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Comparison of Patient Factors Influencing the Selection of an Orthodontist, General Dentist, or Direct-To-Consumer Aligners for Orthodontic Treatment

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dentistry at Virginia Commonwealth University.

By

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ABSTRACT

COMPARISON OF PATIENT FACTORS INFLUENCING THE SELECTION OF AN ORTHODONTIST, GENERAL DENTIST, OR DIRECT-TO-CONSUMER ALIGNERS FOR ORTHODONTIC TREATMENT

By Jeffrey C. Olson, D.D.S.

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Purpose: To evaluate the factors that influence potential orthodontic patients choosing between an orthodontist, general dentist, and direct-to-consumer (DTC) aligners for their treatment, and to determine the demand for each provider type.

Methods: An electronic survey was administered to 250 individuals among the general population of adults in the United States. Questions were designed to determine the respondent's level of interest in pursuing orthodontic treatment with each provider type, evaluate their current level of knowledge concerning provider options, and identify factors influencing their selection. Pearson's chi-squared test and ANOVA were used to evaluate the factors influencing patients in their selection.

Results: When asked their preference in provider type, 43.8% of respondents selected orthodontist, 34.1% selected DTC aligners, and 22.1% selected general dentist. Among respondents with the highest level of interest in pursuing orthodontic treatment, 50% selected an

orthodontist and 27% selected DTC aligners. For respondents with moderate levels of interest in pursuing treatment, only 21% selected an orthodontist and 48% selected DTC aligners. The biggest perceived advantage of treatment with an orthodontist was quality of treatment, and the biggest disadvantage was cost. For DTC aligners, the biggest perceived advantage was convenience, followed by cost, and the biggest disadvantage was quality of treatment. Among adults with children, 34% selected DTC aligners for themselves and only 16% selected DTC aligners when selecting for their children.

Conclusion: Adults in the United States have similar levels of interest in pursuing orthodontic treatment with orthodontists and DTC aligners and, to a lesser degree, general dentists. A significant portion of those who select DTC aligners for their treatment are patients who would not have otherwise undergone treatment with an orthodontist. Patients tend to select orthodontists due to quality of treatment, whereas DTC aligners are selected due to convenience, followed by cost. Even among parents who prefer DTC aligners for their own treatment, parents tend to select an orthodontist for their child's treatment.

INTRODUCTION

In 1900, Dr. Edward H. Angle formally established orthodontics as America's first dental specialty.¹ Since that time, patients have sought out treatment from orthodontic specialists, who receive additional education beyond dental school. Over the course of two to three years in accredited orthodontic residency programs, these specialists learn to diagnose and comprehensively treat patients with dentofacial abnormalities and malocclusions, providing patients with an improved smile and functional occlusion.²

More than a century later, the introduction of clear aligner therapy, along with a shift toward direct-to-consumer advertising, has altered the way some patients seek orthodontic treatment. The traditional orthodontic marketing model emphasized the specialist's appeal to general dentists for referrals. In the early 2000s, however, orthodontic product companies began advertising directly to consumers. These advertisements ranged from full-page ads in popular woman's magazines to prime time television commercials, placing an increased emphasis on products such as clear aligners or specific bracket systems rather than on the service provided by an orthodontic provider.³ The growth of clear aligners and changes in advertising strategies have also coincided with an increase in adult patients undergoing treatment, rising by an estimated 16% from 2012 to 2014 alone, with 27% of all patients being adults.⁴

Amid these changes in consumer habits, an increasing number of non-specialists have begun providing orthodontic treatment. Studies reported that 18-20% of general dentists provide routine comprehensive orthodontic treatment and 32-57% offer some form of limited orthodontic treatment.⁵⁻⁷ An increase in the number of these practitioners providing clear aligner therapy has

also been observed.^{7,8} With nearly 200,000 general dentists in the United States, the number of practitioners providing orthodontic care may continue to grow.⁹

In this era of direct-to-consumer marketing, a new form of orthodontic treatment has originated in the form of direct-to-consumer (DTC) aligners.³ Patients purchase a kit via mail-order and take impressions of their teeth at home. Alternatively, patients may elect to go to a scanning center, where a technician can take a 3D scan of their teeth. These impressions and scans are then returned to a company and are used to manufacture sets of clear aligners designed by a licensed dentist. After receiving these aligners in the mail, patients wear them to straighten their teeth without visits to or supervision from a provider.

DTC aligner companies have swiftly gained attention in the orthodontic community,¹⁰⁻¹³ advertising a reduced cost, shorter treatment time, and greater convenience compared to traditional treatment. Significant investment has been placed in advertising through television, social media, and other mediums.³ However, the level of demand for DTC aligners still remains largely unknown.

Despite the advantages advertised by DTC aligner companies, concerns about the safety and efficacy of this treatment modality have been expressed by members of the orthodontic and dental profession. Specifically, a lack of scientific evidence demonstrating the effectiveness of DTC aligners has been cited, along with the potential serious health risks of undergoing treatment without supervision by a qualified health care provider.^{10,14}

Previous studies have compared the effectiveness of orthodontic treatment performed by orthodontists, general dentists, and, to a limited degree, DTC aligners,^{8,15-17} but there are no studies to date that evaluate the factors that influence a patient's selection of a provider type. Studies examining the effects of the emerging DTC aligner option on consumer habits are also

lacking, and the level of demand for this new treatment modality remains unclear. Given the rising concern within the orthodontic community, it is critical that these questions be answered, providing some guidance as the specialty adapts to an ever changing landscape.

The purpose of this study was to determine the demand for orthodontic treatment with each provider type (orthodontist, general dentist, and DTC aligners) and to identify what factors influenced patients to select each given option. This will provide some direction to orthodontists as they seek to meet the needs of their patients, as well as offer valuable information to the leaders of professional organizations as they advocate for the interests of their members.

MATERIALS AND METHODS

An original 22-question survey was developed and administered to the general population via a web-based delivery (Appendix 1). Following approval from the Institutional Review Board (IRB) at Virginia Commonwealth University (HM20012257), the electronic survey was administered via a commercial polling company (Survey Sampling International, LLC; Shelton, Connecticut) that has existing databases of contact information for reliable panelists. A total of 307 individuals received electronic invitations to participate in the survey from May 2018 through July 2018. The target population included adults aged 18 to 65 years old, residing in the United States.

The survey was designed so respondents could not return to previous questions. This prevented respondents from changing answers to previous questions after being given additional information throughout the survey, thus eliminating bias. Additionally, responses from those who completed the survey too quickly or too slowly, or who selected the same answer choice repeatedly were excluded according to previously established norms.

The survey questions were designed to:

- 1) Establish the respondent's level of interest in receiving orthodontic treatment.
- 2) Evaluate what the respondent values in the selection of a treatment provider.
- 3) Evaluate the respondent's current level of knowledge regarding orthodontic provider options.
- 4) Determine the respondent's level of interest in each of the three provider options, as well as their rationale.

- 5) Collect demographic information to correlate to the respondent's selection.

Statistical Analysis

Analysis of variance (ANOVA) was used to evaluate the levels of demand for the orthodontic treatment options, with Tukey's post-hoc test for differences between pairs of treatment options. Pearson's chi-squared test or ANOVA were used to identify and evaluate the factors that influenced patients in their selection of an orthodontic treatment choice, depending upon the nature of the factor. Repeated measures ANOVA was used to evaluate differences in levels of demand for treatment and in-patient factors between the treatment option groups. Analyses were performed using SAS EG v.6.1. (SAS Institute, Cary, NC) and RStudio with R v.3.3.3 (RStudio Inc, Boston, MA). Significance level was set at 0.05.

RESULTS

Survey invitations were extended to 307 individuals, and a total of 283 responses were obtained. After removing surveys that were completed too quickly or slowly, or in which the same answer choice was selected repeatedly, a total of 250 survey responses were analyzed. Analyses regarding overall selection of a provider used $n = 249$ responses because one respondent chose “Other” as their preferred provider option and was excluded (they specified “None” when asked to clarify). After these exclusions, the overall response rate was 81.4%.

Regarding the respondents’ demographics, 126 (50.4%) were female, 198 (79.2%) identified as non-Hispanic Caucasian, 192 (76.8%) reported education beyond a high school diploma/GED, and 143 (57.2%) reported full-time employment. Complete demographics are given in Table 1.

Table 1: Respondent Demographics

	<i>Percentage</i>
Gender	
Female	50.4
Male	49.6
Age	<i>Percentage</i>
18 to 24 years	17.6
25 to 34 years	26.4
35 to 44 years	20.0
45 to 54 years	18.4
55 to 65 years	17.6
Ethnicity	<i>Percentage</i>
Non-Hispanic Caucasian	79.2
Black / African American	4.8
Hispanic / Latino	6.0
Asian / Pacific Islander	5.2
Native American	3.6
Other	1.2
Education	<i>Percentage</i>
Less than High School	1.2
High School / GED	22.0
Associates / Some College	35.2
Bachelors	27.2
Beyond Bachelors	14.4
Community Size	<i>Percentage</i>
Small Town (< 2,500)	13.2
Town/Small City (2,500-50,000)	43.2
Large City (50,000-500,000)	28.4
Metropolitan (> 500,000)	15.2
Employment	<i>Percentage</i>
Full-time	57.2
Part-time	12.8
Unemployed	30.0
Dental Insurance	<i>Percentage</i>
Yes	72.8
No	25.2
Not Sure	2.0

When respondents were asked to state whether they would select an orthodontist, general dentist, or DTC aligners if they were to pursue orthodontic treatment, 44% selected an orthodontist, 34% selected DTC aligners, and 22% selected a general dentist. There was no significant difference between the selection of an orthodontist and the selection of DTC aligners (p -value=0.0849), but both orthodontists and DTC aligners were selected at a significantly higher rate than general dentists (p -value<0.0001 and p -value=0.0112, respectively).

The respondents' overall selection of a provider was significantly associated with several demographic variables including age (p -value=0.005), gender (p -value=0.0221), education level (p -value=0.0486), and insurance coverage for orthodontics (p -value=0.0005). Respondent preference, however, was not significantly associated with race/ethnicity (p -value=0.8469), the size of their community (p -value=0.4182), employment status (p -value=0.7456), dental insurance coverage (p -value=0.1197), social media habits (p -value=0.1973), whether or not the respondent had a child that may pursue orthodontics (p -value=0.3095), or the respondent's perception of the complexity of their potential treatment (p -value=0.3057). Complete results are given in Table 2.

Regarding age and gender, male respondents in the younger age groups (18-45 years old) were significantly more likely to select an orthodontist than all other age and gender groups (59% vs 33-44%) and less likely to select DTC aligners than all other age and gender groups (10% vs 40-52%; see Figure 1). Respondents with a college education or beyond were more likely to select orthodontists (51% vs 34-38% among lower education levels). Respondents with a high school degree or less and with some college or an associate degree all selected DTC aligners at a higher rate than those with a college degree or beyond (41-47% vs 22%). Among respondents with dental insurance, those who reported that their dental insurance did cover

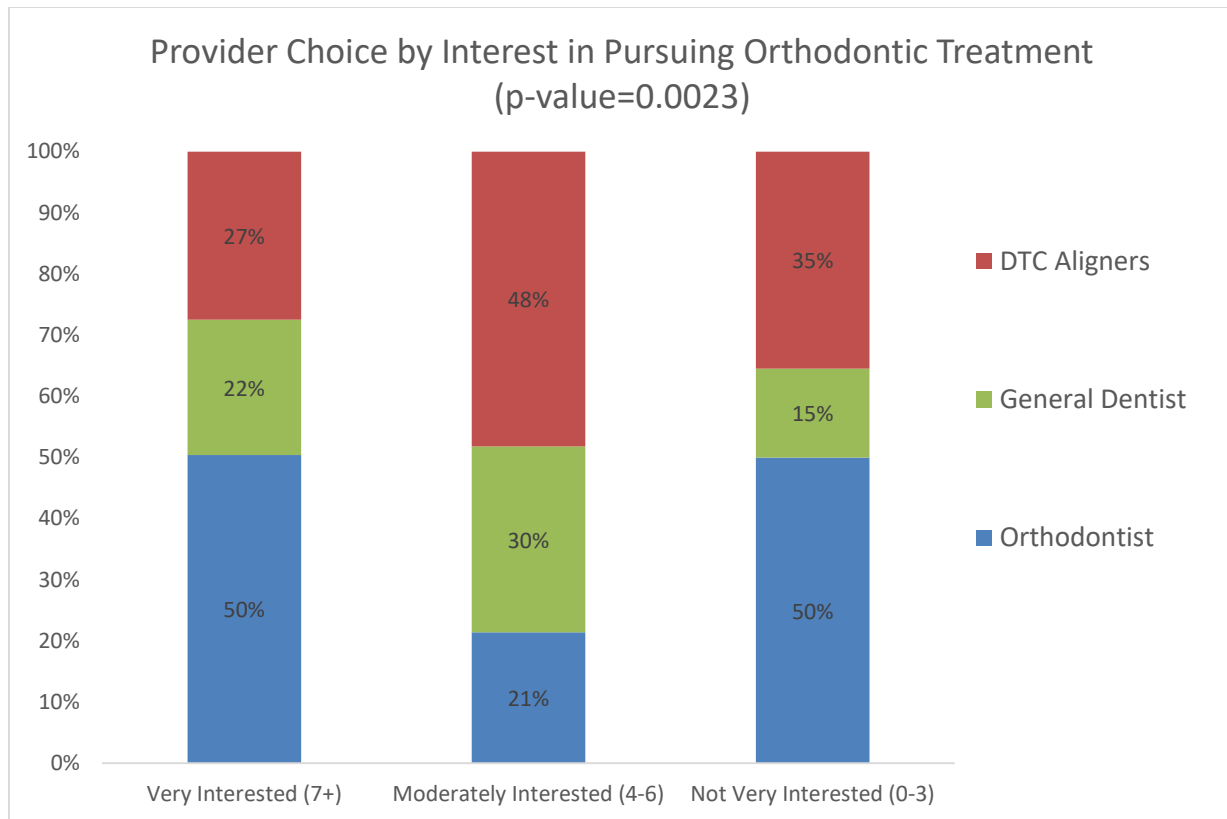
orthodontics were least likely to select DTC aligners (17% vs 32-48%). Respondents who were unsure of their orthodontic coverage had the lowest rate of selecting an orthodontist (33% vs 51-54%). Interestingly, respondents who reported they did not have orthodontic insurance coverage and respondents who reported they did have orthodontic insurance coverage all selected an orthodontist with a similar rate (51% and 54%, respectively). Full results are given in Table 2.

Table 2: Preference in Provider Based on Demographic Characteristics

	Orthodontist	General Dentist	DTC Aligners	P-value(Chi-squared)
Age				0.005
18-24	18 (41%)	16 (36%)	10 (23%)	
25-34	29 (44%)	17 (26%)	20 (30%)	
35-44	28 (56%)	11 (22%)	11 (22%)	
45-54	16 (35%)	5 (11%)	25 (54%)	
55-65	18 (42%)	6 (14%)	19 (44%)	
Gender				0.0221
Male	61 (49%)	31 (25%)	32 (26%)	
Female	48 (38%)	24 (19%)	53 (42%)	
Race/Ethnicity				0.8469
Non-Hispanic Caucasian	85 (43%)	43 (22%)	69 (35%)	
Other	24 (46%)	12 (23%)	16 (31%)	
Highest Level of Education				0.0486
High school or Less	20 (34%)	11 (19%)	27 (47%)	
Some College or Associate's Degree	33 (38%)	18 (21%)	36 (41%)	
College Degree or Beyond	35 (51%)	18 (26%)	15 (22%)	
Size of Community				0.4182
Small Town (less than 2,500)	12 (36%)	9 (27%)	12 (36%)	
Town/Small City (2,500-50,000)	12 (36%)	9 (27%)	12 (36%)	
Large City (50,000-500,000)	41 (38%)	24 (22%)	43 (40%)	
Metropolitan (More than 500,000)	35 (50%)	15 (21%)	20 (29%)	
Employment Status				0.7456
Full-time	67 (47%)	31 (22%)	45 (31%)	
Part-time	14 (44%)	6 (19%)	12 (38%)	
Not employed	28 (38%)	18 (24%)	28 (38%)	
Dental Insurance				0.1197
Yes	81 (45%)	45 (25%)	55 (30%)	
No	27 (43%)	8 (13%)	28 (44%)	
Not sure	1 (20%)	2 (40%)	2 (40%)	
Does your insurance cover orthodontic Treatment				0.0005
Yes	45 (51%)	29 (33%)	15 (17%)	
No	15 (54%)	4 (14%)	9 (32%)	
Not sure	21 (33%)	12 (19%)	31 (48%)	
Use of social media				0.1973
Multiple time per day	71 (44%)	37 (23%)	53 (33%)	
Once per day	18 (41%)	11 (25%)	15 (34%)	
Once per week	5 (33%)	6 (40%)	4 (27%)	
Less than once per week	7 (41%)	1 (6%)	9 (53%)	
I never use social media	8 (67%)	0 (0%)	4 (33%)	
Perceived Complexity of Treatment				0.3057
Simple	40 (41%)	19 (19%)	39 (40%)	
Moderate	50 (42%)	30 (25%)	38 (32%)	
Complex	19 (58%)	6 (18%)	8 (24%)	
Do you have a child that you may pursue orthodontics for?				0.3095
Yes	40 (40%)	27 (27%)	34 (34%)	
No	69 (47%)	28 (19%)	51 (34%)	

Respondents were asked at the beginning of the survey to rate their level of interest in pursuing treatment to straighten their teeth on a scale from 0 to 10. There was a significant difference in average interest based on which provider type the respondent would select (p-value=0.0105). Respondents who indicated that they would choose DTC aligners also reported the lowest average interest in pursuing orthodontic care (5.45 vs 6.02 for orthodontists and 6.47 for general dentists). After this initial analysis, interest was then categorized into 3 levels: not very interested (0-3), moderately interested (4-6), and interested (7+). When comparing the provider choice by categorical interest level, there was a significant difference in preference based on interest (p-value=0.0023). For those who were moderately interested, only 21% selected an orthodontist and 48% selected DTC aligners. For those who were either interested or not very interested, 27-35% selected DTC aligners and 50% selected orthodontist. The interest in DTC aligners was the highest among those who were moderately interested (48%) and lowest among those who were most interested (27%). These findings are illustrated in Figure 1.

Figure 1: Provider Choice by Interest in Pursuing Orthodontic Treatment



*P-value from chi-squared test

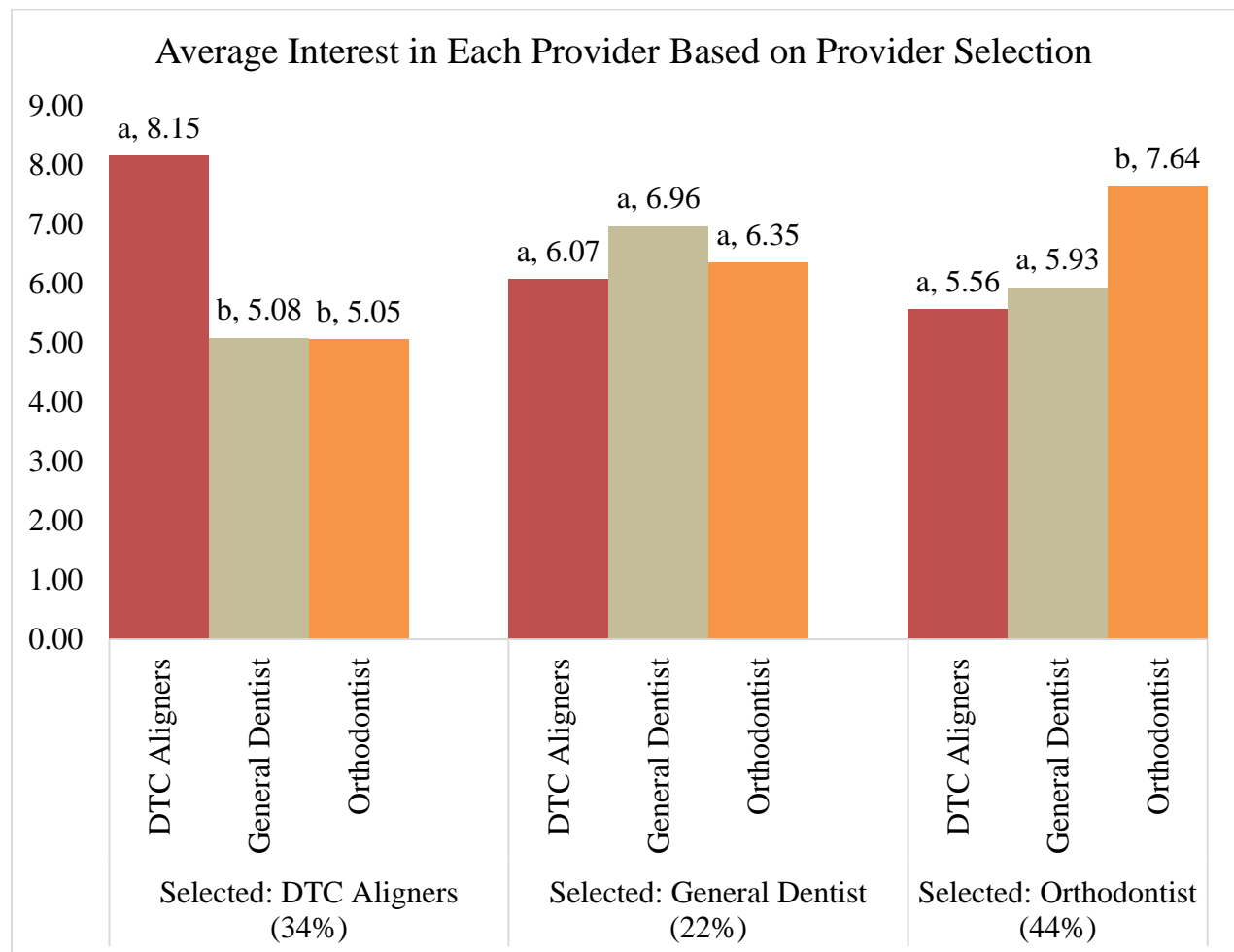
Each respondent also rated their level of interest in pursuing orthodontic treatment from each individual provider option on a scale from 0 to 10. DTC aligners received the highest rating (mean 6.54, standard deviation 3.19), followed by orthodontists (6.44, 3.05) and general dentists (5.84, 2.95). Repeated measures ANOVA found an overall difference in levels of interest between the provider options ($p = 0.0234$). General dentist was rated significantly lower than DTC aligners (5.84 vs 6.54, adjusted p -value=0.0307), and marginally lower than orthodontists (5.84 vs 6.44, adjusted p -value=0.0741). The difference between at-home aligners and orthodontists was not statistically significant (6.54 vs 6.44, adjusted p -value=0.9347).

There was a significant interaction between the level of interest in each provider when categorized by the respondent's definitive selection of a provider (p -value<0.0001). As expected,

those who selected DTC aligners for their provider rated DTC aligners significantly higher than general dentist and orthodontist (Tukey's adjusted p -value <0.0001 for both comparisons).

Similarly, those who selected an orthodontist rated orthodontist significantly higher than DTC aligners (p -value <0.0001) and general dentist (p -value $=0.0005$). For those who selected general dentist, however, interest levels in each of the three provider types did not differ significantly from each other. See Figure 2.

Figure 2: Average Interest in Each Provider Based on Provider Selection



*Within each provider type, categories labeled with the same letter were not significantly different; results from Repeated Measures ANOVA

Respondents were also asked questions regarding their current knowledge of provider options. 78% of respondents reported that they were currently under the regular care of a general dentist. When asked if general dentists can straighten teeth, 40% responded “yes,” 29% responded “no,” and 31% responded “not sure.” Similarly, when asked whether their general dentist offered services to straighten teeth, 35% responded “yes,” 27% responded “no,” and 37% responded “not sure.” Regarding other provider options, 45% of respondents had heard of DTC aligners prior to taking the survey. The most common way respondents had heard of DTC aligners was through television advertisements (45%), followed by social media and internet advertisements (27%), family and friends (24%), and Google or other search engine (3.5%).

Provider preference was not significantly associated with whether the respondent was under the regular care of a general dentist ($p\text{-value}=0.4151$) or if they had prior knowledge of DTC aligners before the survey ($p\text{-value}=0.5821$). However, provider preference was significantly associated with whether the respondent believed that general dentists can straighten teeth ($p\text{-value}=0.0002$), and whether their general dentist provided orthodontic care ($p\text{-value}<0.0001$). Complete results are given in Table 3.

Table 3: Provider Preference Based on Respondents' Prior Knowledge

	Orthodontist	General Dentist	DTC Aligners	P-value
Are you currently under the care of a general dentist (visit at least once per year)?				0.4151
Yes	85 (44%)	46 (24%)	63 (32%)	
No	24 (44%)	9 (16%)	22 (40%)	
To your knowledge, can a general dentist straighten teeth (with braces, Invisalign®, etc.)?				0.0002
Yes	43 (43%)	35 (35%)	22 (22%)	
No	36 (49%)	10 (14%)	27 (37%)	
Not Sure	30 (39%)	10 (13%)	36 (47%)	
Does your general dentist offer straightening of teeth (braces, Invisalign®, etc.)?				<0.0001
Yes	39 (44%)	33 (38%)	16 (18%)	
No	34 (50%)	8 (12%)	26 (38%)	
Not Sure	36 (39%)	14 (15%)	43 (46%)	
Prior to this survey, had you heard of companies offering at-home straightening of teeth?				0.5821
Yes	45 (40%)	26 (23%)	41 (37%)	
No	64 (47%)	29 (21%)	44 (32%)	

*P-value from Chi-squared test

Respondents also rated the importance of various treatment factors (convenience, quality of treatment, relationship with provider, cost, customer service, recommendations from family/friends, and length of treatment) on a scale from 0 to 10 in terms of importance in their selection of a provider. The importance of a few treatment factors was significantly different based on the respondent's preference for a provider. Those factors included: quality of treatment (p-value=0.0001), cost (p-value=0.0004), and recommendations from family and friends (p-value=0.0046). Specifically, those who preferred DTC aligners rated cost significantly higher than those who preferred orthodontist or general dentist (9.04 vs 7.93, 7.69, respectively). Ratings for quality of treatment were significantly higher among those who selected an orthodontist or DTC aligners when compared to general dentist (Tukey's adjusted p-

values=0.0292, <0.0001, respectively). Quality of treatment ratings were not different when comparing those who selected orthodontist and those who selected general dentist (Tukey's adjusted p-value=0.0722). Recommendations from family or friends was the lowest rated factor for all three groups and was significantly lower among those who selected DTC aligners compared to those who selected orthodontist or general dentist (4.86 vs 6.15, 6.07, respectively). Full results are given in Table 4.

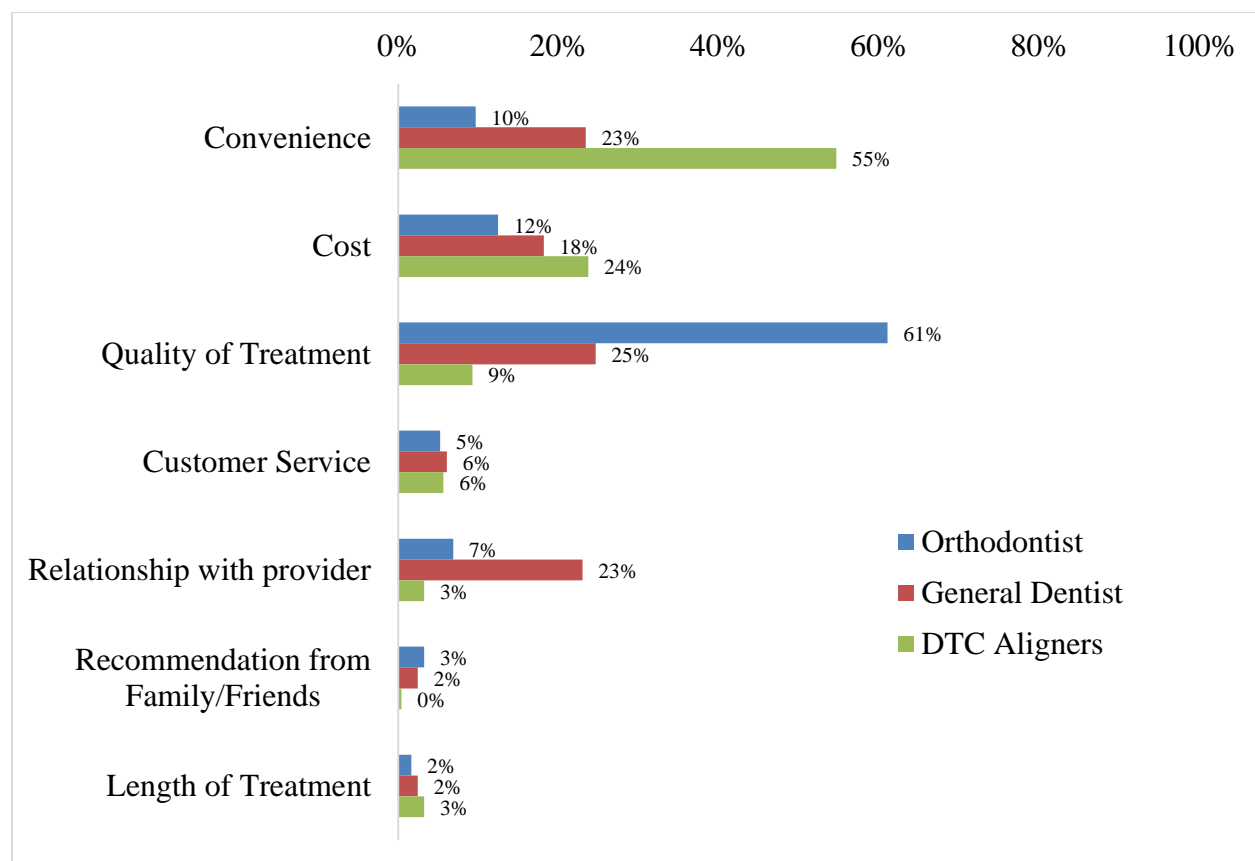
Table 4: Average Importance of Factors Based on Respondent's Provider Preference

	Orthodontist	General Dentist	DTC aligners	P-value
Convenience	7.55, 0.24	6.93, 0.34	7.48, 0.27	0.2985
Quality of Treatment	8.32, 0.20	7.42, 0.29	9.00, 0.23	0.0001
Relationship with provider	6.92, 0.23	6.22, 0.32	6.85, 0.26	0.1805
Cost	7.93, 0.21	7.69, 0.30	9.04, 0.24	0.0004
Customer Service	7.72, 0.21	7.47, 0.29	7.56, 0.24	0.7742
Recommendation from Family/Friends	6.15, 0.27	6.07, 0.38	4.86, 0.31	0.0046
Length of Treatment	7.07, 0.23	7.42, 0.32	7.32, 0.26	0.6263

*P-value from Repeated Measures ANOVA

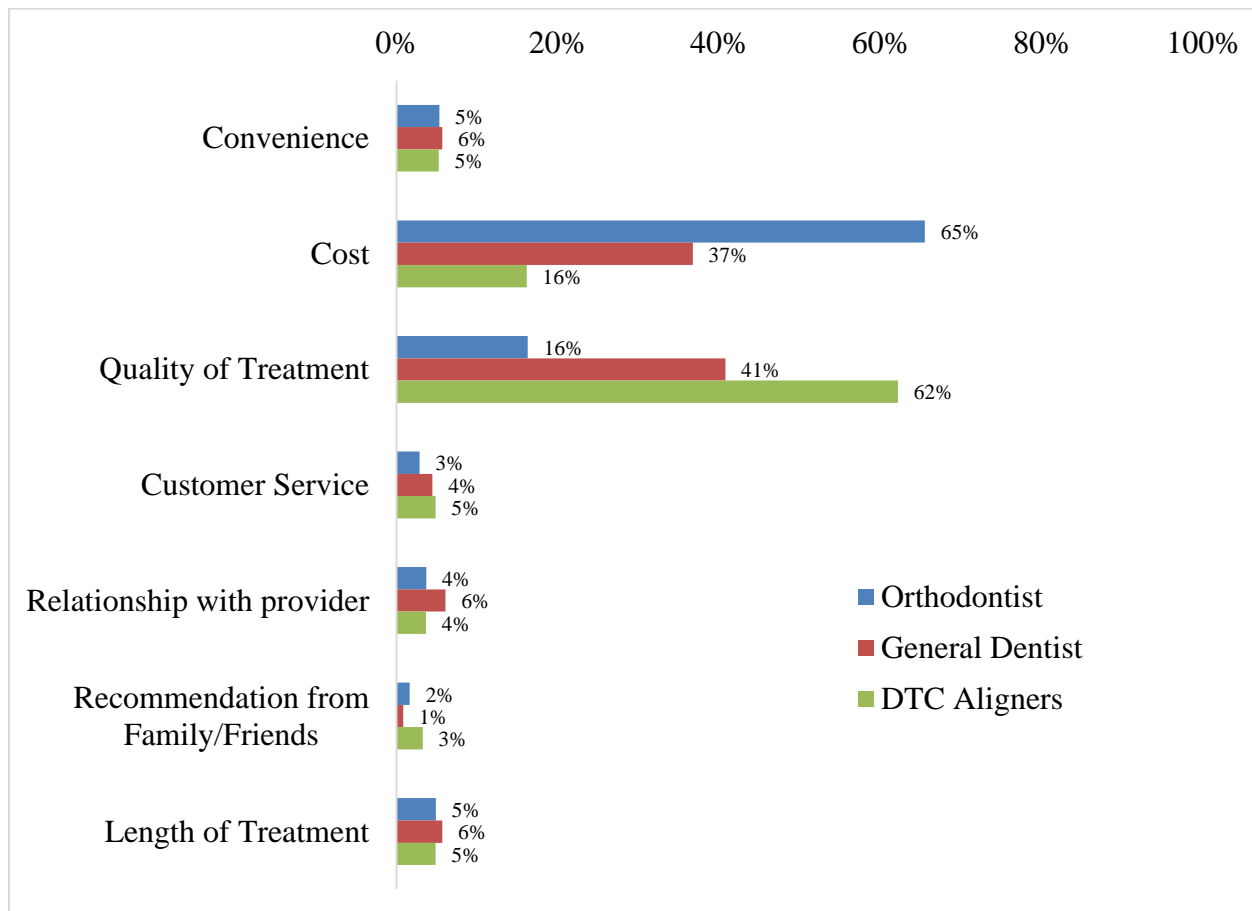
Respondents also indicated the biggest advantage and biggest concern (selecting from the same treatment factors as previously) for each provider type. The biggest advantages and concerns differed significantly based on provider type ($p\text{-value} < 0.0001$). For orthodontists, the biggest advantage indicated most often was quality of treatment (61% vs 25% and 9% for general dentists and DTC aligners, respectively). For general dentists, the biggest advantages were roughly equally distributed among convenience (23%), quality of treatment (25%), relationship with provider (23%), and cost (18%). For DTC aligners, the biggest advantage was convenience (55%), followed by cost (24%). Full results for the biggest advantages are given in Figure 3.

Figure 3: Biggest Advantage by Provider Type



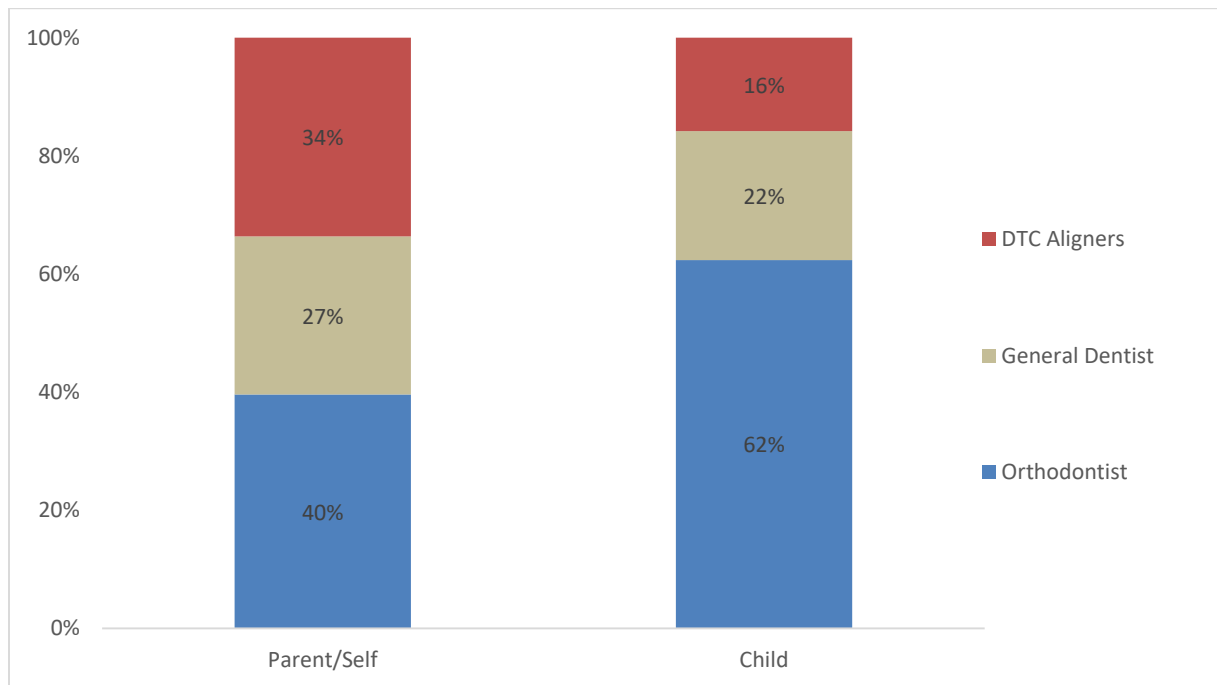
For the biggest concern, cost was rated the highest for orthodontists (65% vs 37% and 16% for general dentists and DTC aligners, respectively). Quality of treatment was selected most often as the biggest concern for both DTC aligners (62%) and general dentists (41%). All other factors were selected less by less than 10% of respondents. Full results for the biggest concerns are given in Figure 4.

Figure 4: Biggest Concern by Provider Type



Among the respondents, 40% indicated that they have a child for whom they may pursue orthodontic treatment in the future. These parents' provider preference for their own orthodontic care differed significantly from their provider preference for their child ($p = 0.0001$). Parents selected orthodontist for themselves 40% of the time compared to 62% when selecting for their child, and DTC aligners 34% of the time for themselves compared to only 16% of the time for their children (Figure 5).

Figure 5: Parents' Provider Preference for Self vs Child (p-value*=0.0001)



*P-value from chi-squared test

DISCUSSION

Since the establishment of the orthodontic specialty in 1900, patients have primarily sought treatment from highly qualified orthodontic specialists. Today, however, increasing numbers of non-specialists also provide orthodontic treatment. Amid a shift toward direct-to-consumer advertising, the emergence of DTC aligners gives potential patients more choices than ever before. This study reports the overall level of interest in each provider group and analyzes the factors affecting patients as they select a provider.

The results of this study are based on a sample that accurately represents the general adult population in the United States. Surveys associated with orthodontic research are often limited to a sample of convenience consisting of current patients, college students, limited geographic areas, or easily obtainable mailing lists.¹⁸⁻²¹ In addition these studies tend to be retrospective in nature, polling patients who have already selected an orthodontist and undergone treatment.²¹ Here, a large commercial polling company was used to obtain a better representation of the general adult population served by orthodontists in the United States, eliminating the bias associated with limited samples and retrospective polling. This study's sample consisted of potential future patients, rather than current or previous patients.

Most of the sample's demographics were consistent with data from the 2010 United States Census.²² Only 6% of respondents identified as Hispanic/Latino (compared to 18.1% in the census) and 4.8% identified as Black/African American (compared to 13.4% in the census). The sample also had higher education levels compared to the U.S. Census, with 41.6% having a bachelor's degree or higher (compared to 30.9%) and only 1.2% having less than a high school degree (compared to 12.8%). Similar ethnic and educational differences have been cited in previous orthodontic studies.^{19,20,23,24}

The only demographic factors that were significantly associated with provider preference were education level, orthodontic insurance coverage, age, and gender. Specifically, respondents with higher education levels and orthodontic insurance coverage selected an orthodontist significantly more often than DTC aligners. Regarding age and gender, young male respondents (18-45 years old) were significantly more likely to select an orthodontist and less likely to select DTC aligners than other age and gender groups. Although no previous data exist regarding the selection of DTC aligners, these results are surprising because previous studies document that females seek orthodontic care more than males.^{25,26} Our findings may be explained by further analysis, which shows that this younger male group also had significantly higher levels of education and more orthodontic insurance coverage, and therefore would be more likely to prefer orthodontists to DTC aligners. Regarding other demographic factors, the respondent's ethnicity, community size, employment status, and use of social media were not significantly associated with provider selection.

This study confirms previous findings that there is a significant demand for orthodontic treatment among adults. Though studies analyzing demand for treatment among adults in the United States are lacking, the need for orthodontic treatment among adults throughout the world ranges from 30-50%, whereas the demand for treatment ranges from 14-37%.^{24,26-29} The percentage of orthodontic patients in the United States who are adults has risen from 5% in 1960 to 27% in 2010.³⁰ More recent data shows that the number of adult patients seeking treatment continues to grow.^{4,31,32} Approximately half of the respondents in this study indicated that they were very interested in treatment (7+ on a scale of 10). Given this high level of interest, the sample represents a pool of potential orthodontic patients who are seriously considering seeking treatment.

Our results showed that adults in the United States have a significant level of interest in pursuing orthodontic treatment with both orthodontists and DTC aligners. While respondents had less interest in treatment with general dentists, the difference between the selection of orthodontists and DTC aligners was not statistically significant. These results are especially interesting given that patients currently undergoing treatment with orthodontists vastly outnumber patients being treated with DTC aligners. There are an estimated 5.42 million patients undergoing active treatment by orthodontic specialists in the United States and Canada,⁴ while DTC aligner companies claimed to have treated as many as 350,000 total patients as of January 2019.³³

Respondents with the highest level of interest in pursuing treatment preferred orthodontists by a significant margin, while those with only moderate interest preferred DTC aligners by a similarly wide margin. This pronounced difference suggests that those who are ready to proceed with treatment are likely to select an orthodontist, while those who are more hesitant to proceed with treatment prefer DTC aligners. In addition, respondents who selected an orthodontist as their preferred provider had very low interest levels in DTC aligners. Similarly, those who selected DTC aligners had little interest in orthodontists. These results suggest that patients who undergo treatment with an orthodontist are unlikely to have otherwise undergone treatment with DTC aligners, and vice versa. Taken together, our results may provide some reassurance to orthodontists who are concerned that the emergence of DTC aligners will significantly disrupt the patient flow in their practices.

Orthodontic specialists are educated to provide comprehensive care for a range of complex malocclusions, whereas DTC aligners tend to focus on simple alignment of teeth. Because of this, one may expect respondents who perceive their treatment to be more complex to

prefer orthodontists. However, no association was found between self-perceived complexity and the selection of a provider. Interestingly, it has been shown that individuals with less complex malocclusions often have a greater interest in pursuing orthodontic treatment than those with more complex malocclusions.^{34,35} Together, these findings indicate that an individual's perception of the complexity of their malocclusion does not have a significant impact on their selection of an orthodontic provider. In addition, the results highlight the need to educate potential patients on the value of seeking the opinion of qualified orthodontic professionals to insure that they receive proper care.

Our findings suggest that potential patients often must choose between a perceived higher quality of treatment with an orthodontist or the perceived convenience and lower cost associated with DTC aligners. The biggest advantage for selecting an orthodontist was consistently perceived to be quality of treatment, and the biggest concern was cost. The biggest advantage for selecting DTC aligners was convenience, followed by cost, and the biggest concern was quality of treatment. Interestingly, 61% of those who selected DTC aligners believed quality of treatment to be the biggest concern, indicating that the respondents selected DTC aligners despite believing them to be a lower quality treatment option. These respondents likely selected DTC aligners because they placed an increased value on convenience and cost.

Previous studies on the role of convenience in the selection of a provider have focused on convenience factors that can be provided by an orthodontist, such as evening appointments, Saturday openings, and accessible office locations, all of which were found to be of moderate importance.^{18,20} Because patients undergoing treatment with DTC aligners do not have regular office visits, these convenience factors do not apply. Some might believe that DTC aligners are less convenient because they often require patients to take their own impressions or wait for mail

orders, while limiting access to a provider when concerns arise. Our results, however, suggest that potential patients more often see DTC aligners as a convenient alternative, eliminating the need to attend regular office visits and reducing the need to take time off from work.

Regarding cost, studies have shown that having a favorable payment plan has a far greater impact on a patient's provider selection than the overall cost of treatment.^{18,21,36} Given that cost is perceived as the biggest disadvantage for orthodontists, it is recommended that orthodontists provide payment plans that are appropriately catered to patient needs.

Recommendations from family and friends and a patient's relationship with the provider appeared to also play an important role in the selection of a provider. The importance of recommendations from family and friends was rated significantly higher among those who selected orthodontists and general dentists than for those who selected DTC aligners. This finding is supported by previous studies showing that peers have a significant effect in influencing patients to seek treatment,³⁷ and that a provider's reputation is an important factor in a patient's decision-making process.^{18,20} Respondents in our survey did not rate relationship with the provider highly for any selected provider. Previous studies have shown that having a doctor with a caring attitude is the most important factor in selecting an orthodontist.^{20,21} Because these studies were retrospective surveys, patients had already established a positive relationship with their provider at the time of the survey, possibly explaining why they rated the relationship higher.

Our findings regarding the selection of a general dentist highlight the need to educate potential patients as they choose an orthodontic provider. The respondents who selected a general dentist had roughly equal levels of interest in all three provider groups. This finding suggests that while these respondents selected a general dentist, they may be easily influenced to

select a different provider. The same trend was not seen among respondents who selected an orthodontist or DTC aligners, who all expressed very low levels of interest in any other provider group besides the one they selected. In addition, there was not a clear understanding among respondents as to whether or not general dentists could provide orthodontic treatment. Many respondents also cited both cost and quality of treatment as advantages for a general dentist, while many others cited both factors as disadvantages. Together, these findings indicate that there is a lack of knowledge among the general public regarding the role of a general dentist in providing orthodontic care. Studies have shown that orthodontists evaluate orthodontic case complexity more accurately and treat cases in less time with better quality outcomes compared to general dentists.^{15,38} By better educating potential patients on the value of treatment with highly qualified orthodontic specialists, patients will be equipped to make a properly informed decision regarding their orthodontic care.

We found that 45% of respondents had heard of DTC aligners prior to taking the survey, highlighting the rapid nature of their emergence as a treatment option. The most common way respondents learned of DTC aligners was through television advertisements, followed by social media and internet advertisements, then family and friends. With the traditional referral-based orthodontic marketing model, patients selected an orthodontic provider based on a referral from their general dentist. Direct-to-consumer marketing, which has emerged as a significant strategy for DTC aligner companies, places an increased emphasis on the product itself rather than on the service delivered by the provider. Proponents of direct-to-consumer marketing claim that it empowers consumers with information, while its opponents are concerned that it does not give patients the full disclosure needed to make an informed decision regarding treatment.³ While there is evidence that clear aligners can be used effectively to treat various malocclusions,³⁹

previous studies have all been performed under the direct supervision of dental professionals. There are no studies currently available regarding the safety and effectiveness of treatment with DTC aligners.

Direct-to-consumer marketing has emerged as a significant strategy not only for DTC aligners, but also for some orthodontists. While the specialist's appeal to general dentists and current patients for referrals remains the main source of patients, marketing strategies have expanded significantly in recent years, with an increase in external marketing. Though websites have been popular among orthodontists for many years, it has now become common to invest \$10,000-\$20,000 in more elaborate websites to attract new patients.³ In 2015, 89% of patients or their parents and 76% of orthodontists utilized social media,¹⁹ and patients are increasingly turning to information on the internet to select a provider.⁴⁰ It is important for orthodontists to be aware of these trends to better understand their potential patients' decision-making process and more effectively cater to them.

Parents' provider preference for their own orthodontic care differed significantly from their preference for their child. Though many parents selected DTC aligners for themselves, the vast majority preferred that their child see an orthodontist. A number of possible explanations for this exist. Parents may desire the highest quality of treatment for their children, but be willing to compromise for their own treatment. Parents may believe that they would be compliant with DTC aligners, while their children would not. Others may perceive that it is more socially acceptable for their children to go to an orthodontist than it is for adults. They may choose DTC aligners due to the convenience of eliminating office visits, avoiding the need to take additional time off from work. It has been shown that mothers are the primary decision makers, rather than children themselves, in selecting an orthodontic provider.¹⁸ Therefore, we can expect that most

children, who represent the largest portion of orthodontic patients, will continue to seek treatment with orthodontists.

Limitations in this study were mainly due to the nature of survey-based research. Great care was taken to minimize bias by avoiding leading questions and preventing respondents from returning to previous questions after obtaining new information. The information presented to the respondents regarding provider options was kept neutral, providing only factual information. Surveying prospective patients in the general population is relatively rare in orthodontic research, allowing for minimal bias.

This study provides valuable insight regarding the impact of DTC aligners on the consumer habits of potential patients. It can be used to provide direction to orthodontists as they seek to meet the needs of their patients, as well as offer valuable information to the leaders of professional organizations as they advocate for the interests of their members.

CONCLUSIONS

- Adults in the United States have a significant level of interest in pursuing orthodontic treatment with orthodontists and DTC aligners, and to a lesser degree, with general dentists.
- Adults with the highest level of interest in seeking orthodontic care tend to select an orthodontist, whereas those with moderate levels of interest tend to select DTC aligners.
- A significant portion of adults who select an orthodontist for their treatment would not otherwise have undergone treatment with DTC aligners, and vice versa.
- Males under the age of 45 with higher levels of education and orthodontic insurance coverage tend to prefer orthodontists to DTC aligners.
- Adults tend to select orthodontists due to quality of treatment, whereas they select DTC aligners due to convenience and cost.
- Even among parents who prefer DTC aligners for their own treatment, parents tend to select an orthodontist for their child's treatment.
- There is a significant need to educate potential patients on the value of pursuing treatment with highly qualified orthodontic specialists

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APPENDIX

Appendix 1: Complete Survey

You are invited to participate in a research study investigating how people choose a treatment provider to straighten their teeth. All responses are anonymous and no personal identifiers will be collected. Your participation in this study is voluntary. You may stop answering questions at any point and withdraw from the study. The survey should take 5 – 10 minutes to complete. If you elect to participate, please read and follow the instructions below. Thank you for your participation.

The survey contains questions about your interest in straightening your teeth. For the purpose of this study we ask that you answer all questions based on potential treatment for yourself, **not based on treatment for your child or any other dependent.**

We thank you for your willingness to participate in this study.

If you have any further questions, you may contact the research team at:

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1. Have you ever had your teeth straightened? (i.e. with braces, Invisalign®, etc.):

☐ Yes

☐ No

a. If yes, how long ago did you have your teeth straightened?

☐ <1 year ago

☐ 1-5 years ago

☐ 6-10 years ago

☐ 10+ years ago

☐ I am currently undergoing treatment to straighten my teeth

2. Please indicate your current level of interest in straightening your teeth on a scale from 0-10, with 0 being 'not interested' and 10 being 'extremely interested:'

Not interested 0 1 2 3 4 5 6 7 8 9 10 Extremely interested
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

3. In your opinion, how complex would expect your treatment to be, considering the amount of straightening your teeth require?

☐ Simple

☐ Moderate

☐ Complex

4. Please indicate how important each of the following factors would be to you while selecting a treatment provider to straighten your teeth. Rate each factor on a scale from 0-10, with 0 being 'not important' and 10 being 'extremely important:'

a. **Convenience**

Not important 0 1 2 3 4 5 6 7 8 9 10 Extremely important
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

b. **Quality of treatment**

Not important 0 1 2 3 4 5 6 7 8 9 10 Extremely important
☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

c. **Relationship with provider**

Not important ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely important

d. **Cost**

Not important ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely important

e. **Customer service**

Not important ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely important

f. **Recommendation from family/friends**

Not important ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely important

g. **Length of treatment**

Not important ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely important

5. Are you currently under the care of a general dentist (visit at least once per year)?

☐ Yes ☐ No

6. To your knowledge, can a general dentist straighten teeth (with braces, Invisalign®, etc.)?

☐ Yes ☐ No ☐ Not sure

7. Does your general dentist offer straightening of teeth (braces, Invisalign®, etc.)?

☐ Yes ☐ No ☐ Not sure

Traditionally, straightening of teeth is a service provided by orthodontists, who have received additional education beyond dental school. However, many general dentists also provide services to straighten teeth.

Recently, a new option for straightening teeth has become available, allowing individuals to straighten their teeth from home at a reduced cost. With this option, patients receive at-home kits to take an impression, or mold, of their teeth. These impressions are then mailed in to a company that makes a series of clear aligners, which are returned to the patients. By wearing these clear aligners, patients straighten their teeth from home without regular visits or direct supervision from a treatment provider.

8. Prior to this survey, had you heard of companies offering at-home straightening of teeth?

☐ Yes

☐ No

a. If yes, where did you hear about it? (Mark all that apply)

☐ From family/friends

☐ Social media/internet advertisement

☐ Television advertisement

☐ Google or other search engine

☐ Other. Please describe _____

9. Please answer the following question as though you have decided to pursue treatment to straighten your teeth. Please indicate your level of interest in each of the following treatment provider options, on a scale from 0 to 10, with 0 being 'not interested' and 10 being 'extremely interested':

a. **Orthodontist**

Not interested ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely interested

b. **General Dentist**

Not interested ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely interested

a. **At-home aligners**

Not interested ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 Extremely interested

10.

- a. In your opinion, which of the following is the biggest advantage of straightening teeth with an **orthodontist**?

- | | |
|---|---|
| <input type="checkbox"/> Convenience | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Quality of treatment | <input type="checkbox"/> Customer service |
| <input type="checkbox"/> Relationship with provider | <input type="checkbox"/> Recommendation from family/friends |
| <input type="checkbox"/> Length of treatment | <input type="checkbox"/> Other. Please describe: _____ |

- b. Which of the following is your biggest concern with straightening teeth with an **orthodontist**?

- | | |
|---|---|
| <input type="checkbox"/> Convenience | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Quality of treatment | <input type="checkbox"/> Customer service |
| <input type="checkbox"/> Relationship with provider | <input type="checkbox"/> Recommendation from family/friends |
| <input type="checkbox"/> Length of treatment | <input type="checkbox"/> Other. Please describe: _____ |

11.

- a. In your opinion, which of the following is the biggest advantage of straightening teeth with a **general dentist**?

- | | |
|---|---|
| <input type="checkbox"/> Convenience | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Quality of treatment | <input type="checkbox"/> Customer service |
| <input type="checkbox"/> Relationship with provider | <input type="checkbox"/> Recommendation from family/friends |
| <input type="checkbox"/> Length of treatment | <input type="checkbox"/> Other. Please describe: _____ |

- b. Which of the following is your biggest concern with straightening teeth with a **general dentist**?

- | | |
|---|---|
| <input type="checkbox"/> Convenience | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Quality of treatment | <input type="checkbox"/> Customer service |
| <input type="checkbox"/> Relationship with provider | <input type="checkbox"/> Recommendation from family/friends |
| <input type="checkbox"/> Length of treatment | <input type="checkbox"/> Other. Please describe: _____ |

12.

- a. In your opinion, which of the following is the biggest advantage of straightening teeth with **at-home aligners**?

- | | |
|---|---|
| <input type="checkbox"/> Convenience | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Quality of treatment | <input type="checkbox"/> Customer service |
| <input type="checkbox"/> Relationship with provider | <input type="checkbox"/> Recommendation from family/friends |
| <input type="checkbox"/> Length of treatment | <input type="checkbox"/> Other. Please describe: _____ |

- b. Which of the following is your biggest concern with straightening teeth with **at-home aligners**?

- | | |
|---|---|
| <input type="checkbox"/> Convenience | <input type="checkbox"/> Cost |
| <input type="checkbox"/> Quality of treatment | <input type="checkbox"/> Customer service |
| <input type="checkbox"/> Relationship with provider | <input type="checkbox"/> Recommendation from family/friends |
| <input type="checkbox"/> Length of treatment | <input type="checkbox"/> Other. Please describe: _____ |

13. If you were to proceed with treatment to straighten your teeth, which provider/option would you choose?

- ☐ Orthodontist
☐ General Dentist
☐ At-home Aligners
☐ Other. Please Explain _____

14. Do you have a child for whom you may pursue straightening of teeth in the future?

- ☐ Yes ☐ No

- a. If yes, which provider/option would you choose to straighten your child's teeth?

- ☐ Orthodontist
☐ General Dentist
☐ At-home Aligners
☐ Other. Please Explain _____

And a few final questions for statistical purposes...

15. Please indicate your age:

- ☐ 0-18 yo ☐ 18-24 yo ☐ 25-34 yo ☐ 35-44 yo
☐ 45-54 yo ☐ 55-65 yo ☐ 66+ yo

16. Please indicate your gender:

- ☐ Male ☐ Female

17. Please specify your ethnicity:

- ☐ Non-Hispanic Caucasian ☐ Hispanic or Latino ☐ Black or African American
☐ Native American ☐ Asian/Pacific Islander ☐ Other

18. Please indicate the highest level of education you have completed:

- ☐ Not graduated from High School ☐ High School/GED
☐ AA / Some College ☐ Bachelors degree ☐ Education beyond Bachelors degree

19. Please indicate the size of the community you live in:

- ☐ Small Town (less than 2,500) ☐ Town/Small city (2,500-50,000)
☐ Large City (50,000-500,000) ☐ Metropolitan (more than 500,000)

20. Are you currently employed?:

- ☐ Yes, full-time ☐ Yes, part-time ☐ No

21. Do you have dental insurance?:

- ☐ Yes ☐ No ☐ Not sure

a. If yes, does it cover orthodontic treatment (braces, Invisalign®, etc.)?

☐ Yes

☐ No

☐ Not sure

22. Please indicate how often you view/use social media:

☐ Multiple times per day

☐ Once per day

☐ Once per week

☐ Less than once per week

☐ I never use social media

Thank you for your time and effort in the completion of the above survey. Please feel free to write comments on the following page. Please do not include any personal identifying information.

Comments: