MÆDICA - a Journal of Clinical Medicine

ORIGINAL PAPER

MAEDICA – a Journal of Clinical Medicine
2024; 19(1): 42-47
https://doi.org/10.26574/maedica.2024.19.1.42

25G Pars Plana Vitrectomy-Lensectomy and Sulcus IOL Implantation for Patients with Cataract and Cornea Guttata

Stratos V. GOTZARIDIS[c], Evita Evangelia CHRISTOU[b], Jignesh PATEL[c], Giorgos CHATZILAOU[a], Konstantinos ANANIKAS[c]

[a]My Retina, Athens Eye Center, Athens, Greece

[b]Oxford Eye Hospital, Oxford University Hospitals NHS Foundation Trust, Oxford, UK

[c]Ophthalmology Department, Colchester Eye Centre of Excellence, East Suffolk and North Essex NHS Foundation Trust, Turner Road, Mile End, Colchester CO4 5JR, UK

ABSTRACT

Introduction: *Corneal guttata is a non-inflammatory progressive decline of endothelial cell density (ECD) which represents an early clinical feature of Fuch's dystrophy. In patients with corneal guttata, the relative risk for corneal transplantation after phacoemulsification has been found to be 68.2 times higher than in those without it. In the present study, five patients with corneal guttata underwent 25G pars plana vitrectomy (PPV) with concurrent lensectomy and intraocular lens (IOL) implantation in the sulcus. The aim of the present study is to investigate whether this technique has a less damaging effect on endothelial cells as compared to standard phacoemulsification.*

Methods: *This retrospective case series study was conducted at "My Retina" Athens Eye Centre, Greece. Five patients with moderate to dense cataract and clinical signs of corneal guttata were included. All patients had ECD measurement prior to and after surgery. The operation included 25-gauge pars plana vitrectomy (PPV) with subsequent lensectomy and a three-piece IOL implanted in the sulcus with intact anterior capsule.*

Results: *The mean value of ECD was 1157.8±237.51 cells/mm^2 preoperatively and 1118.2±227.42 cells/mm^2 postoperatively, indicating a 3.4% reduction from initial values. Retinal detachment was not observed on any of the operated patients after surgery. The IOL was well centered to the sulcus in all patients. Iatrogenic retinal tears were identified in one patient and were treated with laser retinopexy and SF6 gas tamponade.*

Conclusions: *Our results show that PPV along with lensectomy through fragmatome may cause less corneal decompensation than femtosecond laser-assisted cataract surgery (FLACS) or phacoemulsification, especially in patients with corneal guttata. Therefore, reducing the risk for possible future corneal transplantation.*

Keywords: corneal guttata, low endothelial cell density, vitrectomy, fragmatome, phacoemulsification, sulcus IOL.

Address for correspondence:
Evita Evangelia Christou MD, PhD
Email: evitachristou@gmail.com

Article received on the 25th of February 2023 and accepted for publication on the 8th of March 2024

ABBREVIATIONS

AC: anterior chamber
PPV: pars plana vitrectomy
BCVA: best corrected visual acuity
ECD: endothelial cell density
IOP: intraocular pressure
CE: corneal endothelium
FECD: Fuchs endothelial corneal dystrophy
VA: visual acuity
IOL: intraocular lens

INTRODUCTION

The corneal endothelium (CE) serves as a barrier between the corneal stroma and the aqueous humor of the anterior chamber (AC). It functions as a pump in order to keep the stromal hydration status at 78%. This ability plays a pivotal role in sustaining the endothelial cell density (ECD). As a result, progressive endothelial cell loss leads to reduction of the pump activity, causing fluid accumulation in the cornea, reduction of transparency and reduced visual acuity (VA) (1). In particular, when the ECD drops below 600 to 800 cells/mm^2, the endothelial pump function becomes compromised. Besides, endothelial cells do not regenerate, thus cell loss is compensated by enlargement, migration and increasing heterogeneity of residual cells (14).

The progressive decline of ECD is a well-established clinical feature, known as corneal guttata. It is typically observed in patients with early Fuchs endothelial corneal dystrophy (FECD) and in the aging population, but it can also be present after ocular trauma, inflammation, glaucoma and surgery (2). The estimated prevalence of corneal guttata varies from 4.1% to 11%. As far as surgery is concerned, phacoemulsification can result in ECD reduction between 4.2% and 16.1% (3-5). This reported percentage can presumably increase in cases with co-existent risk factors, including prolonged operation, nucleus sclerosis, short axial length, pseudoexfoliation, diabetes mellitus and posterior capsule rupture (PCR) (6-8). A notable aspect to consider is that, in patients with corneal guttata, the relative risk for corneal transplantation after phacoemulsification has been found to be 68.2 times higher than in those without it. In addition, the possibility for future corneal transplantation may have more than three-fold increase in cases with dense cataract or PCR irrespective of the presence of corneal guttata (9, 10).

In the present case series study, we sought to characterize ECD in patients with corneal guttata who underwent 25G pars plana vitrectomy (PPV) with concurrent lensectomy and intraocular lens (IOL) implantation in the sulcus. The aim of this investigation is to point out whether this technique may have a less deleterious effect on endothelial cells as compared to conventional methods for cataract extraction. To our best knowledge, this is the first study to assess the efficacy of PPV along with lensectomy in patients with corneal guttata. ❑

MATERIALS AND METHODS

The study was conducted at 'My Retina Athens Eye Center' in accordance with the institutional review board (IRB) guidelines and adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained from all patients enrolled in the study.

This was a retrospective case series study. We recruited five patients with moderate to dense cataract and clinical signs of corneal guttata who underwent 25G PPV with concurrent lensectomy and IOL implantation to the sulcus.

All procedures were performed by a single experienced vitreoretinal surgeon (SG) under topical anesthesia with a standard three-port 25-gauge PPV. After core vitrectomy, the peripheral vitreous was thoroughly removed. Posterior vitreous detachment (PVD) was conducted in cases that did not preexist (three eyes, as two eyes had already PVD). Once we had conducted posterior capsulorhexis with the vitreous cutter, we induced nucleus drop and performed lensectomy with fragmatome and a three-piece IOL implantation (AcrySof MA60AC IOL, Alcon) in the sulcus with intact anterior capsule. Finally, we examined the periphery of the retina. In one of the cases where PVD was conducted by the surgeon, two iatrogenic breaks were found and treated with endolaser and SF6 gas tamponade. Also, one patient had prophylactic endolaser to suspicious areas without use of gas tamponade.

All patients underwent a comprehensive pre- and postoperative eye examination. A detailed examination included anterior segment and dilated fundus examination by slit-lamp bio-

TABLE 1. Preoperative and postoperative endothelial cell density (ECD) measurements

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Preoperative ECD	1019 cells/mm^2	1578 cells/mm^2	1058 cells/mm^2	1026 cells/mm^2	1108 cells/mm^2
Postoperative ECD	998 cells/mm^2	1522 cells/mm^2	1012 cells/mm^2	995 cells/mm^2	1064 cells/mm^2

TABLE 2. Appropriate methods to avoid unwanted pregnancy

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Preoperative BCVA (logMAR)	0.2	0.6	0.3	0.4	0.7
Postoperative BCVA (logMAR)	0.1	0.1	0.1	0.1	0.1

microscopy, measurements of BCVA using the ETDRS logMAR chart at 4 m and measurements of IOP using the air tonometer Tonoref II (Auto Ref/Kerato/Tonometer, Nidek Co, LTD, Japan), which was confirmed by Goldmann applanation tonometry. At the same time, all patients had ECD measurement by the CEM-530 (Nidek Co, Ltd, Gamagori, Japan), which was performed prior to and after the operation, at the time that each patient had a clear cornea (Table 1). All patients were examined during a follow-up period of six months. ❑

RESULTS

A total of five eyes of five patients were included in this case series study. Participants' mean age was 75.8±4.08 years (range 71–82). All patients underwent a single successful 25G PPV with concurrent lensectomy and sulcus IOL implantation.

The mean value of ECD was 1157.8±237.51 cells/mm^2 preoperatively and 1118.2±227.42 cells/mm^2 postoperatively, indicating a 3.4% reduction from initial values.

Concerning visual outcomes, the mean value of BCVA improved from 0.44±0.21 preoperatively to 0.1 logMAR postoperatively (Table 2).

Patient number 4 had previously undergone vitrectomy for vitreomacular traction syndrome and the remaining four had no retinal pathology before surgery. Iatrogenic retinal tears were identified in patient number 1 and were treated with laser retinopexy and SF6 gas tamponade. Peripheral suspicious lesions predisposing to retinal detachment were identified in patient number 5 and were treated with prophylactic laser retinopexy. Retinal detachment was not observed in any of the five study participants postoperatively. The IOL was well centered to the sulcus in all patients. No other complication was noticed during the follow-up period of six months.

Concerning the corneal status, all patients had mild edema accompanied by endothelial striae during the first postoperative period. This may be attributed to the manipulations within the anterior chamber for the sulcus IOL insertion. The procedure of lensectomy was performed in the vitreous cavity away from the endothelium and with the anterior capsule intact. Therefore, the delivered energy to endothelium is minimal and there are no fluidics turbulence that can deplete the endothelial cells. Corneal edema resolution occurred as follows; patients 2 and 5 had clear cornea without edema or striae two weeks after surgery, patients 3 and 4 had clear cornea at four weeks and patient 1, with the lowest ECD, had a clear cornea at six weeks.

Regarding the IOP, no major fluctuations occurred to any of the patients and no IOP lowering medications were needed until the end of the follow-up. ❑

DISCUSSION

The compromised endothelial function may be a primary cause of corneal clarity reduction and a leading indication for corneal transplantation worldwide. The identification of surgical techniques that have the less harming effect on ECD represent a valuable and unmet need. In view of the above, we sought to assess the EC function in patients with severe corneal guttata who underwent 25g PPV – lensectomy and sulcus IOL implantation. Of note, our results indicate 3.4% reduction in ECD postoperatively. This finding remarkably demonstrates a lower incidence of EC dysfunction after PPV when com-

pared to previous reports. In particular, Friberg *et al* mentioned an ECD reduction of 14.1% in patients who underwent vitrectomy with concurrent lensectomy and scleral buckle, while the percentage declined to 7.7% in those who experienced solely vitrectomy and lensectomy (11). Furthermore, in diabetic patients, ECD deterioration was 16.5% in cases who underwent vitrectomy along with lensectomy as opposed to 9.4% in those who experienced only vitrectomy (12). It is a speculation that the ECD depletion might have been higher in the former studies on account of the more sizable instruments and obsolete vitrectomy machines. Currently, the advanced emerging technology along with the small incision devices have contributed to minimal invasive surgery, minimizing the detrimental effects on ocular tissue. Additionally, in our cases, the anterior capsule remained intact. In conjunction with the fact that the whole operation takes place to the vitreous cavity, we suggest that the endothelium is protected by the energy delivery of the fragmatome and the overall fluidic turbulence, minimizing the CE damage.

Indeed, more controlled evidence is warranted in order to characterize the impact of vitrectomy on CE; to date, available data is limited, mainly referring to the toxic effect of silicone oil.

Regarding the phacoemulsification procedure, the ECD reduction rate and overall risk for future corneal transplantation should be inevitably identified in patients with corneal guttata. Both the ultrasound time and power are well-established features that proportionally contribute to ECD diminishment (8). Notable aspects to consider, even in cases without corneal guttata there are anatomical variations such as shallow AC and dense cataracts that commonly make CE more susceptible to additional damage during phacoemulsification. In particular, patients with dense cataract and shallow AC have been found to experience 12.94% decline in ECD as compared to their counterparts with deep AC and 9.61% ECD reduction (13). Moreover, torsional and longitudinal settings were found to lead to a similar ECD reduction of 7% (14) and also, both divide-and-conquer and phaco-chop technique have presented with an ECD loss of 5-6.3% (15).

Recently, femtosecond laser-assisted cataract surgery (FLACS) represents a pronounced choice for patients suffering from corneal guttata or FECD (16-18). Few studies have evaluated ECD reduction following FLACS or phacoemulsification for moderated to dense cataracts in patients with FECD, thus providing contradictory outcomes. Indeed, some studies have reported an ECD reduction ranging from 8.2–26.1% in FLACS as opposed to 19.5–32.2% in phacoemulsification cases, while others mentioned similar results (16-18, 19). Interestingly, comparing our results to those of former studies, we assume that vitrectomy along with lensectomy through fragmatome may cause less corneal decompensation than FLACS or phacoemulsification, especially in patients with co-existent corneal guttata.

We hypothesize that a feasible explanation why vitrectomy along with lensectomy is overlooked as an option in patients with dense cataract and corneal guttata or FECD is to avoid the possibility of retinal detachment (RD). The risk of RD following vitrectomy is merely indisputable, however, both the beneficial outcomes for CE and refinement of technology that is currently used may add strength to this technique.

Obviously, further evidence is needed to establish the actual risk for RD of our proposed technique. In our study, there were hopefully no patients to develop RD throughout the follow-up. Comparing the incidence of RD in patients undergoing vitrectomy with the usage of fragmatome due to retained lens material to the vitreous cavity secondary to complications in cataract surgery to our proposed technique would not be accurate. In cases of posterior capsule rupture with vitreous loss, the intraoperative manipulations may increase the risk for vitreous traction and retinal break formation. Conversely, PPV is a more controlled procedure concerning the vitreous. Hence, the incidence of RD is 1% in patients undergoing PPV for epiretinal membranes (20), ranges from 3.92% to 5.70% after 12 months for macular hole (21) and markedly varies for symptomatic vitreous floaters. Concerning the latter, Tan *et al* conducted one of the largest studies addressing the issue and analyzed the safety of vitrectomy for floaters by looking at the incidence of iatrogenic retinal breaks and post-vitrectomy RD in 116 patients. Their study included both 20-gauge (29 cases) and 25-gauge (87 cases). The authors reported a RD ratio of 2.5% (22).

Viberg A *et al* analyzed data from 276 362 patients who had cataract surgery from 2010 to 2012 and from 2 091 patients with endothelial failure who underwent corneal transplantation between 2010-2017. From all patients who underwent phacoemulsification, 3 338 subjects were registered to have corneal guttata and 152 needed corneal transplantation reaching to a percentage of 4,6% (9).

The sulcus IOL implantation is a common choice for many surgeons in cases that it cannot be properly supported 'in the bag'. Despite being a safe option as an alternative method, some adverse outcomes following their use have been seldom reported. The latter might range from iris chafing, secondary glaucoma, recurrent iridocyclitis and cystoid macula edema to more critical complications like vitreous hemorrhage and chronic inflammation. The decentration of IOL could be another potential unfavorable condition that may cause symptomatic glare and monocular diplopia and require multiple surgical procedure of IOL exchange or repositioning in the long-term. However, detrimental effect on corneal endothelium consists an uncommon complication, while visual and refractive outcomes after sulcus IOL implantation are satisfactory (23, 24).

To our view, this study supports the theory that our proposed technique is less likely to lead to a second operation (RD, corneal transplantation) than the standard phacoemulsification. ❑

CONCLUSION

In conclusion, the current study points out that PPV with concurrent lensectomy through fragmatome may reduce EC decompensation in patients with severe corneal guttata. Additional prospective longitudinal studies are warranted to validate our findings and determine the accuracy of this technique in improving visual outcomes and diminishing the possibility of corneal transplantation.

What is known on this topic

- In patients with corneal guttata, studies have reported an ECD reduction ranging from 8.2% to 26.1% in FLACS as opposed to 19.5–32.2% in phacoemulsification.
- In a study by Viberg A *et al*, 4.6% of 276 362 patients with corneal guttata required corneal transplantation.
- The effect of vitrectomy in ECD reduction is variable across the literature, with results ranging between 7.7% and 16,5%.

What this study adds

- 25G PPV, followed by lensectomy and sulcus IOL implantation with intact anterior capsule, shows lower ECD reduction than standard phacoemulsification and FLACS.
- 25G vitrectomy can be a safe alternative in patients with corneal guttata and moderate-dense cataracts. ❑

Conflicts of interest: none declared.
Financial support: none declared.
This study was obtained by My Retina Athens Eye Center. A written informed consent was given by all patients enrolled in the study. Furthermore, the study was obtained in accordance with the Declaration of Helsinki for all participants.

References

1. **Ong Tone S, Kocaba V, Böhm M, et al.** Fuchs endothelial corneal dystrophy: The vicious cycle of Fuchs pathogenesis. *Prog Retin Eye Res* 2021;80:100863.
2. **Altamirano F, Ortiz-Morales G, O'Connor-Cordova MA, et al.** Fuchs endothelial corneal dystrophy: an updated review. *Int Ophthalmol* 2024;44:61.
3. **Higa A, Sakai H, Sawaguchi S, et al.** Prevalence of and risk factors for cornea guttata in a population-based study in a southwestern island of Japan: the Kumejima study. *Arch Ophthalmol* 2011;129:332-336 10.
4. **Sarnicola C, Farooq AV, Colby K.** Fuchs Endothelial Corneal Dystrophy: Update on Pathogenesis and Future Directions. *Eye Contact Lens* 2019;45:1-10.
5. **Matthaei M, Hribek A, Clahsen T, et al.** Fuchs Endothelial Corneal Dystrophy: Clinical, Genetic, Pathophysiologic, and Therapeutic Aspects. *Annu Rev Vis Sci* 2019;5:151-175.
6. **Hayashi K, Yoshida M, Manabe S, Hirata A.** Cataract surgery in eyes with low corneal endothelial cell density. *J Cataract Refract Surg* 2011;37:1419-1425.
7. **Viberg A, Liv P, Behndig A, et al.** The impact of corneal guttata on the results of cataract surgery. *J Cataract Refract Surg* 2019;45:803-809.

8. **Price FW Jr, Feng MT.** Impact of corneal guttata on cataract surgery results. *J Cataract Refract Surg* 2019;45:1692.
9. **Viberg A, Samolov B, Claesson Armitage M, et al.** Incidence of corneal transplantation after phacoemulsification in patients with corneal guttata: a registry-based cohort study. *J Cataract Refract Surg* 2020;46:961-966.
10. **Viberg A, Byström B.** Incidence of corneal transplantation after challenging cataract surgery in patients with and without corneal guttata. *J Cataract Refract Surg* 2021;47:358-365.
11. **Koushan K, Mikhail M, Beattie A, et al.** Corneal endothelial cell loss after pars plana vitrectomy and combined phacoemulsification-vitrectomy surgeries. *Can J Ophthalmol* 2017;52:4-8.
12. **Kopecky A, Nemcansky J.** Changes in the anterior segment of the eye following uncomplicated pars plana vitrectomy. A review. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2019;163:207-211.
13. **Hwang HB, Lyu B, Yim HB, Lee NY.** Endothelial Cell Loss after Phacoemulsification according to Different Anterior Chamber Depths. *J Ophthalmol* 2015;2015:210716.
14. **Reuschel A, Bogatsch H, Barth T, Wiedemann R.** Comparison of endothelial changes and power settings between torsional and longitudinal phacoemulsification. *J Cataract Refract Surg* 2010;36:1855-1861.
15. **Storr-Paulsen A, Norregaard JC, Ahmed S, et al.** Endothelial cell damage after cataract surgery: divide-and-conquer versus phaco-chop technique. *J Cataract Refract Surg* 2008;34:996-1000.
16. **Kang KH, Song MY, Kim KY, et al.** Corneal Endothelial Cell Changes After Femtosecond Laser-Assisted Cataract Surgery in Diabetic and Nondiabetic Patients. *Eye Contact Lens* 2021;47:664-669.
17. **Yong WWD, Chai HC, Shen L, et al.** Comparing Outcomes of Phacoemulsification with Femtosecond Laser-Assisted Cataract Surgery in Patients With Fuchs Endothelial Dystrophy. *Am J Ophthalmol* 2018;196:173-180.
18. **Fan W, Yan H, Zhang G.** Femtosecond laser-assisted cataract surgery in Fuchs endothelial corneal dystrophy: Long-term outcomes. *J Cataract Refract Surg* 2018;44:864-870.
19. **Zhu DC, Shah P, Feuer WJ, et al.** Outcomes of conventional phacoemulsification versus femtosecond laser-assisted cataract surgery in eyes with Fuchs endothelial corneal dystrophy. *J Cataract Refract Surg* 2018;44:534-540.
20. **Jackson TL, Donachie PH, Williamson TH, et al.** The Royal College of Ophtalmologists' National Ophtalmology Database Study of Vitroretinal Surgery: Report 4, Epiretinal Membrane. *Retina* 2015;35:1615-1621.
21. **Vaziri K, Schwartz SG, Kishor KS, et al.** Rates of Reoperation and Retinal Detachment after Macular Hole Surgery. *Ophthalmology* 2016;123:26-31.
22. **Tan HS, Mura M, Lesnik Oberstein SY, Bijl HM.** Safety of vitrectomy for floaters. *Am J Ophthalmol* 2011;151:995-998.
23. **João MD, Costa JV, Sousa K, et al.** Visual and refractive outcomes following secondary intraocular lens implantation. *Semin Ophthalmol* 2022;37:619-625.
24. **Mehta R, Aref AA.** Intraocular Lens Implantation In The Ciliary Sulcus: Challenges And Risks. *Clin Ophthalmol* 2019;13:2317-2323.