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Combined Internal Limiting Membrane (ILM) Flap and Autologous Plasma Concentrate (APC) to Close a Large Traumatic Macular Hole in a Pediatric Patient

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Summary Statement

The authors describe a surgical technique using autologous plasma concentrate with internal limiting membrane flap to successfully close a large, traumatic macular hole in a pediatric patient

Keywords

Autologous plasma concentrate; Platelet Rich Plasma; Internal limiting membrane peeling; Internal limiting membrane flap; Macular hole; Intraoperative optical coherence tomography; Trauma; Traumatic macular hole; Pediatric retina

Introduction

Chronic, large macular holes, particularly those associated with prior trauma or retinal detachment, portend a poorer prognosis. While most idiopathic macular holes successfully close with the standard surgical technique of combined vitrectomy, internal limiting membrane (ILM) peeling, and the use of gas tamponade, traumatic large holes are more recalcitrant to closure. In recent years, innovative techniques have been developed expanding the vitreoretinal surgeon's armamentarium to deal with these challenging macular holes. These include the use of ILM flaps^{1,2}, scleral shortening techniques³, adjuvant blood components^{4,5}, plasmin-assisted vitrectomy^{6,7}, and autologous retinal free flaps⁸.

While many of these techniques address the size of the macular hole and those associated with high myopia, few techniques are aimed at addressing traumatic macular holes, especially in the pediatric population. Traumatic macular holes may have different characteristics from idiopathic macular holes. They tend to occur in a younger age group and present with worse vision, although the rate of spontaneous closure of smaller full-thickness traumatic holes is reported to be around 40%.^{9,10} Additionally, on OCT these holes may have, a larger basal diameter, an irregular configuration of the retinal edges, and surrounding

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retinal pigmentary epithelial changes and retinal thinning.¹¹ We describe the use of a combination of an ILM flap with autologous plasma concentrate (APC) to close a large pediatric traumatic macular hole, with surgeon visualization assisted by microscope-integrated intraoperative optical coherence tomography (MIOCT)¹².

Surgical Technique

Description of Case and Technique

A 14-year-old boy presented with a large macular hole in the left eye 3–4 years after a blunt football injury to that eye. His visual acuity was 20/320 in the affected left eye. OCT showed a large 1390 μm (inner diameter) and 1830 μm (basal diameter) full-thickness macular hole. In the surrounding retina, there was an epiretinal membrane, intraretinal cystic changes and temporal retinal thinning. (Figure 1A)

In this technique, we first performed a 25-gauge pars plana vitrectomy (Constellation; Alcon) and detached the firmly adherent posterior hyaloid with the vitreous cutter to the mid-periphery. Diluted indocyanine green dye (ICG) was injected and allowed to stain the ILM for 30 seconds and then removed. A Finesse loop was used to elevate an edge and ILM forceps were used to first remove the epiretinal membrane and the nasal ILM. Then a temporal ILM flap was generated and placed over the large macular hole. (Figure 1B) Next fluid-air exchange with repeated soft-tip aspiration over the optic nerve was performed to verify all the residual fluid was removed. Autologous blood was harvested from the patient's antecubital vein with a citrate-based anticoagulant using a sterile technique. An Arthrex APC kit (Arthrex Inc, Naples, FL) was used to centrifuge the anticoagulated blood (1500 rpm for 5 minutes) and generate autologous conditioned plasma (APC) supernatant, which was enriched in platelets. Using a soft-tip cannula, two drops of the APC were placed into the macular hole. MIOCT visualization confirmed the proper location of the inverted ILM flap as well as the placement and volume of the APC; (Figure 1C) both of these were not identifiable on conventional surgical visualization. Air was then exchanged with XX% C3F8 gas. (Supplemental Video 1) The patient was instructed to position prone for one week.

Three months following the surgery, the macular hole was closed with some reconstitution of outer retinal layers visible on OCT imaging. (Figure 1D) VA was 20/200 with pinhole to 20/100.

Discussion

Surgical options for large traumatic macular holes, particularly in pediatric patients, are limited. In 2010, Nawrocki et al described the use of the inverted ILM flap to improve closure rates for large idiopathic macular holes.¹³ This technique has since been reported in traumatic macular holes with success.¹⁴ Autologous blood and platelet products have also been used successfully in patients with idiopathic macular hole and myopic macular holes.⁴ A prior report of the use of APC was reported by Wachtlin et al in four pediatric patients with macular hole though these holes were around 300 μm in size.^{15,16} Our technique combined these two methods: we believe this technique is particularly advantageous for pediatric patients with a large macular hole as the APC with the ILM flap provide a strong

plug and a scaffold for cell proliferation to seal the hole and allow for anatomical closure. Intraoperative OCT was particularly helpful in this case in confirmation of the location of the ILM flap as well as the placement of the APC.

APC is plasma enriched with autologous activated platelets, growth factors and cell adhesion molecules including PDGF, IGF-1, TGF-B, bFGF, and EGF and is presently FDA approved to enhance wound healing in orthopedic and plastic surgery procedures. The APC acts as a “glue” and helps to hold the sometimes flimsy flap in proper position and promotes the proliferation of glial cells through the presence of growth factors. Unlike other substances APC has the advantage of dissipating over time rather than acting as a permanent plug. Although not yet substantiated by histopathologic correlation, the proliferating glial cells induced by the ILM scaffold and APC then provide an environment suitable for photoreceptors to migrate to the fovea explaining the improvement in vision.

Few surgical options exist for patients with large traumatic macular holes. We believe the combined use of a scaffold for cellular proliferation, the ILM flap, along with the growth factors provided by APC has the potential for the highest success in the most difficult cases in the pediatric population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure:

Preoperative, intraoperative and postoperative OCT imaging of the traumatic macular hole closed with ILM flap and autologous platelet concentrate (APC).

A) Preoperative OCT of large traumatic macular hole measuring 1390 μm in inner diameter.

B) Intraoperative still frame from MIOCT showing ILM flap (asterisk) positioned over the hole.

C) Intraoperative still frame from MIOCT showing APC (arrow) placed in and overlying the hole.

D) Anatomical closure on OCT at post-operative month 3.