

## Impact of anterior capsular polishing on capsule opacification rate in eyes undergoing femtosecond laser-assisted cataract surgery

*Gitansha S Sachdev, B Soundarya, Shreyas Ramamurthy, Charanya Lakshmi, Ramamurthy Dandapani*

**Purpose:** To evaluate the impact of anterior capsular polishing on capsule opacification and contraction in eyes undergoing femtosecond laser-assisted cataract surgery (FLACS). **Methods:** This prospective interventional comparative analysis included patients undergoing FLACS between August 2016 and May 2017. The eyes were subdivided into three groups based on the extent of intraoperative anterior capsular polishing performed: complete 360-degree polishing; inferior 180-degree polishing; and no polishing. Visual acuity, posterior capsular opacification (PCO) score, anterior capsular opacification (ACO) grade, and capsulorhexis diameter were evaluated at 1-week, 6-months, and 1-year postoperative visits. **Results:** The study included 99 eyes of 90 patients. No significant differences were observed between the three groups in ACO grade and capsulorhexis contraction at all follow-up visits. There was a statistically significant difference in PCO grade among the groups at 6-month and 1-year follow-up but it was found to be clinically insignificant. One eye in the no polishing group underwent neodymium:yttrium-aluminum-garnet (Nd:YAG) capsulotomy at the 1-year follow-up visit. **Conclusion:** A lower incidence of PCO was demonstrated in the 360-degree polishing group, although it was visually insignificant. No significant difference in postoperative capsular contraction was demonstrated between the cohorts up to one-year follow-up.

**Key words:** Anterior capsular polishing, capsular contraction, capsular opacification, femtosecond laser-assisted cataract surgery

Posterior capsular opacification (PCO) is the most common cause of visual loss following uneventful cataract extraction. The proliferation and subsequent migration of the residual equatorial lens epithelial cells (LECs) result in the opacification of the anterior and posterior capsule.<sup>[1,2]</sup> Moreover, the transdifferentiation into myofibroblasts causes subsequent fibrosis and anterior capsular contraction. The resultant features include decline in visual acuity with loss of contrast sensitivity, and intraocular lens (IOL) tilt or decentration.<sup>[3]</sup>

Numerous studies have demonstrated the impact of anterior capsular polishing on the incidence of PCO, wherein some authors have demonstrated a reduction in the incidence,<sup>[4,5]</sup> while other studies provide contrary data.<sup>[2,3,6]</sup> However, one of the major limitations in the previous reports is the construct of a manual capsulorhexis with its associated variations in uniform capsular-IOL overlap (affecting IOL centration, tilt, and PCO formation) and capsulorhexis dimensions (affecting extent of capsular contraction). Our study demonstrates the effect of anterior capsular polishing in eyes undergoing femtosecond laser-assisted cataract surgery (FLACS) which enables a well-centered and consistent capsulotomy allowing a 360-degree IOL overlap.<sup>[7,8]</sup>

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## Methods

This prospective interventional comparative analysis was conducted at a tertiary eye care hospital in South India. The study was approved by the local ethics committee and adhered to the tenets of the declaration of Helsinki. Informed consent was obtained from all participants. Patients undergoing FLACS between August 2016 and May 2017 were included in the study. Exclusion criteria were dense corneal or media opacities interfering with imaging and subsequent femtosecond laser delivery, inadequate phacomodriasis not allowing construct of a 5 mm capsulotomy, ocular comorbidities affecting visual acuity, traumatic or subluxated cataracts, primary PCO, conditions associated with increased incidence of capsular phimosis including pseudoexfoliation, high myopia, and retinitis pigmentosa and intraoperative complications precluding in-the-bag IOL implantation with adequate centration.

The following investigations were carried out at 1 week, 6 months, and 12 months' postoperative visit: corrected Snellen's visual acuity; slit-lamp biomicroscopy and dilated fundus evaluation; intraocular pressure evaluation (Goldmann applanation tonometry); PCO score using slit-lamp

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imaging system (Topcon SL-D701) and EPCO software;<sup>[9]</sup> capsulorhexis diameter measurement using slit-lamp imaging system (Topcon SL-D701) and ImageJ software system;<sup>[10,11]</sup> and contrast sensitivity using ETDRS contrast (Aurochart, Aurolab, India) in both mesopic and scotopic conditions. Anterior capsular opacification (ACO) was graded into four groups based on slit-lamp evaluation (grade 0—no opacification, grade 1—only the edge of capsulotomy is opacified, grade 2—diffuse opacification with folds, grade 3—intense opacification with folds, grade 4—constriction of capsulotomy opening).<sup>[12]</sup>

### Surgical technique

All surgeries were performed by a single experienced surgeon (DR) on the Centurion platform (Alcon, USA). The Catalys femtosecond platform (Optimedica, CA, USA) was utilized to construct a 5 mm capsulotomy (centered on the scanned capsule), lens fragmentation, and corneal incisions. The direct chop technique was utilized for emulsification of the pre fragmented nuclear segments followed by complete cortical removal. The irrigation and aspiration cannulas (sandblasted) were swiped to achieve complete 360-degree anterior capsular polishing (CP group), inferior 180-degree polishing (IP group), or no polishing (NP group). Based on randomization, eyes were equally divided into three groups using random number tables. Posterior capsular polishing was done in all necessary cases. A single-piece IOL (TecnisZCB00, AMO, USA) was implanted in the capsular bag with a 360-degree capsular overlay.

Postoperative regimen included tapering doses of topical steroids (loteprednol suspension 0.5% w/v), antibiotics (ofloxacin 0.3% drops), and nonsteroidal anti-inflammatory drops (ketorolac tromethamine 0.5%).

### Statistical analysis

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. A Shapiro-Wilk's test ( $P > 0.05$ ) and a visual inspection of their histograms, normal Q-Q plots, and box plots showed that the ACO and PCO grade (pixels), contrast sensitivity, and capsulotomy diameter parameters were abnormally distributed and were assessed by comparing the median values. Kruskal-Wallis test and Wilcoxon test were used to assess statistical significance.  $P < 0.05$  was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

## Results

A total of 120 eyes were enrolled and equally randomized into three groups. Twenty-one eyes were lost to follow-up at subsequent visits and were excluded from the final analysis. The study included 99 eyes of 90 patients with a one-year follow-up. Among these, 33 eyes (33.33%) underwent complete 360-degree polishing (CP group), 36 eyes (36.36%) underwent inferior 180-degree polishing (IP group), and the remaining 30 eyes (30.3%) underwent no polishing (NP group).

The median age of the patients in all 3 groups was 60 years. Among the 99 eyes, 58 (58.6%) were males and 41 (41.4%) were females. The median preoperative corrected visual acuity in the CP, IP, and NP groups were LogMAR 0.20, 0.25, and 0.20, respectively ( $P = 0.420$ ).

### Visual outcomes

Figs. 1-3 represent the visual outcomes in the three groups. No significant difference was demonstrated in the postoperative median corrected distance visual acuity (CDVA) at all follow-up visits ( $P = 1, 0.98, \text{ and } 0.97$  at 1 week, 6 months and 1 year, respectively).

### Anterior capsular opacification (ACO) grade

Comparison of the ACO grade between the three groups [Fig. 4] demonstrates no statistically significant difference at all follow-ups ( $P = 0.80, 0.36, \text{ and } 0.24$  at 1 week, 6 months, and 1 year, respectively).

### Posterior capsular opacification (PCO)

Table 1 demonstrates the PCO grade (pixels) across the three groups, with significantly higher EPCO grade in the NP group at 6-month ( $P = 0.01$ ) and at 1-year follow-up ( $P = 0.01$ ) period. However, this was not clinically significant as no impairment of visual acuity was noted. One eye in the NP group underwent neodymium:yttrium-aluminum-garnet (Nd:YAG) capsulotomy at 1-year follow-up visit. This was secondary to glare and a loss of contrast in the eye with a multifocal implant, although no loss of CDVA was noted.

### Capsular contraction

Intergroup comparison of median vertical, horizontal, and diagonal axes (155 degrees and 45 degrees) diameters [Table 1] showed no statistical difference at all follow-up visits ( $P > 0.05$ ).

### Contrast sensitivity

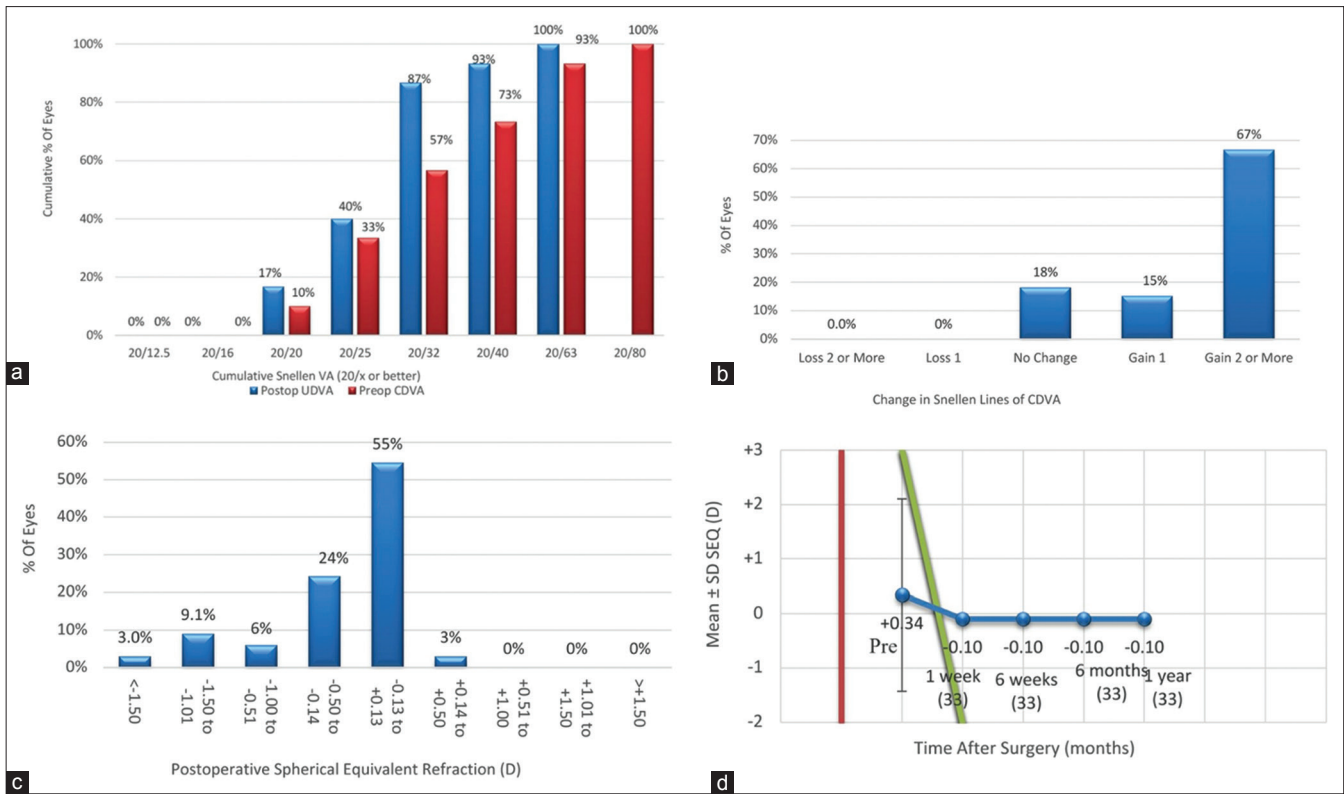
Intergroup comparison of median light-on high contrast, light-off high contrast, light-on low contrast, and light-off low contrast showed no statistically significant difference at 1<sup>st</sup> week, 6<sup>th</sup> month, and 1 year ( $P > 0.05$ ).

## Discussion

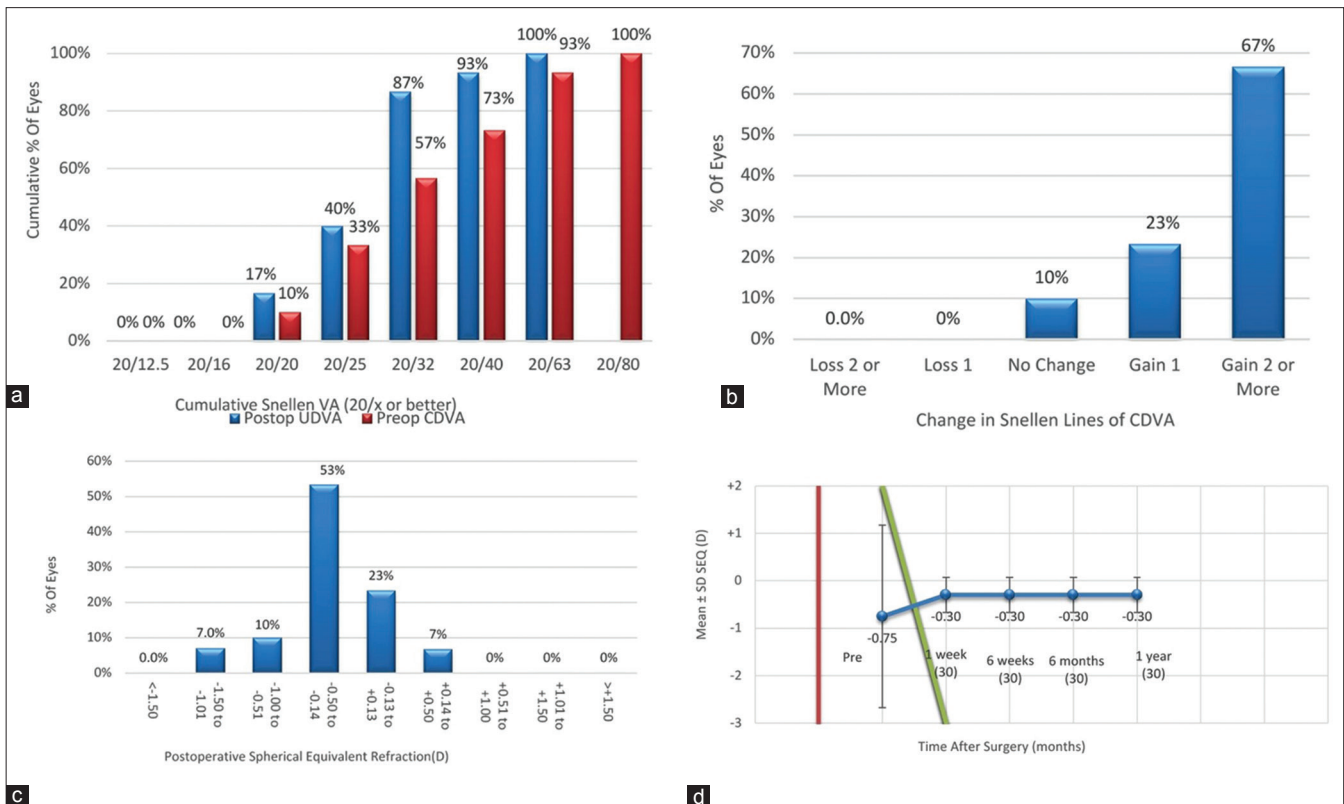
The development of postoperative ACO and PCO is considered as a wound healing response of the residual LECs and may be decreased by the removal of these cells.<sup>[13-17]</sup> To date, only mechanical removal of the LECs by anterior lens capsule (ALC) polishing has been used clinically and other physical or pharmacological methods have not found application due to lack of sensitivity and specificity.<sup>[18-21]</sup> The ultrasound irrigation and aspiration tip was found to be the most effective instrument for mechanical polishing.<sup>[22]</sup>

Previous publications demonstrating the effect of anterior capsular polishing on subsequent opacification provide contrarian views. An *ex vivo* study conducted by Liu and coworkers revealed that anterior capsular polishing removed many LECs but it did not reduce residual cell growth and increased cell proliferation in capsular bag cultures.<sup>[2]</sup> Shah *et al.* demonstrated no obvious advantage of scraping on ACO development in a cohort of 120 eyes with a 6-month follow-up.<sup>[3]</sup> Similar results were noted by Matthias *et al.* over a longer follow-up of three years. The study revealed that anterior capsular polishing did not prevent the formation of PCO, on the other hand, it allowed for more regenerative cataract.<sup>[6]</sup>

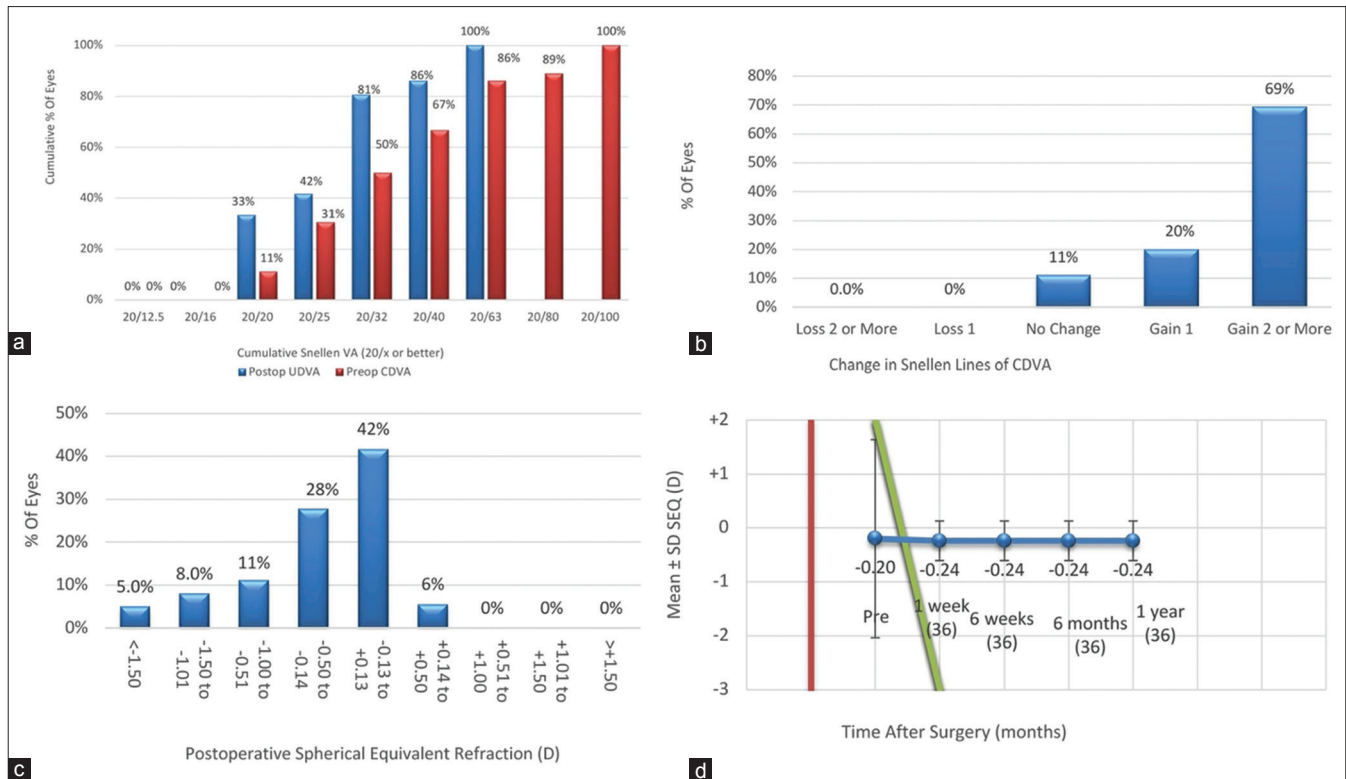
However, numerous other studies have reported a reduction in the incidence of opacification in eyes that underwent ALC polishing. Bolz *et al.* demonstrated



**Figure 1:** Standard graphs for reporting surgical outcomes following femtosecond laser-assisted cataract surgery (FLACS) with complete anterior capsular polishing (a) cumulative visual acuity, (b) safety, (c) accuracy, (d) spherical equivalent



**Figure 2:** Standard graphs for reporting surgical outcomes following FLACS with inferior anterior capsular polishing (a) cumulative visual acuity, (b) safety, (c) accuracy, (d) spherical equivalent



**Figure 3:** Standard graphs for reporting surgical outcomes following FLACS with no capsular polishing (a) cumulative visual acuity, (b) safety, (c) accuracy, (d) spherical equivalent

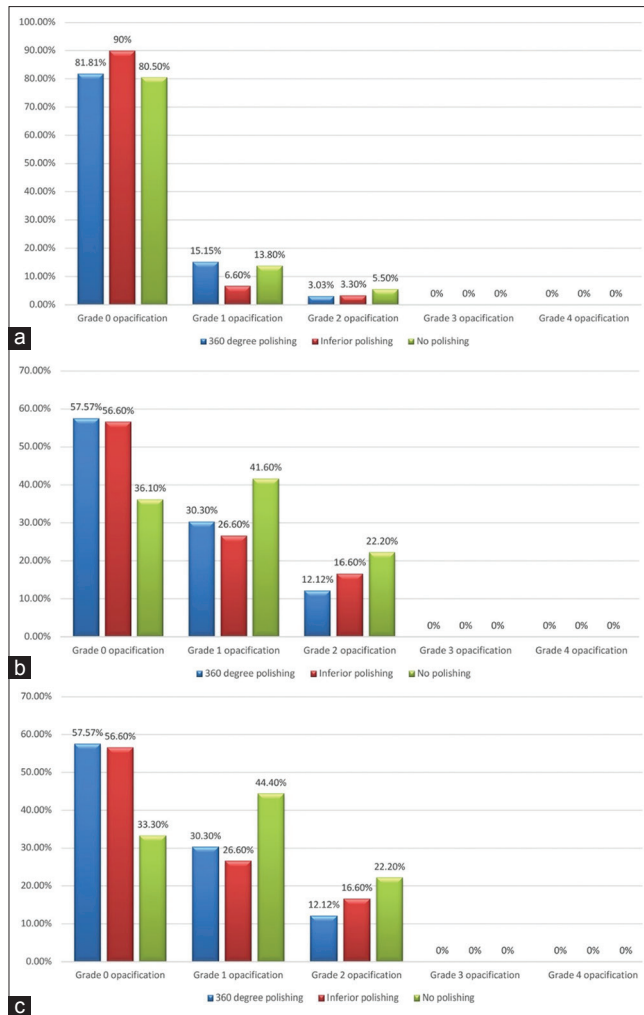
**Table 1: Comparison of median PCO grade and capsulotomy diameters in the three intervention groups at different follow-up time periods**

Parameter	Follow-up period	Polishing			Kruskal-Wallis test (P)
		Inferior (Median)	360° (Median)	No (Median)	
PCO score (Pixels)	1 week	0.00	0.00	0.00	0.368
	6 months	0.012	0.00	0.014	0.010
	1 year	0.018	0.00	0.019	0.019
Capsulotomy diameter (Pixels)	1 week	375	370	373.5	0.052
	6 months	371	369	368	0.253
	1 year	371	368	366	0.07
Horizontal	1 week	361	363	358	0.67
	6 months	362	358	361	0.754
	1 year	362	359	358	0.196
Diagonal (155°)	1 week	369	368	366.5	0.558
	6 months	365	366.5	362	0.582
	1 year	367	363.5	363.5	0.391
Diagonal (45°)	1 week	375	368	368	0.067
	6 months	368	365	365	0.367
	1 year	366	363	363.5	0.249

PCO: Posterior capsular opacification

significantly lower ACO with no reduction in PCO intensity and no statistically significant increase in the development of regenerative PCO over a 5-year follow-up.<sup>[5]</sup> Similarly, Baile *et al.* showed a decrease in the rate of ACO and capsular

phimosis in eyes that had undergone anterior capsular polishing at 1 year.<sup>[4]</sup> Sacu *et al.* demonstrated lower ACO and fibrotic PCO with round-edged silicone IOLs 3-years postoperatively.<sup>[23]</sup>



**Figure 4:** Cluster bar diagram comparison of polishing with anterior capsular opacification (ACO) grade at different follow-up periods (a) 1-week, (b) 6-month, and (c) 1-year postoperative visit

The data published thus far is limited by the fact that a number of these studies implanted silicon IOLs with a greater incidence of PCO. Another major limitation was the construct of a manual capsulorhexis, with its associated variations in capsular-IOL overlap (affecting IOL centration, tilt, and PCO formation) and inconsistent capsulorhexis dimensions (affecting extent of capsular contraction).

We studied the effect of complete, inferior and no capsular polishing in eyes undergoing FLACS. Our study demonstrates a higher incidence of PCO at both 6-month and 1-year follow up in the non-polishing arm. However, no clinical significance was found as visual outcomes between the three groups were not significantly different. This could be attributed to a more peripheral opacification with a longer follow-up required to determine the incidence of central opacification. Additionally, the impact on contrast sensitivity as a function of visual loss has not been studied in the previous cohorts. Contrast sensitivity was not statistically as well as clinically different between groups and among each group between follow-ups. The anterior capsular opacification and subsequent contraction revealed no significant difference.

## Conclusion

In conclusion, no advantage of anterior capsular polishing was noted on the postoperative visual outcomes and contrast in eyes undergoing FLACS, at 1-year follow-up visit. The incidence of PCO was similar in the inferior and no polishing group. Longer follow-up data is necessary to study the long term impact.

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## Conflicts of interest

There are no conflicts of interest.

## References

- Trivedi RH, Werner L, Apple DJ, Pandey SK, Izak AM. Post cataract-intraocular lens (IOL) surgery opacification. *Eye* 2002;16:217-41.
- Liu X, Cheng B, Zheng D, Liu Y, Liu Y. Role of anterior capsule polishing in residual lens epithelial cell proliferation. *J Cataract Refract Surg* 2010;36:208-14.
- Shah SK, Praveen MR, Kaul A, Vasavada AR, Shah GD, Nihalani BR. Impact of anterior capsule polishing on anterior capsule opacification after cataract surgery: A randomized clinical trial. *Eye* 2009;23:1702-6.
- Baile R, Sahasrabudhe M, Nadkarni S, Karira V, Kelkar J. Effect of anterior capsular polishing on the rate of posterior capsule opacification: A retrospective analytical study. *Saudi J Ophthalmol* 2012;26:101-4.
- Bolz M, Menapace R, Findl O, Sacu S, Buehl W, Wirtitsch M, *et al.* Effect of anterior capsule polishing on the posterior capsule opacification—inhibiting properties of a sharp-edged, 3-piece, silicone intraocular lens: Three- and 5-year results of a randomized trial. *J Cataract Refract Surg* 2006;32:1513-20.
- Menapace R, Wirtitsch M, Findl O, Buehl W, Kriechbaum K, Sacu S. Effect of anterior capsule polishing on posterior capsule opacification and neodymium:YAG capsulotomy rates: Three-year randomized trial. *J Cataract Refract Surg* 2005;31:2067-75.
- Friedman NJ, Palanker DV, Schuele G, Andersen D, Marcellino G, Seibel BS, *et al.* Femtosecond laser capsulotomy. *J Cataract Refract Surg* 2011;37:1189-98.
- Kránitz K, Takacs A, Miháltz K, Kovács I, Knorz MC, Nagy ZZ. Femtosecond laser capsulotomy and manual continuous curvilinear capsulorhexis parameters and their effects on intraocular lens centration. *J Refract Surg* 2011;27:558-63.
- Joo CK, Shin JA, Kim JH. Capsular opening contraction after continuous curvilinear capsulorhexis and intraocular lens implantation. *J Cataract Refract Surg* 1996;22:585-90.
- Hansen SO, Crandall AS, Olson RJ. Progressive constriction of the anterior capsular opening following intact capsulorhexis. *J Cataract Refract Surg* 1993;19:77-82.
- Davison JA. Capsule contraction syndrome. *J Cataract Refract Surg* 1993;19:582-9.
- Werner L, Pandey SK, Apple DJ, Escobar-Gomez M, McLendon L, Macky TA. Anterior capsule opacification: Correlation of pathologic findings with clinical sequelae. *Ophthalmology* 2001;108:1675-81.
- Hanson RJ, Rubinstein A, Sarangapani S, Benjamin L, Patel CK. Effect of lens epithelial cell aspiration on postoperative capsulorhexis contraction with the use of the AcrySof intraocular lens: Randomized clinical trial. *J Cataract Refract Surg* 2006;32:1621-6.
- Werner L, Pandey SK, Escobar-Gomez M, Visessook N, Peng Q, Apple DJ. Anterior capsule opacification: A histopathological study

- comparing different IOL styles. *Ophthalmology* 2000;107:463-71.
15. Gonvers M, Sickenberg M, Van Melle G. Change in capsulorhexis size after implantation of three types of intraocular lenses. *J Cataract Refract Surg* 1997;23:231-8.
  16. Hayashi K, Hayashi H, Nakao F, Hayashi F. Reduction in the area of the anterior capsule opening after polymethylmethacrylate, silicone, and soft acrylic intraocular lens implantation. *Am J Ophthalmol* 1997;123:441-7.
  17. Nagata T, Minakata A, Watanabe I. Adhesiveness of AcrySof to a collagen film. *J Cataract Refract Surg* 1998;24:367-70.
  18. You YS, Lim SJ, Chung HS, Lee YG, Kim CY, Hong YJ. The effective concentration and exposure time of mitomycin-C for the inhibition of lens epithelial cell proliferation in rabbit eyes. *Yonsei Med J* 2000;41:185-9.
  19. Hara T, Hara T. Ultrasound spatula. *Arch Ophthalmol* 1989;107:767-8.
  20. Hueber A, Eichholtz CD, Kociok N, Esser JM, Esser PJ. Lens epithelial cells express CD95 and CD95 ligand treatment induces cell death and DNA fragmentation *in vitro*. *Eur J Ophthalmol* 2003;13:241-5.
  21. Michaeli-Cohen A, Belkin M, Goldring A, Rosner M, Assia EI. Prevention of posterior capsule opacification with the CO2 laser. *Ophthalmic Surg Lasers* 1998;29:985-90.
  22. Mathey CF, Kohnen TB, Ensikat HJ, Koch HR. Polishing methods for the lens capsule: Histology and scanning electron microscopy. *J Cataract Refract Surg* 1994;20:64-9.
  23. Sacu S, Menapace R, Wirtitsch M, Buehl W, Rainer G, Findl O. Effect of anterior capsule polishing on fibrotic capsule opacification: Three-year results. *J Cataract Refract Surg* 2004;30:2322-7.