Systematic Review and Meta-Analysis

Medicine®

OPEN

Comparison of hydrophobic and hydrophilic intraocular lens in preventing posterior capsule opacification after cataract surgery

An updated meta-analysis

Yang Zhao, MD[a], Ke Yang, MD[a], Jiaxin Li, MA.Sc[b], Yang Huang, MD[c], Siquan Zhu, MD[a,*]

Abstract

Background: Posterior capsular opacification (PCO) is a common long-term complication of cataract surgery. Intraocular lens design and material have been implicated in influencing the development of PCO. This study evaluated the association of hydrophobic and hydrophilic intraocular lenses on preventing PCO.

Methods: Medline, Cochrane, EMBASE, and Google Scholar databases were searched until August 3, 2016, using the following search terms: cataract, posterior capsule opacification, and intraocular lens. Eligible studies included randomized controlled trials (RCTs), retrospective, and cohort studies.

Results: Eleven studies were included in the study with a total of 889 eyes/patients. The overall analysis revealed that hydrophobic intraocular lenses were associated with lower Nd:YAG laser capsulotomy rates than hydrophilic lenses [odds ratio (OR) = 0.38, 95% confidence interval (95% CI) = 0.16–0.91, *P* = .029]. Hydrophobic intraocular lenses were also associated with lower subjective PCO score (diff. in means: −1.32, 95% CI = −2.39 to −0.25, *P* = .015) and estimated PCO score (diff. in means: −2.23; 95% CI, −3.80 to −0.68, *P* = .005) as compared with hydrophilic lenses. Objective PCO score was similar between lens types. (diff. in means: −0.075; 95% CI, −0.18 to 0.035; *P* = .182). Pooled analysis found that visual acuity was similar between hydrophobic and hydrophilic intraocular lenses (diff. in means: −0.016; 95% CI, −0.041 to 0.009, *P* = .208).

Conclusion: In general, PCO scores and the rate of Nd:YAG laser capsulotomy were influenced by intraocular lens biomaterial. Lens made of hydrophobic biomaterial were overall superior in lowering the PCO score and the Nd:YAG laser capsulotomy rate, but not visual acuity.

Abbreviations: CI = confidence intervals, Nd:YAG = neodymium-doped yttrium aluminum garnet, OR = odds ratio, PCO = posterior capsular opacification, RCTs = randomized controlled trials, SD = standard deviations.

Keywords: biomaterial, cataract, hydrophilic, hydrophobic, intraocular lens, Nd:YAG laser capsulotomy, posterior capsule opacification

1. Introduction

Patients having cataract surgery with intraocular lens implantation have great benefit from the development of surgical techniques and new types of lens materials.[1] However, posterior capsular opacification (PCO) remains a common long-term complication of the procedure. PCO can result in reduction of visual performance 1 or 2 years postcataract surgery.[2] The rates of PCO following cataract surgery are estimated to be 12% at year 1, 21% at year 3, and 28% at 5 years after surgery.[2] Treatment of PCO with neodymium-doped yttrium aluminum garnet (Nd:YAG) laser capsulotomy is effective; however, complications, including retinal detachment, macular edema, and increases in intraocular pressure, may also occur.[3]

Studies have found that several surgical- and intraocular lens related factors may play a role in the development of PCO.[1,4–11] Two aspects of the intraocular lenses seem important: the biomaterials and the edge design of the lenses. Acrylic intraocular lenses that have hydrophobic or hydrophilic surfaces have a long history in clinical practice and are associated with lower PCO and rates of Nd:YAG laser capsulotomy than lenses made of other biomaterials such as silicone or hydrogel.[6,8,12] Acrylic material has a relative low propensity to induce cell proliferation in the capsular bag.[9] In addition, studies have shown that lenses with sharp edge design inhibit lens epithelial cell migration resulting in a reduced rate of PCO.[4,5]

Only a limited number of studies have compared hydrophobic and hydrophilic lenses in relationship to development of PCO or the rate of Nd:YAG laser capsulotomy. Most of the studies are limited by the small sample size. Three prior meta-analyses

Editor: Khaled Ahmed Abdelrahman.

The authors have no conflicts of interest.

Supplemental Digital Content is available for this article.

[a] Beijing Tongren Eye Center, Beijing Key Laboratory of Ophthalmology and Visual Science, Beijing Tongren Hospital, Capital Medical University, Beijing, [b] Medical School, Pingdingshan University, Pingdingshan, [c] Department of ophthalmology, the Chinese People's Liberation Army General Hospital, Beijing, China.

[*] Correspondence: Siquan Zhu, Beijing Tongren Eye Center, Beijing Key Laboratory of Ophthalmology and Visual Science, Beijing Tongren Hospital, Capital Medical University, 1 Dongjiaominxiang Dongcheng District, Beijing 100073, China (e-mail: siquan10@yeahmca.c n).

Medicine (2017) 96:44(e8301)

Received: 21 August 2017 / Received in final form: 20 September 2017 / Accepted: 25 September 2017

http://dx.doi.org/10.1097/MD.0000000000008301

assessed the efficacy of different intraocular lens material in preventing PCO lowering the rate of Nd:YAG laser capsulotomy.[1,10,11] The aim of the current study was to provide an updated evaluation on the efficacy of hydrophobic and hydrophilic intraocular lens materials in preventing PCO and reducing the rate of Nd:YAG laser capsulotomy.

2. Methods

2.1. Search strategy

The following terms were used to search Medline, Cochrane, EMBASE, and Google Scholar databases until August 3, 2016: cataract, posterior capsule opacification, intraocular lens. Eligible studies included randomized controlled trials (RCTs), retrospective studies, and cohort studies. In addition, references of papers were hand-searched to identify other potential studies.

Studies had to have evaluated patients >18 years of age who had age-related (senile) cataracts and who had undergone cataract surgery that included either a hydrophobic or hydrophilic intraocular lens (1, 2, or 3 pieces). Eligible studies had to have reported quantitatively outcomes of interest. Excluded studies included case series, case reports, letters, comments, and personal communications. Studies that investigated patients with congenital cataract or traumatic cataract, or who studied pediatric patients were excluded. Studies were identified and considered for inclusion and the data were extracted by 2 independent reviewers, and a third reviewer was consulted to decide any differences in opinions.

2.2. Study selection and data extraction

The following information/data were extracted from studies that met the inclusion criteria: the name of the first author, year of publication, study design, number of patients in each group, patient age and gender, and the major outcomes.

2.3. Quality assessment

The quality of the included studies was assessed using the Cochrane Collaboration tool for assessing risk of bias.[13]

2.4. Outcome measures

The primary outcomes were Nd:YAG laser capsulotomy rate, PCO score (subjective, estimated, and objective), and visual acuity.

2.5. Statistical analysis

Study characteristics were summarized as mean, mean ± standard deviations (SD), mean (range: min., max.), or median (min., max.) for continuous variables and n (%) for gender. The primary outcomes were summarized as n or n (%) for categorical data and mean ± SD or mean (range: min, max) or median (interquartile range, IQR: 1st and 3rd quartiles) or mean with P values for continuous data. An effect size, odds ratio (OR) with corresponding 95% confidence intervals (95% CIs) for categorical data and difference in means with 95% CI for continuous data were calculated for each individual study and for all studies combined.

For Nd:YAG capsulotomy rate, OR >1 indicated patients with hydrophobic treatment had a higher rate than patients who received hydrophilic treatment; OR < 1 indicated patients with hydrophobic treatment had a lower rate of Nd:YAG capsulotomy than those with hydrophilic treatment; OR = 1 indicated the Nd:YAG capsulotomy rate was similar between treatments. For PCO score and visual acuity, a difference in means >0 indicated patients with hydrophobic treatment had higher PCO score or visual acuity than patients with hydrophilic treatment; a difference in means < 0 indicated patients with hydrophobic treatment had lower values than those with hydrophilic treatment; and a difference in means of 0 indicated the PCO score and visual acuity were similar between lens types.

A χ^2 test for homogeneity was conducted, and an inconsistency index (I^2) and Q statistics were determined. If the I^2 statistic was >50%, a random-effects model (DerSimonian–Laird method) was used. Otherwise, a fixed-effects model (Mantel–Haenszel method) was employed. Combined effects were calculated, and a 2-sided P value of <.05 was considered significant. A sensitivity analysis was conducted using a leave-one-out approach. Publication bias was not performed due to <10 studies being included in the meta-analyses.[14] All data were arranged using MicrosoftOffice Excel2007 (Microsoft Corp, Redmond, WA) and all analyses performed using Comprehensive Meta-Analysis statistical software, version 2.0 (Biostat, Englewood, NJ).

2.6. Ethics

This study did not involve human subjects, so informed consent was not required. In addition, no approval was required from an institutional review board.

3. Results

The search identified 503 potential studies, of which 448 were excluded after initial abstract and title review for not meeting the inclusion/exclusion criteria (Fig. 1). Fifty-five studies underwent full-text review and 44 were excluded for not comparing hydrophobic and hydrophilic lenses, not reporting outcomes of interest, being a single-arm study, did not quantitatively compare the 2 types of lenses, and the data could not be analyzed.

A total of 11 studies were included in the study with a total of 889 eyes/patients (Table 1).[3,12,15–23] All included studies were RCTs. The number of patients in each study ranged from 24 to 120. The mean age at the time of the operation ranged from 65.8 to 75 years and the length of follow-up ranged from 1 to 9 years. Among the studies, all intraocular lenses were acrylic and the piece number were either 1 or 3. The optic edge of the intraocular lenses varied across the studies.

Treatment outcomes are summarized in Table 2. In general, the PCO score (i.e., subjective, objective, and estimated score) was lower with hydrophobic intraocular lenses than with hydrophilic lenses for across the studies. In addition, hydrophobic lenses result in lower rate of Nd:YAG capsulotomy than hydrophilic lenses in most of the included studies.

3.1. Meta-analysis

3.1.1. Nd:YAG capsulotomy rate. Eight studies (Chang et al [2017], Shcriefl et al,[21] Iwase et al,[18] Vasavada et al,[19] Kang et al,[20] Kugelberg et al,[16] Kang et al,[15], and Kugelberg et al [3]) reported complete date for rate of Nd:YAG capsulotomy for each type of lens. A random-effects model of analysis was used as high heterogeneity was seen (Q statistic = 19.77, I^2 = 64.6%, P = .006). The overall pooled analysis indicated that the hydrophobic

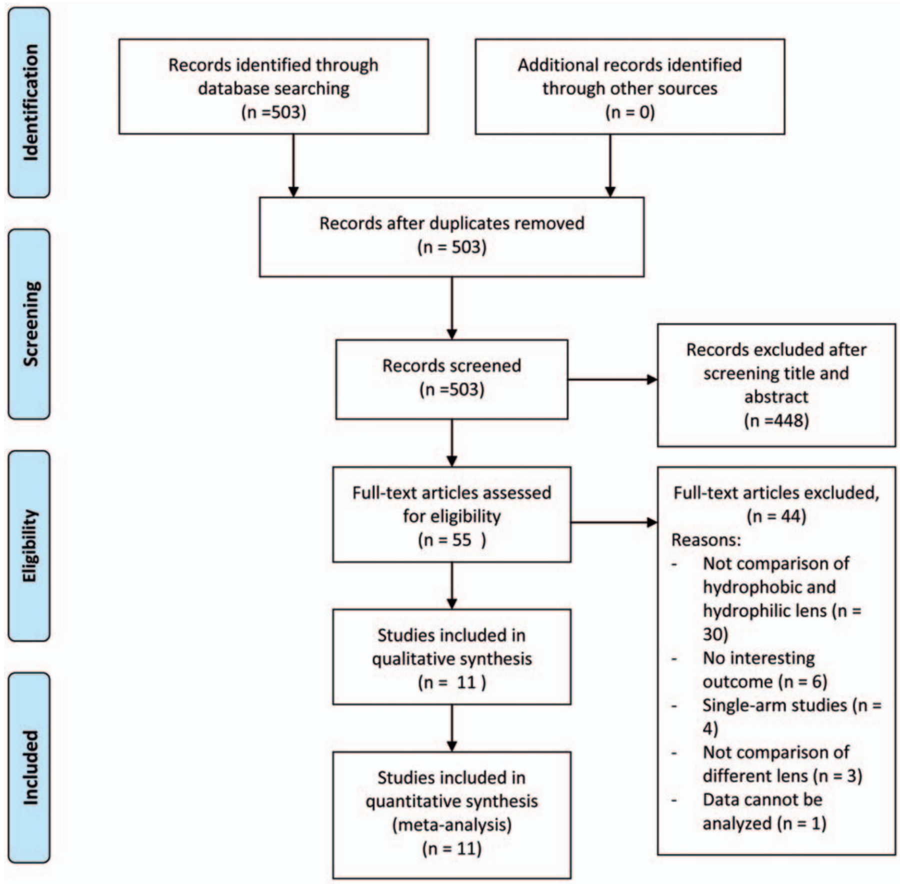


Figure 1. Study selection flow diagram.

intraocular lenses resulted in a lower rate of Nd:YAG capsulotomy than hydrophilic lenses. (OR: 0.38; 95% CI, 0.16–0.91; $P=.029$) (Fig. 2).

3.1.2. PCO score. Two studies had complete data for subjective PCO score (Schriefl et al[21] and Gangwani et al[23]), 5 had full data for objective PCO score (Chang et al [2016], Schreifl et al [2015], Kang et al,[20] Kang et al,[15] and Healy et al [2005]) and 2 (Schriefl et al[21] and Vasavada et al[19]) reported complete data for estimated PCO score. These studies were included in the pooled analysis. A random effect model was performed due to the presence of large heterogeneity in the data (subjective PCO score: Q statistic=2.39, $I^2=58.26\%$, $P=.122$; objective PCO score: Q statistic=44.37, $I^2=90.99\%$, $P<.001$; estimated PCO score: Q statistic=7.90, $I^2=87.34\%$, $P=.005$). Pooled analysis found that hydrophobic lenses were associated with lower subjective PCO score (diff. in means: −1.32, 95% CI=−2.39 to −0.25, $P=.015$) and estimated PCO score (diff. in means: −2.23; 95% CI, −3.80 to −0.68, $P=.005$) as compared with hydrophilic intraocular lenses. Objective PCO score was similar between lens types. (diff. in means: −0.075; 95% CI, −0.18 to 0.035; $P=.182$) (Fig. 3).

3.1.3. Visual acuity (LogMAR). Six studies (Chang et al [2016], Schriefl et al,[21] Kang et al,[20] Cleary et al,[17] Kugelberg et al,[16] and Kang et al[15]) reported full data for visual acuity and were included in the analysis. A random effect model was performed due to the high degree of heterogeneity observed in the data (Q statistic=49.16, $I^2=89.83\%$, $P<.001$). Pooled analysis found that visual acuity was similar between hydrophobic and hydrophilic intraocular lenses (diff. in means: −0.016; 95% CI, −0.041 to 0.009, $P=.208$) (Fig. 4).

3.2. Sensitivity analysis

Sensitivity analysis was performed using the leave-one-out approach in which separated meta-analyses were done with each study is left out in turn. The direction and magnitude of the combined estimates did not markedly differ with the removal of and one study (Supplemental Figure 1, 2, 3, http://links.lww.com/MD/B923) indicating that the meta-analysis had good reliability and that the data were not overly influenced by any study.

3.3. Quality assessment

All 11 included studies were RCTs and used random sequence generation for randomization of patients (Fig. 5). The 11 studies had no selective reporting and low risk of reporting bias. However, only 4 studies had allocation concealment and 3 used double blinding. Six studies had no incomplete outcome data and had a low risk of attrition bias. None of the studies used intent-to-treat analysis. Overall, the studies were of good quality.

4. Discussion

PCO is a common long-term complication of cataract surgery. Intraocular lens design and material have been implicated in influencing the development of PCO. The current study, which

Table 1

Summary of the clinical characteristics of enrolled studies.

Ref.	Study design	Bilateral/ unilateral	n (eyes/patients)	Group	IOL			Mean age, y	Male (%)	Length of follow-up, y
					Piece number	Optic material	Optic edge			
Chang (2016)	RCT	Unilateral	60/60	Hydrophobic	NA	Acrylic	sharp-edged	73.4	38%	9
			60/60	Hydrophilic				72.1		
Schriefl et al[21]	RCT	Bilateral	60/60	Hydrophobic	3	Acrylic	Square edge	75	32%	4
			60/60	Hydrophilic	1					
Gangwani et al[23]	RCT	Bilateral	35/35	Hydrophobic	1	Acrylic	6.0 mm optic diameter	72	NA	4
			35/35	Hydrophilic-hydrophobic copolymer						
Iwase et al[18]	RCT	Bilateral	63/63	Hydrophobic	1	Acrylic	Double-square-edged	73.4	32%	4
			63/63	Hydrophilic						
Vasavada et al[19]	RCT	Bilateral	33/33	Hydrophobic	1	Acrylic	Sharp square edge	65.8	70%	3
			33/33	Hydrophilic		Acrylic				
			31/31	Hydrophobic		Acrylic	Sharp square edge	67.3	65%	3
			31/31	Hydrophilic		Polyhydroxyl copolymer	Double-squared edge			
Cleary et al[17]	RCT	Bilateral	24/24	Hydrophobic	3	Acrylic	NA	73.5	46%	2
			24/24	Hydrophilic	1					
Kang et al[20]	RCT	Unilateral, simple cataract group	28/28	Hydrophilic	3	Acrylic	Double squared edge	68.2	NA	1
			30/30	Hydrophobic			Double round edge			
		Unilateral, complicated cataract group	37/37	Hydrophilic			Double squared edge	67.1		
			39/39	Hydrophobic			Double round edge			
Kang et al[15]	RCT	Unilateral	50/50	Hydrophobic	3	Acrylic	NA	66.5	46%	1
			50/50	Hydrophilic				69.5	42%	
Kugelberg et al[16]	RCT	Unilateral	58/60	Hydrophobic	1	Acrylic	NA	72	32%	2
			57/60	Hydrophilic				73	46%	
Kugelberg et al[3]	RCT	Unilateral	59/59	Hydrophobic	1	Acrylic	Square-edged	73	NA	1
			57/57	Hydrophilic				72		
Heatley et al[12]	RCT	Bilateral	53/53	Hydrophobic	1	Acrylic	NA	NA	NA	1
			53/53	Hydrophilic						

RCTs = randomized controlled trial.

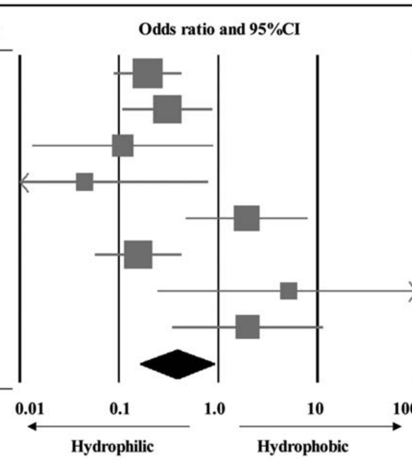
Table 2

Summary of the results of PCO scores, visual acuity, and Nd:YAG capsulotomy among the enrolled studies.

Ref.	hydrophobic/ hydrophilic	Subjective PCO score	Objective PCO score	Estimated PCO score	CDVA or BDVA, best corrected distance visual acuity (logMAR)	Nd:YAG capsulotomy, n (%)
Chang (2016)	Hydrophobic	NA	Median = 0.26 (IQR: 0–3)	NA	Median = 0 (IQR: -0.08 to 0.13)	17/60 (28%)
	Hydrophilic		Median = 3 (IQR:1–3)		Median = 0 (IQR: −0.08 to 0.11)	40/60 (67%)
Schriefl et al[21]	Hydrophobic	20 mo: 0.9 ± 1.2 4 y: 1.9 ± 2.0	20 mo: 1.2 ± 1.4 4 y: 2.0 ± 2.0	4 y: 2.4 ± 2.4	4 y: median = 0.097 (range: 0–0.22)	20 mo: 4/39 (10%) 4 y: 17/34 (50%)
	Hydrophilic	20 mo: 2.3 ± 2.1 4 y: 3.7 ± 3.0	20 mo: 2.1 ± 1.8 4 y: 3.0 ± 2.2	4 y: 5.5 ± 3.7	4 y: median = 0.2 (range: 0–1.0)	20 mo:12/39 (31%) 4 y: 26/34 (77%)
Gangwani et al[23]	Hydrophobic	1.9 ± 1.9	NA	NA	NA	NA
	Hydrophilic-Hydrophobic copolymer	2.6 ± 2.0				
Iwase et al[18]	Hydrophobic	NA	NA	NA	NA	2 y: 1 (2%)
	Hydrophilic					2 y: 8 (13%)
Vasavada et al[19]	Hydrophobic	NA	NA	1 mo: 0.00 ± 0.08 1 y: 0.02 ± 0.11 2 y: 0.02 ± 0.14 3 y: 0.03 ± 0.52	3 y: 0.18 (20/30)	0
	Hydrophilic (Group C)	NA	NA	1 mo: 0.00 ± 0.20 1 y: 0.23 ± 0.47 2 y: 0.46 ± 1.21 3 y: 0.93 ± 1.37	3 y: 0.30 (20/40)	4/31 (12.9%)
	Hydrophobic	NA	NA	1 mo: 0.00 ± 0.11 1 y: 0.01 ± 0.32 2 y: 0.00 ± 0.13 3 y: 0.01 ± 0.14	3 y: 0.18 (20/30)	0
	Hydrophilic (group A)	NA	NA	1 mo: 0.00 ± 0.14 1 y: 0.31 ± 0.49 2 y: 1.30 ± 1.35 3 y: 2.18 ± 1.45	3 years: 0.40 (20/50)	5/31 (16.1%)
Cleary et al[17]	Hydrophobic	NA	NA	NA	6 mo: 0.004 ± 0.092 12 mo: 0.005 ± 0.110 24 mo: − 0.009 ± 0.093	
	Hydrophilic	NA	NA	NA	6 mo: 0.031 ± 0.091 12 mo: 0.040 ± 0.094 24 mo: 0.023 ± 0.107	
Kang et al[20]	Hydrophilic	NA	0.081 ± 0.043	NA	0.029 ± 0.094	1 (3.6%)
	Hydrophobic		0.075 ± 0.052		0.031 ± 0.089	2 (6.7%)
	Hydrophilic		0.181 ± 0.108		0.232 ± 0.210	2 (5.4%)
	Hydrophobic		0.110 ± 0.141		0.270 ± 0.240	4 (10.3%)
Kang et al[15]	Hydrophobic	NA	Mean = 0.076, P = .288	NA	Baseline: 0.582 ± 0.366 6 mo: 0.046 ± 0.086 12 mo: 0.034 ± 0.077 P = .554	2 (4%)
	Hydrophilic		Mean = 0.041		baseline:0.592 ± 0.407 6 mo: 0.039 ± 0.062 12 mo: 0.032 ± 0.082	0 (0%)
Kugelberg et al[16]	Hydrophobic	NA	NA	NA	−0.017 ± 0.099	6/58 (10%)
	Hydrophilic				0.051 ± 0.14	24/57 (42%)
Kugelberg et al[3]	Hydrophobic	NA	Median = 0.055 (P < .001)	NA	NA	4 (6.8%)
	Hydrophilic		Median = 0.18			2 (3.5%)
Heatley et al[12]	Hydrophobic	NA	0.08 ± 0.13	NA	NA	NA
	Hydrophilic		0.12 ± 0.14			

BDVA = best distance visual acuity, CDVA = corrected distance visual acuity, Nd:YAG = neodymium-doped yttrium aluminum garnet, PCO = posterior capsule opacification.

Study name First author (year)	Hydrophilic (n/N)	Hydrophobic (n/N)	Odds ratio	Lower limit	Upper limit	Z-value	p-value	Relative weight
Chang (2016)	40/60	10/60	0.198	0.091	0.430	-4.090	0.000	18.83
Schriefl (2015)	26/34	17/34	0.308	0.109	0.870	-2.223	0.026	16.80
Iwase (2011)	8/63	1/63	0.111	0.013	0.915	-2.043	0.041	9.52
Vasavada (2011)	9/64	0/64	0.045	0.003	0.796	-2.116	0.034	6.42
Kang (2009)	3/65	6/69	1.968	0.471	8.221	0.928	0.353	13.79
Kugelberg (2008)	24/57	6/58	0.159	0.059	0.429	-3.625	0.000	17.14
Kang (2008)	0/50	2/50	5.206	0.244	111.238	1.056	0.291	5.83
Kugelberg (2006)	2/57	4/59	2.000	0.352	11.372	0.782	0.434	11.67
Combined effect			**0.384**	**0.162**	**0.909**	**-2.177**	**0.029**	

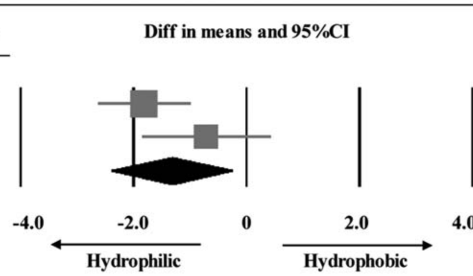


Heterogeneity test: Q-value = 19.77, df=7, p-value=0.006, I-squared=64.6%

Abbreviations: n, number of eyes had Nd:YAG capsulotomy; N, number of total eyes at the last follow-up; CI, confidence intervals (lower and upper limit) of Odds ratio.

Figure 2. Forrest plot of Nd:YAG capsulotomy rate of patients received hydrophobic and hydrophilic lens.

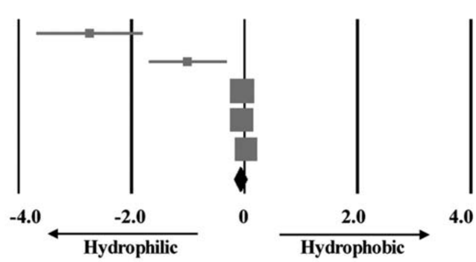
Study name First author (year)	Diff. in means	Standard error	Lower limit	Upper limit	Z-value	P-value	Relative weight
Subjective PCO score							
Schriefl (2015)	-1.800	0.417	-2.618	-0.982	-4.313	0.000	56.48
Gangwani (2011)	-0.700	0.575	-1.827	0.427	-1.217	0.224	43.52
Combined effect	**-1.321**	**0.545**	**-2.390**	**-0.252**	**-2.423**	**0.015**	



A

Heterogeneity test: Q-value = 2.396, df=1, p-value=0.122, I-squared=58.26%

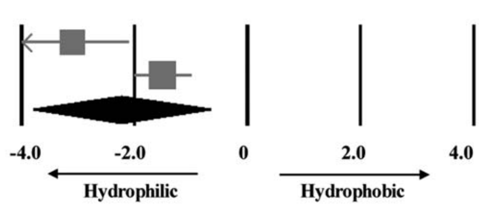
Study name First author (year)	Diff. in means	Standard error	Lower limit	Upper limit	Z-value	P-value	Relative weight
Objective PCO score							
Chang (2016)	-2.740	0.479	-3.679	-1.801	-5.720	0.000	1.32
Schriefl (2015)	-1.000	0.348	-1.681	-0.319	-2.876	0.004	2.42
Kang (2009)	-0.037	0.002	-0.041	-0.034	-20.889	0.000	34.17
Heatley (2005)	-0.040	0.028	-0.095	0.015	-1.420	0.156	31.47
Kang (2008)	0.035	0.033	-0.029	0.099	1.068	0.285	30.62
Combined effect	**-0.075**	**0.056**	**-0.185**	**0.035**	**-1.336**	**0.182**	



B

Heterogeneity test: Q-value = 44.37, df=4, p-value<.001, I-squared=90.99%

Study name First author (year)	Diff. in means	Standard error	Lower limit	Upper limit	Z-value	P-value	Relative weight
Estimated PCO score							
Schriefl (2015)	-3.100	0.510	-4.100	-2.100	-6.078	0.000	46.16
Vasavada (2011)	-1.501	0.252	-1.996	-1.006	-5.945	0.000	53.84
Combined effect	**-2.239**	**0.797**	**-3.802**	**-0.677**	**-2.809**	**0.005**	



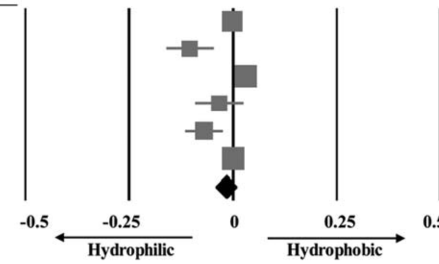
C

Heterogeneity test: Q-value = 7.90, df=1, p-value=0.005, I-squared=87.34%

Abbreviations: CI, confidence intervals (lower and upper limit) of difference in means.

Figure 3. Forrest plot of difference in means of subjective PCO score (A), objective PCO score (B), and estimated PCO score (C) of patients received hydrophobic and hydrophilic lens.

Study name First author (year)	Diff. in means	Standard error	Lower limit	Upper limit	Z-value	P-value	Relative weight
Chang (2016)	0.000	0.012	-0.023	0.023	0.000	1.000	19.68
Schriefl (2015)	-0.103	0.029	-0.159	-0.047	-3.596	0.000	10.72
Kang (2009)	0.032	0.006	0.021	0.043	5.594	0.000	22.42
Cleary (2009)	-0.032	0.029	-0.089	0.025	-1.106	0.269	10.60
Kugelberg (2008)	-0.068	0.023	-0.112	-0.024	-3.012	0.003	13.50
Kang (2008)	0.002	0.003	-0.005	0.009	0.594	0.553	23.09
Combined effect	**-0.016**	**0.013**	**-0.041**	**0.009**	**-1.260**	**0.208**	



Heterogeneity test: Q-value = 49.16, df=5, p-value<.001, I-squared=89.83%

Abbreviations: Diff, difference; CI, confidence intervals (lower and upper limit) of difference in means.

Figure 4. Forrest plot of difference in means of visual acuity of patients received hydrophobic and hydrophilic lens.

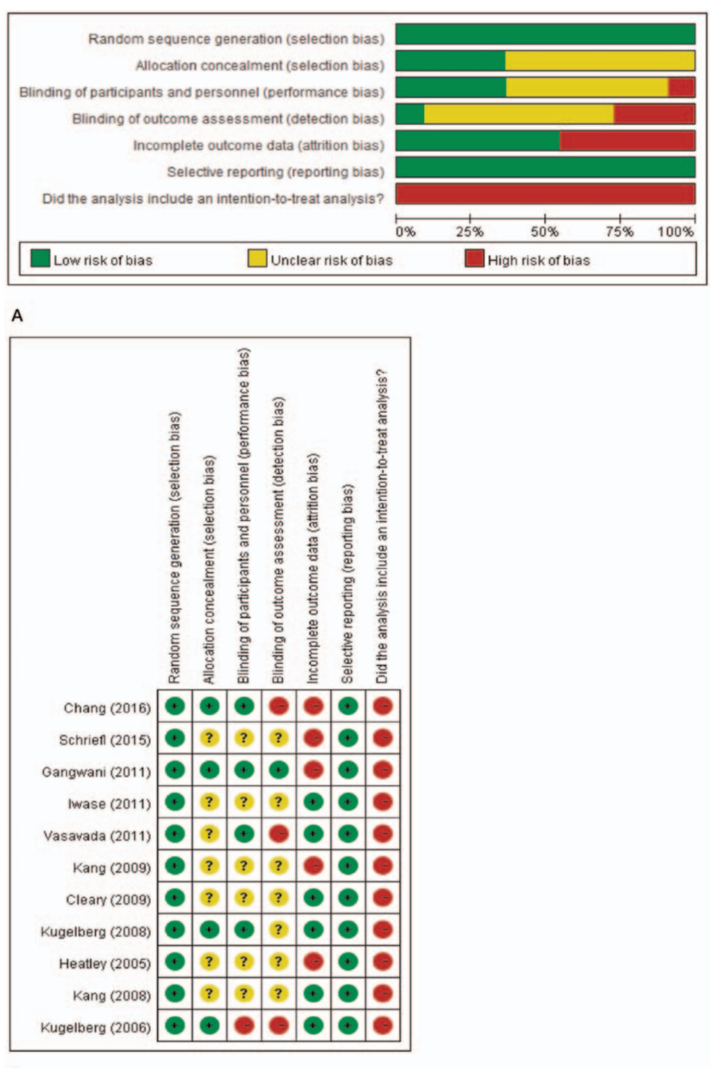


Figure 5. Quality assessment.

included only RCTs, was an updated evaluation of the association of hydrophobic and hydrophilic intraocular lenses on preventing PCO and reducing Nd:YAG laser capsulotomy rate. The overall pooled analysis found that hydrophobic lenses had lower rate Nd:YAG laser capsulotomy than hydrophilic treatment. (OR = 0.38; $P = .029$). Hydrophobic lenses compared with hydrophilic lenses were also associated with better (lower) subjective and estimated PCO score ($P \leq .015$). The objective PCO score and visual acuity were similar between lens types ($P \geq .182$).

The findings of the current study are consistent with a prior meta-analysis that assessed the effect of hydrophilic and hydrophobic acrylic intraocular lens on posterior capsule opacification.[10] The study of Li et al[10] included 9 RCTs with a total of 861 eyes. They found that the hydrophobic acrylic intraocular lens showed benefit with respect to PCO severity at 1-year (standard mean diff: 1.72; $P = .0002$) and 2-year (standard mean diff: 1.79; $P < .0001$) follow-up. Hydrophilic acrylic lenses were associated with about a 7-fold higher risk of Nd:YAG laser capsulotomy than hydrophobic acrylic lenses; the pooled relative risk of Nd:YAG laser capsulotomy rates 2 years postsurgery was 6.96 (hydrophilic vs hydrophobic; $P < .00001$).

Another prior meta-analysis also found the rates of PCO and Nd:YAG laser capsulotomy was influenced by different intraocular lens biomaterial.[1] The study of Cheng et al[1] included 23 RCTs and compared the effect of acrylic, polymethylmethacrylate, hydrogel, silicone, and PMMA lenses. They also examined sharp and rounded-edge designs. The study found that acrylic and silicone intraocular lenses were more effective than PMMA and hydrogel lenses in lowering the rates of Nd:YAG laser capsulotomy and PCO. In addition, they found that sharp optic edges were superior at lowering PCA and the rate or Nd:YAG laser capsulotomy than lenses with round-edge design. In contrast, a meta-analysis performed by Findl et al, [11] which included 66 studies, found no influence of the intraocular lens optic material (i.e., PMMA, hydrogel, hydrophobic acrylic, and silicone) on the development of PCO, although they did observe that silicone-based lenses tended to have lower PCO scores and hydrogel higher PCO scores than the other materials.

The molecular and cellular reasons for the difference in effectiveness between hydrophobic and hydrophilic intraocular lenses are not well understood. The difference may at least in part involve the fact that hydrophobic intraocular lens can adhere to collagen membrane resulting in tight opposition of the lens in the posterior capsular bag, and increased adhesiveness through fibronectin.[12,24] These molecular interactions may result in less space between the intraocular lens and posterior capsule where the lens epithelial cells migrate.[10] In addition, the hydrophilic surface properties have been shown to promote proliferation and migration of lens epithelial cells from the equatorial area to the visual region.[25] Hydrophilic intraocular lenses were also found to have less sharp edges, possibly due to manufacturing methods, which may also increase PCO.[18,26]

The study has several limitations. One limitation is the small sample of included studies. In addition, the studies themselves had small patient populations. The follow-up time varied across studies that may have impacted the findings, as PCO and Nd:YAG laser capsulotomy rate are influenced by length of time following surgery.[10] Also, the lenses differed with respect to edge design, which may have influenced the findings as edge design has been found to impact PCO and Nd:YAG laser capsulotomy rate.[1] Long-term randomized controlled studies, with large sample sizes, are needed to further evaluate the effects of various intraocular lens biomaterials on PCO and the rate of Nd:YAG capsulotomy.

In conclusion, hydrophobic intraocular lenses may have lower Nd:YAG capsulotomy rate and lower subjective and estimated PCO score as compared with hydrophilic intraocular lenses. Further studies are needed to further explore this issue.

References

[1] Cheng JW, Wei RL, Cai JP, et al. Efficacy of different intraocular lens materials and optic edge designs in preventing posterior capsular opacification: a meta-analysis. Am J Ophthalmol 2007;143:428–36.

[2] Schaumberg DA, Dana MR, Christen WG, et al. A systematic overview of the incidence of posterior capsule opacification. Ophthalmology 1998;105:1213–21.

[3] Kugelberg M, Wejde G, Jayaram H, et al. Posterior capsule opacification after implantation of a hydrophilic or a hydrophobic acrylic intraocular lens: one-year follow-up. J Cataract Refract Surg 2006;32:1627–31.

[4] Buehl W, Findl O. Effect of intraocular lens design on posterior capsule opacification. J Cataract Refract Surg 2008;34:1976–85.

[5] Buehl W, Findl O, Menapace R, et al. Long-term effect of optic edge design in an acrylic intraocular lens on posterior capsule opacification. J Cataract Refract Surg 2005;31:954–61.

[6] Findl O, Menapace R, Sacu S, et al. Effect of optic material on posterior capsule opacification in intraocular lenses with sharp-edge optics: randomized clinical trial. Ophthalmology 2005;112:67–72.

[7] Beltrame G, Salvetat ML, Chizzolini M, et al. Posterior capsule opacification and Nd:YAG capsulotomy rates after implantation of silicone, hydrogel and soft acrylic intraocular lenses: a two-year follow-up study. Eur J Ophthalmol 2002;12:388–94.

[8] Hollick EJ, Spalton DJ, Ursell PG, et al. The effect of polymethylmethacrylate, silicone, and polyacrylic intraocular lenses on posterior capsular opacification 3 years after cataract surgery. Ophthalmology 1999;106:49–54; discussion 54–55.

[9] Apple DJ, Peng Q, Visessook N, et al. Eradication of posterior capsule opacification: documentation of a marked decrease in Nd:YAG laser posterior capsulotomy rates noted in an analysis of 5416 pseudophakic human eyes obtained postmortem. Ophthalmology 2001;108:505–18.

[10] Li Y, Wang J, Chen Z, et al. Effect of hydrophobic acrylic versus hydrophilic acrylic intraocular lens on posterior capsule opacification: meta-analysis. PLoS One 2013;8:e77864.

[11] Findl O, Buehl W, Bauer P, et al. Interventions for preventing posterior capsule opacification. Cochrane Database Syst Rev 2010;Cd003738.

[12] Heatley CJ, Spalton DJ, Kumar A, et al. Comparison of posterior capsule opacification rates between hydrophilic and hydrophobic single-piece acrylic intraocular lenses. J Cataract Refract Surg 2005;31:718–24.

[13] Cochrane Handbook for Systematic. Reviews of Interventions. Version 5.1.0. (updated March, 2011). The Cochrane Collaboration. Available at: http://www.mrc-bsu.cam.ac.uk/cochrane/handbook/. Accessed Aug 4, 2016.

[14] Sutton AJ, Duval SJ, Tweedie RL, et al. Empirical assessment of effect of publication bias on meta-analyses. BMJ 2000;320:1574–7.

[15] Kang S, Kim MJ, Park SH, et al. Comparison of clinical results between heparin surface modified hydrophilic acrylic and hydrophobic acrylic intraocular lens. Eur J Ophthalmol 2008;18:377–83.

[16] Kugelberg M, Wejde G, Jayaram H, et al. Two-year follow-up of posterior capsule opacification after implantation of a hydrophilic or hydrophobic acrylic intraocular lens. Acta Ophthalmol 2008;86:533–6.

[17] Cleary G, Spalton DJ, Hancox J, et al. Randomized intraindividual comparison of posterior capsule opacification between a microincision intraocular lens and a conventional intraocular lens. J Cataract Refract Surg 2009;35:265–72.

[18] Iwase T, Nishi Y, Oveson BC, et al. Hydrophobic versus double-square-edged hydrophilic foldable acrylic intraocular lens: effect on posterior capsule opacification. J Cataract Refract Surg 2011;37:1060–8.

[19] Vasavada AR, Raj SM, Shah A, et al. Comparison of posterior capsule opacification with hydrophobic acrylic and hydrophilic acrylic intraocular lenses. J Cataract Refract Surg 2011;37:1050–9.

[20] Kang S, Choi JA, Joo CK. Comparison of posterior capsular opacification in heparin-surface-modified hydrophilic acrylic and hydrophobic acrylic intraocular lenses. Jpn J Ophthalmol 2009;53:204–8.

[21] Schriefl SM, Menapace R, Stifter E, et al. Posterior capsule opacification and neodymium:YAG laser capsulotomy rates with 2 microincision intraocular lenses: four-year results. J Cataract Refract Surg 2015;41:956–63.

[22] Chang A, Kugelberg M. Posterior capsule opacification 9 years after phacoemulsification with a hydrophobic and a hydrophilic intraocular lens. Eur J Ophthalmol 2017;27:164–8.

[23] Gangwani V, Hirnschall N, Koshy J, et al. Posterior capsule opacification and capsular bag performance of a microincision intraocular lens. J Cataract Refract Surg 2011;37:1988–92.

[24] Nagata T, Minakata A, Watanabe I. Adhesiveness of AcrySof to a collagen film. J Cataract Refract Surg 1998;24:367–70.

[25] Dorey MW, Brownstein S, Hill VE, et al. Proposed pathogenesis for the delayed postoperative opacification of the hydroview hydrogel intraocular lens. Am J Ophthalmol 2003;135:591–8.

[26] Hancox J, Spalton D, Cleary G, et al. Fellow-eye comparison of posterior capsule opacification with AcrySof SN60AT and AF-1 YA-60BB blue-blocking intraocular lenses. J Cataract Refract Surg 2008;34:1489–94.