Systematic Review

Effectivity of Posterior Optic Capture in Preventing Visual Axis Opacification Following Pediatric Cataract Surgery: A Systematic Review and Meta-Analysis

PJO – Official Journal of Ophthalmological Society of Pakistan

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ABSTRACT

Common complication after pediatric cataract surgery is visual axis opacification (VAO). Current surgical approach commonly used today is posterior capsulotomy with anterior vitrectomy (AV), but posterior optic capturewithout AV, has been introduced as an alternative. This study reviews posterior optic capture in preventing VAO following pediatric cataract surgery.Literature searches through various databases and comprehensive analysis results in 5 selected articles. Selected studies state that optic capture is as effective as conventional methods in preventing VAO. Optic capture is a safer alternative for IOL implantation, as it results in fewer inflammatory complications and eliminates the need for AV. Hence, optic capture reduces the additional risks associated with AV.Posterior optic capture is comparable to the standard surgical approach in preventing VAO. Furthermore, it is safer in terms of inflammatory sequelae and lens epithelial cell proliferation. Optic capture presents an alluring alternative surgical approach to overcome the need for vitrectomy.

Key Words: Optic capture, pediatric cataract, secondary opacification.

How to Cite this Article: Zahra RA, Casey A, Barliana JD. Effectivity of Posterior Optic Capture in Preventing Visual Axis Opacification Following Pediatric Cataract Surgery: A Systematic Review and Meta-Analysis. 2025;41(1):99-104. **Doi: 10.36351/pjo.v41i1.1957**

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Received: October 06, 2024
Revised: November 11, 2024
Accepted: December 28, 2024

INTRODUCTION

Cataract accounts for nearly 10% of blindness in pediatric patients. Pediatric cataracts can be an isolated disease or associated with systemic conditions.[1] Untreated cataracts can lead to reduced quality of life and a socio-economic burden due to significant visual impairment. Therefore, early detection and prompt treatment are mandatory to prevent further complications. Diagnosis of pediatric cataract involves detailed history taking and compulsory ophthalmologic exams by slit lamp examination, intraocular pressure, and visual assessment.[2] Cataract surgery is indicated when strabismus or nystagmus is present, more than 3 mm of central opacity, and obscuring the posterior pole centrally and is recommended to be performed at a younger age to prevent deprivation amblyopia, namely at the age of 4-6 weeks for unilateral cataract and less than 10 weeks for bilateral cataract. Surgery for bilateral cataracts in older children should be deliberated when visual acuity reaches ≤20/40.[1,2] Common complication that can arise after pediatric cataract surgery is visual axis opacification (VAO), which can cause deprivation amblyopia since it disrupt the quality of optical image required for visual development.[3] After intraocular lens (IOL) implantation, posterior capsule is usually intact and promote lens opacification due to proliferation of epithelial cells within the posterior capsule of lens. Rapid proliferation in pediatric patients is influenced by anterior vitreous face (AFV) arising in the healing eye, capsule remains, and

extensive growth of fibrous tissue at the posterior part of the iris.[4,5] The surgical approach commonly used today to prevent VAO alongside the lensectomy procedure is posterior capsulotomy with anterior vitrectomy. This procedure allows a strong rim to hold IOL in the bag. Unfortunately, certain cases of pediatric cataract, mainly persistent fetal vasculature (PFV) and weak capsule in the posterior lenticonus, creates a larger opening at the posterior capsule and result in instable IOL implantation. Posterior optic capture, without anterior vitrectomy, has been introduced as an alternative approach as it is less inflammatory.[6] Based on our observations, there has been no published systematic review regarding the effectiveness of posterior optic capture in preventing VAO in pediatric cataract. Hence, the aim of this study is to conduct a systematic review on the effectiveness of posterior optic capture in preventing visual axis opacification (VAO) in pediatric cataract surgery.

METHODS

Literature searching was conducted through a number of electronic databases: PubMed, Cochrane, and Science Direct during March of 2023. Boolean operators AND and OR were utilized to perform searches using keywords “posterior optic capture” AND “visual axis opacification” OR “posterior capsule opacification” AND “pediatric cataract”.

Study Selection and Data Extraction

Articles obtained from the database are imported into the Rayyan AI Powered Tool for systematic reviews.[7] After the automated software removed duplicates, we identified 99 records. The remaining 99 records were independently reviewed based on their titles and abstracts. Three reviewers (RA, AC, and JDB) excluded articles not available in full text, articles that were not in English, and articles that served as a background article. We restricted our study to research conducted within the past 10 years. Reviewers separately assessed the titles and abstracts of the remaining articles to determine their eligibility. The inclusion criteria involved pediatric cataract patients, posterior optic capture compared to conventional surgery approach (posterior capsulotomy with anterior vitrectomy), with incidence of visual opacification as the outcome. Eligible articles were then appraised separately by RA and AC for possible inclusion in this study. JDB did a final check on the included studies to ensure the required data was complete. The article selection process is illustrated using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 diagram in **Figure 1**.[8]

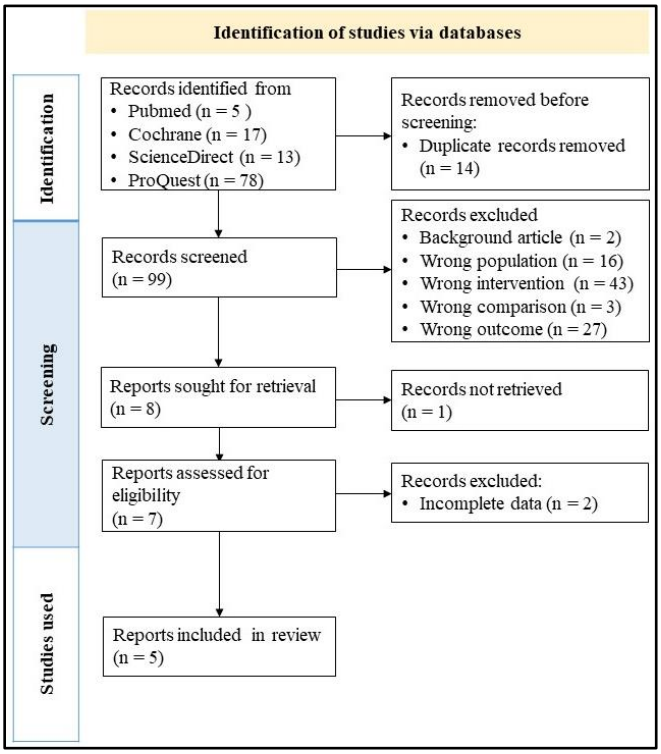

Figure 1: Search Strategy flowchart.

Characteristics of the included studies were extracted by one reviewer (RA), including first author, study design, level of evidence, country and study setting, number of cataract patients, number of eyes assessed, laterality of cataract, age at the time of surgery, and length of follow-up.

Risk of Bias Assessment in Selected Study

The risk of bias was independently appraised by RA, AC, and JDB. Assessment regarding risk of bias of 3 RCTs (Devebacak et al, Kaur et al, and Vasavada et al), were conducted using Revised Cochrane risk-of-bias tool for randomized trials (RoB 2 tool), presented in Figure 2.[9] Meanwhile, case series study by Khatib et al, was assessed using The National Institutes of Health (NIH) quality assessment tool.[10] A Measurement Tool to Assess Systematic Reviews (AMSTAR) was used to evaluate meta-analysis by Wei-Zhou et al.[11]

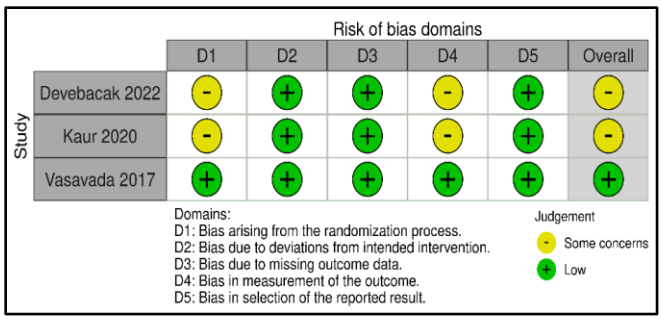

Figure 2: Risk of bias assessment of selected RCTs.

Statistical Analysis

Reviewers divided the population into 2 groups, namely the group that received optic capture without anterior vitrectomy (group 1) and the group that received posterior capsulotomy with anterior vitrectomy (group 2). Reviewers extracted data regarding the number of eyes that developed VAO after surgery in each group. Results were expressed as *p* value, 95% confidence intervals (CI), risk ratios (RR) for RCT and meta-analysis, meanwhile odds ratio (OR) expresses outcome for case series.

RESULTS

The PRISMA 2020 flowchart regarding the study selection process is displayed in Figure 1. From 4 databases, we obtained 113 studies (5 by PubMed, 17 by Cochrane, 13 by ScienceDirect, and 78 by ProQuest) and then removed 14 duplicates. Two studies were excluded at the last step of screening because of incomplete data. Five included studies consisted of 1 meta-analysis, 3 RCTs, and 1 case series, hence the level of evidence ranged from 1a to 2b.[12–16] Risk of bias assessment of RCTs is shown by Figure 2. Studies by Devebacak et al and Kaur et al, had some concerns in the overall risk of bias, mainly due to unclear randomization process and bias in measurement of outcome.[12,13] Whereas the RCT by Vasavada et al, had overall low risk of bias.[15] The case series by Khatib et al, qualified as a good study as it was clear in terms of study question, consecutive cases, comparable subjects, clear intervention, and well-described results.[14] Meta-analysis by Wei-Zhou et al, had low overall risk of bias, unfortunately some components were not clearly stated in the full text: statement regarding that review methodology was established prior to conducting the review, list of excluded studies, funding sources, and risk of bias table.[16]

Four selected studies were published in 2017-2022, while the meta-analysis published in 2016 only discussed studies published before 2010. Most of the selected studies state the number of patients included, except for the meta-analysis by Zhou HW which only stated the number of eyes included.[16] The meta-analysis conducted by Zhou et al, collected studies from 1996 to 2009 and compared a group receiving optic capture with a group not receiving it, without distinguishing between those who underwent anterior

Table 1: Study Characteristics.

Study (year)	Study design	Level of evidence	Country/ Setting	Number of patients	Number of eyes	Laterality		Mean age at the time of surgery	Median length of follow-up
						Unilateral	Bilateral		
Devebacak (2022)	Prospective RCT	1b	Turkey, single center	37	51	33	18	59.2±32.6 months (Group 1) and 46.5±21.9 months (group 2)	20.1±8.5 months
Kaur (2020)	Prospective RCT	1b	India, single center	15	30	0	30	21 ± 14.7 months	25.69 ± 1.06 months
Khatib (2017)	Retrospective comparative case series	2b	Israel, single center	94	123	27	67	57.3 ± 47.1 months	63.13 months
Vasavada (2017)	Prospective RCT	1b	India, single center	61	61	37	24	18.2 ± 11.47 months (Group 1) and 14.8 months ±11.47 (Group 2)	6-month follow-up and 12-month follow-up
Wei-Zhou (2016)	Meta-analysis	1a	China, PubMed & EMBASE database	No data	194	0	194	Ranging from 4 months to 16 years	Ranging from 1 month to 4.5 years

Table 2: Visual Axis Opacification.

Study (year)	Visual Axis opacification (Affected eyes/ total eyes)		*P* value	Outcome
	Group 1(optic capture without anterior vitrectomy)	Group 2 (posterior capsulotomy with anterior vitrectomy)		
Devebacak (2022)	3/24	2/27	0.545	RR: 1.69; 95% CI: 0.31 to9.26;
Kaur (2020)	0/15	0/15	1.000	RR: 1.00; 95% CI: 0.02 to 47.3
Khatib (2017)	4/21	22/102	0.257	OR: 0.85; 95% CI: 0.26 to2.80
Vasavada (2017)	0/26	1/30	0.573	RR: 0.39; 95% CI: 0.02 to 9.34
Wei-Zhou (2016)	7/69	1/67	0.069	RR: 6.79; 95% CI: 0.85 to 53.76

vitrectomy or not. Therefore, we extracted partial data from this meta-analysis to compare the optic capture group without anterior vitrectomy to the group undergoing posterior capsulotomy plus anterior vitrectomy. Afterward, reviewers calculated the risk ratio as well as other statistical analysis mentioned in this study. Prospective RCT by Kaur et al, only included bilateral congenital cataract for their study, one eye from each patient underwent optic capture without AV, while the other eye underwent posterior capsulotomy with anterior vitrectomy (AV).[13] Mean age at the time of surgery and the median length of follow up from each studies varies greatly. The study characteristics are described in detail in Table 1.

Table 2 summarizes the VAO incidence in each group after the respective intervention. Study by Devebacak et al and Wei-Zhou et al, has RR greater than 1, meaning VAO more likely to occur in patients receiving optic capture without anterior vitrectomy.[12,16] Meanwhile, both groups revealed no opacification after respective surgeries in study by Kaur et al, with the RR of one, which indicated there was no difference of VAO occurrence between the two groups.[13] Two studies (Khatib et al and Vasavada et al), had the OR/RR less than one, indicating a reduced risk for the group 1 and suggested that the optic capture may actually prevent the VAO from occurring.[14,15] Five selected studies had the p value greater than 0.05 and 95% CI crossed one, meaning there were no statistically significant difference between the two interventions in visual axis opacification incidence, despite various result in risk ratio or odds ratio. Nonetheless, meta-analysis by Wei-Zhou that compared optic capture vs no capture without differentiating anterior vitrectomy procedure concluded that optic capture significantly reduces the incidence of VAO (RR: 0.12; p value 0.03; 95% CI: 0.02 to 0.85).[16]

DISCUSSION

Visual axial opacification (VAO) is a major complication following pediatric cataract surgery, with an incidence rate of nearly 40%.[4] The VAO is predisposed by inflammatory membranes that is fibrous or residual lens epithelial cells (LECs). Opacification at the center of the visual axis promotes visual impairment. The incidence of VAO is higher in children than in adults and requires prevention with proper surgical technique. Opacification caused by proliferation of cells can be prevented by eliminating the scaffolding structures for LECs migration to the anterior vitreous face, therefore it is achieved by the standard care: primary posterior capsulotomy (PPC) and anterior vitrectomy.[17] Anterior vitrectomy disorganize the anterior hyaloid membrane, causing vitreous loss. This procedure promotes secondary complications, namely cystoid macular edema and retinal detachment.[12,18] Furthermore, not all hospitals have the facilities to perform vitrectomy. Therefore, posterior optic capture, without anterior vitrectomy, has been introduced as an alternative approach.

This review aimed to evaluate the surgical outcome of an alternative technique (optic capture without AV) compared to the standard procedure (PPC with AV) in terms of VAO development. Our review shows that all the selected studies suggest there was no statistically significant difference between the two interventions regarding visual axis opacification incidence, regardless of the various outcomes. Devebacak et al, expressed that in pediatric cataract surgery, there is a higher occurrence of postoperative inflammation in the anterior chamber compared to adults, which can lead to inflammatory deposits on the intraocular lens, anterior and posterior synechiae, and the formation of secondary membranes, thus potentially impact the visual acuity.[12] Inflammatory reactions can be initiated by the presence of vitreous strands within the anterior chamber. Hence,

withdrawing anterior vitrectomy and opting for optic capture method could be a suitable strategy to circumvent the supplementary proinflammatory effects that can arise from undergoing vitrectomy.[12]

In Kaur et al, prospective RCT, optic capture may reduce friction and abrasion at the posterior surface in the iris, since the procedure captures the optic behind the capsule.[13] Comparative case series by Khatib et al, reported that the main reason for epithelial lens regrowth depends on the patient's age instead of the surgical technique, where regrowth is more common and faster in younger children. Additionally, they stated there was no difference between the two surgical approaches in the frequency of epithelial lens regrowth.[14] Meta-analysis by Wei Zhou concluded that optic capture application significantly minimized visual axis opacification and geometric decentration, yet it did not result in significant improvement in best-corrected visual acuity (BCVA).[16] After examination, the reviewers found that the significant results were influenced by the fact that Wei Zhou compared optic capture group vs no optic capture group (both with and without anterior vitrectomy). It was found that the optic capture with anterior vitrectomy group provided the best outcomes and showed no opacification at all. On the other hand, the group without optic capture and without anterior vitrectomy had the worst outcomes, with the highest rate of opacification.[16] A small-scale case-control study included in the meta-analysis reported that anterior vitrectomy was the only effective method for preventing or delaying secondary cataract formation in pediatric patients. However, it should be noted that optic capture does not contradict anterior vitrectomy. Based on these findings, a combined approach of optic capture and anterior vitrectomy emerges as a preferable surgical method.[19]

Posterior optic capture is an effective way to manage posterior capsular abnormalities, like weak posterior capsules found in conditions such as posterior lenticonus or persistent fetal vasculature (PFV). It increases the contact area between the anterior and posterior capsules, resulting in better IOL centralization and lower rates of PCO.[6,20]

In our review, we included high-quality studies, with the majority being evidence levels of 1a-1b. This indicates the reliability of the studies. However, there were some concerns regarding the risk of bias in two RCTs and one meta-analysis. Additionally, there were no limitations regarding the patient's age at the time of surgery and the length of follow-up in each study. While the group undergoing optic capture demonstrated a lower occurrence of inflammatory consequences, the results did not reach statistical significance. To establish conclusive findings, it is imperative to conduct further research with a larger sample size.

CONCLUSION

Posterior optic capture is comparable to the standard surgical approach in preventing VAO. Furthermore, it is safer in terms of inflammatory sequelae and lens epithelial cell proliferation. Optic capture presents an alluring alternative surgical approach to overcome the need for vitrectomy.

Funding: This study was not funded by any organization.

Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

REFERENCES

1. **Khan AO, Chang P, El-Dairi M, Lee KA, Utz M, Mireskandari K, et al.**Section 6, Pediatric Ophthalmology and Strabismus. In: Basic and Clinical Science Course. American Academy of Ophthalmology; 2022.
2. **Umfress A.** Cataracts in children, congenital and acquired [Internet]. American Academy of Ophthalmology. 2022 Available from: https://eyewiki.aao.org/Cataracts_in_Children,_Congenital_and_Acquired#History. Accessed: Mar 22, 2023
3. **Wilson E.** Pediatric cataracts: Overview [Internet]. American Academy of Ophthalmology. 2015 Available from: https://www.aao.org/education/disease-review/pediatric-cataracts-overview. Accessed Mar 22, 2023
4. **Shrestha UD, Shrestha MK.** Visual Axis Opacification in Children Following Paediatric Cataract Surgery. JNMA J Nepal Med Assoc. 2014;**52(196):**1024–1030. Doi: 10.31729/jnma.2807.
5. **Menapace R.** Prevention of Posterior Capsule Opacification. In: Cataract and Refractive Surgery. Springer; p.101–122. (Essentials in Ophthalmology). Doi: 10.1007/3-540-26678-X_6.
6. **Sukhija J, Kaur S, Korla S.** Posterior optic capture of intraocular lens in difficult cases of pediatric cataract. Indian J Ophthalmol. 2022;**70(1):**293–295. Doi: 10.4103/ijo.IJO_1588_21.

7. **Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A.** Rayyan – a web and mobile app for systematic reviews. Indian J Ophthalmol. 2020;**68:**2356–2365. Doi: 10.1186/s13643-016-0384-4.
8. **Page M, McKenzie J, Boutron I, Hoffmann T, Mulrow C, Shamseer L, et al.** The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;**372:**n71. Doi: 10.1136/bmj.n71.
9. **Sterne J, Savović J, Page M, Elbers R, Blencowe N, Boutron I, et al.** RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;**366:**l4898. Doi: 10.1136/bmj.l4898.
10. Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies [Internet]. 2017. Available from: https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools. Accessed: Mar 22, 2023.
11. **Shea B, Reeves B, Thuku M, Hamel C, Moran J, Moher D, et al.** AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. BrMedJ. 2017;**(358:**j4008). Doi: 10.1136/bmj.j4008.
12. **Devebacak A, Biler ED, Degirmenci C, Uretmen O.** Optic Capture Without Anterior Vitrectomy in Pediatric Cataract Surgery. AmJOphthalmol. 2023;**247:**88–95. Doi: 10.1016/j.ajo.2022.11.007
13. **Kaur S, Sukhija J, Ram J.** Comparison of posterior optic capture of intraocular lens without vitrectomy vs endocapsular implantation with anterior vitrectomy in congenital cataract surgery: A randomized prospective study. Indian J Ophthalmol. 2020;**68(1):**84–88. Doi: 10.4103/ijo.IJO_522_19.
14. **Khatib N, Tsumi E, Baidousi A, Nussinovitch H, Bilenko N, Lifshitz T, et al.**Infantile cataract: comparison of two surgical approaches. Can JOphthalmol. 2017;**52(5):**527–532. Doi: 10.1016/j.jcjo.2017.02.023.
15. **Vasavada AR, Vasavada V, Shah SK, Trivedi RH, Vasavada VA, Vasavada SA, et al.** Postoperative outcomes of intraocular lens implantation in the bag versus posterior optic capture in pediatric cataractsurgery. J Cataract Refract Surg. 2017;**43(9):**1177–1183. Doi: 10.1016/j.jcrs.2017.07.022
16. **Zhou HW, Zhou F.** A Meta-analysis on the clinical efficacy and safety of optic capture in pediatric cataract surgery. Int J Ophthalmol. 2016;**9(4):**590–596. Doi: 10.18240/ijo.2016.04.20.
17. **Küchlin S, Hartmann ES, Reich M, Bleul T, Böhringer D, Reinhard T, et al.**Pediatric Cataract Surgery: Rate of Secondary Visual Axis Opacification Depending on Intraocular Lens Type. Ophthalmology. 2022;**129(9):**997–1003. Doi: 10.1016/j.ophtha.2022.05.007.
18. **Cao K, Wang J, Zhang J.** Efficacy and safety of vitrectomy for congenital cataract surgery: a systematic review and meta-analysis based on randomized and controlled trials. Acta Ophthalmologica. 2019;**97(3):**233–239. Doi: 10.1016/S0140-6736(16)31979-1.
19. **Koch DD, Kohnen T.** Retrospective comparison of techniques to prevent secondary cataract formation after posterior chamber intraocular lens implantation in infants and children. J Cataract Refract Surg. 1997;**23:**657–663. Doi: 10.1016/S0886-3350(97)80050-8.
20. **Xie YB, Ren MY, Wang Q, Wang LH.** Intraocular lens optic capture in pediatric cataract surgery. Int J Ophthalmol. 2018;**11(8):**1403–1410. Doi: 10.18240/ijo.2018.08.24

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