

Comparison Between Pars Plana Vitrectomy with and without Encircling Band in the Treatment of Pediatric Traumatic Rhegmatogenous Retinal Detachment

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Background and Objectives: To compare anatomical and visual results of pars plana vitrectomy (PPV) with or without additional encircling band in the management of pediatric traumatic rhegmatogenous retinal detachment (RD) in a tertiary referral center.

Methods: A retrospective review of children diagnosed with traumatic rhegmatogenous retinal detachment treated by pars plana vitrectomy with or without encircling band.

Results: One hundred thirty-nine eyes of 139 children diagnosed with traumatic rhegmatogenous retinal detachment. Surgeries were performed between May 2011 and November 2016. Patients were followed up for at least 18 months after last intervention. The included eyes were categorized into two groups. Group A (vitrectomy with additional encircling band) included 72 eyes of 72 children; 58 boys and 14 girls. Group B (vitrectomy without encircling band) included 67 eyes of 67 children; 58 boys and 9 girls. In group A, the mean age was 9.21 ± 3.24 . Attached retina was achieved in 61% (44 out of 72 eyes), of which 34 eyes remained attached after silicon oil removal, and 10 eyes remained attached under silicon oil tamponade. Recurrent RD under oil was present in 28 eyes (38.9%). In group B, the mean age was 11.06 ± 3.64 . Attached retina was present in 61.2% (41 out of 67 eyes), of which 30 eyes remained attached after oil removal, and 11 eyes remained attached under silicon oil tamponade. Recurrent RD was present in 26 eyes (38.8%). In group A, the final visual acuity (VA) ranged from NLP to 0.5; 58.7% of patients achieved VA more than counting fingers at 1 meter, and 34.6% of patients achieved VA of 0.05 or more. In group B, the final postoperative VA ranged from NLP to 0.9; 16% of patients achieved VA from counting fingers at 1 meter to 0.05, and 29.2% achieved VA of 0.05 or more.

Conclusion: Although no statistically significant difference between the two groups (combined vitrectomy and encircling band versus vitrectomy alone in pediatric traumatic retinal detachment), it is wise to consider adding encircling band in severe trauma cases.

Keywords: trauma, pediatric retinal detachment, encircling band, pars plana vitrectomy, silicon oil

Background

Eye injuries are the leading cause of monocular visual disability and monocular blindness in children.¹

One of the consequences of ocular trauma is retinal detachment.² Pediatric retinal detachment (RD) constitutes 3.2–6.6% of all cases of RD.³ Consequently, pediatric RD is a great challenge for ophthalmologists. Children usually present

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late and have clinical features of longstanding RD such as macular involvement and proliferative vitreoretinopathy (PVR).⁴ Although traumatic retinal detachments in the pediatric population have been discussed, no study compared the role of adding or omitting encircling band in conjunction with pars plana vitrectomy. The introduction of trans conjunctival surgery decreased the need for 360° SB. Starting from 2009, we shifted to trans conjunctival PPV (20G, 23G, 25G, or combined cannula system). We omitted using 360° encircling band to get the benefits of transconjunctival surgery in 2009. As we were convinced by the role of the encircling band in combination to PPV, we postponed using this technique in children. In this retrospective series we tried to evaluate the role of encircling band in pediatric traumatic RD and whether omitting its use will affect the final results.

Methods

This was a retrospective interventional non-comparative case series that included children with traumatic rhegmatogenous retinal detachment. Data of patients was retrospectively collected from medical records among pediatric RRD cases operated on in Magrabi eye hospital in the period from May 2011 to November 2016. The follow-up period was at least 18 months after the last surgical intervention. All surgeries were performed by the same surgeon (H.G.).

Ethics Approval and Consent to Participate

The institutional review board of Magrabi Eye Hospital and Center approved the present study. All parents or legal custodians of the children recruited in the study received a thorough explanation of the nature of the surgical procedures entailed, the expected outcome and possible complications, and provided an informed consent. The informed consent ensured the use of their data to be used in these study. Only those accepted for publication were enrolled in the study. The study adhered strictly to the tenets of the Declaration of Helsinki (2013 revision).

Inclusion Criteria

Children diagnosed as traumatic rhegmatogenous retinal detachment.

Exclusion Criteria

1. Children treated by scleral buckle only (conventional buckle and cryo).
2. Children who did not complete the follow-up period, ie, 18 months after the last surgical intervention.
3. Children who had previous PPV.
4. Cases of retinal detachment secondary to traumatic endophthalmitis.

Surgical Procedures

A written (informed) consent was obtained from the parents. Vitreoretinal intervention was done immediately after referral once the condition of the globe was suitable. Group A (operated before June 2014) included 72 children, and we applied 360° encircling scleral 240 band. Group B (operated after June 2014), included 67 children without additional encircling band. Lens-sparing vitrectomy in both groups, but a lensectomy was done in cataractous eyes, subluxated lens or if lens touch occurred. The vitrectomy procedure consisted of core vitrectomy; triamcinolone acetonide (TA) assisted posterior vitreous detachment (PVD) induction. Perfluorocarbon liquid was used to stabilize the posterior retina. Vitreous base shaving was done (as safe as possible). Air-fluid exchange and aspiration of subretinal fluid, endo laser retinopexy followed by silicone oil (SO) 5000 centistokes (CS)/air exchange. Inferior surgical iridectomy (at 6 o'clock) was created in aphakic eyes. Closure of sclerotomies was done using 7/0 vicryl sutures.

Postoperative Care

Cooperative children were instructed to maintain a prone position 8 hours per day for 1 week. All the included children had slit-lamp examination in the first postoperative day. If possible, fundus examination, and color fundus photography were done to assess and document retinal reattachment. The follow-up was scheduled at 1, 3, and 6 weeks, and then every 8 weeks. In each visit, the following data were recorded: best-corrected visual acuity (when possible), intraocular pressure in cooperative children, retinal reattachment. Uncooperative or young children had examination under general anesthesia; anterior segment examination was done using the surgical microscope, IOP was measured using Schiottz tonometer and the fundus was examined using the indirect ophthalmoscope.

Table 1 Demographic Data of the Two Groups

	Mean Age	Male	Female	Total Number
Group A	9.21± 3.24	58	14	72
Group B	11.06± 3.64	58	9	67

Revision Vitrectomy

A second (revision) vitrectomy was preceded for recurrent RD. The revision surgery consisted of SO removal. Triamcinolone assisted removal of any residual vitreous cortex; peeling of epiretinal membranes. Relaxing retinotomy and or retinectomy were used for immobile and shortened retina. Air–fluid exchange and aspiration of sub retinal fluid were done. Endo laser was applied followed by silicone oil 5000 CS injection, and closure of sclerotomies.

Silicone Oil Removal

In eyes with stable retinæ for at least 6 months post-operative, SO was removed using 2 ports (20G, 23G or combination of both). One port was used for infusion, and the other for oil aspiration. The retina was thoroughly examined looking at the retinal periphery and the sites of retinal breaks. SO was manually or mechanically aspirated, followed by partial air fluid exchange (multiple times). Some adjuvant procedures were done (if needed) such as peeling of epimacular membranes; IOL implantation in aphakic eyes if there's enough capsular support. 7/0 vicryl sutures were used to close sclerotomies.

Statistical Analysis

The clinical data were recorded in a report form. These data were tabulated and analyzed using SPSS computer program (statistical package for social science) version 20. Statistical tests used are mean, SD, chi-square test, and P value. P value < 0.05 was considered statistically significant, whereas >

0.05 was statistically insignificant. A P value < 0.01 was considered highly significant in all analyses.

Results

Demographic Data

Age

In group A the mean age was 9.21± 3.24, while in group B the mean age was 11.06±3.64, with no statistically significant difference.

Gender

Group A included 72 children; 58 boys, and 14 girls, while group B included 67 children; 58 boys, and 9 girls, [Table 1](#).

Preoperative Visual Acuity (VA)

The preoperative visual acuity (VA) ranged from PL to 0.2, and could not be assessed in 4.5% of children in both groups.

In group A, 37.5% of patients had VA of HM, 33.3% had visual acuity PL. Other grades of VA were distributed as follows; CF at 50 cm in 6.9%, CF at 1 m in 11.1%, CF at 2 m in 1.4%, 0.05 in 6.9%, 0.1 in 1.4%, and 0.2 in 1.4%.

In group B, 41.8% of patients had visual acuity of HM, PL vision was present in 32.8%. Other grades of VA were distributed as follows; CF at 20 cm in 1.5%, CF at 50 cm in 4.5%, CF at 1 m in 7.5%, CF at 2 m in 1.5%, 0.05 in 3%, 0.1 in 1.5%, 0.2 in 1.5%, and the vision could not be assessed in 4.5% of cases, [Table 2](#).

Lens Status

In group A the lens was clear in 38.9%, cataractous in 8.3%, pseudophakic in 9.7%, aphakic in 38.9%, subluxated in 2.8%, and dislocated in 1.4% of patients.

In group B the lens was clear in 46.3%, cataractous in 22.4%, pseudophakic in 8.9%, aphakic in 19.4%, subluxated in 1.5% and dislocated in 1.5%, [Table 3](#)

Table 2 Preoperative VA in the Two Groups: + Counting Fingers, * Perception of Light, ** Hand Motion, ++ Visual Acuity

	PL*	HM**	CF ⁺ at 20cm	CF at 50cm	CF at 1m	CF at 2m	0.05	0.1	0.2	VA++ Not Assessed
Group A	24 (33.3%)	27 (37.5%)	0 (0%)	5 (6.9%)	8 (11.1%)	1 (1.4%)	5 (6.9%)	1 (1.4%)	1 (1.4%)	0 (0%)
Group B	22 (32.8%)	28 (41.7%)	1 (1.5%)	3 (4.5%)	5 (7.5%)	1 (1.5%)	2 (3.0%)	1 (1.5%)	1 (1.5%)	3 (4.5%)

Table 3 Lens Status

	Phakic Clear	Cataractous	Aphakia	Pseudophakia	Subluxated	Dislocated	Total
Group A	28 (38.9%)	6 (8.3%)	28 (38.9%)	7 (9.7%)	2 (2.8%)	1 (1.4%)	72 (100%)
Group B	31 (46.3%)	15 (22.4%)	13 (19.4%)	6 (8.9%)	1 (1.5%)	1 (1.5%)	67(100%)

Table 4 Types of the Retinal Breaks; * Macular Hole, ** Giant Tear

	Undetectable Breaks	Upper Breaks	Multiple Breaks	Disinsertion	Lower Breaks	Temporal Break	MH*	GT**	Central Breaks	Macular Exit with Tear	Extra Macular Exit with Tear	Total
Group A	25 (34.7%)	16 (22.2%)	2 (2.8%)	5 (6.9%)	10 (13.9%)	2 (2.8%)	3 (4.2%)	8 (11.1%)	2 (2.8%)	0 (0%)	0 (0%)	72 (100%)
Group B	17 (25.4%)	7 (10.4%)	8 (9%)	3 (4.5%)	7 (10.4%)	2 (3.0%)	5 (7.5%)	7 (10.4%)	0 (0%)	2 (3%)	8 (11.9%)	67 (100%)

Type of Retinal Break

In group A the retinal breaks were located in the upper quadrants in 22.2% and in the lower quadrants in 13.9%, multiple breaks were found in 2.8%, disinsertion in 6.9%, macular hole in 4.2%, giant breaks in 11.1%, central breaks in 2.8%, and undetectable breaks in 34.7%

In group B the retinal break was located in the upper quadrants in 10.4%, in the lower quadrants in 10.4%, multiple breaks in 9%, disinsertion in 4.5%, macular hole in 7.5%, giant breaks in 11.9%, macular exit in 3%, extra macular exit 11.9%, and undetectable in 25.4%, [Table 4](#).

Silicone Oil Removal (SOR)

In cases of stable retinae at least 6 months silicone oil was removed. Silicone oil removal (SOR) was carried out in 34 eyes in group A (47.2%) and in 30 eyes (44.8%) in group B.

Causes of non-removal of SO include hypotony, and recurrent RD under oil that could not be repaired (due to extensive proliferation), [Table 5](#).

Duration of SO

The mean duration between the first surgery and silicone oil removal was 11.13±5.46 months in group A and it was 11.7±7.63 months in group B.

Duration of Follow-Up After SOR

All cases were followed up after the last surgical intervention for at least 18 months. Range of follow-up in group A was 18–60 months, and it was 18–81 months in group B.

Table 5 Silicone Oil Removal

	Silicone Oil Not Removed	Silicon Oil Removed	Total
Group A	38 (52.8%)	34 (47.2%)	72 (100%)
Group B	37 (55.2%)	30 (44.8%)	67(100%)

Procedures Carried Out During SOR

In phakic cataractous eyes irrigation aspiration (IA) of the lens with IOL implantation was done. In group A irrigation and aspiration of the lens with IOL implantation in 16 eyes out of 32 eyes from which SO was removed (50%). Peeling of epimacular membranes (EMM) was done in one eye (3.1%). In group B irrigation and aspiration of the lens with IOL implantation was done in 19 eyes out of 30 eyes from which SO was removed (63.3%), [Table 6](#).

Postoperative (Final) VA

In both groups, the final VA ranged from no PL to 0.9, and the VA could not be assessed in 2.5% of children.

In group A the final VA was distributed as follows; NPL (5%), PL (10.6%), HM (21.3%), CF at 50 cm (1.4%), CF at 1 m (18.4%), CF at 2 m (5.7%), 0.05 (12%), 0.1 (7.8%), 0.16 (5.7%), 0.2 (1.4%), 0.3 (2.8%), 0.4 (2.8%), 0.5 (2.1%).

In group B the final VA was distributed as follows; NPL (10.2%), PL (12.4%), HM (18.2%), CF at 50 cm (8.8%), CF at 1 m (12.4%), CF at 2 m (3.6%), 0.05 (6.6%), 0.1 (5.1%), 0.16 (5.1%), 0.2 (4.4%), 0.3 (2.9%), 0.4 (0.7%), 0.5 (2.2%), 0.6 (1.5%), and 0.9 (0.7%). [Table 7](#) shows the final VA distribution in the two groups.

Final Anatomical Results

In group A attached retina was achieved 44 eyes out of 72 (61.1%), of which 34 eyes (47.2%) remain attached after SOR, and 10 eyes (13.9%) were attached in the presence

Table 6 Procedures Carried Out During Silicone Oil Removal. * Irrigation Aspiration, ** Intra Ocular Lens, + Epimacular Membrane

	I&A* with IOL** Implantation	Peeling of EMM ⁺	Total
Group A	16	1	17
Group B	19	0	19

Table 7 Final VA: Visual Acuity, No Perception of Light, Perception of Light, † Hand Motion, ‡ Counting Fingers

	VA Not Assessed	NLP	PL [‡]	HM [†]	CF [‡] at 50cm	CF at 1m	CF at 2m	0.05	0.1	0.3	0.4	0.5	0.6	0.9	Total
Group A	0 (0%)	7 (5%)	15 (10.6%)	30 (21.3%)	2 (1.4%)	26 (18.4%)	8 (5.7%)	17 (12%)	6 (4.3%)	4 (2.8%)	3 (2.1%)	4 (2.8%)	0(0%)	0 (0%)	72 (100%)
Group B	7 (5.1%)	14 (10.2%)	17 (12.4%)	25 (18.2%)	12 (8.8%)	17 (12.4%)	5 (3.6%)	9 (6.6%)	6 (4.4%)	4 (2.9%)	1 (0.7%)	3 (2.2%)	2 (1.5%)	1 (0.7%)	67 (100%)

of SO. Recurrent RD under oil was present in 28 eyes (38.9%). In group B attached retina were reported in 41 eyes (61.2%), 30 eyes (44.8%) remained attached after silicone oil removal, and 11 eyes (16.4%) were kept flat in the presence of SO. Recurrent RD under oil was present in 26 eyes (38.8%)(Table 8).

Discussion

The addition of an encircling band during vitrectomy is a debatable issue especially in pediatric retinal detachment surgery. Since the introduction of transconjunctival PPV there is a decreasing interest in the use of an encircling band.

Starting from 2009, we started transconjunctival PPV without an encircling band, especially this era was accompanied by the introduction of high-speed cutters and bright illuminations that improved the shaving abilities. Nevertheless, we were conservative in abundant encircling band in pediatric retinal detachments until the year 2014. Previous studies⁵ compared vitrectomy with and without encircling band in cases of myopic macular hole retinal detachment (MHRD) showed no statistically significant difference whether the buckle was added or not. We started to do transconjunctival PPV without additional encircling band in pediatric retinal detachment starting from June 2014.

Many studies⁶⁻⁹ discussed pediatric traumatic retinal detachment from many aspects such as the clinical features, the anatomical and visual outcomes, and the risk factors. Neither of these studies discussed the effect of

change in the surgical technique on the outcomes, ie, whether abundant use of encircling band has any effect on either anatomical or visual outcomes.

The aim of this retrospective analysis is to evaluate whether the abundant use of encircling band will affect the final results in pediatric traumatic RD surgery or not. In this study, we compared anatomical and visual results of PPV and SO tamponade with or without encircling band in pediatric traumatic retinal detachment.

We think that it is valuable to address this idea in the category of pediatric traumatic RD as many of these cases have a bad fundus view; due to corneal scarring making vitrectomy more challenging. The rationale of adding scleral buckle is to support the vitreous base, to create new ora; that may compensate inadequate vitreous base shaving (due to poor visualization or strongly adherent vitreous), Moreover the buckle may decrease traction from PVR.

The use of additional buckle helps to preserve the clear crystalline lens as much as possible. In our opinion, keeping the crystalline lens in pediatric surgery is beneficial because it decreases the incidence of postoperative inflammation (which usually is marked in children), as well as aphakia is a huge risk for amblyopia and aphakic glaucoma.

A suggested advantage is that the buckle might decrease the need for retinotomies, and or retinectomies, or it might decrease their size, although there was no statistically significant difference between the two groups in our results.

Sarrazin et al⁶ compared two groups of pediatric traumatic retinal detachment due to open and closed globe injuries. The study included 60 eyes of 58 children. Retinal detachment followed open globe injury in 37 eyes and in 23 eyes was due to closed globe injuries. The surgical technique included 3-port pars plana vitrectomy with encircling band. The study did not emphasize the change of the technique and its impacts on the outcomes. The study concluded that the anatomic and

Table 8 Final Anatomical Status * Silicone Oil Removal, ** Silicone Oil, † Retinal Detachment

	Attached Retina After SOR *	Attached Retina Under SO**	Lower RD [†] Under SO	Total
Group A	34 (47.2%)	10 (13.9%)	28 (38.9%)	72 (100%)
Group B	30 (44.8%)	11 (16.4%)	26 (38.8%)	67 (100%)

Table 9 Review of Literature of Pediatric Retinal Detachment, SB Scleral Buckle, PPV Pars Plana Vitrectomy, RD Retinal Detachment

Author	Study Design	Type of Detachment	Year	Number of Eyes	Procedure	Anatomical Results
Butler et al ¹⁰	Retrospective	Rhegmatogenous	2001	15	SB+ cryo 73.3% PPV 26.6%	13/15 (86.6%)
Weinberg et al ⁸	Retrospective	Different etiologies	2003	39	SB+ cryo 41% PPV 13% SB +PPV 46%	79%
Sarrazin et al ⁶	Retrospective	Traumatic	2004	60	PPV+SO	45–65%
Madanat & Mustafa ¹¹	Retrospective	Traumatic 45.5% Myopic 15.2% Others 39.3%	2005	33	PPV SB and cryo or laser PPV+SB	75.75%
Chen et al ⁷	Retrospective	Rhegmatogenous	2006	35	SB+ cryo 72% PPV & SB+PPV 28%	80% 50%
Gonzales et al ¹²	Retrospective	Rhegmatogenous	2008	46	SB 26% PPV 30% SB+PPV 44%	52% by one procedure 78% by a second surgery
Oono et al ¹³	Retrospective	Rhegmatogenous	2012	48	SB+ cryo 77% PPV 23%	83% by one surgery 96% by a second surgery
Rejda et al ¹⁴	Retrospective	Traumatic 57% Myopic 36% Uveitis related 7%	2017	14	PPV	86%
Read et al ⁹	Retrospective	Tractional 29% Traumatic 26% Rhegmatogenous 22% Other types 23%	2017	231	SB 16% PPV+ gas 19% PPV+SO 7% SB+PPV 57%	62% Overall success 78% for rhegmatogenous and 39% for tractional RD
This study	Retrospective	Traumatic RD	2018	139	SB+PPV+SO 51.8% PPV+SO 48.2%	61.1% 61.2%

functional results were guarded. Anatomic outcome was 45% in cases of open globe injury and 65% after closed globe injury. In our study the final anatomical results were 61.2% in both groups, which are comparable to Sarrazin et al.

Chen et al⁷ studied pediatric RD in Taiwan. The study included 35 eyes, and the main risk factors for RD were congenital anomalies, myopia, and trauma. The study ensured the fact that multiple interventions were needed, and the fellow eye is at risk of RD. The surgical techniques were scleral buckle, vitrectomy or a combination of both techniques. The study showed that anatomical results in the vitrectomy patients approached 50%. Our final

anatomical results are comparable to Chen et al; 62.1% in both groups. The visual results ranged from NLP to 1.0. In our study, the VA ranged from NLP to 0.9 in both groups.

Weinberg et al⁸ studied the risk factors and surgical outcomes of pediatric retinal detachment. The study included 39 eyes treated by conventional scleral buckle 41%, vitrectomy 13%, or combined buckle and vitrectomy 46%. The study concluded the need for multiple procedures, and the poor visual outcomes, which are also similar to our observations. Weinberg et al recorded that 31% of patients had a final vision of NLP. In our study, the incidence of NLP vision was 7.6% in both groups.

Read et al⁹ reviewed 231 pediatric eyes of different etiologies; 60 eyes of the studied group were traumatic detachments. The surgical procedures were scleral buckle (SB), PPV alone or a combination of both techniques. The incidence of missed retinal break was 50% and 32% of open and closed globe injuries respectively, which are similar to the results in our work; the incidence of missed break was 34.7% in group A, and 25.4% in group B. The overall anatomical success was 65% compared to 62.1% in our study.

All the previous studies used different surgical techniques, scleral buckle, vitrectomy or additional encircling band in addition to vitrectomy. Neither of those studies made a clear conclusion whether the additional band may improve the surgical outcomes.

A summary of some pediatric RD studies is presented in Table 9.

Conclusion

Although there was no statistically significant difference between the two groups (combined vitrectomy and encircling band versus vitrectomy alone in pediatric traumatic retinal detachment), it is wise to consider adding an encircling band in severe trauma cases.

Limitations of the Study

This study is limited by its retrospective nature.

Disclosure

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