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Original research

Youtube videos as a source of information on digital indirect bonding: A content analysis

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Purpose
The aim of this study was to evaluate YouTube videos as a source of information for digital indirect bonding techniques.

Materials and Methods
The keyword "digital indirect bonding" was first searched on YouTube, resulting in 57 recorded videos. Descriptive parameters, including source, target audience, purpose, duration, upload date, number of likes, dislikes, views, and comments, were then evaluated. After this initial assessment, the interaction index and viewing rate were calculated. Video content quality was determined using a 5-point scale that categorized videos as having poor, moderate, or good content quality. This rating was based on the presence and discussion of various topics related to digital indirect bonding, including digital scan, digital bracket placement, transfer tray production from a 3D-printed model or direct production as a 3D-printed tray, clinical application, and advantages and/or disadvantages. The videos were assessed for quality using the global quality scale (GQS) and video information and quality index (VIQI). Statistical evaluation was conducted using Kruskal-Wallis, Chi-square, and Pearson correlation analysis, and intraclass correlation coefficients were calculated to determine the rating reliability.

Results
The majority of the videos were classified as having poor content quality (41.9%), followed by moderate (38.7%) and good (19.4%) content quality. No significant differences were found between the videos in terms of descriptive parameters. However, videos with good content quality had significantly higher GQS and VIQI scores than moderate and poor content videos. The total content showed significant correlations with GQS and VIQI ($r=0.780$ and $r=0.446$, respectively; $p<0.05$).

Conclusion
In conclusion, while the majority of YouTube videos regarding digital indirect bonding were of poor content quality, those that were of good content quality could be considered a useful source of professional information.

Keywords: *Digital, indirect bonding, information, video, YouTube*

Introduction

Interest in fixed orthodontic treatment has increased due to the growing importance placed on aesthetics and appearance. Since their introduction in the mid-1960s, orthodontic attachments have generally been directly bonded to enamel surfaces in clinical practice (1). The use of light-cured adhesives with direct bonding techniques has provided clinicians with unlimited working time since the early 1980s, allowing for more control over the positioning of brackets and tubes during bonding procedures (2). However, improper positioning of attachments on the posterior teeth can lead to problems due to difficulties in accessibility and visibility. In 1972, Silverman *et al.* (3) introduced the indirect bonding technique, which provides more accurate bracket positioning and shortens clinical

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chair time. The traditional indirect bonding technique involves laboratory and clinical stages. First, each bracket is accurately placed on study models with various adhesive materials, increasing laboratory working time. Then, a transfer tray is produced with different materials before clinical application (4).

Digital technology has been rapidly spreading among orthodontists, offering immense convenience throughout the treatment process, from diagnosis to follow-up (5). In orthodontic practice, digital technology has been integrated with intraoral scanners, computer-aided design and manufacturing systems, and three-dimensional (3D) printers (6). Parallel to this development, the time-consuming steps of the traditional indirect bonding technique have led orthodontists to prefer digital bracket placement, considering advantages such as increased bracket-positioning accuracy, reduced bracket repositioning, and decreased need for wire bending (7).

The digitalized indirect bonding technique requires smart workflows, including virtual bracket placement and production of 3D-printed study models, as well as transfer trays made of different materials (e.g., thermoplastic or silicone) or direct production as a 3D-printed tray (8). This new digital bonding technique provides precise transfer, increased patient comfort, and decreased orthodontic treatment duration (9, 10). However, the digital indirect bonding system provided bracket positioning with maximum linear transfer error in the buccolingual direction and maximum angulation error in the torque (11). Other disadvantages have been reported such as increased total working time based on the digital bracket placement, immediate bracket failures and cost (12). The limits of users by the types of bracket models was another drawback and the lack of working with different bracket types has recently been highlighted by researchers (13).

Most social media users receive health-related information from the Internet (14). YouTube videos are commonly utilized to access information because they provide both visual and audio content and can be accessed without membership fees. Al-Silwadi *et al.* (15) stated that providing audiovisual information to orthodontic patients using the Internet notably raised their awareness of treatment options, risks, and benefits. However, orthodontists should be aware of the impact of possible misinformation (16). Kılınç and Sayar (17) reported that the information contained in YouTube orthodontic videos could cause the spread of misleading information through the absence of an assessment system for qualifying videos before they are uploaded. For this reason, the quality of data obtained from the YouTube video platform has recently gained importance. In this respect, numerous studies have evaluated the quality of orthodontics-related information across YouTube videos in the past five years (17-30).

Nowadays, the conventional indirect bonding method has been replaced by the digital technique with the widespread use of digital workflows in clinical practice. However, no studies are available that evaluate YouTube videos about digital indirect bonding in terms of characteristics, content, and quality. The aim of this study was to evaluate whether YouTube videos could serve as a source of information for digital indirect bonding techniques. The null hypothesis was that there would be no difference among YouTube videos in terms of content quality.

Materials and Methods

Online search protocols

The ethical approval was not obtained for this study because public data was used. The YouTube video database was searched on November 1, 2021, to assess the available information on the digital indirect bonding technique. The possible keywords related to the digitalized indirect bonding technique, including indirect bonding and digital bonding were determined using a GoogleTrends website search. Consequently, the keyword digital indirect bonding was used in the YouTube search. The YouTube parameter was view count sorting, with no additional search filters. In total, it was accessed and recorded 57 videos. Videos were excluded from this study if they were (a) not recorded in English, (b) longer than 30 minutes, (c) shorter than 1 minute, (d) silent, (d) irrelevant to the subject, (e) duplicates, or (f) advertisements. The videos uploaded in parts were combined into a single video. Additionally, the duration of webinar videos with continuing education (CE) was longer than 30 minutes. Based on this, these videos were not evaluated during this study.

Data classification

The videos' sources were classified into three groups: dentists/specialists, dental companies or manufacturers, and other sources. The videos' target audiences were categorized into three groups: laypeople, professionals, and both. The videos' purposes were categorized into three groups: professional information, patient information, and general information. To evaluate the videos' content quality (VCQ), the videos were rated according to their informations about each of five topics: digital scan, digital bracket placement, transfer tray production from a 3D-printed model or direct production as a 3D-printed tray, clinical application, and advantages and/or disadvantages.

Evaluation process

Each topic was awarded 1 point. The total score ranged from 0 to 5. Each video was classified as having poor (0–1 points), moderate (2–3 points), or good (4–5 points) content.

Descriptive information such as video duration, time elapsed since upload, numbers of views, likes, dislikes and comments were recorded and then the interaction index and viewing rate were assessed based on the formulas (31): * Interaction index = (Number of likes-dislikes)/(Number of views) × 100 * Viewing rate = View number / The time elapsed since its upload × 100

The videos were rated using the global quality scale (GQS), and a 5-point Likert scale was used to evaluate each video's flow, usefulness for patients, and general quality. The overall audiovisual quality was evaluated with the video information and quality index (VIQI), and a 5-point Likert scale was used to assess the following parameters: flow of information, information accuracy, quality, and precision.

Reliability measurements

The reliability assessment of all parameters for intra- and interexaminer was carried out. Two researchers separately evaluated all videos and reassessed these videos two weeks later to determine intra- and interexaminer reliability of rating.

Statistical analysis

The data were analyzed with SPSS (version 25; IBM Corp. Armonk, NY, USA). The Shapiro-Wilk test was used to test normality. For non-normally distributed data, Kruskal-Wallis test was used to evaluate the differences among videos with different content. For categorical variables, the percentages were calculated and the diferences were assessed with Chi-square test. The correlations between total VCQ, GQS, VIQI and other descriptive parameters were calculated using Pearson correlation coefficients. The rating reliability was evaluated using intraclass correlation coefficient (ICC) values. The significance level was determined at $p<0.05$.

Results

After the initial search using "digital indirect bonding" as a keyword, a total of 57 videos were screened, of which 26 were excluded from evaluation. Exclusion criteria were a running time of over 30 minutes or under a minute (n=9), duplicates (n=4), non-English language (n=1), silent videos (n=1), advertising (n=2), videos that were irrelevant to the subject (n=8) or videos in multiple parts (n=1).

The ICC values ranged from 0.932 to 0.967 for intraexaminer reliability and from 0.877 to 0.941 for interexaminer reliability. The descriptive characteristics are shown in Table 1. A majority of videos (61.3%) were uploaded by dental companies or manufacturers and the remaining videos were uploaded by dentists or specialists. About 70% of videos aimed to provide professional information and approximately half of all videos targeted dental professionals. The mean duration of videos about digital indirect bonding was 5.29 minutes. The mean number of days since upload was 1,125.87 days. The mean number of views was 2,463.71. The mean number of likes was 11.42 (ranged from 0 to 73), whereas the mean number of dislikes was 0.84 (ranged from 0 to 7). The mean interaction rate was 0.83 and the mean viewing rate was 267.92. The total video content score was 1.94±1.09 for all included videos.

According to the VCQ assessment, of the 31 videos that were analyzed, 13 (41.9%), 12 (38.7%) and 6 (19.4 %) were respectively categorized as showing low-, moderate- and high-quality content. There were no significant differences between the groups in terms of descriptive parameters (Table 2).

The comparisons of descriptive parameters are shown in Table 3. There were no significant differences in terms of duration, days since upload, numbers of views, likes, dislikes, comments and interaction index, viewing rate, quality and precision parameters under the VIQI assessment. Conversely, there were significant differences in terms of total VCQ and GQS scores between videos with low-quality, moderate-quality and high-quality content ($p=0.001$; $p<0.05$). Pairwise comparisons showed that the low-quality content group had significantly lower mean values of total VCQ and GQS scores than moderate- ($p=0.001$ and $p=0.002$, respectively; $p<0.05$) and high-quality videos ($p=0.001$; $p<0.05$). Moderate-quality videos had significantly lower mean values of total VCQ and GQS scores than the high-quality content group ($p=0.014$ and $p=0.002$, respectively; $p<0.05$).

The results also showed significant differences in flow, accuracy and total VIQI scores between the groups ($p=0.022$, $p=0.014$, and $p=0.025$; respectively; $p<0.05$) as presented in Table 3. Pairwise comparisons demonstrated that the high-quality content group had significantly higher mean scores of flow and accuracy compared to low quality ($p=0.009$ and $p=0.005$, respectively; $p<0.05$) and moderate-quality videos ($p=0.007$ and $p=0.017$, respectively; $p<0.05$). In terms of total VIQI scores, high-quality videos scored significantly higher than low quality and moderate-quality content ($p=0.009$ and $p=0.023$, respectively; $p<0.05$).

The correlations between total VCQ, VIQI and GQS scores and other video parameters are shown in Table 4. A strong correlation was found between VCQ and GQS scores ($r=0.780$; $p=0.001$; $p<0.05$). Moderate correlations were found between VCQ and VIQI ($r=0.446$; $p=0.012$; $p<0.05$), GQS and VIQI ($r=0.412$; $p=0.021$; $p<0.05$), GQS and duration ($r=0.501$; $p=0.004$; $p<0.05$), and VIQI and interactive index ($r=0.387$; $p=0.032$; $p<0.05$). Moreover, moderate negative correlations were found between VCQ and number of dislikes ($r=-0.427$; $p=0.017$; $p<0.05$) and between VIQI and number of dislikes ($r=-0.489$; $p=0.005$; $p<0.05$).

Table 1. *Descriptive characteristics of the YouTube videos about the digital indirect bonding.*

		n	%
Source	**Dentist/specialist**	12	38.7
	Dental company or manufacturer	19	61.3
	Other	0	0.0
Purpose	**Professional information**	22	71.0
	Patient information	0	0.0
	Both	9	29.0
Target audience	**Layperson**	0	0.0
	Professional	16	51.6
	Both	15	48.4
	Mean±SD		**Min-Max**
Duration (minute)	5.29±5.68		1.26-25.51
Days since upload	1125.87±708.83		34-2595
Number of views	2463.71±4183.01		83-20818
Number of likes	11.42±16.35		0-73
Number of dislikes	0.84±1.51		0-7
Number of comments	1.29±2.84		0-15
Interaction index	0.83±1.35		-0.24-5.61
Viewing rate	267.92±370.2		9.58-1436.7
Total video content score	1.94±1.09		1-5
GQS score	2.39±1.09		1-5
VIQI assessment			
Flow	3.52±1		2-5
Accuracy	3.81±0.79		3-5
Quality	3.74±0.73		3-5
Precision	3.9±0.83		3-5
Total VIQI score	14.97±3.01		11-20

Table 2. *Comparison of descriptive categorical features between different video content groups.*

		Poor (n=13)		Moderate (n=12)		Good (n=6)		
		n	%	*n*	%	*n*	%	[a]p
Source	**Dentist/specialist**	4	33.3	5	41.7	3	25.0	0.700
	Dental company/manufacturer	9	47.4	7	36.8	3	15.8	
Target audience	**Professional**	9	56.3	6	37.5	1	6.3	0.102
	Professional and layperson	4	26.7	6	40.0	5	33.3	
Purpose	**Professional information**	11	50.0	8	36.4	3	13.6	0.278
	General information	2	22.2	4	44.4	3	33.3	

[a] Chi-Square Test

Table 3. *Comparison of video parameters between different video content groups.*

	Poor (n=13)		Moderate (n=12)		Good (n=6)		p
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	
Duration (minute)	4.96±6.93	1.26-25.51	4.8±4.43	1.32-15.07	7.01±5.52	2.16-14.54	0.281
Days since upload	1075.46±670.09	34-2378	1143±815.69	143-2595	1200.83±677.61	467-2361	0.901
Number of views	2472.46±3473.42	99-11453	2965.92±5771.36	83-20818	1440.33±943	196-2471	0.958
Number of likes	14.77±23.23	0-73	7.42±9.82	0-31	12.17±5.31	5-19	0.225
Number of dislikes	1.46±2.07	0-7	0.5±0.8	0-2	0.17±0.41	0-1	0.126
Number of comments	2.15±4.1	0-15	0.67±1.23	0-4	0.67±1.21	0-3	0.454
Interaction index	0.75±1.35	0-5.05	0.44±0.62	-0.24-1.51	1.77±2.08	0.26-5.61	0.128
Viewing rate	306.27±402.39	9.58-1424.5	300.94±424.64	11.58-1436.7	118.81±62.09	34.27-191.8	0.893
VCQ	1±0	1-1	2.17±0.39	2-3	4.5±1.22	4-5	0.001**
GQS	1.54±0.52	1-2	2.50±0.67	2-4	4±0.63	3-5	0.001**
VIQI assessment							
Flow	3.23±0.93	2-5	3.33±0.98	2-5	4.5±0.55	4-5	0.022*
Accuracy	3.54±0.66	3-5	3.67±0.78	3-5	4.67±0.52	4-5	0.014*
Quality	3.69±0.75	3-5	3.5±0.67	3-5	4.33±0.52	4-5	0.060
Precision	3.77±0.83	3-5	3.75±0.87	3-5	4.5±0.55	4-5	0.137
Total VIQI score	14.23±2.77	11-20	14.25±2.9	11-20	18±1.9	16-20	0.025*

Table 4. *Correlation coefficients for total video content quality (VCQ), global quality scale (GQS), video quality information index (VIQI) and other factors.*

	VCQ	GQS	VIQI	Duration	Days since uploaded	Number of views	Number of likes	Number of dislikes	Number of comments	Interaction index	Viewing rate
VCQ	1	0.780**	0.446*	0.331	-0.027	0.002	0.089	-0.427**	-0.151	0.220	-0.047
GQS		1	0.412*	0.501**	0.010	0.207	0.304	-0.194	-0.016	0.218	0.136
VIQI			1	0.339	-0.147	0.095	0.188	-0.489**	-0.024	0.387*	0.126

*$p<0.05$, **$p<0.01$

Discussion

Recently, increased demands for clinical applications that require less chair time have led orthodontists to use digital workflows during bonding procedures. Using digital indirect bonding technology necessitates the use of intraoral or desktop scanner, digital bracket placement software, and a 3D printer (6). Within this context, various dental products are available for orthodontists. Considering the requirements, commercial suppliers play an important role in the transition from conventional indirect techniques to digital indirect bonding in orthodontic practice.

According to the results, dental companies uploaded most sources of information about digital indirect bonding.

This was an expected result. The need for an operating system that allows virtual transfer tray design resulted in most information originating from dental manufacturers. As the source was dental companies, the videos were prepared to provide educational information for dental professionals. This finding could be associated with the fact that the evaluated title was more technical, as stated in the previous study (30). In this study, dental professionals were observed to be poor at explaining their knowledge on YouTube. Another finding was the limited number of videos created by patients. Based on this, it was considered that digital technique had been applied inadequately to patients in clinical practice. Considering the high cost of equipment (e.g., 3D printers), such a result could be expected.

In this study, a 5-point Likert scale was used to perform the content analysis. Most of the videos (41.9%) were classified as poor, 38.7% as moderate, and 19.4% as good. Likewise, the content of the YouTube videos on different topics, such as orthognathic surgery, lingual orthodontic treatment, impacted canines, clear aligners, surgically assisted rapid palatal expansion, mini screws, craniofacial distraction osteogenesis, orthodontic retention and retainers was generally found to be deficient in previous studies (18, 19, 21, 22, 25-29). On the other hand, conflicting results were reported about the quality of videos on certain subjects (20, 23, 24). Previous videos about orthognathic surgery and cleft lip and palate were rated as moderate (20,23). Yavuz *et al.* (24) demonstrated that good general content was found in most videos related to accelerated orthodontics. A recent study revealed that videos with high-quality content provided reliable and acceptable information about adult orthodontics (30). The differences between content qualities may be associated with audience interest and the popularity of video titles for different topics, whereas adequate content quality may be explained by more detailed information in the same video topics.

According to the video characteristics, the length of the assessed videos was within the range of previous studies in the field of orthodontics (19, 22, 25, 26). The longest video (25.51 minutes) was given an information from a doctor channel. However, videos that were too long (duration ≥ 30 minutes) or too short (duration less than1 minute) were not evaluated in this study. One of them was the webinar videos with CE credits. The high-quality videos were the longest ones, in accordance with earlier findings (22-25, 27, 29, 30).

The digital indirect bonding videos identified as having poor, moderate, and good content had 2,471.46, 2,965.92, and 1,440.33 views, respectively. Longer videos with good content demonstrated lower numbers of views and viewing rates. Similarly, Lena and Dindaroğlu (19) reported that audience interest decreased when the duration of YouTube videos was increased. Regarding the number of likes, videos with poor content received the most positive feedback. This result was surprising. It should be kept in mind that dental companies due to the need for advertisements could manipulate the number of likes or dislikes. Based on the results, videos with good content had higher interaction index values than the other videos. However, viewers had not found more content interesting. The number of views could be related to the duration of the video rather than the video content. Short videos had more viewings, as found in previous studies on different orthodontic topics (16, 19, 24, 27). This finding was supported by the fact that viewers lost interest with the prolonged duration of a video (19).

The general quality of the videos was examined using GQS scores based on the usefulness and general concern of a video to patients. According to the total mean score of GQS (2.39 ± 1.09 out of 5), the videos were generally of poor to moderate quality and had limited usability for patients. Regarding the VIQI assessment, the videos of different content quality did not differ from each other in terms of the use of still images, animation, interviews with individuals in the community, video captions, and a report summary. There were also no differences between poor, moderate, and good content videos on the level of coherence between the video title and the content. However, good content videos had significantly higher scores for information of flow and accuracy. These differences accounted for the increased total VIQI scores of good content videos. Based on these findings, the null hypothesis was rejected.

In this study, the total content quality scores showed significant correlations with the GQS and VIQI scores.The more content, the better the flow, and the greater the accuracy of the information, the better the quality of the videos. A moderate correlation was found between the VIQI and GQS scores. As a result of technological developments, increased fluency, accuracy, quality, and precision attract more viewers. Although the GQS scores and video duration showed a moderately positive correlation, the increased quality and flow of information and its usefulness for patients should be presented in a duration that was acceptable to viewers. On the other hand, a negative correlation was found between the VIQI scores and the number of dislikes, as expected.

One limitation of this study was the lack of real-time data collection. Another limitation was the absence of videos uploaded by patients to explain their experiences. The results of this study found out a need for new videos, particularly those explaining the feelings of patients who experienced a bonding session with the digital indirect bonding technique. Within the limitations of this study, the content analysis showed that the number of good content videos was inadequate (nearly 20%) about the digital indirect bonding technique. New videos with more details and durations that are acceptable for users should be created and uploaded by professionals, in parallel with the trend toward the increased use of the digital indirect bonding technique.

Conclusion

YouTube was deficient as a source of information about the digital indirect bonding technique. Only a small number of YouTube digital indirect bonding-related videos demonstrated good content quality. Although the content quality of most videos was poor, they could be useful for providing professional information. More informative videos on this topic should be uploaded by professionals.

Türkçe özet: *Dijital indirekt bonding tekniği hakkında bilgi kaynağı olarak YouTube videolarının değerlendirilmesi: Bir içerik analizi. Amaç: Çalışmamızın amacı dijital indirekt bonding tekniği hakkında bilgi kaynağı olarak YouTube videolarının değerlendirilmesidir. Gereç ve Yöntem: YouTube'da "dijital indirekt bonding" anahtar kelimesi aranmış ve ilk değerlendirme sonrasında 57 video kaydedilmiştir. Videolar kaynak, amaç, hedef kitle, süre, yükleme tarihi, beğenilme, beğenilmeme, izlenme ve yorum sayıları gibi tanımlayıcı parametreler açısından değerlendirilmiş*

ve ardından etkileşim indeksi ve izlenme oranı hesaplanmıştır. Video içerik kalitesi; dijital tarama, dijital braket yerleştirme, 3D modelden transfer plağı üretimi veya 3D transfer plağın doğrudan üretimi, klinik uygulama, avantajlar ve/veya dezavantajlar konu başlıklarını içeren 5 puanlık Likert ölçeği kullanılarak zayıf, orta ve iyi içerikli olarak belirlenmiştir. Videolar kalite açısından global kalite skoru (GKS) ve video bilgileri ve kalite indeksi (VBKI) ile değerlendirilmiştir. İstatistiksel değerlendirmede Kruskal-Wallis, Ki-kare ve Pearson korelasyon analizleri kullanılmıştır. Güvenilirliği belirlemek için sınıf içi korelasyon katsayıları hesaplanmıştır. Bulgular: Videoların çoğu içerik kalitesine göre zayıf (% 41.9), ardından orta (% 38.7) ve iyi (% 19.4) içerikli olarak sınıflandırılmıştır. Videolar arasında tanımlayıcı parametreler açısından farklılık bulunmamıştır. İyi içerikli videolar, orta ve zayıf içerikli videolara göre anlamlı derecede daha yüksek GKS ve VBKI puanlarına sahiptir. Toplam içerik, GKS ($r=0.780$; $p<0.05$) ve VBKI ($r=0.446$; $p<0.05$) ile pozitif yönde anlamlı ilişki göstermiştir. Sonuç: Çoğu YouTube videosunun dijital indirekt bonding ile ilgili içerik kalitesi düşük olmasına rağmen iyi içerikli videolar yararlı bir profesyonel bilgi kaynağı olarak kabul edilebilir.
*Anahtar kelimeler**:** Bilgi, dijital, indirekt bonding, video, YouTube*

Ethics Committee Approval: Not required.

Informed Consent: Not required.

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Author contributions: SC, EC participated in designing the study. SC, EC participated in generating the data for the study. SC, EC participated in gathering the data for the study. SC, EC participated in the analysis of the data. SC, EC wrote the majority of the original draft of the paper. SC, EC participated in writing the paper. SC has had access to all of the raw data of the study. SC has reviewed the pertinent raw data on which the results and conclusions of this study are based. SC, EC have approved the final version of this paper. SC, EC guarantee that all individuals who meet the Journal's authorship criteria are included as authors of this paper.

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