• Comment •

Comparison of complication rates between femtosecond laser-assisted cataract surgery and conventional phacoemulsification cataract surgery

Eric Y Jin[1], *David Z Chen*[1,2]

[1]Yong Loo Lin School of Medicine, National University of Singapore, Singapore 117597, Singapore
[2]Department of Ophthalmology, National University Hospital, Singapore 119074, Singapore
Correspondence to: David Z Chen. Department of Ophthalmology, Level 7, 1E Kent Ridge Road, Singapore 119228, Singapore. david_chen@nuhs.edu.sg
Received: 2022-07-13 Accepted: 2022-09-26

DOI:10.18240/ijo.2023.01.25

Citation: Jin EY, Chen DZ. Comparison of complication rates between femtosecond laser-assisted cataract surgery and conventional phacoemulsification cataract surgery. *Int J Ophthalmol* 2023;16(1):156-158

Dear Editor,

We read with interest the Meta-analysis conducted by Chen *et al*[1] on the clinical outcomes and complication rates between femtosecond laser-assisted cataract surgery (FLACS) and conventional phacoemulsification cataract surgery (CPCS). The authors reported no statistical difference between both methods for all measured complications except posterior capsular tear, with CPCS displaying a higher rate of posterior capsular tear. Since its inception in 2011[2], FLACS has been extensively compared to CPCS as a viable option to remedy cataract in patients. FLACS involves using a femtosecond laser to assist in the initial steps of the cataract surgery, such as clear corneal incision, capsulotomy, and lens nucleus fragmentation. However, much debate remains on this topic, with studies even claiming that there is no difference in visual outcomes between both methods[3].

The Meta-analysis conducted by Chen *et al*[1] on 25 randomized controlled trials (RCTs) collected before November 2, 2019 compared parameters such as visual outcomes and complication rates between FLACS and CPCS. However, this excluded two important new RCTs, namely the FEMCAT[4] (n=1389) and FACT[5] (n=780). Since intraoperative and postoperative complications are uncommon, the additional of these two large multicenter trials, among other newer studies, could improve pooled estimate of their incidences. As such, we complemented the previous Meta-analysis with data from studies after November 2, 2019 to obtain more comprehensive and updated results.

We used the original search protocol and expanded the dates to June 12, 2022 (inclusive). Only RCTs published in the English language with relevant comparisons in clinical outcomes and complication between FLACS and CPCS were included, and searches were made in PubMed, EMBASE, and the Cochrane library. Statistical analysis was performed using RevMan 5.4.1 using the methods as described by the authors.

A total of 8 additional RCTs[4-11] were selected. Characteristics of all the studies, including those used in Chen's study when comparing complication rates, are described in Table 1[4-19]. Forrest plots of intraoperative and postoperative complications is detailed in Figure 1.

Overall, CPCS resulted in higher rates of posterior capsular tears than FLACS. However, subgroup analysis using only the newer studies showed no statistical difference between the two groups. Likewise, there was a trend towards higher incidence of capsular complications excluding posterior capsular tears in CPCS, though this was not statistically significant. There was also no significant difference between the 2 groups in occurrence of macular edema and elevated IOP.

While our study reinforces the findings by Chen *et al*[1] that posterior capsular tears are more common in CPCS compared to FLACS, the majority of difference was the result of one study by Stanojcic *et al*[10]. We note that study had an unusually high rate of posterior capsular tear for the CPCS group at 3%, which was atypical since the mean predicted posterior capsular tear risk was 1.59%. Nonetheless, the inclusion of 2436 cases from 4 new studies are a significant increase from the 474 cases from the 2 studies in the original Meta-analysis, and a pooled statistically significant difference in posterior capsular tear rates provides more corroborating evidence that suggests FLACS has greater intraoperative safety. Posterior capsular tear is a serious intraoperative complication and can often result in significant increase in follow-up medications

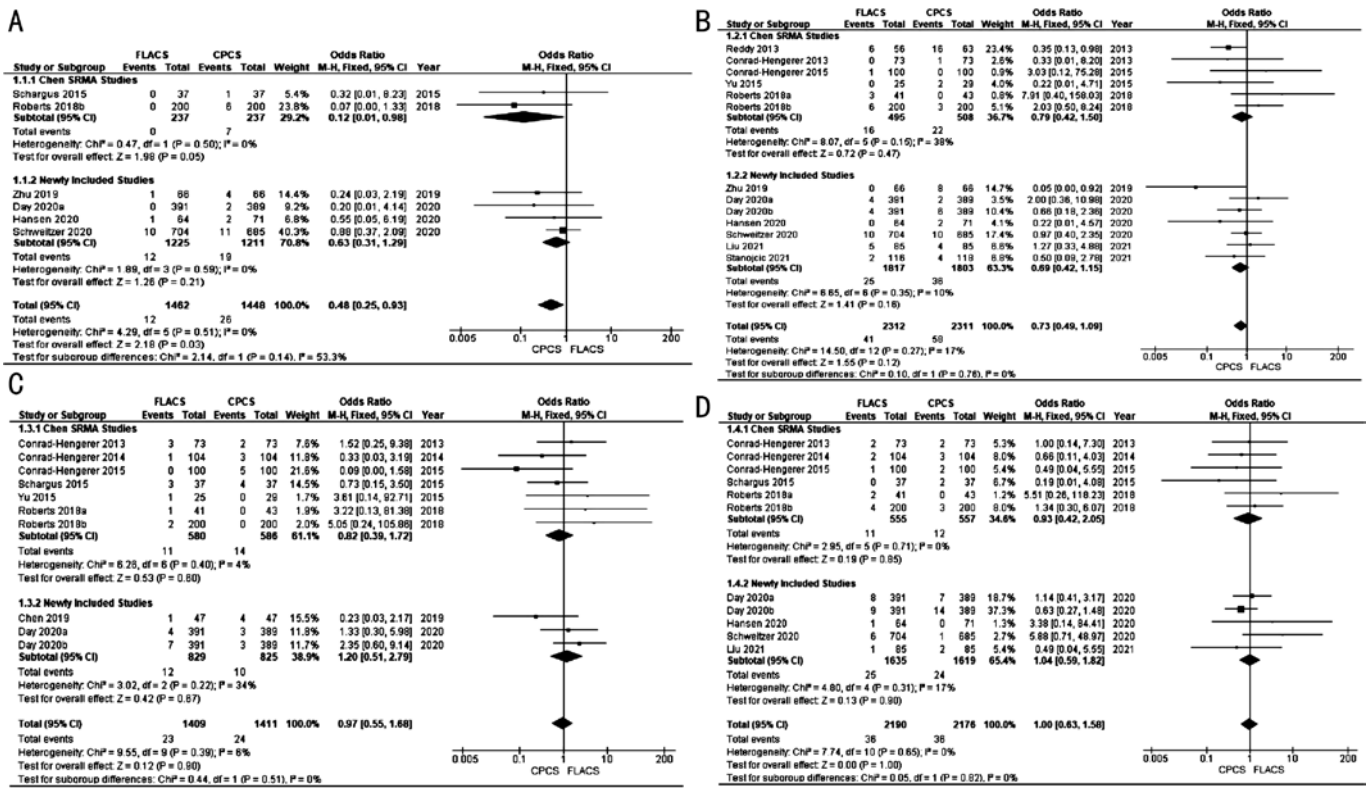

Figure 1 Intraoperative and postoperative complications A: Incidence of posterior capsular tear; B: Incidence of capsular complications excluding posterior capsular tears; C: Incidence of elevated intraocular pressure; D: Incidence of macular edema.

Table 1 Characteristics of included studies

First author	Year	Type of FLACS machine	Country	Age (mean±SD)		Sex (male:female)		Number of eyes		Follow-up period
				FLACS	CPCS	FLACS	CPCS	FLACS	CPCS	
Original studies used in Chen's SRMA										
Conrad-Hengerer[12]	2013	Catalys	Germany	70.9	70.9	27:46	27:46	73	73	3mo
Reddy[13]	2013	Victus	India	58.5±11.6	61.3±9.7	30:26	37:26	56	63	1d
Conrad-Hengerer[14]	2014	Catalys	Germany	71.3	71.3	46:58	46:58	104	104	6mo
Conrad-Hengerer[15]	2015	Catalys	Germany	71.6±9.25	71.6±9.25	44:56	44:56	100	100	6mo
Schargus[16]	2015	Catalys	Germany	71.8±9.25	71.8±9.25	15:22	15:22	37	37	6mo
Yu[17]	2015	LENSAR	China	62.3±11.6	56.5±16.6	NA	NA	25	29	3mo
Roberts[18]	2018a	LenSx	UK	69.7±12.0	72.5±10.5	18:23	18:25	41	43	4wk
Roberts[19]	2019b	LenSx	UK	69.9±10.9	70.5±9.8	100:100	82:118	200	200	4wk
Newly included RCTs										
Chen[6]	2019	NA	China	52.75±3.18	52.75±3.18	60:34	60:34	47	47	3mo
Zhu[7]	2019	LenSx	China	69.39 ±13.50	66.26±12.58	33:33	30:36	66	66	1mo
Day[5]	2020a	Catalys	England	68±10	68±10	182:210	192:201	391	389	3mo
Day[8]	2021b	Catalys	England	68±10	68±10	182:210	192:201	391	389	1y
Hansen[9]	2020	LenSx	USA	68.7±8.5	69.0±14.1	25:39	27:44	64	71	3mo
Schweitzer[4]	2020	Catalys	France	72.4±8.6	72.1±8.7	168:272	159:271	704	685	3mo
Stanojcic[10]	2021	LenSx	England	70.1±9.4	69.8±9.4	57:59	51:67	116	118	12mo
Liu[11]	2021	LDV Z8	Singapore	69.5±6.8	69.5±6.8	48:37	48:37	85	85	1y

CPCS: Conventional phacoemulsification cataract surgery; FLACS: Femtosecond laser-assisted cataract surgery; RCT: Randomized controlled trial; SD: Standard deviation; SRMA: Systematic review Meta-analysis.

and procedures for patients[10]. In addition, the trend towards higher incidence of capsular complications other than posterior capsular tear further suggests at the intraoperative safety profile of FLACS over CPCS. More research is needed to explore the cause for increased rate of posterior capsular tear during CPCS, and standardized prospective studies designed to specifically evaluate surgical complications between FLACS and CPCS may be helpful.

ACKNOWLEDGEMENTS

Conflicts of Interest: Jin EY, None; **Chen DZ,** None.

REFERENCES

1 Chen L, Hu C, Lin X, Li HY, Du Y, Yao YH, Chen J. Clinical outcomes and complications between FLACS and conventional phacoemulsification cataract surgery: a PRISMA-compliant Meta-analysis of 25 randomized controlled trials. *Int J Ophthalmol* 2021;14(7):1081-1091.

2 Friedman NJ, Palanker DV, Schuele G, Andersen D, Marcellino G, Seibel BS, Batlle J, Feliz R, Talamo JH, Blumenkranz MS, Culbertson WW. Femtosecond laser capsulotomy. *J Cataract Refract Surg* 2011;37(7):1189-1198.

3 Moshirfar M, Waite AJ, Ellis JH, Huynh R, Placide J, Barke MR, McCabe SE, Ronquillo YC, Hoopes PC Jr, Bradley MJ, Hoopes PC. A one year longitudinal comparative analysis of visual outcomes between femtosecond laser-assisted cataract surgery and standard phacoemulsification cataract surgery. *Clin Ophthalmol* 2021;15: 4667-4680.

4 Schweitzer C, Brezin A, Cochener B, Monnet D, Germain C, Roseng S, Sitta R, Maillard A, Hayes N, Denis P, Pisella PJ, Benard A. Femtosecond laser-assisted versus phacoemulsification cataract surgery (FEMCAT): a multicentre participant-masked randomised superiority and cost-effectiveness trial. *Lancet* 2020;395(10219):212-224.

5 Day AC, Burr JM, Bennett K, Bunce C, Doré CJ, Rubin GS, Nanavaty MA, Balaggan KS, Wilkins MR, Group FT. Femtosecond laser-assisted cataract surgery versus phacoemulsification cataract surgery (FACT): a randomized noninferiority trial. *Ophthalmology* 2020;127(8):1012-1019.

6 Chen JM, Wang DT, Zheng JQ, Gao C. Efficacy of femtosecond laser-assisted phacoemulsification for cataract patients and its influence on serum levels of inflammatory factors. *J Coll Physicians Surg Pak* 2019;29(2):123-127.

7 Zhu YN, Chen XY, Chen PQ, Xu W, Shentu XC, Yu YB, Yao K. Lens capsule-related complications of femtosecond laser-assisted capsulotomy versus manual capsulorhexis for white cataracts. *J Cataract Refract Surg* 2019;45(3):337-342.

8 Day AC, Burr JM, Bennett K, Hunter R, Bunce C, Doré CJ, Nanavaty MA, Balaggan KS, Wilkins MR. Femtosecond laser-assisted cataract surgery compared with phacoemulsification: the FACT non-inferiority RCT. *Health Technol Assess* 2021;25(6):1-68.

9 Hansen B, Blomquist PH, Ririe P, Pouly S, Nguyen C, Petroll WM, McCulley JP. Outcomes of resident-performed laser-assisted *vs* traditional phacoemulsification. *J Cataract Refract Surg* 2020;46(9):1273-1277.

10 Stanojcic N, Roberts HW, Wagh VK, Li JO, Naderi K, O'Brart DP. A randomised controlled trial comparing femtosecond laser-assisted cataract surgery versus conventional phacoemulsification surgery: 12-month results. *Br J Ophthalmol* 2021;105(5):631-638.

11 Liu YC, Setiawan M, Chin JY, Wu B, Ong HS, Lamoureux E, Mehta JS. Randomized controlled trial comparing 1-year outcomes of low-energy femtosecond laser-assisted cataract surgery versus conventional phacoemulsification. *Front Med* (*Lausanne*) 2021;8:811093.

12 Conrad-Hengerer I, Al Juburi M, Schultz T, Hengerer FH, Dick HB. Corneal endothelial cell loss and corneal thickness in conventional compared with femtosecond laser-assisted cataract surgery: three-month follow-up. *J Cataract Refract Surg* 2013;39(9):1307-1313.

13 Reddy KP, Kandulla J, Auffarth GU. Effectiveness and safety of femtosecond laser-assisted lens fragmentation and anterior capsulotomy versus the manual technique in cataract surgery. *J Cataract Refract Surg* 2013;39(9):1297-1306.

14 Conrad-Hengerer I, Hengerer FH, Al Juburi M, Schultz T, Dick HB. Femtosecond laser-induced macular changes and anterior segment inflammation in cataract surgery. *J Refract Surg* 2014;30(4):222-226.

15 Conrad-Hengerer I, Al Sheikh M, Hengerer FH, Schultz T, Dick HB. Comparison of visual recovery and refractive stability between femtosecond laser-assisted cataract surgery and standard phacoemulsification: six-month follow-up. *J Cataract Refract Surg* 2015;41(7):1356-1364.

16 Schargus M, Suckert N, Schultz T, Kakkassery V, Dick HB. Femtosecond laser-assisted cataract surgery without OVD: a prospective intraindividual comparison. *J Refract Surg* 2015;31(3): 146-152.

17 Yu AY, Ni LY, Wang QM, Huang F, Zhu SQ, Zheng LY, Su YF. Preliminary clinical investigation of cataract surgery with a noncontact femtosecond laser system. *Lasers Surg Med* 2015;47(9):698-703.

18 Roberts HW, Wagh VK, Sullivan DL, Archer TJ, O'Brart DPS. Refractive outcomes after limbal relaxing incisions or femtosecond laser arcuate keratotomy to manage corneal astigmatism at the time of cataract surgery. *J Cataract Refract Surg* 2018;44(8):955-963.

19 Roberts HW, Wagh VK, Sullivan DL, Hidzheva P, Detesan DI, Heemraz BS, Sparrow JM, O'Brart DPS. A randomized controlled trial comparing femtosecond laser-assisted cataract surgery versus conventional phacoemulsification surgery. *J Cataract Refract Surg* 2019;45(1):11-20.