


Teledentistry and COVID-19 molecular surveillance strategy for a safe clinical environment in Paediatric Dentistry

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Abstract The aim of this manuscript is to describe a hybrid care model to paediatric patients on a virtual basis for dental treatment before conducting an in-person surveillance by using combined nasal/oral swabbing (NOS). This longitudinal study used a convenience sample of paediatric patients and members of the dental team from an undergraduate paediatric dentistry clinic at the University of São Paulo School of Dentistry during the COVID-19 pandemic. Firstly, parents were contacted and teledentistry was used for screening children who need dental treatment. Appointments were scheduled once a week for two months, in which a pre-COVID-19 screening was performed. Dental team and children's parents completed a questionnaire addressing COVID-19-related symptoms. Members of the dental team and children were tested for COVID-19 before entering the dental clinic, by NOS and RT-PCR screening. Ninety-three individuals were enrolled and all of them completed the electronic questionnaire on symptoms and had NOS collected weekly, totalising 241 pairs of swabs. No participant reported COVID-19 symptoms before entering the clinic for treatment. Only one child tested positive in the third week of sampling. The hybrid care model associated with molecular testing for asymptomatics provided a safe clinical environment regarding the transmission of SARS-CoV-2.

Descriptors: COVID-19. Teledentistry. Pediatric Dentistry. Molecular Diagnostic Techniques.

Teleodontología y estrategia de vigilancia molecular para COVID-19 proporcionando un entorno clínico seguro en Odontología Pediátrica Resumen

El propósito de este manuscrito es describir un modelo híbrido de atención odontológica, a través de una plataforma virtual que precede a la realización de vigilancia molecular presencial mediante hisopado nasal/oral combinado, en pacientes pediátricos. En este estudio longitudinal se utilizó una muestra de conveniencia de pacientes pediátricos y miembros del equipo odontológico en la clínica de pregrado de la Facultad de Odontología de la Universidade de São Paulo durante la pandemia de COVID-19. En primer lugar, se contactó con los padres y se utilizó la consulta virtual para seleccionar a los niños que requerían tratamiento odontológico. Se programaron citas una vez a la semana durante dos meses, en las que se realizó el cribado previo a COVID-19. El equipo dental y los padres de los niños rellenaron un cuestionario en el que se abordaban los síntomas relacionados con la COVID-19. A continuación, los miembros del equipo dental y los niños fueron sometidos a pruebas de detección de COVID-19 antes de entrar en la clínica para atendimento mediante cribado con hisopo nasal/oral y RT-PCR. Se inscribieron 93 personas, todas las cuales cumplimentaron el cuestionario electrónico sobre síntomas y se les recogieron muestras semanalmente, con un total de 241 pares de hisopos. Ningún participante declaró síntomas de COVID-19 antes de entrar en la clínica para recibir tratamiento. Sólo un niño dio positivo en la tercera semana de toma de muestras. El modelo de tratamiento híbrido unido a las pruebas moleculares para asintomáticos proporcionó un entorno clínico seguro con respecto a la transmisión del SARS-CoV-2.

Descritores: COVID-19. Teleodontología. Odontología Pediátrica. Técnicas de Diagnóstico Molecular.

Teleodontologia e estratégia de vigilância molecular para a COVID-19 proporcionando um ambiente clínico seguro na Odontopediatria Resumo

O objetivo deste manuscrito é descrever um modelo de atendimento

odontológico híbrido, por meio de uma plataforma virtual anterior a realização de uma vigilância molecular presencial usando esfregaço combinado nasal/oral, em pacientes pediátricos. Este estudo longitudinal utilizou uma amostra de conveniência de pacientes pediátricos e membros da equipe odontológica na clínica de graduação da Faculdade de Odontologia da Universidade de São Paulo durante a pandemia COVID-19. Primeiro, os pais foram contactados e a consulta virtual foi utilizada para o rastreamento de crianças que necessitavam de tratamento odontológico. Foram agendadas consultas uma vez por semana durante dois meses, nas quais foi realizado um rastreamento pré-COVID-19. A equipe odontológica e os pais das crianças preencheram um questionário que abordava os sintomas relacionados com a COVID-19. Em sequência, os membros da equipe odontológica e as crianças foram testados para o COVID-19 antes de entrarem na clínica para atendimento, através do rastreamento com esfregaço nasal/oral e RT-PCR. Noventa e três indivíduos foram inscritos e todos eles preencheram o questionário eletrônico sobre os sintomas e tiveram amostras coletadas semanalmente, totalizando 241 pares de cotonetes. Nenhum participante comunicou sintomas de COVID-19 antes de entrar na clínica para tratamento. Apenas uma criança testou positivo na terceira semana de amostragem. O modelo de tratamento híbrido associado a testes moleculares para assintomática proporcionou um ambiente clínico seguro no que diz respeito à transmissão da SARS-CoV-2.

Descritores: COVID-19. Teleodontologia. Odontopediatria. Técnicas de Diagnóstico Molecular.

INTRODUCTION

The new severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 2019 (COVID-19) which was declared as a pandemic by the World Health Organization (WHO)¹ on March 11, 2020, brought a new reality to the world. New habits were established, such as the use of face masks in public places, frequent hand hygiene with soap and water or 70% alcohol, and social-physical distancing^{2,3}. All these measures have been introduced into society to slow down the virus spread.

Both dental care and dental education were adapted during the pandemic period. One of the main tools used during this period is teledentistry, which has been contributing to both teaching undergraduate students and monitoring or screening patients who need dental advice or treatment⁴. Teledentistry is defined as any remote dental care, treatment planning, consulting and follow-up at a distance in which telecommunication technology is used to avoid direct personal contact with patients^{5,6}. This is, therefore, an alternative tool for dental care of patients with a greater need for in-person treatment, besides serving to screen for COVID-19⁴. Children needing dental treatment during the pandemic period had to come to the dental office. But for safety reasons, non-pharmacological measures have been routinely established to try to reduce contamination in the dental office, like in other indoor and public places³.

Given the current global condition and the efforts made by scientists, health care professionals and governments to control the spread of SARS-CoV-2, it is important to develop less invasive testing and screening methods to identify the virus and control the pandemic. Therefore, a minimally-invasive COVID-19 screening protocol⁷ (e.g. nasal and oral swabs⁸) might be used to allow a safe attendance at dental schools. The aim of this study was to describe a hybrid care model (i.e. virtual and in-person) in dental paediatric patients associated with SARS-CoV-2 surveillance by using nasal-oral swabs and RT-PCR screening in an undergraduate paediatric dentistry clinic during the COVID-19 pandemic.

METHODS

Ethical Approval

The study was approved by the Research Ethics Committee of the University of São Paulo School of Dentistry according to protocol number 4749508 and carried out in compliance with resolution number 466/12 Brazilian National Health Council. All stages of the study were conducted in accordance with the Declaration of Helsinki.

Participation in this study was voluntary. Written informed consent was obtained before the study from all members of the dental team and children's parents as well as a term of consent by the children.

Study Population and Data Collection

This longitudinal study was conducted with a convenience sample of members of the dental care team (i.e. undergraduate and postgraduate students and lecturers) and paediatric patients attending the Paediatric Dentistry Clinic of the University of São Paulo School of Dentistry (FOUSP), Brazil. All the participants were asymptomatic for COVID-19 and were recruited from May to June 2021.

Strategy for a Safe Clinical environment in Paediatric Dentistry

Teledentistry

Due to the Covid-19 pandemic, the Department of Paediatric Dentistry has implemented teledentistry activities in the undergraduate curriculum to assist babies, toddlers and children (0-12 years old) who were patients. During the lockdown period, activities based on teleorientation and telemonitoring were performed. When the lockdown was over and patients were allowed to visit the paediatric dentistry clinic, the use of teledentistry was essential to screen patients who need dental treatment.

Firstly, the Department of Paediatric Dentistry made contact with the parents of children who were used to be treated in the dental clinic before the lockdown period in order to know whether their children still needed dental treatment and whether they were interested in having a teleconsultation. In case of agreement with having a teleconsultation, the parents were sent an electronic informed consent form to let them know about the security using teledentistry and to explain in detail the technical procedures involved in the teleconsultation.

The teleconsultation sessions were carried out by two undergraduate dental students under the supervision of a lecturer of the discipline of paediatric dentistry. One of the students was responsible to make the question while the other took notes. As they were not health professionals yet, it was necessary to conduct the teleconsultation under supervision of a lecturer. The Video for Health (V4H) platform (<https://v4h.cloud/>) was used as it allows an efficient, practical and safe way to monitor the patient's health by providing video services for online care⁹.

Through teleconsultation it was possible to talk to the parents and children and assess the child's current general and oral health. In addition, the two students could guide the parents about preventive measures for oral hygiene and nutrition. At the end of the virtual interview, all biosafety guidelines were provided to the children and their parents as well as an in-person appointment was scheduled for the child. Each teleconsultation lasted 40 minutes in average.

Therefore, through teleconsultation it was possible to be introduced to the parents and children before the first in-person clinical appointment as a stage of psychological preparation for the children; to collect information on the children's general and oral health; to provide oral health education to parents and children; and to optimize the scheduling flow for patients seeking appointments, mainly screening for urgent dental needs.

It is important to highlight that the undergraduate students were previously instructed with theoretical content on children's oral health care and trained on protocols and standards for use of telehealth platforms by following the regulations of the Brazilian Federal Council of Dentistry and in accordance with the Brazilian General Data Protection Law¹¹ and the Health Insurance Portability and Accountability Act (HIPAA) compliance¹².

Electronic Questionnaire on COVID-19 Symptoms

Those patients needing dental treatment were invited for an in-person appointment. At the reception of the dental clinic, body temperature of the members of the dental team (i.e. undergraduate and postgraduate students and lecturer) and of the children undergoing dental treatment was measured with a digital non-contact infrared thermometer (value below 37°C/98.6°F). In addition, the dental team and children's parents answered an electronic questionnaire (Table 1) on COVID-19 symptoms (e.g. if they had fever recently or was with fever, breathing difficulty, or if they had contact with someone positive for COVID-19). Only after that the members of the dental team and the children were allowed to enter the dental clinic.

Combined Nasal-Oral Swabs

Next, combined nasal-oral swabs were self-collected by the members of the dental team and from the children undergoing dental treatment by using a dry rayon swab (Inlab, Brazil), in which each region was individually collected

with a swab. The collection was performed in the nostrils (right and left) by using the same swab and a new swab was used in the left and right buccal mucosa. The two swabs were placed in the same screw-cap 15-ml tube (Sarstedt AD & CO., Germany), which were labelled with collection date and participant information, before performing the dental treatment. The test results were known 48 hours after the testing.

The dental care team followed the biosafety rules established by the university, such as use of N95 mask, disposable apron and face shield.

All the steps are described in a flowchart (Figure 1).

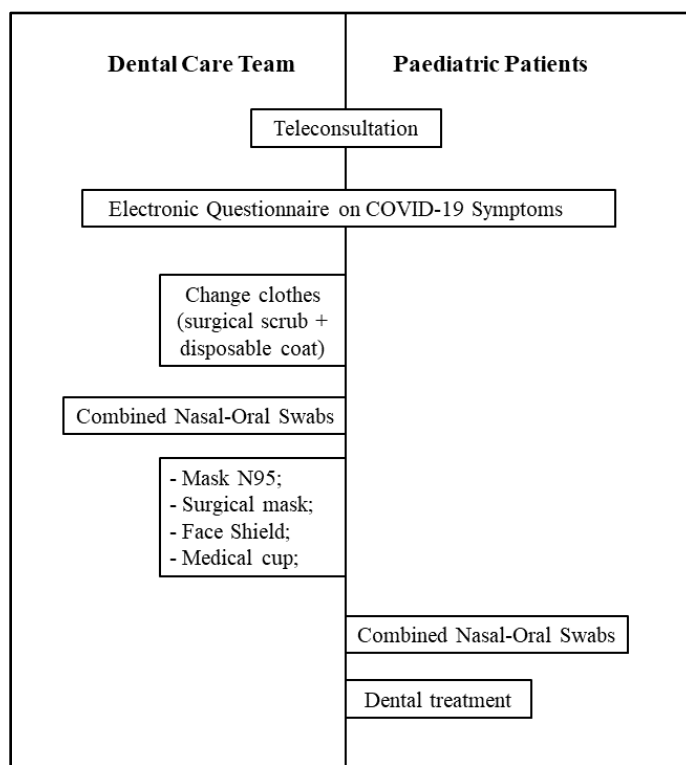


Figure 1. Flowchart demonstrating the methodology.

Detection of SARS-CoV-2 RNA

The RealStar® SARS-CoV-2 RT-PCR kit 1.0 (Altona Diagnostics GmbH, Germany) was used to detect the SARS-CoV-2 RNA, which is based on the target reaction for two genes, namely, envelope (E) and spike (S). Results were considered positive when both target genes show an amplification curve. Pre-amplification sample preparation included an extraction-free protocol in which the collected swabs were washed with 1 ml of wash buffer (ExtraStar® Swab Wash Buffer 1.1, Altona Diagnostics, Germany) and taken directly for RT-PCR. In addition, an extraction protocol using viral DNA/RNA kit (Extracta, Loccus, Brazil) and automated nucleic acid extractor (Extracta 32, Loccus, Brazil) was performed. Positive samples were separated for possible characterization of variants of concern (VOC) by using the PKamp™ VariantDetect™ SARS-CoV-2 RT-PCR assay (PerkinElmer, Finland).

Statistical analysis

Statistical analysis was performed with Microsoft Excel software (Microsoft, USA). Descriptive statistics were performed to analyse the responses of the dental team and children's parents for the survey questions, as well as the result (positive or negative) of the detection of SARS-CoV-2 in the samples.

RESULTS

A total of 93 individuals participated in the study, being 54 members of the dental care team and 39 children. Of this total, 34 were male (13 from the dental care team and 21 children) and 59 were female (41 from the dental care team

and 18 children). The age of the dental care team ranged from 23 to 64 years old, with a mean of 29 ± 8.5 years, whereas the age of the children ranged from 3 to 13 years old, with a mean of 7.5 ± 2.2 years. All children were previously screened by using teleconsultation.

All those involved in the study completed the electronic questionnaire on COVID-19 symptoms (Figure 2), which was applied every week for two months. All participants had their body temperature checked with a digital non-contact infrared thermometer (value below $37^{\circ}\text{C}/98.6^{\circ}\text{F}$) before entering the dental clinic. As there was no report of symptoms for COVID-19 on the day of dental appointment, all participants were considered asymptomatic.

1. Body temperature
2. Oxygen saturation ratio
3. Have you had a fever in the last two weeks?
4. Are you experiencing shortness of breath or breathing difficulties?
5. Are you experiencing any other symptoms? (e.g. flu, gastrointestinal upset, headache and/or tiredness)
6. Have you recently experienced a loss of smell or taste?
7. Do you suffer from any illnesses? (e.g.: heart, lung, kidney, diabetes and/or autoimmune disease)
8. Have you had contact with someone who tested positive for COVID-19? If yes, when?
9. Have you ever had COVID-19? If yes, when?

Figure 2. Questionnaire on COVID-19 symptoms.

Regarding the vaccination data of the members of the dental care team, 50 (92.5%) had received at least the first dose, whereas only four (7.5%) received no dose (Table 1).

Table 1. Characteristics of the dental care team.

	Variable	n (%)
Gender	Female	41 (76.0)
	Male	13 (24.0)
Age (years)	23 -35	47 (87.0)
	36-51	4 (7.5)
	>52	3 (5.5)
Vaccine	AstraZeneca/Oxford	33 (61.0)
	CoronaVac/Butantan	10 (18.5)
	Pfizer/Biontech	7 (13.0)
	Moderna/Janssen	-
	None	4 (7.5.0)
Doses	1 st	35 (65.0)
	2 nd	15 (27.5)
	Single dose	-
	None	4 (7.5)

A total of 241 pairs of swabs were collected from children ($n = 72$) and members of the dental care team ($n = 169$). With regard to the paediatric patients, only one child of the 72 (1.4%) tested positive for SARS-CoV-2 in the third week of collection regarding both extraction-free and viral RNA extraction protocols. The cycle threshold values were 38.2 for E gene target and 37.8 for S gene target in the extraction-free protocol, whereas in the viral RNA extraction protocol they were 28.5 and 28.3, respectively. Subsequent analysis of the positive sample for VOC characterization suggests an infection by the gamma variant (also known as P.1).

The child's parents were notified on the positive result test via phone call and instructed to maintain physical and social distancing for 15 days, in addition to observing possible symptoms of the disease.

DISCUSSION

Due to the limitations of the in-person dental care, teledentistry has been more widespread and used in public and private institutions. Teledentistry has proven to be relevant for patients in terms of diagnostic support, health orientation and shorter waiting lines as well as for undergraduate students⁴ in terms of educational tool for patient care.

COVID-19 pandemic, besides impacting the health policies, has also changed the way healthcare is provided⁵. Literature shows the positive results of the performance of teledentistry at this moment^{4-6,12-14}. In fact, online care allowed taking anamnesis as well as identifying dental needs, besides providing an initial contact between professional and paediatric child without the use of personal protective equipment. Individual protective equipment might be a problem in terms of the psychological conditioning of the children. In addition, the use of teledentistry reduced the costs with transportation for the children's parents⁶ and at the same time it reduces the risk of contagion that would result from the displacement of the patient and his family, for another face-to-face dental care. In this setting, teledentistry has been very successful in removing barriers to healthcare and education¹⁵ and teleconsultation is likely to remain even after the pandemic is under control. However, remote dental care should only happen when it is possible to follow up the patient and provide in-person care⁴, as in this study.

Despite of teledentistry being a good tool for oral health care, a systematic review¹⁶ demonstrated that dentists have a moderate knowledge about it, and its use during the COVID-19 pandemic was very low. In this sense, the undergraduate, postgraduate students and lectures that participated in this study have acquired knowledge and experience about telehealth. The teledentistry tool should be incorporate in Dentistry Curriculum and used as a regular tool like as option to the first appointments in any clinical activity at Dental School.

The dental care team has complied with the biosafety protocol as established by the dental school and university. Every care was taken both when putting on and taking off the personal protective equipment. The literature has shown how important biosafety measures are, especially in the dental environment^{17,18}. At the beginning of the pandemic, when little was known about the SARS-CoV-2, it was believed that the dental office was not safe for either the dentist or the patient because of the aerosols produced during the treatment^{19,20}. However, dentists have always been very careful about biosecurity, and in the current pandemic, we can emphasize this quality even more.

As well as the use of personal protective equipment was established for the dental team, the prior application of the COVID-19 screening questionnaire for both groups of participants allowed us to track whether anyone had any of the most common symptoms of the disease. In addition, temperature measurement was a precaution taken to prevent any individual from entering the dental school with fever²¹. This protocol has also been implemented by other institutions of higher education.

The screening for COVID-19 using combined nasal-oral swabs had excellent acceptability. Some studies discuss the presence of SARS-CoV-2 in salivary glands and oral mucosa^{22,24}, thus making it possible to use fluids from the oral cavity to diagnose COVID-19 in a less invasive manner⁸. Faster and less invasive sample collections may be an option for screening as the participants reported none or minimal discomfort during the test⁷.

None of the members of the dental team was RT-PCR positive for COVID-19. This demonstrates that whole process involving pre-COVID-19 screening and proper use of personal protective equipment, including the high vaccination rate in this group (despite being only the first dose in most participants), served as protective measures for all the participants. As the dental care team was negative for SARS-CoV-2, the patients were safe for dental treatment as well.

With regard to the child who tested positive for COVID-19, we believe that it is unlikely that she had become infected in the dental clinic environment because all the students and teachers involved in the care tested negative. Furthermore, we did not monitor the child's parents and social contacts to suggest from where the contamination occurred. The two students who evaluated the child did not get contaminated either, as well as the teachers who had contact with her

during the dental care, probably due to the biosafety protocol followed. Therefore, the child's parents were advised to undergo quarantine with social distancing and to evaluate possible symptoms in the child and close people.

Although all paediatrics patients and members of the dentistry team had been screened for COVID-19 and no symptoms were detected or reported, one sample from a patient was RT-PCR positive, indicating a low incidence of infection during the study. In fact, low rates of SARS-CoV-2 viral RNA in asymptomatic children by using RT-PCR detection has been reported²⁵. However, one study showed a higher incidence (~20% positive rate) in children attending primary school in Liege, Belgium²⁶. A much higher incidence could be explained due to the time period of the study, which was performed during the second wave of COVID-19 pandemic. The results showed that it is important to monitor asymptomatic children when they participate in group activities by screening them for COVID-19 at schools or in clinics. The choice for an extraction-free protocol increases the testing capacity because it is less time-consuming and has a sensitivity comparable to that of the viral RNA extraction protocol, as shown in our results. This approach is easily applied to population-based screening tests^{27,28}. Another possibility is the use of pooled samples, such as a periodic group approach for serial testing²⁹. The detection of a SARS-CoV-2 gamma VOC is in accordance with the epidemiological data available at the time of the study, as this variant has become dominant since March 2021 in Brazil³⁰ after its appearance in Manaus³¹.

Despite the rapid viral spread and new variants of SARS-CoV-2, vaccination has not yet been released for children of all age groups³². Since many children carry the virus and remain asymptomatic, minimally invasive testing is relevant for screening SARS-CoV-2. Therefore, a simple, less invasive and cheaper testing method may be a viable alternative, especially at this time when many children have returned to regular school attendance⁷.

The present study used a convenience sample, which may represent a limitation. Nevertheless, we can highlight the importance of monitoring SARS-CoV-2 in children by emphasizing the use of less invasive sample collection to stop or at least reduce the viral spread, especially in this new moment of the pandemic, in which several little known variants are circulating worldwide³¹, as is the case of the omicron variant. Further research must be done taking into account a higher number of participants, randomizing groups, and maintaining the same biosafety conditions.

CONCLUSION

Teledentistry associated with COVID-19 screening and molecular surveillance for SARS-CoV-2 allowed conducting a safe in-person dental care for dental staff and children. Moreover, screening tests and molecular surveillance play a relevant role, especially for children of all ages who are not yet vaccinated, which allows a higher circulation of the new variants.

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