Telemedicine service for keratoconus monitoring: patient satisfaction and prospects for further expansion

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Abstract

Background: During the COVID 19 pandemic, Keratoconus patient care moved from in-person clinics to virtual care. We surveyed patients satisfaction with the new virtual clinic model.

Materials and Methods: We assessed the views of keratoconus patients enrolled in the novel virtual service between 1 June and 31 July 2020 in individual structured telephone interviews using Likert questions.

Results: Of the 88 patients enrolled, the opinions of 69 patients could be evaluated (78.4%). Compared to previous in-person visits, mean waiting times for diagnostic examinations dropped from 43 (±32) min to 4 (± 3) min ($p<0.001$). The majority of patients (68; 99%) were satisfied or very satisfied with the overall service irrespective of the communication channel (telephone or video). A majority also indicated a desire to continue attending the virtual keratoconus clinic after the pandemic and supported the idea of decentralized sites for future diagnostic measurements.

Discussion: A novel virtual service to monitor keratoconus progression was well received and was associated with shorter waiting times. There was a strong interest on the part of patients to further develop the virtual keratoconus clinic.

Conclusions: This study demonstrates that keratoconus patients managed very well the conversion from in-person to virtual care. A solid majority of keratoconus patients also supported further expansion of the virtual consultations to a completely decentralized telemedicine model.

Introduction

The Royal Victoria Eye and Ear Hospital (RVEEH) is the main tertiary provider for subspecialty eye disorders in Ireland. Patients with keratoconus are periodically followed for disease progression in a specialist keratoconus clinic. Hospital-based and led by an advanced nurse practitioner (ANP), this allows for in-person care and therapeutic intervention in cases of disease progression. However, government-imposed lockdown restrictions as part of the COVID-19 pandemic led to social distancing guidelines which prompted a restriction of face-to-face consultations, contact time, and physical proximity in routine ophthalmic assessments. To prevent a disruption in care during the pandemic, the keratoconus monitoring clinic was converted to a virtual clinic using telemedicine in the form of telephone or video consultations. During this time, patients underwent a structured interview that included both a subjective assessment and an evaluation of objective disease parameters. The primary goal of the interviews was to understand the patients' perspective and to derive recommendations for action for the further development of the clinic at the RVEEH. However, we believe that some of the insights gained should be of interest to a broader audience.

In this study, we therefore present an analysis of patient satisfaction with the externally imposed conversion from in-person care to telemedicine care and we derive recommendations for further expansion of the telemedicine system for the care of keratoconus patients.

Methods

We conducted a prospective single center study using individual structured telephone interviews with patients who had initially received face-to-face care through the established

keratoconus monitoring service and subsequently through the newly implemented virtual keratoconus clinic. Ethics approval for this project was granted by the RVEEH Ethics Committee.

Setting

The structures of the established keratoconus monitoring clinic and the newly implemented virtual keratoconus monitoring clinic are shown in Fig. 1. Both clinics were led by an ANP. The established keratoconus monitoring clinic (Fig.1, upper box) consisted of a visual acuity test (with spectacle correction), corneal tomography (Pentacam® HR, Oculus GmbH, Wetzlar, Germany), and a slit lamp examination. The results were then reviewed together with the patient and the patient was subsequently counseled regarding the next course of action.

The newly implemented virtual keratoconus monitoring clinic (Fig. 1, lower box) consisted of the same three steps, which were, however, separated from each other in terms of location and time. The abbreviated diagnostic step consisted of visual acuity testing and corneal tomography. In contrast to the established clinic, no slit-lamp examination was performed and the results were neither reviewed nor discussed with the patient immediately afterwards. In a second step, the data were reviewed by the ANP in the absence of the patient. The third step, consultation with the patient, was conducted about 5 days later by the ANP. The consultations in June 2020 were conducted by telephone, the consultations in July 2020 by video.

Questionnaire development and data collection

The questionnaire was based on the validated Telemedicine Satisfaction and Usefulness Questionnaire by Bakken et al.,[1] which was adapted to the setting of the RVEEH

by an expert panel of four cornea specialists and the ANP. The questionnaire was tested on four subjects to obtain the final form. It included demographic information, questions about the patient's satisfaction with the virtual keratoconus clinic appointment and as such, allowed a rating of the new virtual consultation in comparison with the familiar face-to-face consultations, and expectations and wishes for future follow-up appointments. We collected clinical data on the condition of the eyes and measured the time patients spent in the hospital.

Participant selection and survey administration

The patients cared for in the keratoconus monitoring clinic included all keratoconus patients except those who have received a corneal transplant. The patients were informed by means of an information letter about the reasons for the transformation of the in-person care into virtual care, as well as about the concrete workflow of the new virtual clinic.
Patients who attended the diagnostic visit of their first virtual keratoconus clinic between 1 June and 31 July 2020 were invited to participate in the survey. Inclusion criteria were attendance during this time period and a willingness to participate. Exclusion criteria were inability to understand the English questionnaire due to non-fluency in English or learning disability, and patient age under 16 years. A flow chart of the patients evaluated in the survey is given in Fig. 2. The survey in the form of a structured telephone interview was conducted after step 3 of the virtual keratoconus clinic (the telephone or video consultation), by a previously uninvolved investigator (KCI).

Statistical analysis

We summarized continuous variables with means and standard deviations, and categorical variables with percentages. Differences between groups where tested statistically with parametric and non-parametric methods as appropriate. We considered a p-values less

than five percent as statistically significant. The analysis was performed using the Stata 16.1 statistics software package (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.).

Results

During the study period, 88 patients had their first visit to the virtual keratoconus clinic. For the survey, the experience of 69 patients (78.4%) could be evaluated. The third step of the virtual keratoconus clinic (the actual consultation with the patient, Fig. 1) was conducted by telephone for 44 patients and by video for 25 patients. Patient demographic and ophthalmologic characteristics are summarized in Supplemental Table S1 and show no statistically significant differences between the two groups.

Time and distance

The mean time patients spent in the hospital altogether during the diagnostic visit of the virtual clinic was measured as 11 minutes (range 5-22 min), of which the mean waiting time for diagnostic tests was measured as 4 minutes (range 1-13 min). Waiting times for diagnostic examinations in the previous keratoconus monitoring clinic were measured to be 43 minutes on average (range 5 - 180 min; $p < 0.001$).

Mean travel time (one way) was 89 minutes (SD 74, median 60, range 5 to 300 minutes), and the corresponding mean travel cost (one way) to the clinic was reported as 16 euro (SD 19, median 7, range 0 to 120 euro).

Patient satisfaction and preferences for future consultations

Patient responses regarding satisfaction and further development of the virtual clinic are shown in Table 1. Overall, 98% (n=43) of patients in the telephone group and all patients (n=25) in the video group were satisfied with the virtual clinic appointment, with 89% (n=39) in the telephone group and 84% (n= 21) in the video group agreeing that the outcome of the virtual clinic was the same as that of the previous outpatient department visits. Also, 91% (n=40) of patients in the telephone group and 88% (n=22) of patients in the video group were happy to attend the hospital only for measurements, without having a discussion of the results. Eighty-four percent (n=37) of patients in the telephone group and 80% (n=20) of patients in the video group reported that the virtual clinic was more efficient compared to their previous visit to the outpatient clinic. While all patients (n=69) were willing to reattend the keratoconus clinic during the pandemic, 73% (n=32) in the telephone group and 52% (n=13) in the video group indicated that they would prefer to continue in the virtual clinic rather than the outpatient department clinic after the COVID-19 pandemic. Eighteen percent (n=8) in the telephone group and 28% (n=7) in the video group said they would prefer in-person care to virtual care after the pandemic. Continuing the virtual clinic with technical measurements at a local optician would be supported by 66% (n=29) of patients in the telephone group and by 76% (n=19) of patients in the video group; disapproval was expressed by 23% (n=10) in the telephone group and 20% (n=5) in the video group.

Table 2 summarizes patient preferences regarding the preferred channel for consultation (phone, video, email). There was a statistically highly significant difference between the telephone and video groups regarding the question of whether the other communication channel would have been preferred: while a switch to video communication would have been rejected by 91% (n=40) of patients in the telephone group, a switch to telephone communication would have been rejected by only 48% (n=12) in the video group

($p < 0.001$). A significant majority of 61% (n=69) of all patients declined to receive an e-mail message only instead of a telephone or video call in the event of a stable finding.

Discussion

This study presents an analysis of patient satisfaction with an externally imposed conversion from in-person care to telemedicine care and it derives recommendations for further expansion of the telemedicine system for the care of keratoconus patients.

Regarding patient satisfaction, we found a wide acceptance of the virtual keratoconus clinic. Sixty-eight out of 69 patients selected either the "strongly agree" or "agree" response to the statement "Overall, I was satisfied with my keratoconus virtual clinic appointment" (Tab. 1 - statement 1). Interestingly, more than 80% of the patients considered the virtual clinic to be equivalent to the previous keratoconus monitoring clinic in terms of outcome (1-2). An equally large majority did not see any problem in visiting the hospital only for measurements and not being immediately informed about the results (1-3), even if there were isolated disagreements about these two statements. The picture is rounded off by a widespread appreciation of having been cared for despite the pandemic (1-4), as well as a willingness to continue attending the virtual Keratoconus clinic during the pandemic (1-5). This high degree of agreement to a short-term change of treatment modality is remarkable for a patient group for whom managing change may be more challenging as reviewed by Mannis *et al*.[2] Rather, the results of the present study suggest that the patients interviewed had sufficient coping mechanisms to manage the transition from in-person to virtual care. The following aspects may have been supportive: First, these were not initial consultations with a correspondingly high need for patient education, but rather follow-up examinations of patients who were familiar with the process. Second, the majority of patients attending for follow-up examinations does not show keratoconus progression, as stabilizing treatment with

corneal cross-linking tends to occur on referral to the keratoconus service and less often during routine follow-up. Third, contrary to reports that keratoconus patients may not find it easy to establish trusting relationships,[3] all respondents felt that the virtual consultation was conducted in a confidential manner (1-6) and that personal information could be shared with the nurse practitioner (1-7). Although not specifically asked about it as part of the interview, numerous patients emphasized the importance that the virtual consultation staff had already been familiar to them from in-person consultations, again underscoring the importance of continuity of care for patients with chronic conditions.[4]

Interestingly, the virtual clinic was not received positively simply because it was the only alternative to a pandemic-related shutdown of elective patient care: regarding the further expansion of the present telemedicine system, we observed that slightly more than half of the patients wanted to remain in the virtual keratoconus clinic even after the pandemic (1-10). Efficiency gains represent an obvious explanation for the preference of telemedicine over the previous face-to-face consultations: approximately 80% of all patients found the virtual clinic more efficient (1-8) and all patients, without exception, felt that they would have spent less time in hospital with the virtual clinic (1-9). These perceptions were supported by the measured mean waiting time values, which were reduced from the previous 43 minutes to 4 minutes in the virtual clinic.

A similar distribution of agreement was found for the related statement about remaining in the virtual keratoconus clinic if the technical measurements of the diagnostic visit were performed at a local optician instead of in the hospital (1-11). Efficiency gains may also be used as an explanation here: the introduction of telemedicine in its present form did not yet change anything in terms of travel expenditure, since patients still had to travel to the hospital for the diagnostic visit. However, the mean travel times of almost three hours for the outward and return journeys and the mean travel costs of 32 euro suggest that the

establishment of decentralized locations for the diagnostic visit could lead to considerable savings. The preference for a hospital-independent setting may also have been contributed to by the fact that hospital environments are perceived as particularly stressful by keratoconus patients: given that keratoconus most often occurs in otherwise healthy young adults, the eye care setting may represent the patient's only contact with disease and health care specialists.[5] Another aspect of a further expansion of the present telemedicine system concerns patient preference for a particular communication channel. Regardless of which group was surveyed, more than half were satisfied with their assigned channel (telephone or video) and stated that they either did not need the other or they did not mind (Tab. 2 - questions 1,2). However, a significantly higher proportion of patients in the telephone group opposed changing their communication channel than this was the case for the video group ($p < 0.001$). This suggests that a telephone consultation sufficiently covers the patients' needs. As shown by the four consultations converted from video to telephone, the telephone channel proved to be more robust: the conversion was prompted twice by insufficient connection quality, once by an unsuitable simple phone, and once by a hands-free call made while driving (Fig. 2). A majority also rejected the option of communicating stable results only in the form of an e-mail (2-3).

This report is consistent with the current literature in that it confirms the role of the COVID-19 pandemic as a catalyst for the establishment of digital health approaches in ophthalmology.[6] However, published results on the use of telemedicine in corneal disease are limited to studies on the diagnostic value of anterior segment images (taken with portable cameras,[7] smartphones,[8] or tablets[9]) that are forwarded to specialists for evaluation. This "store-and-forward" approach is used in ophthalmology for screening retinal diseases[10] and monitoring stable glaucoma,[11] as the required imaging systems in the form of fundus cameras and optical coherence tomographers are widely available and the images generated are easily

dispatchable. These two conditions also apply to corneal tomography, on which the assessment of keratoconus stability is largely based.

Therefore, a strength of the present work is to present data on yet another ophthalmic application of telemedicine in the form of keratoconus monitoring. Reports coming directly from patients about treatment satisfaction and preferences are a recognized source of data because they represent the only direct voice that individuals have in the health decision-making process.[12] Data collection was started simultaneously with the conversion from the established face-to-face keratoconus monitoring clinic to the virtual keratoconus clinic: therefore, all patients could be assessed for inclusion from the start and the time window between virtual consultation and interview was identical for all participants. Staffing and equipment were kept constant, so that the only change induced was the conversion to virtual consultations. All interviews were conducted by the same interviewer, who left the RVEEH after the project was completed, hence reducing the risk of social desirability bias on part of the institution. Due to the pandemic, the questionnaires were completed in the form of telephone interviews. However, there seem to be no significant differences between responses from face-to-face and telephone interviews[13] and interviews in the familiar surroundings of the patients' home are considered an effective strategy against social desirability bias on part of the patients.[14]

It is appropriate to recognize potential limitations of this study. First, although the survey was based on validated questions,[1] the validity of the final questionnaire was not tested using a statistical method.[15] Instead, an expert panel evaluated the questions for content validity, i.e. for relevance to the two overarching topics[16] and pilot tests were conducted to ensure that participants understood the meaning of the questions. Second, assigning patients to either telephone or video consultation based on the month of inclusion resulted in unequally sized and arguably clinically different groups. Third, the present study allows

conclusions exclusively about patients for keratoconus monitoring; generalizability to newly diagnosed keratoconus cases is not applicable.

As an implication for clinical practice, we conclude that the continuation of virtual consultations during the pandemic meets with broad acceptance among patients. We will limit ourselves to telephone consultations, as video consultations do not meet patient demands and the connection may be less robust for technical reasons. The feedback from patients and the efficiency gains in the form of reduced waiting times encourage us to consider continuing the virtual clinic even beyond the pandemic. We are also taking the feedback and potential efficiency gains in terms of reduced travel time and costs as an incentive to evaluate a hub-spoke model in which the diagnostic visit is performed at a local eye care professional and review and consultation are performed centrally by the hospital. Interesting questions to be addressed by further research would be to what extent the model of the virtual keratoconus clinic could be extended to keratoconus screening or to the education and counseling of newly diagnosed keratoconus cases.

Conclusion

In summary, we have shown that keratoconus patients broadly accepted the change from in-person to virtual consultations. A solid majority of keratoconus patients also supported further expansion of the virtual consultations to a completely decentralized telemedicine model. The establishment of a relationship of trust with the attending health care professional in the context of in-person consultations prior to conversion to virtual consultations seems to have significantly facilitated the switch to telemedicine.

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Authors' disclosure statement

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Figures legends

Figure 1. Comparison of the in-person with the virtual keratoconus monitoring service.

Patients interviewed in this survey were accustomed to a nurse-led in-person keratoconus service, in which diagnostics and assessment of findings were discussed with the patient during the same on-site visit (upper box). For the newly implemented virtual service, the individual steps were separated from each other in terms of both time and location (lower box).

Figure 2. Flow chart of patients after applying inclusion and exclusion criteria.

The assignment of the modality with which the patient was consulted in the virtual keratoconus clinic (telephone or video) was based on the calendar month in which the patient visited the virtual clinic for the first time. Patients for whom a video connection was not possible for technical reasons were advised by telephone and reassigned accordingly for analysis.