to

14 years age group ($P = 0.012$). In other words, a decrease in the PPVP height in patients with myopia may occur mainly between the ages of 9 to 14 years.

PPVP Width:Height Ratio Was Correlated With Myopia

The PPVP width:height ratio was calculated in our study. The results indicated that the mean ratio was 7.79 ± 5.06 , $6.29 \pm$

TABLE 2. PPVPs Size Comparison by Age and Refractive Error

Variable	Group	PPVPs Width, mm	P^*	PPVPs Height, mm	P^*	Ratio	P^*	AL (mm)	P^*
Age, y	RE								
	5 to 8	Hyperopia	3.23 ± 1.57		0.61 ± 0.39		7.69 ± 5.72		22.76 ± 0.62
	Low to moderate myopia	3.39 ± 0.82	0.849	0.63 ± 0.30	0.354	6.23 ± 2.36	0.286	21.01 ± 0.98	$P < 0.001$
9 to 14	High Myopia	3.15 ± 0.47		0.39 ± 0.09		8.17 ± 1.50		26.27 ± 0.43	
	Hyperopia	2.72 ± 0.27		0.33 ± 0.17		8.21 ± 1.24		21.55 ± 0.71	
	Low to moderate myopia	4.17 ± 0.99	0.142	0.82 ± 0.38	0.015	5.81 ± 2.46	0.005	24.66 ± 0.91	$P < 0.001$
15 to 18	High Myopia	4.15 ± 0.98		0.49 ± 0.18		9.01 ± 2.19		26.74 ± 0.90	
	Hyperopia								
	Low to moderate myopia	5.08 ± 0.48	0.086	0.83 ± 0.64	0.601	12.31 ± 6.23	0.240	24.03 ± 2.06	0.115
RE	Age, y								
	Hyperopia	5 to 8	3.23 ± 1.57		0.61 ± 0.40		7.69 ± 5.72		22.76 ± 0.62
	9 to 14	2.72 ± 0.27	0.667	0.33 ± 0.17	0.370	$8.21 \pm 1/24$	0.905	21.55 ± 0.07	0.022
Low to moderate myopia	15 to 18								
	5 to 8	3.39 ± 0.82		0.63 ± 0.30		6.23 ± 2.36		24.01 ± 0.98	
	9 to 14	4.17 ± 0.99	0.001	0.82 ± 0.38	0.118	5.81 ± 2.46	0.004	24.66 ± 0.91	0.073
High myopia	15 to 18	5.08 ± 0.48		0.83 ± 0.64		12.31 ± 6.23		24.03 ± 1.07	
	5 to 8	3.15 ± 0.46		0.39 ± 0.09		8.17 ± 1.50		26.27 ± 0.43	
	9 to 14	4.15 ± 0.98	0.051	0.49 ± 0.18	0.485	9.02 ± 2.19	0.058	26.75 ± 0.90	0.404
	15 to 18	2.64 ± 0.36		0.55 ± 0.14		4.91 ± 1.16		27.14 ± 0.16	

Ratio means width/height.
* Stands for ANOVA analysis.

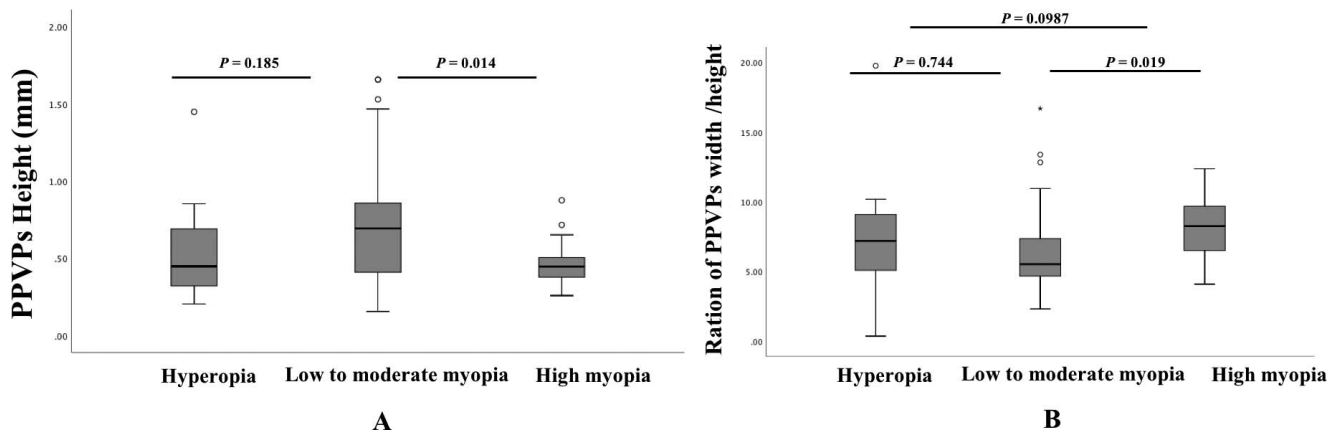


FIGURE 4. The PPVP Height and Ratio were Associated With Myopia. (A) shows the height of the PPVPs in the refractive error groups. The average height was 0.56 ± 0.37 mm, 0.70 ± 0.35 mm, 0.47 ± 0.16 mm in the hyperopia, low to moderate myopia and high myopia groups, respectively ($F = 3.597$, $P = 0.032$) by ANOVA. (B) shows that the PPVP width:height ratios were 7.79 ± 5.06 , 6.29 ± 2.72 , and 8.29 ± 2.30 in the hyperopia, low to moderate myopia and high myopia groups, respectively ($F = 3.335$, $P = 0.041$) by ANOVA. There was a significant difference between the low to moderate myopia group and the high myopia group ($P = 0.019$).

2.72 , and 8.29 ± 2.30 for the hyperopia, low to moderate myopia and high myopia groups, respectively ($F = 3.335$, $P = 0.041$). The ratio in the high myopia group was higher than that in the low to moderate myopia group ($P = 0.019$), as shown in Figure 4B.

To further analyze the causes of the changes, we classified them based on age and refractive error, as shown in Table 2. The results indicated that the effect of myopia on the width:height ratio was the greatest in the 9 to 14 years age group. The ratios were 8.21 ± 1.24 , 5.81 ± 2.46 , and 9.01 ± 2.19 in the hyperopia, low to moderate myopia and high myopia groups, respectively, and there was a significant difference between the refractive error groups according to age ($F = 6.507$, $P = 0.005$). The ratio in the high myopia group was higher than that in the low to moderate myopia group ($P = 0.005$). There was no significant difference between the refractive error groups in the 5 to 8 and 15 to 18 years groups ($F = 1.287$, $P = 0.286$, $F = 2.727$, $P = 0.240$, respectively). The ratio was significantly different between the age groups in the low to moderate myopia group. The ratios were 6.23 ± 2.36 , 5.81 ± 2.46 , and 12.31 ± 6.23 for the 5 to 8, 9 to 14, and 15 to 18 years groups, respectively ($F = 6.077$, $p = 0.004$).

In summary, the PPVP width increased with age, especially in the low to moderate myopia group. The PPVP height decreased with myopia progression, especially in the 9 to 14 years group.

Connections Between PPVPs and Cloquet's Canal Were Associated With the AL

A total of 22 eyes (22.4%) had clear connection between the PPVPs and Cloquet's Canal. The connection was classified by age and AL. The AL was divided into the following groups: 1 (median, 22.50; range, 21.45–22.83 mm), 2 (median, 23.99 mm; range, 23.00–24.37 mm), and 3 (median, 26.18 mm; range, 25.28–28.81 mm). The results showed that connections were 0%, 50%, and 50% for the AL groups, respectively, in the 5 to 8 years group ($\chi^2 = 7.363$, $P = 0.025$). The connections were 0%, 40% and 60% for the AL groups, respectively, in the 9 to 14 years group ($\chi^2 = 1.538$, $p = 0.463$), and the connections were 33.3%, 0%, and 66.7% for the AL groups, respectively, in the 15 to 18 years group ($\chi^2 = 0.667$, $p = 0.209$), as shown in Figure 5A. By controlling for AL in the analysis, it was found that age was not the cause of the differences in the connections ($\chi^2 =$

6.964 , $P = 0.031$, $\chi^2 = 2.286$, $P = 0.279$, $\chi^2 = 0.301$, $P = 0.860$, respectively) for each AL group, as shown in Figure 5B.

DISCUSSION

Our study indicated that the PPVP width increased with age and was not affected by myopia. The PPVP height was reduced in the high myopia group, especially in the 9 to 14 years high myopia group. Horizontal PPVP extension was related to age, while vertical PPVP shortening was associated with high myopia. The connections between PPVPs and Cloquet's Canal were mainly associated with AL in early childhood.

PPVPs were first reported by Kishi and Shimizu⁷ who applied fluorescein to autopsy eyes. Stanga et al.¹¹ found that bursa premacularis PPVPs were detected in 57.1% of eyes. Our study found that 92.9% of the eyes from 5 to 18 years presented PPVP structures, which was consistent with previous studies in which 97.3% of eyes in children presented PPVPs.¹²

Li et al.¹² examined children from 5 to 11 years old and found that the PPVP width increased with age. In our study, we found that age, not the degree of myopia, was the main factor for the increase of PPVP width. In addition, the effect of age on PPVP width was mainly observed in the low to moderate myopia groups and not in the hyperopia or high myopia groups. Figure 3 shows that the PPVP width increased with ages from 5 to 18 years in the low to moderate myopia group. This result suggested that PPVP width extension with age was the main change in the low to moderate myopia group.

In addition, our study indicated that the PPVP height decreased with myopia progression in the 9 to 14 years group. Larsen's study reported that AL progressed through three important growth stages, as it increased rapidly after birth to age 1.5 years, increased slowly from 2 to 5 years, and the increased minimally from 6 to 13 years.¹³ The AL in the high myopia group was obviously longer than those in the other myopia groups in the 9 to 14 years group, as shown in Table 2. Based on the above results, we supposed that the decrease in PPVP height was mainly related to myopia progression during the ages of 9 to 14 years. This period is an important time period for "acquired high myopia." Whether vitreous changes during this period were the cause of vitreoretinal interface changes in the high myopia group remains to be further studied.

PPVPs and Cloquet's Canal Connections by Axial Length and Age

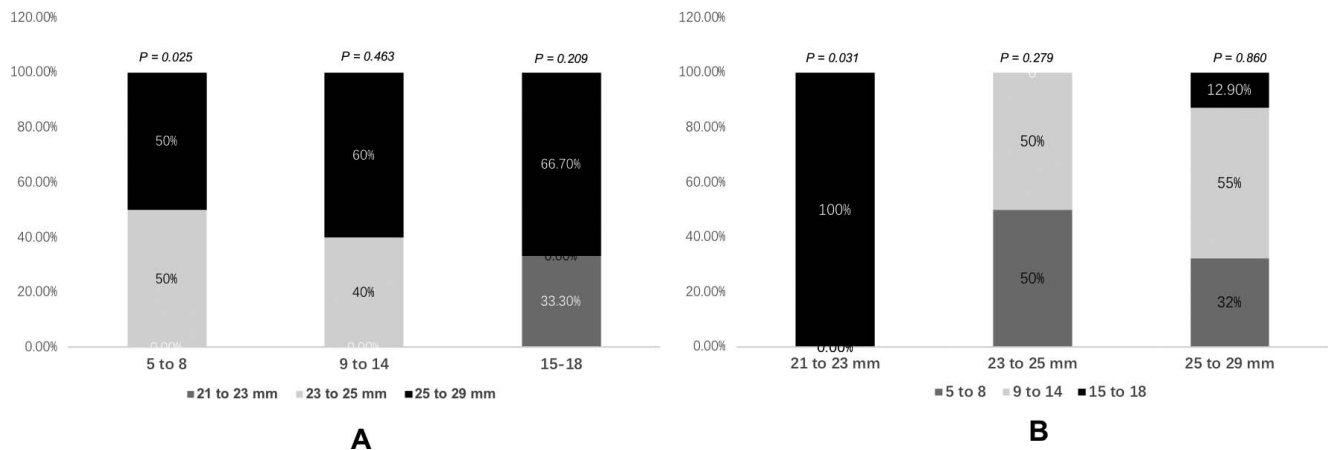


FIGURE 5. Connections between PPVPs and Cloquet's Canals by age and AL. The proportions of connections between PPVPs and Cloquet's Canals by age and AL group. (A) The abscissa represents age, the ordinate represents proportion, and the histogram represents the proportions in the AL groups; the proportions of connections were 0%, 50%, and 50% for each AL group, respectively, in the 5 to 8 years group ($\chi^2 = 7.363, P = 0.025$); 0%, 40%, and 60% for the AL groups, respectively, in the 9 to 14 years group ($\chi^2 = 1.538, P = 0.463$); and 33.3%, 0%, and 66.7% for the AL groups, respectively, in the 15 to 18 years group ($\chi^2 = 0.667, P = 0.209$) by χ^2 test. (B) The proportion of connections among the age groups after controlling for eye AL variables. The connections were 0%, 0%, and 100% for the age groups, respectively, in the 21 to 23 mm AL group ($\chi^2 = 6.964, P = 0.031$), 50%, and 50% for the age groups, respectively, in the 23 to 25 mm AL group ($\chi^2 = 2.286, P = 0.279$); and 32%, 55%, and 12.9% for the age groups, respectively, in the 25 to 29 mm AL group ($\chi^2 = 0.301, P = 0.860$).

Figure 6 shows vitreous structure changes associated with myopia; the PPVP width increased with age, and the PPVP height decreased with myopia degree. It was hypothesized that unequal expansion of PPVPs in the horizontal and vertical directions may be accompanied by the progression of myopia. The cause of the decrease in the PPVP height with the increase in the AL in the high myopia group was not clear. A previous hypothesis suggested that the bursa premacularis may protect the macular fovea from shear stress.¹⁴ Based on this hypothesis, we proposed that as the vertical distance of the

PPVP decreased, the force of the vitreous body on the retina was applied rapidly and transversely to the retina; this might be an important reason for the tangential tension of the vitreoretinal interface, resulting in macular holes or retinoschisis.¹⁵⁻¹⁷ This hypothesis has not been reported yet, and further research is needed to support it.

A connection between the PPVP and Cloquet's Canal was observed in 22.4% of the eyes in our study, which was lower than that in a previous study that found connections in 93.1% of adults.¹⁰ Age was regarded as the main factor for the

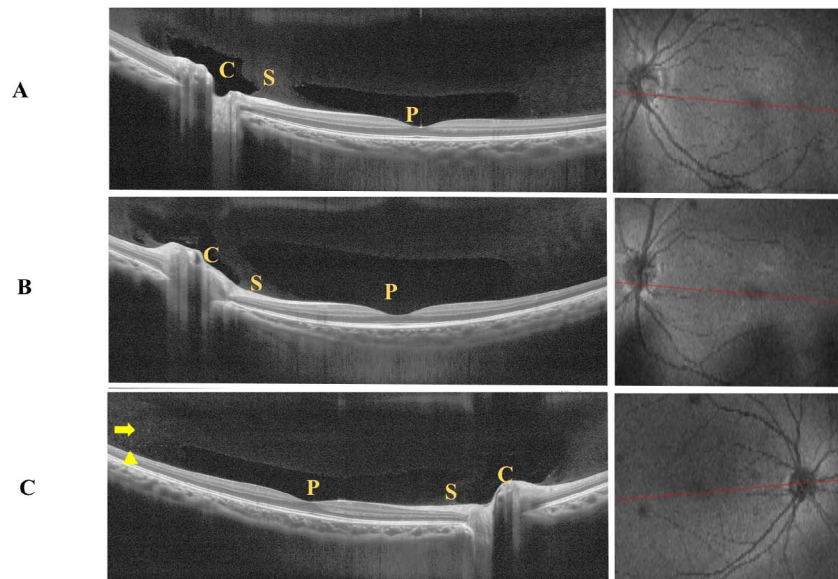


FIGURE 6. Vitreous features that changed with the progression of myopia. Vitreous features varied with the progression of myopia by OCT. (A) is the image of a 9-year-old boy with an AL of 23.12 mm; the refractive error is -0.25 DS, the PPVP width is 3.361 mm, the PPVP height is 0.469 mm, and the width:height ratio is 7.12. (B) is the image of a 13-year-old boy with an AL of 23.8 mm; the refractive error is -1.25 DS, the PPVP width is 4.079 mm, the PPVP height is 0.814 mm, and the width:height ratio is 8.50. (C) is the image of a 12-year-old girl with an AL of 26.26 mm; the refractive error is -7.00 DS, the PPVP width is 4.174 mm, the PPVP height is 0.401 mm, and the width:height ratio is 10.4.

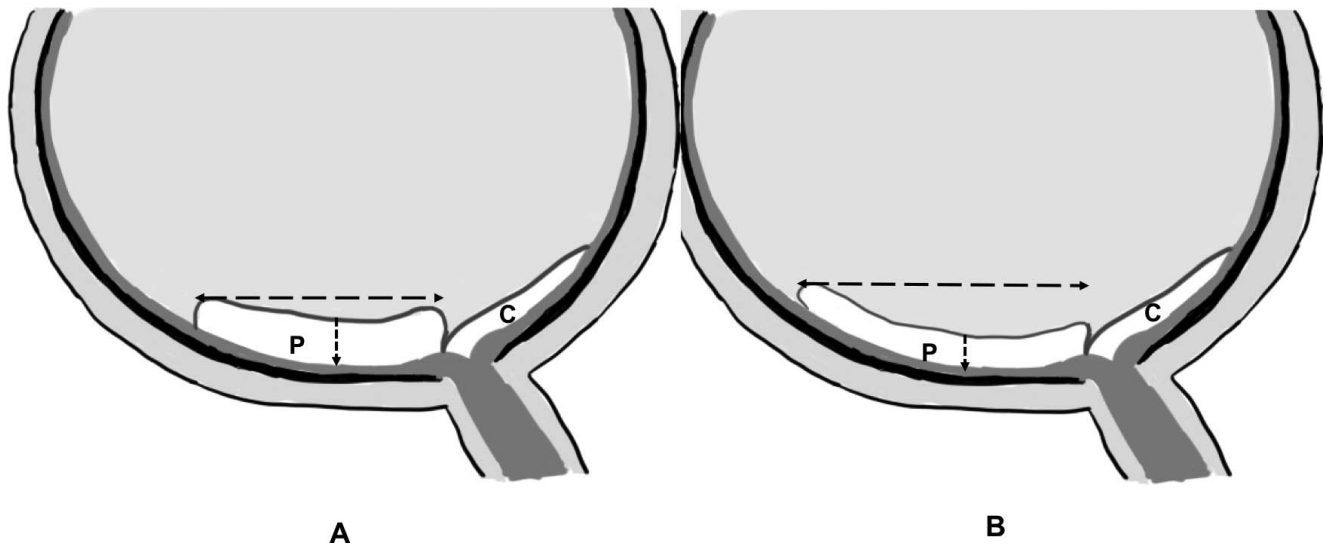


FIGURE 7. Diagram of PPVP enlargement with myopia development. The diagram shows the horizontal and longitudinal enlargement of PPVPs with the progression of myopia. (A) The vitreous morphology of a normal eyeball; P stands for PPVP, C stands for Cloquet's Canal, the *horizontal dashed line* indicates the width of the PPVP, and the *vertical dashed line* indicates the height of the PPVP. (B) The morphologic features of PPVPs in myopia patients; the *horizontal dashed line* increased with age, while the *vertical dashed line* decreased with myopia degree.

connection.¹² In our study, we found that relatively long ALs (25–28 mm) were more likely to be associated with connections in the young age group than relatively short ALs, as shown in Figure 5A. Larsen noted that connections may develop as the AL increases.¹³ Therefore, AL growth due to age or myopia may be an important factor for connection changes.

In conclusion, the PPVP width was mainly related to age, and the PPVP height was mainly related to myopia progression in the 9 to 14 years group. Figure 7 shows the changes in the widths and heights of PPVPs with myopia progression. The imbalance in the horizontal and vertical expansion of PPVPs may be the main feature of PPVPs in patients with high myopia. Increased ALs were associated with the likelihood of connections between PPVPs and Cloquet's Canals. A large sample and a prospective study are needed to investigate the relationship between PPVP and vitreoretinal interface changes in the future.

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