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A service evaluation of the use of Teledentistry in Orthodontic Assessment during Covid-19: from a clinician and patient perspective Abstract

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ABSTRACT: Background: Following the outbreak of coronavirus (Covid-19), severe lockdown and quarantine measures were implemented across the globe. In order to protect patients and practitioners, dental organisations recommended that all elective and non-emergency procedures were postponed. Throughout the pandemic, Orthodontic treatment has been significantly affected as it involves a large population who need routine return-visits which are not classified as essential treatments. In order to provide a service to patients, teledentistry was used to assess and examine routine and emergency Orthodontic patients within a Hospital Orthodontic Department. The aims of this service evaluation were to assess the feasibility, strengths, weaknesses, and value of teledentistry in the assessment of orthodontic patients, during Covid-19, from a clinician and patient perspective.

Methods: Orthodontic patients (20) were chosen at random from the departmental waiting list. These patients included emergency orthodontic patients and those patients whose orthodontic appointments had been cancelled and treatments postponed, as a result of Covid-19.

Data was collected over a series of virtual Orthodontic clinics. One clinician assessed and examined all patients. Each participating patient, was sent a URL code to access the system. A questionnaire which recorded patient demographics and asked nine questions (Likert Scale used) was completed by clinician and patients. Responses and observations were entered into a Microsoft Excel spreadsheet and data was analysed. Descriptive statistics were used to compile and organise the characteristics of the data set.

Results: There was a response rate of 100%. From a clinician's perspective, it was possible to establish an appropriate diagnosis for 85% of patients, and they felt that they were able to deliver information to the patient quickly and accurately for 100% patients. From a patient's perspective 100% felt that they were able to effectively communicate and 100% found the appointment reassuring. Overall, both clinicians (100%) and patients (95%) found the system easy to use.

Conclusion: Teledentistry is not without its shortcomings however, our results found that there was a high acceptability for the use of teledentistry amongst patients and clinicians alike during Covid-19. In a post-Covid-19 world, perhaps integrated teledentistry will become part of the ''new normal''.

I. INTRODUCTION

Covid-19

In December 2019, a cluster of pneumonia cases, caused by a newly identified β-coronavirus, occurred in Wuhan, China. The World Health Organization named this coronavirus as coronavirus disease 2019 (Covid-19) on 11th February 2020. It is the seventh coronavirus discovered which affects human beings, causes the disease known as COVID-19 (coronavirus disease – 2019) [1,2,3,4] and has led to a global pandemic. It is thought that Covid-19 is primarily spread through interpersonal transmission via respiratory droplets and droplets and from close person-to-person contact with an infected individual [5]. The more closely a person interacts with others and the longer this interaction, the higher the risk of COVID-19 spreading [6].

Impact on Dentistry

In an effort to slow viral transmission, governments imposed severe quarantine and lockdown measures world-wide.Owing to their occupational proximity to the nasopharynx and the oral cavity of patients, dental practitioners are at a high risk for nosocomial transmission of respiratory infectious diseases [7]. Dental organisations recommended that dental practitioners postpone all

elective procedures except for urgent and emergency care, particularly those in hospital-based practices [8]. Throughout the Covid-19 pandemic, Orthodontic treatment has been significantly affected as it involves a large population who need regular routine care. This has led to an unprecedented number of patients having their appointments cancelled and their treatment put on hold, the long-term consequences of which are yet to be known.

Teledentistry

Teledentistry is a domain of telemedicine (which is a subset of telehealth) that is specifically dedicated to dentistry [9]. Using information technology, teledentistry allows for dental care, education, guidance and treatment to be provided remotely as opposed to through face-to-face contact [10]. It 'is a combination of telecommunications and dentistry, involving the exchange of clinical information and images over remote distances for dental consultation and treatment planning'' [11]. There is a growing body of evidence supporting the efficacy of teledentistry which has been provided by some of the studies on paediatric dentistry [12, 13], oral medicine [11, 14] orthodontics [15]and periodontics [16].

Teledentistryreduces the need for patients to travel to attend the clinic and it has been used throughout the United Kingdom, in dentistry and medicine [17, 18, 19]to support with the coronavirus response. It has enabled staff, including those in quarantine and in high-risk groups, to work remotely, allowing them to supplement clinical services during the surge. It has also enabled patients who are shielding and self-isolating, to be triaged and assessed as well as those patients who have had their non-essential consultations and treatment cancelled.

The aim of this clinical service evaluation was to assess the feasibility and value of teledentistry in the assessment of orthodontic patients, during Covid-19, from a clinician and patient perspective.

II. MATERIALS AND METHOD

Design

In order to provide a service to patients, teledentistry was used to assess and examine routine and emergency patients within a Hospital Orthodontic Department, using the National Health Service (NHS) Attend Anywhere Platform.

Data was collected over a series of Orthodontic Clinics (July-August 2020).

One clinician, of Dental Core Training Grade, assessed and examined twenty patients who were chosen at random from the departmental waiting list.

Each participating patient was emailed or texted a URL to access the system and then accepted (by the clinician) from the platform's 'Waiting room' to the 'Clinic' and the appointment began.

On conclusion of the consultation, the length of the consult was determined and recorded and the clinician (Fig. 1) and the patient (Fig. 2) were both asked to complete a questionnaire. The first part of the questionnaire gathered information about patient demographics (age, gender, the address from which they would have been travelling if they had been allocated a face-to-face consultation) and the device and camera view they were accessing the platform on.

The second part of the questionnaire was completed separately by the clinician and the patient. Each individual clinician and patient was posed (verbally) with nine affirmative statements, which were measured against the following Likert Scale: 1. Strongly agree 2. Agree 3. Disagree 4. Strongly Disagree 5. Not applicable.

Of these nine questions, three were asked to both the patient and the clinician. These ascertained their assessment of the visual quality, audio quality and the system's ease of use.

Figure 1.
Figure 2.

Analysis

Completed responses and observations were then entered into an Excel spreadsheet (Microsoft Excel MS Office Standard 2010) and the data was analysed. Descriptive statistics were used to compile and organise the characteristics of the data set. Data was expressed as percentages. If a patient rated a statement as strongly agree or agree these were classified together, confirming the statement. Similarly, if a patient rated a statement as disagree or strongly disagree, these too were classified as rejecting the statement.

III. RESULTS

Demographics and device information

There was a response rate of 100% with all twenty patients agreeing to complete the questionnaire. Fifteen female patients and five male patients between the ages of 12 and 47 were contacted with the mean age being 19.55 years.

The platform was accessed using a mobile phone or iPad by 55% and all using a front facing camera view. From a clinician's perspective there was a difference in image quality between front facing camera view and rear facing camera view for only 18% patients where the quality of front facing

camera view was superior to that of rear facing camera view. 90% of patients found it more difficult to hold their device and use the system using a rear facing camera view.

The average distance saved (by not having to attend a face-to-face appointment) was 28.2miles. The shortest distance saved was 1.9miles and the longest distance saved was 210miles (by a student who had moved cities to attend University). The average length of the consultation was 6mins 36secs.

The clinician's results (Fig. 3), revealed that it was possible to establish an appropriate diagnosis for 85% of patients. The clinician felt that they were able to deliver information to the patient quickly and accurately for 100% patients and were confident that the information delivered was understood by 100% patients. They were able to identify problems that may not have been reported for 55% of people

The clinician felt that they were able to make a general assessment of a patient's oral hygiene for 90% patients and it was possible to assess the occlusion (overbite, overjet and incisor relationship) of 95% patients.

The clinician found the system easy to use for 100% patients and found both the visual quality and the audio quality of the platform to be acceptable for 90% patients.

Figure 3.

Patientresults (Fig. 4) revealed that 100%of patients felt that they were able to effectively communicate any orthodontic issues that they were experiencing and that they understood the information and instructions delivered by the dental team. In addition, 100% of patients found the appointment reassuring but 65% missed the personal interaction of attending a face-to-face appointment.

The cost of travel saved by not having to attend in clinic was significant to 30%and 75%either agreed or strongly agreed found that the time saved by NOT having to attend in person in clinic was significant to them,

The system was found to be easy to use by 95%of patients, with 90%reporting the visual quality and the audio quality to be acceptable.

Figure 4.

IV. DISCUSSION

Prior to Covid-19, teledentistry had been used in dentistry and across a variety of dental specialties including Oral Medicine [20, 21], Oral and Maxillofacial Surgery [22, 23], Paediatric Dentistry [12] and Prosthodontics [23]. In Paediatric Dentistry, a study has suggested that teledentistry can rival visual and tactile examination in its accuracy of caries diagnosis and classification [12]. In service restricted locations, the early detection of oral cancer by primary care dental practitioners has been aided by teledentistry [14]. In periodontology, teledentistry was of significant public benefit as it allowed information and direction to be delivered remotely [9]. It is not a new concept inOrthodontics [24, 15], with Favero L et al. [25] having stated that it can be particularly useful to manage selective minor orthodontic emergencies many of which can be solved by reassuring patients and parents.

Teledentistry has been successfully used to identify appropriate orthodontic referrals [15] and in Temporomandibular Joint Disorders, provides accurate diagnosis and acceptable treatment [26]. The cost-savings and benefits associated with teledentistry are significant for patients fromremote or island communities who need to travel far for specialist assessment or treatment [27]. The healthboard in this service evaluation involved a large rural geographic area.

Throughout the pandemic, most clinical specialties have taken advantage of using the NHS Attend Anywhere Platform to deliver Remote Clinical Consultations. From the public's perspective, the number one benefit of this was 'reducing the spread of infection', However, other benefits such as being 'more convenient', offering an 'improved access to services', 'saving time' and 'reducing the need to travel', have been cited in a Scottish report [28].

From an orthodontic perspective, it was possible to assess the fit of retainers, identify missing brackets/rubber ligatures and identify mispositioned wires. The clinicianwasable to assess patients' occlusion,reinforce simple oral hygiene practices and appliance instruction. It was possible for the clinician to discharge orthodontic patients who no longer required further treatment and follow-up as well as to prioritise those patients in anticipation of return to face-to-face appointments.

The fact that a high percentage of patients found that the time saved by not having to attend a face-to-face appointment was significant to them, is complimented by the ability of a clinician to conduct remote consultations in a timely manner. Time saved was particularly important to University students and patients living abroad as they were given the option of having an examination in any location. In today's busy society, the ability to arrange a remote consultation anyplace anytime is advantageous. Particularly with Covid-19 forcing travel restrictions worldwide and with a future of uncertainty ahead, clinicians may find teledentistry to become more central to their practice.

It is reassuring that, overall, both clinicians and patients found the system easy to use and that the audio and visual quality was acceptable. Patients reported that they found the system easier to use having watched the initial instruction video (this should be stressed to future patients). As previously stated byTella et al. [29], it may not always be possible to have a stable Internet connection leading to the system freezing, time lapse, etc. In a report produced by the Scottish Government it revealed that from a patient/public perspective, poor internet connectivity was the main barrier to virtual consultations [28]. In order to ensure acceptability long-term, this issue must be addressed and digital connectivity improved. It should be noted that technical issues impacted upon a handful of remote consultations**.**

Other findings that were noted throughout the evaluation included the importance of good lighting to allow an accurate assessment as well as the value of having a parent present for a paediatric patient to optimise understanding. Also, clear directions on the positioning of the camera to allow for best view of their teeth, aided the speed and accuracy of the examination. It should be noted that there was minimal difference in image quality reported between front and rear camera views which allows patients more freedom regarding their choice of device and positioning of same.

Although our results demonstrate that teledentistry was of benefit in examining orthodontic patients, it is prudent to acknowledge its limitations and that teledentistry is not to serve as alternatives to careful clinical examination in orthodontics.

Factors such as skeletal pattern soft tissue are crucial to treatment planning and it would not be possible to assess these remotely. For example, the ability to palpate an unerupted tooth, the ability to assess the occlusal curvature and the ability to assess whether there are any dentoalveolar compensations present, are all not possible with teledentistry. In addition, although the clinicianwas able to examine the general indication of a patients' standard of oral hygiene, this is no substitute for a full clinical assessment of oral hygiene

This is echoed by the fact that the clinician did not feel as confident in identifying problems which were not reported. Thus, the potential for unknown issues to be left untreated in unsuspecting patients is greater with nearly half of patients stating that they would have preferred a face-to-face appointment.

That said, we must look to a future beyond the COVID-19 pandemic, where teledentistry may serve to become a routine adjunct in the delivery of patient care. Challenges resulting from physical distancing and the use of Personal Protective Equipment have affected productivity and added unquestionably to an already lengthy NHS waiting list. Teledentistry may be considered as a valuable tool in helping to manage these waiting lists.

Clinician's will need to learn how to integrate teledentistry into their practice efficiently and appropriately, as well as to develop the new and required skills to use teledentistry correctly. Correct patient case selection is paramount to the success of teledentistry. This will undoubtedly be governed by a host of factors including the nature of the issue, patient preferences, geography, resources, and provider acceptance, to optimise patient wellbeing without compromising clinical care.During subsequent waves of infection, when movement of the public is restricted or when patients are self isolating, teledentistry may be used for both triage and routine dental care where appropriate.

Considering Covid-19 and the risks it poses, the Scottish Government have recommended that health and care services should offer video consulting where appropriate [28].

The limitations of our survey design must also be acknowledged. Our sample size was small and for more reliable results, a larger survey response is needed. In addition, 75% of our participants were female and only 25% male and thus it is not possible to rule out gender bias. As there was only one clinician who carried out the assessments, it is also not possible to rule out clinician bias. Although the Likert Scale was pragmatic to use and easily understood by both clinician's and patients, it does assume an even metric between the various points and is subject to midline and outlier confusions. In addition, as the survey was not confidential, a patient might have assumed any negative feedback to compromise their relationship with the clinician. As affirmative statements were used in the questionnaire, this may lend themselves to a patient agreeing, or disagreeing, more readily as opposed to giving a more honest, accurate answer.

V. CONCLUSION

The delivery of Dentistry has become severely compromised during the current COVID-19 pandemic and many patients, fearful of getting infected with COVID 19, are reluctant to seek dental care. Teledentistry is not without its shortcomings however, our results found that there was a high acceptability for the use of teledentistry amongst patients and clinicians alike during the COVID-19 pandemic. Benefits included system ease of use, cost and time effectiveness and patient reassurance.

Although teledentistry has served as a temporary solution, beyond the crisis it has the potential to provide access to dental care for millions of patients worldwide. It may become an attractive option for patients and clinicians as well as improve patient satisfaction.In a post-COVID-19 world, perhaps integrated teledentistry will become part of the ‘‘new normal’

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List of abbreviations:
Covid-19: Coronavirus Disease 2019
NHS: National Health Service

Ethics approval and consent to participate: Project did not require ethical approval but was approved as an audit/evaluation by local research and development office.

Consent for publication: Not applicable.

Availability of data and materials: All data generated or analysed during this study are included in this published article [and its supplementary information files].

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Fig. 1

Before beginning consultation take note of the following:

1.What device is the patient using?

a) If using mobile phone, was frontal or rear camera view used?

b) If frontal camera view, ask patient to switch to rear camera view. Assess if image quality has improved?

c) Does this make it more difficult for them?

2. The distance the patient would have travelled to attend face to face consultation:

After completing the consultation record:

3. Length of consultation:

Each of the following affirmative statements is to be measured against the following Likert Scale:

1.Strongly agree 2. Agree 3. Disagree 4. Strongly Disagree 5. Not applicable

Questions for clinician:

1. I was able to establish an appropriate diagnosis
2. I was able deliver information to the patient quickly and accurately
3. I felt confident that the information delivered to the patient was understood
4. I was able to identify problems that may not have been reported.
5. I was able to make an assessment of the patient's oral hygiene.
6. It was possible for me to assess the patient's occlusion (overbite, overjet and incisor relationship).

Questions for both clinician and patient:

7. I found the system easy to use
8. I found the visual quality acceptable
9. I found the audio quality acceptable

Anything that you would like to add:

Fig.2

If applicable: When switched from frontal to rear camera view, is this more difficult for you?

Each of the following affirmative statements is to be measured against the following Likert Scale:

1.Strongly agree 2. Agree 3. Disagree 4. Strongly Disagree 5. Not applicable

Questions for patient:

1. I was able to effectively communicate any orthodontic issues that I was experiencing
2. I was able to understand the information and instructions delivered by the dental team
3. I found the appointment reassuring
4. I missed the personal interaction experienced when attending a face-to-face appointment.
5. The cost of travel saved by NOT having to attend in clinic was significant to me.
6. The time saved by NOT having to attend in person in clinic was significant to me

Questions for both clinician and patient using near-me:

1. I found the system easy to use
2. I found the visual quality acceptable
3. I found the audio quality acceptable

Anything that you would like to add:

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Fig. 3

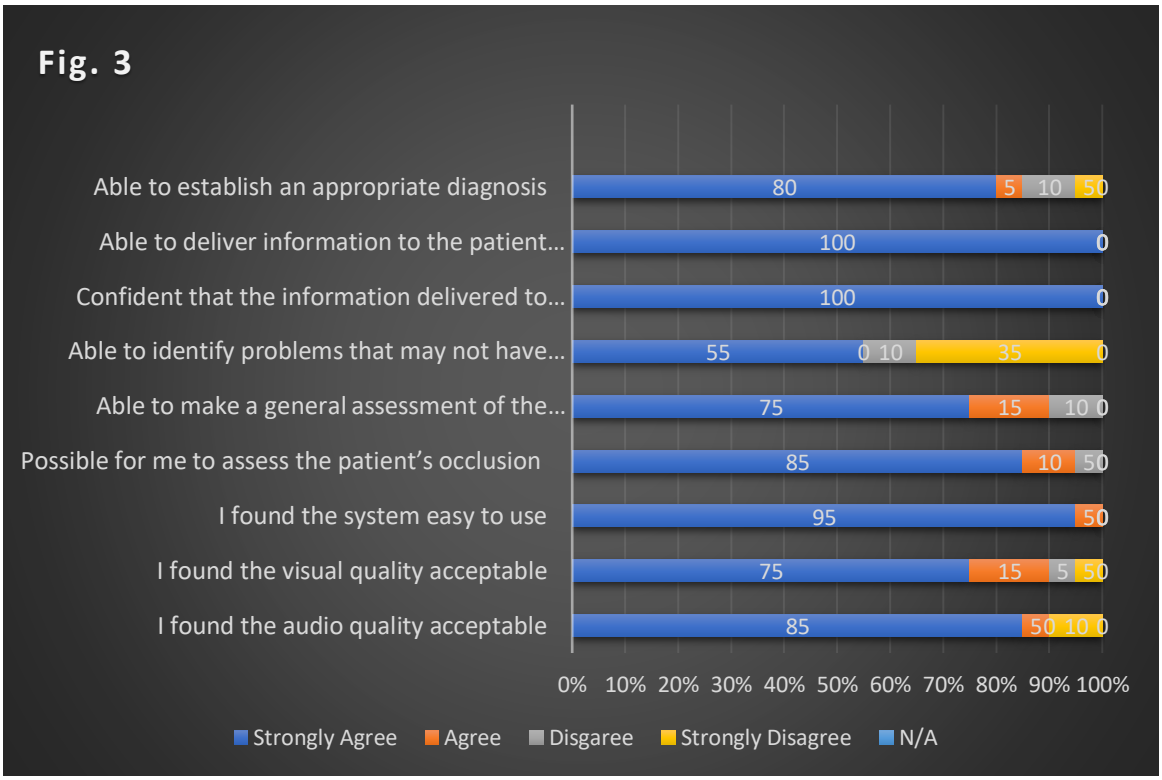

Fig. 4