Original Article

Assessment of the quality and accuracy of information contained within the websites of marketed orthodontic products: a cross-sectional investigation

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ABSTRACT

Objectives: To assess the quality and accuracy of information contained within the websites of providers of marketed orthodontic products.

Materials and Methods: Twenty-one websites of orthodontic appliance and adjunct (product) providers were identified. The website content was assessed via two validated quality-of-information instruments (DISCERN and the *Journal of the American Medical Association* [JAMA] benchmarks) and an accuracy-of-information instrument. Website content was qualitatively analyzed for themes and subthemes.

Results: More than half (n = 11; 52.3%) of the assessed websites contained clinician testimonials. The mean (SD) DISCERN score was 33.14 (5.44). No website recorded the minimum of three JAMA benchmarks required to indicate reliability. The most common content themes related to quality-of-life impact and treatment duration. Just 8% of the statements within the websites were objectively true. The Pearson correlation coefficient indicated that the DISCERN scores were correlated with the accuracy-of-information scores ($r = .83$; $P < .001$).

Conclusions: The quality and accuracy of information contained within the websites of the providers of marketed orthodontic products was poor. The combined use of DISCERN and the accuracy-of-information instrument may help overcome the shortcomings of each. Clinicians should check the accuracy of information on orthodontic product provider websites before adding links to those websites on their own sites. (*Angle Orthod*. 2024;94:273–279.)

KEY WORDS: Advertising; Ethics; Internet; Marketing; Orthodontics; Quality of information

INTRODUCTION

The Internet has revolutionized the communication of information globally, with research indicating that Internet resources are integral to shared decision-making processes regarding health care assessment and management.[1] The Internet, however, is an unregulated environment.[2] Inaccurate, incomplete, or erroneous information can deleteriously affect patient decision-making and management of health conditions.[3]

Several investigations have demonstrated that online orthodontic information provided by a wide range of website authors is deficient.[2,4–7] In addition, the quality of orthodontic information provided by dental professionals, including orthodontists, has been shown to be suboptimal.[8,9] Global studies have indicated that orthodontic and dental practice websites are generally not compliant with regulatory requirements regarding advertising.[10–13]

The interaction of the orthodontic profession with commercial interests is essential as it enables the development and incorporation of new products and services into practice.[14] Direct-to-consumer (DTC) marketing/advertising by orthodontic product providers has increased in recent years in tandem with the emergence of new technology, appliances, and adjuncts.[14,15] Several studies have indicated that the evidence underpinning the content

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of orthodontic product provider marketing claims is suboptimal.[14,16,17] The content of commercial orthodontic provider websites is of additional relevance, as recent investigations have shown that the presence of names of products and links to commercial orthodontic providers are present within the websites of up to 90% of dental and orthodontic practices.[9,10]

In 2022, a study found that most marketing claims made about six orthodontic products on Instagram were inaccurate.[18] Data, however, are lacking regarding the quality and accuracy of content related to products within the websites of orthodontic product providers.

The aim of the present study was to assess the quality of information and accuracy of information contained within the websites of marketed orthodontic products.

MATERIALS AND METHODS

Institutional ethical approval was not required for this cross-sectional study, as only information in the public domain was evaluated. The websites of orthodontic product providers were chosen for analysis on June 1, 2023, based on their presence in the orthodontic literature and popularity of use among clinicians.[9,10,18–22] Inclusion criteria related to the requirement that the information was present on the provider's website and written in the English language. Website content presented in video format was excluded.

A Microsoft Excel spreadsheet (Microsoft, Redmond, Wash) was used to document the names of the product provider and products, the product type (orthodontic clear aligner, fixed appliance/bracket, DTC aligner, combination of product types, other), and the country of intended readership. The presence and/or number of the following were also recorded:

- A photographic gallery of "before/after treatment" photographs
- Clinician testimonials
- Patient testimonials.

In addition, information on the websites related to the quality and reliability of information and the accuracy of claims within the websites was assessed.

Quality and Reliability of Information

The information contained within each website was evaluated using the DISCERN instrument.[23] This is a validated questionnaire tool (16 questions) developed to assess the quality of health information. It contains questions within two sections pertaining to content reliability and treatment choices and a third section that enables the user to give an overall assessment score. The questions are answered according to a Likert scale, in which a maximum score of 5 indicates that a question related to the material is comprehensively, reliably, and satisfactorily addressed. A minimum score of 1 indicates that the content is deficient, unreliable, and unsatisfactorily addressed. DISCERN scores can range from 16 to 80. Health information can be categorized according to the overall score from the evaluation:

- Between 63 and 80: excellent
- Between 51 and 62: good
- Between 39 and 50: fair
- Between 28 and 38: poor, and
- Between 16 and 27: very poor.[4]

In 1997, the *Journal of the American Medical Association* (JAMA) established four benchmarks by which the quality of websites providing health information could be determined.[24] The benchmarks relate to information about authorship (names and credentials of authors), attribution (sources/references of information), currency (date of information posting/updating), and disclosure (conflicts of interest). A minimum of three benchmarks indicates that a website is trustworthy or reliable.[24,25]

Qualitative Analysis of Content

Sentences and statements regarding the product made on each of the websites were recorded in a Microsoft Excel spreadsheet. Initial inductive coding of the themes and subthemes contained within the content was undertaken by two authors (Dr Meade and Dr Jensen) on five of the websites. Once agreement on the themes and subthemes was reached, the use of a codebook was adopted to aid assessment, and the first-named author allocated the content to themes. Ongoing refinement of the codebook ensured that thematic saturation was reached with the identification of new themes and subthemes. Disagreement was resolved through joint discussion.[26] Statements could relate to more than one theme.

Accuracy of Claims

In the absence of a specific instrument to assess the accuracy of statements regarding orthodontic products, an instrument originally developed to assess drug advertisements, and recently adapted to evaluate claims regarding Instagram posts about orthodontic treatment, was used.[18,27] This involved categorization of 20 randomly chosen sentences and statements (via the random.org website) per website by the first-named author according to the categories of accuracy outlined in Table 1 and evaluated against the current evidence base.

Table 1. Categories, Definitions, and Examples of Accuracy Of Website Statements

Accuracy of Statement	Definition	Example
Objectively true [A]	A statement that is consistent with the evidence base with all pertinent positive and negative information presented	"Once braces are removed a retainer is required to prevent relapse or movement of teeth from occurring."
Selected facts [B]	A statement that presents some true selected facts consistent with the evidence base but excludes pertinent positive and negative information	"Unlike braces, Invisalign clear aligners are removable and virtually invisible."
Minimal facts [C]	A statement that magnifies the benefit, with the benefit supported by inadequate evidence	"By following your custom treatment plan, you will quickly notice your clear aligners are not only comfortable and easy-to-use, but virtually invisible."
Nonfacts [D]	A statement that declares an intangible feature, commonly through opinion or lifestyle claims. Opinions reveal nothing objectively true, but consumers are left to misinterpret	"Now you can have the smile of your dreams without anyone knowing you are being treated."
False [E]	A statement that was objectively false because of inconsistency with or contrary to the evidence base	"Treatment time with the .... System is typically much faster than with conventional braces."

Each statement was allocated a numerical score according to the degree of accuracy of the statement to enable determination of the association of website content accuracy with the DISCERN scores. Therefore, a statement evaluated as "A" was accorded 5, "B" was accorded 4, "C" was accorded 3, "D" accorded 2, and "E" accorded 1.

Statistical analysis was carried out via GraphPad Prism software (GraphPad Software Inc, La Jolla, Calif). The Shapiro-Wilks test was carried out to determine whether the distribution of the DISCERN scores was parametric. As the scores were parametric, Student's *t*-tests were used to determine significant differences between groups and subgroups. The Pearson correlation coefficient was used to detect an association between the DISCERN scores and the accuracy of the statements.

Intraclass correlation (ICC) intra- and interrater testing for the DISCERN scores was carried out on 10 randomly (via the random.org website) chosen websites 8 weeks after initial data measurements.

RESULTS

The websites of 21 orthodontic product providers were evaluated. All were targeted at patients or potential patients. Most (n = 14; 66.67%) were targeted at Internet users in the United States, followed by Australia (n = 6; 28.57%) and indeterminate (n = 1; 4.77%). Ten websites (47.61%) related to information regarding clear aligner therapy (CAT), six (28.57%) contained information regarding more than one orthodontic appliance type, and two (9.52%) provided information about fixed appliances. The remaining websites provided information on a non-CAT aligner system (n = 1; 4.77%), an accelerated orthodontic system (n = 1; 4.77%), and a remote orthodontic monitoring system (n = 1; 4.77%). Sixteen websites (76.19%) provided information regarding orthodontic appliances provided by patients via clinicians, while four websites (19.04%) featured information about appliances provided directly to the patient or consumer. A "before and after photo" gallery was present in 13 (61.9%) of the websites. Eleven (52.3%) websites contained clinician testimonials, whereas 13 (61.9%) contained patient testimonials.

Table 2 outlines the mean (SD) scores for the answers of each of the 16 DISCERN questions. The mean (SD) DISCERN score for the websites was 33.14 ([5.44]; maximum: 48, minimum: 24). The mean (SD) score for section 1 was 17.38 (2.89) and for section 2 was 13.62 (2.82).

Most (n = 17; 80.95%) websites were categorized as "poor" quality, 9.52% (n = 2) were categorized as "fair" quality, and 9.52% (n = 2) were categorized as "very poor" quality.

There was no difference ($P = .09$; 95% confidence interval [CI]: −0.59, 8.83) between the mean DISCERN (SD) score for websites with clinician testimonials (31.18 [3.25; 95% CI: 29.00, 33.57) and for websites without clinician testimonials (35.30 [6.67; 95% CI: 30.54, 40.06]). There was no difference ($P = .61$; 95% CI: −8.23, 4.98) between the mean (SD) DISCERN scores for websites with information regarding orthodontic appliances provided to patients via clinicians (32.63 [6.05]; 95% CI: 29.40, 35.85) and information about appliances provided directly to the patient or consumer (34.25 [2.50]; 95% CI: 30.27, 38.23).

The JAMA currency benchmark was met by 17 (80.95%) of the websites. No website met the authorship benchmark. One (4.76%) and two (9.52%) websites met the attribution and disclosure benchmarks, respectively. No website satisfied three or four benchmarks.

Table 3 shows the distribution of statements according to themes. Table 4 outlines the subthemes related to the quality-of-life impact theme. Figure 1 shows that

Table 2. Mean (SD) Score per DISCERN Item

DISCERN item	Mean/5(SD)	Min, Max
SECTION 1. Is the "publication" reliable?		
1. Are the aims clear?	3.50 (0.59)	2, 4
2. Does it achieve its aims?	2.86 (0.65)	2, 3
3. Is it relevant?	2.71 (0.46)	1, 3
4. Is it clear what sources of information were used to compile the publication (other than the author or producer)?	1.71 (0.72)	1, 3
5. Is it clear when the information used or reported in the publication was produced?	2.43 (0.67)	1, 3
6. Is it balanced and unbiased?	1.48 (0.68)	1, 3
7. Does it provide details of additional sources of support and information?	1.62 (0.67)	1, 3
8. Does it refer to areas of uncertainty?	1.50 (0.68)	1, 3
SECTION 2. How good is the quality of information on treatment choices?		
9. Does it describe how each treatment works?	2.67 (0.78)	2, 4
10. Does it describe the benefits of each treatment?	2.71 (0.50)	2, 3
11. Does it describe the risks of each treatment?	1.38 (0.73)	1, 3
12. Does it describe what would happen if no treatment is used?	1.05 (0.22)	1, 2
13. Does it describe how the treatment choices affect overall quality of life?	1.67 (0.80)	1, 3
14. Is it clear that there may be more than one possible treatment choice?	1.95 (0.86)	1, 4
15. Does it provide support for shared decision-making?	2.19 (0.68)	1, 4
SECTION 3. Overall rating of the publication		
16. 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	2.19 (0.40)	2, 3

8% of the statements within the websites were objectively true.

The Pearson correlation coefficient (*r*) between the DISCERN scores and the accuracy of the statements was .83 (95% CI: .58 to .94, $P < .001$). The value for R^2 was .69. This indicated that the association between the DISCERN scores and the accuracy of the statements was .83 and that 69% of the variation in DISCERN scores was explained by the accuracy of statement scores.

ICC intra- and interrater reliability testing for DISCERN scores ranged from .86 to .94, indicating good to excellent reliability of the method.[28]

Table 3. Distribution of Website Content According to Themes (N = 459)

Theme	n (%)
Appliance durability	3 (0.07)
Appliance safety	4 (0.09)
Breathing/airway	2 (0.04)
Compliance with wear protocols	30 (6.52)
Cost	17 (3.70)
Dental health	31 (6.80)
How treatment works	19 (4.13)
Quality of life impact	110 (23.96)
Maintenance	31 (6.75)
Occlusal outcome	8 (1.74)
Patient clinician relationship	33 (7.19)
Rate of tooth movement	11 (2.39)
Research	7 (1.52)
Retention/relapse	15 (3.26)
Satisfaction (patient)	33 (7.19)
Technology	20 (4.36)
Temporomandibular joint	1 (0.02)
Treatment duration	40 (8.71)
Treatment risk	23 (5.01)

DISCUSSION

The findings of the present study indicated that the quality of information contained within the websites of orthodontic product providers was poor and that most statements within the websites were not objectively true. The popularity of the Internet for the dissemination and sharing of health information and the importance of patient-centered care highlight the pertinence of the investigation.

The websites related to 21 orthodontic product providers were assessed in the present survey compared with the 13 to 31 websites evaluated in similar investigations, and was greater than the 6 products assessed in a study concerning the content of Instagram posts.[2,4,5,18,25,29,30] All websites had content aimed at the patient or consumer. The quality of the website content was assessed via two validated instruments. The DISCERN instrument is commonly adopted and can be used by health care providers and consumers as a guide to the quality of medical and dental information.[23] The mean DISCERN score among the websites in the present investigation was 33.14, which compared with mean DISCERN scores of 32.76 to 41.87 observed in studies evaluating the quality of online content about DTC aligners, orthodontic temporary anchorage devices, orthodontic clear aligners, orthognathic surgery, and lingual orthodontics.[4,6,7,29,30] It also compared with mean DISCERN scores of 36.71 to 43.78 among a combined total of 406 specialist orthodontic practice websites in 2 recent surveys in North America and Australia.[22,31] No website reached the DISCERN score of 50, which is considered to be the minimum score to reflect acceptable quality.[4]

Table 4. Quality of Life Impact Subthemes[a]

Theme	Subtheme	n (%)	n (%)
Quality of life impact	Appearance	26 (5.66)	110 (23.96)
	Appliance appearance	6 (1.30)	
	Comfort/discomfort	57 (12.41)	
	Diet	15 (3.26)	
	Speech	3 (0.07)	
	Swallowing	3 (0.07)	

[a] Values pertain to the overall percentage of content.

The poor scores related to the DISCERN items regarding what would happen if no treatment was carried out, and the risks associated with treatment corresponded with findings elsewhere and suggests a reluctance to provide information that could potentially deter customers from purchasing the product or service.[4,5,7]

The most common theme identified in the websites related to the impact of orthodontic products on patients' quality of life. This finding was consistent with prior research and aligns with the fact that this aspect of orthodontic treatment holds significant importance for patients.[32,33] The present survey showed that just 8% of the statements on the websites in the present survey were objectively true. Although this was greater than the 1.7% recorded in the study regarding claims about orthodontic products contained within Instagram posts, it indicated that the provision of evidence-based orthodontic information was lacking. This echoed the findings of studies that investigated the evidence base of claims within advertisements about orthodontic products made in orthodontic journals.[16,17]

A purported disadvantage of the DISCERN tool is its inability to evaluate the scientific accuracy of health information.[6] Interestingly, the present survey found an association between DISCERN scores and the accuracy of information of scores. This suggested that combined use of the two tools may be helpful in addressing this deficiency.

Although clinicians provided testimonials on more than half of the websites, authorship was the least commonly observed JAMA benchmark. In addition, no website satisfied the minimum of three JAMA benchmarks required for acceptable trustworthiness, which replicated the outcome in a study investigating websites providing DTC aligners.[4]

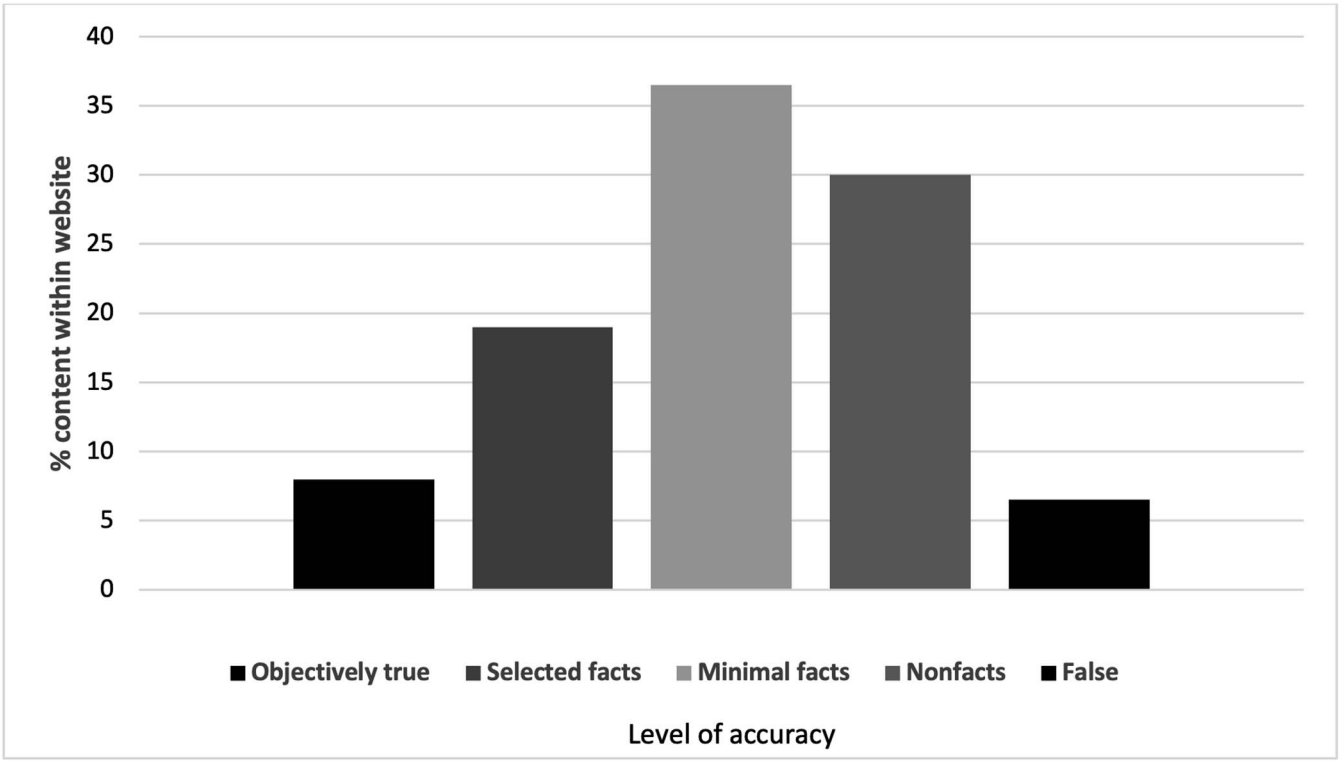

Figure 1. Distribution of website content according to the level of accuracy.

The findings of this study have important considerations. If the websites of commercial products are being used by dental practitioners to aid treatment choices, a significant potential to mislead patients exists.[3,34] In addition, the presence of patient testimonials and "before and after photos" without treatment context can potentially raise unrealistic patient expectations of treatment outcomes.[12,34] Also, the use of clinician testimonials on websites with suboptimal quality of information risks breaches that trust, which is integral to the social contract between patients and health care providers.[35]

A limitation of the present study included the assessment of content related to a selected number of marketed orthodontic products, and therefore, the findings may not be applicable to the websites of other orthodontic product providers. The evaluated websites, however, related to commonly used products, and it may be reasonable to expect the observed deficiencies to be replicated elsewhere.[6,9,18–20] Another potential limitation was the cross-sectional nature of the study. The dynamic nature of the Internet means website content may frequently change, and regular review of content is required to investigate the nature of changes in website information quality over the long term.[31]

A strength of the investigation was the use of validated instruments. In addition, high intrarater and interrater scores of the measured data were recorded with an 8-week interval between the two time points of measurement, minimizing the risk of memory bias.

The marketing of orthodontic products and services and the delivery of high-quality orthodontic information should not be mutually exclusive.[4] There is a pressing need for the future development and stringent implementation of dental and orthodontic advertising policies aimed at safeguarding the interests of both patients and consumers. In addition, the development of associated ethical frameworks by professional health care organizations is essential to ensure that clinicians are aware of their ethical obligation to ensure the optimal quality of information provided, whether directly or indirectly. Care will be required to negotiate a balance between the commercial interests of the product providers and orthodontists and the protection of the patient from misleading and potentially harmful advertising practices.[3]

CONCLUSIONS

- The quality and accuracy of information contained within the websites of the providers of marketed orthodontic products was poor.
- The combined use of DISCERN and the accuracy-of-information instrument may help overcome the deficiencies of each instrument.
- Clinicians should ensure that content within the websites of the providers of marketed orthodontic products is high quality and accurate before including those links in their own websites.

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