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The influence of different types of intraocular lenses on the development of posterior capsular opacification

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ADMINISTRATIVE INFORMATION

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 8 December 2025 and was last updated on 8 December 2025.

INTRODUCTION

Review question / Objective Posterior capsule opacification (PCO) is the most common long-term complication after cataract surgery with implantation of an intraocular lens (IOL). It can be treated by cutting a hole in the posterior lens capsule with an Nd:YAG laser (Neodymium:YAG laser capsulotomy), however this procedure may lead to other complications. It is also expensive and not available in large parts of the developing world. Therefore, there have been many studies aimed at exploring the effects of different IOLs designs on multiple PCOs. This review included 59 prospective, randomised, controlled trials and cohort studies assessing the effect of different IOLs on PCO. Intervention measures include IOL materials, IOL edge design, 1-piece and 3-piece IOLs, spherical and aspherical IOLs. All trials had a follow-up time of at least 6 months. The effect of the intervention on PCO was assessed by measuring(subjective or objective) PCO score and the number of performed Nd:YAG laser capsulotomies. The results of the review were divided into four parts. In part one (effect of IOL material on PCO), the meta-analysis of the included trials found when excluding the influence of optical edges and other differences, the PCO rate of hydrophobic acrylic IOLs are significantly lower than that of hydrophilic acrylic IOLs, and the PCO rate of silicone IOLs are significantly lower than that of hydrophobic acrylic IOLs and PMMA IOLs. In part two (effect of IOL edge design on PCO), the meta-analysis showed significantly lower PCO rates in IOLs with sharp posterior optic edges than in IOLs with round optic edges. In part three (effect of 1-piece与3-piece IOL on PCO), there was no difference between 1-piece and 3-piece IOLs. In part four (influence of spherical and aspherical IOLs on PCO), there was no difference between

spherical and aspherical IOLs. In summary, primarily the choice of the IOL edge design and IOL materials seem to have a significant influence on the development of PCO. Therefore, IOLs with sharp optic edges should be preferred, and silicone IOLs seem to be a better choice.Posterior capsule opacification (PCO) remains the most common long-term complication after cataract surgery. But it can be treated by Nd:YAG laser capsulotomy. Therefore, many studies try to find the optimal IOL design influencing the development of Posterior capsule opacification (PCO).

Condition being studied Posterior capsule opacification(PCO) is the most common postoperative complication after cataract surgery and can often cause vision loss. Posterior capsule opacification development is attributed to the residual lens epithelial cells (LECs) in the capsular bag after cataract surgery that experience proliferation, migration, metaplasia, differentiation and opacification . Nd:YAG capsulotomy is currently the only effective treatment of PCO. However, the measure could potentially cause vision-threatening complications including increasing intraocular pressure, IOL damage, cystoid macular edema and retinal detachment. The pathogenesis of PCO is multifactorial, and the incidence of PCO varies. Several risk factors have already been identified for the progression of PCO, which include edge design and lens materialPosterior capsule opacification (PCO) is the most common long-term complication after cataract surgery with implantation of an intraocular lens (IOL). It can be treated by cutting a hole in the posterior lens capsule with an Nd:YAG laser (Neodymium:YAG laser capsulotomy), however this procedure may lead to other complications. It is also expensive and not available in large parts of the developing world.

METHODS

Participant or population We included studies involving patients with age-related cataracts undergoing surgery with IOL implantation in one or both eyes. There were no restrictions on race or sex.
We excluded articles with a follow-up time of less than 6 months, as well as articles on cataracts with other eye diseases, such as uveitis-complicated cataract.We excluded trials in children (i.e. those in which cataract onset occurred prior to 16 years of age).

Intervention Intervention measures include IOL materials, IOL edge design, 1-piece and 3-piece IOLs, spherical and aspherical IOLs. We excluded articles with a follow-up time of less than 6 months.

Comparator Intervention measures include IOL materials, IOL edge design, 1-piece and 3-piece IOLs, spherical and aspherical IOLs.

Study designs to be included Randomised controlled trials (RCTs) and cohort studies.

Eligibility criteria This review included only randomised controlled trials (RCTs) and cohort studies with a follow-up time of at least 6 months. We have included articles published between 2000 and 2025.

Information sources We searched the Cochrane Central Register of Controlled Trials (CENTRAL) ,PubMed, MEDLINE , EMBASE ,China National Knowledge Infrastructure (CNKI),China Wanfang Database and China Weipu Database. There were no language restrictions in the search for trials.

Main outcome(s) 1.Influence of IOL optic material on PCO
This study included 7 types of IOL optical materials (hydrophilic acrylic IOLs, hydrophobic acrylic IOLs, silicone IOLs, PMMA IOLs, hydrogel IOLs, heparin surface modified IOLs, heparin surface unmodified IOLs). The meta-analysis included in the study showed significant differences between different IOL optical materials (hydrophilic acrylic IOLs, hydrophobic acrylic IOLs, silicone IOLs, PMMA IOLs). When excluding the influence of optical edges and other differences, the PCO rate of hydrophobic acrylic IOLs are significantly lower than that of hydrophilic acrylic IOLs, and the PCO rate of silicone IOLs are significantly lower than that of hydrophobic acrylic IOLs and PMMA IOLs. This suggests that silicone IOLs have better effect in controlling the occurrence and development of PCO.
2.Influence of IOL edge design on PCO
We could provide clear evidence that sharp edge IOLs develop significantly less PCO than round edge IOLs of the same optic material. Looking at the pooled results of all studies comparing sharp and round optic edges (irrespective of the optic material), there was a clear difference between the two IOLs edge designs in PCO score and YAG rates.
3.Influence of 1-piece and 3-piece IOL on PCO
The meta-analysis of the included studies showed no significant differences between the one-piece and three piece designs. Although three piece IOLs seem to have lower PCO rates in several studies,

this meta-analysis is complicated by the inclusion of different IOLs materials and edge designs.In those cases, the difference in optic edge design and optic material probably had more effect on the development of PCO than the difference in one-piece and three-piece designs.
4.Influence of spherical and aspheric IOL on PCO
The meta-analysis results showed that the PCO rate of spherical IOLs were lower than that of aspheric IOLs.

Quality assessment / Risk of bias analysis Quality assessment of included RCT studies was performed using the Cochrane group's Risk of Bias (ROB) tool. The cohort studies were evaluated using the Newcastle Ottawa Scale (NOS). Two review authors assessed the trial quality and resolved disagreements by discussion, the use of additional referees or both. The review authors were not masked to any trial detail during the assessment.

Strategy of data synthesis We pooled data using Stata15.1 software. The heterogeneity across studies was qualitatively assessed using Cochrane Q test, and then quantitatively estimated the level of heterogeneity with I2 statistic. All included studies were considered heterogeneous if $P < 0.1$ and $I2 > 50.0\%$, and otherwise regarded as homogeneous if $P > 0.1$ and $I2 < 50.0\%$. Publication bias was checked when the accumulated number of included studies for individual outcomes was more than 10 through drew funnel plot. Moreover, a sensitivity analysis was carried out to evaluate the stability of the meta-analysis estimates. The Egger test assessed the potential publication bias, and when the obtained $P > 0.05$, it indicates that there is no publication bias in the experiment.

Subgroup analysis NA.

Sensitivity analysis Sensitivity analysis was conducted using Stata software to reflect the sensitivity of the article by observing the changes in effect size after removing one study.

Country(ies) involved China - Chengdu University of Traditional Chinese Medicine.

Keywords posterior capsular opacification, Neodymium:YAG laser capsulotomy, Intraocular lens, Hydrophilic acrylic IOLs, hydrophobic acrylic IOLs, polymethyl methacrylate IOLs.

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