The Anatomical and Functional Outcomes of Different Surgical Methods in Pediatric Retinal Surgeries

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ABSTRACT

Purpose: The etiology of pediatric retinal detachments and the effects of different surgical methods on anatomical and functional outcomes were evaluated.

Materials and Methods: Sixty-five eyes of 61 children were retrospectively reviewed. Group 1 underwent vitrectomy with silicone, Group 2 underwent vitrectomy with silicone and scleral buckling (SB), and Group 3 underwent ILM removal, heavy silicone, and SB.

Results: Four out of 61 children developed bilateral retinal detachment. Retinal re-detachment occurred in 11 eyes (57.8%) in Group 1, 8 eyes (33.3%) in Group 2, and 3 eyes (13.6%) in Group 3. Proliferative vitreoretinopathy (PVR) was present in 24.6% of cases.The VA was assessed by counting fingers (CF) (range LP- 20/200) preoperatively. After surgery, VA was CF at 2 m in Group 1, CF at 5 m in Group 2, and 20/50 in Group 3. In the last follow-up, the rate of patients with a BCVA of <20/200 was 46.7% and anatomical success was 85.3%.

Conclusion: In detachments occurring in pediatric patients, vitrectomy combined with SB is more effective. Combining them with ILM extraction and heavy silicone use, if possible, has a high effect on surgical achievements and recurrences.

Keywords: Scleral buckle, Pediatric detachments, ILM, Heavy silicone.

INRODUCTION

All types of retinal detachments occur less frequently in pediatric population than in normal population (3%–13%), but they are more serious and are associated with a challenging treatment process due to their consequences.[1] In general, causes, clinical characteristics, outcomes of surgery and prognosis are completely different in pediatric cases than in adults. Although the most common cause is trauma (18%–53%), myopia (22%–34%), congenital and developmental anomalies are also frequently encountered. It is more common in boys and often involves both eyes (7%–25%). [2-4]

Poor vision at baseline, delay in describing complaints and associated macular involvement and proliferative vitreoretinopathy (PVR), as well as anatomical characteristics of pediatric age group reduce anatomical and functional success in pediatric cases and endangers the eye. Therefore, anatomic and functional success rates in these age groups are low compared with those in adults.[5-7] While the overall success rate in adults is 90% and above, this rate is 70-80% in children and even 50-60% in younger age groups.

In addition, recurrence rates after surgery are also very high in pediatric patients. The main cause of recurrence is high cell proliferation and PVR. In addition, these patients have a lifelong risk to develop cataract, glaucoma and recurrent RD. Therefore, surgical techniques to be applied are of great importance.

The aim of this retrospective study was to evaluate anatomical and functional outcomes after different retinal surgeries and techniques in retinal detachments encountered in the pediatric age group.

MATERIALS AND METHODS

We retrospectively reviewed 65 eyes of 61 pediatric patients (under the age of 16 years) who underwent retinal surgery

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for retinal detachments (rhegmatogeneous, tractional and traumatic) between September 2006 and September 2018. This analysis was approved by the Human Subject Research Office of Uskudar University School of Medicine. Consent form was obtained from their parents on behalf of any patients under the age of 16. Patients were excluded from the study if they had another surgery before like glaucoma, cornea etc. or inadequate clinical follow-up.

Age at onset, sex, etiology, local or systemic disease conditions, presence of PVR, corrected visual acuity (BCVA) at baseline and after surgery, anatomical and functional success rates, and complications were evaluated within the scope of the study.

Visual acuity was evaluated using a Snellen chart, if possible, and then converted to log MAR for statistical analysis. If obtaining expression was not possible, it was calculated by predicting the target by pointing, following, or fixation. Considering a BCVA of <20/200 as a functional loss, the fusion of retina in the final examination (silicone or non-silicone) was regarded as an anatomical success.

Thirty-seven out of 65 eyes were traumatic, the rest of them were non traumatic. Accordingly, 37 eyes had traumatic (open and closed trauma) detachment, 18 had rhegmatogenous (myopia, late premature retinopathy, Stickler's syndrome, Wagner's Syndrome, and Sturge–Weber Syndrome) detachment, and 10 had tractional (early retinopathy of prematurity, Coats' disease, and FEVR) detachment. Fourteen of the traumatized eyes were accompanied by various types of foreign objects. The underlying pathologies are shown in Table 1 (see Table 1).

According to the above diagnoses, patients were divided into three groups. Pars plana vitrectomy with standard silicone oil tamponade was used in Group 1 (19 eyes). Pars plana vitrectomy (PPV), standard silicone oil tamponade, and encircle scleral buckling (SB) were performed in 24 eyes (Group 2) and PPV with ILM removal, heavy silicone oil (Densiron) tamponade, and SB were performed in 22 eyes (Group 3). Heavy silicone was removed approximately 4.3 months (2–8 months) later. The surgical approach was at the surgeon's discretion which varied over time.

Table 1: *Characteristics of pediatric cases*

		N	*%*
Etiology	Trauma	**37**	**56,9**
	Myopia	**10**	**15,3**
	Coats' disease	**7**	**10,7**
	ROP	**4**	**6,1**
	Wagner's syndrome	**2**	**3**
	FEVR	**2**	**3**
	Stickler's syndrome	**2**	**3**
	Sturge–Weber syndrome	**1**	**1,5**
Type	Trauma	**37**	**56,9**
	Rhegmatogenous	**18**	**27,6**
	Tractional	**10**	**15,3**
Trauma Type	Open	**25**	**67,5**
	Closed	**12**	**32,4**
	Foreign Body	**14**	**37,8**

Statistical analysis was performed using a paired Student t-Test. A p-value of $p<0.05$ was considered statistically significant.

Surgical Technique

Under general anesthesia, 23-gauge or 25-gauge three-port PPV was performed in all surgeries. Scleral sponge (number 506) was placed posterior to the equator. Vitreous base and posterior hyaloid are removed using with intravitreal triamcinolone acetonide especially inferiorly where most arising area of recurrence of RD. After fluid-air exchange peripheral vitreous base remnants are trimmed again under the air. The internal limiting membrane (ILM) was stained using brilliant blue in all eyes and removed with membrane scrapers and ILM forceps under perfluorodecalin between posterior pole and equator.

RESULTS

Sixty-five eyes of 61 children were evaluated in the study. Of the 61 patients, 24 were girls and 37 were boys. The mean age was 9.2 years (range: 2.2–16 years). The mean duration of follow-up was 47 months (range: 2.3–9.5 years).

Clinical features of pediatric detachments are shown in Table 1. The majority of the patients had a traumatic etiology (56.9%) and 24.6% of the eyes had grade C PVR. Except for eyes with a traumatic cataract, all eyes were in phakic state. The majority of eyes with retinal detachment had total retinal detachment and breaks in the type of flaps and dialysis.

Table 2 presents the surgical techniques used in the study. Accordingly, all patients underwent PPV and silicone oil insertion. Of these patients, 70.7% additionally underwent SB and 33.8% underwent ILM extraction and heavy silicone insertion (see Table 2).

Similarly, 72.4% of the eyes required single surgery, whereas 27.6% required multiple surgeries. Retinal re-detachment occurred in 11 eyes (57.8%) of 19 patients in Group 1, 8 eyes (33.3%) of 24 patients in Group 2, and 3 eyes (13.6%) of 22 patients in Group 3. These differences

Table 2: *Characteristics of procedures and recurrence.*			
		N	**%**
Primary Surgery	Only PPV	**19**	**29,2**
	Combined with SB	**46**	**70,7**
Recurrence	Absent	**43**	**66,1**
	Present	**22**	**33,8**
	Group 1	**11**	**57,8**
	Group 2	**8**	**33,3**
	Group 3	**3**	**13,6**
Secondary Surgery	Group 1	**11**	**57.8**
	Group 2	**8**	**33.3**
	Group 3	**3**	**13.6**

were statistically significant between group 1 and group2-3 ($p<0.05$). Revision surgery, phthisis bulbi, and corneal decompensation developed in 6 eyes (31.5%) in Group 1 and 3 eyes (12.5%) in Group 2, whereas no phthisis bulbi was observed in Group 3. These differences were also statistically significant group 1 and group 2-3 ($p<0.05$). Three eyes in Group 1 and 2 eyes in Group 2 underwent evisceration.

Of recurrent cases in Group 1, seven required revision surgery and four underwent scleral band application in addition to heavy silicone implantation during surgery. Two of them did not accept revision surgery, two cases had phthisis bulbi. Standard silicone was inserted in all the eight patients undergoing revision surgery in Group 2. No intervention was made in one patient who had limited lower quadrant detachment and had no macular involvement. In Group 3, standard silicone was applied with the addition of scleral band in all recurrence cases in this group.

Heavy silicone oil was removed 4.3 months (range: 2–8 months) after surgery, on average. During this period, emulsification was detected in four cases and inflammation in two cases. Intraocular pressure rises secondary to inflammation or emulsification in four patients were controlled with topical antiglaucomatous drops until the silicone was removed. Similarly, six patients in Group 1 and five patients in Group 2 with an increased pressure were given antiglaucomatous drops.

Epiretinal membrane could not be detected in any patients who underwent ILM extraction in Group 3, and epiretinal and preretinal membranes were detected in eight patients in Group 1 and seven patients in Group 2.

Cataract surgery was required in 51 (78.4%) eyes. All eyes were in phakic status in the preoperative period, except in eyes that developed cataract due to trauma. In general, 36 (55.3%) eyes had vitreous hemorrhage, 54 (83%) eyes had retinal detachment, 14 (21.5%) eyes had foreign bodies, 27 (41.5%) eyes had traumatic cataract, and 7 (10.7%) eyes had endophthalmitis. All cases of endophthalmitis were in the traumatic group. Macular involvement was found in 43 (66.1%) eyes. Proliferative vitreoretinopathy (stage A–C) was also present at initial presentation in 16 of 65 eyes (24.6%). The PVR grading was designed according to Retina Society Classification.

In some patients, visual acuity could not be completely determined due to lack of cooperation with young patients. However, visual outcomes generally correlated with the anatomical outcomes. In our study, values reaching over 20/200 were considered functional success and anatomical success in the final control. The mean preoperative visual acuity level was CF (range LP- 20/200) in all groups. The mean postoperative visual acuities were CF at 2 m (range, no LP- 20/200) in Group 1, CF at 5 m (range, no LP- 20/150) in Group 2, and 20/50 (range CF- 20/30) in Group 3 (Table 3). Visual acuity levels achieved in group 3 were statistically significant than groups 1 and 2 ($p<0.05$).

DISCUSSION

This study was conducted to elucidate the etiology of pediatric retinal detachments, as well as clinical characteristics and surgical techniques applied. Of retinal detachments, 3%–13% occur in pediatric patients and adolescents.[8-9]

Table 3: *Anatomical and Visual Outcomes.*		
Anatomical Success 85,3 %		
	N	***%***
Group 1	**13**	**68,4**
Group 2	**21**	**87,5**
Group 3	**22**	**100**
Visual Outcomes 46,7 %		
	N	***%***
>20/200 Group 1	**5**	**26,3**
Group 2	**11**	**45,8**
Group 3	**15**	**68,1**
Final BCVA		
	N	***%***
No LP	**4**	**6,1**
LP-CF at 5 m	**41**	**63**
20/200–20/50	**13**	**20**
20/50–20/30	**7**	**10,8**

In general, trauma is the most common etiological cause (35%–45%) in pediatric patients with retinal problems. [10-11] In our study, trauma (56.9%) followed by high myopia (15.3%) were the most common causes. None of the patients had a history of surgery. Geographic factors also played a role in our relatively high rates. In addition, both in our study and in other studies, the predominance of boys was remarkable, the rates being as high as 70%–80%.[2, 3] This can be explained to a certain extent by a high number of trauma cases. Prognosis is poorer in perforating injuries and in those associated with foreign objects than in blunt injuries. [12,13]

High myopia, which is the second most common cause, has a reported rate of 11%–45% in other studies, whereas it was 15.3% in the present study, corresponding to average of literature.[14,15] In this group of patients, some patients with Stickler's syndrome and Wagner's syndrome except high myopia were previously in our follow-up program. High myopia is one of the first-line causes of retinal detachment in adults, but it is relatively less common in the pediatric age group because the complications of high myopia often peak around middle age after childhood.

In surgery, techniques combined with vitrectomy and SB are often used.[16-17] The use or addition of SB is preferred in the presence of PVR and if the tractional component is dominant. SB is used alone in around 15%–20% of the patients. Silicone tamponade is often the preferred tamponade during surgery. We used silicone tamponade in all our patients, and we preferred heavy silicone in 22 eyes of primary cases. Depending on the severity of the condition, there were cases in which we kept heavy silicone longer than usual (4.3 months on average). During this period, the silicone was removed in a shorter period in cases that developed emulsification, inflammation, or glaucoma. In addition, glaucoma that was detected in 15 (23%) eyes during the follow-up period was controlled by the application of anti-glaucomatous drops.

Despite the techniques used in pediatric surgery, success rates still remain low compared with that in adults. The presence of severe pathologies and syndromes threatening the vision, the presence of a foreign body with a history of serious trauma, delays in children's ability to express their complaints, and the dominance of macular involvement on initial presentation reduce the success rate. In addition, in our study, there was macular involvement in 43 eyes (66.1%) in the preoperative period. Iatrogenic damages in surgery, anatomical difficulties at the entrance sites, difficulty manipulating the separation of the posterior hyaloid and complications that may occur during this period, and difficulties in the use and duration of tamponade constitute problems in the pediatric age group.[18-20] We believe that in addition to vitrectomy, it is very useful to supplement pediatric cases with SB. Our success and recurrence rates in Group 2 and Group 3 cases that underwent SB are significantly different than those in patients in Group 1 in whom SB was not used (see Table 3).

In terms of preventing recurrences, if possible, ILM extraction and heavy silicone use are significantly effective while increasing the success of surgery.[21] The most important finding detected in the present study is that supplementing surgery with SB in pediatric cases is very important in terms of achieving anatomical and functional success as well as preventing recurrences. In addition, heavy silicone use and ILM removal, if possible, offer high efficacy index with SB.

In contrast, success rates are even lower in syndromes and diseases with similar traction component such as FEVR, Coats' disease, and particularly in the ROP. In other studies, the anatomical success rate was found to be 33% in the ROP group and 40% in the FEVR group.[12] The success rate in rhegmatogenous and sometimes even in trauma groups is higher than in the tractional retinal detachment (TRD) groups. Success in TRD groups usually remains approximately 50%.

In general, our anatomical and functional success rates were 68.4% and 26.3% in Group 1, 87.5% and 45.8% in Group 2, and 100% and 68.1% in Group 3, respectively. Anatomical and functional success rates vary between 75% and 85% rates in other studies.[11, 18, 20]

The phthisis rates were 31.5% and 12.5% in Groups 1 and 2, respectively. No phthisis was observed in Group 3. The recurrence rates in our study were 57.8% in Group 1, 33.3% in Group 2, and 13.6% in Group 3 (Table 2). The benefit of heavy silicone and ILM extraction together with SB is striking both in terms of increasing functional success and preventing recurrences.

In addition to all these, age is one of the main factors affecting anatomical and functional success. Young age always appears to be a poor prognostic factor due to development of PVR and structural anomalies. The success rate is much lower and recurrence rates are similarly higher particularly in children aged less than 5 years than in those aged 16–18 years.[10]

Particularly in the pediatric age group, PVR has a more severe course due to high cellular proliferation in these age groups.[22] In general, the reported PVR ratio is 20%–60%, whereas it was 24.6% in our case.[23] This rate is higher especially in trauma cases with TRD combined with

foreign bodies. In advanced cases of PVR, the recurrence rate is naturally high (50%–72%).[24-25]

The success rate in the study by Wang et al. was 70%–80%, and the lowest success rates were noted in TRD groups as in other studies.[25-27] In a study by Read et al., the best anatomical and functional outcomes were detected in detachments with tears and the worse outcomes were detected in trauma and tractional cases.[10]

In general, success rates in operations supported by SB in our study were much higher than those of PPV only. Furthermore, in our study, the success rate, both in terms of anatomical and functional outcomes, was lower in Group 1 than the other groups. Anatomical-functional success rates were higher and recurrence rates were significantly lower in the group of patients who underwent heavy silicone insertion and ILM extraction supported by SB. In addition, the use of SB in trauma cases and in those with a tractional component is beneficial in terms of achieving anatomical and functional success while also avoiding development of phthisis in case of possible failure.

CONCLUSION

Both surgical difficulties and complex etiological conditions in pediatric cases reduce anatomical and functional success. In order to maintain this success at reasonable levels and reduce recurrence rates, we recommend ILM extraction and heavy silicone use with SB and assisted vitrectomy, if possible. If using heavy silicone is hindrance, posterior fixation of scleral buckle behind the equator and the use of standard silicone should be preferred.

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