Optical coherence tomography findings and retinal changes after vitrectomy for optic disc pit maculopathy

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Purpose: To study the optical coherence tomography (OCT) patterns in optic disc pit maculopathy and retinal changes after vitreous surgery. Materials and Methods: Retrospective review of consecutive cases with optic disc pit maculopathy seen at two tertiary eye institutes from January 2005 to June 2009. Results: Twenty-four eyes of 23 patients are included. The presenting visual acuity ranged from 20/400 to 20/20 (median: 20/80). The median age at presentation was 24 years (range, 6-57 years). Optical coherence tomography demonstrated a combination of retinoschisis and outer layer detachment (OLD) in 19 (79.17%) eyes, OLD only in 3 (12.5%) eyes and retinoschisis only in 2 (8.33%) eyes. An obvious communication (outer layer hole) between the schisis and OLD was seen in 14 (73.68%) of the 19 eyes with both features. Of the 21 eyes with retinoschisis, schisis was present in multiple layers in 15 (71.43%) and single layer in 6 (28.57%) eyes. Eleven eyes underwent pars plana vitrectomy including creation of posterior vitreous detachment (PVD), fluid-air exchange, low intensity laser photocoagulation at the temporal edge of the optic disc pit and non-expansile perfluoropropane gas (14%) injection. Five (45.45%) of 11 eyes undergoing vitrectomy had complete resolution and 4 (36.36%) eyes had partial resolution of maculopathy. Visual acuity improved in 8 (72.72%) of 11 eyes. Conclusion: Optical coherence tomography demonstrates multiple layer schisis and outer layer detachment as main features of optic disc pit maculopathy. Vitrectomy with PVD induction, laser photocoagulation and gas tamponade results in anatomical and visual improvement in most cases with optic disc pit maculopathy.

Key words: Optical coherence tomography, optic disc pit, retinal detachment, retinoschisis

Materials and Methods

Consecutive cases of optic disc pit maculopathy seen at two tertiary eye institutes from January 2005 to June 2009 were retrieved through review of medical case records. All patients underwent complete ocular examination, fundus photography and OCT imaging as a part of routine analysis. Optical coherence tomography images were initially obtained by using the time domain OCT (Stratus™ OCT, Carl Zeiss Meditec, Dublin, CA, USA) and for subsequent cases by high definition spectral domain OCT (Cirrus™ OCT, Carl Zeiss Meditec, Dublin, CA, USA). The various parameters retrieved from review of case records and OCT images included: presenting visual acuity, baseline OCT pattern, details of vitreous surgery, postoperative OCT pattern and postoperative visual acuity at last follow-up visit. The data obtained was analyzed by frequency and descriptive statistics.

Results

Twenty-four eyes of 23 patients are included. There were 11 males and 12 females. The median age at presentation was 24 years (range, 6-57 years). The presenting visual acuity ranged from 20/400 to 20/20 (median: 20/80).

Three patterns of maculopathy were noted on OCT. A combination of retinoschisis and outer layer detachment (OLD) was seen in 19 (79.17%) eyes, OLD only in 3 (12.5%) eyes and retinoschisis only in 2 (8.33%) eyes. [Figs. 1-3]. An obvious communication (outer layer hole) between the schisis and OLD was seen in 14 (73.68%) of the 19 eyes with both the
features [Fig. 1]. Of the 21 eyes with retinoschisis, schisis was present in multiple layers in 15 (71.43%) and single layer in 6 (28.57%) eyes. [Figs 1 and 2] Posterior vitreous detachment was not seen in any of the eyes. Eleven of 24 eyes underwent pars plana vitrectomy. In all cases, the surgery consisted of vitrectomy including creation of posterior vitreous detachment, fluid-air exchange, low intensity laser photocoagulation at the temporal edge of the optic disc pit and non-expansile perfluoropropane gas (14%) injection. This was followed by instruction for head down and prone posture for 10 days to 2 weeks.

Five (45.45%) of 11 eyes undergoing vitrectomy had complete resolution and 4 (36.36%) eyes had partial resolution of maculopathy [Table 1]. Two (18.18%) eyes did not respond to vitrectomy. Of 11 eyes, OLD resolved completely in 7 (54.54%) eyes, decreased in 2 (18.18%) eyes and did not respond in 2 (18.18%) eyes [Figs. 4 and 5]. Of 10 eyes with retinoschisis, it resolved completely in 4 (40%) eyes, decreased in 4 (40%) eyes and did not respond in 2 (20%) eyes [Figs. 4 and 5]. Visual acuity improved in 8 (72.72%) of 11 eyes.

**Table 1: Outcome of eyes undergoing vitrectomy for optic disc pit maculopathy**

| Case No. | Age (years) | Pre-op BCVA | Pre-op OCT | Follow up (months) | Postop BCVA (last FU) | Postop OCT (last FU) |
|----------|-------------|-------------|------------|--------------------|----------------------|----------------------|
| 1        | 25          | 20/80       | RS OLD    | 12                 | 20/30                | RS:resolved OLD:resolved |
| 2        | 6           | 20/60       | OLD       | 36                 | 20/20                | OLD:resolved          |
| 3        | 32          | 20/80       | RS OLD    | 6                  | 20/200               | RS:persistent OLD:persistent |
| 4        | 17          | 20/120      | RS OLD    | 18                 | 20/120               | RS:persistent OLD:persistent |
| 5        | 37          | 20/80       | RS OLD    | 13                 | 20/60                | RS:resolved OLD:resolved |
| 6        | 26          | 20/80       | RS OLD    | 6                  | 20/60                | RS: decreased OLD:resolved |
| 7        | 35          | 20/120      | RS OLD    | 3                  | 20/120               | RS: minimal OLD:Decreased |
| 8        | 18          | 20/200      | RS OLD    | 10                 | 20/120               | RS: minimal OLD:resolved |
| 9        | 12          | 20/200      | RS OLD    | 14                 | 20/40                | RS:resolved OLD:resolved |
| 10       | 22          | 20/200      | RS OLD    | 3                  | 20/100               | RS: decreased OLD:decreased |
| 11       | 16          | 20/400      | RS OLD    | 3                  | 20/125               | RS:resolved OLD:resolved |

BCVA: Best corrected visual acuity, FU: Follow-up, OCT: Optical coherence tomography, OLD: Outer layer detachment, RS: Retinal schisis

**Figure 1:** (a) Color fundus image shows the macula of a 24-year-old male with optic disc pit maculopathy. (b) OCT fundus image shows the position of horizontal raster line scan. (c) OCT shows intraretinal fluid splitting the retina at multiple levels (both the inner and outer retinal layers). An outer layer detachment communicates with the intraretinal fluid through an outer layer hole (arrow)

**Figure 2:** Horizontal raster line scan at the fovea in a 14-year-old female with optic disc pit maculopathy shows a splitting of the ILM by intraretinal fluid

**Figure 3:** Horizontal raster line scan at the fovea in a 6-year-old male with optic disc pit maculopathy shows sub-retinal fluid

**Figure 4:** Horizontal raster line scan at the fovea in a 24-year-old male with optic disc pit maculopathy shows a splitting of the ILM by intraretinal fluid

**Figure 5:** Horizontal raster line scan at the fovea in a 14-year-old female with optic disc pit maculopathy shows a splitting of the ILM by intraretinal fluid
The present study highlights that schisis-like separation of retinal layers at multiple levels is the main feature of optic disc pit maculopathy. This corroborates with a recently published study which suggests that fluid may enter the retinal layers at multiple levels from the optic disc pit. As the intraretinal fluid does not cleanly split the retina into two layers, it may not appropriate to call it schisis. However, the term has been commonly used to describe optic disc pit maculopathy. Lincoff et al. suggested a bilaminar structure of optic disc pit maculopathy consisting of an inner layer separation and an outer layer detachment. However, the present study suggests that a term like inner layer separation may not be appropriate as intraretinal fluid may split any of the inner and outer retinal layers.

An outer layer detachment due to sub-retinal fluid (SRF) was present in 22 of the 24 cases in the present series. The present series suggests that SRF may originate due to various mechanisms. The commonest mechanism could be an extension of fluid from the intraretinal schisis like cavities into the sub-retinal space. This theory is supported by the fact that an outer layer hole could be demonstrated in 73.68% of cases with both schisis and an outer layer detachment. This is in contrast to a recent series, which could demonstrate an outer layer hole in only 27% cases with retinal detachment. An alternative explanation for SRF could be a direct extension from the optic disc pit into the sub-retinal space, as observed in 3 cases in present series. In some cases, we could not explain the origin of SRF. We believe that the SRF originated in these cases by one of the above described mechanism, but could not be demonstrated as OCT sections were not performed over the entire extent of the schisis.

Laser photocoagulation has limited success rate in optic disc pit maculopathy. In the present study, 9 of the 11 eyes had anatomical improvement after vitreous surgery, which is comparable to previous reports. There are various ways to explain the success of vitreous surgery. Previous studies have hypothesized the role of broad based vitreo-retinal and vitreo-papillary traction in pathogenesis of optic disc pit maculopathy. However, none of the surgical series including the present one has demonstrated these features on OCT. Induction of posterior vitreous detachment along with gas tamponade without laser photoacoagulation has been shown to be effective for treatment of the optic disc pit maculopathy. The plausible explanation could be a release of continued vitreo-retinal traction by PVD induction. The same mechanism may also explain the success of a macular buckling procedure advocated by Theodossiadis et al. In the present study, we also used laser photocoagulation. Laser photoacoagulation helps to create a full thickness retinal scar creating an effective barrier to flow of fluid from the pit into the retinal layers. Gas tamponade in addition is likely to keep the space adjacent to the pit dry for a sufficient time to allow laser to act. Once a scar is formed, the resolution of residual intraretinal and sub-retinal fluid will depend on the RPE function. The plausible reasons for failure of vitreous surgery in two cases in the present study could be either an incomplete removal of posterior hyaloid or failure to create a good laser adhesion.

The present series is the first study of vitreous surgery for optic disc pit maculopathy in Asian eyes. As the retina is heavily pigmented in these eyes, the laser take may be better. Vitrectomy combined with laser photoacoagulation is likely to have a better or comparable outcome as compared to Caucasians and oriental eyes. However, this hypothesis needs further investigation.

The present study is limited by its retrospective nature. We have not used objective measurements to assess the anatomical impact of the vitreous surgery. However, all cases subjected to vitreous surgery had gross accumulation of intraretinal fluid preoperatively which decreased in all cases with successful response to surgery.

Outer layer detachment tended to resolve in most of the cases resulting in visual improvement. However, intraretinal schisis like cavities persisted to a variable extent. A previous study has shown that intraretinal changes may require a year.
to resolve after surgery.\textsuperscript{[11]} The cases presented in the present study are likely to show complete resolution if followed for a longer duration.

In conclusion, splitting of retinal layers by intraretinal fluid at multiple levels is the main feature of optic disc pit maculopathy. Outer layer detachment seems to be a secondary phenomenon. However, OLD may arise directly from the optic disc pit in some cases. Vitrectomy with PVD induction, laser photocoagulation and gas tamponade results in anatomical and visual improvement in most cases with optic disc pit maculopathy.

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