Preferences of Fixed Orthodontic Appliance Use in Conjunction with Clear Aligner Therapy

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Jacob A. Powell, D.D.S.

San Antonio, TX

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The views expressed in this study are those of the authors and do not reflect the official policy of the United States Air Force, the Department of Defense, or the United States Government. The authors do not have any financial interest in the companies whose materials are discussed in this article.

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DEDICATION

I dedicate this work to my beautiful wife, Annalisa, and my four wonderful children, Jacob, Audrey, Ethan, and Colette, who have supported me and endured so much throughout my education. I also give a special thanks to my parents, Robert and Lois, for teaching me and guiding me to a path of success in all facets of life. And finally, I dedicate this project to my Heavenly Father, who has blessed me with abundance and given me the strength to achieve my goals.

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ABSTRACT

Purpose: To determine preferences for the use of conventional fixed orthodontic appliances in conjunction with clear aligner therapy (CAT), such as Invisalign, amongst dental providers primarily in the United States of America (U.S.A). **Methods**: A survey was composed and sent to approximately 2300 orthodontists and 45,600 dentists. The questionnaire focused on gathering information regarding the subjects' use of CAT for certain malocclusions, premolar extraction cases, incisor extraction cases, and orthognathic cases. It explores preferences in respect to the use of fixed appliances for either beginning or finishing clear aligner treatment. Analysis of the data was performed to determine providers' preferences in using fixed appliances. Data between two groups (orthodontists and non-orthodontists) was compared to look for any statistically significant differences. **Results**: Orthodontists were more likely than non-orthodontists to use fixed appliances to finish CAT on Class I ($p=.0113$), premolar extraction ($p=.0015$), and incisor extraction cases ($p=.0011$) when using Invisalign, and on Class I ($p=.0004$) cases when using ClearCorrect. Non-orthodontists were more likely than orthodontists to use fixed appliances to finish Cl III cases ($p=.0174$) when using in-house lab CAT. Roughly half of the providers (53.4%) believe that midcourse corrections are "often" or "very often" necessary. **Conclusions**: Orthodontists are generally more likely to use fixed appliances to finish CAT, depending on the brand and case type. About half of dentists believe that midcourse corrections are "often" or "very often" necessary.

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I. INTRODUCTION

In the 1940's, Dr. Harold Kesling broke convention in orthodontic technique by developing his thermoplastic "tooth positioner". Using a series of these positioners, he was able to accomplish orthodontic movement to a desired position. Since the 1980s, clear thermoplastic sheets have been used as aligners for minor tooth movements. Both of these techniques require extensive laboratory time and materials. Therefore, they were not very cost-effective.

All of this changed with technological advancements in stereolithography. In the late 1990s, Align Technology used this innovation to create a sequence of 3D printed casts and multiple aligners to achieve greater tooth movement. This form of therapy is generally referred to as Clear Aligner Therapy (CAT). Today, several proprietary companies (Invisalign, ClearCorrect, MTM, CA, Originator, etc) are an extremely popular alternative to conventional orthodontic therapy among patients and dentists alike. Patients are drawn to the obvious benefit of wearing virtually invisible appliances (Walton, 2010).

But how does CAT perform in comparison to traditional orthodontic methods? According to *Contemporary Orthodontics* (Proffit, 2013), CAT reportedly performs well in clinical applications that involve mild to moderate crowding, mild to moderate spacing, distal tipping of molars, posterior dental expansion, lower incisor extraction for severe crowding, and absolute intrusion. Conversely, CAT reportedly does not perform well with severe rotations, dental expansion for blocked-out teeth, high ectopic canines, leveling by relative intrusion, molar uprighting, incisor extrusion, translation of molars, and closing

premolar extraction spaces. However, Proffit noted that incisor extrusion, translation of molars, and closing premolar extraction spaces can possibly be achieved using attachments. In 2003, Bollen et al discovered that once patients completed their aligner sequence, they either required an additional set of aligners or fixed appliance therapy to reach their initial treatment objectives.

Using the ABO objective grading system (OGS), Djeu (2005) looked at treatment outcomes of 48 Invisalign and traditional appliance cases. The Invisalign group lost 13 OGS points more than the braces group on average, and the OGS passing rate for Invisalign was 27% lower than that for braces. Invisalign scores lower than braces for buccolingual inclination, occlusal contacts, occlusal relationships, and overjet.

The few studies on extraction cases are case reports. Two cases reported success in closing extraction spaces (Womack 2006, Honn 2006). However, a case report of upper first premolar extractions showed that space closures of extraction were the result of crown tipping of the adjacent teeth rather than bodily movement. This led to a need to continue the treatment with a phase of fixed appliance therapy to achieve the desired tooth movements (Giancotti, 2006).

Kravitz (2009) concluded that the mean accuracy of tooth movement with Invisalign was 41%. The most accurate movement was lingual constriction (47.1%) and the least accurate movement was extrusion (29.6%). If teeth

required rotation of more than 15 degrees, the accuracy of the rotation fell significantly.

Vicens and Russo (2010) performed a study that compared the use of Invisalign by orthodontists and general practitioners. They found several significant differences between the two groups. General dentists were starting more Invisalign cases than orthodontists within a 12 month period leading up to the survey. When looking at both groups, those who had been certified in Invisalign longer started less Invisalign cases in the 12 months leading up to the survey. Differences in opinion were also found regarding what level of experience was necessary to treat a Class I malocclusion with a large diastema and whether a Class II subdivision case should be treated with Invisalign.

More recent studies have shown CAT in a more favorable light. Perhaps this is a result of improvement and evolution of the appliance. With the use of attachments and bonded hooks for elastics, more significant tooth movement can occur. Rossini (2015) found an 88% predictability in upper molar distalization. He also concluded that CAT was effective in controlling anterior intrusion.

Li et al (2015) compared an extraction Invisalign treatment group with a traditional braces group on the basis of Discrepancy Index (DI) score. The initial DI score was greater than 25. The finished cases were graded using the ABO grading system. In the Invisalign group, 48 cases received passing grades, and 24 received failing grades. In the braces group, 60 passed and 20 failed. There

was no significant statistical difference in the pass rate between the two groups. However, Invisalign took longer (31.5 months compared to 22 months).

Other case studies have indicated that it was possible to use Invisalign appliances in conjunction with orthognathic surgery to treat severe skeletal jaw discrepancies (Womack 2008, Boyd 2005). However, treatment in the Boyd article had to use fixed appliances almost 30% of the treatment time to achieve a desired result.

Gu et al (2017) published a retrospective case-control study that compared the treatment effectiveness and efficiency of the Invisalign system with conventional fixed appliances. Using the peer assessment rating (PAR) index, pretreatment and posttreatment records of 48 Invisalign and 48 fixed appliance patients were evaluated. Treatment outcome, duration, and improvement between the two groups were analyzed. Posttreatment weighted PAR scores were not statistically different between the two groups. On average, Invisalign treatment was completed 5.7 months faster than treatment with fixed appliances, which is statistically significant. However, the odds of achieving a “great improvement” (Richmond, 1992) in the Invisalign group were 0.329 times the odds of achieving a “great improvement” in the fixed appliance group.

II. OBJECTIVES

A. Purpose of Study

The primary purpose of this study is to determine if orthodontists and non-orthodontists differ in their preferences for the use of conventional fixed orthodontic appliances in conjunction with clear aligner therapy. Secondary purposes of the study are to determine the overall (orthodontists and non-orthodontists) preferences of using fixed appliances with CAT. This study will explore the likelihood of fixed appliance use specifically to begin or finish treatment with multiple brands of CAT used in various malocclusions and cases types. It will also investigate the likelihood of fixed appliance use for American Board of Orthodontics (ABO) cases, whether providers propose that fixed appliances may be necessary as a part of treatment, and reasons for not using fixed appliances to start or finish CAT.

B. Specific Hypothesis

There is a difference between orthodontists and non-orthodontic providers in their preferences for using fixed appliances in conjunction with clear aligner therapy.

C. Null Hypothesis

There is no difference between orthodontists and non-orthodontic providers in their preferences for using fixed appliances in conjunction with clear aligner therapy.

III. MATERIALS AND METHODS

A. Experimental Design

This study was conducted by formulating a questionnaire (Figure 1, see Appendix) intended for dental providers that utilize CAT in their practice. Those who do not use CAT were promptly disqualified from taking the survey with the first question. The survey consists of a range of 28 to 83 questions. The number of questions depends on how many different brands of CAT the individual uses.

The questionnaire began by asking if the provider used CAT in their practice. If answered affirmatively, the survey continued. If answered no, the survey ended and the provider was disqualified from the study. The next 4 questions determined the respondent's primary specialty in the dental field and their experience with using fixed appliances and CAT. It is assumed that the majority of these providers are either orthodontists or general dentists. However, all dental specialties were included.

The next section of the questionnaire consisted of 11 questions that are specific to the brand of CAT they use. The brands included in the survey were Invisalign, ClearCorrect, MTM, CA, and Originator. Also included were clear aligners that are fabricated in the provider's in-house lab. If the provider uses multiple brands then the same questions were repeated for each brand. If the provider does not use a particular brand then the survey automatically skipped those questions and resumed to the next brand.

In order to gain an understanding of their experience using that product the respondent was asked how many cases per year they start for that particular brand of CAT. Next, the survey inquired which age groups (adult or adolescent) the provider tends to use CAT for.

We found that it would be useful to know if orthodontists are using CAT for board certification by the American Board of Orthodontists (ABO). Requirements for passing the ABO exam require a high standard of treatment. Whether or not orthodontists use CAT for their ABO board patients may indicate their level of confidence in achieving an ideal finish with CAT. A follow up question was necessary to inquire if fixed appliances were likely to be used for finishing these cases.

Next, the provider was asked what their level of likelihood is for using that brand of CAT for several types of malocclusion or cases. The different categories are Class I malocclusion, Class II correction, Class III correction, premolar extractions, lower incisor extractions, open bite, and orthognathic surgery. Afterward, they were asked to indicate if they inform the patient that it may be necessary to use fixed appliances to begin and/or finish treatment for each of the above case types. They were also asked to indicate their level of likelihood for using fixed appliances to begin and/or finish each case type. Then, they indicated their level of agreement or disagreement for reasons listed to not use fixed appliances in conjunction with CAT. The reasons are as follows:

1. Not necessary for achieving an ideal finish
2. Patient rejection

3. Increased costs
4. I don’t carry bracket systems in my clinic
5. Increased chair time

Following this, the respondent was asked how often they believe a “midcourse correction” is necessary for this particular brand of CAT to achieve an ideal result.

To end the questionnaire, a series of demographic questions were asked. These include gender, age, which dental school they attended, when they graduated dental school, how they received their CAT training, and in what state or territory they practice. The state or territory they indicated was then converted to its corresponding region based on the United States Census Bureau.

This survey was sent via email to approximately 2,300 orthodontists who are members of the American Association of Orthodontists (AAO). An additional 45,600 emails were sent to dental providers in the U.S.A. The survey was hosted on the website www.surveymonkey.com. Analysis of the data was performed to determine providers’ preferences in using fixed appliances. Data between two groups of orthodontists and non-orthodontists was compared to look for any statistically significant differences.

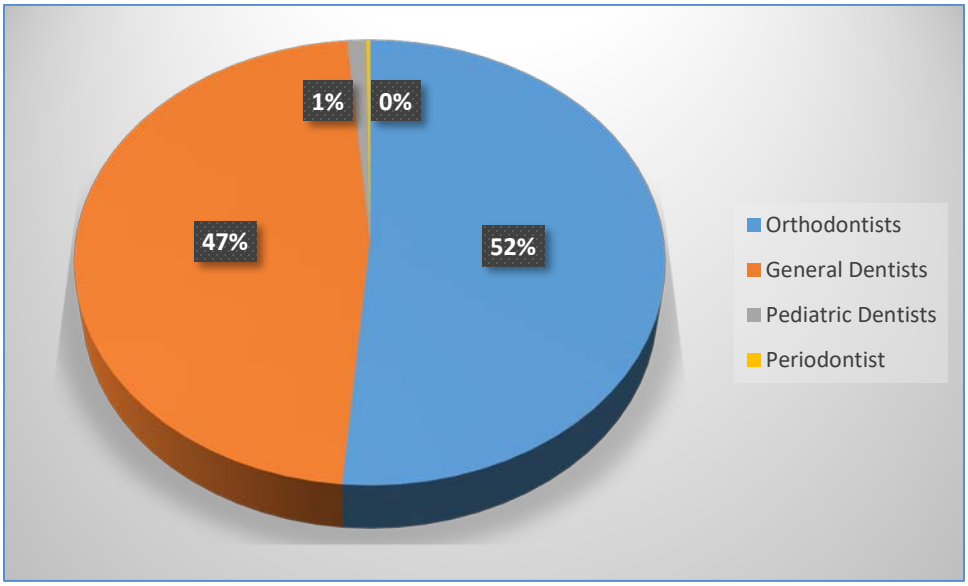
Refer to Figure 1 in the Appendix for the complete questionnaire as found on www.surveymonkey.com.

IV. RESULTS

A total of 723 providers began the survey. However, only 440 of them completed it. The 283 unfinished surveys were discarded. Data was only gathered and analyzed from the completed questionnaires.

Of the 440 respondents, 226 described their primary specialty as being an orthodontist, 208 were general dentists, 5 were pediatric dentists, and 1 was a periodontist (See Figure 2). For statistical analyses, the respondents were divided up into two groups; orthodontists and non-orthodontists.

Figure 2. Dental specialties among respondents



A total of 349 respondents indicated that they use Invisalign, the most of all the brands. The second most commonly used clear aligner were those made by the provider's in-house lab (98 out of 440). The next brand was ClearCorrect, used

by 95 of the providers. After this was MTM, as 22 reported using this brand. No providers reported using CA or Originator brands of clear aligner therapy.

When comparing orthodontists and non-orthodontists in their tendencies of telling patients that fixed appliances may be needed to finish clear aligner therapy, several significant differences were identified. The Pearson Chi-Square test was used to compare percentages. When Invisalign is used, orthodontists are more likely than non-orthodontists to tell their patients that fixed appliances may be necessary to finish cases with Cl I malocclusions (35.2% vs 15.8%, $p<.0001$), premolar extractions (72.5% vs 44%, $p=.0008$), and lower incisor extractions (55.4% vs 28.9%, $p<.0001$). A similar trend exists with orthognathic surgery cases (67.6% vs 45.8%), however the result is only close to statistical significance ($p=.0573$).

When ClearCorrect is used, orthodontists are more likely than non-orthodontists to tell their patients that they may need fixed appliances to finish the case if they present with a Cl I malocclusion (69.2% vs 29%, $p=.0005$) or need a lower incisor extraction (88.9% vs 39.1%, $p=.0112$).

Only 22 respondents indicated using MTM, and even less may use it for any given case type. For example, only two providers report using it for premolar extraction cases. As a result, the comparisons were either insignificant or significance was indeterminable due to an insufficient sample size. Also, for in-house lab fabricated clear aligners, there were no significant differences between

orthodontists and non-orthodontists in their tendencies to tell patients that fixed appliances may be necessary to finish treatment.

Some significant differences were also identified when comparing orthodontists and non-orthodontists in their likelihood of using fixed appliances to finish clear aligner therapy. The Wilcoxon rank sum test was used to compare rank sum scores. When Invisalign is used, orthodontists are more likely than non-orthodontists to finish with fixed appliances in cases with Cl I malocclusions (185.3 vs 161.3, p=.0113), premolar extractions (83.2 vs 61, p=.0015), and lower incisor extractions (135.6 vs 106, p=.0011).

When using ClearCorrect, orthodontists are more likely than non-orthodontists to use fixed appliances to finish Cl I cases (55.7 vs 36.1, p=.0004).

Once again, with treatment involving MTM clear aligners, the sample size was minimal and was either determined to be insignificant or significance was indeterminable.

When using in-house lab fabricated clear aligners, non-orthodontists were found to be more likely to use fixed appliances to finish Cl III cases than orthodontists (20.9 vs 12.8, p=.0174).

When comparing orthodontists and non-orthodontists in their preferences of telling patients that fixed appliances may be needed to begin clear aligner therapy, there were several significant findings. The Pearson Chi-Square test was used to compare percentages. When Invisalign is used, orthodontists are more likely than non-orthodontists to tell their patients that fixed appliances may be

necessary to begin cases with Cl I malocclusions (16.3% vs 5.7%, p=.0022) and Cl II malocclusions (25.3% vs 13%, p=.0117).

With both ClearCorrect and MTM brands, no statistically significant differences were found. Similar to previous discussions, much of the data for MTM was not sufficient enough to determine statistical significance.

With in-house lab CAT, non-orthodontists were more likely to tell patients they may need fixed appliances to begin cases involving Cl II malocclusions (40% vs 5%, p.0153), Cl III malocclusions (5% vs 57.1%, p=.0022), premolar extractions (66.7% vs 8.3%, p=.045), lower incisor extraction (62.5% vs 20%, p=.0415), and orthognathic surgery (75% vs 0%, p=.002).

When exploring differences between orthodontists and non-orthodontists in their likelihood of using fixed appliances to begin clear aligner therapy, only a few statistical differences were discovered. The Wilcoxon rank sum test was used to compare rank sum scores. Orthodontists who use Invisalign are more likely than non-orthodontists to use fixed appliances to begin CAT with patients who have Cl I malocclusion (184.1 vs 162.9, p=.0197), Cl II malocclusion (154.7 vs 130.2, p=.0048), and lower incisor extractions (132.3 vs 111.9, p=.0151). No other differences were found for this category with the other CAT brands.

The results of these comparisons between orthodontists and non-orthodontists and their preferences in telling patients that fixed appliances may be needed and ultimately using fixed appliances in conjunction with CAT are summarized in Table 1 below. Significant values in which orthodontists and non-

orthodontists differed in their preferences ($p<0.05$) are highlighted in yellow and green, respectively.

Table 1. Differences in provider preferences for fixed appliances with CAT

		Class 1	Class 2	Class 3	Premolar ext	Incisor ext	Open bite	Orthognathic Surg
Inform patient that fixed appliances may be needed to finish CAT	Invisalign	O, p<.0001	p=0.494	p=0.2195	O, p=.0008	O, p<.0001	p=0.602	p=.0573
	ClearCorrect	O, p=.0005	p=.0549	p=0.6269	p=0.2662	O, p=.0112	p=1.0	ID
	MTM	p=0.7656	ID	ID	ID	p=0.505	ID	ID
	In-house Lab	p=0.1846	p=0.3329	p=0.2662	p=0.3055	p=0.5257	p=0.1948	p=0.2102
Likelihood of using fixed appliances to finish CAT	Invisalign	O, p=.0113	p=.0751	p=0.8813	O, p=.0015	O, p=.0011	p=0.8123	p=0.1271
	ClearCorrect	O, p=.0004	p=0.1453	p=.0780	p=0.3032	p=0.3148	p=0.190	p=0.5440
	MTM	p=0.4323	ID	ID	ID	p=0.2482	ID	ID
	In-house Lab	p=0.4513	p=0.7970	NO, p=.0174	p=0.7547	p=0.4254	p=0.2449	p=0.4091
Inform patient that fixed appliances may be needed to begin CAT	Invisalign	O, p=.0022	O, p=.0117	p=0.3282	p=.0779	p=0.1129	p=0.5381	p=0.1370
	ClearCorrect	p=0.8009	p=0.8277	p=0.3869	p=0.5991	p=0.7633	p=0.2142	ID
	MTM	p=0.5392	ID	ID	ID	p=0.3865	ID	ID
	In-house Lab	p=0.1842	NO, p=.0153	NO, p=.0022	NO, p=.0450	NO, p=.0415	p=.0992	NO, p=.0020
Likelihood of using fixed appliances to begin CAT	Invisalign	O, p=.0197	O, p=.0048	p=0.3261	p=0.2486	O, p=.0151	p=0.1922	p=0.2579
	ClearCorrect	p=.0927	p=0.5820	p=0.8470	p=0.1827	p-0.3586	p=0.4350	p=0.5121
	MTM	p=0.8814	ID	ID	ID	ID	ID	ID
	In-house Lab	p=0.2682	p=0.5889	p=0.5228	p=0.7397	p=0.9268	p=0.6761	p=0.3316

ID = Insufficient Data

NO = Non-orthodontist

O = Orthodontist

Orthodontists and non-orthodontists also differ in their level of agreement regarding reasons for not using fixed appliances with clear aligner therapy. Each brand was evaluated by the respondent choosing their level of agreement for reasons to not start and/or finish CAT with fixed appliances. To compare the two groups, the Wilcoxon rank sum test was used.

When using the Invisalign brand, non-orthodontists exhibited a higher level of agreement than orthodontists with the following reasons for not using fixed

appliances. 1. Patient rejection (194.3 vs 159, p=.0006). 2. Increased costs (197.9 vs 156, p<.0001). 3. Do not carry bracket systems in the clinic (244.1 vs 117.9, p<.0001). 4. Increased chair time (215.1 vs 141.8, p<.0001).

With ClearCorrect brand, non-orthodontists were also more likely than orthodontists to agree with these reasons for not using fixed appliances. 1. Not necessary for achieving an ideal finish (52.0 vs 37.9, p=.0193). 2. Increased costs (54.4 vs 31.8, p=.0001). 3. Do not carry bracket systems in the clinic (55.6 vs 28.8, p<.0001). 4. Increased chair time (53.3 vs 34.5, p=.0021).

For non-orthodontists using MTM, there was a higher level of agreement that not carrying bracket systems in the clinic was a reason for avoiding the use of fixed appliances to begin or finish CAT (13.1 vs 6, p=.0220).

When treating with clear aligners fabricated in an in-house lab, non-orthodontists were more likely than orthodontists to agree with the following reasons for not using fixed appliances. 1. Increased costs (58.8 vs 44.3, p=.0137). 2. Do not carry bracket systems in the clinic (59.0 vs 44.2, p=.0036). 3. Increased chair time (61.6 vs 42.8, p=.0013).

Orthodontists and non-orthodontists also differ in their view for how often a midcourse correction of Invisalign treatment is necessary to achieve an ideal result. A Wilcoxon rank sum test result indicated that orthodontists believed a midcourse correction during treatment for Invisalign cases was needed significantly more often than for non-orthodontists (194.6 vs 151.3, p<.0001).

There was no statistically significant difference in this measurement between the two groups for the remaining three clear aligner brands.

The likelihood of using fixed appliances to finish clear aligner therapy for all respondents combined (orthodontists and non-orthodontists) was examined. The total of those that indicated they are likely to use, very likely to use, and only use fixed appliances to finish each case type and each brand was calculated. The following table (Table 2) shows these totals, the total sample size, and the percentage of respondents that are likely to use, very likely to use, or only use fixed appliances to finish treatment with each brand. The final portion of the table shows the combined results for all of the brands.

Table 2. Providers' reliance on fixed appliances to finish CAT

Invisalign

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	12	349	3.4%
Cl II	83	349	23.8%
Cl III	140	349	40.1%
Premolar extraction	214	349	61.3%
Incisor extraction	119	349	34.1%
Open bite	111	349	31.8%
Orthognathic surgery	256	349	73.4%

Clear Correct

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	15	95	15.8%
Cl II	51	95	53.7%
Cl III	77	95	81.1%
Premolar extraction	76	95	80.0%
Incisor extraction	65	95	68.4%
Open bite	73	95	76.8%
Orthognathic surgery	86	95	90.5%

MTM

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	4	22	18.2%
Cl II	16	22	72.7%
Cl III	20	22	90.9%
Premolar extraction	21	22	95.5%
Incisor extraction	19	22	86.4%
Open bite	21	22	95.5%
Orthognathic surgery	21	22	95.5%

In-house Lab

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	16	98	16.3%
Cl II	70	98	71.4%
Cl III	73	98	74.5%
Premolar extraction	86	98	87.8%
Incisor extraction	4	98	4.1%
Open bite	16	98	16.3%
Orthognathic surgery	20	98	20.4%

All combined

	Don't use CAT, Very likely or Likely	Total	Percentage
Class I	47	564	8.3%
Class II	220	564	39.0%
Class III	310	564	55.0%
Premolar extraction	397	564	70.4%
Incisor extraction	207	564	36.7%
Open bite	221	564	39.2%
Orthognathic surgery	383	564	67.9%

The same questions were asked, with the difference of determining the likelihood of using fixed appliances to begin (rather than finish) clear aligner therapy. Data for all respondents was combined (orthodontists and non-orthodontists). The total of those that indicated they are likely to use, very likely to use, and only use fixed appliances to begin each case type and each brand was calculated. Table 3 illustrates these totals, the total sample size, and the percentage of respondents that are likely to use, very likely to use, or only use fixed appliances to begin each brand. The final portion shows results for all of the brands combined.

Table 3. Providers' reliance on fixed appliances to begin CAT

Invisalign

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	16	349	4.6%
Cl II	88	349	25.2%
Cl III	163	349	46.7%
Premolar extraction	238	349	68.2%
Incisor extraction	126	349	36.1%
Open bite	123	349	35.2%
Orthognathic surgery	279	349	79.9%

Clear Correct

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	23	95	24.2%
Cl II	54	95	56.8%
Cl III	72	95	75.8%
Premolar extraction	75	95	78.9%
Incisor extraction	64	95	67.4%
Open bite	71	95	74.7%
Orthognathic surgery	85	95	89.5%

MTM

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	2	22	9.1%
Cl II	15	22	68.2%
Cl III	18	22	81.8%
Premolar extraction	20	22	90.9%
Incisor extraction	18	22	81.8%
Open bite	21	22	95.5%
Orthognathic surgery	21	22	95.5%

In-house Lab

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	11	98	11.2%
Cl II	69	98	70.4%
Cl III	73	98	74.5%
Premolar extraction	79	98	80.6%
Incisor extraction	75	98	76.5%
Open bite	76	98	77.6%
Orthognathic surgery	84	98	85.7%

All combined

	Don't use CAT, Very likely or Likely	Total	Percentage
Cl I	52	564	9.2%
Cl II	226	564	40.1%
Cl III	326	564	57.8%
Premolar extraction	412	564	73.0%
Incisor extraction	283	564	50.2%
Open bite	291	564	51.6%
Orthognathic surgery	469	564	83.2%

The number of years that the provider has been using clear aligners influences preferences for beginning with fixed appliances. A Kruskal-Wallis test showed that there was a statistically significant difference in preference of using fixed orthodontic appliances to begin treatment for Class III corrections for those who used the ClearCorrect brand therapy among the groups of number of years the provider has been using clear aligner, $\chi 2(3) = 8.01$, $p = 0.046$, with a mean rank score of 17.00 for 10-15 years, 9.69 for 0-5 years, 9.33 for 15-20 years, and 7.30 for 5-10 years. This indicates that those providers with 10-15 years of experience using CAT are more likely to begin ClearCorrect treatment on a Class III patient with fixed appliances.

A Kruskal-Wallis test also showed that dentists who graduated from dental school between 1970-80 were more likely to finish Invisalign treatment on a Class I patient with fixed appliances than were those who graduated in other decades ($\chi 2(3) = 14.86$, $p = 0.011$, with a mean rank score of 207.79 for 1970-80, 186.18 for 1990-2000, 171.58 for 2010 to present, 160.91 for 1980-1990, 158.19 for 2000-10, and 147.30 for 1970 or earlier).

When comparing regions of where the providers practice, there are no significant differences in preferences for beginning or finishing with fixed appliances.

Only 3 of the 226 orthodontists that completed the survey indicated that they have used CAT for cases that they took to challenge the American Board of Orthodontics (ABO) board exam. Of those three, one reports being very likely to use fixed appliances, one reports being neither likely nor unlikely to used fixed appliances, and one reports being unlikely to use fixed appliances for an ABO case. This sample size was too small to calculate any statistical significance.

The reasons for not using fixed appliances with CAT by all providers (orthodontists and non-orthodontists) were also evaluated by grouping those that strongly agree or agree with each reason for each brand. Table 4 summarizes these results by reporting the total that strongly agree or agree, the total sample size, and the percentage value of providers that strongly agree or agree.

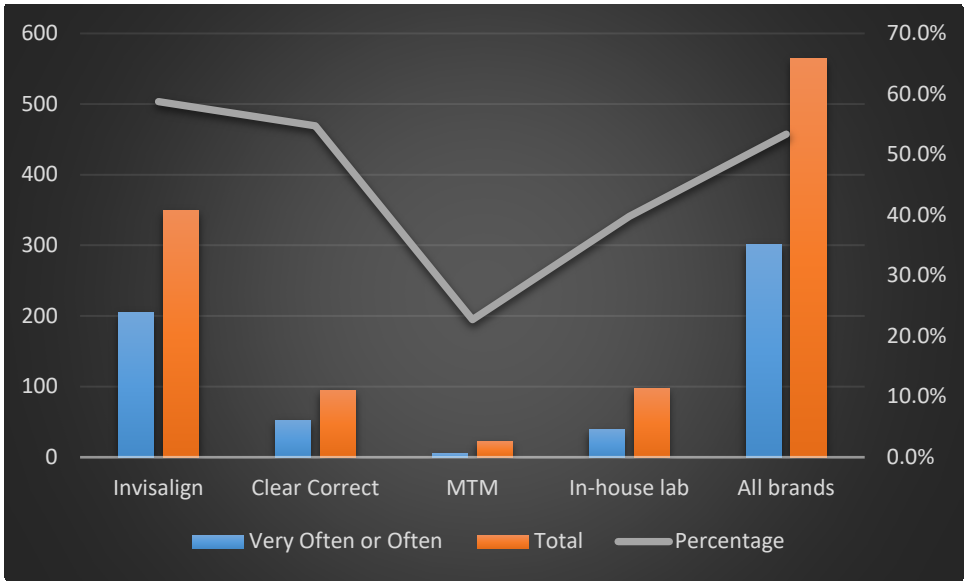
Table 4. Reasons for not using fixed appliances with CAT

		Strongly agree or agree	Total	Percentage
Invisalign	Not necessary for an ideal finish	237	349	67.9%
	Patient rejection	237	349	67.9%
	Increased costs	200	349	57.3%
	Provider doesn't carry brackets	98	349	28.1%
	Increased chairtime	129	349	37.0%
Clear Correct	Not necessary for an ideal finish	46	95	48.4%
	Patient rejection	65	95	68.4%
	Increased costs	58	95	61.1%
	Provider doesn't carry brackets	34	95	35.8%
	Increased chairtime	37	95	38.9%
MTM	Not necessary for an ideal finish	10	22	45.5%
	Patient rejection	13	22	59.1%
	Increased costs	11	22	50.0%
	Provider doesn't carry brackets	6	22	27.3%
	Increased chairtime	11	22	50.0%
In-house lab	Not necessary for an ideal finish	54	98	55.1%
	Patient rejection	54	98	55.1%
	Increased costs	43	98	43.9%
	Provider doesn't carry brackets	9	98	9.2%
	Increased chairtime	36	98	36.7%
All brands	Not necessary for an ideal finish	347	564	61.5%
	Patient rejection	369	564	65.4%
	Increased costs	312	564	55.3%
	Provider doesn't carry brackets	147	564	26.1%
	Increased chairtime	213	564	37.8%

All providers' responses were gathered for how often they believe a midcourse correction during treatment was necessary to achieve ideal results. Those who responded "very often" or "often" were grouped together. A total of 205 of the 349 (58.7%) Invisalign providers, 52 of the 95 (54.7%) ClearCorrect providers, 5 of the 22 (22.7%) MTM providers, and 39 of the 98 (39.8%) in-house

lab CAT providers responded accordingly. The following Figure 3 summarizes these results with a total for all of the CAT brands.

Figure 3. Provider's Preference for Using Midcourse Correction



V. STATISTICAL ANALYSIS

The data in this study are either categorical or ordinal variables. Categorical data were presented as the number (percentage) of participants, and the Pearson Chi-square was used to test for association. Wilcoxon rank sum test (nonparametric two sample t-test) or Kruskal-Wallis test (nonparametric one-way ANOVA) was used to compare the ranks between/among groups. Statistical analyses were performed using SAS version 9.4 (Statistical Analysis Software, Cary, NC).

VI. DISCUSSION

The purpose of this study was to determine if orthodontists and non-orthodontists differ in their preferences for the use of conventional fixed orthodontic appliances in conjunction with clear aligner therapy. This study also attempts to explore preferences for using fixed appliances with CAT among all providers (orthodontists and non-orthodontists). Numerous studies have been accomplished that focused on strengths and weaknesses of CAT. Other studies have assessed and compared efficacy of both conventional fixed appliances and CAT. However, to our knowledge, no studies have investigated providers' preferences in their use of fixed appliances in conjunction with CAT.

A goal of 385 responses to the survey was surpassed, as 440 completed questionnaires were obtained. Collection of 440 surveys with up to 83 potential questions answered on each survey resulted in an enormous amount of data. Due

to the massive amount of data and the numerous possibilities for comparing different responses among different demographical categories, the authors have chosen to mostly report data that seemed the most relevant to the objectives of the research project. Also, much of the statistics that show no significant results were omitted for purposes of brevity and primarily only those values of $p < 0.05$ are reported and discussed.

As expected, most of the respondents were orthodontists and general dentists. The survey was open to all dental providers as some may have training in CAT, but may fall under other specialty groups. In this study, 5 pediatric dentists and 1 periodontist completed the questionnaire. They were grouped with the general dentists in a "non-orthodontist" category.

As expected, Invisalign is the most popular brand used. CA and Originator brands were completely removed from analysis because no subjects reported using these products. CA is a product used predominantly in Europe. This survey was sent primarily to providers in the United States of America. Originator is a product from TP Orthodontics, based in Indiana. Coincidently, this company was founded by Dr. Harold Kesling, the pioneer of thermoplastic tooth positioners. Originator was introduced in 2010 and has not gained as much market share as other CAT competitors.

Comparisons were made between orthodontists and non-orthodontists' likelihood of finishing and beginning CAT with fixed appliances. They were also compared in their likelihood of proposing to the patient that fixed appliances may

be necessary to either finish or begin CAT. These inquiries were made for all 4 brands. For most of these comparisons, no statistical difference was found. However, when a difference was found, orthodontists were generally more likely to incorporate fixed orthodontic appliances in their CAT treatment. Orthodontists were more likely than non-orthodontists to:

1. Tell their patients fixed appliances may be necessary to finish Invisalign cases with Class I malocclusions, premolar extractions, and lower incisor extractions.
2. Tell their patients fixed appliances may be necessary to finish ClearCorrect cases with Class I malocclusions and lower incisor extractions.
3. Use fixed appliances to finish Invisalign cases with Class I malocclusions, premolar extractions, and lower incisor extractions.
4. Use fixed appliances to finish ClearCorrect cases with Class I malocclusions.
5. Tell their patients fixed appliances may be necessary to begin Invisalign cases with Class I and Class II malocclusions.
6. Use fixed appliances to begin Invisalign cases with Class I and Class II malocclusions, and lower incisor extractions.

Non-orthodontists were more likely than orthodontists to:

1. Use fixed appliances to finish in-house lab CAT cases with Class III malocclusion.

2. Tell their patients fixed appliances may be necessary to begin in-house lab CAT cases with Class II and Class III malocclusions, premolar extractions, lower incisor extraction, and orthognathic surgery.

It is plausible to expect orthodontists to be more likely to use and to suggest to the patient that it may be necessary to use conventional fixed appliances. The additional training and experience of a specialist enhances their understanding of proper occlusal relations. Also, orthodontists may hold themselves to standards set forth by the ABO when preparing a case for board certification. Moreover, patients seeking orthodontic treatment through their general dentist may be referred to the orthodontist if the case is more difficult, while the simple or moderately difficult cases are kept by the general dentists. The more difficult pool of cases treated by an orthodontist may inherently be more likely to require fixed appliances to achieve a “greater improvement”, as described by Richmond (1992).

Non-orthodontists were more likely than orthodontists to use fixed appliances to finish in-house lab CAT and to tell patients that fixed appliances may be needed to begin in-house lab CAT. There is no obvious explanation for this trend other than the sample size was quite small and may not be reliable.

As orthodontists are more likely than non-orthodontists to incorporate fixed appliances in their CAT practice, it is understandable that they would differ in their reasoning for not using fixed appliances. Non-orthodontists, more often than orthodontists, indicated that they don’t use fixed appliances with Invisalign because of patient rejection, increased costs, no bracket systems in their clinic,

and increased chair time. When using ClearCorrect, non-orthodontists were more likely to not use fixed appliances because they are not necessary for achieving an ideal finish, increased costs, no bracket systems in their clinic, and increased chair time. For MTM, not carrying bracket systems in the clinic was more likely to be a reason for non-orthodontists to opt out of using fixed appliances. For in-house lab CAT, non-orthodontists were more likely to avoid fixed appliance use because of increased costs, no bracket systems in their clinic, and increased chair time. In no instance were orthodontists more likely to attribute any of these reasons as rationale for avoiding fixed appliance use with all brands of CAT.

When providing CAT to a patient, the provider can decide to "reboot" the treatment if the trays are not seating properly and the case is not tracking as planned. This is often referred to as a midcourse correction, or a refinement. Certain brands, including Invisalign, include this option in the treatment fee. For Invisalign cases, orthodontists are more likely than non-orthodontists to believe that a midcourse correction is necessary to achieve an ideal result. For all other brands there was no difference in opinion on this matter.

Now that we understand how orthodontists and non-orthodontists differ and are similar in many of their preferences for using fixed appliances with CAT, it is helpful to observe the overall (orthodontists and non-orthodontists) preferences for providers. The responses "very likely", "likely", and "I don't use brand X for this case type" were grouped together. This grouping can help us understand how difficult it can be to achieve an ideal result for certain case types because providers

either find it necessary to use fixed appliances frequently with CAT, or avoid using CAT altogether.

Trends observed are that Class I cases, in general, show a small percentage of providers finishing with fixed appliances in conjunction with the clear aligners. This is an obvious expectation, as Class I malocclusions tend to be easier cases to treat. For no apparent reason, incisor extraction and orthognathic cases treated with in-house lab aligners registered a low percentage for providers finishing with fixed appliances. When results for all clear aligner brands are combined, we generally see that less providers use fixed appliances for Class I cases (8.3%), whereas premolar extraction (70.4%), orthognathic surgery (67.9%), and Class III cases (55%) yield a higher percentage of providers opting to utilize fixed appliances. Traditionally, these case types can be more difficult, especially the closing of extraction spaces. A higher likelihood of using fixed appliances to finish these cases can be attributed to the level of difficulty.

Similar findings were observed when determining the likelihood of using fixed appliances to begin CAT. Providers are least likely to use fixed appliances to begin Class I cases (9.2%). Orthognathic surgery (83.2%) and premolar extraction cases (73%) yield the highest percentage of those choosing to use fixed appliances. The same reasons of level of difficulty are assumed to influence these findings.

Providers with 10-15 years of experience using CAT are more likely to begin ClearCorrect treatment for a Class III patient using fixed appliances. More

experience with using CAT may help the provider to understand the appropriate applications and limitations of the product and may influence them to use fixed appliances when difficult cases arise. However, if this was the reason for this particular finding then one would expect to see similar trends among other traditionally difficult case types, such as premolar extractions and orthognathic surgery cases.

Similar reasoning can be applied to the finding that providers who graduated from dental school in the 1970's are more likely to finish Invisalign treatment with fixed appliances on Class I patients. Those with more experience or a more traditional dental education may feel more comfortable incorporating conventional treatment methods into modern treatment modalities. But again, if this were true then we would observe this finding among the other brands and the more difficult case types.

A reliable manner of assessing efficacy of CAT is whether or not orthodontists use this treatment for the ABO board exam and if they used fixed appliances in conjunction with the clear aligners. The ABO currently requires (but is in the process of phasing out) submitted cases by the examinee. The finished casts and the treatment plan and progress of the patient are evaluated by board examiners using the Cast-Radiograph Evaluation and Case Management Form. A provider's willingness to submit a CAT case for rigorous and objective grading at such a high standard indicates the provider's true perception regarding the efficacy of CAT. Of the 226 orthodontists that completed the survey, only 3 reported using CAT for ABO cases. This was not a large enough sample size to

perform any statistical analysis. Also, the survey did not inquire if orthodontists were board certified or not. In retrospect, this question should have been included in the survey. Since the total number of board certified orthodontists in the survey is unknown, no conclusions can be made regarding the tendencies for providers to use, or not use, CAT for board cases.

All providers' responses for their reasons for not using CAT were grouped together for each brand. These findings are illustrated in Table 4. When the choice is made to not use fixed appliances with CAT, the majority of providers strongly agree or agree that fixed appliances are not needed to achieve an ideal finish (61.5%), patients will reject fixed appliances (65.4%), and using fixed appliances will increase costs (55.3%). An ideal finish is a subjective definition. Perhaps an ideal result, as it pertains to this question, is perceived as being "good enough"; the patient is pleased, the esthetics are acceptable, and occlusion is satisfactory. Patients rejecting fixed appliances is understandable. Esthetic demands are a reality and patients seek CAT for the esthetic benefits. Using both fixed appliances and paying a proprietary company for their product will clearly increase costs. Since these companies routinely include refinements or midcourse corrections in their fee, providers would find financial benefit in selecting these options rather than cutting into their fixed appliance inventory.

The results for how often providers find a midcourse correction necessary to achieve an ideal result are found in Figure 3. When combining the data for all 4 brands, we see that roughly half (53.4%) of providers report that a midcourse correction is necessary to achieve an ideal result.

VII. CONCLUSIONS

The following conclusions were derived from this study:

1. The null hypothesis was rejected. There are differences between orthodontists and non-orthodontic providers in their preferences for using fixed appliances in conjunction with clear aligner therapy.

2. For most comparisons among the various brands and case types, orthodontists and non-orthodontists were not statistically different in their preferences. However, when there were differences among the company brands, orthodontists were more likely to use fixed appliances with CAT. When there were differences among in-house lab CAT use, non-orthodontists were more likely to use fixed appliances with CAT.

3. Compared to non-orthodontists, orthodontists believe that a midcourse correction is needed more often to finish Invisalign cases with an ideal result.

4. Class I cases are the least likely to be treated with fixed appliances and premolar extraction and orthognathic surgery cases are the most likely to be treated with fixed appliances.

5. When providing reasons for not using fixed appliances with CAT, the majority of providers agree or strongly agree that it is not necessary for achieving an ideal finish, patients will reject it, and increased costs will occur.

6. Roughly half (53.4%) of providers believe that a midcourse correction is necessary to achieve an ideal result.

VIII. APPENDICES

Figure 1. Questionnaire as found on www.surveymonkey.com (next page)

1. Do you provide clear aligner therapy (e.g., Invisalign) in your practice? If no, this survey does not apply to you.

- ◯ Yes
- ◯ No

2. What is your primary dental specialty?

- ◯ General Dentist
- ◯ Orthodontist
- ◯ Pediatric Dentist
- ◯ Periodontist
- ◯ Endodontist
- ◯ Oral Surgeon
- ◯ Prosthodontist
- ◯ Oral Radiologist
- ◯ Oral Pathologist
- ◯ Public Health Dentist

3. How many **FIXED** appliance orthodontic cases (brackets and wires) do you start per year?

- ◯ 1-50
- ◯ 51-100
- ◯ 101-150
- ◯ 151-200
- ◯ 201-250
- ◯ 251-300
- ◯ 301 and above
- ◯ None

1

4. How many years have you been providing **FIXED** appliance orthodontic (brackets and wires) treatment?

- ◯ 0-5 years
- ◯ 5-10 years
- ◯ 10-15 years
- ◯ 15-20 years
- ◯ 20 years or more

5. How many years have you been providing clear aligner therapy?

- ◯ 0-5 years
- ◯ 5-10 years
- ◯ 10-15 years
- ◯ 15-20 years
- ◯ 20 years or more

6. Do you use Invisalign brand clear aligner therapy?

- ◯ Yes
- ◯ No

7. How many patients do you start per year for Invisalign? Please type a number of your best estimation.

8. What age groups do you use Invisalign for?

- ◯ Only adults
- ◯ Mostly adults
- ◯ Equal amount of adults and adolescents
- ◯ Mostly adolescents
- ◯ Only adolescents

9. Have you ever used Invisalign for an American Board of Orthodontics (ABO) case?

- ◯ Yes
- ◯ No

10. For your Invisalign American Board of Orthodontics (ABO) cases, how likely were you to include fixed orthodontic appliances as a part of treatment?

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely or unlikely
- ◯ Unlikely
- ◯ Very unlikely
- ◯ Not applicable

11. Please choose your level of likelihood for using Invisalign with the following case type.

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Class I malocclusion	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯

12. When discussing an Invisalign treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to finish treatment for the following case types?

	Yes	No	I don't use Invisalign for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

13. For Invisalign cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to finish clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use Invisalign for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

14. When discussing an Invisalign treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to begin treatment for the following case types?

	Yes	No	I don't use Invisalign for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

15. For Invisalign cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to begin clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use Invisalign for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

16. Please specify your level of agreement or disagreement with the following statement related to your reasons for not starting/finishing Invisalign cases with brackets?

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Not necessary for achieving an ideal finish	◯	◯	◯	◯	◯
Patient rejection	◯	◯	◯	◯	◯
Increased costs	◯	◯	◯	◯	◯
I don't carry bracket systems in my clinic	◯	◯	◯	◯	◯
Increased chairtime	◯	◯	◯	◯	◯

17. For Invisalign cases, how often do you believe a "midcourse correction" during treatment is needed to achieve ideal results?

- ◯ Very Often
- ◯ Often
- ◯ Neither Often nor Rarely
- ◯ Rarely
- ◯ Very Rarely

18. Do you use ClearCorrect brand clear aligner therapy?

- ◯ Yes
- ◯ No

19. How many patients do you start per year for ClearCorrect? Please type a number of your best estimation.

20. What age groups do you use ClearCorrect for?

- ◯ Only adults
- ◯ Mostly adults
- ◯ Equal amount of adults and adolescents
- ◯ Mostly adolescents
- ◯ Only adolescents

21. Have you ever used ClearCorrect for an American Board of Orthodontics (ABO) case?

- ◯ Yes
- ◯ No

22. For your ClearCorrect American Board of Orthodontics (ABO) cases, how likely were you to include fixed orthodontic appliances as a part of treatment?

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely or unlikely
- ◯ Unlikely
- ◯ Very unlikely
- ◯ Not applicable

23. Please choose your level of likelihood for using ClearCorrect with the following case type.

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Class I malocclusion	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯

24. When discussing a ClearCorrect treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to finish treatment for the following case types?

	Yes	No	I don't use ClearCorrect for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

25. For ClearCorrect cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to finish clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use ClearCorrect for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

26. When discussing a ClearCorrect treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to begin treatment for the following case types?

	Yes	No	I don't use ClearCorrect for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

27. For ClearCorrect cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to begin clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use ClearCorrect for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

28. Please specify your level of agreement or disagreement with the following statement related to your reasons for not starting/finishing ClearCorrect cases with brackets?

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Not necessary for achieving an ideal finish	◯	◯	◯	◯	◯
Patient rejection	◯	◯	◯	◯	◯
Increased costs	◯	◯	◯	◯	◯
I don't carry bracket systems in my clinic	◯	◯	◯	◯	◯
Increased chairtime	◯	◯	◯	◯	◯

29. For ClearCorrect cases, how often do you believe a "midcourse correction" during treatment is needed to achieve ideal results?

- ◯ Very Often
- ◯ Often
- ◯ Neither Often nor Rarely
- ◯ Rarely
- ◯ Very Rarely

30. Do you use MTM brand clear aligner therapy?

- ◯ Yes
- ◯ No

31. How many patients do you start per year for MTM? Please type a number of your best estimation.

32. What age groups do you use MTM for?

- ◯ Only adults
- ◯ Mostly adults
- ◯ Equal amount of adults and adolescents
- ◯ Mostly adolescents
- ◯ Only adolescents

33. Have you ever used MTM for an American Board of Orthodontics (ABO) case?

- ◯ Yes
- ◯ No

34. For your MTM American Board of Orthodontics (ABO) cases, how likely were you to include fixed orthodontic appliances as a part of treatment?

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely or unlikely
- ◯ Unlikely
- ◯ Very unlikely
- ◯ Not applicable

35. Please choose your level of likelihood for using MTM with the following case type.

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Class I malocclusion	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯

36. When discussing a MTM treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to finish treatment for the following case types?

	Yes	No	I don't use MTM for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

37. For MTM cases, how likely are you to use fixed orthodontic appliances (brackets and wires) tofinish clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use MTM for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

38. When discussing a MTM treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to begin treatment for the following case types?

	Yes	No	I don't use MTM for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

39. For MTM cases, how likely are you to use fixed orthodontic appliances (brackets and wires) tobegin clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use MTM for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

40. Please specify your level of agreement or disagreement with the following statement related to your reasons for not starting/finishing MTM cases with brackets?

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Not necessary for achieving an ideal finish	◯	◯	◯	◯	◯
Patient rejection	◯	◯	◯	◯	◯
Increased costs	◯	◯	◯	◯	◯
I don't carry bracket systems in my clinic	◯	◯	◯	◯	◯
Increased chairtime	◯	◯	◯	◯	◯

41. For MTM cases, how often do you believe a "midcourse correction" during treatment is needed to achieve ideal results?

- ◯ Very Often
- ◯ Often
- ◯ Neither Often nor Rarely
- ◯ Rarely
- ◯ Very Rarely

42. Do you use CA brand clear aligner therapy?

- ◯ Yes
- ◯ No

43. How many patients do you start per year for CA? Please type a number of your best estimation.

44. What age groups do you use CA for?

- ◯ Only adults
- ◯ Mostly adults
- ◯ Equal amount of adults and adolescents
- ◯ Mostly adolescents
- ◯ Only adolescents

45. Have you ever used CA for an American Board of Orthodontics (ABO) case?

- ◯ Yes
- ◯ No

46. For your CA American Board of Orthodontics (ABO) cases, how likely were you to include fixed orthodontic appliances as a part of treatment?

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely or unlikely
- ◯ Unlikely
- ◯ Very unlikely
- ◯ Not applicable

47. Please choose your level of likelihood for using CA with the following case type.

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Class I malocclusion	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯

48. When discussing a CA treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to finish treatment for the following case types?

	Yes	No	I don't use CA for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

49. For CA cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to<u>finish</u> clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use CA for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

50. When discussing a CA treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to <u>begin</u> treatment for the following case types?

	Yes	No	I don't use CA for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

51. For CA cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to<u>begin</u> clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use CA for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

52. Please specify your level of agreement or disagreement with the following statement related to your reasons for not starting/finishing CA cases with brackets.

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Not necessary for achieving an ideal finish	◯	◯	◯	◯	◯
Patient rejection	◯	◯	◯	◯	◯
Increased costs	◯	◯	◯	◯	◯
I don't carry bracket systems in my clinic	◯	◯	◯	◯	◯
Increased chairtime	◯	◯	◯	◯	◯

53. For CA cases, how often do you believe a "midcourse correction" during treatment is needed to achieve ideal results?

- ◯ Very Often
- ◯ Often
- ◯ Neither Often nor Rarely
- ◯ Rarely
- ◯ Very Rarely

54. Do you use Originator brand clear aligner therapy?

- ◯ Yes
- ◯ No

55. How many patients do you start per year for Originator? Please type a number of your best estimation.

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56. What age groups do you use Originator for?

- ◯ Only adults
- ◯ Mostly adults
- ◯ Equal amount of adults and adolescents
- ◯ Mostly adolescents
- ◯ Only adolescents

57. Have you ever used Originator for an American Board of Orthodontics (ABO) case?

- ◯ Yes
- ◯ No

58. For your Originator American Board of Orthodontics (ABO) cases, how likely were you to include fixed orthodontic appliances as a part of treatment?

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely or unlikely
- ◯ Unlikely
- ◯ Very unlikely
- ◯ Not applicable

59. Please choose your level of likelihood for using Originator with the following case type.

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Class I malocclusion	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯

60. When discussing an Originator treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to finish treatment for the following case types?

	Yes	No	I don't use Originator for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

61. For Originator cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to finish clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use Originator for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

62. When discussing an Originator treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to begin treatment for the following case types?

	Yes	No	I don't use Originator for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

63. For Originator cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to begin clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use Originator for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

64. Please specify your level of agreement or disagreement with the following statement related to your reasons for not starting/finishing Originator cases with brackets?

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Not necessary for achieving an ideal finish	◯	◯	◯	◯	◯
Patient rejection	◯	◯	◯	◯	◯
Increased costs	◯	◯	◯	◯	◯
I don't carry bracket systems in my clinic	◯	◯	◯	◯	◯
Increased chairtime	◯	◯	◯	◯	◯

65. For Originator cases, how often do you believe a "midcourse correction" during treatment is needed to achieve ideal results?

- ◯ Very Often
- ◯ Often
- ◯ Neither Often nor Rarely
- ◯ Rarely
- ◯ Very Rarely

66. Do you use clear aligner therapy fabricated from your own in-house lab?

- ◯ Yes
- ◯ No

67. How many patients do you start per year for in-house lab clear aligner therapy cases? Please type a number of your best estimation.

68. What age groups do you use in-house lab clear aligner therapy cases for?

- ◯ Only adults
- ◯ Mostly adults
- ◯ Equal amount of adults and adolescents
- ◯ Mostly adolescents
- ◯ Only adolescents

69. Have you ever used an in-house lab clear aligner therapy case for an American Board of Orthodontics (ABO) case?

- ◯ Yes
- ◯ No

70. For your in-house lab American Board of Orthodontics (ABO) cases, how likely were you to include fixed orthodontic appliances as a part of treatment?

- ◯ Very likely
- ◯ Likely
- ◯ Neither likely or unlikely
- ◯ Unlikely
- ◯ Very unlikely
- ◯ Not applicable

71. Please choose your level of likelihood for using in-house lab clear aligner therapy with the following case types.

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Class I malocclusion	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯

72. When discussing an in-house lab clear aligner therapy treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to finish treatment for the following case types?

	Yes	No	I don't use in-house aligners for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

73. For in-house lab clear aligner therapy cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to finish clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use in-house aligners for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

74. When discussing an in-house lab clear aligner therapy treatment plan with a patient, do you tell the patient that fixed orthodontic appliances (brackets and wires) may be needed to begin treatment for the following case types?

	Yes	No	I don't use in-house aligners for this case type
Class I malocclusion	◯	◯	◯
Class II corrections	◯	◯	◯
Class III corrections	◯	◯	◯
Premolar extraction	◯	◯	◯
Lower incisor extraction	◯	◯	◯
Open bite	◯	◯	◯
Orthognathic surgery	◯	◯	◯

75. For in-house lab clear aligner therapy cases, how likely are you to use fixed orthodontic appliances (brackets and wires) to begin clear aligner therapy with the following case types?

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely	I don't use in-house aligners for this case type
Class I malocclusion	◯	◯	◯	◯	◯	◯
Class II corrections	◯	◯	◯	◯	◯	◯
Class III corrections	◯	◯	◯	◯	◯	◯
Premolar extraction	◯	◯	◯	◯	◯	◯
Lower incisor extraction	◯	◯	◯	◯	◯	◯
Open bite	◯	◯	◯	◯	◯	◯
Orthognathic surgery	◯	◯	◯	◯	◯	◯

76. Please specify your level of agreement or disagreement with the following statement related to your reasons for not starting/finishing in-house lab clear aligner therapy cases with brackets?

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Not necessary for achieving an ideal finish	◯	◯	◯	◯	◯
Patient rejection	◯	◯	◯	◯	◯
Increased costs	◯	◯	◯	◯	◯
I don't carry bracket systems in my clinic	◯	◯	◯	◯	◯
Increased chairtime	◯	◯	◯	◯	◯

77. For in-house lab clear aligner therapy cases, how often do you believe a "midcourse correction" during treatment is needed to achieve ideal results?

- ◯ Very Often
- ◯ Often
- ◯ Neither Often nor Rarely
- ◯ Rarely
- ◯ Very Rarely

78. What is your gender?

- ◯ Female
- ◯ Male

79. What is your age?

- ◯ 20-30
- ◯ 30-40
- ◯ 40-50
- ◯ 50-60
- ◯ 60 or older

80. What dental school did you attend? Listed in order of state.

81. When did you graduate from dental school?

- ◯ 1970 or earlier
- ◯ 1970-1980
- ◯ 1980-1990
- ◯ 1990-2000
- ◯ 2000-2010
- ◯ 2010 to present

82. Where did you receive your clear aligner therapy training from? Choose all that apply.

- ☐ Dental school
- ☐ Residency
- ☐ Formal course (taught by a clear aligner therapy company)
- ☐ Training from a mentor dentist
- ☐ I received no formal training

83. Which U.S. state or territory do you practice in?

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