

OBSERVATION VS. SURGERY IN TRAUMATIC MACULAR HOLE: A CASE REPORT HIGHLIGHTING FUNCTIONAL OUTCOME

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Abstract

Introduction: Traumatic macular hole (TMH) is a rare consequence of blunt ocular trauma, often leading to visual impairment. While spontaneous closure is possible, the decision between observation and surgical intervention remains debated.

Case Report: A 15-year-old male presented with blurry vision in his left eye two weeks after being punched. Examination revealed a macular hole, choroidal rupture, and vitreous hemorrhage. Optical coherence tomography (OCT) confirmed a full-thickness macular hole. Given the potential for spontaneous closure, a three-month observation period was chosen. Follow-ups showed no improvement in visual acuity or anatomical closure, leading to the decision against surgery.

Discussion: While vitrectomy has high anatomical success rates, final visual acuity may not differ significantly between surgically and spontaneously closed holes. Factors such as initial visual acuity, ellipsoid zone integrity, and associated ocular injuries influence functional outcomes. In this case, the presence of choroidal rupture and vitreous hemorrhage supported the decision for conservative management.

Conclusion: TMH management should balance anatomical and functional outcomes. Observation is a reasonable approach in select cases, particularly in younger patients with a chance of spontaneous closure. Individualized treatment decisions are essential, considering potential surgical risks and visual prognosis.

Keywords: Macular Hole, Traumatic Macular Hole, Blunt Ocular Trauma, Functional Success **Cite**

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INTRODUCTION

Macular hole (MH) is a vitreoretinal disorder characterized by a partial or full-thickness defect in the neurosensory retina at the center of the macula, leading to visual impairment.^[1] Traumatic macular hole (TMH) is the second most common cause of MH, primarily resulting from blunt ocular trauma. It is an uncommon complication of eye injury and is more frequently observed in young men and can develop immediately after injury or appear weeks later.^[2-5] Clinical presentation of TMH typically includes decreased visual acuity and metamorphopsia. Visual acuity in TMH cases varies widely, influenced by many factors.^[6-9]

The management of TMH remains controversial, with no definitive guidelines on the optimal treatment approach. While spontaneous closure can occur, particularly in young patients with smaller holes and an intact posterior vitreous^[10-12], surgical intervention is often considered for persistent cases.^[6] Vitrectomy, first described for idiopathic macular holes (IMHs), has been adapted for TMH repair, with reported anatomical closure rates exceeding 80%.^[8, 13-15] However, anatomical success does not always translate into functional success, as visual outcomes depend on multiple factors beyond hole closure.^[6, 9, 16]

This case report presents a young male patient who developed a TMH following blunt ocular trauma. We discuss the clinical presentation, diagnostic findings, and management considerations, highlighting the importance of weighing anatomical and functional outcomes when determining the best treatment strategy.

CASE REPORT

A 15-year-old male patient presented with a complaint of blurry vision in the left eye for the past two weeks. Blurred vision was defined as seeing straight lines appear bent and noticing floating threads sometimes. The patient mentioned a history of being punched on the eye by his friend

two weeks before admission to the hospital. No history of previous illnesses, use of glasses, or surgeries were reported.

On ocular examination, visual acuity (VA) was emmetropia on the right eye and 1 meter finger counting on the left eye. Intraocular pressure (IOP) and ocular movement (OCM) were within normal limits on both eyes. Anterior segment of left eye showed subconjunctival hemorrhage, others were within normal limit. Posterior segments were also evaluated. On funduscopy, the left eye showed choroidal rupture, macular hole, epiretinal membrane and vitreous hemorrhage, hence further evaluation was necessary. Optic nerves were within normal limits. Patient underwent Optical Coherence Tomography (OCT). Left eye showed vitreous traction on the preretinal layer, disappeared foveal depression on the epiretinal layer, and full thickness macular hole on the intraretinal layer. Right eye showed no abnormality.

Based on symptoms, signs, and imagings, the patient was assessed as post traumatic macular hole, choroidal rupture, vitreous hemorrhage, epiretinal membrane and subconjunctival hemorrhage of the left eye. Patient was planned to have a 3-month observation to evaluate the macular hole closure. Patient was discharged and prescribed some medications such as tranexamic acid b.d.d., eye drop levofloxacin q.d.d., and eye lubricant q.d.d..

Fowler position bed rest during the take-home medication was also suggested, and the patient was planned to be followed-up on the next 4 weeks.

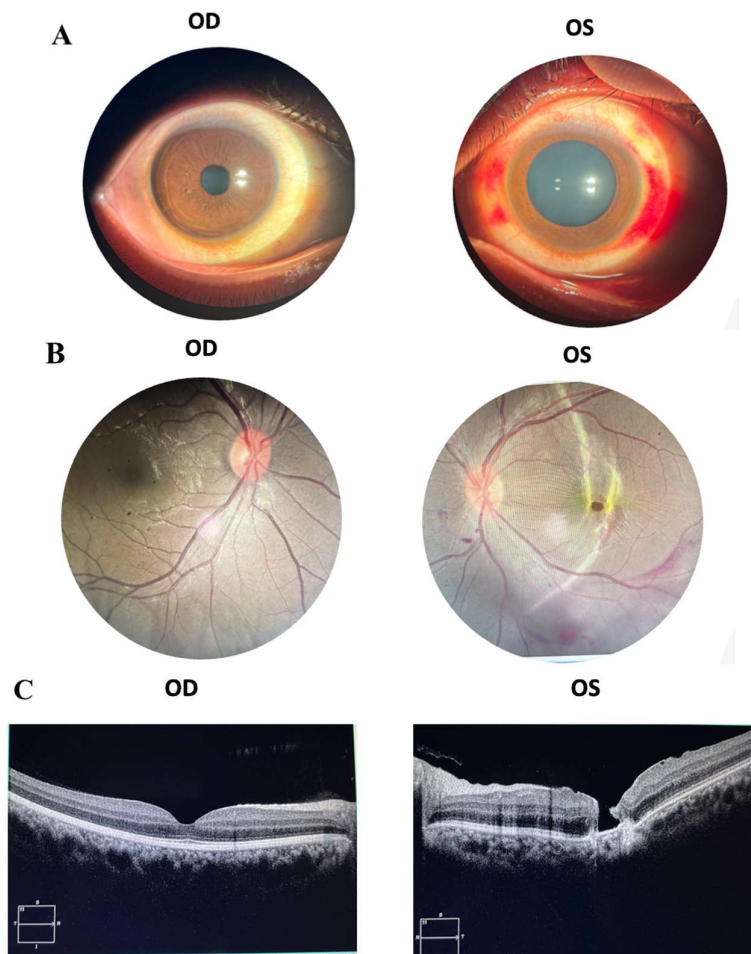


Figure 1. (A) Subconjunctival hemorrhage seen in the left eye (B) on Funduscopy, retina showed retina: choroidal rupture, macular hole and vitreous hemorrhage (C) OCT of the left eye showed preretinal vitreous traction, epiretinal foveal depression disappeared with intraretinal full thickness macular hole.

At four weeks follow-up, the left eye showed decreased subconjunctival hemorrhage and seemed no improvement on both funduscopy and OCT. Three-month observation management continued, the patient was discharged and planned

to be followed up on the next 6 weeks. At the next six weeks follow-up, the left eye showed no subconjunctival hemorrhage but funduscopy and OCT still showed no closure of the macular hole.



Figure 2. (A) Subconjunctival hemorrhage decreased (B & C) funduscopy and OCT remained the same.

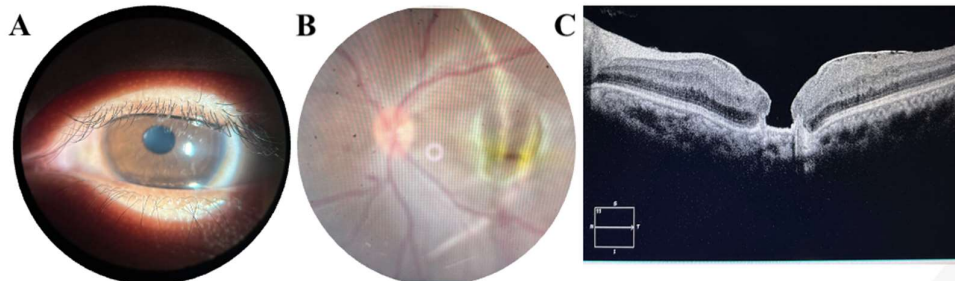


Figure 3. (A) Subconjunctival hemorrhage is gone (B & C) there are no improvements in funduscopy and OCT.

All the visual acuity on the follow up time remain 1 meter finger counting on the left eye. Because vitreous traction and an epiretinal membrane were found around the macular hole on funduscopy, the likelihood of spontaneous closure is reduced. The patient was then educated that the prognosis for surgical intervention is poor. The patient's family and the patient subsequently refused the procedure, and the doctor and patient agreed to proceed with conservative management.

DISCUSSION

Macular hole (MH) is a condition affecting the vitreoretinal interface, characterized by a partial or full-thickness defect in the neurosensory retina at the center of the macula.^[1] TMH is the second most frequent cause of MH, typically resulting from blunt ocular trauma and is more commonly observed in young men in their early twenties.^[2-4] TMH develops due to an antero-posterior compression of the eye, accompanied by equatorial expansion, followed by a rebound contrecoup that leads to vitreofoveal traction. The

tangential traction force between the vitreous and retina during this rebound phase plays a significant role in the formation of the macular hole.^[15] This mechanism aligns with our case involving a young male patient who sustained a direct punch to the eye. In most cases, TMH presents immediately after the trauma; however, it can also develop weeks later.^[2, 5] In this case, the patient reported blurry vision immediately following the injury.

Patients with TMH typically report decreased vision and metamorphopsia. In this case, the patient experienced blurry vision and described seeing straight lines as bent, which aligns with the definition of metamorphopsia. Clinical examination remains the primary method for diagnosing TMH. Visual acuity (VA) in TMH cases generally ranges from 20/30 to 20/400, according to some studies^[6, 7],

while others report a typical range of 20/80 to 20/400.^[8] Our patient's VA was measured at 0.5 meters counting fingers, equivalent to 20/2000 or logMAR +2.00. Although this falls outside the commonly reported ranges, it remains consistent with findings by Venugopal et al., who observed that 25.69% of their cases had a VA worse than 20/400.^[9] Biomicroscopic examination of the posterior segment typically reveals a full-thickness defect in the neurosensory retina at the fovea. TMHs tend to have an elliptical shape with irregular margins. Their average size ranges from 0.2 to 0.5 times the diameter of the optic disc.^[8, 17] In this case, an elliptical hole was found with a diameter of approximately one third of the optic nerve diameter. Free operculum is observed in approximately 5% of cases, while retinal detachment surrounding the hole occurs in about 10% of cases. The posterior vitreous remains fully attached in 85% of cases and partially attached in 15%, with complete posterior vitreous detachment being rare.^[18] Yellowish deposits are often visible at the base of the hole, while the presence of an epiretinal membrane is uncommon and, if it does occur, tends to develop at a later stage. Various associated findings can frequently be observed in both the anterior and posterior segments, including vitreous hemorrhage, hyphema, chorioretinal atrophy, choroidal ruptures, angular recessions, commotio retinae, diffuse retinal edema, retinal hemorrhage, retinal tears, retinal dialysis, retinal detachment, and photoreceptor and retinal pigment epithelium (RPE) damage.^[8, 15, 19] Additional findings in our patient included subconjunctival hemorrhage in the anterior segment, along with choroidal rupture and vitreous hemorrhage in the posterior segment.

Common imaging modalities used in TMH diagnosis including retinal fluorescein angiography (FA) and optical coherence

tomography (OCT).^[8] FA shows late central round hyperfluorescence or hyperfluorescence due to a window defect, depending on the RPE changes that have developed. FA may be done if associated with polypoidal choroidal vasculopathy (PCV) or retinal macroaneurism (RAM). Only macular hole does not always need FA evaluation unless there are other factors including unexplained severe vision loss.^[16] OCT is the gold standard in the diagnosis, management, and follow-up in MH.^[8, 15, 16] OCT shows complete retinal thickness loss at the foveal level with an abrupt slope between the steep edges of the hole and the pigmentary epithelium; the presence of operculum; cystic retinal changes; presence of an epiretinal membrane; and presence of abnormalities in the surrounding retina.^[6, 8, 20]

The management of TMH remains a topic of debate. Observation is a viable approach, as spontaneous closure is possible, particularly in children and young adults.^[10-12] Miller et al. reported a spontaneous closure rate of 50% in children and 28.6% in adults in a long-term follow-up study, with a median closure time of 5.6 weeks, while no cases closed without intervention beyond 67.3 weeks.^[10] Chen et al. reported an average spontaneous closure time of 2.5±1.6 months, with a range of 0.5 to 5 months and a median of 1.5 months, noting that 80% of closures occurred within three months.^[12] Other

studies have documented spontaneous closure rates ranging from 37% to 44% within two months post-injury. Smaller TMHs are more likely to resolve on their own, especially in patients aged ≤ 24 years with small holes (0.1–0.2 disc diameters), intact posterior vitreous, and no epiretinal membrane.^[11,12] In this case, an observation was chosen in anticipation of spontaneous closure.

However, Miller et al. also found that TMHs undergoing delayed vitrectomy—typically around one year post-injury—had lower closure rates compared to those treated earlier.^[10] Currently there are no established clinical guidelines regarding the optimal timing for surgical intervention in TMHs that do not close spontaneously. Therefore, vitreoretinal surgeons must balance the waiting period to allow for spontaneous closure without delaying intervention to the point where surgical success is compromised.^[6] Given this, a waiting period of one to three months before considering surgery is a reasonable approach to managing TMH.^[6, 21, 22] Based on this evidence, we opted for an observation for up to 3 months since the incident rather than immediate surgical intervention.

Vitrectomy for the surgical closure of IMHs was first described by Wendel et al. as a five-step procedure: (1) pars plana vitrectomy, (2) induction of posterior vitreous detachment (PVD) if not already present, (3) epiretinal membrane peeling, (4) fluid-gas exchange, and (5) one week of occiput-up positioning.^[23] Following Kelly and Wendel's report, surgical adjuvants such as TGF-beta 2, platelet concentrate, and serum were introduced to enhance MH closure.^[24] These adjuvants were later applied in the treatment of TMHs, being placed within the hole after fluid-air exchange and before the tamponade agent. Their proposed mechanism is to facilitate chorioretinal adhesion, preventing

further fluid accumulation in the subretinal space and promoting closure.^[6, 25]

Previous studies showed that vitrectomy has shown favorable outcomes in TMH cases.^[8, 13–15] A study by Tang et al. with 21 out of 23 patients (91%) achieved hole closure after one surgery.^[13] Lei and Chen also reported that of 13 patients who underwent vitrectomy, 11 patients achieved hole closure (84.6%).^[15] These results are supported by a meta-analysis of surgical outcomes in all published reports of vitrectomy for TMH which found a successful closure rate of 83%.^[14] However, anatomical success does not necessarily equate to functional success. Anatomical success refers to the closure of the MH following vitrectomy, as confirmed by funduscopy and OCT examinations, whereas functional success is determined by the improvement in visual acuity after surgery. A successfully closed hole does not always guarantee a corresponding improvement in visual acuity.^[9, 16] Tang's study reported 21 patients achieved anatomical success, yet only 19 patients achieved functional success. Nearly half of the operated eyes demonstrated a visual acuity improvement of 15 or more letters, and over one-third achieved visual acuities of 55 letters or better (20/80).^[13]

Several factors influence postoperative visual acuity. The integrity of the ellipsoid band has been shown to have a strong correlation with visual outcomes, as greater

attenuation of this band is associated with poorer visual acuity.^[6, 10, 13, 15] Basal diameter also plays a role, with larger diameters linked to worse vision.^[15, 17] Huang et al. reported that compared to idiopathic macular holes (IMHs), traumatic macular holes (TMHs) tend to be thinner, have a wider base, be less circular, and are associated with poorer visual outcomes.^[17] Additionally, their previous findings indicated that better visual acuity was observed in eyes with thicker retinas.^[26] More recently, Venugopal et al. identified initial visual acuity as a key predictor of visual outcomes, surpassing other independent factors such as gender, age at diagnosis, and coexisting retinal conditions.^[9]

The decision to proceed with surgical intervention is made at the discretion of the examining physician, based on an evaluation of the potential visual outcome.^[9] Visual outcomes in TMH cases may be limited by tissue damage from associated conditions such as commotio retinae, vitreous hemorrhage, retinal hemorrhage, choroidal rupture, retinal pigment epithelium (RPE) damage, and subretinal choroidal neovascularization and fibrosis.^[6, 9] These factors are believed to hinder significant visual improvement, leading to the decision not to undergo the surgery to avoid surgical complications.^[9] Surgical complications may include retinal hemorrhages, retinal detachment, and visual defects. Unlike IMH surgery, where cataract formation is a common complication, it is not typically observed in TMH surgery.^[8] Similarly, in this patient, the presence of additional findings, including choroidal rupture and vitreous hemorrhage, led us to opt against surgical intervention.

Regardless of whether closure occurs spontaneously or through vitrectomy, TMH closure is generally associated with an improvement in visual acuity by at least two

lines, with the potential for even greater recovery.^[2, 5, 6] In the first prospective comparative study by Chen et al., which evaluated TMH outcomes by comparing observation with early vitrectomy, early surgical intervention resulted in a significantly higher closure rate (100% vs. 66.7%). However, despite the superior anatomical success achieved with vitrectomy, there was no significant difference in functional success between surgically closed macular holes and those that closed spontaneously.^[21, 22]

This case highlights that visual acuity outcomes are crucial for the patient's long-term vision as crucial as the speed of macular hole closure. Therefore, surgical management of TMH should not be pursued solely for anatomical success but should also consider functional success. Given that visual prognosis is influenced by multiple factors beyond hole closure, including concomitant ocular pathology, a comprehensive assessment is essential before determining the need for surgical intervention. The decision not to undergo surgery also considers the risk of complications that could potentially worsen the patient's visual prognosis.

CONCLUSION

Traumatic macular hole (TMH) is a rare but significant consequence of ocular trauma, often presenting with variable visual impairment and anatomical changes.

While spontaneous closure is possible, particularly in younger patients, surgical intervention remains a viable option for persistent cases. However, this case underscores the importance of considering functional success as well as anatomical success when determining the best management approach. Given that visual prognosis is influenced by multiple factors, including initial visual acuity, retinal integrity, and associated ocular injuries, the decision to perform vitrectomy should be carefully individualized. In some cases, observation may be a reasonable approach, particularly when the likelihood of spontaneous closure is high, or when additional ocular damage may limit visual recovery.

Ultimately, treatment decisions for TMH should be guided by a comprehensive clinical assessment, balancing the potential benefits of surgery against the risks of complications.

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