J. Maxillofac. Oral Surg.
https://doi.org/10.1007/s12663-021-01596-z

ORIGINAL ARTICLE

Is Tele-Dentistry an Effective Approach for Patient Follow-up in Maxillofacial Surgery

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Received: 8 February 2021 / Accepted: 22 May 2021

Abstract
Purpose To explore the feasibility and diagnostic accuracy of the tele-dentistry for the follow-up of different diagnostic groups of Turkish patients in maxillofacial surgery.
Materials and Methods In this study, follow-up patients were allocated to four groups as dental implant, minor surgical procedure, infection-medication-related osteonecrosis of the jaws (MRONJ) and temporomandibular joint disorder (TMD). In all groups, remote examination via video call and subsequently face-to-face clinic examination were performed. The quality and accuracy of the video call were scored by the same investigator. Also, patient satisfaction regarding the video call was evaluated with a questionnaire.
Results Twenty-one patients (12 females, 9 males) between 18 and 71 years (38.90 ± 17.88) participated in the study. A strong preference of 71% and 95% toward video call by patients was seen in the questionnaires performed after video call and face-to-face examination, respectively. Regarding the rating of the clinician, no significant differences were found between groups in terms of the quality and accuracy of video call ($p \geq 0.05$).
Conclusion Remote follow up of diagnostic groups which can benefit from tele-dentistry pose a promising remedy that is reliable as in-person visits and also can reduce the clinical visits in routine clinical practice.

Keywords Video call · Smartphone · Oral surgery

Introduction

Since the 'Coronavirus disease 2019' (Covid-19) declared as a pandemic by the World Health Organization (WHO) on March 11, 2020, governments all around the world have imposed many restrictions to reduce the spread of this outbreak [1, 2]. Thus, a significant challenge was emerged for every aspect of healthcare services in providing routine care, due to the lockdown and necessity of social distancing [3, 4]. Particularly in dentistry, rather than other healthcare specialties, aerosol-generating procedures put clinicians and patients at risk of Covid-19 because of the transmission potential of the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) through airborne droplets and respiratory secretions [5]. Also, undocumented cases that reported to cause nearly 80% of the spread, increase the transmission risk in dental settings dramatically [6]. In order to reduce the risk of transmission in dental practice, non-urgent treatments were suspended and emergency treatments were maintained in most countries around the world [7]. However, the uncertainty regarding the course of the pandemic force caregivers to find alternative solutions that could maintain healthcare while keeping stakeholders away from being exposed to SARS-CoV-2 [8, 9].

Tele-dentistry is a domain of telemedicine which enables remote communication between clinicians and patients by combining digital technology and clinical dentistry. Although not a new approach, nowadays tele-dentistry has gained rising attention because of the compulsory adaptive changes that the pandemic brings along [2, 9, 10]. Rather than a traditional medical approach, tele-

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Published online: 31 May 2021

dentistry is an innovative method which reduces hospital visits, costs related to accommodation and travel as well as the utilization of consumable personal protective equipment [2, 9, 11]. Tele-dentistry reported being implemented by hospital-based systems and smartphone applications in either real time or in store and forward format [10, 12]. Among the smartphone applications, WhatsApp is a popular application that enables to share of information among patients and clinicians. This application provides the security of shared information by using several codes in an end-to-end encryption system. Besides given advantages, the primary challenge of this application is the inadequacy of the system for the cases requiring intervention. The privacy and security issues, and the difficulties in archiving information are also considered among the limitations [2, 13, 14].

Tele-dentistry in maxillofacial surgery has been reported to be a useful tool for consultation, patient triaging, treatment planning, and follow-up purposes previously [15–19]. The aim of this study was therefore to explore the feasibility and diagnostic accuracy of the tele-dentistry via video call for the follow-up of different diagnostic groups of Turkish patients in maxillofacial surgery practice. Also, we aimed to evaluate patients' and clinician attitude toward remote care.

Materials and Methods

This study was conducted between August 15 and September 25, 2020, at the Oral and Maxillofacial Surgery Department of Ordu University with the patients who had undergone different treatments and were still under follow-up. The protocol of the present study was approved by the Ethics Committee of the Ordu University (No: 2020/166) and carried out in accordance with the ethical standards specified in the Helsinki Declaration of 1964. The informed consent was obtained from each patient for their participation in this study. Patients who were over 18 years old, have a smartphone with WhatsApp application and an internet connection, and were still under follow-up without the need for radiological examination or intervention included in the study. Patients who did not want to participate, did not cooperate remotely, did not a have smartphone with deserved properties and were unable to use technology, have hearing or visual difficulties, or language barriers were excluded. The patients who meet the inclusion criteria were allocated to the following groups; dental implant, minor surgical procedure (third molar surgery), dental infection and medication-related osteonecrosis of the jaws (MRONJ) and temporomandibular joint disorder (TMD).

Patients were reached from the archival records and informed about the study. To test the feasibility and diagnostic accuracy of virtual follow-up, the patients who declare to participate in the study were contacted via WhatsApp (WhatsApp Inc., Mountain View, California, USA) application the day before the clinical follow-up appointment and their examination have been carried out via video call. During the examination, parameters such as pain, mouth opening, swelling, temporomandibular joint (TMJ) sound, osteonecrosis area and pus drainage were evaluated and scored by the same investigator. 10 point (0 indicated ''no pain'' whereas 10 indicated ''unbearable pain'') Visual Analog Scale (VAS) was used to evaluate the pain. Mouth opening was assessed by observing the fingers of the patient that can stack between the teeth. TMJ sound, swelling, osteonecrosis area and pus flow were assessed in line with the declaration of the patients and live view of the area from the camera. The quality of the interview, the ability of the patients to express themselves through the application, the ease of the interview, and the accuracy of examination via video call were scored by the same investigator by means of 5-point scale (0 indicated 'very bad' while 4 indicated 'very good'). The patients were examined in the clinic appointment, and the same parameters were evaluated the day after the video call. The accuracy of the virtual examination was evaluated by comparing the results of the video call and the face-to-face examination in the clinic. The patient satisfaction regarding the video call was evaluated with a two-part questionnaire consisting of 8 questions created on Google forms (Google LLC, Mountain View, California) and shared with patients at the end of the video call and in-person appointments. The first part assessed the patients' demographic information. The second part evaluates video call. The questions in second part scored as yes or no by patients. The survey data were obtained from the google forms.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows software (version 23.0, IBM Corp, Chicago, USA). Shapiro Wilk test was used to explore the normality of the continuous variables. Continuous data were present as Mean ± (SD) and Median (Min–Max), categorical variables present as frequencies. Wilcoxon rank test was used to compare the mouth opening and pain level of the patients during remote and clinical examinations. Kruskal–Wallis test was used to compare the mean age, clinicians' rating among the groups and total rating of the clinician regarding educational level. To analyze the difference in the total rating of the clinician regarding gender independent samples t test was used. Differences regarding

gender and educational level among the groups were analyzed with Chi-Square test. All tests were two-tailed, and $p < 0.05$ was accepted as significant.

Results

Twenty-one patients (12 females, 9 males) between 18 and 71 years (38.90 ± 17.88) participated in the study. No significant differences were found regarding age, and gender ($p \geq 0.05$), while significant difference was observed in terms of educational level ($p = 0.013$) among the groups. Descriptive statistics in each group were shown in Table 1. High concordance observed between the findings obtained during the virtual and clinical examinations in terms of the presence of infection, swelling, muscle pain, TMJ sound, and pus drainage for each patient (Table 2). In terms of mouth opening, pain in rest and chewing no significant differences between virtual and clinical measurements were observed in all groups ($p \geq 0.05$), (Table 2).

Regarding the rating of the clinician who performed the examinations no significant differences were found for quality of the interview, the ability of the patients to express themselves through the application, the ease of the interview, the accuracy of examination of patients between groups ($p \geq 0.05$), (Fig. 1, Table 3). Results of the patient satisfaction questionnaire performed after examinations were presented in Table 4. The total rating scores of the clinician showed no significant difference for virtual and clinical ratings in terms of gender ($p = 0.859$. $p = 0.808$) and education level ($p = 0.806$. $p = 0.555$) of the patients, respectively.

Discussion

Advances in communication technologies along with the availability of broadband internet infrastructure created a route for unprecedented utilization of remote health care applications [18]. In this sense, tele-dentistry, although not used as widely as in medicine, stands out as an innovative approach has been used for diagnosis, treatment planning, consultation and monitoring in different specialties of dentistry since the 1990s [10, 12]. Nowadays, because of the effects of the global crisis a paradigm shift observed toward the use of tele-dentistry applications in dental care [2, 8, 9].

This study was aimed to explore the feasibility and diagnostic accuracy of tele-dentistry for the follow-up of different diagnostic groups of Turkish patients in maxillofacial surgery. We also aimed to evaluate patients' and clinician attitude toward remote care. Results of this study revealed that patients reported high preference rates regarding remote care as 71% after video call and 95% after face-to-face examination. In terms of the clinicians' ratings of the video call appointment also high scores observed for all diagnostic groups. However, the infection-MRONJ group has the lowest score followed by the implant group when compared to other groups.

In the study of Cronin et al. [20] who aimed to explore patients and clinicians acceptability of teleconsultation performed via telephone appointment for different diagnostic groups in maxillofacial surgery practice compared with the in-person assessment they observed that 59.1% of the patients reported a strong preference for teleconsultation. However, clinicians rated 59.5% of remote consultations as requiring further review including the conditions like orthognathic surgery, TMD, salivary gland diseases, and head and neck cancer due to the inability to perform traditional face-to-face examination. In the studies of El-Azzi et al. [9, 21] clinicians and patients attitudes toward

Table 1 Descriptive statistics among the groups

Variables	TMD	Implant	Minor surgery	Infection-MRONJ	*p* value
Age (year)					
Mean ± SD	30.25 ± 13.96	45.50 ± 11.18	25.20 ± 5.80	49.50 ± 23.98	0.145*
Median (Min–Max)	28.50 (18–46)	40.50 (35–61)	24 (20–35)	60.50 (19–71)	
Gender (n)					
Man	1	3	3	2	0 .690¥
Woman	3	3	2	4	
Education level (n)					
Primary School	0	0	2	1	0.013¥
High School	2	0	1	5	
University	2	6	2	0	

*Kruskal–Wallis test, ¥Chi-Square test

Table 2 Evaluated parameters

Parameters	TMD		Minor surgery		Implant		Infection-MRONJ	
	Mean ± SD	Median (Min–Max)	Mean ± SD	Median (Min–Max)	Mean ± SD	Median (Min–Max)	Mean ± SD	Median (Min–Max)
Maximum mouth opening								
Video call	2.5 ± 0.57	2.5 (2–3)	2.80 ± 0.44	3 (2–3)	2.83 ± 0.40	3 (2–3)	2.67 ± 0.51	3 (2–3)
Clinical examination	2.5 ± 0.57	2.5 (2–3)	2.80 ± 0.44	3 (2–3)	2.83 ± 0.40	3 (2–3)	2.67 ± 0.51	3 (2–3)
Pain on rest								
Video call	1.75 ± 1.25	2 (0–3)	0.8 ± 1.09	0 (0–2)	0.33 ± 0.51	0 (0–1)	1.50 ± 1.37	1.5 (0–3)
Clinical examination	1.75 ± 1.25	2 (0–3)	0.8 ± 1.09	0 (0–2)	0.33 ± 0.51	0 (0–1)	1.50 ± 1.37	1.5 (0–3)
Pain on chewing								
Video call	4 ± 2.16	3.5 (2–7)	1 ± 1	1 (0–2)	0.33 ± 0.51	0 (0–1)	2.00 ± 2.09	1.5 (0–5)
Clinical examination	4 ± 2.16	3.5 (2–7)	1 ± 1	1 (0–2)	0.33 ± 0.51	0 (0–1)	2.00 ± 2.09	1.5 (0–5)
	P	A	P	A	P	A	P	A
Presence of infection								
Video call	0	4	0	5	0	6	5	1
Clinical examination	0	4	0	5	0	6	4	2
Muscle pain								
Video call	1	3	0	5	0	6	1	5
Clinical examination	1	3	0	5	0	6	1	5
TMJ sound								
Video call	2	2	0	5	0	6	0	6
Clinical examination	2	2	0	5	0	6	0	6
Pus drainage								
Video call	0	4	0	5	0	6	0	6
Clinical examination	0	4	0	5	0	6	0	6
Swelling								
Video call	0	4	2	3	0	6	4	2
Clinical examination	0	4	3	2	0	6	4	2

P present, *A* absent

virtual clinics regarding different subspecialty of interests were explored. Before the pandemic, they reported that patients' acceptance of virtual consultation was largely positive with the highest acceptance observed in the trauma clinic while the lowest seen in TMJ clinic. Regarding clinicians' attitude although most of the clinicians participating in the study were happy to perform virtual clinic, some of them have concerns about applicability because the lack of physical examinations leads to the missing diagnosis. The surveyed clinicians suggested that benign or stable conditions were appropriate for remote care. On the other hand, in their subsequent study during the pandemic, they observed low conversion rates of remote consultations to face-to-face consultations, and clear attitude changes among senior staff and patients toward favoring the remote care. In this study, a high preference for teledental examination observed among patients and clinician. However, TMJ group showed the highest acceptance by clinician and patients while the lowest acceptance seen in the infection-MRONJ and implant groups, respectively. These differences among the studies may occur due to the fact that in

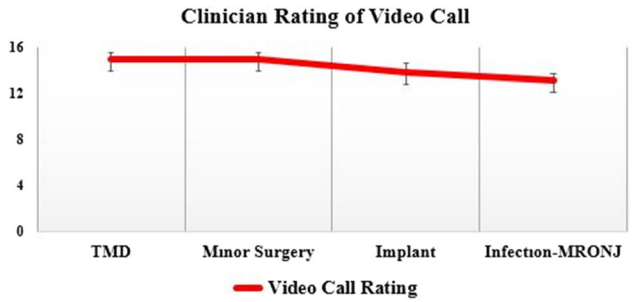

Fig. 1 Rating of the clinician of the quality and accuracy of video call among the groups

our study examinations only performed in follow-up patients.

Patient-related factors such as gender, age and education level also might have an important role in the applicability of remote care. Previous studies reported that the willingness of patients to have a virtual consultation affected by the age and the younger generation uses the medical online consultation service more commonly [21, 22]. In the study of Shenoy et al. [23], however, age and gender reported having no influence on the acceptability. Age and education level showed no significant differences in terms of satisfaction and diagnostic accuracy among the diagnostic groups in this study. However, the lowest acceptance regarding the infection-MRONJ and implant groups by patients in this study may have originated from the higher mean age of both groups which may cause difficulties in using technology. Regarding diagnostic accuracy, the infection-MRONJ and implant groups also obtained the lowest scores from the clinician when compared to other groups. This may be related to the unsuitability of remote care for MRONJ and implant patients or inadequate technique infrastructure in patients of these groups.

In the last decade, with the development of 4G network, smartphones with high technical audio and video settings, and utility of this tool a wide range of people have gained telemedicine a new trend [24]. It is considered that if the technique conditions were available patients and clinicians could communicate similar to in-person consultation [4]. Studies using a smartphone application for remote care reported different results in terms of diagnostic accuracy. Fonseca et al. [24] used videoconference via smartphone application Face Time app for trauma assessment by analyzing the correlation between telemedicine and in-person management. They reported that assessment of trauma by videoconference via smartphones is a feasible method showing a high concordance with in-person assessment. However, they also mentioned that some difficulty which limits spreading of this approach is expected, such as in case of complex soft tissue injuries. Lyu et al. [25] explored the feasibility of the WeChat application for the

Table 3 Clinician rating of video call

	TMD		Minor surgery		Implant		Infection-MRONJ		*p* Value
	Mean ± SD	Median (Min–Max)	Mean ± SD	Median (Min–Max)	Mean ± SD	Median (Min–Max)	Mean ± SD	Median (Min–Max)	
Quality of the interview	3.5 ± 0.57	3.5 (3 – 4)	3.80 ± 0.44	4 (3 – 4)	3.33 ± 0.51	3 (3 – 4)	3.50 ± 0.54	3.5 (3 – 4)	0.511*
Patients' express themselves	3.75 ± 0.50	4 (3 – 4)	3.40 ± 0.89	4 (2 – 4)	3.50 ± 0.54	3.5 (3 – 4)	2.83 ± 0.98	2.5 (2 – 4)	0.378*
Accuracy of examination	3.75 ± 0.50	4 (3 – 4)	3.80 ± 0.44	4 (3 – 4)	3.33 ± 0.51	3 (3 – 4)	3.33 ± 0.81	3.5 (2 – 4)	0.407*
Ease of interview	4 ± 0	4 (4 – 4)	4 ± 0	4 (4 – 4)	3.67 ± 0.51	4 (3 – 4)	3.17 ± 0.75	3 (2 – 4)	0.052*
Total score	15 ± 0.81	15 (14 – 16)	15 ± 1.41	16 (13 – 16)	13.83 ± 1.47	13.5 (12 – 16)	13.17 ± 2.22	14 (10 – 16)	0.269*

*Kruskal–Wallis test

Table 4 Patient satisfaction questionnaire

Questions	After virtual examination (%)		After face-to-face examination (%)	
	Yes	No	Yes	No
Are you satisfied with video call?	100	0	100	0
Do you think you can express yourself sufficiently during the video call?	100	0	100	0
Would you prefer face-to-face examination instead of the video call?	29	71	5	95
Would you like to have video call with another application instead of WhatsApp?	43	57	80	20
Overall, do you believe this method is useful?	95	5	100	0

follow-up patients with head and neck tumor. They suggested that rather than a replacement for clinical follow-up, WeChat application is cost-effective, and a convenient tool to assist in-person consultations in China. Petruzzi et al. [26] in another study used WhatApp to consult clinical images and reported that telemedicine agreed with the clinico-pathologic assessment for 82% of cases. Giudice et al. [2] also used WhatApp application in their study to investigate the advantages of telemedicine in dental practice during Covid-19 dissemination for urgent conditions and patients in follow-up. They concluded that telemedicine allowed successful monitoring, reducing costs and, decreasing the risk of Covid-19 dissemination by limiting human contact.

In the present study, we also prefer the WhatApp application to explore the feasibility and accuracy of remote care because it is simple, reliable, requires no costs and has benefits in terms of privacy in the healthcare setting. We found high accuracy among remote and face-to-face examinations which echo the results of the previous studies [2, 26]. In the present study also, patients were reported positive attitude toward using other smartphone applications instead of WhatApp. However, regulatory restrictions and medico-legal liability issues still have all been identified as barriers to the widespread use of this tool. Thus, creating new modalities which ensure the quality and security of health care is crucial for the implementation of tele-dentistry in the feasible areas of routine dental care in future.

This study has some limitations that should be considered when interpreting the results. Although the small sample size is a limitation this is a pilot feasibility study in Turkish patients. Another limitation of this study was the lack of standardization regarding the quality of video calling on which affected by smartphones. Diagnostic groups in our study were limited and did not include pathologies of odontogenic origin, malign or pre-malign conditions, salivary gland pathologies or orthognathic follow-up patients. Besides, in the current study, only a physician performed and evaluated video consultation and face-to-face examination that can affect the results.

Conclusion

Based on the results, it can be concluded that by judicious selection of subspecialty of interest in oral and maxillofacial surgery utilization of tele-dentistry for follow-up is a feasible and diagnostically accurate method which can limit the clinical visits in routine clinical practice. Although high preference rates were observed in this study, further studies are needed to clearly reveal the real attitudes of patients and clinicians on tele-dentistry and to determine the applicability of this approach to routine care.

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