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Teledentistry and management protocol in a pediatric dental department during the first COVID-19 lockdown

C. Damoiselet\textsuperscript{a,1}, T. Veynachter\textsuperscript{b,c,1}, S. Jager\textsuperscript{b,d}, A. Baudet\textsuperscript{b}, M. Hernandez\textsuperscript{b,e}, C. Clément\textsuperscript{b,c,*}

\textsuperscript{a} Université de Lorraine, Faculté d’odontologie, F-54000 Nancy, France  
\textsuperscript{b} CHRU-Nancy, Université de Lorraine, Faculté d’odontologie, F-54000 Nancy, France  
\textsuperscript{c} Université de Lorraine, Interpsy, EA 4432, F-54000 Nancy, France  
\textsuperscript{d} Université de Lorraine, 2LPN, EA7489, F-54000 Nancy, France  
\textsuperscript{e} Université de Lorraine, SIMPA, EA 7300, F-54000 Nancy, France

\textbf{ABSTRACT}

\textbf{Background:} During the first COVID-19 lockdown, from March 12 to May 15, 2020, private dental practices in France and in many other countries remained closed. Dental emergencies were therefore partly redirected to hospital dental departments. The aim of this article is to describe the modalities of remote management of emergencies during this period, by the pediatric dentistry department of Nancy University Hospital (France), via an oral teledentistry protocol.

\textbf{Patients and methods:} All parents of children in difficulty were invited to contact the department by phone. Initial triage was managed by externs, interns, or dental practitioners following a management protocol specifically adapted to pediatric dentistry for this context. Depending on the situation (type of complaint, geographical location of the patients, possibility of travel, availability of digital equipment, etc.), an oral teledentistry solution was proposed using the Covotem\textsuperscript{b} software (Maincare Society, Canejan, France) via the Pulsy platform (public interest grouping validated by the Grand Est Regional Agency for Health) and possibly using an intraoral photographic protocol suggested by the team.

\textbf{Results:} During this period, 176 patients used the pediatric dental department, 40 of whom were managed via oral teledentistry. Of these children, 57\% (23/40) required an appointment in the department during the lockdown, 30\% (12/40) did not require follow-up, and 13\% (5/40) required a post-lockdown appointment. This teledentistry protocol resulted in a diagnosis in most cases (93\%).

\textbf{Conclusion:} Patient management through oral teledentistry appears to be an effective tool for planning and organizing oral healthcare. It should be more widely considered in dentistry in the current context of pressure in medical emergencies, significant medical needs, and medical desertification.

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\section{1. Introduction}

In March 2020, the COVID-19 pandemic reached France and the rapid spread of the virus affected the healthcare system significantly. To limit the epidemic, the French National Council of Dental Surgeons closed all private dental practices. As a result, dental departments in hospitals were organized to cope with an increased number of patients, while maintaining high safety standards. In order to achieve this goal, teledentistry was used to improve patient management and continuity of care [1]. Teledentistry is defined as “a combination of telecommunications and dentistry, involving the exchange of clinical information and images over remote distances for dental consultation and treatment planning” [2]. It is a viable option for remote screening, diagnosis, consultation, treatment planning, and supervision [3] in order to, for example, prepare a treatment decision, prescribe medication, or provide specialist advice [1]. According to French law, teledentistry comprises five acts, one of which is the “medical response” or management of medical emergencies [4]. For this reason, the dental department of Nancy University Hospital first established a phone management protocol, based on the one created by another French city in 2015 [5] and modified at the national level for the SARS-CoV-2 crisis. In the second step, our team set up a management protocol with videoconference following the guidelines of the French National Authority for Health (Haute Autorité de Santé) [6]. Nevertheless, this usual practice causes difficulties in dentistry. Indeed, using the webcam does not offer a qualitative intraoral view and thus requires the use of an intraoral camera [7,8]. This article describes the attendance and management of patients in a pediatric
dental department, through a teledentistry protocol, during the first COVID-19 lockdown.

2. Material and methods

The teledentistry protocol was used in the pediatric dental department of Nancy University Hospital in France from March 12 to May 15, 2020. First, the case was managed by phone to carry out the initial triage by externs, interns, or dental practitioners. After this call and depending on the situation (type of complaint, geographical location of the patients, possibility of travel, availability of digital equipment, etc.), the patient was referred to one of the following: (1) immediate appointment in the department; (2) management via photographs only; (3) management appointment via webcam only; (4) management appointment via webcam with photographic protocol; or (5) management via phone only. After analysis by the dental practitioner, a decision was made between three other possibilities: “appointment during lockdown,” “appointment after lockdown,” or “no appointment.” This flowchart is presented in Fig. 1.

A computer with a web camera was installed in a dedicated room in the department to perform live consultations. To improve the intraoral view, and thus the diagnosis, the dental team created an intraoral photographic protocol (Fig. 2). The parent or legal guardian was invited to use a mobile device such as a phone or digital tablet, in accordance with the 2017 World Health Organization report on mobile health (mHealth) [9]. Simultaneously, a questionnaire was provided containing medical information and the chief complaint, along with the consent form (Figs. 3 and 4). All these documents were prepared by the head of the adult dental emergencies department, who is a graduate in teledentistry (C.C). They were then adapted by the practitioner and by the head of the pediatric dentistry department (S.J).

Technically, the teledentistry procedure was as follows. First, access for the management was achieved with the Covotem® software (Maincare Society, Canejan, France) via the secure platform Pulsy (public interest grouping approved by the Grand Est Regional Agency for Health for telemedicine, Villers-lès-Nancy, France). All practitioners involved have received training in the use of the Covotem® software organized by the CHRU. A patient record was created, or added to the software if she/he had already consulted the dental department, and an email was then sent including the following information:

- The date, time, and link for the case management appointment
- An explanation tutorial
- A technical test performed before the appointment by the patient to check the functioning of the device

Also, a text message was sent, prior to the appointment, including the date, time, and link for the videoconference appointment.

At the same time, the questionnaire and the consent form were provided by the practitioner via the secure professional messaging system apicrypt® (APICEM, Coudekerque, France). Subsequently, after having filled in the documents, with photographs if required, the patient sent them back to the same email address. If required, prescriptions were sent by email in the same way to a pharmacy chosen by the patient. During the teledentistry appointment, oral consent was obtained by the dental surgeon. Patients whose condition only required photographs used exclusively the last part. All data
were extracted from medical files completed after teledentistry and/or appointment to the department.

3. Results

During the lockdown, 176 patients used the pediatric dental department. A total of 40 patients aged 5.8 ± 2.1 years (between 2 and 11 years old) used the teledentistry service. Among them, four chief complaints were reported: 35% (14/40) of the requests were due to an infection, 33% (13/40) to oral pain, 30% (12/40) to dental trauma, and 10% (4/40) to a request for medical advice. Pain was reported in 21% (3/14) of the infections. In 93% (37/40) of cases, a complete diagnosis was obtained by teledentistry only. The others required an appointment in the pediatric department.

The patients who benefited from teledentistry were not offered the same solution to identify their problem. Four different solutions were followed: 57% (23/40) used the phone and photographs; 23% (9/40) the phone and webcam; 13% (5/40) the phone, webcam, and photographs; and 7% (3/40) the phone only.

After management of the case, a personalized follow-up was set up by the dental surgeons. Among the patients, 57% (23/40) required an appointment in the department within the following days (Fig. 5), 13% (5/40) required a post-lockdown appointment, and in 30% (12/40) of the cases, teledentistry resolved the problem without an appointment.

4. Discussion

In the context of the pandemic, one of the major challenges was to limit patient travel and thus the risk of contamination by SARS-CoV-2, while simultaneously meeting the health needs of the population. Indeed, teledentistry was shown to be an efficient means of scheduling appointments according to the patient’s needs and of avoiding a massive influx of patients [10]. It also minimizes contact with pre-symptomatic patients and contributed toward limiting the spread of the virus [10,11]. In this study, only 40 patients out of 176 benefited from teledentistry management during the lockdown, but it prevented 30% (12/40) of unnecessary trips, ensuring the safe and correct functioning of the department. Another study conducted in a pediatric private dental practice in North Carolina, United States, reported that nearly half of all emergencies can be treated with teledentistry. This percentage can be as high as 60% for complications related to tooth eruption, or 75% for other problems such as ankyloglossia, tooth sensitivity, or aphthous ulcers [12].

Another aspect of the lockdown was a change in the need for dental care. Indeed, although the global number of appointments tended to decrease for obvious health reasons, an increase in oral
emergencies and particularly oral trauma was reported [13]. This was also observed in pediatric dentistry, with a fourfold decrease of caries complaints before and during lockdown (from 20.0% to 5.1%), a threefold increase of swellings (from 4.0% to 13.1%), and a twofold increase in dental trauma (from 6.8% to 14.6%) [14]. In the retrospective study by Fux-Noy et al., the main diagnosis was alveolar-dental abscesses affecting 32.3% of children consulting in emergency during the COVID-19 pandemic [14]. This finding was in accordance with the present study, in which 35% of patients used teledentistry because of an infection, constituting the main complaint.

The pandemic has also generated a lot of anxiety for the population [15] and especially for patients suffering from dental emergencies [16]. In our situation, the need to travel during the epidemic and, moreover, to a university hospital treating patients infected with the SARS-CoV-2 virus, was another important source of anxiety reported. Consequently, we consider that the strength of teledentistry is that it provided rapid medical contact and advice with a practitioner specifically trained in pediatric dentistry, which appeased many parents subjected to a potentially traumatic event. Several studies have shown a high level of satisfaction with teledentistry [17,18]. Unfortunately, we did not measure patient satisfaction directly, but we did and still do receive “unsolicited comments” both from parents and practitioners that suggest a reasonable level of satisfaction with telemedicine services. Worried parents of patients very much appreciated being reassured by a practitioner via a webcam. Practitioners found that the webcam was a good way of tackling the anxiety of parents (especially in cases of dental trauma). Teledentistry could also lead to substantial savings in terms of time and money [19], by allowing the organization and preservation of human and financial resources necessary for the proper management of patients.

However, teledentistry has encountered certain limitations. First, from a technical perspective, the lack of an intraoral camera or the absence of panoramic radiographs reduces the accuracy of the diagnosis [20]. But these problems can be partially solved, as in our study, with mobile devices. The use of a mobile phone to take intraoral photographs enables a rapid assessment of the situation and efficient patient management [20,21]. It also has a sensitivity and specificity of more than 80% for diagnosis and treatment planning of dental caries in children [20].

From the patient’s point of view, the use of these modern technologies could be a hindrance for people who have no or poor competence with digital devices, which is the case for 48% of the French population [22]. Another obstacle for teledentistry would be the potential breakdown of the caregiver—patient relationship [23,24].

From the practitioner’s point of view, other difficulties are reported, mainly the need for training [25] and organizational problems or technical issues during the implementation of teledentistry [26]. For our team, the most complicated aspect was having to manage the two modalities of practice: management by teledentistry and curative conventional management of patients (since dental externs and interns were not authorized by the regulatory authorities to take charge of patients in the chair during this period). It would be essential for the future to consider the activity of a practitioner only in management, as has been described in North Carolina [12]. Dental surgeons also cited the poor quality of intraoral photographs [27]. Therefore, it is important to properly guide the patient’s parents or the patients themselves with a good protocol to ensure image quality [21]. The last barrier is the lack of financial support for teledentistry, which is a major issue in several countries [26,27].

This teledentistry protocol resulted in a diagnosis in most cases (93%). Consequently, triage was possible, which enabled better organization of healthcare and follow-up. Despite its strengths, this study has some limitations. First, it includes only one pediatric dental department in France, which is therefore not representative of all other pediatric dental practices. Moreover, in the organization of the university hospital, orthodontic treatments were performed in another location, which explains why no orthodontic emergencies were reported in this study. In addition, the department was run by dental surgeons with an exclusively pediatric dentistry practice, which meant that their expertise made triage and decision-making easier than for a general dentist, in a private practice, for example. However, this emergency experiment enabled the refinement of another protocol that had been halted due to the pandemic. This multicenter prospective diagnostic study on intraoral diagnostic tools called “ONE-1” (Oral graNd Est) was able to resume in phase 1 in four facilities for dependent older adults in a department of eastern France particularly affected by the aging population and medical desertification. Phase 2 will be carried out in establishments for people living with a disability.

5. Conclusion

Teledentistry management using intraoral photographs facilitates the diagnosis and proper referral of patients in an emergency and pandemic context such as the COVID-19 pandemic, but also enables medical care to be scheduled and planned in a sanitary and secure manner. Nevertheless, some difficulties exist for both patients and practitioners. However, good support from the latter can mitigate these drawbacks. The major obstacle to teledentistry practice remains the lack of recognition and financial support in France for this medical service, whose major importance in dentistry should be reconsidered in these times of pressure in medical emergencies, significant medical needs, and professional medical desertification.

Conflicts of interest

The authors declare no conflict of interest.

References

[1] Ordre National des Chirurgiens Dentiste. [Internet]. La lettre N°173. La télémédecine bucco-dentaire c’est maintenant ! 2018. https://www.ordre-chirurgiens-dentistes.fr/wp-content/uploads/2020/12/La_Lettre_173-2018-1.pdf (Accessed January 16 2022).
[2] Deshpande S, Patil D, Dhoak A, et al. Teledentistry: a boon amidst COVID-19 lock-down-a narrative review. Int J Telemed Appl 2021:2021:8859746.
[3] Irving M, Stewart R, Spallke H, et al. Using teledentistry in clinical practice as an enabler to improve access to clinical care: a qualitative systematic review. J Telemed Telecare 2018;24:129–46.
[4] Code de la Santé Publique. [Internet]. Décret n° 2010-1229 du 19 octobre 2010 relatif à la télémédecine. https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000022532449/ (Accessed February 06 2022).
[5] Pegon-Machat E, Decerle N, Tubert-Jeannin S. Construction et évaluation d’un outil d’orientation des patients vers une unité d’urgence odontologique. Santé Publique 2015;1:79–88.
[6] Autorité de Santé Haute. [Internet]. Modalités de prise en charge d’un appel de demande de soins non programmés dans le cadre de la régulation médicale. 2011. https://www.has-sante.fr/upload/docs/application/pdf/2011-10/reco2012c_regulation_medecine.pdf.
[7] Queyroux A, Saricassapian B, Herzog D, et al. Accuracy of teledentistry for diagnosing dental pathology using direct examination as a gold standard: results of the tel-e-dent study of older adults living in nursing homes. J Am Med Dent Assoc 2017;18:528–32.
[8] Inquimbert C, Hiraiza-Tsuciya S, Yoshii S, et al. Concordance study between regular and teledentistry diagnosis of dental caries. J Telemed Telecare 2021:27:509–17.
[9] World Health Organization. [Internet]. mHealth: Use of appropriate digital technologies for public health: report by the Director-General. https://apps.who.int/iris/bitstream/handle/10665/274134/B142_20-en.pdf?sequence=1&isAllowed=y, Accessed February 06 2022.
[10] Macapagal F. Applications of teledentistry during the COVID-19 pandemic outbreak. Appl Med Inform 2020;42:133–41.
[11] Samaranayake L, Fakhruddin KS. Pandemics past, present, and future. Their impact on oral health care. J Am Dent Assoc 2021;152:972–80.
[12] Brecher EA, Keels MA, Carrico CK, et al. Teledentistry implementation in a private pediatric dental practice during the COVID-19 pandemic. Pediatr Dent 2021;43:463–7.
[13] Lengte F, Jahn P, Zeller AN, et al. Changes in emergency patient presentation to a maxillofacial surgery department during the COVID-19 pandemic. J Oral Maxillofac Surg 2021;79:2123, e1–e6.
[14] Fux-Noy A, Mattar L, Shmueli A, et al. Oral health care delivery for children during COVID-19 pandemic—a retrospective study. Front Public Health 2021;9:637351. doi: 10.3389/fpubh.2021.637351.
Shah SMA, Mohammad D, Qureshi MFH, et al. Prevalence, psychological responses and associated correlates of depression, anxiety and stress in a global population, during the coronavirus disease (COVID-19) pandemic. Community Ment Health J 2021;57:101–10.

Faccini M, Ferruzzi F, Mori AA, et al. Dental care during COVID-19 outbreak: a web-based survey. Eur J Dent 2020;14:514–9.

Amtha R, Gunardi I, Astoeti TE, et al. Satisfaction level of the oral medicine patients using teledentistry during the COVID-19 pandemic: a factor analysis. J Int Soc Prev Community Dent 2021;11:414–20.

Watfa MO, Bernfeld NM, Orenac D, et al. Rapid implementation of teledentistry during the Covid-19 lockdown. Adv Oral Maxillofac Surg 2021;2:100031.

Kshirsagar MM, Dodamani AS, Dodamani GA, et al. Teledentistry: a new horizon in COVID-19 pandemic for oral health. Int J Clin Pediatr Dent 2021;14:441–2.

AlShaya MS, Assery MK, Pani SC. Reliability of mobile phone teledentistry in dental diagnosis and treatment planning in mixed dentition. J Telemed Telecare 2020;26:45–52.

Maret D, Peters OA, Auria JP, et al. Smartphone oral self-photography in teledentistry: recommendations for the patient. J Telemed Telecare 2021;1357633X211028513.

Institut National de la Statistique et des Etudes Economiques. [Internet] L’économie et la société à l'ère du numérique. 2019. https://www.insee.fr/fr/statistiques/4238593?sommaire=4238635 (Accessed February 06 2022).

Hjelm NM. Benefits and drawbacks of teledentistry. J Telemed Telecare 2005;11:60–70.

Allouche M, Hervé C, Pirnay P. Le nécessaire questionnement éthique autour de la relation de soin en télémedicine bucco-dentaire. Med Sci 2017;33:1105–9.

Nassani MZ, Al-Maweri SA, AlSheddi A, et al. Teledentistry—knowledge, practice, and attitudes of dental practitioners in Saudi Arabia: a nationwide web-based survey. Healthcare 2021;9:1682.

Mishra G, Gupta V, Kumar S, et al. Role of teledentistry during Covid-19 pandemic: a review. Uttar Pradesh State Dent J 2020;1:25–9.

Haider MM, Allana A, Allana RR. Barriers to optimizing teledentistry during COVID-19 pandemic. Asia Pac J Public Health 2020;32:523–4.