Could telehealth help eyecare practitioners adapt contact lens services during the COVID-19 pandemic?

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ABSTRACT

The COVID-19 pandemic has necessitated government-imposed restrictions on social interactions and travel. For many, the guidance has led to new ways of working, most notably a shift towards working remotely. While eye care practitioners (ECPs) may continue to provide urgent or emergency eye care, in many cases the travel restrictions present a unique challenge by preventing conventional face-to-face examination. Telephone triage provides a useful starting point for establishing at-risk and emergency patients; but patient examination is central to contact lens patient care.

The indeterminate period over which conventional practice will be suspended, and the risk that resumption of 'normal' practice could be impeded by a potential secondary peak in COVID-19 cases, hastens the need for practitioners to adapt their delivery of eyecare. Specifically, it is prudent to reflect upon supportive evidence for more comprehensive approaches to teleoptometry in contact lens practice.

Smartphone based ocular imaging is an area which has seen considerable growth, particularly for imaging the posterior eye. Smartphone imaging of the anterior eye requires additional specialised instrumentation unlikely to be available to patients at home. Further, there is only limited evidence for self-administered image capture. In general, digital photographs, are useful for detection of gross anterior eye changes, but subtle changes are less discernible.

For the assessment of visual acuity, many electronic test charts have been validated for use by practitioners. Research into self-administered visual acuity measures remains limited.

The absence of a comprehensive evidence base for teleoptometry limits ECPs, particularly during this pandemic. Knowledge gaps ought to be addressed to facilitate development of optometry specific evidence-based guidance for telecare. In particular, advances in ocular self-imaging could help move this field forwards.

In response to the COVID-19 pandemic, governments across the world have announced measures which severely restrict social interactions and travel. [1] For many, the guidance has led to new ways of working, most notably a shift towards working remotely. While, at the time of writing, UK eye care practitioners (ECPs) may continue to provide urgent or emergency eye care,[2] the travel restrictions present a unique challenge by preventing conventional face-to-face examination of many patients.

UK optometric professional bodies have worked at commendable speed to issue guidance on conducting telephone consultations. [3-4] However, while this is useful for patient triage, contact lens practice is not a discipline which easily lends itself to such telehealth. Patient examination is central to clinical decision making; screening at-risk patients; and to the incidental detection of asymptomatic pathologies.

Other healthcare professions, such as in medicine, are guided by a growing evidence base for conducting telephone and video consultations [5-7], but there are comparatively fewer studies specific to primary care optometry particularly contact lens practice.

At present, consideration of more comprehensive telecare may seem premature, particularly in view of the general expectation that more stringent social distancing measures will soon be relaxed. Timelines are, however, indefinite and the resumption of 'normal' practice could still be impeded by the potential secondary peak in COVID-19 cases.[8]

In the UK, the General Optical Council (GOC) along with other healthcare providers, have signed a joint regulatory statement acknowledging that during the pandemic, professionals may need to depart from established procedures [9]. The GOC have taken a pragmatic approach to contact lens wear and supply [10]. In conducting remote consultations, ECPs are asked to exercise their professional judgement to decide the level of aftercare provided and how to provide it. This flexibility should support contact lens wearers by avoiding unnecessary anxiety, minimise non-compliance, and deter the use of non-prescribed contact lens products sourced online.

To offer patients the best care under current circumstances, it is prudent to reflect and build upon ways of offering remote patient screening in the context of contact lens practice.

1. **Triage for anterior eye**

Telehealth can present in various forms, ranging from monitoring using mobile phone apps (mHealth), video consultations, to outreach clinics which forward test results for clinical interpretation.

Advanced digital technology is not, however, the only method of optimising remote consultations. Improvements in history taking through use of validated questionnaires or adoption of patient-reported outcome measures may also help strengthen provision of care.

ECPs can offer more comprehensive aftercares and improve differential diagnoses by revisiting some of the fundamentals of contact lens history taking. [11] Adapting existing triage questions to focus on areas which represent key contact lens related symptoms e.g. eye pain, redness, glare, would help identify the presence and determine the urgency of anterior segment disease. [12]

2. **Enhancing compliance during the pandemic**

Non-compliance is common amongst contact lens wearers. [13-14] While the current cessation of regular daily routines may exacerbate some non-compliance behaviours e.g. irregular lens replacement, improvements can be made in other areas such as the adoption of better hand hygiene. The current handwashing campaigns could lead to longer-term benefits, particularly for lens wearers, if habits are sustained beyond the pandemic.

Typically, aftercare appointments provide an opportune time to reinforce messages about compliance, but in the absence of such interactions reliance on alternative approaches will inevitably increase. Patient education is generally advocated as the main method of addressing non-compliance, though behaviour modification techniques such as social influencing have also been suggested. [15-18] The studies investigating efficacy of compliance-encouraging approaches have reported mixed results, [19-21] but current supportive efforts by ECPs could include sending information or lens replacement reminders via SMS messages; providing written or verbal information (e.g. videos or patient information sheets); or making patients aware of lens care phone apps.

Previously, the tracking of lens ordering patterns to identify non-compliant patients has been recommended, [22] but in view of the current changes to daily routines and online lens purchasing options, the validity of this approach may be compromised.

3. **Subjective refraction and visual acuity**

The potential for measuring visual acuity and refractive error using handheld electronic devices is a growing area of research. [23-27] Most studies have employed a healthcare worker to assist in taking measurements. Nevertheless, early evidence for unassisted visual acuity testing and subjective refraction is emerging. [28-31]

A validation study of a web-based refraction and visual acuity test (Easee BV Amsterdam, Netherlands) in adults (aged 18-40 years) showed excellent agreement with conventional subjective refraction (intraclass correlation coefficient 0.92); and did not find a significant difference in acuity measurements when compared to the ETDRS chart ($p>0.05$). The study was limited to a refractive range of -6 to +4D and excluded individuals with diabetes. [28]

Other studies which have employed self-testing have shown less successful outcomes. Unassisted use of a smartphone-based refractor application (Netra, EyeNetra Inc., Somerville, MA, USA) in adults (aged 18-35 years, refractive range -9.25 to +0.50D) showed a significantly more median myopic overcorrection of 0.60D when compared to conventional subjective refraction. Median visual acuity estimates were also significantly lower with the app. [29] The findings echoed previous work where the same app showed absolute differences in spherical error of more than 0.50D for approximately 60% of eyes when compared to subjective refraction, and estimates of VA were also poorer (participant age range 20-90 years, refractive range −15.25 to 4.25D). [32]

A more intermediary approach to visual acuity estimation was found by using remote control of the computer based COMPlog test chart (Complog Medisoft Inc, UK). [33] Measurements were obtained in adults (age range 18-51 years), both with and without the physical presence of an optometrist. No significant difference in outcomes was noted between the two approaches ($p>0.05$).

To advance at-home vision screening, current vision testing apps require validation specifically for self-use. At-home vision screening tests may also offer parents and guardians the potential to assume a greater role in child vision screening. [34-36] Differences in device screen size, testing distance, and lighting conditions, are factors which need to be considered when evaluating home screening.

4. Imaging

One area of teleophthalmology which has seen substantial growth is smartphone ophthalmoscopy, particularly for posterior eye examination. In most cases, however, this approach requires additional specialised instrumentation which is generally unavailable to patients at home e.g. a macro lens or use of a slit lamp [37-43].

Thus far, research into smartphone ophthalmoscopy has largely concentrated on validation studies, screening of individuals through satellite clinics, and its potential utility for teaching. [44-49] Nevertheless, there is some limited evidence showing that where the necessary equipment has been made available, successful self-imaging of both the fundus [50-51] and anterior segment is possible.[52] The pursuit of such self-imaging is, of course, only worthwhile if clinicians can draw accurate diagnoses from the images themselves.

Use of teleophthalmology using retinal photography is well established, particularly for diabetic screening programmes, [53-54] but studies investigating the anterior segment have yielded mixed results. [55-58]

A comparison between digital slit lamp images and conventional slit lamp examination found that while gross corneal signs, such as a corneal graft, could be detected using digital images (sensitivity 88%; specificity 98%), sensitivity to more subtle corneal and conjunctival signs was poorer, with some pathologies not being detected at all. [55] Similarly, a comparison between conventional corneal examination versus digital images (obtained using the Apple iTouch 5G, [Apple, Cupertino, CA] and Nidek VersaCam [Nidek, Fremont, CA] cameras), showed sensitivity with photographs was, in general, high for pathologies such as pterygium (sensitivity >90%), but not corneal scarring (sensitivity <58%). [56] Of particular relevance to contact lens work is a report which showed grading of corneal staining was underestimated when using digital images compared to live grading using a slit lamp. [59] Thus, the overarching indication is that subtle anterior eye changes are generally less discernible using photographs compared to direct observation. Improvements in sensitivity, though not necessarily specificity, to detection of anterior segment pathology using photographs may be achieved by considering the photos in combination with patient history and visual acuity information.[57]

Anterior eye imaging, particularly self-imaging, presents several additional challenges compared to fundus photography: the need to use diagnostic drugs (e.g. fluorescein sodium), to obtain cross-sectional images, and constraints around lid eversion. All these techniques are possible for an ECP in an outreach clinic, but impractical for a patient at home.

Although the usefulness of anterior eye self-imaging can be extended by capturing images with the eye in different positions of gaze, the capture of digital anterior eye images using a smartphone camera has a number of limitations. The optical magnification without a macro lens is typically ~2 times. At higher magnifications, the shorter depth of focus will render the image vulnerable to small camera movements and the closer working distance makes it harder for the user to judge the focus and positioning (due to the camera being off-set from the screen).

For all types of anterior imaging, there will be variations in camera quality, image hue, and intensity, but whether such lack of standardisation will negatively impact clinical outcomes is less clear. Images of conjunctival hyperaemia obtained using different smartphone cameras and lighting conditions showed that although objective evaluation of images differed, clinician evaluations remained unaffected.[60] Nonetheless, it would be helpful to develop image standard references similar to those available for the posterior eye.[61] The introduction of objective image analysis software and other semi-automated image segmentation tools could then be used to further standardise practice. [62-64] However, it is hard to envisage current smartphone technology being able to detect corneal pathology such as infiltrates and neovascularisation without accessories. In addition, the palpebral conjunctiva is not visible without specialised techniques. [65]

5. Contact lenses fitting

With specific reference to contact lenses; there are various lens replacement reminder apps for patients and web-based tools to support practitioner prescribing, but patient driven teleoptometry is less well developed. The feasibility of lens fitting apps is likely to be limited by difficulties in visualising lenses, particularly soft lenses, against the non-uniform background of the ocular surface, without the magnification and illumination benefits provided by a slit lamp. The potential for future lens fitting assessment apps may be inferred from studies investigating video evaluation of lens fits.

Smythe et al (2001) reported an approximate 80% agreement in fit reliability between live versus (electronically compressed) video evaluation of the RGP lens fits by ECPs, [66] although the agreement for estimation of refit parameters was slightly lower (67%). Belda-Salmerón et al (2015) went further by comparing video evaluation of soft lens fits using objective analysis software to subjective lens evaluation by optometrists. Though, good concordance between subjective and objective approaches was reported for a range of parameters, objective analysis was deemed more reliable and sensitive. [67]

6. **Summary**

There are, of course, many other vision related apps which show promising outcomes e.g. for the assessment of manifest and latent deviations; [68] visual field screening [69]; and contrast sensitivity. [70] The majority remain unvalidated for self-administration by patients.

In addition to well researched and validated tools; usability, practitioner opinions, and medico-legal implications are likely to influence the uptake of teleoptometry.

In summary, this unique period of global change has led to shifts in the way many professions work. While other health professions are transitioning to telehealth services, the absence of a comprehensive evidence base for teleoptometry somewhat limits ECPs. Given the uncertain duration over which conventional methods of practice will be suspended, gaps in the research ought to be addressed to facilitate development of optometry specific evidence-based guidance for telecare. Specifically, advances in ocular self-imaging and standardisation of such imaging would help to move this field forwards.

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