

Teleconsultation as a follow up tool for ophthalmic cases: Effect on diabetic retinopathy, amblyopia, age related macular degeneration and glaucoma

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Short title: Teleconsultation as a follow up tool for ophthalmic cases

Abstract:

Purpose: To evaluate the reliability and utility of teleconsultations in following up patients with ophthalmic complaints during the COVID-19 lockdown.

Patients and Methods: This retrospective study was carried out on 298 eyes of 149 individuals with different ophthalmic complaints at Ophthalmology department from March 2020 to November 2020. Cases were divided into three groups: glaucoma, refractive errors with amblyopia, and retinal pathology patients. Comparison in the clinical outcome (examination and investigations) before starting teleconsultation and after resuming normal in-person attendance to clinics was carried out.

Results: Regarding refractive error and amblyopia cases, Amblyopia improved in 38.7% of the cases while worsened in 22.6% of cases and rest of the cases had stationary course. In glaucoma patients, visual acuity was nearly the same after follow up in both eyes. However, IOP (Intraocular pressure) increased (right eye 15.4 to 17, p value 0.003) and (left eye 16 to 17, p value 0.134), RNFL (Retinal nerve fiber layer) decreased (right eye 92.37 to 85.30, p value 0.001 and (left eye 92.36 to 87.50, p value 0.03), and rim area decreased (right eye 1.35 to 1.28, p value 0.004 and left eye 1.37 to 1.28, p value 0.001). In retinal pathology cases, despite that 78% of the patients did not have any complaint during the pandemic, these patients had Vitreous hemorrhage (15.7%), Macular edema worsen (3.4%), New NVEs (neovascularization elsewhere) (2.2%), Vitro-macular traction (1.1%), and Vitreoretinal proliferation (2.2%) and Six (6.7%) patients required surgical intervention.

Conclusion: Tele-ophthalmology showed satisfactory results as a follow-up tool for patients with refractive errors, glaucoma and retinal diseases, allowing adherence in follow-ups despite the many restrictions imposed throughout the COVID-19 pandemic.

Key-Words: Amblyopia; Covid-19; Diabetic Retinopathy; Glaucoma; Telemedicine.

INTRODUCTION:

Within the context of the pandemic caused by the coronavirus disease 2019 (COVID-19), ophthalmic care has undergone significant transformations. As a result of social distance restrictions, patient visits & clinic workflow have been significantly impacted & office-based operations have been restricted to just dealing with urgent cases. In order to reduce the likelihood of patients experiencing illnesses that could potentially cause vision loss, medical practices have

begun providing healthcare services remotely through the use of teleconsultation¹.

One definition of teleconsultation is "remote consultation," which describes the interactions that take place between a physician & an individual as a method of providing diagnostic or therapeutic guidance through the use of electronic means².

Prior to this, the majority of telemedicine in ophthalmic practice was implemented through the use of 'store-and-forward' methods. These techniques were most commonly

utilized for tele-emergency consults & screenings for diabetic eye disorder & retinopathy of prematurity³. When it comes to the detection & monitoring of neovascular age-related macular degeneration (AMD) & screening for glaucoma, store-& -forward telemedicine has also been attempted. This is accomplished through the use of digitally transmitted images^{4,5}.

Due to the absence of biomicroscopic evaluation & the necessary complicated investigations for diagnosis & therapy, remote consultation in the field of ophthalmology presents a number of challenges. But when it comes to assessing individuals who have already been diagnosed, teleophthalmology might be more convenient¹.

The purpose of this research was to evaluate the reliability & utility of teleconsultation in following up individuals with ophthalmic complaints during the COVID-19 lockdown.

SUBJECTS AND METHODS:

This was a retrospective research performed on 298 eyes of 149 individuals with different ophthalmic complaints at Ophthalmology department from March 2020 to November 2020.

Inclusion criteria: Patient's age > 5 and <75 years old, Male and female patients both included, Diabetic patients who have diabetic retinopathy changes documented, Children with refractive error with one or two eyes amblyopia, Confirmed Glaucoma patients on treatment, Confirmed dry and wet age-related macular degeneration and Patients with confirmed ophthalmic diagnosis.

Exclusion criteria: Patient's age <5 and >75 years old, diabetic patients which have no diabetic retinopathy changes yet, Ocular hypertension patients (not confirmed glaucoma) and Children with refractive errors but no amblyopia.

Methods

Patients in this study were divided into five main sub-groups and be subjected to the following accordingly:

Diabetic retinopathy patients: Patient's history was reviewed, Classify the patients to proliferative and non-

proliferative diabetic retinopathy, Comparison between last visit to the clinic before Covid-19 lockdown and first visit to the clinic after the lockdown, Comparison aspects (Visual acuity, funduscopy and Optical Coherence Tomography (OCT) macula) and history of Confirmed Covid-19 infection during the lockdown.

Patients with refractive error and one eye or two eyes

amblyopic: The patient's history was reviewed, comparing their last visit to the clinic before and after the lockdown, and their visual acuity, refraction, and amblyopia improvement or worsening.

Confirmed glaucoma patients on medications: Patient's history was reviewed. Comparison between last visit to the clinic before Covid-19 lockdown and first visit to the clinic after the lockdown. Comparison aspects (intra-ocular pressures, Retinal nerve fiber layer thinning and rim area in OCT disc). History of Confirmed Covid-19 infection during the lockdown period.

Age-related macular degeneration: The patient's history was reviewed to classify them into dry and wet age-related macular degeneration, and their visual acuity and OCT macula were compared before and after the Covid-19 lockdown.

Ischemic events (Central retinal artery occlusion, Central retinal vein occlusion, Branch retinal vein occlusion): The patient's history was reviewed, classification based on diagnosis, comparison between clinic visits before and after lockdown, visual acuity and OCT macula, and confirmed Covid-19 infection history.

RESULTS:

Regarding refractive error cases, mean age was 11.6 years old .67.8% of the cases had hypermetropia, 25.8% had myopia, and 77.4% had astigmatism. Only 54.8% of amblyopia cases were compliant with patching (**Table 1**). We recorded only three positive COVID cases. After follow up, cycloplegic refraction, the spherical diameter significantly changed (rt eye 1.09 to 0.75, p value 0.03 and lt eye 1.55 to 1.20, p value 0.07) (**Table 2**).

Table 1: Baseline characteristics in refractive error cases.

Variables			
	Age*	11.6	±3.4
		11.0	2--18
Diagnose n,%	Hypermetropic	21	67.8%
	Myopic	8	25.8%
	Astigmatism	24	77.4%
Compliance with patching n, %		17	54.8%
Covid cases n, %		3	9.7%

*Data showed as Mean ± SD \ Median, Range

Table 2: Follow up of refractive error cases.

Variable	Rt eye				P value	Lt eye				P value
	Before		After			Before		After		
VA n, %	6	8	25.8%	11	35.5%	6	19.4%	5	16.1%	
	6 to 12	16	51.6%	18	58.1%	19	61.3%	20	64.5%	
	12 to above	7	22.6%	2	6.5%	6	19.4%	6	19.4%	
Cycloplegic refraction*	Spherical.	1.09	3.56	0.75	3.94	1.55	4.09	1.20	4.41	
		1.50	(-8)-6.75	1.25	-9.50-6.75	0.03	1.50	-8.75-10.75	1.50	-9.50-10.75
	Cylindrical	-1.60	1.15	-1.58	1.20	-1.70	1.23	-1.71	1.22	
		-1.25	(-5)-(-0.5)	-1.00	(-5)-(-0.5)	0.59	-1.25	(-4.75)-(-0.5)	-1.25	(-4)-(-0.5)

*Data showed as Mean ± SD \ Median, Range, VA: Visual acuity, Rt: right, Lt left

Amblyopia improved in 38.7% of cases while worsened in 22.6% of cases and the rest had stationary amblyopia. In term of squint, there was significant change in squint percentage after follow up p=0.001 (**Table 3**).

Table 3: Follow up of refractive error cases.

Variable	Before	After	P value
Amblyopia n,%	Both eyes	10	32.3%
	One eye	21	67.7%
Squint n,%	Better	12	38.7%
	Same	12	38.7%
	Worse	7	22.6%
Squint n,%	Esotropia	7	22.6%
	Exotropia	3	9.7%
	Orthophoric	21	67.7%

In glaucoma cases, Visual acuity was nearly the same after follow up in both eyes. We observed significant change in certain parameters: IOP (Intraocular pressure) increased (rt (right)eye 15.4 to 17, p value 0.003) and (lt(left) eye 16 to 17,

p value 0.134), RNFL (Retinal nerve fiber layer) decreased (rt eye 92.37 to 85.30, p value 0.001 and Lt eye 92.36 to 87.50, p value 0.004 and Lt eye 1.37 to 1.28, p value 0.001). (Table 4).

Table 4: Follow up of glaucoma cases.

Variable	Rt eye				P value	Lt eye				P value
	Before		After			Before		After		
VA, n, %	6	12	40.0%	12	40.0%	15	50.0%	13	43.3%	
	6 to 12	14	46.7%	12	40.0%	12	40.0%	14	46.7%	
	12 to above	2	6.7%	4	13.3%	1	3.3%	1	3.3%	
	CF	2	6.7%	2	6.7%	1	3.3%	1	3.3%	
	NPL	0	0	0	0	1	3.3%	1	3.3%	
IOP*	15.4	±4.4	17.0	±4.3		16	±5	17	±4	
	14.0	9--27	16.0	10--28	0.003	15	10--27	16	11--28	0.134
CD ratio*	0.46	±0.18	0.51	±0.19		0.48	±0.17	0.53	±0.19	
	0.40	0.2--0.9	0.50	0.2--1.0	0.06	0.40	0.2--0.9	0.50	0.07--0.9	0.08
RNFL*	92.37	±23.72	85.30	±23.30		92.36	±23.61	87.50	±20.62	
	100.50	42--126	87.50	40--121	0.001	96.50	35--130	87.50	49--121	0.03
Rim area*	1.35	±0.57	1.28	±0.56	0.004	1.37	±0.55	1.28	±0.53	
	1.34	0.4--3.1	1.30	0.46--3.1		1.21	0.39--2.8	1.21	0.39--2.70	0.001

*Data showed as Mean ± SD \ Median, Range, VA : visual acuity , IOP : Intraocular pressure , CD ration::cup to disc ratio , RNFL Retinal nerve fiber layer , Rt :right , Lt left

There was significant decrease in right eye CMT and significant decrease in left average thickness after follow-up in retinal disease cases p=0.003 (Table 5).

Table 5: Eye assessment in retinal disease cases.

Variables	Rt eye				Lt eye				P value
	Before		After		Before		After		
6	5	5.6%	3	3.4%	10	11.2%	9	10.1%	
6 to 12	40	44.9%	39	43.8%	39	43.8%	31	34.8%	
12 to	37								
VA, above		41.6%	38	42.7%	36	40.4%	38	42.7%	
n,% CF	3	3.4%	2	2.2%	2	2.2%	5	5.6%	
NPL	2	2.2%	2	2.2%	2	2.2%	2	2.2%	
PL	2	2.2%	2	2.2%	0	0	1	1.1%	
HM	2	2.2%	0	0	0	0	2	2.2%	
	16.5	±3.2	16.5	±3.0	16.9	±3.1	17.0	±4.2	
IOP*	15.5	10--30	16.0	10--27	16.5	10--27	16.0	9--40	
					0.97				0.78
	353.0	±124.0	312.0	±105.0	343	±132	333.2	±194.3	
CMT*	309.0	188--873	290.0	114--639	300	158--879	301.0	115--1856	
					0.03				0.57
	367.6	±128.9	335.2	±84.0	339.9	±118.6	298.0	±129.0	
Average thickness*	317.0	197--808	314.0	209--627	322.0	139--931	290.0	107-1031	
					0.05				0.003

Data showed as Mean ± SD \ Median, Range, VA: Visual acuity , IOP : Intraocular pressure , CMT :central macular thickness ,CF: Counting fingers , NPL :No perception of light , PL: perception of light , HM: Hand motion. Rt: right, Lt left

Patient's complaints were in the form of floaters (5.6%), (3.4%), New NVEs (neovascularization elsewhere) (2.2%), blurring of vision (6.7%) diminution of vision (7.9%) and Vitreous hemorrhage (15.7%), Vitro-macular traction (1.1%), (78%) had no complain. However, we detected new changes and Vitreoretinal proliferation (2.2%). Six (6.7%) patients in funds examination in the follow up; Macular edema worsen required surgical intervention (**Table 6**).

Table 6: Eye assessment in retinal disease cases

Variables			
	Covid cases, n,%	6	6.7%
	EMD visit, n,%	15	16.9%
Complain, n,%	Floaters	5	5.6%
	Blurring of vision	6	6.7%
	Diminution of vision	7	7.9%
	No complain	70	78.6%
Fundus examination changes, n,%	Macular edema worsen	3	3.4%
	New NVEs	2	2.2%
	Vitrous hemorrhage	14	15.7%
	Vitromacular traction	1	1.1%
	Vitreoretinal ptoliferation	2	2.2%

NVEs: neovascularization elsewhere.

DISCUSSION:

Remote consultation, often known as teleconsultation, is a term that describes interactions between a clinician & an individual that take place through the use of electronic means in order to provide diagnostic or therapeutic guidance^{2,6}.

The main results of our study were as following:

Among 30 glaucoma patients included in this study VA was nearly the same after follow up in both eyes. A significant change was observed in certain parameters: IOP increased, RNFL decreased, and rim area decreased significantly.

A retrospective examination of individuals who were enrolled in a glaucoma suspect telemedicine monitoring program throughout the first two years of the program was carried out. This research was in agreement with the previous research. It was detected that 2.3% of the patients had RNFL loss globally at 1 year follow up and 1.5% of the patients had RNFL loss at 2-year follow up. There was not a single patient who was sent to the clinic due to visual loss or increased IOP. Also, among a sample of patients with glaucoma included in Jones et al. study, it was found that home monitoring of VFs was viable with earlier and more reliable detection of disease progression⁷.

An implanted telemetry sensor was used to do monitor intraocular pressure (IOP) remotely in individuals with glaucoma throughout the lockdown for the coronavirus disease 2019 (COVID-19).

Mansouri et al. investigated the feasibility & utilization of this kind of monitoring. Among 37 patients glaucoma patients included in Mansouri et al. study, Ocular hypotensive drugs would have been increased in eight percent of cases as a result of substantial changes in intraocular pressure and the failure to meet IOP objectives. It would have prompted an additional office appointment for 5.4 percent of individuals to verify IOP & discuss any apparent concerns with adherence. Regarding the other 64.8 percent of individuals, it was determined that the condition was under control, & there was no appointment set for a visit to the clinic. During the COVID-19 epidemic, nine out of ten centers felt that remote IOP measurements were beneficial. This was the response to the question⁸.

Regarding refractive error cases, after follow up, VA improved especially in the right eye. In term of cycloplegic refraction, the spherical power significantly changed.

A smartphone-based refraction system was utilized in the research carried out by Tousignant et al., The outcomes of this system were compared with the results obtained by professional refraction. Refraction from the Netra device, whether performed by an untrained or trained refractor, resulted in overcorrection of myopia & less visual comfort when compared to professional subjective refraction, according to the findings of their comparison investigation⁹.

In the present study only 54.8% of amblyopia cases were compliant with patching. Amblyopia improved in 38.7% of cases while worsened in 22.6% of cases and the rest had stationary amblyopia. In term of squint, there was significant change in squint percentage after follow up.

In agreement with this study a previously conducted study found that teleophthalmology was not effective in treating squint¹⁰.

Among 89 cases with retinal disease included in this follow up; deterioration of VA in certain cases up to PL and HM was reported. Furthermore; on recording OCT changes, it was found that patients complained of floaters (5.6%), blurring of vision (6.7%) and diminution of vision (7.9%). Additionally, we detected new changes in funds examination in the follow up; Macular edema worsen, (3.4%), New NVEs (2.2%), Vitreous hemorrhage (15.7%), Vitreomacular traction (1.1%), and Vitreoretinal proliferation (2.2%). Six (6.7%) patients required surgical intervention.

Teleophthalmology was evaluated as a potential method for the screening & monitoring of neovascular AMD in the research that was carried out by Li et al. The end-of-research visual acuities of individuals who got teleophthalmologic follow up were not observed to vary from those of individuals who received regular follow up (P =.99). This was the conclusion reached by the researchers¹¹.

According to the findings of Hautala et al. research, the rate of visual impairment caused by DR rose by 86 percent in the region that was serviced by a mobile eye screening unit that made use of telemedicine technology¹².

Another investigation came to the conclusion that teleophthalmology achieves the same intended therapeutic

effect as the traditional method when it comes to individuals who have vascular proliferative disease (ROP, DR, ARMD, etc.) & optic nerve disorders, as glaucoma¹³.

CONCLUSION:

Teleophthalmology showed satisfactory results as a follow up tool for patients with refractive errors, glaucoma and retinal diseases, allowing adherence in follow ups despite the many restrictions imposed during the COVID-19 pandemic.

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Data Availability: The authors declare that all data supporting the findings of this study are available within the article and its supplementary information file.

Competing interests: The authors declare no competing interests.

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Conflict of interest

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