# Phacotrabeculectomy vs Phacoemulsification Glaucoma coexist Cataracts: a Meta-analysis of randomized controlled trials

**Tangshou Xie** ( xts183@sina.com )
The Affiliated Nanping First Hospital of Fujian Medical University
**Xi Liu**
The Affiliated Nanping First Hospital of Fujian Medical University
**Wenrong Rao**
The Affiliated Nanping First Hospital of Fujian Medical University
**Jie Zhu**
The Affiliated Nanping First Hospital of Fujian Medical University

**Research Article**

**Keywords:** Phacotrabeculectomy, Phacoemulsification, Glaucoma, Cataract, Meta-analysis

**Posted Date:** June 17th, 2022

**DOI:** https://doi.org/10.21203/rs.3.rs-1759773/v1

## Abstract

**Purpose**: For analysis, clinical outcomes of phacotrabeculectomy versus phacoemulsification in glaucoma coexist cataracts.

**Methods**: we screened only randomized controlled trials comparing clinical outcomes of Phacotrabeculectomy versus Phacoemulsification published before October 2021. Then, we pooled qualified articles for meta-analysis. We estimated pooled weighted mean difference and risk ratio with 95% conference intervals. We conducted fixed-effects models in this meta-analysis.

**Results**: We pooled 10 randomized controlled trials to Meta-analysis. Phacotrabeculectomy has a superior effect in postoperatively intraocular pressure and postoperative anti-glaucoma medications versus phacoemulsification, but an equal effect in best-corrected visual acuity. The complication ratio of phacotrabeculectomy is higher than phacoemulsification. Our article just presented all views of visual fields of included articles because of insufficient data to analyze.

**Conclusions**: Phacotrabeculectomy is more efficient compared to phacoemulsification in glaucoma coexisting cataracts.


## Introduction

Glaucoma is characterized by cupping the disc, apoptotic degeneration of retinal ganglion cells, and corresponding vision loss. Based on anterior chamber anatomic status monitored by gonioscopy examination, we can classify it into open-angle glaucoma and angle-closure glaucoma, and primary angle-closure is intraocular pressure increase because of pupil block. For the pasted four decades, it conducted Phacotrabeculectomy widespread in glaucoma, contributing to one procedure double proceed in ophthalmologist expectation. The Phacotrabeculectomy, also known as a triple procedure, comprises Phacoemulsification, lens implantation, and Trabeculectomy in one procedure, which aims to remove lens obstacles, improve visual acuity, and decline intraocular pressure. Comparatively, the Phacoemulsification only removes the lens, and the deepens anterior chamber. Today, both procedures are technically mature. Ophthalmologists still discuss the issue that “Phacotrabeculectomy or Phacoemulsification, which one is a superior choice for glaucoma coexisting cataract patients?”. We conducted this meta-analysis to compare the effectiveness and safety of Phacotrabeculectomy with phacoemulsification in glaucoma coexisting cataracts by clinical outcomes.

## Materials And Methods

# Research strategy

The deadline for screening published articles is October 2021.MESH Terms include ‘Phacoemulsification’ and ‘Phacotrabeculectomy’. We screened published articles on clear lens extraction to phacoemulsification in case some of them slipped the net. Identically, ‘Trabectome’, ‘ab interno’, ‘ab externo’, and ‘triple procedure’ were added to the screen based on the key phrase ‘Phacotrabeculectomy’ to avoid articles that should be included in our analysis. We identified by a literature search in the following databases: PubMed, Medline, EMBASE, and Cochrane library. Manual research reference of the included articles, as another path to gain additional studies.

# Selection criteria

Including criteria: (1): patients with a confirmed diagnosis of glaucoma or primary angle-closure; (2): surgical technologies, including Phacotrabeculectomy as the experimental group, and Phacoemulsification as a controlled group; (3): clinical outcomes include intraocular pressure, anti-glaucoma medications, complications, best-corrected visual acuity, and visual field; (4): randomized controlled trials only.

Exclusion criteria: (1): articles do not use trabeculectomy technology and phacoemulsification technology; (2): articles data merged through a published search by the same research team; (3): articles do not report one of the following intraocular pressure, anti-glaucoma medications, complications, best-corrected visual acuity, and visual field; (4): the follow-up time is less than 12 months.

# Outcomes

intraocular pressure, anti-glaucoma medications, complications, best-corrected visual acuity, and visual field were in our view. Statistics of these outcomes will be pooled to analyze if they are acceptable and amalgamated.

# Statistics analysis

Mean ± standard deviation presented intraocular pressure, anti-glaucoma medications, best-corrected visual acuity, and visual field. Risk ratios presented complications. We use the fixation model in this article. We used heterogeneity between studies $I^2$ statistic and we used subgroup analysis to minimize heterogeneity. Publication bias was evaluated by Egger’s test and assessed visually by funnel plot, and we do not evaluate publication bias when studies are less than 10. A value of $P < 0.05$ was considered statistically significant. All statistical analyzes are conducted in STATA.

## Results

The research strategy is shown in Fig. 1. We screened the potential studies ending up in October 2021. 51 studies were identified through database searching. After 26 duplicate records were removed, we screened 25 studies. Through scan titles and abstracts, we excluded 2 comments, 6 non-Phacoemulsification, 1 recorded non-Phacotrabeculectomy, 2 non-randomized controlled trials, and 1 just recorded anterior chamber depth, and 3

republications of merged data. We divided 1 study into ab interno group which was conducted by Kahook-Dual blade technique. Finally, we pooled 10 studies to the final Meta-analysis[1–10]. Characteristics of the included studies is shown in Table 1. Quality assessment of included studies shown in Table 2.

Table 1
Characteristics of the included studies

| Author | Region | Year | Type | Age | | Cases | | Glaucoma | Procedure | | Follow-up | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Phacotrab[z,1] | Phaco[y,2] | Phacotrab | Phaco | | Phacotrab | Phaco | Phacotrab | Phaco |
| Yasmine | Eygpt | 2019 | RCT[x,3] | 57.3 ± 8.3 | 58.8 ± 8.4 | 31 | 32 | PACG[w,4] | phatrab + MMC | Phaco | 16.8 ± 7.5(m[v,5]) | 20.4 ± 6.5(m) |
| Hou | China | 2015 | RCT | 62.38 ± 9.45 | 62.32 ± 8.48 | 24 | 25 | APAC[u,6] | phatrab + MMC | Phaco | 12(m) | 12(m) |
| Allan | Denmark | 1998 | RCT | 57–83 | 77–88 | 10 | 10 | OAG[t,7] | Phatrab | Phaco | 12(m) | 12(m) |
| Tham | China | 2008 | RCT | 71.4 ± 6.6 | 71.9 ± 6.7 | 37 | 35 | CACG[s,8] | phatrab + MMC[r,9] | Phaco | 30.6 ± 5.9(m) | 30.9 ± 8.4(m) |
| Tham | China | 2009 | RCT | 70.4 ± 9.4 | 70.3 ± 7.4 | 24 | 27 | CACG | phatrab + MMC | Phaco | 37.6 ± 10.3(m) | 33.4 ± 10.5(m) |
| Liaska | Athens | 2014 | RCT | 77.0 ± 6.7 | 78.1 ± 7.26 | 29 | 31 | OAG | phatrab + MMC | Phaco | 24(m) | 24(m) |
| Vidya | Saudi Arabia | 2018 | RCT | 61.9 ± 5.7 | 63.7 ± 5.9 | 45 | 46 | PACG | Phatrab | Phaco | 12(m) | 12(m) |
| Howard | Canada | 1993 | RCT | 75.5 | 77.5 | 51 | 51 | POAG[q,10] | ab externo | Phaco | 24(m) | 24(m) |
| Senthil | India | 2021 | RCT | 58.45 ± 9.8 | 61.6 ± 8.9 | 37 | 33 | PACG | Phatrab | Phaco | 2.5 ± 1.8(y[p,11]) | 2.8 ± 2.0(y) |
| Nestor | Spain | 2021 | RCT | 79.4 ± 6.8 | 78.5 ± 6.1 | 21 | 21 | OAG | Phaco | 12(m) | 12(m) | |

[1] Phacotrabeculectomy group;

[2] Phacoemulsification group

[3] Randomized Controlled Trials

[4] Primary angle closure glaucoma

[5] month

[6] Acute primary angle closure

[7] Open angle glaucoma

[8] Chronic angle closure glaucoma

[9] Phacotrabeculectomy+mitomycin

[10] Primary open angle glaucoma

[11] year

[12] Kahook-Dual blade

Table 2
Quality assessment of included studies

| Author | Year | Selection Bias | | Performance Bias | Detection Bias | Attrition Bias | Reporting Bias | Other Bias |
|---|---|---|---|---|---|---|---|---|
| | | random sequence generation | allocation concealment | | | | | |
| Yasmine | 2019 | low[z,1] | low | low | unknown[y,2] | low | low | unknown |
| Hou | 2015 | unknown | unknown | unknown | unknown | low | low | unknown |
| Allan | 1998 | unknown | unknown | unknown | unknown | low | low | unknown |
| Tham | 2008 | low | unknown | low | unknown | low | low | unknown |
| Tham | 2009 | low | unknown | low | unknown | low | low | unknown |
| Liasaka | 2014 | low | low | low | low | low | low | low |
| Vidya | 2018 | low | unknown | unknown | unknown | low | unknown | |
| Howard | 1993 | unknown | unknown | unknown | unknown | low | low | unknown |
| Senthil | 2021 | low | low | low | unknown | unknown | low | unknown |
| Nestor | 2021 | low | low | low | unknown | low | low | low |

[1] Low risk cause bias

[2] Unknown cause bias, Because of insufficient data

[31] High risk cause bias

All included articles have illustrated the symptoms and anterior chamber angle status of patients, just 3 articles recorded visual field which reflects ganglion cell function. Because of insufficient data, we abandoned visual field analysis and just presented views of the included articles. No statistical difference in best-corrected visual acuity, but phacotrabeculectomy is better than phacoemulsification in intraocular pressure, and anti-glaucoma medications. In complications, phacotrabeculectomy is inferior to phacoemulsification. For each target, we used subgroup analysis to minimize heterogeneity.

# Best-corrected Visual Acuity

6 studies pooled in this analysis [1, 2, 4–6, 9] and a fixation effect model was used. We found no significant difference in Best Corrected Visual Acuity (SMD = 0.05, CI: -0.12-0.22, $I^2$=0.0%, P=0.0702).

We conducted a subgroup analysis based on follow-up time. During 1st month, phacotrabeculectomy is inferior to phacoemulsification (SMD = 0.57, CI:0.09 to 0.15). However, when we evaluated best-corrected visual acuity in the 6th month, 12th month, and 24th month, the analysis results were (SMD = 0.05, CI: -0.51 to 0.61), (SMD=-0.04, CI: -0.29 to 0.22, $I^2$=0.0%, P=0.961), and (SMD=-0.02, CI: -0.31 to 0.27, $I^2$=0.0%, P = 0.986) respectively, and we found no difference in both groups.

The subgroup analysis results are the same based on the anterior chamber angle opened or closed. In the angle closed subgroup, the best-corrected visual acuity is (SMD = 0.07, CI: -0.11 to 0.25, $I^2$=0.0%, P=0.621). The angle opened subgroup is (SMD=-0.05, CI: -0.56 to 0.45) based on 1study record of the data. The forest plot of best-corrected visual acuity shown in Fig. 2.

# Intraocular Pressure

We pooled 8 studies to analyze [1–6, 8, 10], and conducted fixation effect model. Phacotrabeculectomy is superior to phacoemulsification in intraocular pressure control (SMD=-0.40, CI: -0.50 to -0.31, $I^2$=19%, P=0.183).

We conducted subgroup analysis based on follow-up time. About results, In 1st month, the analysis result was (SMD=-0.47, CI:-0.73 to -0.21, $I^2$=27%, P=0.250), in 3rd month is (SMD=-0.49, CI:-0.70 to -0.21, $I^2$=9.8%, P = 0.353), in 6th month is (SMD=-0.31, CI: -0.53 to -0.09, $I^2$=27%, P = 0.53), in 9th month is (SMD=-0.42, CI: -0.72 to -0.12, $I^2$=0.0%, P = 0.973), in 12th month is (SMD=-0.25, CI: -0.45 to -0.05, $I^2$=49.5%, P=0.065), and on 24th month is (SMD=-0.57, CI: -0.81 to -0.34, $I^2$=19.2%, P = 0.294). In all follow-up times, the intraocular pressure of the phacotrabeculectomy group is lower than the phacoemulsification group.

The subgroup analysis results are the same based on the anterior chamber angle opened or closed. In the angle closed subgroup, intraocular pressure is (SMD=-0.38, CI: -0.49 to -0.26, $I^2$=8.6%, P=0.347). In the angle opened subgroup is (SMD=-0.47, CI: -0.64 to -0.29, $I^2$=41.5%, P = 0.102). We show the forest plot of intraocular pressure in Fig. 3.

# Anti-glaucoma Medications

5 studies were included in this analysis [1, 3–6], and the fixation effect model was used. In anti-glaucoma medications, the phacotrabeculectomy group was less than the phacoemulsification group (SMD=-0.84, CI: -0.97 to -0.70, $I^2$=44.6%, P=0.028).

We conducted subgroup analysis based on follow-up time. In the 1st month, fewer anti-glaucoma medications applied in the phacotrabeculectomy group (SMD=-0.51, CI: -1.01 to -0.01). Same outcomes on 3rd month (SMD=-0.90, CI:-1.20 to -0.59, $I^2$=23.4%, P=0.271), 6th month (SMD=-0.76, CI: -1.06 to -0.46, $I^2$ =65.2%, P = 0.056), 9th month (SMD=-0.87, CI: -1.24 to -0.50, $I^2$=0.0%, P = 0.810), 12th month (SMD=-0.70, CI: -0.99 to -0.41, $I^2$=74.9%, P = 0.008), and 24th month (SMD=-1.13, CI: -1.44 to -0.82, $I^2$=0.0%, P=0.837). Phacotrabeculectomy groups need fewer anti-glaucoma medications than the phacoemulsification group, and this is significant.

The subgroup analysis results are the same based on whether the anterior chamber angle opened or closed. In the angle closed subgroup, anti-glaucoma medications are (SMD=-0.80, CI: -0.94 to -0.66, $I^2$=45.2%, P=0.034). In the angle opened subgroup is (SMD=-1.27, CI: -1.75 to -0.79, $I^2$=0.00%, P = 0.967). The forest plot of anti-glaucoma medications shown in Fig. 4.

# Visual Field

No statistics of the included studies were pooled and analyzed. Four studies recorded visual fields in the research results. One study showed, of 24 months follow-up, better visual field means deviation in the phacotrabeculectomy group compared to the phacoemulsification group[6]. An explanation, the authors noticed, is maybe the phacotrabeculectomy allows a superior effect 24-hour intraocular pressure control and plays a favorable role in antagonizing postoperatively intraocular spikes. The other three studies[4, 5, 9], contrarily, recorded no difference preoperatively, postoperatively, and between the two groups.

The cup disc ratio is another object to judge ganglion cell damage. Just two articles recorded the vertical cup disc ratio, which was published by the same correspondence author[4, 5]. To prevent potential bias, we did not conduct data statistics but just mention that the vertical cup disc ratio was similar between the two groups preoperatively, 12th month, and 24th -month follow-up points.

# Complications

10 studies were included in this part[1–10]. Complications range from intraoperative complications to postoperative complications. A risk ratio was used, and a fixation effect model was conducted. In complications, the phacotrabeculectomy group had a higher incidence rate than the phacoemulsification group (RR = 4.11, CI: 2.50 to 6.77, $I^2$=27%, P=0.196), which informed that phacoemulsification is a safer technology.

The subgroup analysis results are the same based on the anterior chamber angle opened or closed. In the anterior chamber, angle closed subgroup, complications are (RR = 7.25, CI: 3.04 to 17.30, $I^2$=0.0%, P=0.491). In the angle opened subgroup is (RR=2.44, CI: 1.35 to 4.40, $I^2$=0.0%, P=0.567). The forest plot of complications shown in Fig. 5.

# Publication bias

Egger's test was conducted to evaluate the publication bias and P-value < 0.05 means publication bias. Intraocular pressure (P = 0.874), anti-glaucoma medications (P = 0.116), and complications (P = 0.05) all had no publication bias in the follow-up subgroup analysis. But in angle closed subgroup analysis, publications bias was found in intraocular pressure (P = 0.248) and anti-medications (P = 0.115).

## Discussion

This meta-analysis focused on clinical outcomes, based on 10 randomized controlled trials, showed that the phacotrabeculectomy not only declines intraocular pressure, and fewer anti-glaucoma medications, but also has a high incidence of complications. Meanwhile, both groups have the same effect on postoperative best-corrected visual acuity.

Phacotrabeculectomy has a better effect on postoperative intraocular pressure, as our analysis showed, and fewer anti-glaucoma medications. To minify the heterogeneity, we used subgroup analysis based on the range of follow-up times and the status of the anterior chamber angle.

All subgroup analysis results point out that phacotrabeculectomy is a superior choice to decline intraocular pressure in glaucoma coexisting cataracts compare with phacoemulsification, and we think that may be attributed to adding an aqueous outflow path. This just confirms the results that randomized controlled trials published before[11]. In the anterior chamber depth and trabecular meshwork area, one included study showed that, in primary angle-closure, anterior chamber depth is similar between the phacotrabeculectomy group and phacoemulsification group in 6 months after surgery, and intraocular pressure also no difference in 6 months[2]. Another included study showed both groups have all-time similar postoperative intraocular and angle open quadrants in primary angle-closure glaucoma[9]. This may show two procedures both depth the anterior chamber in angle-closure glaucoma or primary acute angle closed, and more results in angle opened glaucoma are warranted.

Lower intraocular pressure means fewer anti-glaucoma medications, which shows the same result in every subgroup of anti-glaucoma medication analysis. One major reason for the perplex of anti-glaucoma drops implicated one inflammatory mechanism in the development of dry eyes[12]. For the patients' families, choosing an appropriate medical regime can be challenging and various factors like efficacy, safety, cost, and patient compliance must be considered[13]. Our analysis shows that, from early to late, fewer anti-glaucoma medications are applied after the phacotrabeculectomy than the phacoemulsification, which means this may be a better choice for glaucoma patients.

This article is the newest meta-analysis focused on complications. The type of glaucoma is a risk factor. For example, in the authors' area, acute primary angle-closed glaucoma has a higher risk of inducing uveitis, choroidal detachment, and corneal oedema. Inflammation postoperatively in Phacotrabeculectomy is more serious than Phacoemulsification, and more prone to filtering bleb failure. Today, anti-metabolic chemicals such as mitomycin C can reduce fibroblast collagen synthesis and inhibit cell migration and extracellular matrix production so that used widespread[14], but it is hard to

establish dogmatic criteria in glaucoma procedures[15]. According to our experience, to reduce complications, intraocular pressure should be controlled preoperatively and handle all tissues gently in operation, for instance, gentle handling of tissues with non-tooth, non-serrated forceps to minimize tissue trauma and bleeding[16].

Compare with other issues, the best-corrected visual acuity was one of the major reasons that the phacotrabeculectomy was invited in the combined procedure[17]. We found both groups were neck and neck in best-corrected visual acuity. But both procedures contained cataract extirpation and intraocular lens implantation anatomically. According to our analysis, we think it may have other risk factors that affect postoperative best-corrected visual acuity. One study introduces the interesting term “functional visual acuity”, we have reported which conception to be an important method of defining the visual function and correlated well with daily activity, showing the visual acuity of glaucoma patients is related moderately to the foveal threshold[18]. This corresponds to our hypothesis that may be current methods to test visual acuity may not reflect the actual situation of glaucoma patients. On the other aspects, duration of suffering glaucoma and intraocular pressure control under the anti-glaucoma medications before surgery are underlying factors direct this unanticipated result. But currently, the best-corrected visual acuity is still an essential object to evaluate the damage of glaucoma. A Meta-analysis assessing angle-closure glaucoma coexisting cataracts shows the same results in visual acuity evaluation[19].

As a critical factor in monitoring the progression of glaucoma damage, perimetry is so significant that must be a major detector in all kinds of glaucoma surgery. Collateral points are contentious in this article. We think that attributed to the data validity and trustworthiness. Today, although perimetry may be affected by various liabilities like patient cooperation, it is beneficial in long-term follow-up visits after these two procedures. Firstly, except for glaucoma coexisting diabetes, initial surgery is beneficial for glaucoma patients in visual field monitoring[20]. Next, either phacotrabeculectomy or Phacoemulsification alone has a profitable outcome in postoperatively visual fields [21].

## Limitations

The visual field and depth of the retinal nerve fiber layer are important and sensitive factors in discovering the answer. What important but regrettable is, that we still need more statistics to evaluate the two technologies in visual field monitoring. The complication is a negative factor in choosing a procedure, and it should be an aim and fair look at this issue. In the postoperative clinical outcomes, we can not answer the difference by methods of trabeculectomy, including ab interno procedure and ab externo procedure. In a word, this meta-analysis, because of insufficient data, cannot be close to the answer.

## Conclusion

Phacotrabeculectomy is a better choice compared with Phacoemulsification in glaucoma coexisting cataracts.

## Statements & Declarations

**Acknowledgement**: we appreciated all authors’ hard work.

### Funding

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

### Competing interests

The authors have no relevant financial or non-financial interests to disclose.

### Author contributions

All authors contributed to the study's conception and design. Data collection: [Tangshou Xie, Wenrong Rao]. Data analysis: [Tangshou Xie, Xi Liu]. The first draft of the manuscript is: [Tangshou Xie]. Proofreading the article: [Jie Zhu]. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

## References

1. El Sayed YM, Albalkini AS, El Sheikh RH, Osman MA. Mitomycin C-augmented Phacotrabeculectomy Versus Phacoemulsification in Primary Angle-closure Glaucoma: A Randomized Controlled Study. J Glaucoma 2019; 28:911–915.
2. Hou X, Hu D, Cui Z, Zhou J, Cai L, Wang Y. Small-incision phacotrabeculectomy versus phacoemulsification in refractory acute primary angle closure with cataract. BMC Ophthalmol 2015; 15:88.
3. Storr-Paulsen A, Pedersen Jh F, Laugesen C. A prospective study of combined phacoemulsification-trabeculectomy versus conventional phacoemulsification in cataract patients with coexisting open angle glaucoma. Acta Ophthalmol Scand 1998; 76:696–699.
4. Tham CC, Leung DYL, Lam SW, Li FCH, Chiu TYH, Chan JCH, Chan CHY, Poon ASY, Yick DWF, Chi CC et al. Phacoemulsification versus combined phacotrabeculectomy in medically controlled chronic angle closure glaucoma with cataract. Ophthalmology 2008; 115:2167–2173.
5. Tham CC, Leung DYL, Lam SW, Li FCH, Chiu TYH, Chan JCH, Lam DSC, Lai JSM, Lai JS. Phacoemulsification versus combined phacotrabeculectomy in medically uncontrolled chronic angle closure glaucoma with cataracts. Ophthalmology 2009; 116:725–731.
6. Liaska A, Papaconstantinou D, Georgalas I, Koutsandrea C, Theodosiadis P, Chatzistefanou K. Phaco-trabeculectomy in controlled, advanced, open-angle glaucoma and cataract: parallel, randomized clinical study of efficacy and safety. Semin Ophthalmol 2014; 29:226–235.

7. Chelerkar V, Parekh P, Kalyani VKS, Deshpande M, Khandekar R. Comparative Clinical Study of Medically Controlled Nonsevere Chronic Primary Angle-closure Glaucoma with Coexisting Cataract Surgically Managed by Phacoemulsification as against Combined Phacotrabeculectomy. Middle East Afr J Ophthalmol 2018; 25:119–125.
8. Gimbel HV, Meyer D, DeBroff BM, Roux CW, Ferensowicz M. Intraocular pressure response to combined phacoemulsification and trabeculotomy ab externo versus phacoemulsification alone in primary open-angle glaucoma. J. Cataract Refract Surg 1995; 21:653–660.
9. Senthil S, Rao HL, Choudhari N, Garudadri C. Phacoemulsification versus Phacotrabeculectomy in Medically Controlled Primary Angle Closure Glaucoma with Cataract in an Indian Cohort: A randomized controlled trial.. Int Ophthalmol 2021, 10.1007/s10792-021-01997-6.
10. Ventura-Abreu N, García-Feijoo J, Pazos M, Biarnés M, Morales-Fernández L, Martínez-de-la-Casa JM. Twelve-month results of ab interno trabeculectomy with Kahook Dual Blade: an interventional, randomized, controlled clinical study. Graefes Arch for Clin Exp Ophthalmol 2021; 259:2771–2781.
11. Hansapinyo L, Choy BNK, Lai JSM, Tham CC. Phacoemulsification Versus Phacotrabeculectomy in Primary Angle-closure Glaucoma With Cataract: Long-Term Clinical Outcomes. J Glaucoma 2019; 29:15–23.
12. Wong ABC, Wang MTM, Liu K, Prime ZJ, Danesh-Meyer HV, Craig JP. Exploring topical anti-glaucoma medication effects on the ocular surface in the context of the current understanding of dry eye. Ocul Surf 2018; 16:289–293.
13. Chae B, Cakiner-Egilmez T, Desai M. Glaucoma medications. Insight 2013; 38:5–9; quiz 10.
14. Grover DS, Fau. KH, Fellman RL. Historical Considerations and Innovations in the Perioperative Use of Mitomycin C for Glaucoma Filtration Surgery and Bleb Revisions. J Glaucoma 2020; 29:226–235.
15. Wilkins M, Fau IA, Wormald R. Intra-operative mitomycin C for glaucoma surgery. *Cochrane Database of Syst Rev* 2005; 2005:CD002897.
16. Gosiengfiao DH, Latina MA. Avoiding complications in combined phacotrabeculectomy. Semin Ophthalmol 2002; 17:138–143.
17. Lyle WA, Jin JC. Comparison of a 3- and 6-mm incision in combined phacoemulsification and trabeculectomy. Am J Ophthalmol 1991; 111:189–196.
18. Ozeki N, Yuki K, Shiba D, Tsubota K. Evaluation of Functional Visual Acuity in Glaucoma Patients. J Glaucoma 2017; 26:223–226.
19. Wang F, Wu ZH. Phacoemulsification versus combined phacotrabeculectomy in the treatment of primary angle-closure glaucoma with cataract: a Meta-analysis. Int J Ophthalmol 2016; 9:597–603.
20. Musch DC, Fau. GB, Lichter PR, Fau. LP, Niziol LM, Fau. NL, Janz NK, Janz NK. Visual field progression in the Collaborative Initial Glaucoma Treatment Study the impact of treatment and other baseline factors. Ophthalmology 2009; 116:200–207.
21. Rao HL, Fau. JG, Addepalli UK, Fau. AU, Senthil S, Fau. SS, Garudadri CS, Garudadri CS. Effect of cataract extraction on Visual Field Index in glaucoma. J Glaucoma 2013; 22:164–168.

## Figures

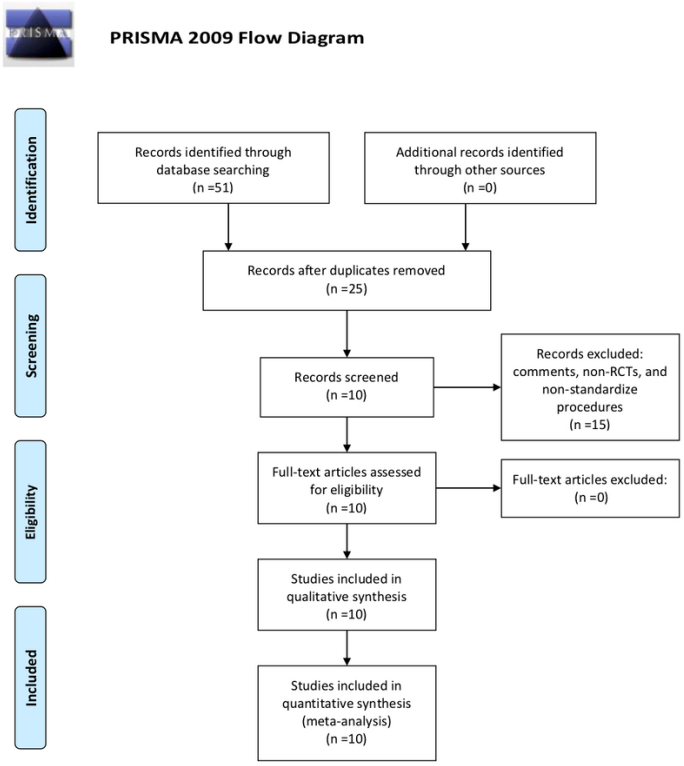


**Figure 1**

Legend not included with this version.

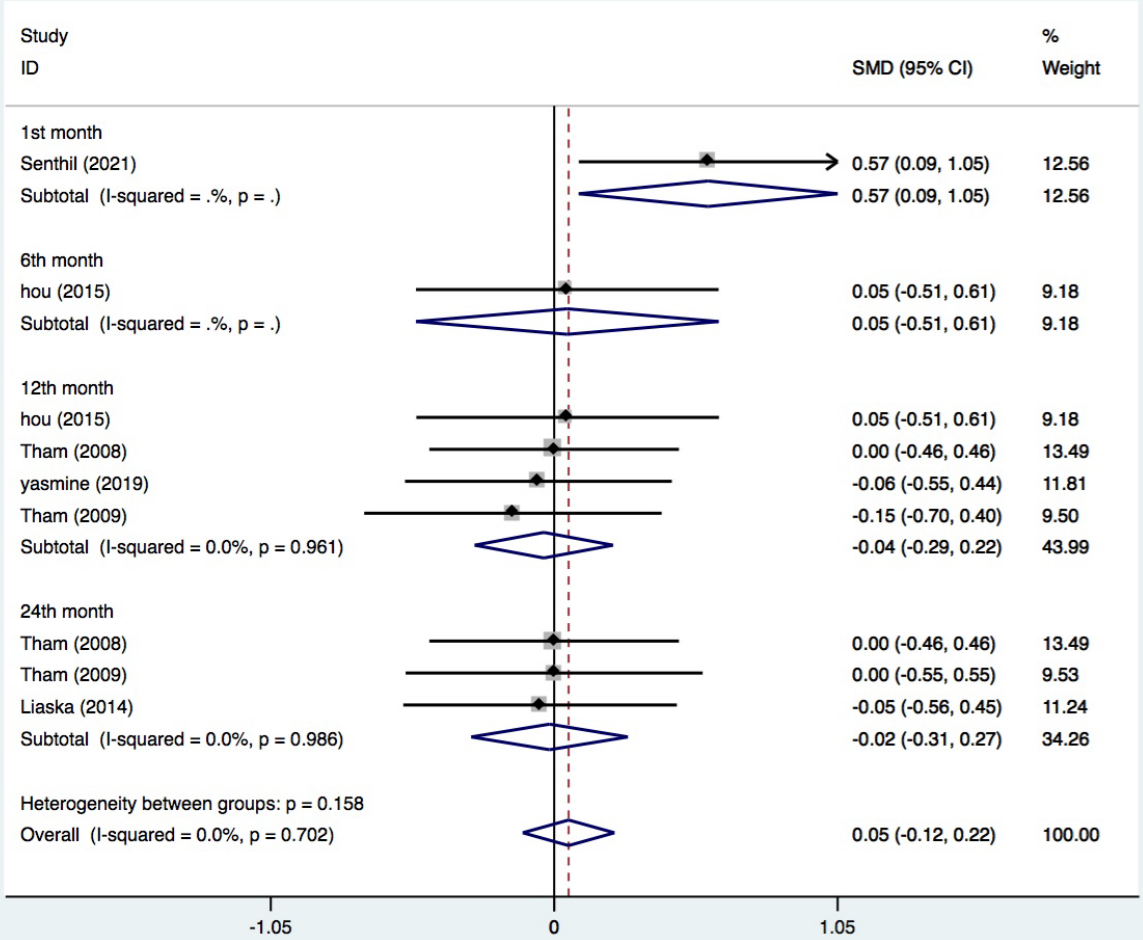


**Figure 2**

Legend not included with this version.

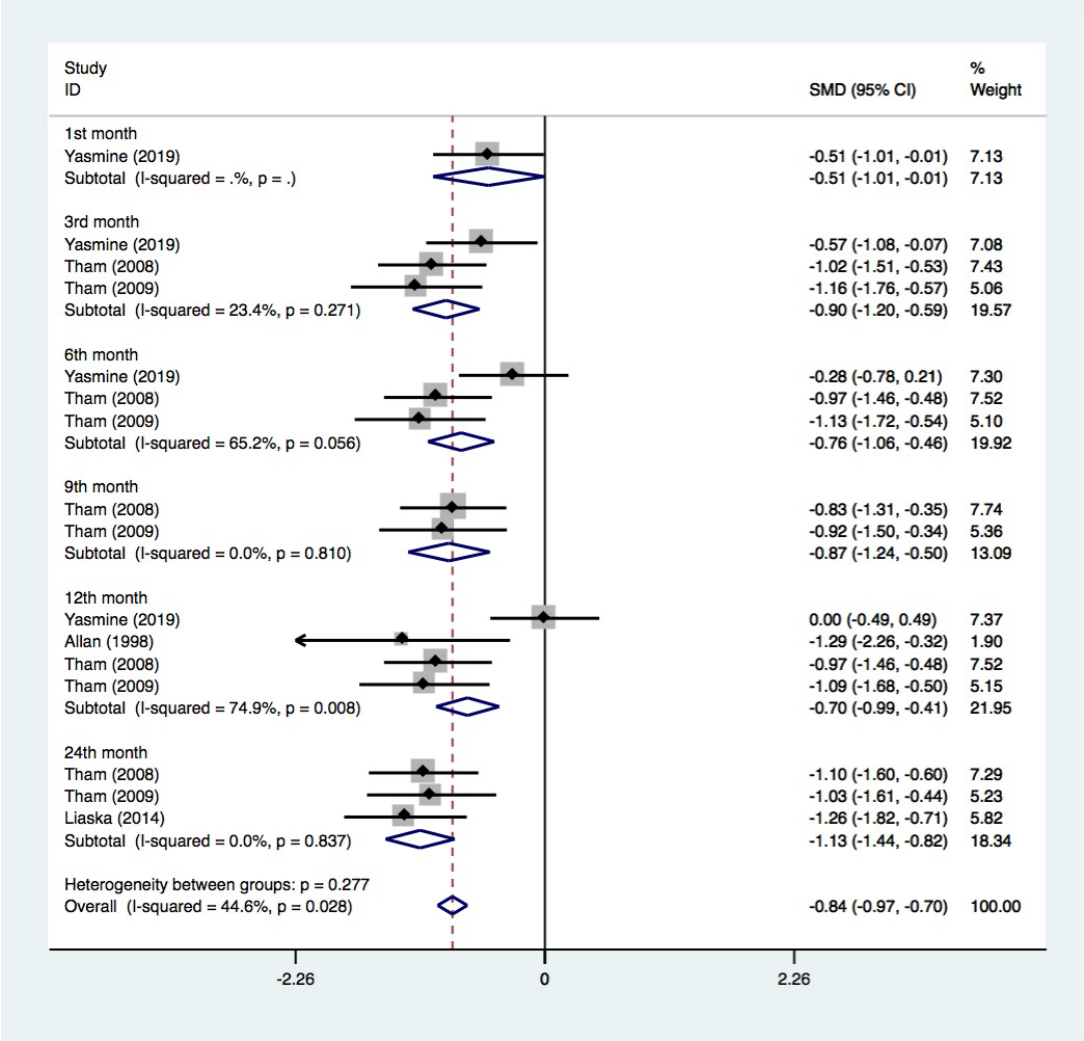


**Figure 3**

Legend not included with this version.

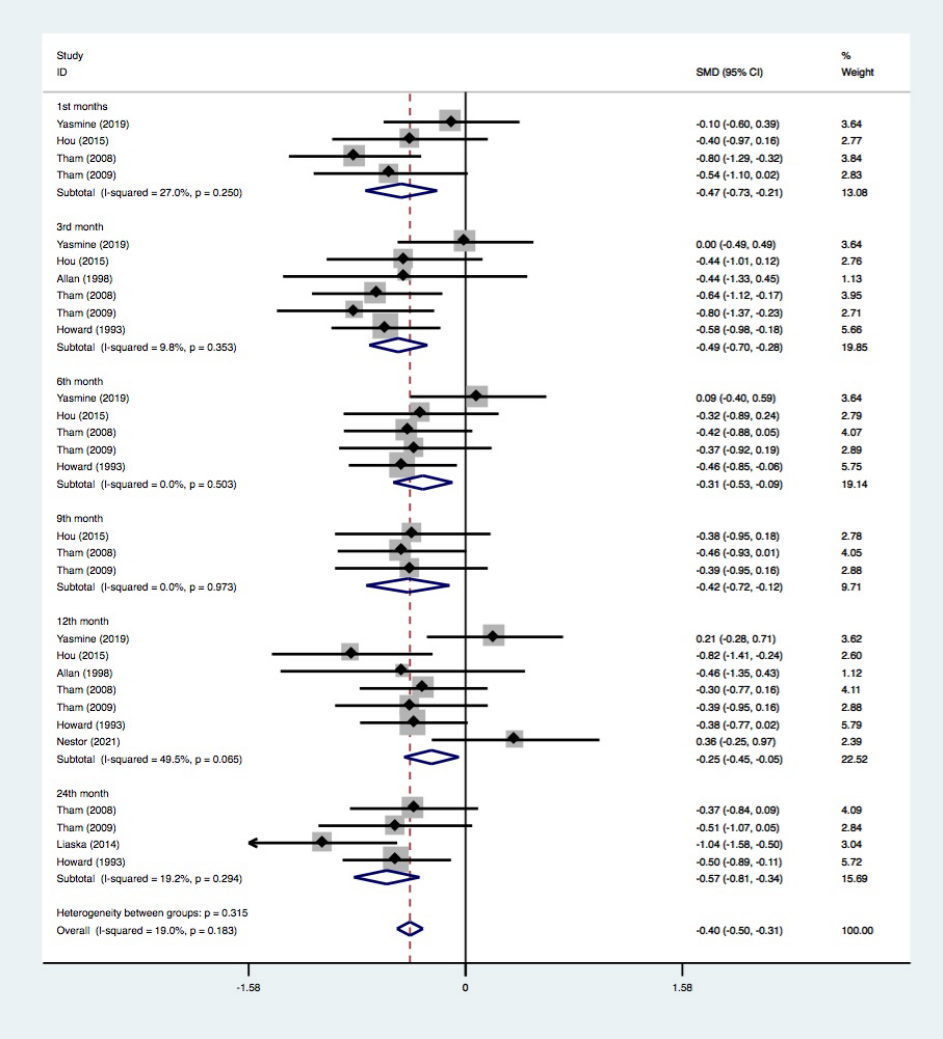


**Figure 4**

Legend not included with this version.

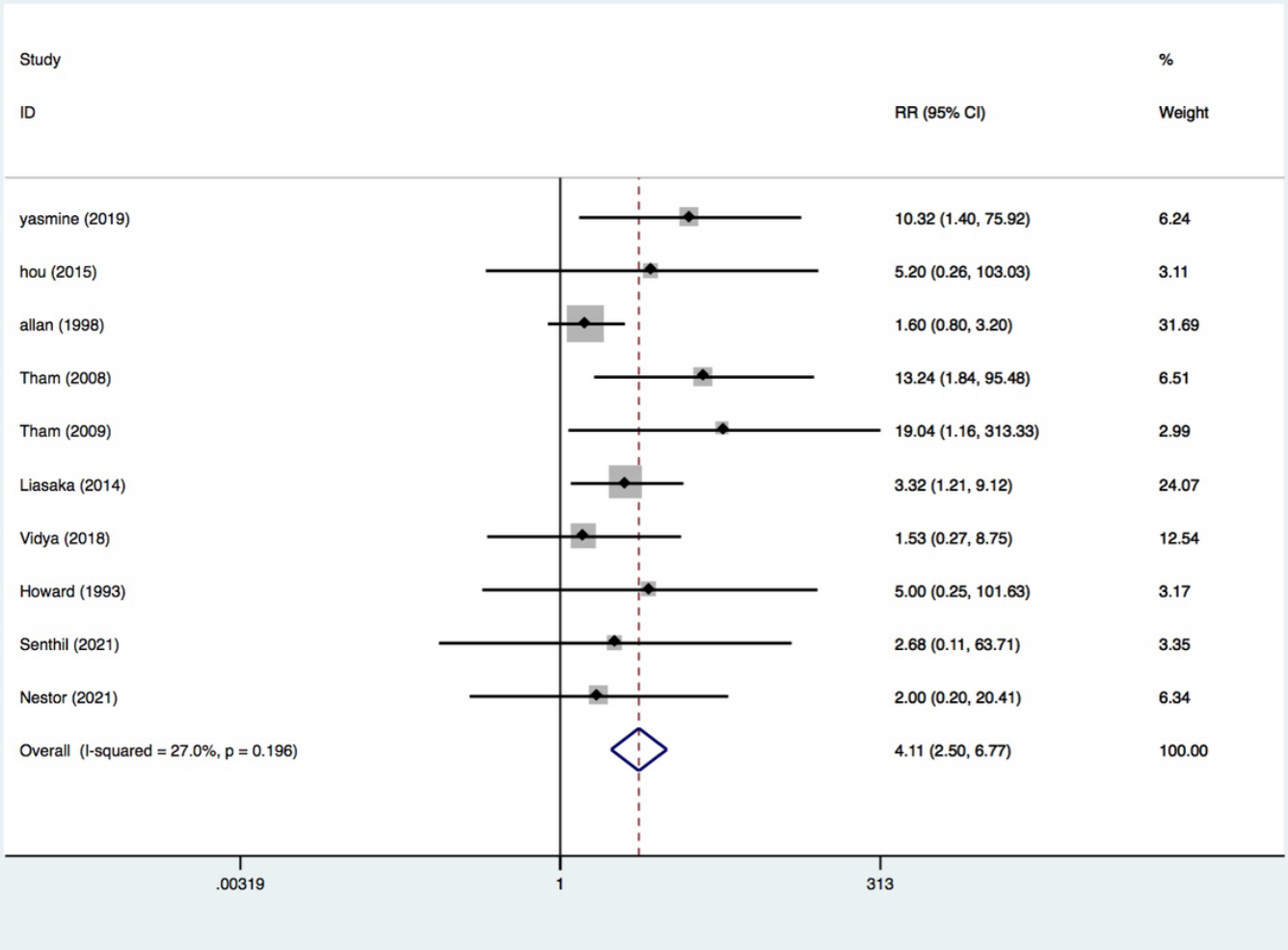


Figure 5

Legend not included with this version.