Iran J Orthod. 2023 June; 18(1): e1091. doi:10.22034/IJO.2023.1972332.1091.
Published online 2023 June 1
Research Article **Open Access**

Clear Aligner Therapy, Challenges and Usage among Iranian Orthodontists

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Received: 2022 November 08; **Revised:** 2023 April 22; **Accepted;** 2023 May 14

Abstract

Aim: This study aimed to assess the frequency of clear aligner use by orthodontists and their perspectives on this matter.
Methods: This descriptive-analytical study evaluated 86 orthodontists practicing in Iran in 2021. An online questionnaire was designed by an expert panel to collect information regarding the frequency of use of clear aligners (CA) by orthodontists, their satisfaction rate with this treatment approach, their perception of CA's advantages and disadvantages and the challenges they encountered while using CA. The results were analyzed using descriptive and regression analysis methods.
Results: Eighty-six orthodontists filled out the questionnaire. Less than one-third of participants reported using CA, and the majority of them reported using it for less than 10% of their patients. Of those not using CA, 75% were interested in using them. The mean satisfaction score with CA was 9.26 out of 20. The main reason for not using CA was difficult access to reputable companies and suboptimal quality of work of the available laboratories. The majority of orthodontists stated that CA could not be used for cases with impacted teeth, orthognathic surgery patients, and syndromic, cleft lip and palate patients. The main shortcoming of CA was perceived to be in the space closure phase, and their cost was 50-100% higher than regular orthodontic treatment. Older orthodontists were less interested in using CA while faculty members were more interested.
Conclusion: The frequency of use of clear aligners by Iranian orthodontists is low and their satisfaction rate with this approach is <50%.

Keywords: Clear Aligners, Orthodontic Treatment, Satisfaction

Background

In recent years, the number of adult patients seeking orthodontic treatment has greatly increased worldwide by an estimated 16% from 2012 to 2014, with 27% of all patients being adults. This in turn, has led to a growing demand for less visible orthodontic treatments such as lingual orthodontic systems, tooth-colored resin and ceramic brackets, and clear aligners (1,2). However, the lingual orthodontic system has been reported to traumatize the tongue, and the main problem with tooth-colored resin and ceramic brackets is the unesthetic appearance of the metal wire. Thus, clear aligners have become more popular because they do not have such shortcomings (3,4). The orthodontic clear aligner (CA) system was introduced in 1997, in which a series of semielastic polyurethane aligners were fabricated according to a computer-generated simulation of progressive tooth alignment. With the development of dental materials and 3D technology, clear aligners have become increasingly popular. Nowadays, they are not confined to treating adults, but a new approach aimed at teenage patients has also been introduced and applied (5-7).

Among the great advantages, such as improved

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aesthetics and comfort for the patient, clear aligners have some disadvantages, including higher costs, the requirement of advanced technology, and the inability to treat certain types of malocclusions (8,9). Recently, various studies have compared the effectiveness of orthodontic treatment performed using clear aligners and traditional fixed orthodontic appliances. These studies have shown mixed results; some indicate significantly poorer outcomes for clear aligners (10-12), while others conclude near equal treatment efficacy in mild to moderate malocclusions (5, 13). According to some recent systematic reviews, evidence is generally lacking about the effectiveness of clear aligner therapy (CAT) (14, 15). Hence, it is difficult for clinicians to choose the best system, and they have to rely on their clinical experience, the opinions of experts, and limited published evidence to apply CAT for their patients (16). Thus, it is prudent to know the perception of clinicians about this treatment modality. Furthermore, it has been shown that aligners are able to correct some malocclusions successfully, while others may pose a greater challenge. Therefore, it is critical for clinicians to be able to select the proper malocclusions to treat with aligners (17).

Apart from evaluating the efficacy of treatment, other aspects of clear aligner treatment have also received much attention in the literature, such as comparison of pain levels between orthodontic treatment with clear aligners and fixed appliances (17, 18), treatment management between orthodontists and general practitioners (19-21), patient factors influencing the selection of the provider type of clear aligners (1), gingival parameters, and patients' satisfaction (22). However, there are no recent studies regarding the factors that influence the orthodontists' preferences about clear lingers, case selection, type of clinical practice, and their perceived limitations of this treatment modality. In addition, studies that assess the reasons why clinicians do not provide CAT in their clinical practice are lacking. This is especially important in developing countries, where access to high technology is limited.

Therefore, this study aimed to evaluate the frequency of using clear aligners by Iranian orthodontists, their perspective on this subject, and the challenges they encountered in applying the clear aligner in their practice.

Methods

This analytical cross-sectional study evaluated Iranian orthodontists in 2020. The minimum sample size was calculated to be 82, assuming α=0.05, β=0.2, and ρ=0.15 for assessment of the effect of five independent variables using the multiple regression feature of PASS 15. This project was a part of an MS thesis approved by the research committee of the International Campus of the School of Dentistry, Tehran University of Medical Sciences (ethical code: IR.TUMS.REC.1399.435).

An electronic questionnaire was designed by an expert panel composed of three orthodontists who were faculty members of the School of Dentistry, Tehran University of Medical Sciences, and an expert in research methodology from the Dental Research Center of the aforementioned university. The questionnaire contained 13 questions regarding the use of clear aligners by orthodontists, their level of satisfaction with clear aligners, their attitude towards the strengths and weaknesses of this treatment approach, the existing obstacles to their widespread use, and the challenges they encountered while using this treatment modality.

The questionnaire was then filled out by three other orthodontists in a face-to-face interview, and then discussed to find out the vague parts and modify it, to improve the content and face validity. An online surveying software (https://survey.porsline.ir) was used to collect data in this study.

The contact information of all orthodontists practicing in Iran was obtained from the Iranian Association of Orthodontists. Orthodontists were randomly selected from the list using a table of random numbers. The selected orthodontists were contacted by phone and briefed about the study. The link to the researcher-designed online questionnaire was sent to those who were willing to participate in the study via WhatsApp. (https://survey.porsline.ir/ s/pplLA7l) The respondents were assured about the confidentiality of their information, and the questionnaires were analyzed anonymously.

At the beginning of the survey, respondents were asked about their demographic information, such as gender, age, years in practice as an orthodontist, and being faculty members or not.

Subsequently, they were asked if they use the clear aligners in their orthodontic clinical practice. Those participants whose answers were negative were asked about their willingness to use clear aligners and their reason for not using them. The others were asked questions regarding their personal experience with CAT, such as the percentage of cases they treated with CA, their satisfaction rate with the treatment results, and the type of company or dental laboratory they work with to manufacture aligners. All participants, whether using CAT or not, were asked about their perception towards the efficacy of CAT, the type of malocclusion that can be treated with CAT, the cost

of CAT, the problematic stage of treatment with CAT, the efficacy of CAT in different types of treatment modalities, and type of tooth movement.

The data were collected over the course of one month, from August to September 2020. The link for the questionnaire was sent to orthodontists until the sample size was achieved. Overall, 117 orthodontists received the link and 86 of them filled it out.

The collected data were reported as mean, standard deviation, frequency, and percentage. Regression analysis (rank regression) was applied to analyze the correlation between age and work experience with the frequency of use of clear aligners. Data was analyzed by SPSS version 22 at a 0.05 level of significance.

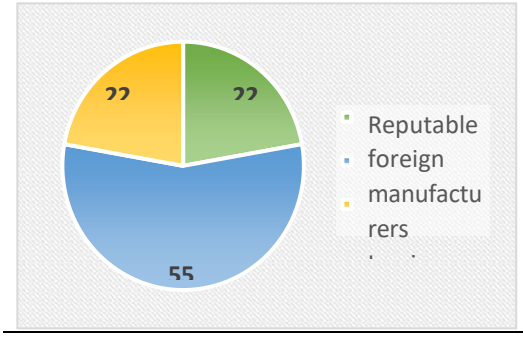


Figure 1. How participants who reported using CAT achieve their aligners

Results

A total of 86 respondents out of 117 orthodontists who received the survey's link completed the questionnaire, and the overall response rate was 73.5%. The orthodontists evaluated in this study had a mean work experience of 7.93 years (range: 0 to 27years) and a mean age of 37.46 years (range: 27 to 61 years).

The results showed that the majority of participants (52.3%) were university faculty members. Only 27 participants (31.4%) reported using CAT, and the majority of those using clear aligners reported using them for less than 10% of their patients. The majority of the CAT users (55.6%) reported that they use aligners produced by domestic dental laboratories (Figure.1). Regarding the level of satisfaction with the results of clear aligners (scores 0-20), score 15 had the highest frequency (9.3%). The highest score was 19, which was reported by one participant, and the lowest score was 0, which was reported by two participants. Overall, the mean satisfaction score was 13.2 out of 20.

In total, 59.3% of all participants and 75% of those who reported not using clear aligners were interested in using them. Table 1 shows the reasons for not using clear aligners by orthodontists. As shown, the majority of orthodontists (53.5%) reported the reason to be difficult access to reputable manufacturers and poor quality of available laboratory work. The indications of clear aligners according to the orthodontists' perception are shown in Table 2. As shown, the majority of orthodontists (51.2%) believed that clear aligners can only be used for simple treatments and very mild crowding. Table 3 presents the cases for which the use of clear aligners may be problematic according to the opinion of orthodontists. As indicated, most of them (79.1%) believed that clear aligners would not be suitable for the treatment of syndromic cleft lip and palate patients.

Considering the stages of orthodontic treatment, 75.6% of participants believed that the main problem of clear aligners is in space closure, followed by the finishing phase (44.2%), the leveling phase (22.1%), and the alignment phase (11.6%). Moreover, the main drawback of clear aligners was reported to be their poor efficacy by the majority of orthodontists (Table 4). Figure 2 shows that 41% of orthodontists stated that the cost of orthodontic treatment with clear aligners is 50-100% higher than that of regular orthodontic treatment.

Table 1. Reasons for not using clear aligners by orthodontists (more than one answer was accepted)

Reasons	Frequency (Percentage)		
	Total n=86	Faculty member n=45	Non-faculty member n=41
Not trusting clear aligners in general	13 (15.1)	6 (13.3)	7 (17.1)
High cost and not being cost-effective	33 (38.4)	17 (37.8)	16 (39.0)
Inaccessibility of reputable manufacturers and low quality of work of domestic laboratories	46 (53.5)	24 (53.3)	22 (53.7)
Poor knowledge about treatment with clear aligners	14 (16.3)	6 (13.3)	8 (19.5)

Table 2. Indications of clear aligners according to the opinion of orthodontists (more than one answer was accepted)

Indications	Frequency (Percentage)		
	Total n=86	Faculty member n=45	Non-faculty member n=41
Only simple treatments and very mild crowding	44 (51.2)	23 (51.1)	21 (51.2)
Simple to moderate treatments	36 (41.9)	19 (42.2)	17 (41.5)
Most cases even severe crowding	14 (16.3)	6 (13.3)	8 (19.5)
Relapse of previous treatments	35 (40.7)	19 (42.2)	16 (39.0)

Table 3. Cases for which the use of clear aligners may be problematic according to the opinion of orthodontists (more than one answer was accepted)

Unsuitable cases for clear aligners:	Frequency (Percentage)		
	Total n=86	Faculty member n=45	Non-faculty member n=41
Extraction orthodontic treatment	34 (39.5)	17 (37.8)	17 (41.5)
Treatment of impacted teeth	52 (60.5)	30 (66.7)	22 (53.7)
Orthodontic treatment of orthognathic surgery patients	65 (75.6)	34 (75.5)	31 (75.6)
Syndromic cleft lip and palate patients	68 (79.1)	36 (80.0)	32 (78.0)

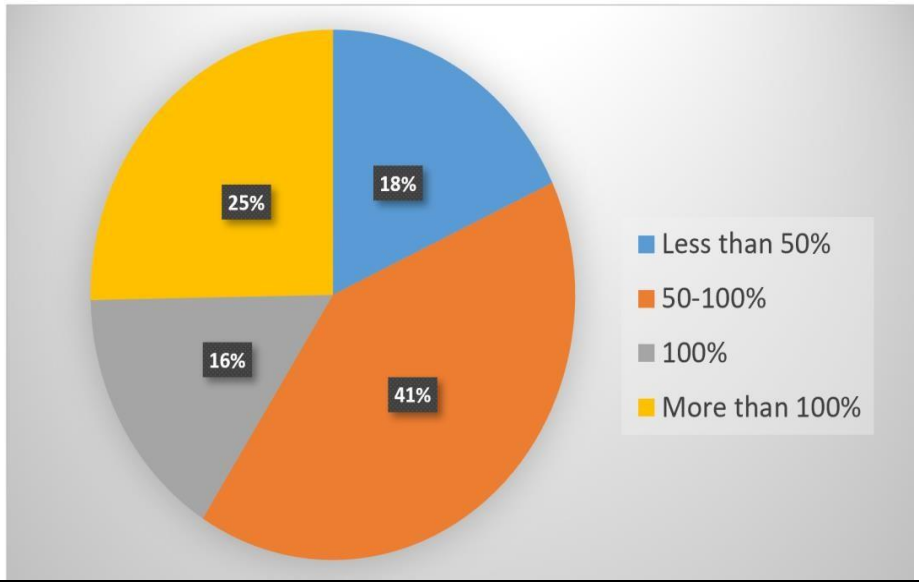


Figure 2. Distribution of participants according to their answer to this question: How much higher is the cost of orthodontic treatment with clear aligners rather than that of conventional orthodontic treatment

Table 4. Problems of clear aligners according to the opinion of orthodontists (more than one answer was accepted)

Stage of treatment	Frequency	
	Faculty member	Non-faculty member
Alignment	7 (15.6%)	3 (7.3%)
Leveling	9 (20%)	10 (24.4%)
Space closure	34 (75.6%)	31 (75.6%)
Finishing	22 (48.9%)	16 (39%)

While 42.2% of the faculty members reported using clear aligners, the majority of non-faculty member orthodontists (80.5%) reported not using them. Of the faculty members using clear aligners, the majority (37.8%) reported using them for less than 10% of their patients. Of these, 11.1% reported purchasing the aligners from reputable international companies, 26.7% reported obtaining them from Iranian laboratories, and 11.1% reported fabricating them in their personal laboratory located in their office.

Regarding the level of satisfaction with CAT among the CAT users, the score with the highest frequency among the faculty members was 10 out of 20, and for non-faculty members, it was 15 out of 20. The mean satisfaction score was 12.6 and 13.4 in these groups, respectively. Those not interested in using clear aligners were 55.6% of the faculty members and 24.4% of the non-faculty members. The reasons for not using clear aligners in the two groups are given in Table 1, and the indications of clear aligners according to their opinion are given in Table 2.

In addition, 80% of the faculty members and 78% of non-faculty members stated that clear aligners are not suitable for patients with syndromic cleft lip and palate (Table 3). Table 5 shows the opinion of orthodontists regarding the efficacy of clear aligners for the treatment of different conditions. 42.2% of faculty members reported that the efficacy of clear aligners for correction of mild crowding is excellent, while 41.5% of non-faculty members reported that the efficacy of clear aligners for correction of mild crowding is good. The majority of clinicians from both groups reported that the efficacy of clear aligners for the correction of moderate crowding and for non-extraction orthodontic treatment is good. For correction of severe crowding, extraction for orthodontic treatment, and for treatments requiring anchorage, most of the participants of both groups reported poor efficacy.

The majority of faculty members considered the treatment efficacy for expansion, treatments with elastic therapy, and treatment of spacing as poor or moderate, while the majority of non-faculty members considered it moderate. For tipping tooth movement, the efficacy of treatment with CAT was mostly perceived as good, while for root torque correction and for bodily tooth movement, it was mostly perceived as poor (Table 5).

Table 5. Opinion of orthodontists regarding the efficacy of clear aligners for the treatment of different conditions

Condition	Group	No answer	Poor efficacy	Moderate efficacy	Good efficacy	Excellent efficacy
Mild crowding	FM	2 (4.5%)	1 (2.2 %)	6 (13.3 %)	17 (37.8 %)	19 (42.2 %)
	Non-FM	3 (7.2%)	2 (4.9 %)	4 (9.8 %)	17 (41.5 %)	15 (36.6 %)
Moderate crowding	FM	1 (2.3%)	5 (11.1 %)	15 (33.3 %)	20 (44.4 %)	4 (8.9 %)
	Non-FM	0 (0 %)	4 (9.8 %)	15 (36.6 %)	17 41.4 %)	5 (12.2 %)
Severe crowding	FM	2 (4.5%)	28 (62.2 %)	11 (24.4 %)	3 (6.7 %)	1 (2.2 %)
	Non-FM	4 (9.8%)	20 (48.8 %)	11 (26.8 %)	5 (12.2 %)	1 (2.4 %)
Non-extraction orthodontic treatment	FM	1 (2.3%)	2 (4.4 %)	8 (17.8 %)	28 (62.3 %)	6 (13.3 %)
	Non-FM	2 (4.8%)	3 (7.3 %)	9 (22 %)	15 (36.6 %)	12 (29.3 %)
Extraction orthodontic treatment	FM	0 (0 %)	19 (42.2 %)	2 (4.4%)	8 (17.8 %)	16 (35.6 %)
	Non-FM	2 (4.8%)	20 (48.9 %)	0 (0%)	5 (12.2 %)	14 (34.1 %)
Treatments requiring anchorage	FM	1 (2.3%)	18 (40 %)	12 (26.6 %)	9 (20 %)	5 (11.1 %)
	Non-FM	3 (7.2%)	16 (39.7 %)	15 (36.6 %)	5 (12.2 %)	2 (4.9 %)
Expansion	FM	2 (4.5%)	16 (35.6 %)	16 (35.6 %)	6 (13.2 %)	5 (11.1 %)
	Non-FM	3 (7.2%)	13 (31.8 %)	16 (39 %)	8 (19.6 %)	1 (2.4 %)
Elastic therapy treatments	FM	1 (2.3%)	6 (13.3 %)	26 (57.8 %)	9 (20 %)	3 (6.6 %)
	Non-FM	4 (9.8%)	9 (22 %)	13 (31.7 %)	13 (31.7 %)	2 (4.8 %)
Spacing treatments	FM	2 (4.5%)	12 (26.7 %)	12 (26.7 %)	10 (22.1 %)	9 (20 %)
	Non-FM	4 (9.8%)	9 (22 %)	14 (34.1 %)	11 (26.7 %)	3 (7.1 %)
Extrusion	FM	1 (2.3%)	16 (35.6 %)	21 (46.6 %)	7 (15.5 %)	0 (0%)
	Non-FM	4 (9.8%)	12 (29.3 %)	12 (29.3 %)	10 (24.3 %)	3 (7.3 %)
Tipping	FM	1 (2.3%)	1 (2.2 %)	14 (31.1 %)	19 (42.2 %)	10 (22.2 %)
	Non-FM	4 (9.8%)	3 (7.3 %)	10 (24.4 %)	13 (31.7 %)	11 (26.8 %)
Root torque correction	FM	1 (2.3%)	27 60 %)	12 (26.6 %)	4 8.9 %)	1 (2.2 %)
	Non-FM	4 (9.8%)	21 51.2 %)	12 (29.3 %)	3 (7.3 %)	1 (2.4 %)
Bodily tooth movement	FM	1 (2.3%)	17 37.7 %)	16 (35.6 %)	10 (22.2 %)	1 (2.2 %)
	Non-FM	4 (9.8%)	21 51.2 %)	11 (26.8 %)	5 (12.2 %)	0 (0 %)

FM: Faculty member

There was a significant relationship between age and being a faculty member with being interested in using CAT, such that older dentists showed significantly lower interest in using clear aligners (P-value=0.00), while faculty members had a significantly higher tendency to use them (P-value=0.029) (Table 6).

Table 6. The effect of age and membership in the faculty on the use of clear aligners

	ß	Degree of freedom	Sig
Age	-0.123	1	0.001
Membership in faculty	-1.200	1	0.029

Discussion

This study assessed the frequency of using clear aligners by orthodontists and their challenges in this respect. The results showed that the rate of using CAT is relatively low among Iranian orthodontists considering that less than one-third of participants reported a history of using CAT and those who reported using CAT, used it in less than 10 % of their cases. It is dramatically less than European orthodontists because a study on the members of the European Aligner Society reveals that the majority of study participants reported using CAT in their practice (21). The study represented respondents from 25 European countries, with 69% from Italy, and among the total of respondents, 79% reported currently using CAT, with a greater percentage of them being orthodontists (83%) than general dentists (65%) (20). This means that the frequency of CAT use among Iranian orthodontists is even lower than European general dentists.

Our study reveals that the faculty members use CAT more than non-faculty members (ratio of 2:1). However, those using clear aligners reported using them for less than 10% of their patients, which can be due to the low satisfaction rate of the faculty members with clear aligners. The main reason for not using clear aligners was reported to be the inaccessibility of reputable international manufacturers, the poor quality of work of domestic laboratories, and the high cost of this treatment modality. In recent years, Iran has suffered from sanctions that have made it nearly impossible for Iranian clinicians to purchase international dental services.

In our study, non-faculty members had a higher satisfaction rate with clear aligners. This finding can be because faculty members are more meticulous in providing treatments and have higher expectations from clear aligners, and thus, they may pay more attention to the details of the treatment outcome. Also, it is possible that in the finishing phase of treatment, faculty members are not able to achieve the ideal results by CAT. There was no data found in the literature that directly shows the satisfaction of

orthodontists applying CAT in other communities. In the study of Best et al. (19), it was reported that only 11% of orthodontists told a patient that his or her case is too complex for Invisalign® clear aligners, which comprised more than half of cases, and only 18% of orthodontists believed that more than half of patients would have had better outcomes with conventional braces. Other studies mostly assessed patients' satisfaction. Azaripour et al. reported that patients treated with Invisalign® have greater satisfaction during orthodontic treatment than patients treated with fixed orthodontic appliances (21). Ackerman et al. compared patient satisfaction after tele-orthodontic treatment with clear aligners provided by a general practitioner or orthodontic specialist, and no significant difference was found (18). They also reported no difference in the clinical effectiveness between the two providers.

In the current research, general dentists were not included, since a pilot survey showed that the amount of use of CAT among general dentists was very low and negligible in Iran. D'Apuzzo et al. (20) evaluated the attitude of European general dentists and orthodontists towards clear aligners. They concluded that a significant difference existed between orthodontists and general dentists in using clear aligners, which was mainly due to the different levels of experience and knowledge. The reason for not using CAT by orthodontists was more likely that CA limited treatment outcomes, whereas general practitioners were reported to not have enough experience to use them. In the present study, only 16% of the orthodontists reported poor knowledge about treatment with clear aligners, and the most common reason was reported to be the inaccessibility of reputable manufacturers and the low quality of work of domestic laboratories, followed by high cost and not being cost-effective.

In the current study, orthodontists mostly believed that clear aligners are only suitable for simple treatments, very mild to moderate crowding, and cases with relapse of previous treatment. The majority of orthodontists believed that clear aligners cannot be used for severe crowding and syndromic or cleft lip and palate patients, impacted teeth, and extraction orthodontic treatment. Comparatively, among

European orthodontists, about half of the respondents were willing to treat a malocclusion with moderate crowding (4–6 mm), and regarding the type of treated patients, about 5% of patients were pre- or post-surgery patients. Moreover, although the majority of CA cases were reported to be class I, a noticeable percentage was also class II or III with various vertical problems (20). This means that, although European orthodontists mostly prefer to use CAT in mild to moderate cases, many complicated cases were also treated by CAT.

Regarding the stages of treatments, most of the Iranian orthodontists stated that the space closure phase in extraction treatment is the most problematic one in the use of clear aligners. This is in accordance with the other findings of this study, in which most participants considered the efficacy of clear aligners in extraction orthodontic treatment, bodily tooth movement, and root torque correction as poor (Table 5). The reason may be that the attachment design of the systems, which was used by most participants in this study, did not have sufficient precision and could not lead to a good or excellent outcome. In extraction cases, understanding of biomechanical considerations, such as proper moment-to-force ratios, is extremely critical to achieve bodily movement rather than tipping of the teeth into extraction spaces, which can be challenging in using clear aligners (22). In a recent study, Zhou and Guo demonstrated that the use of clear aligners improved tooth inclination and arch width, and provided adequate torque in the buccal roots of posterior teeth. They concluded that orthodontic treatment with clear aligners is beneficial (23). Thus, it can be concluded that the available systems for manufacturing aligners can affect the treatment outcome and orthodontists' satisfaction, and according to the effectiveness of the aligner system, selecting an appropriate malocclusion to treat with CAT is a critical therapeutic decision.

In this study, 62.2 % of faculty members and 48.8

% of non-faculty members believed that CAT has poor efficacy in the treatment of severe crowding. In a study on USA orthodontists and general dentists, it was shown that both groups were not confident in treating patients with severe crowding. However, comparably, general dentists were more willing to treat more complex malocclusions with CAT, such as deep bite, severe crowding, and class II malocclusions (19).

Most participants believed that the cost of treatment with clear aligners is 50 to 100% higher than the cost of conventional orthodontic treatment. Irrespective of cost, the majority of orthodontists believed that clear aligners are only suitable for mild to moderate crowding, non-extraction orthodontic treatment, and tooth tipping movement. They reported poor performance of clear aligners for other treatments. Although older studies also reported that movements such as lingual constriction were more predictable, others, such as extrusion, were less predictable (8). However, the steady development of aligner technology has changed these parameters and some recent studies have reported optimal tooth movement in the upper and lower arch, and satisfactory results in treatment cases (5,13). Galan-

Lopez et al. systematically assessed the accuracy and optimal efficacy of tooth movement with clear aligners and concluded that malocclusions can be successfully treated with clear aligners, but the results are not as accurate as the results of fixed metal appliances (24).

Overall, clear aligners can be used for patients who regard esthetic aspects of treatment as crucial; however, it should be noted that clear aligners may not completely obviate the treatment needs, and may have lower accuracy than fixed orthodontic treatment. Long-term clinical studies are required to compare the efficacy of treatment with clear aligners and fixed orthodontic treatment. Also, continuing education courses should be held to familiarize dentists with the benefits of clear aligners.

Conclusion

The frequency of the use of clear aligners by Iranian orthodontists is low and their satisfaction rate with this approach is less than 50%.

The most common reasons for not using clear aligners by Iranian orthodontists are difficulty in accessing reputable manufacturers and poor quality of work of available laboratories. Most of the participants use aligners produced by domestic dental laboratories. Older orthodontists were less interested in using clear aligners, while faculty members were more interested in using them.

The majority of Iranian orthodontists believed that clear aligners were only suitable for mild to moderate crowding, non-extraction orthodontic treatment, and tipping tooth movement.

Conflicts of Interest: None to declare.

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