Vitrectomy, inner limiting membrane peel and gas tamponade in the management of traumatic paediatric macular holes - A case series of 13 patients

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Abstract:

Purpose: To review the outcomes of vitrectomy, inner limiting membrane (ILM) peel and gas tamponade in the management of traumatic macular holes in paediatric cases.

Methods: Retrospective review of a consecutive case series of paediatric cases undergoing vitrectomy, ILM peel and gas tamponade between March 2007 and July 2014 by a single surgeon. Main outcome measures: visual outcome, anatomic closure rate and ocular complications.

Results The macular hole was successfully closed in 12 (92.3%) of the 13 cases identified. Mean visual acuity pre-operatively was 0.93 LogMar improving to 0.54 LogMar at three months and 0.48 LogMar at twelve months. This was statistically significant ($P < 0.001$). There were no intraoperative complications. One patient developed a posterior subcapsular cataract 12 months after surgery.

Conclusion: Vitrectomy and ILM peel have been successful in the treatment of paediatric macular holes. The procedure is efficacious and comparable to plasmin-assisted vitrectomy.

Introduction:

Macular holes may develop as either idiopathic lesions or due to physical trauma. Unlike adult macular holes, those occurring in children are very rare and are mostly traumatic in aetiology, though rare exceptions have been documented [1]. At present the optimum management of macular holes in paediatric populations has not been ascertained; the rarity of paediatric macular holes means that the techniques reported in the literature are largely in the form of single patient case reports or case series. Three such case series each include 4 patients; Azevedo and colleagues report 4 paediatric patients treated with pars planar vitrectomy and internal limiting membrane peel, all of whom had a successful hole closure [2]. Likewise Wachtlin et al report 100% hole closure and substantial visual improvement in each of their 4 patients after vitrectomy and ILM peel with use of autologous platelet injection [3]. A further series of 4 patients reported by Margherio et al were managed differently, with autologous plasmin injection prior to vitrectomy [4].

We present a series of thirteen consecutive cases of paediatric traumatic macular holes treated by vitrectomy and internal limiting membrane (ILM) peel at Moorfields eye hospital and review the outcomes of these cases, which form one of the largest series of its kind in the literature. We focus on the efficacy of vitrectomy and ILM peel in restoring visual function and producing closure of the macular defect.

Methodology:

All patients eighteen years of age and younger who underwent vitrectomy between March 2007 and July 2014 were identified on the Moorfields electronic database. Those cases meeting the following inclusion criteria were reviewed:

- Traumatic macular hole
- Surgical intervention with a vitrectomy and inner limiting membrane peel.
- Full patient demographics available
- Nature of the trauma known
- Pre-operative and post operative visual acuity at 3 and 12 months known
- Documentation from clinical examination or Optical Coherence Tomography of hole closure status

SURGICAL METHOD

STATISTICS

Results:

Thirteen consecutive cases undergoing vitrectomy and ILM peel for traumatic macular hole were identified. The patient profiles are depicted in Table 1. Two cases had co-existent ocular trauma; 360 degree angle recession and zonular weakness with iridodenesis. The interval from trauma to surgery ranged from 28 days to 12 months, with a mean of 5.5 months. Surgery was performed by a single surgeon and gas tamponade was C3F8 14% in all cases. In only one patient was a posterior vitreous detachment (PVD) present pre-operatively with the remainder having a surgically induced PVD. No intraoperative complications were reported and specifically no intraoperative iatrogenic retinal breaks. Post operative complications included cataract in one case. No other complications had been reported at 12 months post surgery.

The mean pre-operative visual acuity was LogMar 0.93 which improved to LogMar 0.54 at three months and LogMar 0.45 at 12 months ($P<0.001$).

Discussion:

Adult macular holes are a relatively common ophthalmological condition with an estimated incidence of 7.8/100000 per year [5]. They are most commonly idiopathic age related conditions that have a greater incidence in females than males [2]. They do also occur much more rarely in children, where they most commonly develop after trauma.

The mechanism of development of a macular hole after trauma is not entirely clear. It has been suggested that vitreous detachment and subsequent traction on the macular region may be causative, however in many cases the vitreous is still firmly adherent to the retina and an alternative mechanism would therefore seem likely such as direct rupture of the fovea due to transmitted force of impact. Other suggested pathogenic mechanisms, based on OCT examination of a developing macular hole include the degeneration of cystoid macular oedema, sub-foveal haemorrhage, contusion necrosis and choroidal rupture as well as sub-clinical changes to the fovea [2, 6, 7]. The internal limiting membrane of the retina has been hypothesised to produce traction on the edges of the macular hole and therefore to help keep it open. This provides the rational for ILM peeling as part of the surgical repair of a macular hole along with vitrectomy [8].

Currently the best practice in management of paediatric macular holes has not been defined by clinical trials; the rarity of paediatric holes means that conducting such a trial would be technically difficult to organise and therefore individual cases and case series thus far provide the evidence base for treatment decisions. Vitrectomy is used as the backbone of all treatments with various additional adjuvant techniques

suggested as beneficial by different authors. It has been noted that macular holes may spontaneously close in some patients, and therefore a period of watchful waiting has been advised by some [9]. However, at younger ages there is a risk of amblyopia developing due to reduced visual acuity caused by a macular hole [4], meaning that conservative management even for a short amount of time is not a risk free strategy. A key difference between the eye in childhood and adolescence and that of the adult is the strength of attachment between the vitreous and the ILM; at younger ages the adhesion is strong [10] which makes creating a posterior vitreous detachment during surgery a challenge in the paediatric patient. There have been several case series where autologous plasmin injection during surgery has been used to aid the creation of a clear separation between the vitreous and the retina, with good macular hole closure and visual results reported [2, 11]. Autologous plasmin, and more recently a recombinant variant, is increasingly used in several adult and paediatric vitreoretinal surgeries [12].

Most paediatric case series reported up until this point have described single figure numbers of patients and without high quality randomised controlled trials it is not possible to confirm which management strategy provides the best visual outcomes. Azevedo and colleagues discuss the use of pars planar vitrectomy and internal limiting membrane peel in the successful closure of 4 paediatric macular holes, providing a substantial improvement in vision in 3 cases [2]. Wachtlin et al report 4 further patients managed by vitrectomy, ILM peel with the additional use of autologous platelet injection, again hole closure was universal and 2 of the 4 patients achieved vision of better than 20/50 in the damaged eye [3]. A further series of 4 patients reported by Margherio et al were managed by vitrectomy with autologous plasmin injection, hole closure was again achieved in each of these patients and 3 achieved vision of better than 20/50, though three also went on to get posterior subcapsular cataracts [4] .

Our series is unusual in the current literature in having a comparatively large number of patients all of whom received the same management. Wu et al. do report a series of 13 patients, however management was not consistent in all cases with 3 receiving ILM peel in addition to the plasmin assisted vitrectomy compared with 10 receiving the plasmin assisted vitrectomy alone [11]. Wu report 11 (92%) of patients gaining 2 lines of vision improvement and six (50%) achieving 20/50 or better. In our series the mean improvement in vision was LogMar 0.48 or four and half lines with 6 (50%) achieving LogMar 0.5 (20/63) or better.

There have been randomised controlled trials of macular hole closure techniques in adult patients as well as a Cochrane review of these comparing vitrectomy alone with vitrectomy plus ILM peel. This meta analysis took in 4 individual trials of 47, 80, 49 and 141 patients and showed that visual outcomes at 6 and 12 months were no different between the group with ILM peeling than the group without. ILM peeling did however produce a significantly greater rate of primary hole closure, as well as a lower rate of requiring further surgical intervention after the initial operation. For this

reason the review concluded that ILM peeling may be a cost effective addition to vitrectomy [13]. The closure rate of macular holes in our series, 92%, is equal to that of Wu et al in their comparable sized case series of paediatric patients [11]. It is also comparable to the rate of closure found in the Cochrane review of those studies reporting ILM peel in adult macular holes (90%) and far better that that of adult macular hole repairs without ILM peel (50% closure rate) [13].

In conclusion, we present a case series of 13 paediatric patients where macular holes were treated by vitrectomy and internal limiting membrane peel producing successful anatomical closure and good visual outcomes for the majority. These results suggest that it is an efficacious procedure and is comparable to plasmin-assisted surgery.

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Image 1

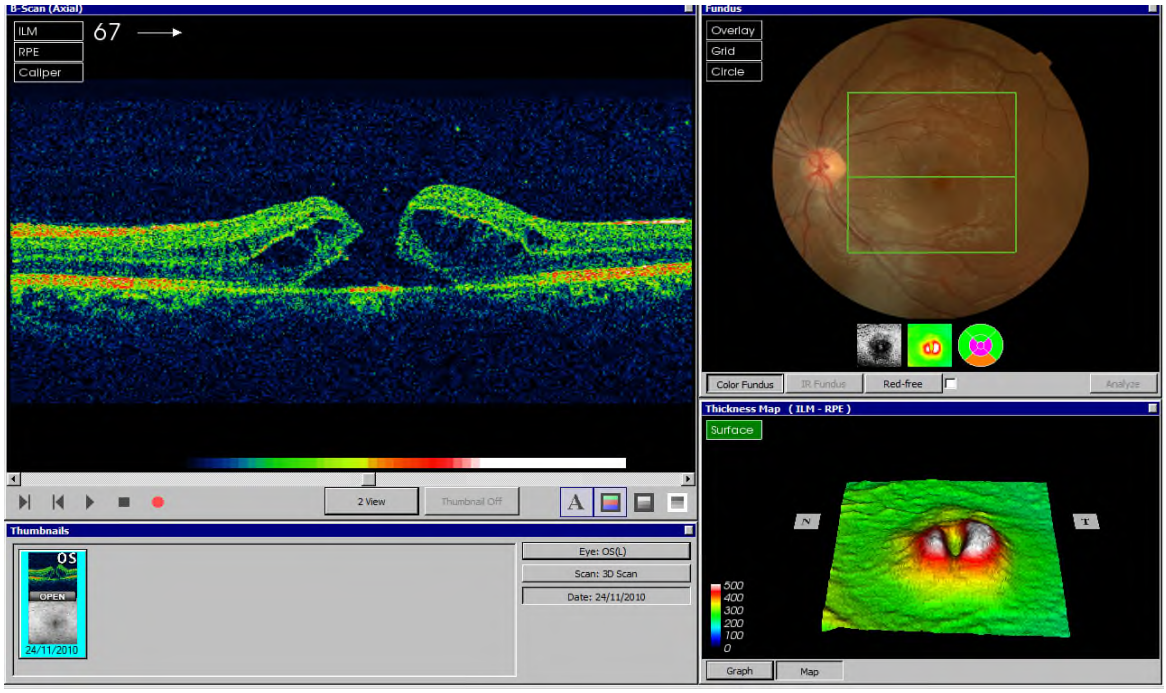
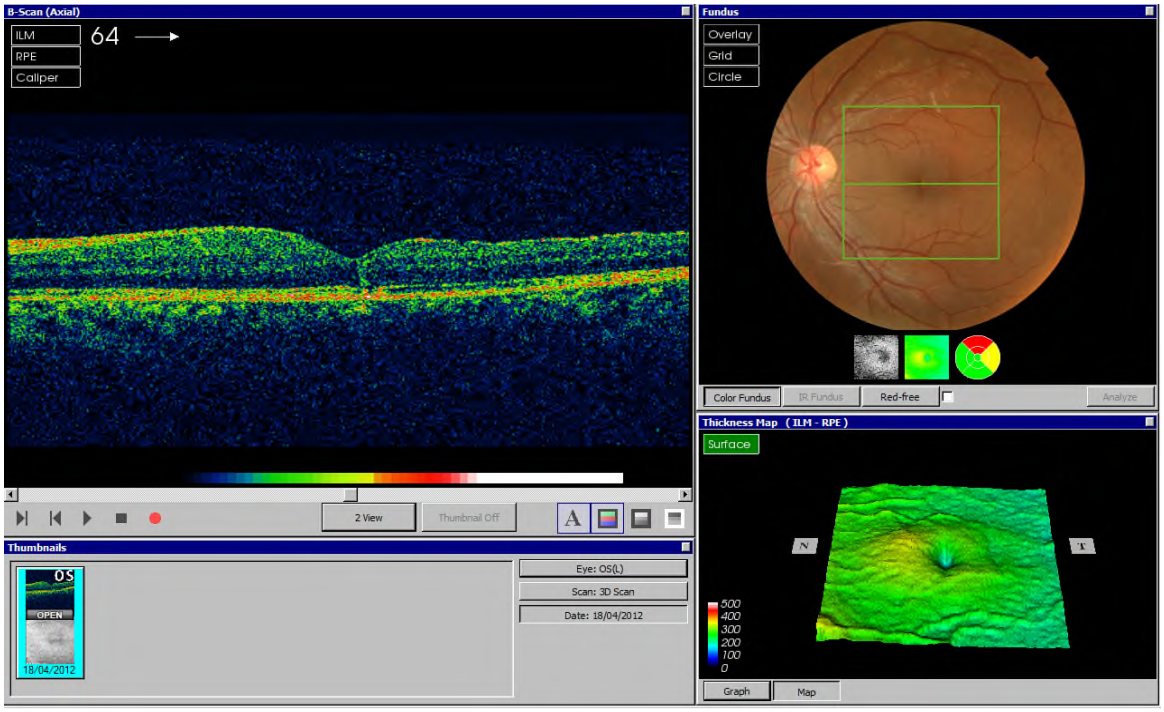


Image 2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OS
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18/04/2012
Eye: OS(L)
Scan: 3D Scan
Date: 18/04/2012

Patient	Age at surgery	Gender	Eye	Nature of Trauma	Pre-op visual acuity (LogMar)	3 month post-op visual acuity (LogMar)	12 month post-op visual acuity (LogMar)	Time from trauma to surgey	Hole closure
1	18	M	R	Assault	1.0	0.8	0.8	2/12	Yes
2	11	M	R	Golf Ball	0.88	0.4	0.2	6/12	Yes
3	17	M	R	Football	0.6	0.5	0.6	12/12	Yes
4	11	M	L	Football	0.6	0.1	0.2	9/12	Yes
5	18	F	L	RTA	1.0	0.6	0.6	7/12	Yes
6	14	M	L	Snowball	2.28	0.66	0.66	9/12	Yes
7	13	M	R	Football	0.8	0.5	0.5	1/12	Yes
8	18	F	R	RTA	0.8	0.6	0.6	5/12	Yes
9	11	M	L	Football	0.8	0.8	0.3	5/12	Yes
10	15	M	R	Football	0.74	0.5	0.5	8/12	No
11	11	M	L	Football	0.8	0.5	0.5	2/12	Yes
12	12	F	R	Stone	0.8	0.5	0.5	3/12	Yes
13	15	M	R	Assault	0.7	0.5	0.5	1/12	Yes

Figure 1; Patient demographics; site of trauma; nature of trauma; pre-operative visual acuity; post operative visual acuity at 3 months and twelve months. RTA: Road Traffic Accident. VT: Vitrectomy