Case Reports in Ophthalmology

Case Rep Ophthalmol 2023;14:433–438
DOI: 10.1159/000533668
Received: May 22, 2023
Accepted: August 16, 2023
Published online: September 12, 2023

Case Report

Eccentric Fixation and Good Visual Acuity in a Child with Large Traumatic Macular Hole: A Case Report

Hassan Asadigandomani[a, b] Nader Mohammadi[a, b]
Hamid Riazi-Esfahani[a, b] Motahhareh Sadeghi[a] Elias Khalili Pour[a, b]

[a]Translational Ophthalmology Research Center (TORC), Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran; [b]Retina Ward, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran

Keywords
Traumatic macular hole · Good visual acuity · Eccentric fixation

Abstract
A girl of 8 years old was referred to our clinic with a history of penetrating injury to her left eye 6 years ago with light perception vision and a large traumatic macular hole in her right eye. Her right eye's vision was 4/10 when she first visited our clinic. Considering the patient's one-eye status, her parents' reluctance to undergo surgery, and the possibility of spontaneous closure of traumatic macular holes, it was determined to observe the patient and evaluate her visual acuity and macular hole condition. In 2 years, the final best corrected visual acuity was 8/10 in the right eye, with infratemporal eccentric fixation in visuoscopy. In addition to evaluating and reporting this case as a traumatic macular hole, we will discuss the role of nonsurgical treatment and the possibility of good visual acuity with eccentric fixation in a child with large traumatic macular hole.

Introduction

Macular hole (MH) is defined as a complete neurosensory defect in the sensory layer of the retina, and ocular trauma can be an etiology for this defect. In 1869, Knapp described the first case of a traumatic macular hole (TMH) [1]. TMH is often caused by sports or work-related trauma, therefore, it is more common in young men in the first 2 decades of life [2, 3].

Correspondence to:
Elias Khalili Pour, ekhalilipour@gmail.com

Case Rep Ophthalmol 2023;14:433–438
DOI: 10.1159/000533668

TMH can be caused by compression of the neurosensory retina following the Berlin edema (early onset) or it can be caused by unroofing of the cyst caused by the trauma (late onset) [4]. A variety of tangential forces or anteroposterior forces can be effective in the pathophysiology of this disease [5]. The prevalence of TMH is 1.4% in closed-globe injuries [6] and 0.15% in open-globe injuries [7].

The vision of these patients has been reported to range from 20/30 to 20/400 depending on the presence of other traumatic injuries such as retinal detachment, vitreous hemorrhage, optic nerve injuries, commotio retinae, etc. [2, 3]. Traumatic macular defects may close spontaneously between 2 and 54 weeks, in about 40% of patients [4, 8]. The high rate of spontaneous closure may be attributable to the fact that TMH patients are young and have a healthy vitreous gel and vitreoretinal attachment. Indeed, young age, small hole size, cystic edema at the border of the MH, and the absence of posterior vitreous detachment have been identified as factors that may accelerate spontaneous closure [9].

In this report, we present a case of TMH and discuss its spontaneous improvement and the potential for good visual acuity with eccentric fixation in a child with an old TMH. The CARE Checklist has been completed by the authors for this case report, attached as supplementary material (for all online suppl. material, see https://doi.org/10.1159/000533668).

Case Report

In March of 2021, an 8-year-old girl was referred to our retinal ward with a diagnosis of TMH. In the patient's medical records, it was noted that her both eyes were injured by several shotgun projectiles at the age of two. A blunt trauma to the right eye was documented, but she underwent intraocular foreign body removal and primary repair surgery for the left eye at a local hospital.

At the time of the visit to our clinic, the right eye had a best corrected visual acuity (BCVA) of 4/10, while the left eye was at the light perception level. The left eye had multiple corneal scarring resulting from prior injury, as shown in Figure 1 and funduscopic examination of the left eye was impossible due to corneal scars. In the examination of the right eye, no pathologies were evident in anterior segment, and intraocular pressure was 14 mm Hg. In the funduscopic examination, there was evidence of a TMH and perifoveal and peripapillary retinal scars, as shown in Figure 2. Optical coherence tomography confirmed the presence of a MH with minimum basal diameter of 418 microns in the right eye. Considering the patient's one-eye status, her parents' reluctance to undergo surgery, and the possibility of spontaneous closure of TMHs, it was determined to observe the patient and evaluate her visual acuity and MH condition.

Four months later, in July 2021, there was an increase in the size of the MH (633 μm), but to our surprise, the patient's BCVA had reached approximately 6/10. The decision was made to continue the conservative follow-up every 4 months. The patient's BCVA improved to 8/10 at the final visit in March 2023, despite the size of the MH not changing substantially, as shown in Figure 3. Each measurement of the patient's BCVA was performed by two separate optometrists to further confirm vision improvement.

Since the patient's BCVA was not compatible with MH, we suspected eccentric fixation which was confirmed with vvisuoscopy using direct ophthalmoscope, and the fixation point was inferior and temporal to the true fovea shown in Figure 2b. To the best of our knowledge, this is the first documented case of large MH with following development of eccentric fixation and good visual acuity.

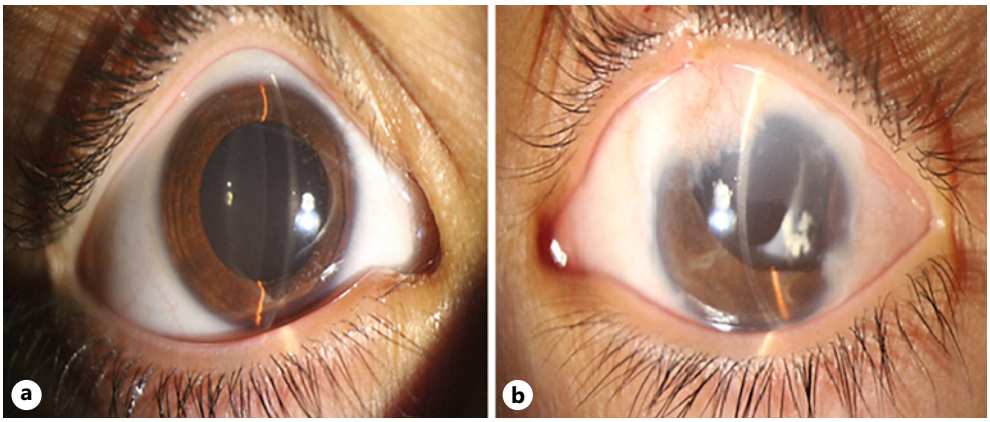

Fig. 1. A slit photograph of the right eye (**a**) reveals unremarkable findings, whereas a slit photograph of the left eye (**b**) reveals corneal scarring and superior vascularization as a result of a previously repaired penetrating injury.

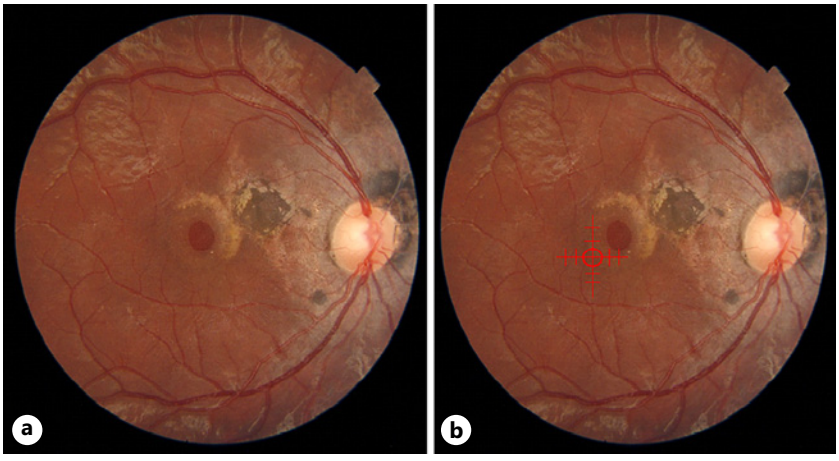

Fig. 2. a Fundus photograph at 6 months of follow-up. **b** Fundus photograph after 2 years of follow-up with corresponding fixation point in visuoscopy.

Discussion

Numerous treatment approaches have been proposed for TMH. Common in these approaches, the first step is observation for 3 months, as spontaneous closure is possible. Surgical intervention is typically recommended if a TMH does not resolve spontaneously within 3 months, according to some studies [2, 9, 10].

There is no analogous case report in the literature, as most similar cases are treated surgically or are spontaneously closed during observation period. Contrary to the recommendations in the literature [11], we were forced to use conservative treatment since the parents refused surgical intervention. To our surprise, we discovered that while the macula did not improve anatomically, it may have improved functionally.

During the 2-year follow-up period, the patient's BCVA increased from 4/10 to 8/10, and eccentric fixation accompanied this progressive improvement in vision. In this uncommon instance, the eccentric fixation of the eye, which had normal vision before the trauma, was responsible for final good vision despite the presence of a persistent TMH. The patient's impaired vision in the opposite eye has probably contributed to her vision improvement in the better eye over time.

Case Rep Ophthalmol 2023;14:433–438
DOI: 10.1159/000533668

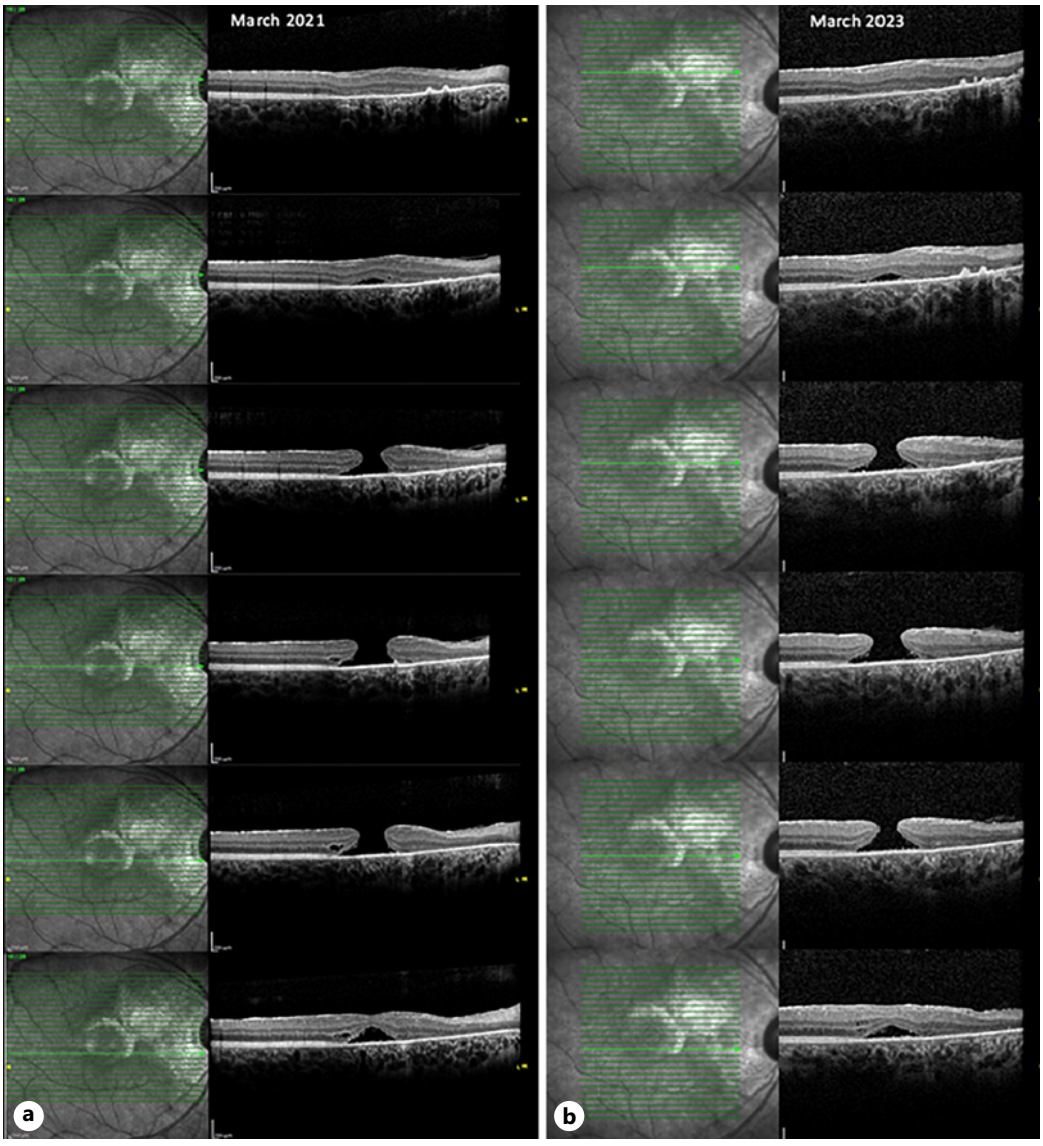

Fig. 3. a Horizontal optical coherence tomography (OCT) in various sections from superior to inferior fovea at the time of presentation (March 2021) reveals atrophic outer retina on the nasal side of the fovea and a TMH measuring 418 microns in the minimal basal diameter. **b** After 2 years of follow-up, corresponding macular OCT slices reveal a MH of the same size and decreasing para-foveal cystic changes.

The patient experienced bilateral ocular trauma 6 years ago. The severity of the trauma to the left eye has garnered greater attention; however, it is important to note that the right eye has also endured substantial trauma. The patient likely experienced eccentric fixation in the right eye approximately 6 years ago. As a result of the neural pathways and retinal cells' notable plasticity, the vision in this eye has shown improvement. However, it is possible that the observed improvement in the patient's vision over the course of 2 years at our medical facility can be attributed to the patient's increased compliance as they age and their enhanced ability to effectively interpret and respond to the Snellen chart during this timeframe. Indeed, it has been established through prior research that the process of nerve cell and retina adaptation is an ongoing phenomenon that persists until adulthood [12, 13].

Kadonosono et al. studied the influence of fellow eyes' visual acuity as a prognostic factor in MH surgery, which is a relatively relevant example in this field. They found that visual recovery after a successful MH operation was inversely proportional to the visual acuity of the fellow eye. Additionally, they discovered that practicing eccentric fixation may enhance vision following MH surgery [14].

At present, a prevalent technique employed for assessing eccentric fixation entails the utilization of a direct ophthalmoscope, which is deemed to be a convenient and user-friendly approach. Nevertheless, it possesses certain limitations. The utilization of visible light may pose challenges in conducting examinations on young patients who frequently exhibit uncooperative behavior. The utilization of the instrument demands a considerable level of proficiency, particularly when examining patients under non-mydriatic circumstances, due to the restricted field of view of the fundus observed through it. Also, the measurement of the distance between the center of the concentric circles projected onto the fundus and the reflection on the foveal depression is only an approximation because the concentric circles are spaced at intervals of 0.5° [15].

Evaluation of fixation center has been conducted in some studies using a MP-1 Microperimeter (Nidek Technologies Srl, Vigonza, Italy) [16, 17]. The fixation centers are determined by MP-1 through the measurement of stability, which is achieved by tracking an arbitrary site of the fundus oculi. The accuracy of eccentric fixation position determinations via MP-1 may be compromised due to the utilization of near-infrared light for measurements during two-dimensional fundus observations, which renders it incapable of precisely identifying the fovea [15].

The utilization of microperimetry assessment has the potential to facilitate the identification of eccentric fixation in the current patient, and it is important to acknowledge that this aspect represents a significant limitation within the present case report. The challenges encountered in this regard include the patient's inadequate compliance with the test and the restricted availability of microperimetry resources.

In summary, the reduced visual acuity of the non-affected eye and the development of eccentric fixation in patients with TMHs, particularly in young children, may serve as two important contributing factors in improving visual acuity. This matter highlights the importance of adaptable visual pathways in young individuals.

Statement of Ethics

This report does not contain any personal information that could lead to the identification of the patient. Ethical approval is not required for this study in accordance with local or national guidelines. Written informed consent was obtained from the parents of patient for publication of the details of her medical case and any accompanying images.

Conflict of Interest Statement

The authors declare that they have no competing interests.

Funding Sources

There were no specific funding sources for this study.

Author Contributions

Elias Khalili Pour, Hamid Riazi-Esfahani, and Motahhareh Sadeghi collected the data. Hassan Asadigandomani and Nader Mohammadi contributed by writing up the manuscript. Elias Khalili Pour and Hamid Riazi-Esfahani analyzed and interpreted the patient images and revised the manuscript.

Data Availability Statement

All data are included in this article. Further inquiries can be directed to the corresponding author.

References

1 Knapp H. Ueber Isolierte Zerreissungen der Aderhaut infolge von Traumen auf dem Augapfel. Arch Augenheilkd. 1869;1:6–29.
2 Gao M, Liu K, Lin Q, Liu H. Management modalities for traumatic macular hole: a systematic review and single-arm meta-analysis. Curr Eye Res. 2017;42(2):287–96.
3 Huang J, Liu X, Wu Z, Sadda S. Comparison of full-thickness traumatic macular holes and idiopathic macular holes by optical coherence tomography. Graefe's Archive Clin Exp Ophthalmol. 2010;248(8):1071–5.
4 Yamada H, Sakai A, Yamada E, Nishimura T, Matsumura M. Spontaneous closure of traumatic macular hole. Am J Ophthalmol. 2002;134(3):340–7.
5 Budoff G, Bhagat N, Zarbin MA. Traumatic macular hole: diagnosis, natural history, and management. J Ophthalmol. 2019;2019:5837832.
6 Viestenz A, Küchle M. Stumpfes augentrauma. Ophthalmologe. 2005;102(1):89–101.
7 Kuhn F, Morris R, Mester V, Witherspoon CD. Internal limiting membrane removal for traumatic macular holes. NJSlack Incorporated Thorofare. 2001:308–15.
8 Miller JB, Yonekawa Y, Eliott D, Kim IK, Kim LA, Loewenstein JI, et al. Long-term follow-up and outcomes in traumatic macular holes. Am J Ophthalmol. 2015;160(6):1255–8. e1.
9 Zhou Q, Feng H, Lv H, Fu Z, Xue Y, Ye H. Vitrectomy vs. Spontaneous closure for traumatic macular hole: a systematic review and meta-analysis. Front Med. 2021;8:735968.
10 Liu W, Grzybowski A. Current management of traumatic macular holes. J Ophthalmol. 2017;2017:1748135.
11 Premi E, Donati S, Azzi L, Porta G, Metrangolo C, Fontanel L, et al. Macular holes: main clinical presentations, diagnosis, and therapies. J Ophthalmol. 2022;2022:2270861.
12 Rahi JS, Logan S, Borja MC, Timms C, Russell-Eggitt I, Taylor D. Prediction of improved vision in the amblyopic eye after visual loss in the non-amblyopic eye. Lancet. 2002;360(9333):621–2.
13 Vagge A, Shields CL, Shields JA, Pointdujour-Lim R, Schnall B. Visual improvement in amblyopic eye following treatment-induced vision loss in dominant eye with uveal melanoma. Br J Ophthalmol. 2020;104(2):202–7.
14 Kadonosono K, Yabuki K, Nishide T, Uchio E, Marron JA. Measured visual acuity of fellow eyes as a prognostic factor in macular hole surgery. Am J Ophthalmol. 2003;135(4):493–8.
15 Nakamoto Y, Takada R, Tanaka M, Matsumoto F, Aomatsu K, Tachibana K, et al. Quantification of eccentric fixation using spectral-domain optical coherence tomography. Ophthalmic Res. 2018;60(4):231–7.
16 Carpineto P, Ciancaglini M, Nubile M, Di Marzio G, Toto L, Di Antonio L, et al. Fixation patterns evaluation by means of MP-1 microperimeter in microstrabismic children treated for unilateral amblyopia. Eur J Ophthalmol. 2007;17(6):885–90.
17 Subramanian V, Jost RM, Birch EE. A quantitative study of fixation stability in amblyopia. Invest Ophthalmol Vis Sci. 2013;54(3):1998–2003.