

Readability and Quality Assessment of Web-Based Information Concerning Post-Endodontic Treatment Selection

Gülbahar Erdiñç¹ , Olcay Özdemir² 

¹ Department of Prosthodontics, Karabük University, Faculty of Dentistry, Karabük, Türkiye

² Department of Endodontics, Karabük University, Faculty of Dentistry, Karabük, Türkiye

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Correspondence

Gülbahar Erdiñç, MD

Address: Department of Prosthodontics
Faculty of Dentistry Karabük University,
Demir Çelik Campus, Karabük, Türkiye

E-mail: gbaharerdinc@gmail.com

ABSTRACT

Objectives: This study aimed to unbiasedly identify the quality and readability of the written information about post-endodontic coronal restorations on Turkish websites using accepted formulas and scales by the literature.

Methods: The study was carried out by setting national pages and national locations in the Google search engine. The terms “root canal treatment and veneer” and “root canal treatment and filling” were used as keywords. The webpages were assessed independently by two readability formulas (Flesh-Kincaid and Ateşman systems) and DISCERN quality kit. The independent statistical and correlation analysis were performed using Kolmogorov-Smirnov, Shapiro-Wilk, Spearman’s rho, and Dunn’s tests. The significance level was taken as $p < 0.05$.

Results: The initial search identified 60 websites, of which eight were excluded due to non-compliance with the study criteria ($n=52$). According to the DISCERN score, the web pages were categorized as fair with the highest rate of 57.69%. A statistically significant positive correlation was found between Ateşman Readability Index and the Flesh-Kincaid Reading Ease score ($r=0.998$; $p < 0.001$). There was no statistically significant correlation between Ateşman Readability Index and DISCERN score ($p=0.259$). Ateşman reading ease scores of the web pages are evaluated, 80.76% of these are classified as moderately difficult.

Conclusions: The readability distribution of the written information about post-endodontic coronal restorations on websites was acceptable to the majority. However, being readable does not indicate that it provides sufficient target technical information. In this context, it can be suggested to use readability and quality scales while preparing websites for dental patient education concerning post-endodontic coronal restorations.

Keywords: Patient education, Readability, Postendodontic restoration, DISCERN, Access to information



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INTRODUCTION

Technological and digital developments provide to attain needed information from anywhere and anytime. Web-based pages can be used to access knowledge on many subjects, including health-related issues [1]. The rate of searching for health-related information is very high compared to others and

the most common purpose of Internet use among the others [2,3]. However, there is no mechanism to check the accuracy of health-related information on the websites. The difficulties of accessing accurate and reliable information on websites have been mentioned in previous studies [4,5].

Readability is generally defined as the ease of comprehension or understanding because of writing style. Objectively evaluating the readability of the text is essential to make this distinction [5]. Various readability evaluation formulas have been developed to assess a text's readability [6-8]. In the 1940s, Rudolph Flesch, developed the Flesch-Kincaid system based upon a formula that incorporates formula average sentence length and the average number of syllables per word [9]. Ateşman et al. developed a scale to evaluate the readability of Turkish texts in 1997 and reported that readability only gives information about the style of the text, not about the quality of the technical information of the text [10]. Besides, Charnock et al. developed the DISCERN tool kit in 1999, enabling information providers and patients to judge the quality of information on websites about dental and medical treatment options [11]. This kit is intended to assist patients in evaluating all aspects of their dental or medical treatment [12].

Various treatment options have been described in the literature, such as filling, veneer, inlay, onlay, overlay, post-core restorations, and recently CAD-CAM systems and endocrowns which can be applied to the endodontically treated tooth [13,14]. However post-endodontic treatment options are still a dilemma for clinicians and patients. There are always burning questions such as: "Is root canal treatment the only approach to treating the tooth? What is the difference between filling and root canal filling? Will it be finished after the root filling? Is it possible to do only restoration for this tooth or is it possible to do only root canal treatment for this tooth?" It is possible to multiply these kinds of questions. The treatment of a tooth is holistic from the patient's point of view but may have different stages that may concern other clinical disciplines and sure it is a must to explain

all treatment steps and options to patients using evidence-based dentistry before starting the management.

It is predictable to want to get an idea about disease or complaints, also, it is possible to search treatment options and risks; therefore Internet is generally used as a tool for research [5]. Especially in the health field, many web pages have shared information on the issues that patients are highly curious [5,15]. In this context, the aim of this study was to unbiasedly evaluate the quality and readability of the written information about both root canal treatment and possible subsequent coronal restorations on Turkish websites using accepted formulas by the literature.

MATERIALS AND METHODS

The readability and quality of the information related to the research topic were evaluated on websites open to the public and accessible to everyone in the present study. Since legal regulations consider that research using publicly available data does not involve human subjects, this protocol did not require ethics committee approval. The study was carried out by setting Turkish pages and Türkiye locations in the Google search engine. The terms "root canal treatment and veneer" and "root canal treatment and filling" were used as keywords in the search engine, and the search was performed on September 3, 2022, by a single researcher using the same computer. After searching for each keyword, the first 30 websites were evaluated. Duplicate pages, links to research studies, advertisements, pages that require membership, pages that require acceptance of cookie settings, and websites that share information only with video instead of written text and do not contain information about all keywords were excluded from the study. Two examiners independently evaluated websites meeting the inclusion criteria (n=52). The source of each web page was classified as private clinics and university hospitals.

Independently, two examiners assessed all web pages included in the study. Regarding both scales, when a divergent judgment was observed between the examiners, the page was re-assessed to the achievement of a consensus score. To evaluate the quality of all websites included in the study and to report unbiased results, a prosthodontist and an endodontist read the texts on all websites. DISCERN instrument was used for the quality assessment. The 16 questions in the DISCERN tool kit were scored and recorded over 1-5 points, with a consensus between the two researchers. The results obtained were calculated as

Main Points;

- Nowadays, it is essential that this information is at a level that patients can understand, as patients often try to get preliminary information from online sources before reaching the physician.
- Root canal treatment and coronal restoration are inseparable, and both should be included in the information.
- According to the DISCERN score, the web pages were categorized as fair, with the highest rate of 57.69%.
- Ateşman reading ease scores of the web pages are evaluated, 80.76% of these are classified as moderately difficult.

mean scores, percentages, and ranges. DISCERN consists of 16 questions, each scored between 1 and 5 according to the completeness of the evaluated information (Table 1). The first to the eighth question addresses the publication's reliability, and questions 9-15 address specific details for treatment options; the last question is a summary question for overall rating. Section 1 consists of eight questions to evaluate the publication's reliability, and section 2 consists of seven questions to analyze the quality of treatment choices. The website's overall quality is assessed in Section 3 with one question. The websites were categorized as by the total DISCERN score, except last question: 15-75: very poor, 27-38: poor, 39-50: average, 51-62: good, and 63-75: excellent.

Table 1. The DISCERN Instrument

Section	Question
1	Are the aims clear?
	Does it achieve its aims?
	Is it relevant?
	Is it clear what sources of information were used to compile the publication (other than the author or producer)?
	Is it clear when the information used or reported in the publication was produced?
	Is it balanced and unbiased?
	Does it provide details of additional sources of support and information?
	Does it refer to areas of uncertainty?
2	Does it describe how each treatment works?
	Does it describe the benefits of each treatment?
	Does it describe the risks of each treatment?
	Does it describe what would happen if no treatment is used?
	Does it describe how the treatment choices affect overall quality of life?
	Is it clear that there may be more than one possible treatment choice?
	Does it provide support for shared decision-making?
3	Based on the answers to all of the above questions, rate the overall quality of the publication as a source of information about treatment choices

To evaluate the readability of the studies, the word count, sentence count, word length, sentence length, and readability index of the texts presented on the websites were calculated using a free automatic online calculator (www.okunabilirlikendeksi.com). The readability level of each website was computed using the Ateşman readability formula, which is widely used for Turkish

texts. At the same time, the readability level of the web pages was classified according to the ranges that rated the readability formulas for reading ease. In addition, the online method used in calculating the readability index was verified manually using the formula below.

Ateşman readability formula = $198.825 - 40.175 \times (\text{total syllables} / \text{total words}) - 2.610 \times (\text{total words} / \text{total sentences})$

The Flesch-Kincaid Grade Level (FKGL) is a standard metric used to evaluate the grade of the complexity of English texts. The FKGL scores equal the US grade level of education that the reader needs to understand. Although Turkish texts were evaluated in this study, based on the use of this formula in different languages in previous studies, an additional evaluation was made using this formula.

FKGL formula = $0.39 \times (\text{words} / \text{sentences}) + 11.8 \times (\text{syllables} / \text{words}) - 15.59$

Reading ease score and descriptive categories were evaluated for both readability formulas. The scores range between 1 and 100, with higher scores deemed easier to read. The scores and classes of Ateşman are 90-100: very easy, 70-79: easy, 50-69: moderately difficult, 30-49: difficult, and 1-29: very difficult. The scores and categories of Flesch are 90-100: very easy, 80-90: easy, 70-80: fairly easy, 60-70: standard, 50-60: fairly difficult, 30-50: difficult, 0-30: very difficult.

Data were analyzed with IBM SPSS V23. Conformity to normal distribution was evaluated by Kolmogorov-Smirnov and Shapiro-Wilk tests. The relationship between normally distributed scores was analyzed using the Pearson correlation coefficient. The relationship between non-normally distributed scores was analyzed using Spearman's rho correlation coefficient. One-way analysis of variance was used to compare normally distributed data according to groups of three or more, and multiple comparisons were examined with Duncan's test. The Kruskal-Wallis H test was used to compare data that were not normally distributed according to groups of three or more, and multiple comparisons were examined with Dunn's test. Analysis results were presented as mean \pm standard deviation and median (minimum–maximum) for quantitative data. The significance level was taken as $p < 0.05$.

RESULTS

The initial search identified 60 websites, of which 8 were

excluded due to non-compliance with the study criteria. The remaining 52 web pages were assessed, and while only 3 were the pages of university hospitals, all the rest were web pages of private clinics.

Statistical analyzes according to sections and total DISCERN score are given in Table 2. Good and excellent categories were not included in the analysis because the number of observations was insufficient and statistical comparison was meaningless. A statistically significant difference was found between Section 1 mean values according to DISCERN levels ($p < 0.001$). This difference was observed between all groups. A statistically significant difference was found between the median values of Section 2 according to DISCERN levels ($p < 0.001$). This difference was observed between very poor and poor levels and fair levels. A statistically significant difference was found between the median values of Section 3 according to DISCERN levels ($p < 0.001$). This difference was observed between very poor and poor groups and fair grades. A statistically significant difference was found between the median values of DISCERN score according to DISCERN levels ($p < 0.001$). This difference was observed between very poor and poor groups and fair grades.

Table 2. Comparison of Section 1-2-3 according to Discern levels

	Very Poor	Poor	Fair	p
Section 1	14.5 ± 2.08 ^a	17.88 ± 1.93 ^b	21.8 ± 2.14 ^c	<0.001 ^c
	14.5 (12 - 17)	17.5 (15 - 22)	22 (18 - 28)	
Section 2	7.75 ± 0.96	11.31 ± 2.47	19.37 ± 2.43	<0.001 ^d
	7.5 (7 - 9) ^b	10 (9 - 17) ^b	19,5 (16 - 23) ^a	
Section 3	1.75 ± 0.5	2.13 ± 0.34	3.4 ± 0.5	<0.001 ^d
	2 (1 - 2) ^b	2 (2 - 3) ^b	3 (3 - 4) ^a	
Discern	24 ± 1.63	31.31 ± 3.07	44.57 ± 3.88	<0.001 ^d
	24 (22 - 26) ^b	31 (27 - 38) ^b	44,5 (39 - 50) ^a	

a-b: There is no difference between levels with the same letter (Duncan test, Dunn test).

^cOne-way analysis of variance,

^dKruskal Wallis H test, mean ± s. deviation, median (min-max)

According to the total DISCERN score and categories, the distribution between the number of web pages is shown in Figure 1. Only two web pages were evaluated as good, no web pages were specified at the excellent level, and the web pages were categorized as fair with the highest rate of 57.69%.

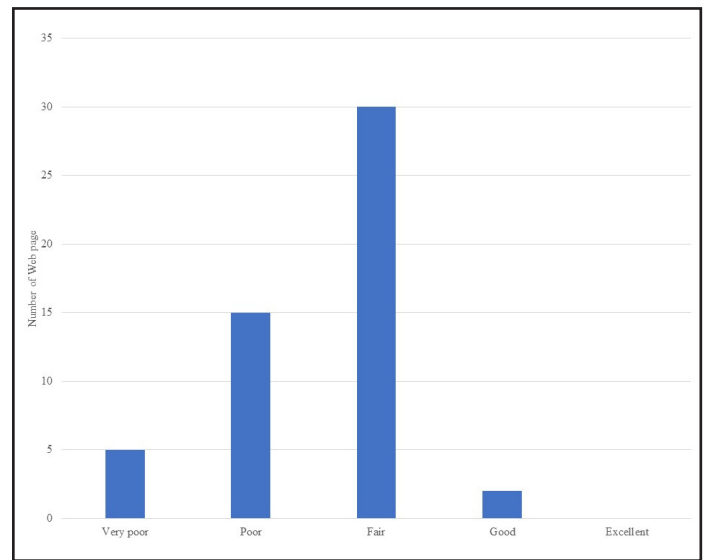


Figure 1. Number of web pages according to the total DISCERN score and categories

A statistically significant difference was found between the median values of the Ateşman readability index according to Ateşman readability levels ($p < 0.001$). This difference is due to the difference between the levels 40-49 and 50-59 and the levels 60-69 and 70-79. When the Ateşman reading ease scores of the web pages are evaluated according to the categories, 7.69% of the web pages are classified as easy, 80.76% as moderately difficult, and 11.53% as difficult (Table 3).

Table 3. Comparison of Ateşman readability index according to Ateşman readability levels

	Mean	Standard Deviation	Median (min.-max.)	Test Statistic	P ^c
40-49	45.9	3.98	46.8 (41 - 49) ^b	40,076	<0.001
50-59	55.63	2.72	56.75 (50 - 59) ^b		
60-69	62.97	2.47	62.85 (60 - 68) ^a		
70-79	72.6	2.43	72.5 (71 - 75) ^a		

a-b: There is no difference between levels with the same letter (Dunn test). ^cKruskal Wallis H test

Table 4 shows data on Flesckincaid levels. A statistically significant difference was found between the median values of the Flesckincaid reading ease score according to the Flesckincaid text levels ($p < 0.001$). This difference is due to the difference between the difficult and fairly difficult levels and the standard and fairly easy levels.

Table 4. Comparison of Flesckincaid reading ease score according to Flesckincaid text levels

	Mean	Standard Deviation	Median (min. - max.)	Test Statics	P ^c
Difficult	44.84	3.87	46.89 (38 - 48) ^b	44.025	<0.001
Fairly Difficult	55.61	2.5	55.84 (51 - 59) ^b		
Standard	63.18	2.57	62.96 (60 - 69) ^a		
Fairly Easy	73.57	3.33	73.55 (71 - 76) ^a		

a-b: There is no difference between levels with the same letter (Dunn test). ^c Kruskal Wallis H test

Table 5. The statistical relationship between all scores

	Ateşman Readability	Flesh-Kincaid Readability	Discern	Section 1	Section 2
Flesh-Kincaid Readability	0.998 ^a ; <0.001				
Discern	-0.160 ^a ; 0.259	-0.165 ^a ; 0.242			
Section 1	-0.186 ^a ; 0.186	-0.192 ^a ; 0.172	0.884 ^a ; <0.001		
Section 2	-0.124 ^b ; 0.380	0.141 ^b ; 0.319	0.946 ^b ; <0.001	0.730 ^b ; <0.001	
Section 3	-0.197 ^b ; 0.161	-0.209 ^b ; 0.136	0.944 ^b ; <0.001	0.796 ^b ; <0.001	0.938 ^b ; <0.001

^a Pearson correlation coefficient, ^b Spearman’s rho correlation coefficient, **r**; **p**

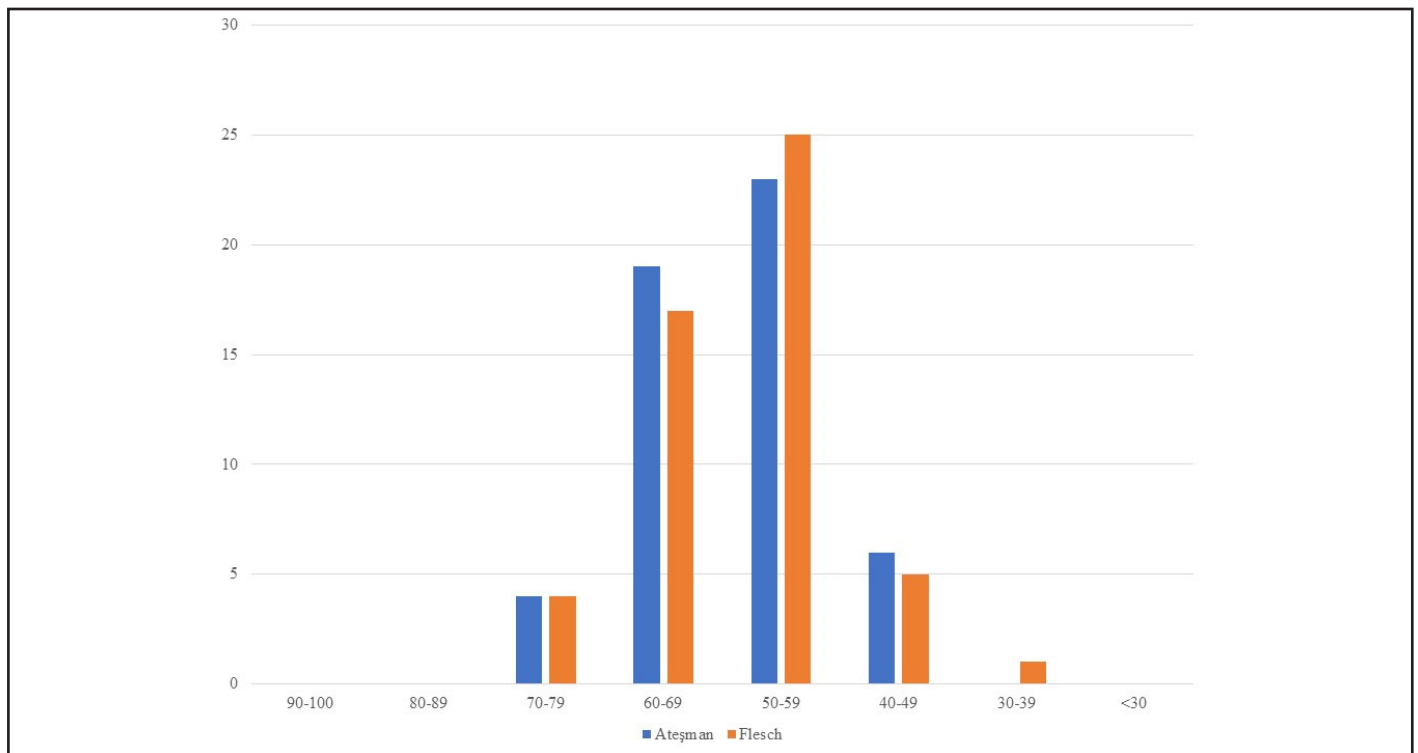


Figure 2. Categories of Ateşman Readability Index and Flesh-Kincaid Reading Ease scores

Table 5 shows the statistical evaluation of the data of all scores obtained in the study. A statistically significant positive correlation was found between Ateşman Readability Index and the Flesh-Kincaid Reading Ease score ($r=0.998$; $p<0.001$). There was no statistically significant correlation between Ateşman Readability Index and DISCERN score ($p=0.259$). As seen in

Figure 2 which shows the number of pages on the x-axis and Ateşman/Flesh Kincaid scores on the y-axis, both readability analyses’ scores are quite similar. A statistically significant positive correlation was found between DISCERN and all Section scores ($p<0.001$).

DISCUSSION

This study aimed to evaluate the readability of web-based information concerning post-endodontic treatment selection. In this regard, the Ateşman and Flesch-Kincaid readability evaluation terms preferred in this study are frequently used, and their consistency with the Turkish language has been demonstrated [1,9,10,12]. The scores of the current study showed that most of the websites were found to have sufficient readability. This evaluation was conducted by two different tools for correlation of the results, Ateşman and Flesch-Kincaid systems, and the independent results were similar statistically.

Besides, the quality of health information is as essential as its readability and comprehensibility [12]. Because most of the information on websites has undergone no quality control, has not been peer-reviewed, and even may not be evidence-based [6]. Therefore, the unbiased information quality of the pages was evaluated using DISCERN tool kit.

The search methodology and evaluation criteria for DISCERN were not made separately as only root canal treatment or any restoration option, and the scoring was made from the perspective of coronal restoration after root canal treatment. The first 30 web pages were selected for the evaluation because it was reported that many internet users do not look more than this number [16]. The results of this study presented that the good and excellent scores were insufficient for the included web pages. However, these results do not indicate that the selected web-based pages provide false or insufficient information on their explanation flow. It may be explained by expressing interdependent treatment options as completely independent treatment options. However, root canal treatment and coronal restoration are inseparable, and the choice of rehabilitation is a decision process that needs to be considered from multiple perspectives. For this reason, it should be emphasized that this process presents integrity while informing the patients.

Several factors affect the prognosis of the endodontically treated tooth. Besides, various factors may well affect the clinical decision-making for endodontics and also post-endodontic restoration. The development of evidence-based guidelines for endodontically treated tooth restoration is complex, with many factors that require consideration [17,18]. The paramount factor is the preservation of tooth structure of root-filled teeth [14]. Although many treatment options have been considered suitable from the past to the present, post-endodontically adhesive

procedures have changed how to replace the lost structure [14,17].

Clinicians often face dilemmas regarding the most appropriate option for the restoration of a tooth after root canal treatment [17]. There is a consensus that the restoration's remaining tooth structure and quality play an important role in prognosis. However, it is not certain and is still contradictory to the indications and management in the literature [14]. This is understandable when considering the development of adhesive and material technology.

Patient preferences are also one of the influencing factors regarding treatment selection [19,20]. Why, patients need to be informed accurately and adequately so that they can cooperate in their treatment options and, therefore, be able to research this information based on evidence. Evidence-based dental treatment is emphasized in healthcare, but there has been less focus on empirically demonstrating the implication of patient education and education resources [21]. Korpela et al. recommended that clinical communication skills should be part of teaching [22].

According to the DISCERN score, Alpaydın et al found the highest rates in the very poor category at 43.3% and the poor category at 44.1% [23]. Considering similar studies, this rate was reported as 47.6% fair [12], approximately 50% fair [24], and poor information quality compared to the average score [25]. The findings of our study are also compatible with previous studies and the contents were found to be fair at the highest rate according to the DISCERN score. Considering the ease of readability of previous studies, Alshehri et al [25] and Wiryakijja et al [26] stated that the texts they examined were in the difficult category. In our study, the readability level was determined as fairly difficult. The Ateşman Readability Index and the Flesch-Kincaid Reading Ease score, which are used to evaluate the ease of readability, were both evaluated and correlated in the present study. Consistent with the findings of our study Değirmenci et al [5] determined that there was a positive correlation between both readability evaluation formulas ($r=0.801$, $p<0.001$).

The web search was limited to Turkish websites in Türkiye, so the outcomes are valid for a limited population. Selecting only two keywords can also be cited among the limitations. Keywords have been limited in this way since patients are unfamiliar with dental terminology, and their knowledge of coronal restoration is generally thought to be limited only to veneer and filling in Turkish. Another limitation of this study is that there may be

differences in the evaluation of quality and readability tools with the updates that occur in the ranking and content of the websites.

When the current results are evaluated, it is very important that the information given by health-related websites is easy to read and presents correct content [27]. In particular, it may be useful to have health-related websites evaluated by a professional before publishing a text, or to allow only professionals to share information on health-related issues, in order to prevent such problems. For patients, in addition to the knowledge gained from the clinician, it should be easy to access accurate and reliable information on websites. In particular, the fact that reliable sources are readable and understandable in public discourse ensures that those who need information stay in the appropriate ones. Accordingly, while preparing a page for website designers, it is important to provide some standards to reach the target audience correctly.

CONCLUSION

The results of this study presented that the readability distribution of the written information about post-endodontic coronal restorations on websites was acceptable to the majority. However, being readable does not indicate that it provides sufficient target technical information. It may be more informative and illustrative for patients to explain the information about post-endodontic restorations in a more relative way rather than under different headings. In this context, it can be suggested to use readability and quality scales while preparing websites for dental patient education concerning post-endodontic coronal restorations.

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