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RESEARCH ARTICLE

Effects of the COVID-19 pandemic on orthodontic care in Finland

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ABSTRACT

Objectives: To investigate the measures that were taken to limit the risk of COVID-19 contagion, how the risk of adverse effects on patient treatment outcomes was mitigated in orthodontic practices in Finland during the COVID-19 pandemic, and how these measures affected the course of orthodontic treatment.

Materials and methods: In January 2021, an online questionnaire was sent by email to the members of the Orthodontic Division of the Finnish Dental Association Apollonia ($n=361$). An additional inquiry was sent to the chief dental officers of 15 health centers.

Results: A total of 99 clinically active members (39.8%) responded to the questionnaire. Of them, 97.0% had made changes in their practices, e.g. using additional protective gear such as visors (82.8%), incorporating preoperative mouthwashes (70.7%), and limiting the use of turbines (68.7%) and ultrasonics (47.5%). Two in three respondents reported temporary lockdowns (mean 1.9 months, range 0.3–5.0 months), during which some occlusions slightly regressed (30.2%) and some relapsed to a previous stage of treatment (9.5%). During this study, 59.6% of respondents reported that some treatments were still behind schedule. One in three respondents had used teleorthodontics because of the pandemic.

Conclusions: Preventive measures and changes in treatment procedures were implemented according to the local COVID-19 situation. Some treatments were prolonged, e.g. because of lockdowns or patient's fear of contracting COVID-19 whilst receiving treatment. New methods like teleorthodontics were introduced for coping with the increased workload.

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Introduction

The largest outbreak of an infectious disease in recent human history began in late 2019 when the novel coronavirus SARS-CoV-2 started spreading and was declared a pandemic by the World Health Organization (WHO) in March 2020 [1]. The virus causes an infectious disease (COVID-19) which manifests with a variety of symptoms from a mild respiratory infection to a severe form, including acute respiratory distress syndrome, pneumonia, and even death. The virus is mainly transmitted by exposure to infectious respiratory fluids ranging from large droplets to very fine particles and aerosols, which may be suspended in the air for minutes to hours [2].

Due to the transmission patterns of the virus, dentists were considered an at-risk group at the beginning of the pandemic [3]. High-speed handpieces and ultrasonics produce vast volumes of aerosols in and from the oral cavity, which in theory puts oral health care professionals in a highly susceptible position for patient-to-doctor transmission. Even if aerosols are not present, instruments and surfaces contaminated by fluids from the mucous membrane pose a cross-infection risk within the clinical environment.

In Finland, the first COVID-19 case was diagnosed in January 2020 among tourists visiting Lapland (Northern Finland). Soon after, all public events with more than 500 attendees were prohibited and traveling abroad was restricted. The Government, in cooperation with the President, declared a state of emergency over the coronavirus outbreak. The Emergency Powers Act was introduced in March 2020 and, among others, cultural institutions (museums, theaters, libraries, sport halls) and schools, educational institutions, and universities were closed. In-person teaching was suspended and replaced with remote teaching; in general, working remotely as much as possible was encouraged for everyone. Despite extensive restrictions, the numbers of COVID-19 infections and COVID-19 patients in intensive care increased in the Uusimaa district in Southern Finland, leading to restrictions in travel to and from Uusimaa for 19 d [4]. During the first year of the pandemic, a total of 1.3% of the Finnish population had been diagnosed with COVID-19 and 1.0% of those infected had died. The risk for COVID-19 infection was almost three-fold in Uusimaa as compared to other districts [5].

The Ministry of Social Affairs and Health gave practical guidance on preparedness at oral healthcare clinics during the coronavirus outbreak [6] and the Finnish Institute for Health and Welfare (THL) published comprehensive pandemic guidelines for oral healthcare units [7]. In fact, these

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guidelines were recommendations intended to be used when drawing up regional and local instructions. In 2021, the Finnish municipalities formed a total of 20 healthcare districts (hospital districts, defined by municipal borders) responsible for each district's special healthcare services. Each district had its own Central Hospital. The municipalities ($n = 309$, of which 107 were categorized as cities) or municipal federations had their own Health Centers ($n = 160$) with its own chief dental officer. As the guidelines by THL were not legally binding, local and regional instructions varied depending on the COVID-19 situation.

During the early weeks and months of the pandemic, the main methods of transmission were not yet fully appreciated. This uncertainty may have influenced professional and governmental guidance and the attitudes of clinicians towards taking preventive measures. With regard to the generally elective nature of the orthodontic treatment, the objectives of this study were to investigate the procedures and precautions implemented at Finnish orthodontic practices to minimize the risk of cross-infection and to combat possible contagion from the novel coronavirus. The second objective was to analyze how these measures affected the course of orthodontic treatment.

Materials and methods

A pilot questionnaire comprising 32 semi-structured and 5 open-ended questions was prepared in December 2020 and tested by in-house orthodontists and specializing dentists ($n = 8$). Based on their feedback, the final questionnaire was created on the online survey and analysis platform Webropol (https://webropol.com/). No ethical approval was needed, because this service study was based on a questionnaire, the respondents were volunteers and the responses anonymous.

In Finnish health centers, publicly funded orthodontic care is provided to those with severe malocclusions up to 18 years of age. Orthodontic treatments are mainly carried out by orthodontically active general dental practitioners (OGDPs), who are actively participating in orthodontic coursework and work under the supervision of a salaried or consulting orthodontist. The majority of health centers with their own resident orthodontist are located in the southern and central parts of the country, while in other regions, orthodontic consultations are procured from outside the area. Therefore, many of the resident orthodontists also privately consult for OGDPs in other health centers. Orthodontic teams also include on-the-job-trained dental hygienists and dental nurses working according to pre-planned, scheduled and instructed treatment protocols, e.g. taking impressions, instructing patients, changing power chains and removing fixed appliances. However, the treating orthodontist or OGDP is always responsible for the care. For further information, please see, e.g. Pietilä et al. [8,9].

To reach as many orthodontists and OGDPs as possible (i.e. those working in public health centers, hospitals, universities and private offices), the electronic link to the questionnaire was sent by email in January 2021 to the members ($n = 361$) of the Orthodontic Division of the Finnish Dental Association Apollonia. Of them, 111 (87 orthodontists and 24 OGDPs) were retired and one orthodontist lived abroad. Thus, a total of 249 members (113 orthodontists and 136 OGDPs) were working actively, of whom 99 (39.8%) responded. Of them, 67 were orthodontists (59.3% of all actively working orthodontist members) and 31 were OGDPs (22.8% of all actively working OGDP members). One of the respondents did not reply to the question of education. The link was circulated by Apollonia and was open for two weeks from the date the respondent first opened it. The respondents were asked to respond by 15 February at the latest. One reminder was sent two weeks after the initial email.

The first section of the online survey included questions concerning respondents' demographics and education (graduation year and academic degree). A description of these details is presented in Table 1, and data on employment is shown in Figure 1.

In the second section, respondents were asked to identify the active methods that had been implemented in their primary workplace to prevent and stop possible COVID-19 contagion. The questions addressed practical changes in orthodontic treatment protocols as well as changes made in dental offices and in organizations as a whole. Because of the possibility that orthodontists were not as well aware of all the changing practices in their places of consultation, the questions concerned the respondent's primary workplace only.

The last section reflected on the changes made in the workplace and the impact of these changes in orthodontic care and workload. The questionnaire's internal consistency was good, 0.858 (95% CI = 0.803–0.895) with McDonalds ω.

In addition to the online survey, a shorter inquiry was sent by email to the chief dental officers of 15 health centers around Finland in May 2021. The health centers were selected on the basis of their geographic location in order to obtain

Table 1. Descriptive data on responding, clinically active orthodontists ($N = 67$) and orthodontically active general dental practitioners (OGDPs) ($N = 31$).

						Range	
General data	Education	*N*	Median	Mean	SD	Min	Max
Graduation (year)	Orthodontists	67	1991	1992	9.0	1970	2013
	OGDPs[a]	31	2010	2006	12.1	1981	2019
Experience (years)	Orthodontists	67	24.0	22.4	9.0	5.0	44.0
	OGDPs[a]	31	5.0	10.8	10.6	1.0	38.0
			Health centre (%)	Private office (%)	Hospital (%)	University (%)	Other (%)
Work place[b]	Orthodontists	67	47 (70.1)	12 (17.9)	4 (6.0)	1 (1.5)	3 (4.5)
	OGDPs[a]	31	26 (83.9)	1 (3.2)	3 (9.7)	–	1 (3.2)

One of the respondents did not reply to the question of education and was therefore excluded from the table.
[a]'OGDPs' also include postgraduate students ($n = 15$).
[b]'Work place' refers to the respondent's primary place of work.

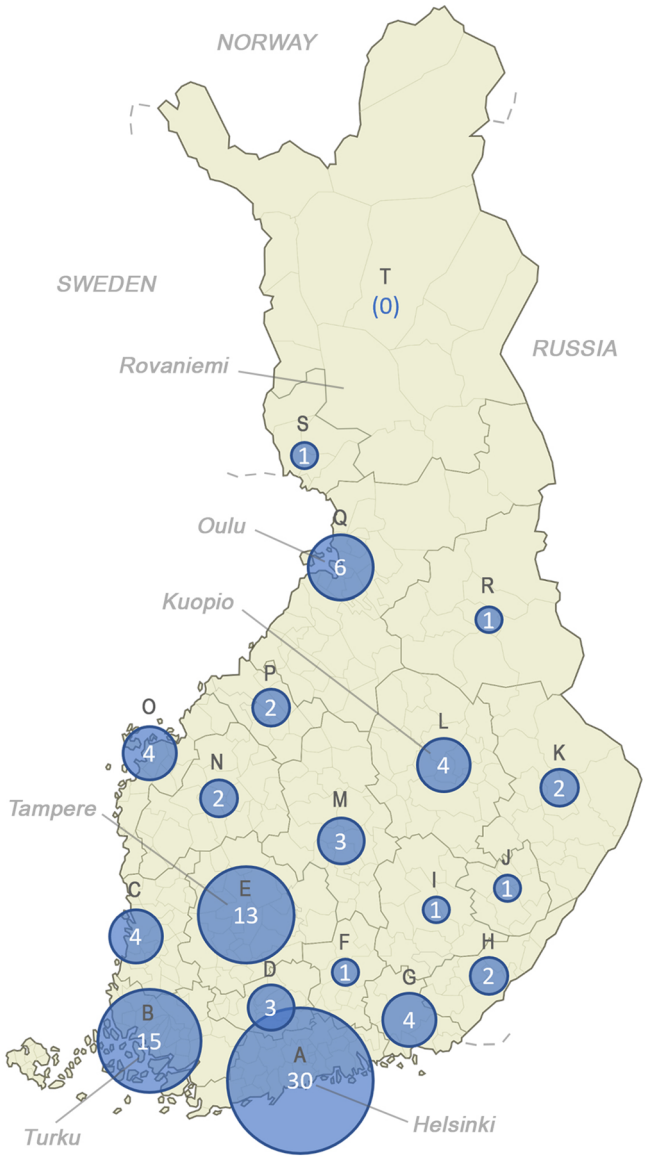

Figure 1. Locations and numbers of responding orthodontists and general practitioners in hospital (health care) districts in Finland. The relationships in the distribution of respondents are illustrated by the circle's radius. In Northern Finland, the number of responding orthodontists and general practitioners was zero. The hospital districts on the map are as follows: A = Helsinki and Uusimaa; B = Southwest Finland; C: Satakunta; D: Kanta-Häme; E: Pirkanmaa; F: Päijät-Häme; G: Kymenlaakso; H: South Karelia; I: South Savo; J: Eastern Savo; K: North Karelia; L: North Savo; M: Central Finland; N: South Ostrobothnia; O: Vaasa; P: Central Ostrobothnia; Q: North Ostrobothnia; R: Kainuu; S: Länsi-Pohja and T: Lapland. (Edited from a public domain bitmap. Source: https://commons.wikimedia.org/wiki/File:Suomi.karttapohja.2016.svg).

even coverage of the whole country. The inquiry consisted of open questions regarding guidelines and instructions received from administrative entities such as THL or Regional State Administrative Agencies.

Statistical analyses

In this descriptive cross-sectional study, comparisons were made according to the respondent's highest orthodontically related academic degree (General Dental Practitioner/Postgraduate Student/Specialist Orthodontist) and the hospital district. The data were cross-tabulated and summarized by proportions. The median with range was calculated for continuous variables. All data were analyzed using IBM SPSS Statistical Package (IBM, SPSS Statistics, V27.0, Armonk, NY).

Results

A total of 123 members (34.1%) of the Orthodontic Division responded to the questionnaire. Of them, 99 (80.5%) were clinically active practitioners. Because those not working clinically ($n = 24$) were asked to fill in demographic data only, their questionnaires were excluded from further analyses. The response rate among the clinically active members ($n = 249$) was 39.8%.

Changes in the waiting area

All but one of the respondents (99.0%) reported changes in the waiting area in their workplace. The most common changes were either the requirement or encouragement to use hand sanitizer (reported by 90.8% of respondents). Face masks were provided to patients without their own face mask (63.3%). Further, patients were interviewed about their recent travel history and current symptoms related to possible COVID-19 infection (31.6%), or a similar screening was done over the phone prior to the appointment (37.8%). Social distancing was encouraged by placing seats further apart from each other (22.4%). All extra items, including magazines, toys and water jugs, were removed from the waiting room (13.3%). Posters were placed on doors and walls, recommending face mask use and discouraging arriving to appointments if feeling sick (11.2%). Patients were encouraged to arrive alone to the dental office (7.1%). Other precautionary procedures were to increase the wiping of surfaces or to close the waiting area.

Changes in the treatment room

Most respondents (97.0%) reported changes in the treatment room. Queries regarding signs and symptoms of COVID-19 infection were repeated in the treatment room (59.6%) regardless of prior queries. In addition to the face masks and gloves, other personal protection was used as well, including visors (82.8%), disposable headgear (57.6%) or additional protective clothing (10.1%). Many respondents specified that they used FFP2-type face masks in aerosol-producing situations. Disinfecting mouthwash was used before treatment (70.7%). Several respondents specified the disinfectant to be a hydrogen peroxide solution and a few, povidone-iodine. The use of aerosol-producing tools was limited, including the unit's turbine (68.7%), ultrasonics (47.5%), water-air spray (30.3%) and micromotor (19.2%). According to the respondents, limitations on the use of these tools had already been scaled back in some places (3.0%), compared to earlier in the pandemic. Changes were also made in postoperative surface disinfection protocols (49.5%), including, for example, more thorough cleaning in places of possible contamination and the incorporation of UV light cleaners. Orthodontists reported changes in cleaning more often than did OGDPs (60% vs. 23%).

Reported differences between general practitioners' and orthodontists' offices

Three out of four respondents (76.8%) stated that the changes in orthodontists' offices were the same as in general dentistry, while 15.2% were not sure. The rest (8.1%) pointed out some differences. These included incorporating mouth disinfectant rinsing except with children and not using visors or other additional protective gear during shorter appointments. The respondents stated that the recommended duration of orthodontic appointments was shorter than in general dentistry, although orthodontic appointments took more time than usual.

Effects of lockdown

During Spring 2020, two out of three respondents (65.7%) reported experiencing a lockdown and treatment of acute cases only. The median duration of lockdowns was 2 months (mean 1.9 months, range 0.3–5.0 months) and the most common start time the 3rd week of March (range January 2020–May 2020). In 13 of the 20 hospital districts, not all municipalities had lockdowns. Of the respondents reporting no lockdown, 22 worked in health centers, 8 in private offices and 4 in hospitals.

One in four (23.4%) respondents were able to make precautionary changes in their treatment protocols in anticipation of upcoming lockdown(s). These were the passivation of arch wires (66.6%) and debonding fixed appliances (40.0%). Other measures taken were decreasing the use of elastics and removable appliances and rescheduling future appointments. The need for each measure was evaluated individually.

The impact of lockdowns on the progression of orthodontic treatment was clarified with multiple response alternatives. Nearly two out of three respondents reported that during lockdowns, orthodontic treatments progressed as planned (61.9%) or there were no changes in occlusions (66.7%), while 30.2% reported unfavourable changes and 9.5% relapse back to some previous stage of treatment.

Changes in treatment protocols during the pandemic

Orthodontic first aid

One in five respondents (19.2%) reported changes in the management of first aid appointments. In the majority of these cases (57.9%), orthodontic first aid appointments had been centralized to other health care professionals. These included general practitioners (72.7%), orthodontists (54.5%), oral hygienists (54.5%) or dental nurses (36.4%). In 42.1% of cases, orthodontic first aid appointments were handled between other appointments. Other solutions were to instruct patients *via* phone, treat them during cancelled appointments or refer them to other offices.

Fixed appliances

Most respondents (86.9%) reported that no changes had been made to protocols for fixed appliance treatment. Still, one in five respondents (19.4%) stated that in some rare cases archwires were passivated and further treatments postponed to Summer (31.6%) or Fall (21.1%) 2020, or further plans had not yet been made (10.5%). Other changes included moving on to retention (11.2%), stretching out the interval between appointments (6.1%) or debonding earlier than planned (4.0%). In some cases, new treatments were postponed.

Screening, occlusion monitoring, removable appliances, retention and final inspections

During the pandemic and after the lockdowns, around half of the treatments, had been rescheduled while the other half were carried out according to original plans. The responses to multiple-choice questions regarding other orthodontic procedures are presented in Table 2.

New treatments

One in three respondents (31.3%) stated that new orthodontic treatments were started according to original plans. These respondents were located in 4 hospital districts (districts A–C and E in Figure 1) and represented 50% of the respondents in those districts. Of them, 22 worked in health centers, 8 in private offices and 2 in hospitals. Half of all respondents (50.5%) reported that new treatments were rescheduled further out than usual and one in four (26.3%) that new treatments would not be started for the time being or were postponed for the foreseeable future. In some cases, treatments of highly prioritized malocclusions were started, while others were postponed until the lockdown was over.

Remote appointments

One in three respondents (32.3%) reported the use of remote appointments because of the pandemic. Of the respondents, close to one in two used remote appointments for monitoring occlusion (56.3%), retention controls (50.0%) and for controlling fixed appliances (6.3%). In Figure 2, the applied methods are presented in more detail. Other procedures

Table 2. Changes in treatment protocols for screening, occlusion monitoring, removable appliances, retention and final inspections.

Number of respondents	Screening	Monitoring occlusion	Removable appliances	Retention	Final inspection
N = 99	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*N* (%)
As planned	33 (35.1)	50 (51.5)	58 (59.2)	57 (58.2)	47 (48.5)
Appointment delayed	52 (55.3)	46 (47.4)	44 (44.9)	47 (48.0)	53 (54.6)
- Median (months)	6.0	4.5	2.5	3.0	6.0
- Range (months)	0.50–12	0.50–12	0.25–6	0.25–12	0.50–12
Appointment cancelled	5 (5.1)	3 (3.1)	3 (3.1)	–	1 (1.0)
Remote appointment	–	7 (7.2)	4 (4.1)	11 (11.2)	–

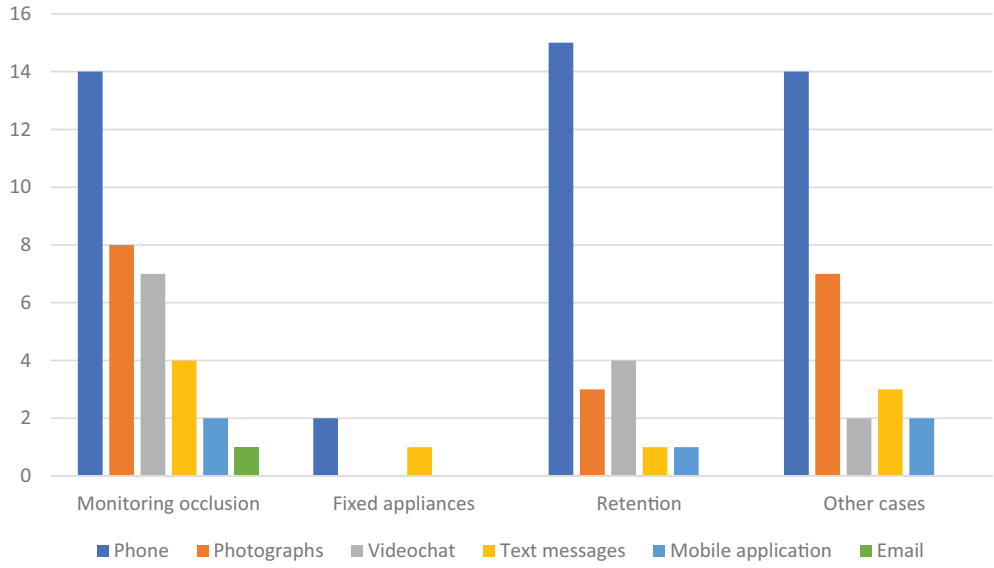

Figure 2. The numbers of respondents using various remote appointment methods, categorized according to the content of the appointment. 'Other cases' included, e.g. controls of removable appliances, giving instructions to first aid cases and discussing treatment plans.

carried out remotely included, e.g. instruction in emergency cases and in appliance use, planning of orthodontic treatments, introductions of these plans and controlling treatments with removable appliances. Fifty percent of those who had utilized remote appointments gave feedback on their experiences. Most of the feedback was positive (43.8%), some was neither positive nor negative (31.3%) and a few comments were negative (25.0%). The main concern was the difficulty of obtaining high-quality photographs from the patient, especially in the case of young children. In video appointments, instructing patients in how to take optimal photographs was deemed difficult. Similarly, the quality of real-time videos was problematic. With more mature patients, remote appointments were seen as a practical and convenient service that could offer great potential in the future. Phone calls were considered practical as well.

Other models

Other tested approaches for the prevention of COVID-19 infections were as follows: patients were asked to arrive promptly to minimize time spent waiting with other patients. If the patient or a family member had signs of fever, the appointment was rescheduled for a month later. Young children's parents or other escorts were only in special cases allowed to come into the office (e.g. for the introduction of a treatment plan). In some places the sterilization of instruments was centralized. Therefore, some dental offices had to purchase more instruments to ensure an adequate number for each patient, for example, specific pliers. Prior to the grinding of removable appliances, they were disinfected and the grinding was done in a draught cupboard.

Social distancing between staff members was enhanced by grouping them and scheduling their breaks so that a minimal number of personnel was present in the breakroom. In order to make easier to track possible exposures, lists were compiled of those present in the breakroom simultaneously. When possible, staff meetings were held remotely.

Effects of the pandemic on workload

At the time of this study, more than half of all respondents (59.6%) stated that treatments were still delayed. One out of four respondents (26.3%, from 19 health centers, 1 private practice and 3 hospitals) had had delays but had since been able to return to regular levels. A minority (14.1%, from 10 health centers, 1 private practice, and 2 hospitals) had followed the regular timetable all along.

The reasons for delays included oral health care professionals being redeployed (36%, in 11 districts, A–E, G, H, K, L, O, Q and T, in Figure 1), staff sickness or self-isolation (41%, from 9 districts, A–D, E–G, K–M and Q, in Figure 1) and the patient's fear of contracting COVID-19 whilst receiving orthodontic treatment (46%, from 12 districts, excluding districts D, I–K, P and R–T, in Figure 1).

Most respondents (59.6%; from 48 health centers, 3 private offices, 7 hospitals and 1 university, located in 19 districts) felt that the workload had increased because no changes had been made in the division of the workload. One in five respondents (19.2%) stated that the distribution of the growing workload had been changed (respondents from 16 health centers and 3 private offices, located in 6 districts, A–C, G, O and Q, in Figure 1), while an equal group of respondents (21.2%; from 9 health centers, 8 private offices and 4 hospitals, in districts A–D, E, G, M–O, Q and R, in Figure 1) had noticed no change in the workload. In most cases, the additional workflow was further distributed to dental hygienists (94.7%) but also to general practitioners (47.4%) and dental nurses (31.6%). The distribution of treatments is presented in Table 3. Additional health care professionals had not been recruited to compensate for the growing workload.

Table 3. Division of workload between dental hygienists, orthodontically active general dental practitioners (OGDPs) and dental nurses.

Number of respondents $N=19$	Dental hygienist N (%)	OGDP N (%)	Dental nurse N (%)
Fixed appliances	5 (26.3)	3 (15.8)	1 (5.3)
Cervical, high-pull and combination headgears	9 (47.4)	6 (31.6)	2 (10.5)
Palatal/lingual arches	10 (52.6)	6 (31.6)	3 (15.8)
Activators	15 (78.9)	7 (36.8)	4 (21.1)
Elastic tractions	12 (63.2)	7 (36.8)	3 (15.8)
Removable retention appliances	13 (68.4)	5 (26.3)	4 (21.1)
Fixed retention appliances	10 (52.6)	5 (26.3)	4 (21.1)
Other appointments[a]	5 (26.3)	3 (15.8)	1 (5.3)

[a]Includes screenings and recalls.

Responses by chief dental officers

Four of the 15 chief dental officers (26.7%) replied to the questionnaire. They represented Western, Eastern and Northern Finland. In all districts, personal protective gear was used intensively and the guidelines from THL and the instructions from local authorities were followed.

In Western Finland, there had been no lockdowns due to the calm COVID-19 situation. The usage of aerosol-producing instruments had been decreased. In Eastern Finland, the situation had been calm during March and April; later, the lockdown lasted from the beginning of May to the end of June 2020. In the early months of the pandemic, micromotor units had been assigned to replace turbines and the use of ultrasonics had been decreased. The local pandemic situation was monitored intensively.

One of the responding health centers in Northern Finland was under lockdown from the end of March to the end of April 2020. The pandemic was locally mild. Infectious patients were kept separate, but otherwise dental care was carried out as usual. In the other responding health center in Nothern Finland, more intensive screening of patients and the use of FFP2 face masks were implemented in Spring-Summer 2021 during the local acceleration phase. No lockdowns were implemented.

Discussion

Practically all responding orthodontic offices had made changes in their practices to prevent the spread of the SARS-CoV-2 virus. Changes in the waiting and treatment rooms were implemented in everyday care. In most cases, the practices followed Finnish national guidelines for dental care, including using additional protective gear such as face shields, incorporating preoperative mouth rinses and limiting the use of aerosol-producing instruments, including turbine handpieces [7]. Similar guidelines have been presented globally [10–13].

Although the survey did not specify the type of face masks used, many respondents reported using N95/FFP2-type masks in aerosol-producing operations. In comparison with regular surgical masks, this mask type has been found to provide greater protection against viral respiratory infections [14]. An international study by Campus et al. [15] has reported the widescale use of FFP2 masks in dental care around the globe.

Preoperative use of mouthwashes in order to decrease the viral load of SARS-CoV-2 in aerosols has been highlighted in several studies [16–20]. The most commonly studied substances have been povidone-iodine, chlorhexidine, hydrogen peroxide and cetylpyridinium chloride solutions; of them, chlorhexidine seems to be the least effective [16]. Some researchers also suggest the addition of other protective gear to decrease the likelihood of contagion [17–19]. However, according to the respondents' comments, hydrogen peroxide seemed the most widely used preoperative substance in the Finnish orthodontic community.

As reported, e.g. by Motevasel et al. and Sabbagh et al. [21,22], teleorthodontics had become a fairly common practice among the Finnish respondents as well. Communicating *via* phone or video chat and receiving patients' clinical photographs from remote appointments were the most common procedures. Modern smartphones can produce high-quality images for a clinician to assess. However, in a video chat, a poor connection can lower the image quality. One could argue that video is not necessary for evaluating occlusion and could be replaced by good-quality clinical photographs. However, some respondents found that instructing patients in how to take these images was challenging. A solution could be a separate mobile application-based system, as recently discussed by Maspero et al. and Giudice et al. [23,24].

The possibility of managing orthodontic first aid cases remotely has also been discussed [21]. However, not all urgent cases are suitable for management *via* the phone. Thus, a chairside appointment is often the most essential [25,26]. Although remote appointments have some indisputable benefits, they have challenges as well. On the basis of the current results, at least a share of Finnish orthodontists is cautiously optimistic regarding the use of teleorthodontics in the future.

In line with findings in other recent studies [21,22], a significant proportion of orthodontic appointments were delayed because of the pandemic. These delays were due to implemented lockdowns, restrictions and precautions made in everyday work routines. Similarly with the findings by Motevasel et al. and Sabbagh et al. [21,22], appointments for screening and new treatments were postponed the most. A significant number of respondents reported some negative effects on occlusion during the lockdown, including relapses towards or to a previous stage of treatment; these were seen already during a one-to-two-month period. While Sabbagh et al. [22] stated that during the crisis, less than 5% of orthodontists in the UK reported any improvements in occlusion, over 60% of their Finnish colleagues stated that treatments progressed as planned even during lockdowns. This difference undoubtedly has several explanations, e.g. differences in national and regional restrictions and length of lockdowns.

For example, orthodontic appliances may have had a higher failure rate during lockdowns, compared to normal times, as suggested by Yavan et al. [27]. According to Sabbagh et al. [22], however, the reported incidence of these breakages was lower than expected.

In Finland, orthodontic care is mainly provided by publicly funded health centers where the majority of treatment is directed at children and adolescents. The extensive public health center network enables large population-based studies with nationwide coverage (Figure 1). Moreover, the public sector is supported by the private sector, and as stated, many orthodontists operate in both public and private offices. However, regionally the COVID-19 situation varied as reflected in reported measures. The current results provide broad insight into the arrangement of pandemic prevention. Based on the authors' best knowledge, this is thus far the only study to investigate the effects of the COVID-19 pandemic specifically in terms of orthodontic treatment protocols.

However, there were some limitations as well. Before the pandemic outbreak, there were no similar data on orthodontic treatment practices. Thus, the results of the current cross-sectional study cannot be directly compared to any previous situation. It is also possible that all reported changes may not have resulted from the pandemic alone; for example, premature debonding is occasionally chosen without the pandemic as well and some of the increases in treatment duration may be partly due to lack of personnel. Although the results were compiled from a uniform base, both geographically and demographically, the low response rate is a limitation for the generalizability of the results. Simultaneously, a similar study by the Finnish Dental Association was also in progress, and it is possible that some orthodontists may not have differentiated between these two studies. Many orthodontists may also have had their hands full with on-going treatments and therefore chose not to respond to the relatively long survey questionnaire.

Conclusions

It seems evident that a sudden pause in orthodontic treatment has a negative effect on occlusion and the duration of orthodontic treatment. However, the lockdowns were rather short and not needed in all regions. Thus, the impact of the pandemic may have been less detrimental in Finland than in some other countries. Furthermore, intuitively, additional precautions during appointments increase the workload and may decrease the number of treated patients. New, innovative methods were introduced to cope with this workload.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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