Original Article

Continuous intraoperative optical coherence tomography-guided shield ulcer debridement with tuck in multilayered amniotic membrane transplantation

Namrata Sharma, Deepali Singhal, Prafulla Kumar Maharana, Rahul Jain, Pranita Sahay, Jeewan S Titiyal

Purpose: The aim of this study is to describe a modified surgical technique of continuous intraoperative optical coherence tomography (iOCT)-guided shield ulcer debridement with tuck-in multilayered Amniotic membrane transplantation (ML AMT) in vernal keratoconjunctivitis (VKC) with shield ulcer with plaque. **Methods:** Seven eyes of seven patients presenting with VKC with shield ulcer with plaque were enrolled in this prospective case series and planned for shield ulcer debridement with ML AMT. Debridement of the ulcer base with double-layered AMT was done under the continuous guidance of iOCT. The main outcome measure was the time for complete reepithelialization. Statistical analysis was performed using the Stata-14.0 program for Windows. Data were presented as mean ± standard deviation/ median (minimum-maximum) and frequency percentage as applicable. **Results:** The surgery could be completed successfully in all cases and iOCT could provide real-time assessment of the depth of dissection during the entire procedure. The duration of complete healing and disintegration of amniotic membrane varied from 7 to 12 days. Recurrence was not seen in any case till 2 months follow-up. **Conclusion:** iOCT provides continuous monitoring of the depth of dissection and allows for a safe and complete debridement of the shield ulcer with plaque.

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Shield ulcer is a shallow indolent ulcer associated with cases of vernal keratoconjunctivitis (VKC). Shield ulcer has been classified into three grades based on which the treatment plan is decided.[1] Grade 1 consists of a transparent base, which is managed medically. Grade 2 consists of a translucent base with or without opaque white or yellow deposits for which medical management is preferred and surgical if nonresolving. Grade 3 consists of an elevated plaque for which ulcer debridement with AMT is the preferred modality of choice. One of the problems commonly encountered during surgery includes difficult depth perception while doing scraping of the ulcer. The fear of perforation often leads to inadequate debridement with consequent poor healing. Herein, we describe a modified surgical technique of shield ulcer debridement with tuck in multilayered Amniotic membrane transplantation (ML AMT) done under real-time assessment of the depth of dissection during the procedure.

Methods

This is a prospective case series including seven eyes of seven patients with VKC with shield ulcer with plaque [Fig. 1] planned to undergo shield ulcer debridement. Written informed consent was obtained from all participants for the study. The study adhered to the tenets of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board.

All cases presented with photophobia, whitish opacity in cornea and diminution of vision. Ocular history was consistent with recurrent episodes of itching, ropy discharge, and redness in the past. Two of the cases were already on treatment from outside for VKC with intermittent use of topical steroids. On examination, all cases showed conjunctival congestion, multiple papillae over tarsal conjunctiva, and ropy discharge. Baseline characteristics and duration of healing is mentioned in Table 1.

Intraocular pressure measured on noncontact tonometry (Nidek technology; Sri Padova, Italy) was within normal limits in all eyes. Posterior segment examination was normal in all eyes. Size of the ulcer was measured using a slit lamp in the greatest dimension and that along an axis perpendicular to it. Site of the shield ulcer was noted and classified as described by Cameron.[1] Medical management was started in all cases

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as topical Olopatadine Hydrochloride 0.1% eye drops twice daily (Pataday; Alcon labs. Minnesota); topical corticosteroids: prednisolone acetate 1% 6 times daily (Predforte; Allergan, Irvine, USA), antibiotic eye drops 3 times daily (Vigamox; Alcon Labs, USA), and lubricating eye drops 8 times daily (Refresh tears; Allergan, Irvine, USA) in both eyes.

These patients were planned for ulcer debridement with AMT under the guidance of continuous intraoperative anterior segment optical coherence tomography (OCT) (OPMI Lumera 700 and RESCAN 700, Carl Zeiss, Meditec, Germany). Intraoperative OCT imaging was done using the RESCAN 700 [microscope integrated iOCT system with a heads-up display system, external video display panel, and a foot pedal control of the OCT scanner, based on the Lumera 700 (Carl Zeiss Meditec) platform]. Anterior segment imaging was achieved with the help of the standard microscope viewing system that included a 9 mm × 9 mm volumetric cube scan and raster scans (2 lines and 5 lines) at 0° orientation.

The surgery was performed under general anesthesia. Initially, the ulcer margins were delineated. The tip of Sinskey hook (Appasamy Associates; Chennai, Tamil Nadu) was used to isolate the margins of the ulcer. The base of the ulcer was debrided using a crescent blade (Alcon Surgical, Fort Worth, Texas, USA). Throughout the procedure, iOCT provided a clear image regarding the completion of plaque removal and thickness of the underlying stroma. Any residual plaque was visible as a hyperreflective membrane or dots. All such residues were removed and a complete plaque removal could be achieved using a real-time feedback imaging [Fig. 2]. This was followed by a 0.5 mm epitheliorrhexis done with the help of Lim's forceps (AA 3145, Appasamy Associates; Chennai, Tamil Nadu) 360° around the ulcer margins to provide a raw edge for the migration of epithelial cells. In addition, a subepithelial shallow pocket was created all along the margin with a crescent blade.

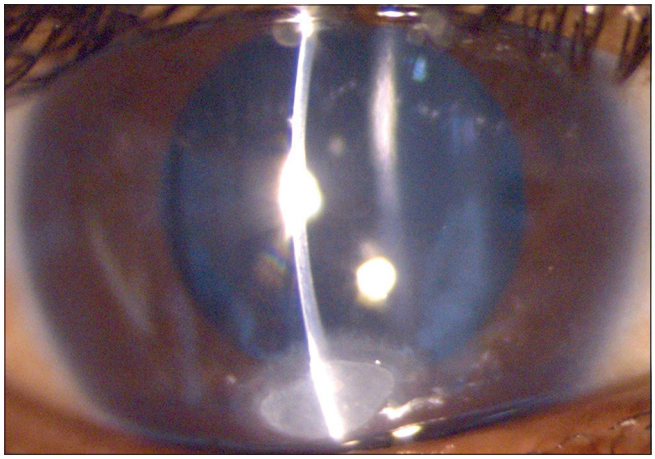

Figure 1: Clinical photograph showing an inferior shield ulcer with plaque

Amniotic membrane graft (AMG) was fashioned conforming to the size and extent of the defect and was applied to the raw area with the help of fibrin glue (Tisseel Kit; Baxter AG, Vienna, Austria) with stromal up. The edges of this AMG were tucked in the subepithelial pocket, which was created along the margins of the ulcer. The second layer of AMT was applied over the surface till 3 mm beyond the limbus 360° and was placed stromal surface down with the help of fibrin glue (Tisseel Kit; Baxter AG, Vienna, Austria). Eight anchoring interrupted sutures were placed with the help of 8-0 vicryl (Ethicon; New Jersey, USA) at 2 mm beyond the limbus taking the bites through the conjunctiva and episclera. Both the layers of the AMG could be confirmed with iOCT as a hyperreflective layer over the ulcer base [Fig. 3]. At the end a soft-bandaged contact lens (Johnson & Johnson Private Limited; Jogeshwari, Mumbai) was placed over the surface and the eye was patched.

Statistical analysis

Statistical analysis was performed using the Stata-14.0 (StataCorp LLC, Texas, USA) program for Windows. Data were presented as mean ± standard deviation/median (minimum-maximum) and frequency percentage as applicable.

Results

The mean age of the patients was 7.9 ± 1.1 years. The study group had two females and five males. Two eyes of two

Table 1: Baseline parameters and duration of healing of patients with vernal keratoconjunctivitis with shield ulcer with plaque

Case	Age (years)	Sex	BSCVA (LogMAR acuity)	Lens status	Size of ulcer (mm)	Site of shield ulcer	Duration of healing (days)
1	7	Male	1.0	Clear	4.5 × 5	I-C-S	7
2	8	Male	0.6	Posterior Subcapsular cataract	3 × 2.5	I	8
3	10	Female	0.6	Clear	5 × 4.5	S	12
4	6	Male	1.0	Posterior Subcapsular cataract	3.5 × 4	S	10
5	7.5	Male	0.5	Clear	5 × 4.5	S	12
6	9	Female	0.8	Clear	3.5 × 2.5	C	8
7	8	Male	0.5	Clear	2 × 3.5	S	9

LogMAR: Log of the minimum angle of resolution, BSCVA: Best spectacle-corrected visual acuity, I: Inferior, S: Superior, C: Central, I-C-S: Inferior-Central-Superior

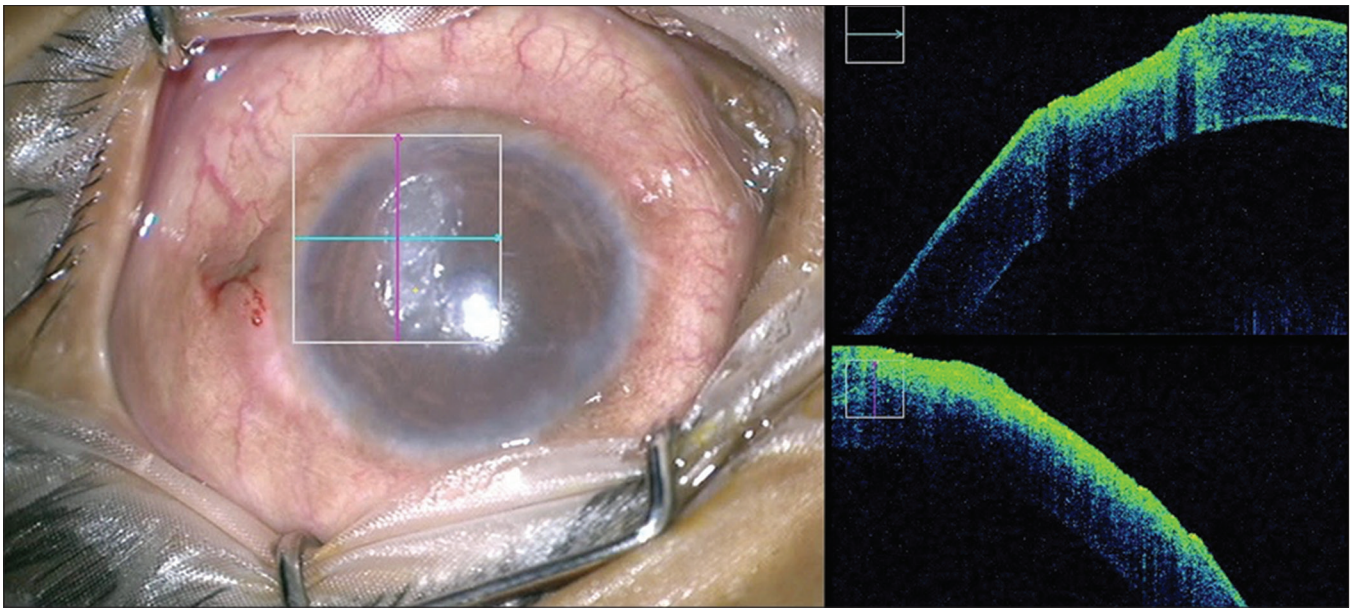

Figure 2: Intraoperative optical coherence tomography clinical photograph showing shield ulcer after debridement

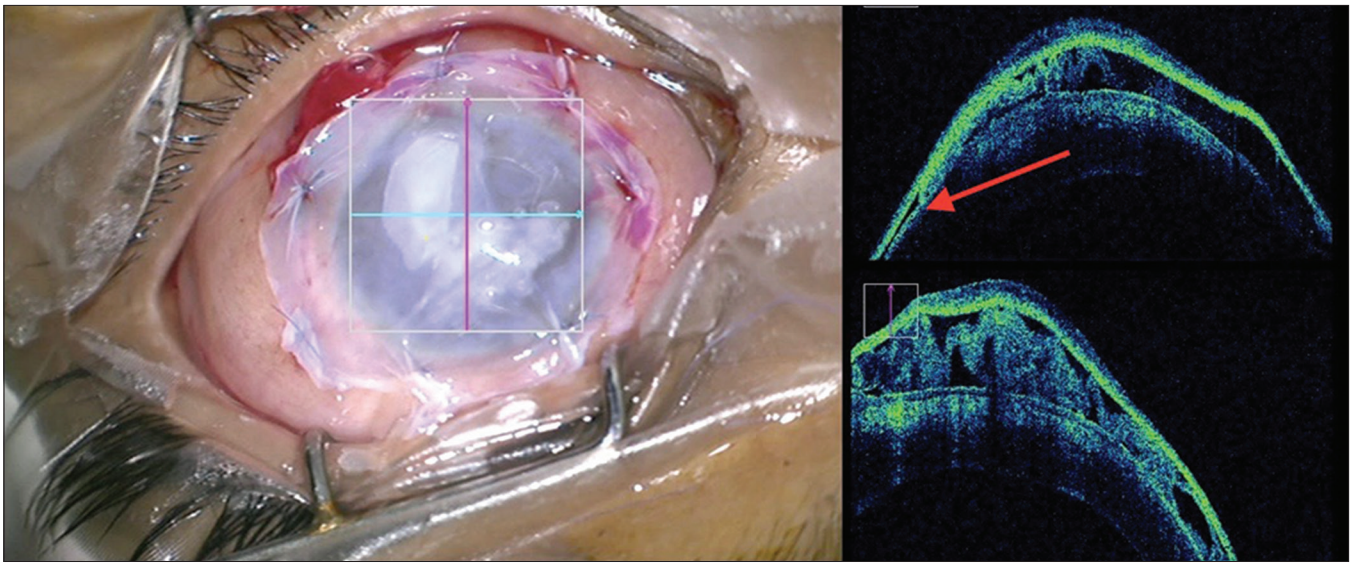

Figure 3: Intraoperative optical coherence tomography clinical photograph showing the two layers of amniotic membrane with tucked in the peripheral edge of the first layer

cases had posterior subcapsular cataract. The median best spectacle-corrected visual acuity was 0.75 ± 0.35 Logarithm of minimum angle of resolution units. The mean size of the shield ulcer was 3.7 ± 1.1 mm × 3.7 ± 0.9 mm. The mean duration of complete healing was 9.4 ± 1.9 days with complete disintegration of amniotic membrane noted at 13.7 ± 2.6 days [Fig. 4].

Discussion

Debridement of the ulcer base with AMT has been described for the management of shield ulcer with plaque.[2] AMT promotes healing by its properties of mechanical protection of the healing epithelium from the lid movements, anti-inflammatory, antiangiogenic effect, and by reducing fibrosis. Basement membrane of AM promotes migration and differentiation of epithelial cells and also reinforces adhesion of the basal epithelial cells.[3-5] It also produces various growth factors such as fibroblast growth factor and transforming growth factor, which promotes epithelialization. Sridhar *et al*. reported complete healing of shield ulcer with disintegration of AMG within 2 weeks.[2] Lin *et al*. reported complete healing of two cases of shield ulcer following AMT with debridement of ulcer at 1 week in Grade 2 ulcer and at 6 weeks in Grade 3 ulcer.[6] Pelegrin *et al*. reported complete healing at 2 weeks in shield ulcer with plaque.[7]

Complete healing was observed in these cases within 10 days. This may be due to all the beneficial effects of AMT as described above.

In contrast to other studies, debridement of the plaque with double-layered AMG with tucking in of the margins was

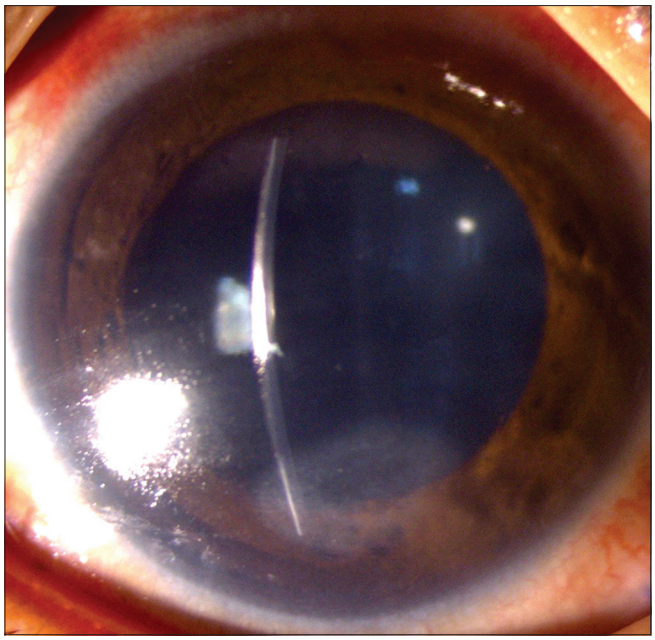

Figure 4: Clinical photograph showing an inferior shield ulcer after healing at day 10

performed in these cases. We believe that tucking in leads to migration of epithelial cells without crossing the margin of the AMG, which could be responsible for the rapid healing of the ulcer. In addition, the second layer acted as a protective scaffold and provided additional growth factors further contributing to rapid healing in this case.

The use of iOCT system has been validated previously by two multicentric trials that are DISCOVER study (RESCAN 700) and PIONEER study (Bioptigen).[8,9] iOCT has been found extremely helpful in providing information related to graft position/orientation, depth of lamellar dissection, visualization of interface fluid and graft/host apposition, surgical manipulations (e.g., manual sweeping, increased air infusion pressure), and visualization of instrument-tissue interaction in lamellar procedures such as descemet stripping automated endothelial keratoplasty, deep anterior lamellar keratoplasty, and descemet membrane endothelial keratoplasty. In addition, during phacoemulsification, it has been found useful for visualization of capsulorrhexis, hydrodissection, groove depth, and intraocular lens placement.

VKC with shield ulcer is a very common entity in our set up. We have been performing ulcer debridement with AMT regularly since last few years. The major difficulty encountered during debridement, in past, used to be difficult visualization and assessment of depth of dissection intraoperatively. However, with the use of iOCT, we could avoid all these difficulties. The continuous iOCT system provides real-time images and helps to better visualize the depth of the surgical dissection. Both the layers of AMG were visualized and confirmed as a hyperreflective layer under iOCT.

Conclusion

Till date, continuous iOCT systems have not been used in guiding the debridement and dissection of shield ulcer. We describe this technique of iOCT-guided ulcer debridement and multilayered AMT for the first time. However, the readers must not take the message that iOCT is an inevitable part of the surgery; it is just an another tool that increases the margin of safety and probably the meticulousness of the surgery.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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