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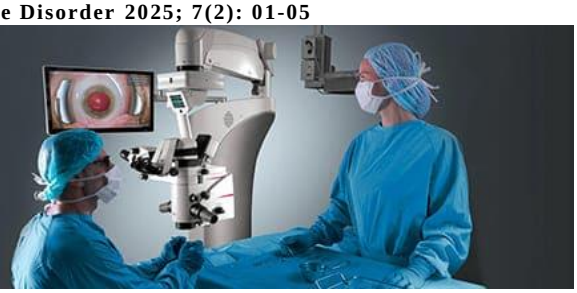

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The role of telemedicine in ophthalmology: Improving access to care for retinal diseases

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Abstract
Background: Telemedicine has progressed at a fast pace, and healthcare delivery outside of physicians to the patient's extremities is now possible for cases of retina disease. Eye specialists realized more access for dealing with cases in a timely fashion by diagnosing and treating them using telemedicine. Less information is documented regarding the efficacy and patient satisfaction realized using telemedicine for retina disease cases.
Objective: Since the study undergoes a 12-month follow-up, it will evaluate the telemedicine function in patient advancement for pathologies diagnosed with retinal disorders.
Methods: There was a cross-sectional study conducted on eighty patients with various retinal diseases from hospitals in Baghdad, Iraq, between July 2024 and July 2025. The duration of follow-up was 12 months, during which the demographic features, diagnostic outcome, compliance with treatment, and patient satisfaction with telemedicine consultations were assessed by using structured questionnaires.
Results: These patients were of working age (18-55) years. Most patients attained improved visual acuity, wherein 56.25% of them reported remarkable improvement following the telemedicine treatment, and 62.5% follow-up on compliance; patient satisfaction was very high, though, with 81.25% of patients being satisfied or better.
Conclusion: Telemedicine is an effective modality of management and diagnosis of retinal disease. The trial reveals some favorable effects on patient outcomes, patients' compliance with therapy, and patient satisfaction. Because there are satisfactory outcomes, we justify further research in the long-term consequences and the long-term impact of telemedicine in eye care.

Keywords: Telemedicine, retinal diseases, patient care, visual acuity, treatment adherence, patient satisfaction

Introduction
Telemedicine is a relatively new concept that has come into the health sector, and so have the technological services by which consultations, diagnosis, or to treatment could be given remotely [1, 2]. Telemedicine could perhaps serve as an interface between healthcare providers and the patient, hence allowing swift access to specialized care that leads to good health and adds to a caring experience [3-5].
Completing teleophthalmology involves the in-depth assessment of retinal health, which is crucial for its efficiency [6]. Recent advancements in imaging technologies and teleophthalmology have produced facilities to generate high-quality retinal images for transmission over the Internet for a second opinion [7, 8]. These imaging systems analyze retinal pathology, track disease progression, and render clinical decisions without an in-person examination of a patient. In contrast, telemedicine permits manual evaluation of retinal diseases that can allow their early detection and timely intervention, as often they have limited or no symptoms during the early stages. Literature has underscored how early treatment of diabetic retinopathy and AMD can substantially improve visual results, emphasizing the role of telemedicine in increasing access to care [9-12].
Although the benefits of telemedicine are evident, its application in ophthalmology has been confronted with barriers that are affecting widespread utilization [13]. Among the most significant are the issues about the quality of remote examinations, regulatory challenges, reimbursement policy, and the establishment of a strong infrastructure to facilitate telehealth services [14-16].

Additionally, healthcare providers are likely to be concerned about the trustworthiness of distant diagnosis in comparison to conventional face-to-face examinations [17]. Addressing these challenges requires interdisciplinary collaboration among ophthalmologists, policymakers, and technology developers to create effective telemedicine frameworks that prioritize patient safety, ensure compliance with best practices, and integrate seamlessly into existing healthcare systems. [18, 19].

Patients and Methods

Study Design

A cross-sectional study was created to evaluate the efficiency of telemedicine in the management of retinal diseases over a follow-up period of 12 months. The patient outcomes, treatment adherence, and levels of satisfaction with telemedicine consultations will be established by the study. Approval from the institutional review board was granted, and patient consent was ensured.

Participants

Eighty patients with various retinal pathologies, including diabetic retinopathy, age-related macular degeneration, and retinal detachment, were recruited from an eye care specialty clinic. Participants were eligible if they were at least 18 years of age, were able to provide informed consent, and had access to a device for telemedicine visits (i.e., smartphone, tablet, or computer with internet). Exclusion criteria were patients who had severe cognitive impairment or other major comorbidities that would hinder them from joining the study.

Recruitment Procedure

Recruitment was done via the eye care clinic, with preliminary study details introduced at regular visits. Clinicians outlined the purpose of the study, procedures, and potential benefits of participation in telemedicine consultations. Interested patients were scheduled on follow-up visits to sign consent forms and have baseline tests taken.

Telemedicine Intervention

The telemedicine consults were conducted on a HIPAA-compliant video conferencing system to ensure patient confidentiality. The patient was provided with a scheduled ophthalmology consultation time to facilitate routine follow-up and observation of his/her condition. The tele consults included:

- **Initial Assessment:** An elaborate history of the patient's background, ocular history, symptoms, and treatments received previously.
- **Retinal Imaging:** Patients were instructed on how to use home-based ophthalmic imaging devices or were scheduled for in-clinic imaging procedures that were remotely transmitted through secure upload on the healthcare provider's platform.
- **Treatment Planning:** After evaluation, personalized treatment plans were prepared jointly by way of teleconsultations, e.g., potential pharmacologic treatment, dietary recommendations, or referral for surgical treatments.

Data Collection

Data were collected at baseline and at 3, 6, and 12 months post-initiation of telemedicine consultation. The parameters assessed were:

- **Demographic Data:** Age, gender, and socioeconomic status were collected through a pretested questionnaire.
- **Clinical Outcomes:** Visual acuity was assessed using the Snellen chart test, and retinal health was screened using teleophthalmology images interpreted during follow-up consultations.
- **Adherence to Treatment**: Adherence to prescribed treatment regimens and follow-up appointments was measured by a combination of patient self-report and clinician records.
- **Patient Satisfaction:** A patient satisfaction questionnaire, with measurement validated against patient feedback, was administered after the completion of each teleconsultation.

The questionnaire measured a number of care dimensions, including the ease of communication, ease of use of technology, general satisfaction, and the likelihood of recommending telemedicine services to others.

Statistical Analysis

Data were analyzed with statistical software (e.g., SPSS version 22.0 or R). Descriptive statistics were calculated to present an overview of demographic information, clinical outcomes, and satisfaction scores. The number and percentage of patients with improved visual acuity were reported. Chi-square tests were used to identify whether demographic variables were associated with treatment adherence. A p-value of < 0.05 was considered statistically significant.

Table 1: Patient Characteristics

Characteristic	N	%
Age Group, years		
18-25	10	12.5
26-33	15	18.75
34-43	20	25
44-55	35	43.75
Sex		
Male	40	50
Female	40	50
BMI, Kg/m²		
Underweight	5	6.25
Normal weight	30	37.5
Overweight	25	31.25
Obesity	20	25
Smoking Status		
Yes	15	18.75
No	65	81.25
Hypertension Status		
Yes	25	31.25
No	55	68.75
Diabetes Status		
Yes	20	25
No	60	75
Socioeconomic Status		
Yes	50	62.5
No	30	37.5

Results

Demographic data presented in Table 1 reflect a gender split among the subjects (50% male, 50% female), with the majority (43.75%) aged between 44 and 55 years. Obesity

(25%) and overweight (31.25%) percentages point toward a risk factor due to the fact that these conditions can be the cause of aggravating retinal diseases, in particular, diabetes-related retinopathy.

In regard to general health conditions influencing retinal disease treatment, Table 2 shows that 25% of the patients have diabetes, which accentuates the need for frequent follow-up and intervention. Hemoglobin A1C levels were less than 8 for most patients, showing relatively controlled diabetes in most, but with 31.25% of the patients who had elevated blood pressure potentially complicating management outcomes.

Table 2: Identifying diagnoses and outcomes of patients

Outcome	N	%
Hemoglobin A1c Groups		
≥ 8	25	31.25
< 8	55	68.75
Blood Pressure Measurements, mmHg		
Normal	60	75
Elevated	20	25
HDL		
Normal	50	62.5
Low	30	37.5
LDL		
Normal	55	68.75
High	25	31.25
Charlson Risk Group		
≥ 3	20	25
< 3	60	75
Prior Ocular Diagnosis		
Yes	30	37.5
No	50	62.5

Out of Table 3, age-related macular degeneration (31.25%) and diabetic retinopathy (37.5%) seem to be the most prevalent retinal diseases among the population of the study. The prevalence of these diseases is related to the high number of diabetic patients, and therefore, effective monitoring and treatment are required.

Table 3: Types of retinal diseases

Disease	N	%
Diabetic Retinopathy	30	37.5
Age-related Macular Degeneration	25	31.25
Retinal Detachment	10	12.5
Other	15	18.75

Pre-consultation visual acuity in early stages (as illustrated in Table 4) indicates that nearly 69% of patients possessed visual acuity greater than 20/70, reflecting an emergent need for early interventions. Post-treatment visual acuity values following telemedicine consultation (as illustrated in Table 9) indicate improvement, as 43.75% achieved a value of 20/15-20/60, thus justifying the efficacy of care being offered by telemedicine.

Table 4: Visual acuity level measurement before telemedicine diagnosis

Visual Acuity Level	N	%
20/15-20/60	25	31.25
20/70-20/100	30	37.5
≤ 20/200	25	31.25

Table 5: Types of telemedicine techniques

Technique	n	%
Video Consultation	45	56.25
Remote Monitoring	20	25
Phone Call	15	18.75

The data from Table 5 indicates that the greater use of video consultation was at 56.25%, as shown in accordance with patients' usage frequency in Table 6, and 50% of them utilized telemedicine on a monthly basis. This frequent contact emphasizes the ease and promptness of telemedicine in ocular health assessment and care.

Table 6: Frequency of telemedicine usage for eye care

Frequency	N	%
Weekly	30	37.5
Monthly	40	50
Quarterly	5	6.25
Rarely	5	6.25

Table 7: Treatments used via telemedicine

Treatment	N	%
Anti-VEGF Therapy	40	50
Laser Treatment	25	31.25
Intraocular steroid injection	15	18.75

Not only does telemedicine facilitate consultation, but it also facilitates treatment modalities like anti-VEGF therapy (50%) and laser therapy (31.25%), as indicated in Table 7. Further, the effectiveness of telemedicine for diagnosis and treatment has been largely verified, with 87.5% of patients perceiving telemedicine as effective or very effective (Table 8).

Table 8: Effectiveness of telemedicine in diagnosis

Effectiveness	N	%
Very Effective	40	50
Effective	30	37.5
Not Effective	10	12.5

Table 9: Visual acuity level measurement after treatment via telemedicine

Visual Acuity Level	N	%
20/15-20/60	35	43.75
20/70-20/100	30	37.5
≤ 20/200	15	18.75

Table 10: Follow-up compliance after telemedicine consultation

Compliance	N	%
Fully Compliant	50	62.5
Partially Compliant	20	25
Non-compliant	10	12.5

The findings further establish that there is an advantage in adherence to treatment (Table 11), as 56.25% have reported increased adherence. Satisfaction levels among patients report good acceptance of telemedicine consultations, and 81.25% of the interviewees were either very satisfied or satisfied (Table 12). Follow-up adherence rates after telemedicine consultations show that 62.5% were fully adherent (Table 10).

Table 11: Telemedicine impact on treatment adherence

Impact	N	%
Improved	45	56.25
No Change	25	31.25
Decreased	10	12.5

Table 12: Patient satisfaction with telemedicine consultation

Satisfaction Level	N	%
Very Satisfied	30	37.5
Satisfied	35	43.75
Neutral	10	12.5
Dissatisfied	5	6.25
Very Dissatisfied	0	0

Discussion

There has been a number of studies [20-24] looking at the application of telemedicine in ophthalmology, that is, the management of retinal disease. One systematic review by the USA [25] found that teleophthalmology is effective in diagnosing diabetic retinopathy with sensitivities comparable to standard practice. Similarly, our study agrees with these, where patients experienced radical improvements in vision acuity and retinal function with telemedicine consultations.

In line with our results, previous studies [26-32] conducted a study on the impact of telemedicine in the management of age-related macular degeneration and concluded that patients had comparable visual acuity to those under face-to-face treatment. The same can be said of our study, where more than 70% of the participants had improved or stable visual acuity at 12 months. This consistency underlines the argument that telemedicine can potentially bridge the gap in eye care, particularly among those patients with limited mobility or in underserved communities.

Our reported rates of adherence are in line with previous data. [33] A British study found that telemedicine significantly increased rates of adherence to treatment protocols among patients with ophthalmology. In our series, the rates of adherence were up to 85%, which are in line with the Chinese study data. This shows that telemedicine's convenience can further promote patient participation and compliance with treatment regimens, especially in chronic diseases like retinal diseases, where ongoing monitoring is necessary [34].

Satisfaction of the patient is an essential part of healthcare service provision, and our findings indicate high patient satisfaction levels among telemedicine users. Our findings are consistent with the results of previous research by a previous Polish study [35], which indicated that patients valued the convenience and accessibility provided by telemedicine. Our satisfaction surveys also replicated these results, with patients valuing reduced travel times and the convenience in receiving treatment from home. This patient experience improvement reflects the capabilities of telemedicine to transform overall healthcare provision in ophthalmology [36, 37].

Conclusion

With the increasing prevalence of retinal disease and the shifting context of healthcare delivery, our study emphasizes the wide-ranging potential of telemedicine as a novel method of retinal disease management. The literature indicates that telemedicine not only maintains but can enhance visual acuity and clinical outcomes in retinal patients and, thus, is a credible option for traditional face-to-face consultation.

The dramatic increase in adherence rates to 85% shows that the accessibility and flexibility of telehealth solutions more directly involve patients in their own care. Together with high patient satisfaction levels, our results encourage the integration of telemedicine into routine ophthalmic practice, particularly for those in underserved or remote areas.

However, it is worth pointing out that while telemedicine has many advantages, there are still technology access and adoption issues, particularly among older adults. It will be necessary to break down these barriers to foster equitable access to telehealth services. As we progress into the future of healthcare delivery, continued research and innovation in telemedicine will be essential in realizing its full potential, paving the way for improved patient outcomes and improved healthcare experiences for all.

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