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Research Article

Retrospective Analysis of Telematic Glaucoma Clinic as A Consequence of COVID-19 Pandemic

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Abstract

Purpose: Due to the COVID-19 pandemic, glaucoma clinics had to adapt to meet the needs of patients with this chronic disease. New technologies allowed us to monitor some of these patients in a telematic way.

Methods: We retrospectively analysed patients with open-angle glaucoma who were visited between September 2021 and March 2022 and compared Visual Field (VF) and Optical Coherence Tomography (OCT) parameters according to whether they had telematic or only face-to-face controls. All patients were stratified in each group according to glaucoma severity.

Results: A total of 204 eyes from 118 patients were included in the analysis, with 100 in the group with only face-to-face controls (group 1/FTF) and 104 in the group with some telematic controls (group 2/HG). In group 2/HG, an average of 3.37 face-to-face visits and 1.27 telematic visits were made, while group 1/FTF had 4.4 face-to-face visits. There was no significant difference in visual acuity, OCT or VF parameters between the prepandemic period and 2 years after the visit. Regarding glaucoma severity, there were more patients with severe glaucoma in group 1/FTF and more patients with mild glaucoma in group 2/HG.

Conclusion: Telematic management of the glaucoma clinic, with the use of appropriate tools, can be useful for maintaining the quality of care during periods of face-to-face consultation saturation or when face-to-face control is completely impossible.

Keywords: Optical Coherence Tomography; Visual Field; Open-Angle Glaucoma; COVID-19

Introduction

Glaucoma is the main cause of irreversible blindness worldwide. The only modifiable risk factor on which we can effectively reduce the risk of progression is Intraocular Pressure (IOP). The loss of retinal ganglion cells results in a progressive decline in the visual field. At birth, the retina possesses more than 1 million ganglion cells. There is physiological loss of ganglion cells due to age. In glaucoma, this loss of ganglion cells becomes more pronounced. It may lead to irreversible blindness in advanced stages of the disease [1].

The European Glaucoma Society recommends that patients with Ocular Hypertension (OHT), suspected glaucoma or Primary Open-Angle Glaucoma (POAG) should be seen every 6 to 12 months. The frequency depends on risk factors, the severity of glaucomatous damage and the presence or absence of progression. They also indicate performing structural and functional tests periodically, such as Optical Coherence Tomography (OCT) and Visual Field testing (VF) [2]. Glaucoma progression is defined as visual field deterioration.

Telemedicine involves utilizing technology, including video conferencing and remote monitoring, to deliver medical care at a distance. Telemedicine allows us both to carry out screenings of the most prevalent pathologies and to monitor them if technology permits us to do so. In ophthalmology, examination is a fundamental pillar of our consultation to make clinical decisions and telemedicine does not replace ophthalmologists, who are the only guarantors of clinical decisions. Telemedicine can be particularly beneficial for those living in remote or underserved areas [3].

In the glaucoma clinic, a complete assessment would include the following:

- Clinical history: Personal and family history, drug or environmental allergies, toxic habits and work profession
- Visual Acuity (VA) and Best Corrected Visual Acuity (BCVA)
- Intraocular Pressure (IOP) measurement
- Pachymetry
- Gonioscopy
- Visualization of the eye fundus
- Retinography and OCT of the optic nerve head, peripapillary fibre layer and macular ganglion cells
- Visual Field (VF)

Since the start of the COVID-19 pandemic in March 2020, due to the restrictions imposed by health authorities, the use of telemedicine has increased considerably throughout the world. First, we carried out unstructured telemedicine without complementary tests, as it was impossible for patients to access hospital consultations. As the months passed and the health indicators improved, but the restrictions persisted due to the lack of a vaccine and the advanced age of our patients, we were allowed to schedule a telematic visit in a more structured way, having previously made an optometry visit with additional tests. The patient came just once and all the tests were performed in a safety environment keeping security distance.

Teleglaucoma has two possible forms: glaucoma screening and glaucoma management [3]. The first group refers to the use of telemedicine to screen high-risk individuals and assist ophthalmologists in the diagnosis of glaucoma. The second form is glaucoma management, which enables frequent monitoring of glaucoma progression in existing patients [4]. Several studies before the COVID-19 pandemic have demonstrated that teleglaucoma can potentially improve the efficacy of glaucoma follow-up [5-7]. Current evidence is based on cost effectiveness, safety and patient satisfaction [8-10]. After the COVID-19 pandemic, teleglaucoma has become an important clinical tool.

The aim of this study was to evaluate the outcomes of patients at Hospital Germans Trias i Pujol, HUGTIP (Badalona, Spain), who had telematic controls and to compare these outcomes with those of patients who had only face-to-face control of glaucoma progression during the COVID-19 pandemic. There are few comparative studies about progression in patients with teleglaucoma and with our report, we want to provide evidence to support its use for clinical management without a reduction in quality of care.

Materials and Methods

Our study was conducted in accordance with the National Statement of Ethical Conduct in Human Research and consistent with the principles of the Declaration of Helsinki. This study received approval on February 24, 2023, from the Institutional Review Board and Ethics Committee of Hospital Universitari Germans Trias i Pujol (HUGTIP) with ID PI-22-099.

We conducted a retrospective analysis of patients who consecutively visited the glaucoma unit of HUGTIP between September 2021 and March 2022. The inclusion criteria were patients who were diagnosed with POAG with more than 2 years of follow-up and a reliable VF Humphrey 24.2 at the previous and final visits. Diagnosis of glaucoma was made by visual field. Both eyes were included in the analysis if agreed with the inclusion criteria.

Exclusion criteria were patients under 18 years old, eyes with other ophthalmological pathologies, such as moderate or severe diabetic retinopathy, any cause of ocular neovascularization or active ocular inflammation that may alter the structural and functional tests. We also excluded patients who did not perform the visual field test in the months prior to the pandemic or in the subsequent control and patients who had only one control in the postpandemic stage.

The following computerized medical records were collected for all patients who visited the hospital beginning in September 2021:

- Number of visits made in the last 2 years, both face-to-face and telematic
- Initial and final Best-Corrected Visual Acuity (BCVA)
- Initial and final Intraocular Pressure (IOP)
- Initial and final peripapillary Retinal Nerve Fibre Layer (RNFL) thickness parameters
- Initial and final macular Ganglion (GC) OCT parameters (mean macular ganglion cell thickness).
- Initial and final VF parameters: Visual Field Index (VFI) and Mean Deviation (MD)
- Number of interventions (cataract or glaucoma surgeries and procedures such as needling or goniopunctures)
- Changes in medication use were made during that period

Patients whose VF and OCT tests did not meet the reliability criteria were excluded. The HFA software sets cut-offs at 20% for Fixation Losses (FL) and at 33% for False Positives (FP) and False Negatives (FN) to indicate an unreliable test [11]. OCT reliability can be judged by multiple criteria and two criteria have been studied extensively: Signal Strength (SS) and the presence of artefacts (i.e., image segmentation or acquisition error) [12].

Patients were classified retrospectively into two groups: those who were always controlled face-to-face (face-to-face group, group 1/FTF) and those who were controlled on 1 or more occasions telematically (hybrid group, group 2/HG). Both groups were from the same period, but the changes in mobility restrictions during the first year of pandemia, patient medical history, age and patient priorities could influence the type of visit. In telematic control all the tests were performed by an optometrist in a safety way, keeping security distance and in different clinics hours, avoiding patient accumulation in the waiting area. Later, a telephone call with the results was done by the ophthalmologist. We did not consider telephonic calls without tests during the first months of the pandemic as telematic visits. All patients were stratified into groups according to glaucoma severity according to VF parameters (mild MD >-6 dB, moderate MD between -6 and -12 dB and advanced MD >-12 dB) to avoid possible bias in the severity of glaucoma.

The hypothesis of the study is that there are no differences in glaucoma progression between groups. The primary outcome was to determine the changes in VA, IOP, VF, RNFL and macular OCT parameters prior to the pandemic and 2 years after the pandemic and compare them according to whether the control was only Face-To-Face (FTF) or mixed with telematic controls (HGs). As secondary outcomes, we compared the number of visits, number of interventions and changes in medication in both groups.

Statistical Analysis

This was a retrospective analysis in which we had two groups. The main variable was the visual field mean Defect (dB) before and after the pandemic. We considered a difference greater than 1 dB in both groups, which would be a value greater than the possible physiological loss, to establish that there were significant differences. The sample size was calculated with G-Power software. Assuming an alpha error of 0.05 in a two-tailed distribution, 200 participants were needed. Normality was assessed by graphical distribution. The mean difference between groups (prepandemic and two-year follow-up) was evaluated with two-sided ANOVA and a mixed effect model considering each subject as a random variable. The Chi-square test was used for qualitative variables.

Results

This retrospective analysis included 204 eyes from 118 patients, 100 from face-to-face controls (group 1/FTF) and 104 from telematic controls (group 2/HG). There were no significant differences between the groups in age, sex, prepandemic BCVA or VF or OCT parameters. There were only differences in glaucoma severity, with more cases of severe glaucoma in group 1/FTF and more cases of mild glaucoma in group 2/HG (p=0,028). All demographic data are described in Table 1.

		Group 1/FTF	Group 2/HG	Total	p
Age	years, Mean (SD)	71.2 (12.5)	68.5 (13.7)	69.8 (13.2)	0.144
Gender	male (n)	45	48	93	0.889
	female (n)	55	56	111	
Glaucoma Severity	mild (n)	41	51	92	0.028
	moderate (n)	18	28	46	
	severe (n)	41	25	66	
Visual acuity	Mean (SD)	1.0 (2.3)	0.8 (0.2)	0.9 (1.6)	0.348
Visual field (MD)		-10.1 (7.1)	-8.4 (6.9)	-9.2 (7.1)	0.096
Visual field (VFi)	%, Mean (SD)	75.0 (22.8)	79.4 (20.9)	77.2 (21.9)	0.153
Intraocular pressure	mmHg, Mean (SD)	16.5 (5.6)	15.9 (4.5)	16.2 (5.1)	0.350
OCT- RNFL (AT)	microns, Mean (SD)	66.6 (13.1)	69.9 (13.3)	68.2 (13.3)	0.086
OCT-GC (AT)	microns, Mean (SD)	65.0 (9.3)	67.5 (8.9)	66.2 (9.2)	0.087

Table 1: Prepandemic demographic data in both groups (FTF: Face-To-Face group; HG: Hybrid Group; MD: Mean Deviation; VFi: Visual Field Index; OCT-RNFL: Optical Coherence Tomography Retinal Nerve Fiber Layer Parameter; AT: Average Thickness; OCT-CG: Optical Coherence Tomography Ganglionar Cells Parameter; SD: Standard Deviation).

At the two-year follow-up, in the 2/HG group, an average of 3.37 face-to-face visits and 1.27 telematic visits were made, while in the 1/FTF group, an average of 4.4 face-to-face visits were made (p=0,001).

There were no significant differences in VA, average thickness of the peripapillary RNFL or ganglion cells measured by OCT, or visual field parameters (VFI and MD) between prepandemic and postpandemic patients. There was a significant difference in IOP, which decreased in the 1/FTF group (-1,3 ± 5,1 mmHg) and increased in the 2/HG group (+0,4 ± 4,6 mmHg) (p=0.008). There were more medication changes in the face-to-face group than in the hybrid group, but the difference was not significant.

The number of interventions was greater in the face-to-face group than in the hybrid group and this difference was significant (p=0.001). In the FTF group, we performed 15 cases of deep sclerectomy, two of which were reconstructed to trabeculectomy, for a total of 4 goniopunctures and 4 needlings. We performed 3 trabeculectomies, two of which involved XEN and one of which involved the use of the Ahmed valve. In the HG group, we performed 3 cases of deep sclerectomy, two cases of bleb revision and one case of XEN. In the HG group, we performed an intervention in 12.9% of patients and 33% had a medication change compared with the FTF group, with an intervention rate of 33% and a medication change of 44%.

All these differences are described in Table 2 and Fig. 1.

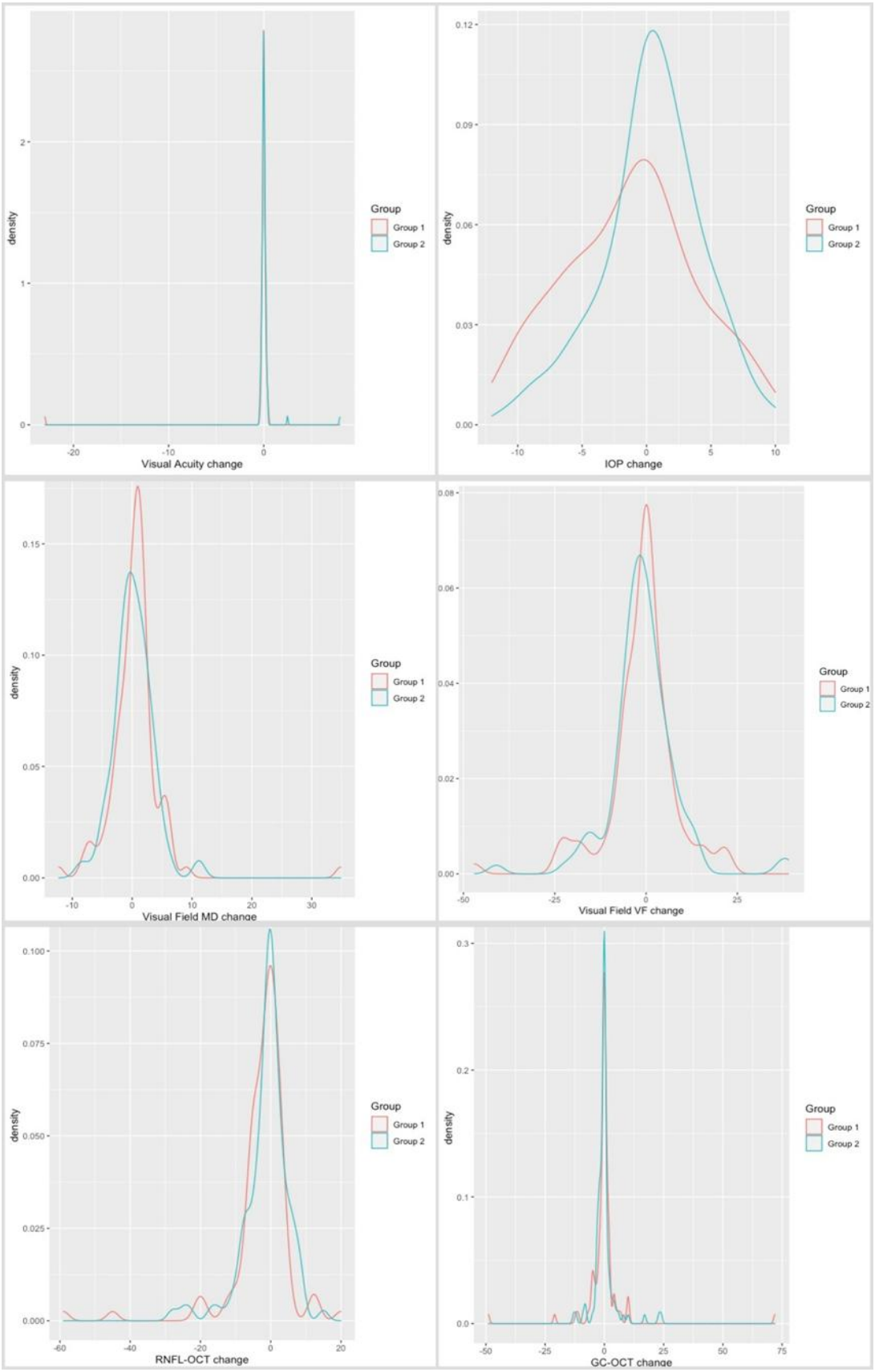

Figure 1: It shows parameters mean change distribution between pre-pandemic time point and 2 years after it between two groups (group 1: face-to-face; group 2: telematic) These parameters were: visual acuity, IOP: Intraocular Pressure, VF: Visual Field, MD: Mean Deviation, VF: Visual Field Index, RNFL-OCT: Retinal Nerve Fiber Layer-OCT, GC-OCT: Macular Ganglionar Cells OCT).

		Group 1/FTF	Group 2/HG	Total	p two-sided ANOVA	p Mixed-Effect Model
IOP change	mmHg, Mean (SD)	-1.3 (5.1)	0.4 (3.9)	-0.5 (4.6)	0.008	0.009
Visual acuity change	Mean (SD)	-0.2 (2.3)	0.1 (0.8)	-0.1 (1.7)	0.175	0.175
Visual field (VFi) change	%, Mean (SD)	-1.1 (9.6)	-0.8 (9.5)	-1.0 (9.6)	0.777	0.776
Visual field (MD) change	dB, Mean (SD)	0.6 (4.8)	0.2 (3.2)	0.4 (4.0)	0.483	0.483
OCT-RNFL (AT) change	microns, Mean (SD)	-2.5 (9.2)	-1.3 (6.5)	-1.9 (8.0)	0.29	0.338
OCT-CG (AT) change	microns, Mean (SD)	-0.2 (9.6)	-0.0 (4.8)	-0.1 (7.5)	0.872	0.307
Interventions	no	67	91	158	0.001	NA
	yes	33	13	46		
Medication change	no	56	70	126	0.113	NA
	yes	44	34	78		

Table 2: Differences in variables in both groups between prepandemic stage and 2 years later (FTF: Face-To-Face group; HG: Hybrid Group; MD: Mean Deviation; VFi: Visual Field Index; OCT-RNFL: Optical Coherence Tomography Retinal Nerve Fiber Layer Parameter; AT: Average Thickness; OCT-CG: Optical Coherence Tomography Ganglionar Cells Parameter; SD: Standard Deviation.

According to glaucoma severity, there were no prepandemic differences between the FTF and HG groups in terms of sex, visual BCVA, IOP, VF or OCT parameters. There was a difference in the mean age of patients in the severe glaucoma group. Patients in the HG group were younger than those in the FTF group (64.7 vs 72.1) (p=0,016). Patients with severe glaucoma had lower IOP than patients with mild glaucoma and this difference was significant (p=0,001). There were no differences in IOP, BCVA, VF or OCT parameters between pre- and postpandemic controls at any of the three severity stages. The number of interventions was significantly greater for moderate glaucoma patients in the face-to-face group (p=0,001). There were no significant differences in the use of glaucoma medications.

Discussion

Our work compared functional and structural changes in patients with POAG who underwent telematic consultations during the COVID-19 pandemic.

Several studies have been conducted on the use of telemedicine for glaucoma screening or management. They found that telemedicine can improve access to care for glaucoma patients. In a survey conducted by Zwinbelberg, et al., the acceptance of telemedicine in patients with chronic open-angle glaucoma was high, at 74%. In another study performed by Rhodes, 71% of patients agreed or were neutral to receiving telediagnosis and 74% of patients agreed or were neutral to receiving teleintervention [13,14].

Most of the published data about telemedicine in glaucoma are related to glaucoma screening. The Philadelphia Telemedicine Glaucoma Detection and Follow-up Study demonstrated that eye screening in high-risk populations requires adequate pathological detection and warrants direct referral to community ophthalmologists with a cost-limited screening protocol [15]. Anton, et al., designed a study in which the combination of OCT images and fundus photographs achieved high specificity and predictive value in glaucoma detection and recently reported the cost-effectiveness of screening for open angle glaucoma compared with opportunistic case findings [16,17].

In terms of glaucoma control less data is available. We haven't found differences in both groups in RNFL and macular ganglion cells in OCT and visual field parameters between prepandemic and 2 years follow up. In a previously published study by Bobeck S Modjtahedi, in which patients suspected of having glaucoma were monitored telematically, only five of 225 patients were referred for further clinical evaluation due to concern for progressive RNFL loss and 92.5% attended their 2-year follow-up visit

[18]. Additionally, in a study from Sanayei, et al., including hybrid visits with tests and virtual clinics for patients with glaucoma or retinal diseases, only 2.7% of visits led to a procedure, 2.3% led to a change in medication and 4.7% were referred for nonurgent consultation [19]. In our study, 12.9% of patients in the HG group underwent a procedure and 33% had a medication change. This difference could be attributed to the severity of glaucoma in our patients. The grade of severity is not documented in the work of Senayei.

We found an increase in IOP in the HG group compared to the decrease in the FTF group, which was not found in the severity subgroup analysis. This could be explained by the lower rate of interventions in the HG group and the lower rate of medication changes. However, these differences in IOP may not be clinically relevant in mild glaucoma patients but could be significant in more severe cases.

One of the limitations of our study is that we included patients with severe glaucoma in the analysis. Due to more severe disease, more intensive care with a greater number of interventions is needed. As this was a preliminary analysis 2 years after the start of the pandemic, only 1 or 2 telematic visits were made in the HG group, alternating with face-to-face visits. This does not diminish the value of the results since it would show that telemedicine in our clinic supports us in monitoring the patient, always alternating it with face-to-face visits. Otherwise, telemedicine should not be considered a replacement for in-person visits. It complements it and its usage should be individualized based on the patient's needs.

Conclusion

Telematic management of the glaucoma clinic is a useful tool in the glaucoma unit. According to our results, it provides safer clinical care for mild glaucoma patients than for moderate and severe glaucoma patients (as our results showed that the FTF group had more interventions and medication changes) and can be useful for maintaining quality in periods of saturation of face-to-face consultations or times in which face-to-face control is completely impossible. Longer-term studies with larger patient populations are necessary to determine the impact of telemedicine on glaucoma management and to effectively leverage the available and upcoming technologies. As a conclusion, telemedicine with a complete program including functional and anatomic tests can provide safe care in terms of glaucoma progression to patients when it alternates with face-to-face visits.

Conflict of Interest

The author declares no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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