A posterior precortical vitreous pocket (PPVP) is a liquefied lacuna anterior to the macular area that is physiologically present in the vitreous of adults. A PPVP first was reported in autopsy eyes, in which the vitreous gel was stained with fluorescein. The presence of PPVPs has been confirmed during triamcinolone-assisted vitrectomy and by spectral-domain optical coherence tomography (SD-OCT). The anterior border of a PPVP is vitreous gel and the posterior border is comprised of a thin layer of the vitreous cortex attached to the retina. A septum is present between the nasal border of the PPVP and Cloquet’s canal. The peculiar structure of the premacular vitreous cortex plays a key role in the development of various vitreomacular disorders, such as macular holes and idiopathic premacular fibrosis. However, the physiologic function of PPVPs is unknown.

Worst described the bursa premacularis, which he observed by injecting India ink into the vitreous in postmortem eyes. In his original report, the bursa was anterior to the detached convex-shaped vitreous cortex that forms the subbursal space. Based on the concept of the bursa premacularis, the vitreous cortex is anatomically detached from the retina in the macular area. Worst described two channels that connect the bursa and Cloquet’s canal. He speculated that inflammation of the anterior chamber after cataract surgery may affect development of cystoid macular edema through the channels.

Swept-source OCT (SS-OCT) is a new generation of OCT that provides higher penetration into the choroid and sclera. SS-OCT enables clear visualization of the vitreous and the choroid. Using SS-OCT, we examined the morphologic features of PPVPs in normal subjects.

**Methods**

We performed SS-OCT (DRI OCT-1 Atlantis; Topcon, Tokyo, Japan) consecutively in both eyes of 58 healthy volunteers (36 men, 22 women) while they were sitting. This OCT system has an A-scan repetition rate of 100,000 Hz, and its light source operates in the 1-μm wavelength region. The light source is a wavelength-tunable laser centered at 1050 nm with a 100-nm tuning range; the axial resolution is 8 μm, the lateral resolution 20 μm, and the imaging depth 2.3 mm in tissue. The ocular fundus was scanned in six horizontal 12-mm scans that included the entire extent of the PPVPs, the centers of which were aligned at the plane through the optic disc and fovea, and two vertical 12-mm scans through the fovea and optic disc.

The subject ages ranged from 22 to 40 years (average, 26.2 ± 0.6 years). No eyes had an ocular disease. Subjects over 40 years of age were excluded to minimize age-related changes in the vitreous such as liquefaction or posterior vitreous detachment.

The refractive powers were measured using a commercial topographer (Autoref-Topographer RT-6000; Tomey Corporation, Nagoya, Japan) and ranged from −9.5 diopters (D) to +3.0 D.
D (average, $-3.4 \pm 0.3$ D) in the right eyes and from $-9.5$ D to $+3.0$ D (average, $-3.2 \pm 0.3$ D) in the left eyes.

During the OCT examination, we placed the scanner head backwards for anterior focusing, which allowed us to capture the anterior extent of the PPVP in the B-scan images. After obtaining the SS-OCT images, we adjusted the contrast to visualize the gel, liquefied pocket, and the cortex.

To estimate the size of the PPVPs, we measured the height between the fovea and the anterior border of the PPVP, according to our previous report, and the maximal width in the 12-mm horizontal scan through the fovea and the disc (Fig. 1).

All values are expressed as the mean $\pm$ standard error of the mean with the range. The differences between groups were analyzed using the Mann-Whitney U test or Wilcoxon signed-rank test. The correlations between groups were analyzed using Pearson’s correlation coefficient test. P values less than 0.05 were considered significant.

The study was conducted according to the tenets of the Declaration of Helsinki. The institutional review board ethics committee approved the study. All individuals provided informed consent after having received a detailed explanation of the purpose of the study.

RESULTS

SS-OCT visualized the PPVPs clearly in both eyes of all participants. The anterior border of the PPVP was delineated by the vitreous gel, and the posterior border was a thin layer of vitreous cortex attached to the retina (Figs. 2, 3). A septum was between Cloquet’s canal and the nasal border of the PPVP.

The configuration of the PPVP was almost symmetrical in both eyes of each subject (Figs. 2, 3). A septum was between Cloquet’s canal and the nasal border of the PPVP. The height of the PPVP at the fovea was 708.1 $\pm$ 47.1 $\mu$m (range, 208–1877) in the right eyes and 676.1 $\pm$ 52.1 $\mu$m (range, 202–1806) in the left eyes. There was no difference between the right and left eyes. There was a significant correlation between the height and the refractive error in the right eyes ($r = 0.43$, $P < 0.001$) and the left eyes ($r = 0.29$, $P < 0.05$). The greater the degree of myopia, the higher the height of the PPVP (Fig. 6).

The mean width of the PPVP through the fovea was 6420.6 $\pm$ 204.9 $\mu$m (range, 3114–9887) in the right eye and 6176.1 $\pm$ 186.2 $\mu$m (range, 1699–9811) in the left eye. There was no significant difference between the width and refractive error in both eyes.

DISCUSSION

PPVPs first were observed in autopsy eyes in which the gel was stained with fluorescein. Triamcinolone-assisted vitrectomy allowed intraoperative visualization of the PPVP. Time-domain OCT depicted the vitreous cortex when it was slightly detached from the retina; however, the imaging failed to show the inner structure of the vitreous. Noise-reduced SD-OCT visualized the PPVP in most eyes. However, because of the low sensitivity of the vitreous and limited scan length, SD-OCT occasionally failed to visualize the entire PPVP.

In the current study, SS-OCT with a 12-mm scan length visualized for the first time the entire structure of the PPVP.
Because of high penetration and high speed, SS-OCT was superior to SD-OCT for depicting the choroid and the vitreous compared. If the vitreous was enhanced by increasing the brightness and contrast in the OCT images, the vitreous structure always was observed if it was present, although the quality of the retinal images decreased due to excessive brightness and contrast.

The PPVPs appeared as boat-shaped vitreous lacunae in the macular area, and the posterior wall of the PPVPs was a thin vitreous cortex attached to the retina. Worst described the bursa premacularis as a pear-shaped sack with its own outer membrane. The bursa premacularis is situated on the convexly elevated posterior vitreous membrane (Pars pelliformis membranae vitrealis), which forms subbursal premac-

Figure 2. Symmetrical posterior PPVPs were seen in both eyes of a 24-year-old woman. The refractive error was −3.5 D in the right eye and −4.5 D in the left eye. (A) A horizontal scan through the fovea and the optic disc showed a boat-shaped PPVP and connecting channel (arrows). (B) A vertical scan through the fovea showed that the anterior border of the PPVP was higher superiority than inferiorly (arrows) in both eyes. The dotted lines in the fundus photographs indicated the scan direction and length. c, Cloquet’s canal; p, PPVP; S, superior; I, inferior.
ular space. The PPVP is probably the same space as the bursa premacularis described by Worst, except there are no membranes, just a layer of premacular cortical vitreous that are adherent to the macula in young adulthood.

While the posterior wall of PPVP is a thin vitreous cortex itself, the anterior border is vitreous gel. The mean height of the PPVPs was 708.1 μm (range, 208–1877) and the mean maximal width was 6420.6 μm (range, 3114–9887) in the right eye.

![Figure 3](image-url)
The PPVPs were symmetrical in both eyes of each individual; thus, the size of the PPVPs did not differ in the left eyes. The height of the PPVPs increased along with the myopic refractive error (Fig. 5). Using SD-OCT, we examined the size of PPVPs without highly myopic eyes and reported that the mean height was $0.5 \pm 0.2$ mm at the fovea and the horizontal diameter was a mean of $6.0 \pm 0.8$ mm.\(^5\) The dimensions of PPVPs in the current study were slightly larger than our previous report because this study contained high myopia probably. In the vertical scans, the superior portion of the PPVP always enlarged when the participants were sitting (Fig. 2B), as we reported previously.\(^{11}\) Gravity may affect the shape of the PPVPs.

A noteworthy finding in the current study was a connecting channel between the nasal side of the PPVPs and the temporal side of Cloquet’s canal in 93.1% of cases, the presence of which suggested that the PPVPs are not isolated lacunae. If Cloquet’s canal extended to the posterior chamber behind the lens (Berger’s space), aqueous humor may drain into the PPVPs via the connecting channels. We described the role of PPVPs in vitreoretinal interface diseases, such as macular holes and idiopathic premacular fibrosis.\(^6,7\) The connecting channel may have a pathophysiologic role in PPVPs. No connecting channel was seen in either eye of four subjects, in whom the refractive errors were emmetropia (two cases); hyperopia (one case); and low myopia (one case; Fig. 5). These cases had small PPVPs with thick septums between the PPVPs and Cloquet’s canal, and the anterior edge of the septum had a lamellar structure (Fig. 4). It is unclear whether the connecting channel collapsed in these cases as a result of the overlying vitreous gel.

Worst described two channels between the bursa and Cloquet’s canal.\(^9\) One channel was a superior branching channel that arose from the roof of the bursa and merged into Cloquet’s canal. However, using SS-OCT, we could not observe the orifice of the superior branching channel in the roof of the PPVP. Because the imaging depth of SS-OCT is 2.3 mm in tissue, we could not explore the anterior extent of the superior branching channels. Another the lower branching channel was connected to the bottom of the bursa and the Martegiani’s space in Cloquet’s canal. The connecting channel in the current study appeared to coincident with the lower branching channel described by Worst.\(^9\)

In conclusion, SS-OCT showed the detailed structure of PPVPs in vivo. The configuration of the PPVP is boat-shaped. Although its central height increased with increasing myopia, its width was unchanged. A channel connected Cloquet’s canal and the PPVPs, which suggested the route of aqueous humor into the PPVPs.
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References


Figure 6. The case of the right eye of a 23-year-old man with −7.0 D of myopia. The height of the PPVP was 1.110 μm and the width was 7.523 μm in the 12-mm horizontal scan through the fovea and disc. The PPVP tended to be higher in myopic eyes. The dotted line in the fundus photography indicated the scan direction and length.