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An assessment of the composite laminate veneer videos on YouTube™

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ABSTRACT

Aims: The aim of this study is to evaluate the content of YouTube™ videos about composite laminate applications, one of the aesthetic dental applications.

Methods: A systematic search was made on YouTube™ using the keywords "bonding-aesthetic filling" and 'composite laminate. The information content of the eligible videos was assessed and categorized based on the uploaders. In addition, the interaction index and viewing rates of the videos were also examined. The data obtained was analyzed using the SPSS 25.0 (Statistical Package for Social Sciences) program.

Results: Out of 100 videos examined, 43 were related to "bonding-aesthetic filling," and 29 to "composite laminate." Key exclusion reasons included lack of explanation (31.6% for "bonding-aesthetic filling" and 62.0% for "composite laminate"). The content evaluation revealed that 62.8% of "bonding-aesthetic filling" videos and 60.7% of "composite laminate" videos were classified as poor content. Poor content videos had significantly higher viewing rates (2815.86±7413.00 views) compared to rich content videos (2770.37±5123.59 views) with a statistically significant difference ($p<0.05$). No significant differences were found in interaction index scores between poor and rich content videos ($p>0.05$). Videos with poor content had more views and comments but shorter lengths and fewer likes than rich content videos. Specialist dentists and private clinics were the primary upload sources, with 36.6% of poor content videos coming from healthcare professionals and 33.3% of rich content videos from the same group.

Conclusion: It was found that the majority of YouTube™ videos related to composite laminate were uploaded without any narrative and their informative content was insufficient. On the other hand, it was observed that as the scientific value of the videos decreased, their viewing rates increased.

Keywords: Dental veneers, composite dental resin, health education, social media, dental research

INTRODUCTION

Aesthetic standards have changed significantly in recent years, especially with social media platforms facilitating comparison in many aspects and the introduction of 'selfie culture' into our lives.[1] In this respect, the developing concept of aesthetic dentistry is the ultimate goal of most therapeutic interventions or procedures rather than a separate discipline or field of dentistry. Aesthetic dentistry is primarily characterized by the smile. Smile aesthetics is considered in a wide range of aspects related to the form, texture, colour, and alignment of the anterior teeth, as well as soft tissues, lips, and facial aesthetics.[2]

Composite laminate veneers are restorations recommended to solve problems such as deformities, aesthetic disorders, and discolorations. They are divided into direct and indirect laminate veneers according to the differences in the production process. In the direct application technique, composite resin materials are applied directly to the tooth surfaces the pre-preparation of which is completed. It has a number of advantages such as no need for tooth preparation, low cost for the patient, reversibility of the treatment, and no additional cementation stage. It is easy to polish and repair but it has disadvantages such as low resistance to abrasion, discoloration, and fracture.[3]

In today's world, the use of the Internet and social media has become a part of everyday life. It has become easier to access more information in a few seconds than one person can read. YouTube™ is the main free video platform, and is considered to be the largest online multimedia library. Founded in 2005, YouTube™ has local versions in eighty languages in more than one hundred countries around the world, with more than five hundred hours of content uploaded every minute.[4]

In recent years, the media has been widely used to share health-related information. YouTube™, the globally popular video-sharing website, receives more than 1 billion hours of views every day, including thirty million medical videos.[5] Given this massive reach, patients increasingly turn to YouTube™ for health information, raising concerns about the accuracy and reliability of the content due to the platform's minimal editorial oversight.[6-8]

80% of Internet users search online for information regarding any health topic, such as a specific disease or treatment, and these searchers account for 59% of all adults.[9] However, there are concerns regarding the accuracy and quality of health-related information in YouTube™ videos due to the minimal editing of a lot of information.[5]

Despite the increasing use of digital platforms for health information, there is a notable gap in the literature concerning the quality and accuracy of YouTube™ videos specifically related to composite laminate veneers. While prior research has explored YouTube™ content in areas like endodontics,[8,10,11] prosthodontics,[12-14] and pediatric dentistry,[15,16] the body of work addressing restorative dentistry, particularly composite laminate veneers, remains sparse. Given the vast number of people turning to YouTube™ for health information, it is crucial to assess the reliability of this content. This study aims to address this gap by evaluating the quality, accuracy, and informational value of YouTube™ videos on composite laminate veneers available in Turkiye, thus highlighting the need for improved educational resources in this domain.

METHODS

Data Collection

Before identifying the videos under the detected search words, a new YouTube™ (http://www.youtube.com) account was created so that old searches would not affect the results and ranking of the videos, and only videos on composite laminates uploaded up to July 2023, were scanned. Since publicly available data were used in this study, ethics committee approval was not needed.[13] All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The Google Trends application was used as the first stage of the study. In Turkiye for the last twelve months, in all categories, YouTube™ search filters were used to search for the most frequently used words or phrases by patients. On 6 June 2023, it was determined that the most used terms in YouTube™ searches in the last twelve months in Turkiye were "bonding-aesthetic filling' and 'composite laminate' in the Turkish language (Figure 1, 2).

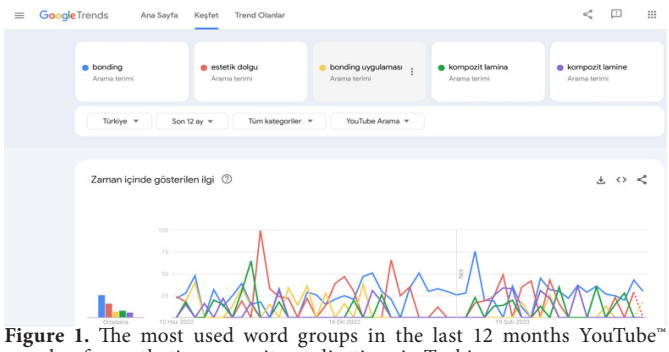

Figure 1. The most used word groups in the last 12 months YouTube™ searches for aesthetic composite applications in Turkiye

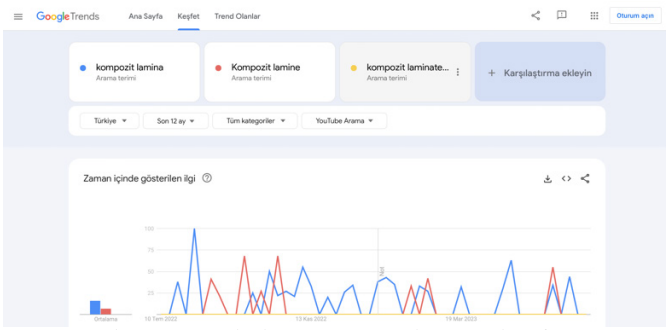

Figure 2. The most used phrases in YouTube™ searches for composite laminate applications in Turkiye in the last 12 months

Similar studies have found that around 95% of users watch the first 60-200 videos listed following the search results.[17] For this reason, the first 100 videos for the topics in the study were viewed and universal resource locators (URLs) were recorded, as search results may change on different days. The inclusion criteria were Turkish, verbal and/or written narration, and acceptable audio and visual quality (480p).[18]

Videos that are not relevant to the topic, repetitive videos, videos lasting longer than 15 minutes, YouTube™ short videos, videos that were are not in Turkish, videos with closed comments, and advertisements were excluded.[19]

Videos that were not evaluated according to the exclusion criteria were excluded from the study and 43 videos for 'bonding-aesthetic filling' and 29 videos for 'composite laminate' were evaluated in our study.

Analysis of Information Content of Videos

The content of the videos was evaluated synchronously by two restorative dental specialists. All the videos included in the study were evaluated in detail in terms of video uploaders, video information quality, and general video information. The videos were classified according to their uploaders as specialist dentists and dentists, private hospitals and private clinics, TV channels, and other users.

The content quality of the videos was analysed by considering 8 different sub-parameters. These were definition, indication, contraindication, method, advantage, disadvantage, postoperative considerations, and cost information. The YouTube™ videos were evaluated in subcategories determined by two researchers. A score of 0 or 1 was given according to whether the relevant topic was mentioned or not. Videos with an average score of 4 and above by two observers were classified as rich content videos, while videos with a score below 4 were classified as poor content videos.[20]

View Rate and Audience Engagement Analysis

For each of the videos, the following parameters were recorded and the engagement index (%) and view rate (%) were calculated.[21]

1) Title and URL
2) Video length
3) Date of loading
4) Time elapsed from the date of loading until today (in days)
5) Who performed the loading (clinic, dentist, commercial)
6) Number of views
7) Number of likes and dislikes
8) Number of comments

Engagement index (%)=[(number of likes-number of dislikes)/ number of views)]x100

View rate (%)=[(number of views)/time since upload)]x100

Statistical Analysis

The data obtained in the study were analyzed using an SPSS (Statistical Package for Social Sciences) for the Windows 25.0 program. Descriptive statistical methods (number, percentage, min-max values, mean, and standard deviation) were used to evaluate the data. The conformity of the used data to normal distribution was tested with the Kolmogorov-smirnov test. When the results were analyzed, it was determined that the variables did not show normal distribution (p>0.05). The Mann Whitney U test was used for the difference between two independent groups in the comparison of quantitative data with data that did not have a normal distribution.

RESULTS

When the exclusion criteria of 57 videos out of a total of 100 videos evaluated for 'bonding-aesthetic filling' were examined, it was determined that 28.1% were irrelevant, 31.6% verbal and/or written narration, 10.5% had insufficient resolution, 3.5% were repetitive videos, 3.5% were advertisements, 3.5% were too long, 1.8% were not in Turkish, and 17.5% were closed to comments.

When the exclusion criteria of 71 videos out of 100 videos evaluated for 'composite laminate' were examined, it was seen that 14.1% were irrelevant, 62% verbal and/or written narration, 9.9% were repetitive videos, 2.8% had insufficient resolution, 2.8% were advertisements, 7% were too long, and 1.4% were closed to comments (Table 1).

Table 1. Exclusion criteria

	Bonding-aesthetic filling		Composite laminate		Total	
Exclusion criteria	**n**	**%**	**n**	**%**	**n**	**%**
Irrelevant	16	28.10	10	14.10	26	20.30
No narration	18	31.60	44	62	62	48.40
Resolution is not enough	6	10.50	2	2.80	8	6.30
Duplicate	2	3.50	7	9.90	9	7
Advertisement	2	3.50	2	2.80	4	3.10
Long duration	2	3.50	5	7	7	5.50
Not Turkish	1	1.80	0	0	1	0.80
Comments are closed	10	17.50	1	1.40	11	8.60
Total	57	100	71	100	128	100

The data on the included videos are summarized in Table 2.

When the upload sources of the videos were analyzed, 23.3% of the 'bonding-aesthetic filling' videos were uploaded by specialist dentists and dentists, 41.9% by private hospitals and private clinics, 11.6% by TV channels, and 23.3% by other users; For 'composite laminate' videos, 50% were Specialists and Dentists, 28.6% were private hospitals and private clinics, 7.1% were TV channels, and 3.6% were other users.

When the video content evaluations are analyzed, it can be seen that 86% of the 'bonding-aesthetic filling' videos include definition, 48.8% indication, 2.3% contraindication, 34.9% method, 60.5% advantage, 41.9% disadvantage, 30.2% postoperative considerations, and18.6% cost.

Table 2. Video characteristics of the included YouTube™ videos

Variables	Bonding-aesthetic filling	Composite laminate	p
	X±SD	X±SD	
Views	30902.9±106907.54	28871.11±73168.41	0.627
Video length (sec)	180.95±188.03	231.3±225.08	0.562
Time since upload (years)	3.51±2.64	2.19±1.68	0.049*
Number of likes	89.67±196.39	146.78±268.12	0.196
Number of dislikes	0	0	-
Number of comments	32.88±104.19	67.37±145.13	0.008*

*p<0.05, Mann Whitney U test, SD: Standard deviation

It can be seen that 71.4% of the 'composite laminate' videos include definition, 46.4% indication, 14.3% contraindication, 46.4% method, 42.9% advantage, 32.1% disadvantage, 28.6% postoperative considerations, and 25% cost (Figure 3).

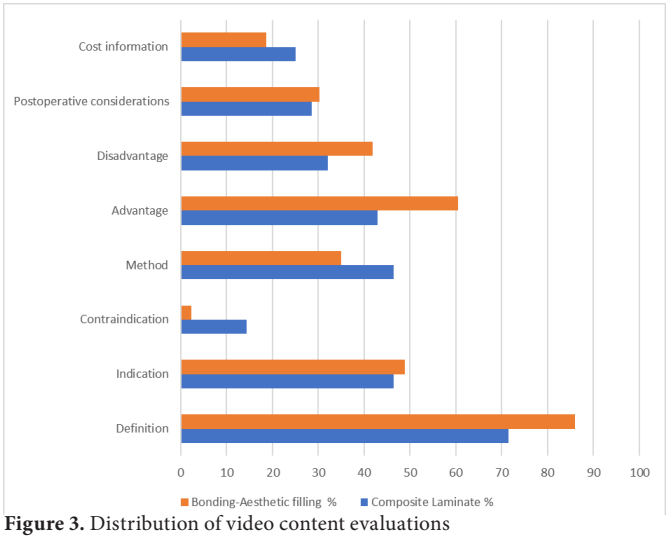

Figure 3. Distribution of video content evaluations

When the video content evaluations are examined, it can be seen that 62.8% of the 'bonding - aesthetic filling' are poor content videos 37.2% are rich content videos; 60.7% of the 'composite laminate' videos are poor content videos and 39.3% are rich content videos (Table 3).

Table 3. Distribution of video content reviews

	Bonding-aesthetic filling		Composite laminate		Total	
	n	**%**	**n**	**%**	**n**	**%**
Video with poor content	27	62.80	17	60.70	44	62
Video with rich content	16	37.20	11	39.3	27	38
Total	43	100.00	28	100.00	71	100.00

There is a statistically significant difference (p<0.05) between the viewing rates according to the video content status (poor content, rich content). It is seen that the viewing rates of poor content videos (2815.86±7413.00) are statistically significantly higher than rich content videos (2770.37±5123.59). There is no statistically significant difference between the Interaction Index according to the video content status (p>0.05).

It can be seen that there is no statistically significant difference between the viewing rate and interaction index according to

video types (bonding-aesthetic filling, composite laminate) (p>0.05).

There is a statistically significant difference between the number of views, video length, number of likes, and number of comments according to video content (p<0.05). It can be seen that the number of views and the number of comments on videos with poor content are higher than for videos with rich content. It can also be seen that the video length and number of likes of rich content videos are higher than for poor content videos (Table 4).

Table 4. Comparison of video features according to video content status

Variables	Video with poor content	Video with rich content	p
	X±SD	X±SD	
Views	36298.02±116541.4	17789.96±27643.78	0.027*
Video length (sec)	140.07±192.06	286.04±190.1	0.000*
Time since upload (years)	3.21±2.71	2.43±1.75	0.385
Number of likes	88.67±225.41	141.81±222.24	0.016*
Number of comments	48.53±130.78	38.85±102.52	0.040*

*p<0.05, Mann Whitney U test, SD: Standard deviation

When the relationship between the video content status and upload sources is examined, it can be seen that 36.6% of the videos with poor content were uploaded by healthcare professionals, 46.3% by private hospitals and private clinics, 2.4% by TV channels, and 14.6% by other users; 33.3% of the videos with rich content were uploaded by healthcare professionals, 25.9% by private hospitals and private clinics, 22.2% by TV channels, and 18.5% by other users (Table 5).

Table 5. The relationship between video content status and upload sources

Upload sources		Video content status	
		Video with poor content	Video with rich content
Specialist dentist and dentist	n	15	9
	%	36.6	33.3
Private hospitals and private clinics	n	19	7
	%	46.3	25.9
TV channel	n	1	6
	%	2.4	22.2
Other users	n	6	5
	%	14.6	18.5

DISCUSSION

With the advances in adhesive techniques, the use of conservative restoration options to improve the aesthetic appearance of teeth has become widespread. Composite laminate veneers are preferred in cases such as adjustment of tooth forms, masking tooth discoloration, closing interdental gaps, and restoration of anterior tooth fractures because they provide a conservative treatment opportunity, good marginal adaptation, and ease of polishing/repair.[22,23] Although detailed information is provided by the doctors before any treatment, individuals need additional information with the expansion of the social media and internet library and this leads to the use of the Internet. Today, there is a demand for health-related information on YouTube™, the video-sharing website.[8,16]

In the literature, there are studies evaluating YouTube™ videos in the field of dentistry.[24,25] However, there is no study on composite laminates, which are one of the popular aesthetic treatments of restorative dentistry. For this reason, the study investigates the quality of YouTube™ videos on composite laminate veneers and whether they can be a reliable source for internet users. Of the first 100 videos examined in the study on the topics of 'bonding-aesthetic filling' and 'composite laminate', 43 videos for ''bonding-aesthetic filling' and 29 videos for 'composite laminate' were included and analyzed. A lack of verbal and/or written narration was the most important exclusion criterion for both 'bonding-aesthetic filling' (n=18, 31.6%) and 'composite laminate' (n=44, 62.0%).

When we examined the characteristics of the YouTube™ videos included in the study, no statistically significant difference was observed in the number of views, video length, number of likes, and number of dislikes regarding the topics of 'bonding-aesthetic filling' and 'composite laminate' (p<0.05). When the time elapsed since uploading was analyzed, it was determined that 'bonding-aesthetic filling' (3.51±2.64) videos were uploaded a statistically significant period earlier than 'composite laminate' (2.19±1.68) videos. Due to the statistically significant lower number of comments on 'bonding-aesthetic filling' (32.88±104.19) videos compared to 'composite laminate' (67.37±145.13) videos, there may be an increase in the popularity of the 'composite laminate' topic today. However, similar to our study, the view rate and engagement index are frequently used to determine the popularity of videos.[25-27] In the study, no statistically significant difference was observed between 'bonding-aesthetic filling' and 'composite laminate' in terms of the visualization rate (p=0.091>0.05) and the interaction index (p=0.410>0.05).

The content analysis of the videos that met the inclusion criteria was evaluated on 8 sub-parameters similar to a study by Yağcı.[28] When the evaluation results are examined, it is noticeable that there is a serious lack of information regarding composite laminate applications published on YouTube™. In the videos on 'bonding-aesthetic filling' and 'composite laminate', the definition (86-71.4%), advantages (60.5-42.9%), and indications (48.8-46.4%) were relatively average, while the contraindications (2.3-14.3%), cost (18.6-25.0%), considerations after the procedure (30.2%, 28.6%), method (34.9-46.4%) and disadvantages (41.9-32.1%) were relatively insufficiently mentioned. This is in line with the results found in similar studies.[20,24]

The content quality of the videos included in the study was evaluated by two Restorative Dentistry specialists. Videos with less than 4 points out of 8 predetermined sub-parameters were classified as videos with poor content. 62.8% of the 'bonding-aesthetic filling' videos and 60.7% of the 'composite laminate' videos were categorized as poor content videos. Similar to our study, many studies evaluating YouTube content have found that the video content quality is poor. Abukaraky et al. [29] examined dental implants on YouTube™ and found that the average usefulness score was poor in 117 videos.

Similar results were found in studies conducted in different fields such as Topsakal et al.'s[20] evaluation of orthodontic videos, Şahin[24] research on porcelain laminate veneers, and Wong et al.'s[30] evaluation of YouTube™ videos on dental fear,

anxiety and phobia. On the other hand, it was observed that there was a statistically significant difference between the view rates of the videos compared to the content status (p=0.021<0.05). When examined in detail, it can be seen that the number of views and comments on videos with poor content is statistically significantly higher than for videos with rich content (p<0.05). Similarly, it can be seen that there is a statistically significant difference between the viewing rates compared to the video content status (poor content, rich content) in favour of poor content (p<0.05). This shows that as the scientific value of the videos decreases, the viewing rates increase. It was observed that YouTube™ videos with rich content had a statistically significant higher video length (p=0.000<0.05). This can be explained by the fact that videos with rich content contain more topics.

When the upload sources of the videos were examined, it was seen that the majority (65.2-78.6%) of the 'bonding- aesthetic filling' and 'composite laminate' videos were uploaded by specialist dentists and dentists-private hospitals and private clinics, except for the 'other users' content. When the distribution of upload sources according to video content status is examined, it can be seen that the majority of videos with poor content (82.9%) are uploaded by this group. On the other hand, 59.2% of the videos uploaded by specialist dentists/dentists - private hospitals / private clinics have rich content.

YouTube™'s algorithm tends to promote videos with higher engagement metrics (e.g., views, likes, and comments). Videos with sensational or provocative content often achieve higher engagement, leading to their promotion by the algorithm. Videos with poor content may omit critical details or present information in a misleading way. Viewers might click on these videos seeking straightforward answers, which they may not get from more nuanced or longer videos with rich content. Shorter, less detailed videos may be easier to watch and share quickly. This convenience can contribute to higher view counts despite the lower quality of the information presented. It has been reported that such reasons may be among the reasons why low quality videos have higher viewing rates.[31,32]

Our recommendations for improving the quality of YouTube™ health information videos include; YouTube™ can improve its algorithms to prioritize content based on accuracy and depth rather than engagement metrics alone. Provide training for content creators on how to produce high-quality educational content. This training could include information on evidence-based practices and appropriately citing sources. Videos that include interviews or contributions from recognized experts in the field can increase the credibility of content. Content creators can collaborate with healthcare professionals to ensure accuracy and relevance. Provide training for viewers on how to critically evaluate online health information. Providing resources on how to evaluate the credibility of sources and how to recognize misleading information can help viewers make informed decisions.

Limitations

The limitations of our study are that our search criteria were produced in Turkish. We believe that searches in different languages may improve the results of the study. In addition, since videos are constantly uploaded and deleted on the YouTube™ platform, the reproducibility of the study cannot be confirmed, and the content will unavoidably change over time as new videos are added and others are removed. The limitations of this study also include the fact that YouTube™ content varies over time and that different results are obtained when different keywords are used.

CONCLUSION

With its increasing popularity in recent years, YouTube™ has become a source of information for healthcare professionals, a way for physicians to reach patients, a source of research on the treatments to be applied by patients, and a source of sharing patient experiences. It can be seen that the concern mentioned in the evaluation studies on videos uploaded on YouTube™ to date is meaningful. It is possible to say that the majority of the YouTube™ videos on the composite laminate applications that we evaluated in this study are presented without any narrative and that their content is weak.

ETHICAL DECLARATIONS

Ethics Committee Approval

Since publicly available data were used in this study, ethics committee approval was not needed.

Informed Consent

Since publicly available data were used in this study, informed consent was not needed.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Quantitative analysis of impression-taking performance-a pilot study to visualize invisible technical steps in dental procedures

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ABSTRACT

Aims: Dental procedures involve intricate techniques that can be challenging to visualize, often hindering imitation and assessment. In this study, the impression-taking performance of abutment teeth was quantitatively analyzed to create objective indexes for dental skill education.

Methods: Participants were divided into two groups of different clinical experience levels: 10 dentists and 10 dental students. An aluminum model of abutment teeth was employed to simplify the experiment. An optical motion capture system (VICON, Oxford, UK) measured participants' movements. The impression accuracy, time length on the analyzed section, impression material pouring speed, total amount of impression material used, and syringe tip trajectory were evaluated. Fisher's exact test and Mann-Whitney U test were used to compare the two groups' results (α=0.05).

Results: In the dentist group, there were few apparent failures and a high impression accuracy. The amount of impression material dispensed tended to be larger in the dentist group, with longer practice time and slower syringe movement speed. This suggested that the inexperienced participants were sufficiently unable to pour out the impression material. The syringe tip trajectories were not significantly different between the groups. An instructor's advice is often limited to abstract feedback; therefore, specific suggestions might assist in effective skill education.

Conclusion: It is possible to quantitatively analyze impression-taking performance and provide helpful information for dental skill education by using this system.

Keywords: Dental skill education, impression-taking, quantitative analysis, optical motion capture, practical behavior, instrument manipulation

INTRODUCTION

Imitation is considered important in skill education as it is the first step in the educational goals of the psychomotor domain.[1] Practical dental skills education involves a program in which students who have acquired the treatment knowledge imitate and practice by observing the videos of treatment procedures or demonstrations provided by the instructors.[2] In addition, several innovations have been implemented, such as the development of videos[3] and various simulation systems[4-6] that are easier for students to understand since dental treatment involves many invasive procedures. However, skills sometimes include content that is difficult to visualize, creating a barrier for learners to imitate the expert performers, and difficulties in correctly assessing the skills have also been reported.[7-9] In recent years, methods for quantifying the morphology of abutment teeth and wax-ups and providing feedback to dental students have been developed to increase the objectivity of evaluation.[10-12] Nevertheless, these evaluations are not based on the skills themselves but on the work results. On the contrary, efforts have been made to quantitatively measure body movements,[13] which have been utilized for the transmission of skills in the field of performing arts,[14,15] facial muscle movements associated with growth,[16] and also involved the analysis of practical dental posture.[17] Dental treatments are performed using various instruments and materials, and the treatment skills include proper handling. Therefore, quantitative analysis of instrument manipulation and establishment of objective evaluation criteria would be useful for dental

clinical skills education. However, few such studies have been conducted to date to address these aspects. The aim of this study was to quantify the practice behavior of operators in the impression-taking of abutment teeth with silicone impression material and to create an objective index for dental clinical skill education that was difficult to provide by conventional methods.

METHODS

This study was performed with the permission of the Ethics Committee of Niigata University Medical and Dental Hospital (Date: 11.03.2022, Decision No: 2021-0316). All participants were informed in writing and orally of the content and purpose of the study so that personal information could be deleted from the obtained data without failure. After providing information that there were no possible disadvantages to cooperating in the study and that they could withdraw their participation at any time, consent was obtained from all participants. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

A total of 20 participants were included in the study, with 10 dentists (6 men, 4 women, average age: 39.9±6.9 years) with more than 7 years of clinical experience and 10 fifth-year dental students (3 men, 7 women, average age: 24.6±2.5 years) in clinical practice comprising two groups with different clinical experience. Practical movements on impression-taking of abutment teeth were analyzed in each group. The impression-taking was performed using a plastic syringe (GC, Tokyo, Japan) and silicone impression material (Examix Fine Injection Type, GC, Tokyo, Japan). A custom-made aluminum model of the abutment teeth of fully cast crowns was employed for impression-taking to simplify the treatment procedure.

The abutment teeth model was designed as a simplified form of the abutment teeth and gingival sulcus after gingival retraction (Figure 1). A conical base was simulated as a crown, and a circular groove was placed around it to simulate a gingival sulcus. A longitudinal groove was created on the side of the conical part. Impressions were taken over an area that included the assumed gingival sulcus and the finish line of the abutment teeth.

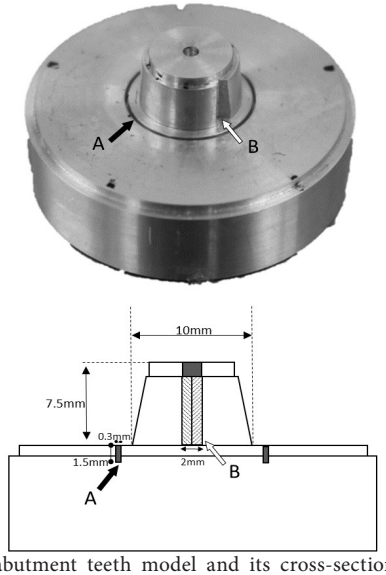

Figure 1. The abutment teeth model and its cross-sectional view: A, a groove simulates the gingival sulcus. B, a longitudinal groove

An optical motion capture system (VICON, Vicon Motion System Ltd, Oxford, UK) and infrared reflective markers (Marker set with a 9.5 mm plastic base, InterReha, Tokyo, Japan) were used for motion measurement. The system can display the three-dimensional positions of the markers in a virtual coordinate system by capturing the infrared reflective markers with two or more infrared cameras (T20S, 2 megapixels 1600 × 1280 pixels, up to 2000 FPS, 690 Hz at full frame frequency). In this experiment, 10 infrared cameras were set up so that three or more cameras could capture all the infrared reflection markers simultaneously at any time without disturbing the participant's movements. A dedicated personal computer (SYS-5039A-iL, Super micro, San Jose, USA) with platform software (NEXUS, InterReha, Tokyo, Japan) was used for system control, data recording, and analysis. The sampling frequency was set at 100 Hz.

Infrared reflective markers were fixed to the syringe body and plunger to measure the syringe motion. Additionally, a removable instrument was fabricated to calculate the position of the syringe tip (Figure 2). Two infrared reflective markers were affixed, one of which was designed to match the tip of the syringe. The direction of the line segment connecting the two markers was aligned with the direction of the ejection of the silicon impression material.

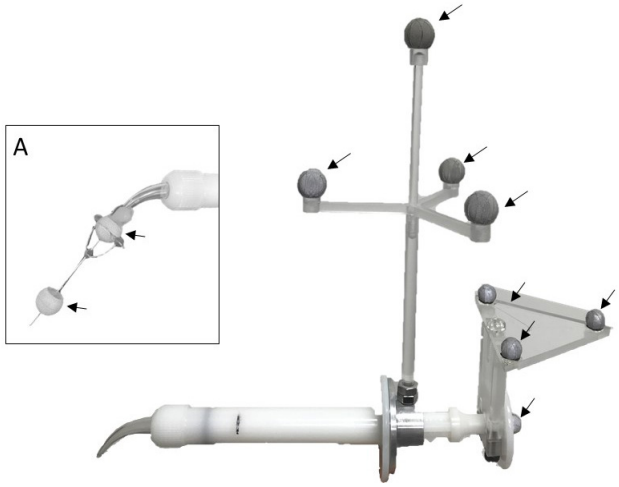

Figure 2. The syringe customized for experiment: black arrows, infrared reflective markers. A, removable instrument attached to syringe tip

To measure the three-dimensional position of an arbitrary point, a pen-shaped digitizing device (referred to as a "digitizer pen") was made with four markers fixed at the top and a jig with a removable marker at the tip. Three markers were placed on the metal plate and the abutment teeth model was fixed.

All participants made impressions on the abutment teeth model set up on a desk (Figure 3). They were instructed to move the syringe in a single stroke and make impressions only once in a clockwise or counterclockwise direction. Furthermore, two additional precautions were taken: do not use finger rests during the movement and do not cover the infrared reflective markers. The measurements were performed before, during, and after the impression-taking operation to calculate the syringe tip position on the syringe coordinate system and correct the measured values. Three random measurements were obtained for each trial performed by each participant under the aforementioned conditions. Considering the learning effect, the third data point in each direction was used for analysis.

Figure 3. The condition of the experiment: white arrows, infrared cameras. The abutment teeth model was bonded to a metal plate and fixed to the desk

The movement of the syringe was evaluated based on the position of the syringe tip relative to the coordinate system of the abutment teeth model. The system was developed by measuring the longitudinal groove assigned to the abutment teeth model using a digitizer pen. The volume of the ejected silicone impression material was calculated from the movements of the markers placed at the rear and inner diameters of the syringe. The mean and standard deviation of the time-series data of the pour volume for 1 s after the start and 1 s before the end defined the analysis for this experiment. The following five parameters were evaluated: impression accuracy, analysis section length, impression material pouring speed, total amount of impression material used, and syringe tip trajectory. The impression accuracy was evaluated by the same evaluator for errors, such as tears and defects. The length of the analysis section was the time of the analysis. The impression-material pouring speed and total impression material used were calculated from the time-series data of the impression-material pouring volume. The horizontal and vertical distances from the finish line of the abutment teeth model to the syringe tip were calculated to determine the syringe tip trajectory. The horizontal distance was expressed as a positive value when the tip of the syringe was positioned outside the finish line equivalent of the abutment teeth model and as a negative value when the tip was positioned inside. In addition, the angle between the syringe tip and the z-axis of the abutment teeth model was calculated (Figure 4). For the impression material pouring speed and syringe tip trajectory, the mean values during the operation were calculated and used as representative values for each participant. Fisher's exact test was conducted to determine the association between the presence of impression tears or defects and the dentist or dental student group. Other parameters were compared between the dentist and dental student groups using the Mann-Whitney U test. To examine the influence of impression-taking direction, the clockwise and counterclockwise results for each group were compared using the Wilcoxon rank-sum test. The data were analyzed using IBM SPSS Statistics ver. 28.0.0.0 (IBM, Armonk, NY, USA), with a statistical significance of $p<0.05$.

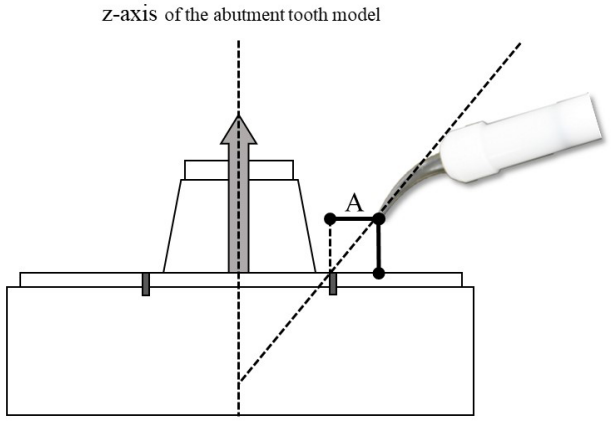

Figure 4. Three parameters calculated for the syringe tip trajectory: A, the horizontal distance from the finish line. B, the vertical distance from the finish line. C, the angle between the syringe tip and the z-axis of the abutment teeth model

RESULTS

None of the participants in the dentist group made impression-taking errors. However, several participants in the dental student group had tears and defects in the silicone impression material (Figure 5). There were significant differences between the two groups in both the clockwise and counterclockwise directions ($p<0.05$), and the dentist group had fewer errors in impression-taking (Table 1).

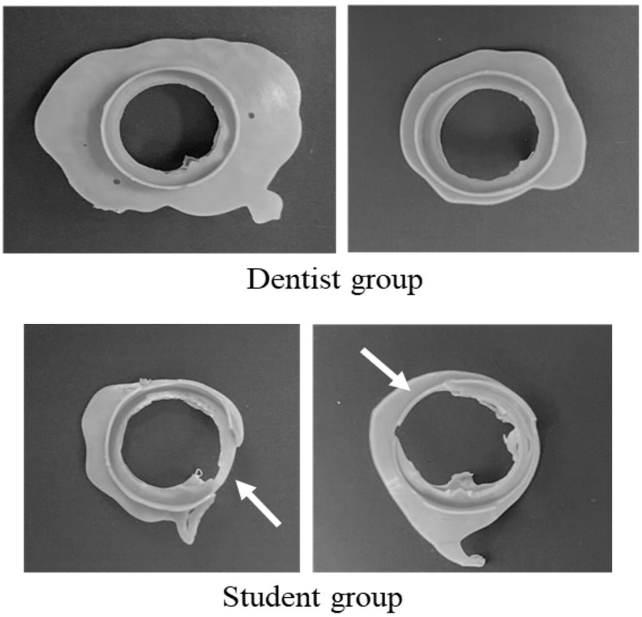

Figure 5. Example of results of impression-taking. White arrows, tears or defects of silicon impression material

The means and standard deviations of other parameters are listed in Table 2. Regarding the angle of the syringe tip, one participant in the dentist group was found to have an incomplete setting of the syringe tip marker during measurement; therefore, this participant was excluded from the analysis. The length of the analysis section was longer in the dentist group than in the dental student group. In addition, handling the impression material in the dentist

Table 1. Results of the analysis of impression accuracy

	Clockwise direction			Counterclockwise direction		
	Dentists (n=10)	Dental students (n=10)	p	Dentists (n=10)	Dental students (n=10)	p
No error	10	4	0.005	10	6	0.043
There were tears or defects	0	6		0	4	

Table 2. Results of the analysis of syringe operation

	Clockwise direction		Counterclockwise direction	
	mean±SD		mean±SD	
	Dentist group	Dental student group	Dentist group	Dental student group
Analysis section length (s)	15.53±5.61	9.17±4.14	13.80±5.05	8.64±3.03
Impression material pouring speed (ml/s)	0.023±0.014	0.015±0.006	0.025±0.010	0.015±0.009
Total impression material used (ml)	0.36±0.13	0.15±0.04	0.40±0.19	0.15±0.06
Syringe tip trajectory				
Horizontal distances (mm)	-0.18±0.53	-0.20±0.41	0.17±0.64	-0.20±0.54
Vertical distances (mm)	0.61±0.90	0.03±0.80	0.22±0.94	0.03±0.63
Angle (°)	17.50±4.90	20.09±6.23	16.72±6.31	21.51±13.56

SD: Standard deviation

group resulted in a faster-pouring speed and larger amount than in the dental student group. There were significant differences between the dentist and dental student groups in all parameters except for the impression material pouring speed in the clockwise direction (Figure 6). However, there were no significant differences in the three parameters of the syringe tip trajectory (Figure 7).

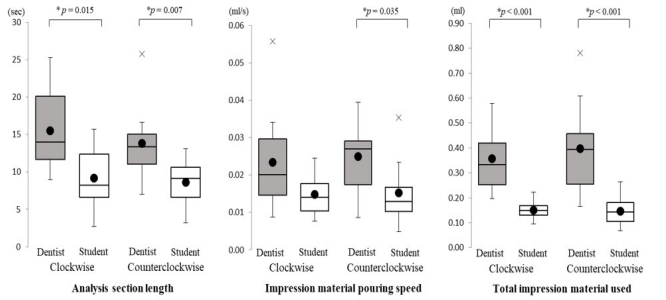

Figure 6. The results of the analysis section length, impression material pouring speed, and total amount of the impression material used: *, p<0.05. ●, mean value in each group

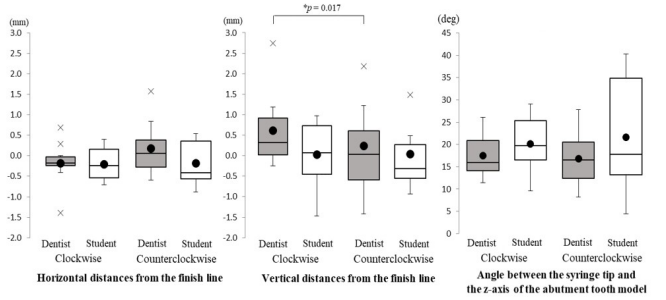

Figure 7. The results of the syringe tip trajectory: *, p<0.05. ●, mean value in each group

In the clockwise and counterclockwise comparisons, a significant difference was observed only in the vertical distance from the finish line to the syringe tip in the dentist group (Figures 6, 7).

DISCUSSION

The tears and defects observed in the cured silicone impression materials indicated that the impression accuracy was higher in the dentist group than in the dental student group. The higher pouring speed and longer treatment time of the impression material in the dentist group indicated that more than a certain amount of impression material was required for a precise impression of the abutment teeth. In contrast, there were few differences in the results in the direction of syringe movement and the trajectory of the syringe tip as expected. While these parameters may not affect the results, it was also considered that the simplified abutment teeth model in this study allowed for a relatively high degree of freedom in syringe manipulation, and the differences in clinical experience were less noticeable in the results. Therefore, it is deemed necessary to conduct further measurements under other clinical conditions and study the effect of these parameters on the impression-taking results.

It is not easy for dental students and trainee dentists to understand the speed of syringe operation and the amount of impression material injected, which were clarified by this study only from observing the demonstrations by instructors. Although directions from the instructor play an important role in skill training,[18] abstract advice such as "move slowly" or "use a little more impression material" are frequently provided. It has been shown that differences in experience can be objectively manifested by operation time or injection speed. From the above discussion, providing specific suggestions to learners by utilizing the indicators obtained in this study might contribute to effective dental skill education. Furthermore, the image of the syringe operation and silicone impression material pouring volume obtained from this analysis system was also considered useful for visualizing and explaining the operator's behavior (Figure 8). In recent years, various educational systems using robots, VR, and MR have been examined and investigated.[19-22] In the future, these systems can be combined with motion analysis to develop an educational system that allows learners to receive real-time feedback during skills training.[23,24]

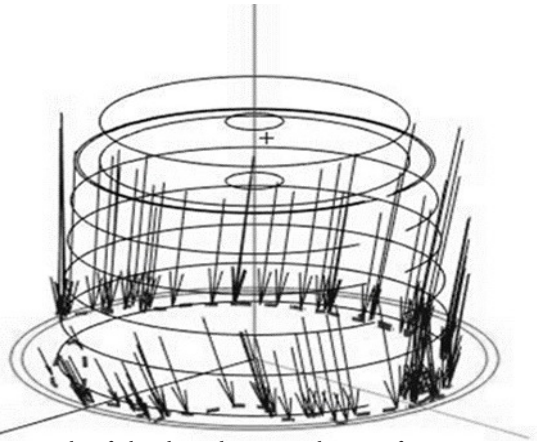

Figure 8. Example of the three-dimensional view of syringe operation and silicone impression material pouring volume: dotted line, syringe tip trajectory; arrow direction, syringe tip direction; arrow length, amount of impression material poured

Limitations

The limitation of this study was that it did not replicate various factors related to the success or failure of impression-taking in clinical practice, such as the morphology of the abutment teeth, the condition of the adjacent teeth and gingiva, and saliva. However, this system makes it possible to quantify the essential steps of the dental practical techniques that cannot be visualized by conventional methods. Further investigations and analyses, including measurements in additional clinical settings, are needed.

CONCLUSION

This study showed that a measurement system using an optical motion capture system can be used to analyze in detail the time-series changes in syringe movements and impression material delivery volumes during impression-taking. This system could be useful in creating new objective indexes for dental clinical education.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of of the ethics committee of Niigata University Medical and Dental Hospital (Date: 11.03.2022, Decision No: 2021-0316).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article

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Has the COVID-19 pandemic altered the frequency of periodontitis? An analysis conducted using Google Trends

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ABSTRACT

Aims: The aim of this study is to compare the frequency of searches for the word "periodontitis" on the internet in the period after SARS-CoV-2 infection and in the previous period, using GT (Google Trends), and in this way to indirectly determine whether there is a relationship between SARS-CoV-2 infection and periodontitis.

Methods: Using the GT online tool in randomly selected countries and around the world, the word "periodontitis" and the word equivalent to the word "periodontitis" in the language of that country were scanned for a 4-year period before and after the SARS-CoV-2 pandemic and compared.

Results: The M (mean) of the RSV data of the word "periodontitis" worldwide in the pre-Covid period (between 2015-2019) in Google Trends was detected as 64.11±7.85, MD (median) was 63, and min and max were 44 and 100, respectively.

Conclusion: In this study, it has been determined that the level of internet searches for the word "periodontitis" has increased compared to the pre-SARS-CoV-2 period since the first occurrence of the SARS-CoV-2 virus worldwide. This study may provide a causal basis for subsequent clinical studies on this subject.

Keywords: Google Trends, periodontitis, SARS-CoV-2 infection

INTRODUCTION

The Internet has rapidly become a primary source for information on health.[1] Millions of individuals search for health-related information every day around the world. Through keyword-based internet searches, users can quickly access a large amount of information.[2] The majority of health-related searches on the internet consists of searching for specific health problems, joining an online health-related support group and searching for someone else's illness or important health problem.[3] When examining people's search habits related to health, it is observed that these searches are mainly conducted using various search engines such as Google, Yahoo!, Bing, and Ask.com.[1] Recent studies suggest that internet search behaviour could be beneficial in predicting public health events.[4] In 2004, Google Inc. developed a tool called Google Trends (GT), which revolutionized free access to web-based interactive search.[5] In addition to its extensive utilization in marketing, sales and advertising, GT also has great potential for scientific studies on oral health.[1,6-8] In the first study where GT was used, researchers tried to predict the flu based on geography and time.[9] Following this study, GT has been used in numerous medical studies not only to predict pandemic diseases like influenza but also to forecast the geographical location and seasonal behaviour of various diseases.[9-13] The emergence of SARS-CoV-2 as a new human pathogen in December 2019 caused major changes in people's lives. For research teams and clinical staff, this virus has highlighted unknown vulnerabilities and overlooked areas of research. Our understanding of the short and long-term complications of SARS-CoV-2 infection is increasing day by day.[14] SARS-CoV-2 infection is thought to have long-term effects on the cardiovascular system, hepatic system, renal system, endocrine system, nervous system, fertility and mental health in recovered patients.[15] Additionally, this virus has challenged long-held assumptions about the oral cavity.[16] Angiotensin-converting enzyme receptor 2 (ACE2) is one of the main known receptors for SARS-CoV-2.[17] In the oral cavity, ACE2 is expressed in greater abundance in the oral mucosa, especially on the lingual surface and salivary-producing glands, than in the oral or palatal mucosa.[18] Due to this distribution of ACE2, SARS-CoV-2 infection has oral complications such as petechiae, geographic tongue, depapillation, glossitis and necrotizing

periodontal diseases.[19,20] The relationship between gingivitis, periodontitis, and SARS-CoV-2 has been investigated due to the presence of periodontal diseases among oral manifestations of SARS-CoV-2.[21-23] It has been determined that there is a relationship between periodontitis[24] and severe SARS-CoV-2 and that the probability of developing severe SARS-CoV-2 in patients diagnosed with periodontitis is 2.81 times higher.[23] In addition, another study found that SARS-CoV-2 patients with periodontitis had a higher rate of admission to intensive care units, mortality, and a greater need for ventilation.[25,26] It remains uncertain whether periodontitis directly plays a role in worsening the clinical course of SARS-CoV-2.[24] Hemoglobin-A1c, white blood cells and C-reactive protein are found in higher levels in SARS-CoV-2 patients with periodontitis, resulting in high-risk complications.[27] Oral hygiene and periodontitis treatment are important to help reduce the risk and transmission of SARS-CoV-2 infection.[28] On the other hand, although it is not clear in research whether periodontitis causes SARS-CoV-2 infection, a mutual relationship between the two can be mentioned.[25] There is no clinical study showing whether the incidence of periodontitis in humans changes before and after SARS-CoV-2 infection. Various search engines are valuable for accessing medical information not only for healthcare professionals but also for the general public.[1] Therefore, in this study, we aimed to compare the frequency of people searching for periodontal/periodontitis disease on the internet in some countries before and after SARS-CoV-2 infection. Our aim is to evaluate whether the internet searches for "periodontitis" are different between the period after the first appearance of SARS-CoV-2 infection and the period before.

METHODS

Google Trends and Ethical Approval

Observational, ecological research was conducted in accordance with the Declaration of Helsinki and Google policy. In the study, as in previous studies, ethics committee approval was not sought because the identity information of the individuals searching on the internet was not known. The GT tool is available at http://google.com/trends/ and can be accessed by all internet users. Users can enter their desired keyword (for example, "periodontitis") into the search tab and view the relative search volume (RSV) for their desired region and time frame.

Determination of the Study Group

In the study, searches were conducted using the term "periodontitis" in countries with English as the official language such as the USA, Australia, the United Kingdom, India, and South Africa. In non-English speaking countries like Germany, France, Italy, Russia, Sweden, Saudi Arabia, and Turkiye, searches were conducted using both the term "periodontitis" and its equivalent in the respective languages. For example, when searching for Saudi Arabia, "periodontitis +التهاب" was typed in the GT search section. The term "periodontitis" was searched for in two time periods: four years before and four years after November 2019, when the first case of SARS-CoV-2 was reported in Wuhan, Hubei province, China (given that the SARS-CoV-2 infection occurred four years ago, we chose the four years before it for statistical analysis). Search data (RSV values) were obtained and evaluated accordingly (Figure).

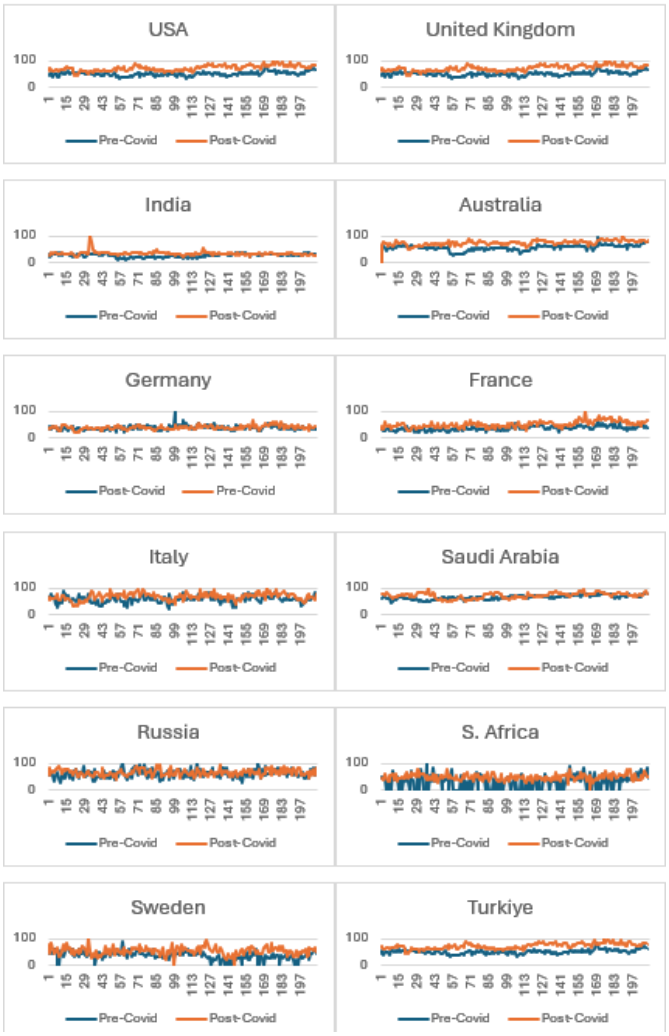

Figure. Graph of RSV values for the word "periodontitis" in the 4-year period before and after November 2019 in USA, Australia, United Kingdom, India, South Africa, Germany, France, Italy, Russia, Sweden, Saudi Arabia and Turkiye

Note: Pre-covid: 4-year period before November 2019, Post-covid: 4-year period after November 2019

Statistical Analysis

Data were analyzed using SPSS software (version 23.0; IBM Corp., Armonk, NY, USA). In this study, mean, standard deviation (SD), median, minimum-maximum and percentage values were given for descriptive statistics. Skewness and Kurtosis values were evaluated to determine whether the data distribution was normal. Kurtosis and skewness values between -1.5 and +1.5 are generally considered to indicate that the data follows a normal distribution.[29] In countries where RSV data is normally distributed, the paired t-test is used to determine the difference between the means of dependent data. For countries where RSV data is not normally distributed, the Wilcoxon test is utilized. For all analyses, $p<0.05$ was considered statistically significant.

RESULTS

Pre SARS-CoV-2 Infection RSV Values

The M (mean) of the RSV data of the word "periodontitis" worldwide in the pre-covid period (between 2015-2019) in Google Trends was calculated as 64.11±7.85. MD (median) was 63, and min and max were calculated as 44 and 100, respectively. M, MD and min-max of RSV values in the pre-covid period were examined and the following data were obtained for each country (Table 1). For USA, M is 56.21±0.69,

Table 1. Means, standard deviations, median and range values of RSV data of USA, Australia, United Kingdom, India, South Africa, Germany, France, Italy, Russia, Sweden, Saudi Arabia and Turkiye

	M		SD		MD		R	
	Pre Cov	Post Cov	Pre Cov	Post Cov	Pre Cov	Post Cov	Pre Cov	Post Cov
USA	56.21	74.40	0.69	0.55	57	75	28-94	50-100
UK	50.03	71.95	0.52	0.70	49	72	30-85	45-100
India	26.36	33.27	0.42	0.49	28	32	9-38	18-100
Germany	37.69	38.56	0.57	0.51	37	39	20-100	20-66
Italy	57.36	67.61	0.83	0.91	58	68	23-90	29-100
Russia	60.79	65.60	1.01	0.81	60	65	26-100	37-97
France	35.93	50.65	0.56	0.82	35	50	18-61	24-100
Australia	53.14	70.86	0.83	0.80	54	70	18-86	44-100
Turkiye	24.98	52.64	1.36	1.21	36	49	0-100	0-80
S. Africa	31.89	48.11	1.66	0.83	28	65	0-73	0-100
Sweden	35.48	53.51	1.09	1.03	37	54	0-89	0-100
S. Arabia	65.40	72.10	0.53	0.70	66	73	46-85	50-100

M: Mean, SD: Standard deviation MD: Median, R: Range

MD is 57 and min-max is 28-94 respectively. For UK, M is 50.03±0.52, MD is 49 and min-max is 30-85 respectively. For Australia, M is 53.14±0.83, MD is 54 and min-max is 18-86 respectively. For India, M is 26.36±0.42, MD is 28 and min-max is 9-38 respectively. For Germany, M is 37.69±0.83, MD is 37 and min-max is 20-100 respectively. For Italy, M is 57.36±0.83, MD is 58 and min-max is 23-90 respectively. For Russia, M is 60.79±1.01, MD is 60 and min-max is 26-100 respectively. For France, M is 35.93±0.56, MD is 35 and min-max is 18-61 respectively. For Turkiye, M is 24.98±1.36, MD is 28 and min-max is 0-73 respectively. For South Africa, M is 31.89±1.66, MD is 36 and min-max is 0-100 respectively. For Sweden, M is 36.11±1.06, MD is 36 and min-max is 0-86 respectively. For Saudi Arabia, M is 65.40±0.53, MD is 66 and min-max is 46-85 respectively.

Post SARS-CoV-2 Infection RSV Values

In the post-covid period worldwide, the M of the RSV value was calculated as 80.80±7.34. The MD was 81, and the min and max were calculated as 58-98, respectively. M, MD and min-max of RSV values in the 209th week of post-covid period were examined and the following data were obtained for each country (Table 1). For USA, M is 74.40±0.55, MD is 75 and min-max is 50-100 respectively. For United Kingdom, M is 71.95±0.70, MD is 72 and min-max is 45-100 respectively. For Australia, M is 70.86±0.80, MD is 72 and min-max is 44-100 respectively. For India, M is 33.27±0.49, MD is 32 and min-max is 18-100 respectively. For Germany, M is 38.56±0.51, MD is 39 and min-max is 20-66 respectively. For Italy, M is 67.61±0.91, MD is 68 and min-max is 29-100 respectively. For Russia, M is 65.60±0.81, MD is 65 and min-max is 37-97 respectively. For France, M is 50.65±0.82, MD is 50 and min-max is 24-100 respectively. For Turkiye, M is 52.64±1.21, MD is 51 and min-max is 0-100 respectively. For South Africa, M is 48.11±0.83, MD is 49 and min-max is 0-80 respectively. For Sweden, M is 53.43±1.07, MD is 53 and min-max is 0-100, respectively. For Saudi Arabia, M is 72.10±0.70, MD is 73 and min-max is 50-100 respectively.

Comparison of Pre-COVID and Post-COVID Period RSV Values

When evaluating the 209-week RSV values globally between the pre-COVID and post-COVID periods, it was found that in the 201st week, the RSV value was higher in the post-COVID period, while in the 6th week, the RSV value was higher in the pre-COVID period. Additionally, in the 2nd week, it was observed that the RSV values were the same in both the pre-COVID and post-COVID periods. There is a significant difference in RSV values between the pre-COVID and post-COVID periods worldwide ($p<0.001$). A significant increase in RSV values has been observed throughout the world in the post-covid period. Additionally, when evaluated separately for the USA, UK, Australia, India, Germany, Italy, Russia, France, Turkiye, and Switzerland, significant differences in RSV values between the pre-COVID and post-COVID periods were observed for all countries ($p<0.001$) (Table 2). RSV values were significantly higher in the post-covid period for all countries.

Table 2. Tests conducted to compare RSV data from USA, Australia, UK, India, South Africa, Germany, France, Italy, Russia, Sweden, Saudi Arabia and Turkiye

	Test	p-value
USA	The paired samples t test	<0.001
UK	Wilcoxon signed ranks test	<0.001
Australia	The paired samples t test	<0.001
India	Wilcoxon signed ranks test	<0.001
Germany	Wilcoxon signed ranks test	<0.001
Italy	The paired samples t test	<0.001
Russia	The paired samples t test	<0.001
France	The paired samples t test	<0.001
Turkiye	The paired samples t test	<0.001
South Africa	The paired samples t test	<0.001
Sweden	The paired samples t test	<0.001
Saudi Arabia	The paired samples t test	<0.001

DISCUSSION

The objective of this study was to assess whether there is a difference in the frequency of internet searches for the term "periodontitis" between the periods before and after the onset of SARS-CoV-2 infection worldwide. The aim was to provide insights that could potentially

guide future clinical research efforts. This study is the first to investigate the word "periodontitis" using GT in the pre- and post-SARS-CoV-2 period. In the study, it was determined that the number of searches for the word "periodontitis" in GT increased significantly in the 4-year period after SARS-CoV-2 infection, worldwide and country-specific, compared to the 4-year period before SARS-CoV-2 infection. This apparent result in our research suggests that periodontitis may be a complication of SARS-CoV-2 infection. As of 29 March 24, 704,533,184 (https://www.worldometers.info/coronavirus/) people worldwide have been exposed to SARS-CoV-2 infection. Numerous studies have demonstrated persistent damage in various organs or systems, including the lungs,[30] heart,[31] kidneys[32] and vascular system,[33] among individuals infected with SARS-CoV-2. The damage appears to result from a severe inflammatory response, thrombotic microangiopathy, venous thromboembolism, and oxygen deprivation.[34,35] In the long term, particles of SARS-CoV-2 persist in a wide variety of organs. It has been shown in studies that even if the virus cannot be detected after SARS-CoV-2 infection and the symptoms of the disease disappear, SARS-CoV-2 does not completely disappear.[36] Stein et al.[37] reported that in a biopsy from a patient who died due to SARS-CoV-2 infection, SARS-CoV-2 RNA was found throughout the body, including brain tissue, for up to 230 days after the onset of symptoms. Lapa et al.[38] reported that in patients who survived and recovered after SARS-CoV-2 infection, hair loss, obesity, memory loss and hypercholesterolemia were observed 3-6 months later, in the period they named as "post-covid syndrome". A recent study conducted by Hany et al.[39] showed that virus particles SARS-CoV-2 form long-term viral reservoirs in the gastrointestinal tract mucosa. The potential for SARS-CoV-2 to create a long-term reservoir and cause damage in the gastrointestinal (GI) mucosa, coupled with one of the entry routes of SARS-CoV-2 being the oral cavity, suggests the possibility of long-term infection in the oral region. One of the main reasons why we conducted this study is that particles of SARS-CoV-2 remain in the mucosa for a long time and cause chronic inflammation in these areas.

Molecules such as ACE-2, furin, cathepsin and TMPRRS, which are important in the entry of SARS-CoV-2 into cells, are found at high levels in periodontal tissues, especially in patients with periodontitis. Additionally, periodontopathic bacteria may play a direct role in the entry mechanism of SARS-CoV-2 by degrading S-protein and cytokines produced during periodontitis.[40] It has been demonstrated that aspiration of periodontal pathogens may increase the severity of SARS-CoV-2 infection in the lungs.[41] It has also been reported that aspiration of saliva with a high viral load may carry the virus to the lower respiratory tract and increase the risk of developing more severe forms of the disease.[42] Numerous studies have investigated the potential presence of a relationship between periodontal diseases and SARS-CoV-2 infection.[21,22,24] Wang et al.[43] investigated the causal relationship between periodontitis and SARS-CoV-2 infection based on MR (Mendelian Randomization) methods and concluded that there is a causal relationship between periodontitis and SARS-CoV-2 infection. In their study, Meng et al.[21] found that periodontitis and GCF (gingival crevicular fluid) IL-1β levels, which are higher in periodontitis, are causally related to increased susceptibility to COVID-19. On the other hand, a study by Drozdzik et al.[22] showed that there was no causal connection between periodontitis and SARS-CoV-2 cases, but it was found that maintaining good periodontal health is positively correlated with the prognosis of the disease in SARS-CoV-2 patients. Marouf et al.[25] reported that patients with periodontitis who have SARS-CoV-2 infection face worse disease outcomes, including a higher risk of admission to intensive care unit, a higher need for ventilation, and a higher mortality rate.

The SARS-CoV-2 pandemic has drastically changed the routine of life and challenged the ways healthcare and dental healthcare are delivered. In most countries, routine dental procedures were suspended during the 1st quarantine.[44] The reason for this could be that dental healthcare workers have been in the highest risk group for contracting SARS-CoV-2 infection during the pandemic, and during this period, dentists may have been more meticulous in adhering to standard protocols. They also reduced working hours and limited dental procedures to emergency treatments to reduce the risk of contracting SARS-CoV-2 infection.[45] According to a study conducted in Beijing, there was a 38% decrease in the number of patients seeking emergency dental treatment in clinics during the SARS-CoV-2 pandemic compared to before the pandemic. Additionally, the ratio of patients visiting clinics for dental issues and oral infections increased from 51% before the pandemic to 71.9% after the outbreak of SARS-CoV-2.[46] According to these studies, it is reported that periodontitis exacerbates the severity of complications from SARS-CoV-2 infection, but it has not been conclusively determined whether SARS-CoV-2 infection directly causes periodontitis. There may be two reasons for the shown increase in the frequency of people searching for the word "periodontitis" on the internet in the period after SARS-CoV-2 infection, both worldwide and on a country basis, compared to the period before SARS-CoV-2 infection. The first reason may be that the SARS-CoV-2 virus causes periodontitis. For this reason, the number of searches for the word "periodontitis" on the internet would have increased in the period after SARS-CoV-2 infection. Second reason may be the suspension of routine dental treatments during the SARS-CoV-2 pandemic, which posed challenges for individuals in accessing dental care. Consequently, this interruption may have contributed to the advancement of gingival diseases and the onset of periodontitis.

The incidence of certain diseases and syndromes has changed following infection with SARS-CoV-2. The strength of this study lies in its status as the first investigation of potential changes in the prevalence of periodontitis. The absence of a clinical design in this investigation may be its major limitation, but the outcomes of forthcoming clinical trials may corroborate the findings of our study.

CONCLUSION

Since the moment the SARS-CoV-2 virus was first seen in the world, the number of searches for the word "periodontitis" on the internet has increased compared to the pre-SARS-CoV-2 period. There may be two potential factors contributing to this phenomenon. The first factor could be the inability of individuals to access routine dental treatments during the period of SARS-CoV-2 infection. The second factor could be the potential of SARS-CoV-2 infection to cause periodontitis.

This conclusion drawn from the study based on internet searches needs further validation through future clinical studies and observations.

ETHICAL DECLARATIONS

Ethics Committee Approval

In the study, as in previous studies, ethics committee approval was not sought because the identity information of the individuals searching on the internet was not known.

Informed Consent

The GT tool is available at http://google.com/trends/ and informed consent is not required as it can be accessed by all internet users.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Author Contributions

Devrim Deniz Üner and Bozan Serhat İzol contributed equally to the literature review, writing and reviewing the manuscript.

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Attitudes and behaviors of dentists regarding rational drug use

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ABSTRACT

Aims: Medicines, which have an important place in health services, are the greatest weapon of societies in preventing and combating diseases. If medicines are not used properly, they may not provide the expected effect and may lead to recurrence of some diseases, development of resistance or some side effects. In recent years, there has been a rapid increase in the number, variety and utilization rates of medicines. This situation has necessitated more rational behavior in the use of medicines, especially by healthcare professionals. Rational drug use can be briefly defined as the administration of appropriate medication in the light of anamnesis and clinical symptoms. Education on rational drug use remains as current in the dental profession as it is in the medical world. In order to determine the extent to which dentists meet the expectations regarding rational drug use and to eliminate possible problems, it is first necessary to determine their knowledge, attitudes, and behaviors on the subject. In this study, it was aimed at comparing and evaluating the attitudes and behaviors of dentists towards rational drug use.

Methods: Our study, which was approved by the ethics committee, was conducted with the participation of 399 volunteer dentists actively working in public hospitals and the private sector in different provinces of our country. The data for the study were obtained through an online questionnaire consisting of 15 questions. The IBM SPSS 25.0 package program was used for data analysis of the survey results. A frequency distribution table was created for general characteristics. A chi-square test was used to compare the relationship between categorical variables.

Results: It was determined that 50.6% of the participants received rational drug use training, 91.5% utilized different sources of information while prescribing, 73.4% did not prescribe drugs requested by patients, and 43.6% did not find the information given to patients about drugs sufficient. When the reasons for this were questioned, lack of information and lack of time were mostly cited. It was found that the level of knowledge of the participants about drugs was mostly focused on indications, route of administration, special conditions, and contraindications. When prescribing medications, the participants generally questioned whether the patients had chronic diseases, drug allergies, and other medications. It was observed that dentists mostly provided information about the duration of treatment, daily dosage, and method of administration regarding the drugs they prescribed.

Conclusion: The basis of irrational drug use in dentistry lies in a lack of knowledge and education. In order to obtain the expected benefit from drugs, we believe that, in addition to instilling awareness of rational drug use in society, the attitudes and behaviors gained, especially by physicians through undergraduate education and in-service training after graduation, should be supported by health policies.

Keywords: Rational medicine, dentist, specialization in dentistry

INTRODUCTION

Pharmaceuticals are an essential element of the health system. In parallel with the developments in medicine, there has been a great increase in the number and variety of drugs worldwide. However, it has been observed that if drugs are not used, when necessary, as much as necessary, and in the required manner, diseases may be prolonged or recur.[1] Studies have reported that excessive drug consumption leads to a number of side effects, including the development of resistance, difficult-to-treat health problems,[2] and an increased financial burden[3] on social security institutions.[4-8] In addition, drugs may deteriorate and fail to provide the desired benefit if they are not stored under appropriate conditions due to their chemical structure. This situation leads to a waste of resources and undermines confidence in the healthcare system.[9]

Although drug expenditures vary according to countries, they constitute a significant portion of health expenditures (7-30% of the budget in developed countries and 24-66% in developing countries).[10] The biggest obstacle to rational use

of drugs is wrong drug policies, infrastructure deficiencies[11] and erroneous attitudes and behaviors (prescribing too many drugs, etc.) of healthcare professionals due to a lack of adequate training before/after graduation.[12]

In addition, patients' insistence or pressure on physicians by some pharmaceutical companies to prescribe certain drugs may affect prescribing behaviors.[13-15] The World Health Organization (WHO) has reported that more than half of the drugs are prescribed or sold off-label, and approximately one in five people use drugs without consulting a healthcare professional.[16] Studies have shown that women are more likely to use drugs without a doctor's advice.[17] Especially in our country, a significant proportion of people may use drugs without the advice of a physician, based on their previous experiences or the recommendation of friends.[7]

As a result of a study conducted in Mersin province, it was found that 26% of the patients who applied to primary health care institutions used drugs without the advice of a physician, 17% used drugs with the advice of their environment (family, friends, or neighbors), and 31.3% took their drugs from the pharmacy without a prescription.[18] These and similar situations may cause the masking of symptoms and thus delay the early diagnosis of diseases.[19]

The development of new treatment methods requires healthcare professionals to act more rationally when prescribing drugs.[9] Rational drug use is a dynamic process that includes "correct diagnosis of diseases, treatment with appropriate methods, prescribing effective, reliable, and low-cost drugs and using them at the appropriate dose, frequency, and duration, informing patients correctly, and monitoring treatment results. Through rational use of drugs, it is possible to prevent physiological, biological, psychological, and financial damages that may result from misuse.[20-24]

It is extremely important to raise awareness in society and especially among healthcare professionals (physicians, pharmacists, nurses, and other healthcare professionals to have adequate therapeutic knowledge) about the rational use of drugs.[4,7,25] In addition to the responsibility of healthcare professionals and the state, universities, professional organizations, pharmaceutical companies, and the media play a significant role in the healthy conduct of the process.[26] The attitudes and behaviors of university students and newly graduated physicians toward rational drug use shed light on the development of rational drug policies.[27]

Although comprehensive studies on rational drug use have been conducted in recent years, the number of these studies on dentistry is quite small. The aim of this study was to compare and evaluate the attitudes and behaviors of dentists actively working in public hospitals and the private sector in different provinces of our country towards rational drug use.

METHODS

The sample of this descriptive and cross-sectional study consisted of 399 dentists who were actively working in public hospitals and the private sector in different provinces of Turkiye and who agreed to participate in the study. In order to conduct the study, the necessary permission was obtained from the Dicle University Faculty of Dentistry Local Ethics Committee (Date: 26.05.2021, Decision No: 2021-31). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The data for the study were obtained through an online questionnaire consisting of a total of 15 questions to determine the attitudes and behaviors of the participants regarding rational drug use as well as their descriptive information. In the first part of the questionnaire, four questions (gender, professional experience, specialty training, and specialty area) were used to question the socio-demographic characteristics of the participants. In the second part of the questionnaire, 11 questions (status of receiving rational drug use education, place of education, utilization of information sources while prescribing, most utilized information sources, prescribing the drugs requested by patients, finding the information given to patients about drugs sufficient, reason for not giving sufficient information, whether the information given is understood by patients, level of knowledge about drugs, which anamnesis information is used while prescribing drugs, and which information is given about prescribed drugs) were used to evaluate the attitudes and behaviors of the participants regarding rational drug use.

Data analysis of the questionnaire results was performed by transferring to the IBM SPSS 25.0 package program. Descriptive statistics were used in the evaluation of the data. A frequency distribution table was created for general characteristics. A chi-square test was used to compare the relationship between categorical variables. The findings were evaluated at a 95% confidence interval and $p<0.05$ was considered statistically significant.

RESULTS

When the gender distribution was evaluated based on the socio-demographic characteristics (Table 1), it was seen that 70.7% of the participants were "female" and 29.3% were "male". When the professional experience of the participants was questioned, it was determined that 61.4% had "1-5 years", 23.1% had "6-10 years", 5.8% had "11-15 years", 5% had "16-20 years", and 4.8% had "more than 20 years" of professional experience.

Table 1. Distribution of socio-demographic characteristics of the participants

		n	%
Gender	Female	282	70.7
	Male	117	29.3
Professional experience	1-5	245	61.4
	6-10	92	23.1
	11-15	23	5.8
	16-20	20	5.0
	Over 20	19	4.8
Specialty training in dentistry	Yes	197	49.4
	No	202	50.6
Dental specialty	Those without specialized training	202	50.6
	Pediatric dentistry	43	10.8
	Periodontology	37	9.3
	Restorative dental treatment	26	6.5
	Oral and maxillofacial surgery	24	6.0
	Endodontics	19	4.8
	Oral and maxillofacial radiology	18	4.5
	Orthodontics	16	4.0
	Prosthodontics	14	3.5
Total		399	100.0

When the specialty training in dentistry was analyzed, it was found that the proportion of "those with specialty training" (49.4%) was almost equal to "those without specialty training" (50.6%). Among the programs with specialty training, the highest rate was in "pediatric dentistry" (10.8%), followed by "periodontology" (9.3%), "restorative dental treatment" (6.5%), "oral and maxillofacial surgery" (6%), "endodontics" (4.8%), "oral and maxillofacial radiology" (4.5%), "orthodontics" (4%) and finally "prosthodontics" (3.5%).

When the status of receiving rational drug use training among the attitudes and behaviors of dentists regarding rational drug use was evaluated (Table 2), the proportion of the participants who received rational drug use training (50.6%) was almost the same as that of those who did not receive training (49.4%). When the places where rational drug use training was received were analyzed, it was found that 32.3% of the participants received this training from "faculties of dentistry", 18% from "ministry of health" and 0.3% from "pharmaceutical companies".

When the status of benefiting from information sources while prescribing was questioned, 91.5% of the participants emphasized that they "benefited from information sources" while prescribing, while 8.5% stated that they "did not". When the information sources most frequently used by the participants were investigated, "internet" ranked first (37.1%), followed by "Vademecum" (24.8%), "colleagues" (12.8%), "diagnostic and therapeutic guides" (6.5%), "drug information software programs" (4.5%), "pharmacology books" (3%), "Turkish drug therapy guide" (TIK-1.5%), and finally "research and promotion studies of pharmaceutical companies" (1%).

When the status of prescribing medicines requested by patients was evaluated, 73.4% of the dentists stated that they "did not prescribe medicines requested by patients" (previously used by the patient, recommended by others, purchased from a pharmacy, etc.), while 26.6% admitted that they "prescribed" them. When the adequacy of the information given to patients about medicines was analyzed, 56.4% of the participants reported that "the information given to patients about medicines was adequate", while 43.6% reported that "the information given was not adequate".

3% stated that they "did not have enough time", 4% stated that they "thought that patients would not pay attention to them about the use of medicines", 3.3% stated that "it was the duty of the pharmacist to explain the information in the prescription", and 3% stated that "patients had enough information about medicines". To the question "Do you check whether the information given about the drugs is understood by the patients?" 75.2% of the participants answered "yes", while 24.8% answered "no".

When the level of knowledge of dentists about drugs was questioned (Table 3), it was found that 98.7% of the participants found the level of knowledge about "indications for use of drugs" to be adequate (moderate, good, and very good), while 90% of the participants found the level of knowledge about "contraindications for use" to be adequate.

While 97.7% of the dentists thought that they had adequate knowledge about the "route of administration", 83.4% of the dentists thought that they had adequate knowledge about the "pharmacologic properties". The rate of those who stated that they had adequate knowledge about "side effects of drugs" was 83.2%, the rate of those who stated that they had adequate knowledge about "drug interactions" was 64.2%, the rate of those who thought that they had adequate knowledge about "warnings and precautions" was 78.5%, the rate of those who thought that they had adequate knowledge about "special conditions" was 94%, and the rate of those who thought that they had adequate knowledge about "bioequivalence of drugs" was 63.7%.

Table 2. Attitudes and behaviors of dentists regarding rational drug use

		n	%
Status of rational drug use training	Yes	202	50.6
	No	197	49.4
Place of rational drug use training	Those who did not receive training	197	49.4
	Faculty of dentistry	129	32.3
	Ministry of Health	72	18.0
	Pharmaceutical company	1	0.3
Utilization of information sources while prescribing	Yes	365	91.5
	No	34	8.5
The most commonly used sources of information when prescribing	Those who do not make use of information sources	35	8.8
	Internet	148	37.1
	Vademecum	99	24.8
	Colleagues	51	12.8
	Diagnostic and treatment guidelines	26	6.5
	Drug information software programs	18	4.5
	Pharmacology books	12	3.0
	Turkiye medication therapy guideline	6	1.5
	Research and promotion activities of pharmaceutical companies	4	1.0
Prescribing medicines requested by patients (previously used by the patient, recommended by others, bought from the pharmacy, etc.)	Yes	106	26.6
	No	293	73.4
Finding the information given to patients about medicines sufficient	Yes	225	56.4
	No	174	43.6
Reasons for not providing patients with sufficient information about medicines	Those providing sufficient information	222	55.6
	I do not have enough information about medicines	71	17.8
	Time is not enough	65	16.3
	I think patients will ignore me about the use of medicines	16	4.0
	It is the pharmacist's duty to explain the information in the prescription	13	3.3
	I think patients have sufficient information about medicines	12	3.0
Do you check that information about medicines is understood by patients?	Yes	300	75.2
	No	99	24.8
Total		399	100.0

Table 3. What do you think about your level of knowledge about medicines?

	Very bad		Bad		Moderate		Good		Very good	
	n	%	n	%	n	%	n	%	n	%
Indications	2	0.5	3	0.8	119	29.8	237	59.4	38	9.5
Contraindications	3	0.8	33	8.2	174	43.6	164	41.1	25	6.3
Method of application	2	0.5	7	1.8	126	31.6	194	48.6	70	17.5
Pharmacological properties	12	3	54	13.6	226	56.6	89	22.3	18	4.5
Side effects	7	1.8	60	15	234	58.6	86	21.6	12	3
Drug interactions (drug/nutrient)	17	4.2	126	31.6	200	50.1	53	13.3	3	0.8
Warnings, precautions	19	4.8	67	16.7	187	46.9	121	30.3	5	1.3
Special conditions (pregnancy, pediatrics, etc.)	2	0.5	22	5.5	161	40.4	159	39.8	55	13.8
Bioequivalence	41	10.3	104	26	173	43.4	77	19.3	4	1

As can be seen from the findings, although most of the dentists stated that they have sufficient knowledge about drugs, almost half of the participants (43.6%) did not find the information given to patients about drugs sufficient. In addition, it is quite thought-provoking that while the most important source of information that dentists should utilize when prescribing drugs should be the literature, a significant proportion of the participants resorted to the internet or the resources published by pharmaceutical companies (good prescribing guides) to obtain information.

When it was investigated which anamnesis information the dentists utilized while prescribing drugs (Table 4), it was found that 65.4% of the participants always questioned "other drugs used by the patients", 87.2% always questioned "whether the patients had drug allergies", 38.3% always questioned "whether the patients had liver disease", 35.8% always questioned "whether the patients had kidney disease", 71.4% always questioned "whether the patients had a chronic disease", 78.9% always questioned "whether the patients were pregnant", and 70.7% "always considered the age of the patients".

When the information provided by dentists about the drugs, they prescribed to their patients was analyzed (Table 5), it was found that 70.1% of the participants "frequently" and "always" provided information about the "name of the drug", while 92% of the participants provided the same information about the "method of administration" and "daily dosage". While 92.2% of the participants stated that they "often" and "always" gave information to their patients about the "duration of treatment", 74.7% of the participants who gave the same information about "when to stop taking the drug" were found to be 74.7%. When asked about providing

Table 4. Which anamnesis information do you utilize when prescribing medication?

	Never		Rarely		Sometimes		Often		Always	
	n	%	n	%	n	%	n	%	n	%
I will question the other medicines he is taking	0	0	5	1.3	37	9.3	96	24.1	261	65.4
I ask about drug allergies	1	0.3	1	0.3	5	1.3	44	11	348	87.2
I inquire about liver disease	6	1.5	11	2.8	118	29.6	111	27.8	153	38.3
I ask about kidney disease	6	1.5	15	3.8	110	27.6	125	31.3	143	35.8
I ask if he/she has a chronic illness	0	0	2	0.5	28	7	84	21.1	285	71.4
I question whether she is pregnant or not	8	2	18	4.5	2	0.5	56	14	315	78.9
I take his/her age into account	3	0.8	5	1.3	26	6.5	83	20.8	282	70.7

Table 5. What information do you give to your patients about the medicines you prescribe?

	Never		Rarely		Sometimes		Often		Always	
	n	%	n	%	n	%	n	%	n	%
Name of the medicine	1	0.3	29	7.3	89	22.3	145	36.3	135	33.8
Method of application	2	0.5	11	2.7	19	4.8	152	38.1	215	53.9
Daily dosage	4	1	9	2.2	19	4.8	152	38.1	215	53.9
Duration of treatment	1	0.3	4	1	26	6.5	133	33.3	235	58.9
When to stop taking the medicine	17	4.3	28	7	56	14	151	37.9	147	36.8
Mechanism of action of the drug	104	26.1	90	22.6	140	35	49	12.3	16	4
Possible side effects of the drug	35	8.8	88	22.1	164	41	86	21.6	26	6.5
The price of medicine	257	64.4	63	15.8	59	14.8	18	4.5	2	0.5
Interaction with other drugs/nutrients	100	25.1	126	31.6	101	25.3	62	15.5	10	2.5
Activities to avoid	100	25.1	75	18.8	112	28	88	22.1	24	6
Other warnings about medicines	44	11	71	17.8	122	30.6	132	33.1	30	7.5

information on the "mechanism of action" and "possible side effects" of the drug, the "sometimes" option received the highest rate of responses (35% and 41%, respectively). While 64.4% of the dentists "never" provided information about the "price of the drug", 1/4 of the participants emphasized that they "never" provided information about the "interaction of the drug with other drugs/foods" and "activities that the patient should avoid" (25.1%). The proportion of participants who "never" gave other warnings about medicines was 11%.

It was determined that there was no statistically significant relationship (p>0.05) between the status of specialty training in dentistry and prescribing the drugs requested by the patients, considering the information given about the drugs sufficient or checking whether the patient understood the drug after giving information about the drug. However, it was determined that there was a significant relationship (p<0.05) between the status of receiving specialty training and the status of receiving training on rational drug use, the place of training, or the reasons for not giving sufficient information about drugs to the patient (Table 6).

It was observed that there was no statistically significant relationship (p>0.05) between the status of specialty training in dentistry and the level of knowledge about indications of drugs or drug interactions. However, it was determined that there was a significant relationship (p<0.05) between the level of specialty training and the level of knowledge about contraindications, route of administration, pharmacological properties, side effects, warnings/precautions, special conditions (pregnancy, pediatrics, etc.), or bioequivalence of drugs (Table 7).

It was determined that there was no statistically significant relationship (p>0.05) between the status of specialty training in dentistry and the questioning of other drugs used by the patients, the presence of drug allergies, the presence of liver or kidney disease, or the consideration of the age of the patients. However, it was determined that there was a significant relationship (p<0.05) between the status of specialty training and the question of whether the patients had a chronic disease or were pregnant (Table 8).

It was found that there was no statistically significant relationship (p>0.05) between the status of specialty training in dentistry and giving information about the mechanism of action of the prescribed drug or activities to be avoided or making other warnings about drugs. However, it was determined that there was a significant correlation (p<0.05) between the status of specialty training and giving information about the name, route of administration, daily dose, duration of treatment, when to stop, possible side effects, price, or interaction with other drugs/nutrients (Table 9).

There was no statistically significant correlation (p>0.05) between the professional experience of the dentists and their utilization of information sources while prescribing, questioning whether there was a drug allergy, taking into account the age of the patients, and giving information about the method of administration or price of the prescribed drugs. However, again with the professional experience of dentists, the status of finding the information given to the patients about the drugs adequate, the reasons for not giving adequate information about the drugs, the questioning of other drugs used by the patients, the presence of liver or kidney disease, a chronic disease or pregnancy, the name of the drugs, daily dosage, duration of treatment, when to stop the drugs, mechanism of action, possible side effects, interaction with other drugs or nutrients, activities to be avoided, making other warnings about medications, or checking whether the patient understood after giving information about medications was significant (p<0.05).

Table 6. The relationship between the status of specialty training in dentistry and attitudes and behaviors related to rational drug use

Rational use of medicines related attitudes and behaviors		Do you have specialty training in dentistry?		X^2	p
		Yes	No		
Receiving training on rational use of medicines	Yes	83	119	11.233	0.001
		42.1%	58.9%		
	No	114	83		
		57.9%	41.1%		
Place of training on rational use of medicines	Faculty of dentistry	61	68	6.045	0.049
		73.5%	57%		
	Ministry of Health	22	50		
		26.5%	42%		
	Pharmaceutical company	0	1		
		0%	0.8%		
Reason for not providing patients with sufficient information about medicines	Time is not enough	28	37	16.305	0.003
		33.7%	39.4%		
	It is the pharmacist's duty to explain the information in the prescription	7	6		
		8.4%	6.4%		
	I do not have enough information about medicines	38	33		
		45.8%	35.1%		
	I think patients will ignore me about the use of medicines	1	15		
		1.2%	16.0%		
	I think patients have sufficient information about medicines	9	3		
		10.8%	3.2%		

Table 7. The relationship between the level of specialty training in dentistry and the level of knowledge about drugs

Level of knowledge about medicines		Do you have specialty training in dentistry? Yes	No	X^2	p
Contraindications	Very bad	3	0	30.574	0.000
		1.5%	0%		
	Bad	13	20		
		6.6%	9.9%		
	Middle	66	108		
		33.5%	53.5%		
	Good	106	58		
		53.8%	28.7%		
	Very good	9	16		
		4.6%	7.9%		
Method of application	Very bad	2	0	9.630	0.047
		1%	0%		
	Bad	1	6		
		0.5%	3%		
	Middle	72	54		
		36.5%	26.7%		
	Good	89	105		
		45.2%	52%		
	Very good	33	37		
		16.8%	18.3%		
Pharmacological properties	Very bad	10	2	28.055	0.000
		5.1%	1%		
	Bad	18	36		
		9.1%	17.8%		
	Middle	128	98		
		65%	48.5%		
	Good	29	60		
		14.7%	29.7%		
	Very good	12	6		
		6.1%	3%		
Side effects	Very bad	5	2	11.562	0.021
		2.5%	1%		
	Bad	23	37		
		11.7%	18.3%		
	Middle	125	109		
		63.5%	54%		
	Good	35	51		
		17.8%	25.2%		
	Very good	9	3		
		4.6%	1.5%		
Warnings, precautions	Very bad	7	12	28.897	0.021
		3.6%	5.9%		
	Bad	32	35		
		16.2%	17.3%		
	Middle	117	70		
		59.4%	34.7%		
	Good	40	81		
		20.3%	40.1%		
	Very good	1	4		
		0.5%	2%		
Special cases (pregnancy, pediatrics, etc.)	Very bad	2	0	10.167	0.038
		1%	0%		
	Bad	12	10		
		6.1%	5%		
	Middle	91	70		
		46.2%	34.7%		
	Good	65	94		
		33%	46.5%		
	Very good	27	28		
		13.7%	13.9%		
Bioequivalence	Very bad	36	5	35.813	0.000
		18.3%	2.5%		
	Bad	42	62		
		21.3%	30.7%		
	Middle	91	82		
		46.2%	40.6%		
	Good	26	51		
		13.2%	25.2%		
	Very good	2	2		
		1%	1%		

Table 8. The relationship between the status of specialty training in dentistry and the utilization of patients' anamnesis information when prescribing drugs

Utilizing anamnesis information when prescribing medication		Do you have specialty training in dentistry?		X^2	p
		Yes	No		
Questioning whether he/she has a chronic disease	Never	0	0	21.268	0.000
		0%	0%		
	Rarely	1	1		
		0.5%	0.5%		
	Sometimes	23	5		
		11.7%	2.5%		
	Often	51	33		
		25.9%	16.3%		
	Always	122	163		
		61.9%	80.7%		
Questioning whether she is pregnant	Never	8	0	36.930	0.000
		4.1%	0%		
	Rarely	17	1		
		8.6%	0.5%		
	Sometimes	1	1		
		0.5%	0.5%		
	Often	38	18		
		19.3%	8.9%		
	Always	133	182		
		67.5%	90.1%		

DISCUSSION

As a doctor or doctor-to-be, your main job when it comes to drugs is to make the right diagnosis based on the patient's symptoms and exam results, come up with a treatment plan that fits the patient's needs.[28] choose drugs based on their effectiveness, safety, and cost, give patients the right information, and check in on their progress.[29] Failures and deficiencies in the education of physicians lie at the basis of irrational drug use. It is known that physicians trained with drug-centered pharmacology education have difficulties using the knowledge they acquired after graduation in rational prescribing and adequately informing their patients. The main reason underlying this problem is that these pre-graduation trainings are more theory-oriented. It is very difficult for physicians who have not acquired the habit of rational prescribing before graduation to overcome this situation. Studies have shown that approximately 90% of prescribing errors are related to the lack of adequate training for newly graduated physicians.[30.] In a study conducted by Çınar, it was stated that people who received in-service training showed more positive behavior in prescribing than those who did not receive training.[31]

In a survey study conducted on 2413 medical school students and newly graduated physicians in the UK, it was reported that 74% of the participants found the education they received on rational drug use inadequate.[32] In a similar study, it was observed that senior medical students who had received training on rational drug use were more competent than senior medical students and general practitioners who had not received such training.[33]

Harmonizing national drug policies with the WHO's essential drug policy (creating drug use guidelines and essential drug lists) and teaching problem-based rational pharmacotherapy as part of health education curricula are the main things that need to be done to encourage more rational drug use.[34] WHO recommends a training model that includes appropriate drug selection and prescribing procedures (based on good prescribing guidelines) through written scenarios, taking into account the efficacy, safety, and costs of drugs.[28]

Rational drug use training, which has been successfully implemented in medicine and pharmacy for many years[35], is recommended to be adapted to the pharmacotherapy regulation process in dentistry.[29] Within the scope of initiatives to promote rational drug use, including problem-based rational pharmacotherapy education in the course and internship programs of dental faculty students in our country, this may prevent possible problems.[21,36,37] In line with this goal, the "national action plan for rational drug use" has started to be implemented. In this plan, physicians and patients should be informed regularly.[38]

The rational pharmacotherapy education model includes a systematic approach that the patient can easily comprehend in the stages of treatment organization and prescribing.[39] Thanks to this approach, physicians have the opportunity to explain the information without interruption, and the burden on patients to understand and retain the information correctly is lightened. Implementation steps of the rational pharmacotherapy education model:

- Making the correct diagnosis and explaining the diagnosis to the patient
- Communicating the purpose and appropriateness of the treatment to the patient,
- Arranging treatment details and providing necessary warnings,
- Agreeing on how treatment will be monitored and terminated,
- Ensure that the information shared with the patient is understood correctly.[40]

This model teaches dentists how to make the right drug choice, instead of recommending the use of a specific

Table 9. The relationship between the status of specialty training in dentistry and the information given about the prescribed drugs

What information is given about the prescribed medicines		Do you have specialty training in dentistry? Yes	No	X^2	p
Name of the medicine	Never	0	1	25.549	0.000
		0%	0.5%		
	Rarely	8	21		
		4.1%	10.4%		
	Sometimes	58	31		
		29.4%	15.3%		
	Often	55	90		
		27.9%	44.6%		
	Always	76	59		
		38.6%	29.2%		
Method of application	Never	1	1	15.101	0.004
		0.5%	0.5%		
	Rarely	3	8		
		1.5%	4%		
	Sometimes	2	17		
		1%	8.4%		
	Often	76	76		
		38.6%	37.6%		
	Always	115	100		
		58.4%	49.5%		
Daily dosage	Never	2	2	25.669	0.000
		1%	1%		
	Rarely	0	9		
		0%	4.5%		
	Sometimes	1	18		
		0.5%	8.9%		
	Often	83	69		
		42.1%	34.2%		
	Always	111	104		
		56.3%	51.5%		
Duration of treatment	Never	1	0	15.639	0.004
		0.5%	0%		
	Rarely	0	4		
		0%	2%		
	Sometimes	6	20		
		3.0%	9.9%		
	Often	61	72		
		31%	35.6%		
	Always	129	106		
		65.5%	52.5%		
When to stop taking the medicine	Never	14	3	19.492	0.001
		7.1%	1.5%		
	Rarely	11	17		
		5.6%	8.4%		
	Sometimes	16	40		
		8.1%	19.8%		
	Often	81	70		
		41.1%	34.7%		
	Always	75	72		
		38.1%	35.6%		
Possible side effects	Never	19	16	13.755	0.008
		9.6%	7.9%		
	Rarely	34	54		
		17.3%	26.7%		
	Sometimes	89	75		
		45.2%	37.1%		
	Often	36	50		
		18.3%	24.8%		
	Always	19	7		
		9.6%	3.5%		
Price of the medicine	Never	144	113	19.935	0.001
		73.1%	55.9%		
	Rarely	17	46		
		8.6%	22.8%		
	Sometimes	29	30		
		14.7%	14.9%		
	Often	7	11		
		3.6%	5.4%		
	Always	0	2		
		0%	1%		
Interaction with other drugs/ nutrients	Never	56	44	23.547	0.000
		28.4%	21.8%		
	Rarely	75	51		
		38.1%	25.2%		
	Sometimes	38	63		
		19.3%	31.2%		
	Often	20	42		
		10.2%	20.8%		
	Always	8	2		
		4.1%	1.0%		

drug in any indication, and shows the way to determine their personal drug list and organize the most appropriate treatment. Establishing a personal medication list for the most common indications will prevent dentists from making drug choices every time and reduce the risk of inappropriate medication being given to patients. Thus, patient harm and unnecessary workload can be prevented, and loss of time and self-confidence can be avoided.[37,40]

A dentist who receives training in accordance with rational drug use criteria will not only have sufficient pharmacology knowledge about the drugs he/she can prescribe but will also gain the ability to decide on the most ideal treatment among different alternatives. In order to determine to what extent trainings on rational drug use in the dental profession are effective, it is first necessary to determine the current knowledge, attitudes, and behaviors of general practitioners and specialist dentists on the subject.[37]

As a result of our study planned with these objectives in mind, it was observed that 58.9% of general practitioner dentists received rational drug use training, 57% of them obtained their training from the faculty of dentistry, and 42% from the ministry of health. Among specialist dentists, the rate of those who received rational drug use training decreased to 42.1%, and 73.5% of them received their training from the faculty of dentistry and 26.5% from the Ministry of Health. Based on the fact that the rate of those who did not receive this training was 49.4%, it is understood that rational drug use training is not fully provided to dentists during undergraduate education, in-service trainings organized after graduation, and especially during specialty training.

In our study, the rate of receiving training on rational drug use also differs among physicians who received specialization training in different branches. While the highest rate among programs with specialization training was seen in the "pediatric dentistry" (10.8%) program, the lowest rate was seen in the "Prosthetics" (3.5%) program. We believe that the reason for the difference between specialization programs varies depending on the frequency of drug use of physicians. However, it is worrying that despite the frequent prescription of medication in the field of oral and maxillofacial surgery, the education rate is only 6%. In a study conducted by Ekici,[41] no difference was found between prescribing behaviors of academicians and research assistants. We believe that the core curricula of specialty training institutions should include information on the importance of rational drug use and pharmacovigilance, issues to be considered while prescribing, in which cases, and how to report adverse effects, and these trainings should be reinforced with certificate programs.

Another important finding of our study is that 91.5% of dentists utilize information sources while prescribing. This result is an indication of how much dentists need information sources when prescribing medication. The fact that dentists mostly utilize the internet (37.1%) and Vademecum (24.8%) as information sources is due to their desire to access information quickly and easily. An unanticipated finding was that the rate of utilization of diagnostic and therapeutic guides was 6.5%, and the level of utilization of pharmacology books remained at 3%. The fact that 12.8% of the participants consulted their colleagues as a source of information indicates that dentists who could not find what they hoped for in reference books tended to prescribe by imitating their more experienced colleagues. When all the findings are evaluated together, it is clear that there is a need for an easily accessible, comprehensive, and up-to-date information source that can be used by dentists.

In our study, when the knowledge levels of the participants about drugs were examined, it was found that they had a high level of knowledge about indications, route of administration, special conditions (pregnancy, pediatrics, etc.), contraindications, pharmacological properties, side effects, and warnings/precautions, respectively. However, the level of knowledge on drug interactions (drug/nutrient) and bioequivalence was found to be moderate. It is possible to explain the low level of knowledge on these subjects by the scarcity of studies on them and the lack of sufficient information on them.

Although a significant number of dentists are aware of the harms of excessive drug consumption, they may prescribe unnecessary drugs due to their heavy workload and limited treatment time. Positive improvements have been found in the prescribing habits of dentists thanks to training on rational drug use.[42] It has been observed that physicians who can spare more time for their patients prescribe fewer drugs.[43]

In studies conducted on dentists in our country, it has been observed that antibiotics, which should be used mostly for the control of acute conditions and for prophylaxis,[44] are prescribed for many dental infections that can be easily treated without any benefit. According to 2006 data, antibiotics take first place with 20% of drug consumption rates in our country.[45]

It has been reported that antibiotic consumption is inversely proportional to the socio-economic development level of societies.[46] Excessive antibiotic consumption causes some bacteria to develop resistance to certain drugs, making it difficult to treat diseases.[47] Infections caused by resistant bacteria lead to prolonged hospitalizations and even increased mortality rates. This situation confirms the need for some regulations in the prescribing behavior of dentists.[48-51] Although certain progress has been made both in the world and in our country, thanks to the measures taken and some restrictions, antibiotic resistance still remains an important public health problem.

In a study conducted by Koyuncuoğlu et al.,[21] it was found that the rate of antibiotic use was 56.8% and the rate of analgesic use was 40.5% in patients receiving drug treatment due to dental problems. It was reported that 73.1% of the patients reused a medication that they had previously used for similar reasons; 9.8% had their physician prescribe medication and kept it at home thinking that it would be necessary; 47.3% did not consult anyone when using the medication, they kept at home due to dental problems; and only 25% consulted their dentist. It was emphasized that keeping medicines at home when they were not needed was a cause of waste. It is certain that the most important factor that reduces the unnecessary use of antibiotics is education and raising awareness in society.[52]

Analgesics are another group of drugs that are prescribed in considerable amounts in dentistry. In a study conducted at the Dicle University Faculty of Dentistry Hospital, it was found that the rate of over-the-counter analgesic use was 31.7%. Although the use of analgesics without a prescription

is thought to be more innocent compared to antibiotics, it should be kept in mind that their unconscious use without consulting a physician may pose a great risk.[53]

One of the important factors negatively affecting rational drug use is the prescription of drugs requested by patients. In a study conducted throughout Turkiye, it was reported that doctors prescribe medicines to avoid discussions with patients and it was suggested that necessary programs be carried out to raise public awareness and that informative posters be prepared. In addition to physicians' knowledge and experience in drug selection, it is also very important that they stay away from guidance.[54] In our study, although approximately ¾ of the participants stated that they did not respond positively to the requests of these patients to prescribe medication, this result is evidence that patients interfere with the prescribing behavior of dentists.

In our study, it was observed that the participants specifically questioned whether the patients had chronic diseases, drug allergies, and other medications while prescribing medication. We believe that these inquiries will prevent adverse drug interactions in cases of multiple drug use. It was found that dentists paid less attention to anamnesis information about patients' age, whether they had kidney or liver disease, and pregnancy status compared to other information when prescribing drugs. The fact that the participants questioned most of the anamnesis information "always" or "frequently" is evidence of the importance they attach to this information when prescribing medication.

CONCLUSION

In our study, it was found that dentists mostly informed their patients about the duration of treatment, daily dosage, route of administration, name, and when to stop taking the medication. Possible side effects are among the issues that need less information. The least informed topic was the price of medicines. From these findings, it can be concluded that participants do not attach much importance to the price of medicines when writing prescriptions. Although physicians have an obligation to inform patients about the diagnosis, treatment plan, prescribed drugs, and interventions to be performed, it is interesting to note that 43.6% of the participants admitted that they did not find the information given to patients about drugs sufficient, and ¼ of them admitted that they did not check whether the information given was understood by the patients. When the reasons for not providing information were questioned, the most common reasons given were that they did not have enough information about the drugs and that they did not have enough time. Although significant progress has been made in rational drug use in our country in recent years, problems arising from the serious lack of knowledge of both physicians and patients still persist. The way to overcome these deficiencies is to inform patients in a way that they can easily understand the treatment planning process. In order to ensure the expected benefits from medicines, it is necessary to instill awareness of rational use of medicines, make educational opportunities widespread and continuous, and protect the attitudes and behaviors acquired and support them with the necessary policies.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Dicle University Faculty of Dentistry Local Ethics Committee (Date: 26.05.2021, Decision No: 2021-31).

Informed Consent

All participants signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Case Report

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Treatment of gingival recession using connective tissue and modified tunnel technique

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ABSTRACT

The tunnel technique is an up-to-date technique that is actively used in the treatment of multiple gingival recessions. The use of a connective tissue graft in addition to the coronally displaced subperiosteal flap, which is freed without disrupting the papillary integrity, provides an increase in keratinized tissue, treatment of gingival recession and thickening of gingival tissue. The aim of this study is to evaluate the results of connective tissue graft placed with tunnel technique. A systemically healthy 26-year-old female patient with gingival recession in her lower right canine and premolar teeth underwent tunnelled connective tissue graft placement and the results of the operation were evaluated at a 2-year follow-up. As a result, the modified tunnel technique and connective tissue graft were found to be very successful in root surface closure.

Keywords: Connective tissue graft, modified tunnel technique, gingival recession

INTRODUCTION

Gingival recession is defined as the apical displacement of the gingival margin that occurs as a result of different conditions and pathologies in relation to clinical attachment loss. All surfaces of the tooth may be affected by these recessions (interproximal, buccal, lingual).[1]

Gingival recession is frequently seen in adults and tends to increase with age. Gingival recession, in which one or more surfaces are affected, is observed in 88% of individuals after the age of 65, while this rate is 50% between the ages of 18 and 64.[2] Dentin sensitivity, cervical lesions such as abrasion erosion, root surface caries, aesthetic problems and difficulty in controlling dental plaque accumulation that occur with gingival recession make this situation clinically important.[3,4]

Gingival recession is classified as associated or unassociated with pathologic alveolar bone loss. Non-pathologic alveolar bone loss may occur due to various predisposing factors such as mechanical trauma, plaque-induced inflammation, thin gingival phenotype, tooth position, orthodontic tooth movement and mechanical trauma.[5] Periodontal inflammation caused by dental plaque and trauma caused by improper tooth brushing can be shown as two important reasons for the occurrence of marginal tissue recession. Along with the control of these factors, the use of appropriate, effective and accurate plaque control methods for the patient is extremely important for the prevention of gingival recession.[6]

In addition to the classification previously made by Miller regarding the treatment of gingival recession, Cairo et al.[7] made a simple classification for recession in the buccal region to predict the outcome of root surface coverage based on clinical evaluation of interproximal attachment levels.

According to this classification, recessions occurring buccally without interproximal attachment loss are called type 1, recessions with equal or less buccal attachment loss are called type 2, and recessions with more interproximal attachment loss than buccal attachment loss are called type 3.[7] New definitions regarding the treatment of gingival recession are based on the evaluation of the amount of open root surface, the status of the enamel-cementum junction and clinical attachment loss in the interproximal region.[2]

At the 2017 World Periodontology Workshop, a new classification based on the measurement of clinical attachment loss and proposed by Cairo et al.[8] was introduced by adding gingival phenotype and open root surface features to the gingival recession classification. With this classification, the potential for root surface coverage can be estimated and the success of root surface coverage in cairo type 1 recession can be predicted as 100%.[9]

Treatment of gingival recession is performed to eliminate dentin sensitivity, prevent root caries, increase the amount of keratinized tissue and for aesthetic purposes.[8] The first

step of an effective prevention and treatment program is to identify factors associated with gingival recession and modifiable conditions. Non-surgical treatment options for gingival recession include optimal plaque control, removal of overhanging subgingival restorations and use of desensitizing agents.[10]

Surgically, various techniques such as laterally shifted flap, free gingival graft, connective tissue graft, directed tissue regeneration, acellular dermal matrix and their combinations have been developed and applied. However, coronally advanced flap and tunnelling procedures with connective tissue graft are considered the most predictable treatment options for single and multiple gingival recession defects.[8]

CASE

A systemically healthy, non-smoking 26-year-old female patient was admitted to our clinic for the treatment of gingival recession in her lower right canine and premolar teeth. Cairo type 1 recession was detected. The patient had a defect not exceeding 2 mm in depth in the cervical region of the crown of tooth number 43 and on the coronal root surface. The patient received phase-1 treatment and oral hygiene motivation before the operation. Since the defect in tooth 43 did not exceed 2 mm, it was not necessary to restore it with composite and root planning was performed on the root surfaces of both teeth. Due to the presence of sufficient keratinized gingiva apical to the recessions and the presence of multiple gingival recessions, it was decided to apply connective tissue with the modified tunnel technique (Figure 1).

Figure 1. Intraoral image of the patient after phase 1 treatment

The technique used by Otto Zühr et al.[11] was preferred. An intra sulcular incision was made with a microsurgical scalpel through the gingival groove. The papillae were freed as much as possible before using the tunnel blades. The periosteum at the base of the papilla was cut with a micro scalpel and the buccal half of the papilla was completely freed with a papillary elevator. The procedure was continued with tunnel blades to avoid perforation of the tunnel, and the incision was advanced in a circular motion until the apical mucogingival margin. The borders of the tunnel were extended one tooth mesial and distal to the receding teeth. The tunnel was checked with a miller's probe to ensure adequate freedom.

A 1.5-2 mm thick connective tissue graft was obtained from the same side palate of the patient and 5.0 non-resorbable polyamide sutures were used. The needle was inserted through the liberated area of the mesial half of tooth 45 and exited the mesial sulcus of 44, and the needle was advanced through the sulcus in an inverted manner and exited the gingival margin of tooth 43, which was severely affected by extraction. The needle was passed through one end of the connective tissue first from the inside to the outside and then from the outside to the inside and the connective tissue was grasped and pulled into the tunnel with the help of a miller probe and the connective tissue was fixed by returning to the area first entered with the needle. On the other side, the free end of the connective tissue was grasped in the same way and advanced into the tunnel mesial to 43 and fixed. Suspension sutures were used to ensure that the flap overlying the connective tissue completely covered the connective tissue and the tissue was fixed (Figures 2 and 3).

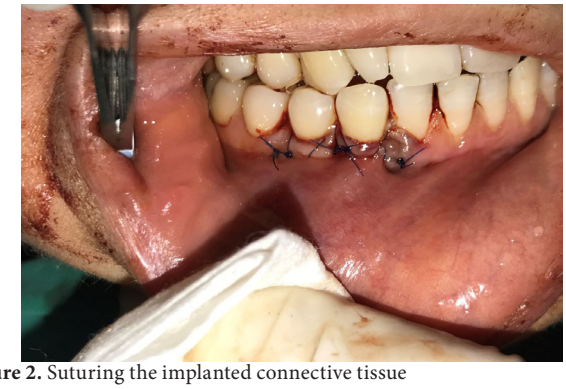

Figure 2. Suturing the implanted connective tissue

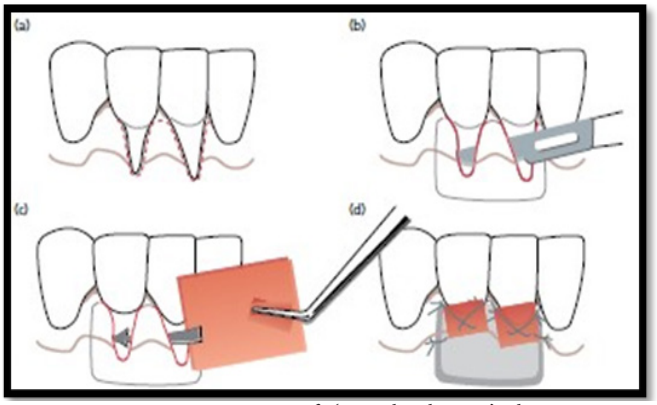

Figure 3. Free connective tissue graft: 'tunnel technique' schematic drawings[6]

The patient was asked not to brush the operation area for 2 weeks and to protect the area from traumatic situations. Postoperatively, the patient was prescribed analgesics, anti-inflammatory and antibiotics for 1 week (etodolac 400 mg tablet and amoxicillin/clavulanic acid 625 mg film tablet). A 0.12% chlorhexidine gluconate mouthwash was prescribed for 2 weeks. 12 days later, the sutures in the recipient and donor sites were removed (Figure 4).

Figure 4. Intraoral image of the patient 12 days later

No complications were observed in the early postoperative period (Figure 5).

Figure 5. Intraoral image of the patient 2 years later

DISCUSSION

Due to its prevalence in the society, many techniques and materials have been used in the treatment of gingival recession to date.[12] In these treatments, it has been aimed to develop the least invasive method as well as to obtain the best clinical result. Although coronally shifted flaps and connective tissue procedures using the modified tunnel technique have been compared in different studies, there is no definite conclusion as to which approach is superior.[13] The results reported in some studies have shown that connective tissue graft is an effective tool for achieving root surface coverage.[12] Tözüm et al.[14] used free connective tissue graft in combination with the tunnel technique in their study and observed a 95% success rate in root surface coverage.

Gingival phenotype is assessed by gingival thickness and keratinized gingival width parameters and has a significant relationship with gingival recession.[15] There are reports that a higher initial gingival thickness increases success in root planing procedures. The literature suggests that gingival recession is less common after regenerative periodontal procedures where the gingiva is thicker (greater than 1 mm) and that a gingival thickness of 1.1 mm is a critical threshold for complete root coverage in mucogingival surgery.[16]

Gingival recession often presents with wedge-shaped damage in the slave area of the affected tooth. It should be decided whether restoration of this area is necessary before covering the root surface.[17] Unless it is very necessary, there should be no restoration in the apical part of the enamel-cement border, only in the area where the defect is located. As long as the defects do not exceed 2 mm, the root surface can be supported with a thick connective tissue.[17] Therefore, restoration of the defect in the cervical third of the root was not deemed necessary in our patient and it was decided to support the gingiva by increasing the thickness of the connective tissue in that area.

The use of the connective tissue technique in combination with the tunnel technique maximizes both papillary and lateral blood flow for the free connective tissue graft. The ability to feed the graft from both the inner and outer regions at the same time increases the survival rate and accelerates wound healing.[18] The half-thickness of the lifted flap and the fact that no horizontal or vertical incisions are used are among the important advantages of the technique. On the other hand, high experience and more specific instruments are needed during the tunnel procedure due to the risk of perforation of the flap in the recipient site.[11] The advantages and disadvantages of each technique in the treatment of gingival recession should be carefully evaluated and patient-specific plans should be made.

CONCLUSION

After 2 years of follow-up, the patient was aesthetically very satisfied with the result, the keratinized gingival width increased, and gingival recession showed almost 100% closure in teeth 43 and 44.

ETHICAL DECLARATIONS

Informed Consent

The patient signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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