Original Article

Perceptions of Orthodontists on Bracket Dislodgement During Fixed Orthodontic Treatment (A Cross Sectional Study)

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Abstract

Objectives: Bracket failure is one of the problems that happen during fixed orthodontic treatment, which slows treatment progression and is costly in time, material, and patient inconvenience. The present study aimed to assess orthodontic professionals' perceptions regarding bracket failure during fixed orthodontic treatment.

Methods: This cross-sectional study was conducted by distributing a self–administered questionnaire among orthodontic professionals. The validity and reliability of the questionnaire were tested before study conduction. In total, 158 orthodontic professionals were approached across Iraq. The questionnaire included eight questions on practice, nine on perceptions, and three on awareness with regard to the prevention and management of bracket failure. Data were analyzed by the Kruskal-Wallis test and Dunn-Bonferroni *post hoc* test.

Results: The majority of the participants either agreed (58.2%) or strongly agreed (27.8%) that instruction on appropriate food consumption is the best way to prevent bracket debonding**.** Years of experience were shown to have a statistically significant association with the rate of bracket failure and number of appointments per week for bracket rebonding, at p=0.01 and p=0.001, respectively. A postgraduate orthodontics degree was shown to have a statistically significant association with perception and awareness within the study population, at p= 0.0005 and p=0.01, respectively.

Conclusions: Orthodontic professionals regarded orthodontists as having the least responsibility for bracket failure. It is recommended to have special practice guidelines for the management of bracket failure.

Keywords: *Bracket dislodgement, Orthodontists, Orthodontics.*

Submitted: November 29, 2020, Accepted: December 7, 2020, Published: June 1, 2021.

Cite this article as: Ismail HM. Perceptions of Orthodontists on Bracket Dislodgement During Fixed Orthodontic Treatment (A Cross Sectional Study). Sulaimani Dent J. 2021;8(1):26-36.

DOI: https://doi.org/10.17656/sdj.10127

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Introduction

Failure of orthodontic bracket bonds is a common occurrence during fixed orthodontic treatment, with reports on the incidence of bracket failure ranging from 3.5% to 23%[1-3]. Incidence can reach 28.3%, according to a recent systematic review [4]. Moreover, the additional treatment required for replacing brackets can have significant time and cost implications since it is not always possible to replace the same bracket[5]. Presentation with debonding is higher among adolescents (25.4%) than adults (12.3%)[6].

Once an orthodontic bracket has failed, the remnant adhesive residue should be removed, which in addition to being time-consuming, can lead to the removal of up to 50 µm of the enamel surface[7], as well as the formation of cracks on the enamel surface[8].

When brackets become debonded during orthodontic treatment, emergency appointments are required for rebonding. This will increase the overall duration of treatment time[15,16], according to a retrospective study that utilized records of 366 active retention patients[16] to analyze the association between treatment time and the number of rebond visits for bracket failure (and the intraoral position of the failed brackets). If rebonding of brackets requires three or more scheduled visits for treatment, the treatment time will be extended by an average of 2.3 months. Re-bonding of each debonded bracket will increase treatment duration by a mean of 0.3 months[16]. Therefore, the occurrence of bracket debonding during orthodontic treatment will prolong the treatment time.

Orthodontists instruct their orthodontic patients to avoid eating hard food, sticky food, or cold and hot foodstuffs to avoid bracket failure[9]. However, this may require patients to change their usual dietary habits[9], and not every patient will be willing to comply with such instructions. Adolescent patients tend to show poorer compliance regarding taking care of their orthodontic appliances[6], which, as a result, leads to bracket debonding. Frequent reminding of care instructions effectively reduces bracket debonding[10]; moreover, repeating instructions on appliance care to the parents has been effective in reducing bracket dislodgement[11].

In most cases, orthodontists blame the patients for the dislodgement, whereas parents may think the fault lies with the orthodontist. Considering that the cause of the dislodgement can be multifactorial, it could be due to the patient disregarding the bracket care instructions given by the orthodontist[6]. Biting on hard foods and brushing forces have also been reported by patients as among the most common causes of debonding [2]; however, it could be due to the orthodontist applying excessive force or improper acid etching, drying, priming, adhesive application, and duration and type of photoactivation[12]. In addition, the patient's psychology can affect the level of compliance regarding appliance care[23].

Ideally, patients and orthodontists should work together to help prevent bracket debonding during treatment. The purpose of this study was to assess the perceptions of orthodontists toward bracket dislodgement during fixed orthodontic treatment. This may help to improve prevention and management protocols through better communication among patients, parents, and orthodontists.

Materials and methods

Study design

This cross-sectional survey was conducted among orthodontists in both the public and private sectors throughout Iraq from July to September 2020. Approval from the ethics committee (number: 436) of the College of Dentistry, University of Sulaimani, was obtained before conducting the survey.

A multi-stage sampling technique was applied in all cities of Iraq to recruit participants for the study. Expansion of knowledge on orthodontists' practice, perception, and awareness regarding prevention and management of bracket failure was the primary outcome of the study.

Elements of the questionnaire and scoring methods

According to a Likert-scale research design, a specially constructed self-administered questionnaire was prepared for the current study (Table 1). The questionnaire was distributed anonymously on a Google Form to the participants via a closed Facebook group of the Iraqi orthodontic society and private email addresses of the orthodontists, with a title statement illustrating the project's purpose. Participation was on voluntary

Table 1: Elements of the questionnaire for the orthodontists

• Age:
• Have you got a postgraduate degree in orthodontics? (Pg degree)
Diploma MSc Ph.D. Training certificate No degree
• How long have you been practicing as an Orthodontist? (Years of Practice)
0-5 6-10 years 11-20 21-30
• Which city are you practicing in? (City) Sulaimani Erbil Duhok Kirkuk Baghdad Al Muthanna Babil Mosul Karbala Basrah Anbar Other

Part I Practice

1. Approximately what percentage of your patients experience bracket dislodgment during treatment(Bracket Debonding%)?
0-10 10-20 20-40 50 60-80 80-100
2. How many appointments (emergency appointments) do you conduct in a week for replacing a debonded bracket in your clinic? (Appt./week) 0 1-2 3-4 5-7 More than 8
3. How long does it take you to rebond a single tooth? (Re-bonding time)
5 minutes 10 minutes 15 minutes 20 minutes 25 minutes
4. If you were to replace a debonded bracket with a patient, when would you recommend replacing it? (replace T)
Straight after the dislodgment (Emergency appointment) Within few days
Within a week Within two weeks, Wait for the next scheduled monthly visit
5. How do you prepare the tooth surface after debonding and prior to repositioning the bracket? (preparation surface)
Using low-speed handpiece Using high-speed turbine Without touching the surface
6. What type of brackets are you using? (Bracket type)
Self-ligating Bracket Standard Bracket Both
7. What kind of orthodontic adhesive are you using for bracket bonding? (Adhesive type)
Resin-based (light-cured) Resin-based (Chemically cured) Resin modified glass ionomer All of the above
8. What kind of light-curing unit are you using? (Type of light)
Halogen light LED light Others

Part II Perceptions

9. Type of diet affects bracket dislodgment during braces?
Strongly agree Agree Neutral Disagree Strongly disagree
10. Patients with a lack of compliance and multiple bracket dislodgments should be discontinued
Strongly agree Agree Neutral Disagree Strongly disagree
11. Food consumption instruction is the best way to help prevent bracket debonding?
Strongly agree Agree Neutral Disagree Strongly disagree
12. Parents are most responsible for the debonding of brackets in children/adolescents with fixed orthodontic appliances
Strongly agree Agree Neutral Disagree Strongly disagree
13. Orthodontists are most responsible for the debonding of brackets in children/adolescents with fixed orthodontic appliances
Strongly agree Agree Neutral Disagree Strongly disagree
14. Repeated instruction on appliance care for children and their parents reduces bracket dislodgement?
Strongly agree Agree Neutral Disagree Strongly disagree
15. The dislodged bracket can be used for rebonding?
Strongly agree Agree Neutral Disagree Strongly disagree
16. Reverting back to smaller wire gauges as a result of bracket debonding is mandatory?
Strongly agree Agree Neutral Disagree Strongly disagree
17. Using intraoral elastics class I, II, and III affect bracket debonding?
Strongly agree Agree Neutral Disagree Strongly disagree

Part III Awareness

18. Emission criteria for LED curing of resin-based orthodontic adhesives should be considered?
Strongly agree Agree Neutral Disagree Strongly disagree
19. Testing the intensity of the light cure you are using for bracket bonding is necessary every year?
Strongly agree Agree Neutral Disagree Strongly disagree
20. Orthodontic adhesive resin instructions (manufacturer instructions) should be read before its application?
Strongly agree Agree Neutral Disagree Strongly disagree

basis, and all potential respondents were informed that their participation would remain anonymous since no identifying information would be requested. Questionnaire validity was verified by a team of 5 specialist orthodontists, whose comments were given careful consideration. Afterward, the questionnaire reliability was tested in a pilot study involving 25 orthodontists (Cronbach's α= 0.615).

The questionnaire was divided into four sections of multiple-choice questions: section one involved questions related to participants' socio-demographic characteristics, including participants' age, years of experience, and postgraduate orthodontic degree. Section two (questions 1-8) focused on the orthodontists' practice regarding bracket dislodgement. Section three (questions 9-17) concentrated on the orthodontists' perceptions about clinical preventive measures regarding bracket dislodgement during the orthodontic treatment course. Section four (questions 17-20) concentrated on the orthodontists' awareness regarding the curing of orthodontic adhesives.

Pretesting of the survey was carried out before implementation to improve the design and increase the response rate.

Calculation of perception and awareness scores

The responses to the questions were scored as follows: 1 point for "totally agree", 2 points for "agree", 3 points for "not sure", 4 points for "disagree", and 5 points for "totally disagree". The orthodontists' responses were then summed to assess the degree of perception and awareness regarding prevention and management of bracket failure.

Statistical analysis

The demographic data were analyzed in terms of mean, standard deviation, range, frequency, and distribution. Summation of the responses on bracket debonding percentage, appointments/week, and rebonding time in the practice section and responses to the questions in the perception and awareness section of the questionnaire was conducted. These results were then compared with the demographic data on postgraduate orthodontics qualifications and years of practice using Kruskal-Wallis and the Dunn-Bonferroni *post hoc* test. The significant difference was set at $p< 0.05$. All statistical analyses were performed using GraphPad Prism (version 8.4.3) software.

Results

In total, 158 orthodontists returned the questionnaire and were included in the final analysis. The mean age of the participants was 39.45±6.87 years, as summarized in Table 2. Regarding the participants' postgraduate qualifications, 8.9% had a Diploma, 53% MSc, 15% Ph.D., 10% training certificate, and 2% had no degree in orthodontics. The largest proportion of responses came from Sulaimani City (40.7%), followed by Baghdad (21%) and Erbil (16%), with the remainder coming from other cities across Iraq.

Practice level

Among the participants, over half (54.4%) had experienced 0-10% bracket failures, followed by 30% and 29% who reported 20%-30% and 30-40% bracket failures, respectively (Table 3).

Nearly half of the participants (48%) revealed that they used standard brackets in their clinic compared to the 41% who used both standard and self-ligating brackets. In addition, a large majority of the participants (84%) in this study reported using resin-based orthodontic adhesives for bonding brackets, while only 6% of the participants were using resin-modified glass ionomer and chemically cured resin-based orthodontic adhesives, respectively (Table 3).

Regarding the number of appointments per week for replacing debonded brackets, nearly half of the participants (49%) reported carrying out 1-2 appointments per week for replacing debonded brackets. Additionally, most participants recommended rebonding the debonded brackets straight after dislodgement (39.2%) or within a few days of bracket debonding (34.2%). Only 15.2% of the participants recommended waiting for the next scheduled monthly appointment for rebonding. Regarding the rebonding time for a bracket, 46.8% of the participants reported taking 5 minutes for rebonding, whereas 45.6% reported taking 10 minutes (Table 3).

Years of experience were found to have a statistically significant association with the rate of bracket failure and number of appointments per week for bracket rebonding, at $p=0.01$ and $p=0.001$, respectively. Furthermore, having a postgraduate degree was shown to have a statistically significant association with the number of appointments/week for bracket rebonding, at $p=0.0$ (Table 4).

Perception and awareness level

The majority of the participants either strongly agreed (48.1%) or agreed (46.9%) that type of diet is related to bracket failure. In response to considering discontinuing treatment of those with repeated bracket debonding, 46.8% agreed that they would consider it, while the remainder were either unsure (22.8%) or disagreed (22.8%) with this consideration (Table 5).

Moreover, most participants either agreed (58%) or strongly agreed (27.2%) that providing instruction to encourage appropriate food consumption is the best way to prevent bracket debonding.

Regarding the person(s) they considered most responsible for bracket failures, one-third of the participants agreed, and another one third (30%)

disagreed that parents are most responsible. In terms of the orthodontists being responsible, 40.2% disagreed, and 6.7% strongly disagreed.

Almost all of the participants either agreed or strongly agreed (70% and 23.8%, respectively) that giving repeated instructions to children and their parents reduces the incidence of bracket dislodgement.

Just over half of the participants agreed (48.8%) or strongly agreed (5%) with reverting to use smaller wire gauges due to bracket debonding. Additionally, the majority of the participants either agreed (56.8%) or strongly agreed (6%) that intraoral elastics are a factor in debonding

Having a postgraduate orthodontics degree was shown to have a statistically significant association with the perceptions of the study population ($p= 0.0005$). At the same time, this was not the case with years of experience ($p>0.05$) (Table 6). However, both years of experience and academic degree were found to have a statistically significant relationship with awareness level (Tables 7 and 8).

Table 2: Demographic background of participants.

Variables	N (%)	Variable	N (%)
Average age (years)	39.45±6.87		
Age range (years)	26-55	Postgraduate degree	
Practice years		Diploma	14 (8.9)
0-5 Years	48 (30.4)	MSc	90 (57)
5-10 Years	46 (29.1)	PhD	22 (13.9)
10-20 Years	56 (35.4)	Training Certificate	30 (19)
20-30 Years	4 (5.1)	No degree	2 (1.3)
Total	316 (100)		

Table 3: Participants' practice scores.

Variables	N (%)	Variable	N (%)
Bracket debonding%		Replace T	
0-10%	86 (54.4)	Straight after the dislodgment	62(39.2)
10- 20%	24 (30.8)	Within a few days	54(34.2)
20-40%	46 (29.1)	Within a week	10(6.3)
50%	10 (6.3)	Within two weeks	8(5)
60-80%	16 (10.1)	Wait for the next scheduled monthly visit	24(15.2)
Appointment /week		Preparation surface	
0	30 (19)	Using low speed handpiece	101(63.9)
1-2	78 (49.4)	High speed handpiece	51(32.2)
3-4	26 (16.5)	Both	6(4)
5-7	12 (7.6)	Bracket type	
More than 8	12 (7.6)	Self-ligating Bracket	16 (10.1)
Rebonding time		Standard bracket	76 (48.1)
5 minutes	74 (46.8)	Both	66 (41.8)
10 minutes	72 (45.6)	Adhesive type	
15 minutes	10 (6.3)	Resin-based light cured	134 (84.8)
20 minutes	2 (1.3)	Resin-based chemically cured	6 (3.8)
		Resin modified glass ionomer cement	6 (3.8)
		All of the above	8 (5.1)
		Types of light	
		Halogen light	12(7.6)
		LED light	146(92.4)
Total	832 (100)		

Table 4: Comparison of participants' practice scores with their demographic background.

Variables	Bracket ebonding% Mean±SD	Comparisons*	p-value**	Appt/week Mean±SD	Comparisons*	p- value**	Rebondingn time Mean±SD	Comparisons*	p-value**
Practice per year									
0-5	1.7±1.3	**0-5 vs 11-20**	**0.001**	2.1±1.1	**0-5 vs 6-10**	**0.01**	1.7±0.6		Nil
6-10	1.9±1.1			2.5±1.1			1.6±0.5		
11-20	2.5±1.3			2.2±0.9			1.5±0.7		
21-30	2.5±1.7			2±0.7			1.7±0.8		
Pg. degree									
Diploma	2.4±1.8		Nil	2.4±1.3	**MSc vs PhD**	**0.01**	1.5±0.5		Nil
MSc	2.1±1.2			2.4±1.1			1.6±0.6		
PhD	2±1.4			2±1.8			1.6±0.7		

Table 5: Participants' perception scores.

	Questions	Strongly agree %	Agree %	Not sure %	Disagree %	Strongly disagree %
1	Type of diet affects bracket dislodgment during treatment?	**45.6**	**49.4**	5.1	0	0
2	Patients with lack of compliance and multiple bracket dislodgments should be discontinued	8.9	**43**	22.8	25.3	0
3	Food consumption instruction is the best way to help prevent bracket debonding?	**27.8**	**58.2**	13.9	0	0
4	Parents are most responsible for de-bonding of brackets in children/adolescents with fixed orthodontic appliances	2.5	31.6	**29.1**	**29.1**	7.6
5	Orthodontists are most responsible for de-bonding of brackets in children/adolescents with fixed orthodontic appliances	2.3	13.9	**36.7**	**40.5**	8.8
6	Repeated instruction on appliance care for children and their parents reduces bracket dislodgement?	**24.1**	**68.4**	5.1	2.6	0
7	The dislodged bracket can be used for rebonding?	11.4	**41.8**	10.1	27.8	8.9
8	Reverting back to smaller wire gauges as a result of bracket debonding is mandatory?	5.1	**49.4**	29.1	11.4	5.1
9	Using intraoral elastics class I, II, and III affect bracket debonding?	2.5	**56.8**	19.8	18.5	2.5

Table 6. Comparison of participants' total perception scores with their demographic background.

Variables	Mean± SD	p-value**	Variables	Mean± SD	Comparisons*	p-value**
Gender			Postgraduate degree			
Male			Diploma	2.15±0.34	MSc vs PhD	0.005
Female			MSc	2.26±0.31	PhD vs training Certificate	0.007
Practice years			PhD	2.01±0.38		
0-5Years	2.21±0.33	0.79	Training Certificate	2.3±0.18		
6-10 Years	2.25±0.21		No degree	2.29±0		
11-20 Years	2.23±0.37					
21-30 Years	2.16±0.3					

* Only significant group comparisons shown

** Significant at $p< 0.05$ by Kruskal-Wallis test followed by Dunn-Bonferroni *post hoc*

Table 7: Participants' awareness scores.

Questions	Strongly agree %	Agree %	Not sure %	Disagree %	Strongly disagree %
Emission criteria for LED curing of resin-based orthodontic adhesives should be considered?	15.2	55.7	21.5	0	7.6
Testing the intensity of the light cure you are using for bracket bonding is necessary every year?	20.3	59.5	16.5	3.8	0
Orthodontic adhesive resin instructions (manufacturer instructions) should be read before its application?	45.6	51.9	2.6	0	1

Table 8: Comparison of participants' total awareness scores with their demographic background.

Variables	Mean± SD	Comparisons*	p-value**	Variables	Mean± SD	Comparisons*	p-value**
Practice years				Postgraduate degree			
0-5 Years	1.81±0.46	0-5 Years vs 5-10	0.007	Diploma	1.99±0.55	Diploma vs PhD	0.01
5-10 Years	2.05±0.41	5-10 years vs 10-20 years	0.008	MSc	1.96±0.36	MSc vs PhD	0.0002
10-20 Years	1.81±0.42			PhD	1.57±0.41	PhD vs Training certificate	0.04
0-30 Years	2±0.24			Training Certificate	1.85±0.5		
				No degree	2±0		

* Only significant group comparisons shown

** Significant at p< 0.05 by Kruskal-Wallis test followed by Dunn-Bonferroni *post hoc*

Discussion

This is the first study to explore orthodontists' perceptions on bracket dislodgement to the author's knowledge. Additionally, only a few published studies have investigated overall patient compliance regarding appliance care and oral hygiene[11,13]. This study investigates the main causes and preventive measures relating to bracket dislodgement from the orthodontist's perspective. Interestingly, an increase in years of experience was related to a decrease in bracket dislodgements and the number of patient appointments per week. It was found that years of experience were strongly related to productivity and skills acquisition[14].

Failure of orthodontic bracket bonds is common during orthodontic treatment, with failure rates reportedly varying between 3.5% and 23%[1-3].In the current study, 55.1% of the participants reported 0-10% of their patients experience bracket debonding during orthodontic treatment, while 30.8% reported rates of 20-30%. Furthermore, 6.4% revealed that 50% of their failure cases had to bracket dislodgement, and another 7.7% reported bracket debonding in 60-80% of their patients. These variations in failure rates might be related partly to the ages of the patients they are treating in their practices as adolescents presented with more debonding (25.4%) than adults (12.3%)[6]. Or it may be related to the different materials and techniques they were using[18].

Half of the participants in the current study (50%) conducted 1-2 appointments /week, 17% of the participants conducted 3-4 appointments/week, followed by 9% with 5-8 appointments/week and 5.1% with more than eight appointments/week. According to a retrospective study, the frequency of bond failure was significantly associated with treatment duration[17]. In bracket failure, it is sometimes necessary to revert to using a smaller wire gauge if the existing wire does not engage in the slot of the rebonded bracket. This is true especially when debonding happens with heavy-gauge stainless-steel wires[16,17]. Nearly half of the participants (49.8%) agreed with mandatory reversion to a smaller diameter once a bracket has debonded. Hence, the occurrence of bracket debonding during orthodontic treatment will prolong treatment time.

De-bonding has many potential causes. Among the most common reasons cited by patients for bond failures in previous studies are hard brushing and biting on hard food substances[2]. Three possible reasons for increased bracket failure rate during the first six months of treatment are O'Brien et al. [18]. Firstly, Any deficiencies in the bond strength of the individual bracket/adhesive combination would become evident within this initial treatment period. Secondly, the initial treatment period is also a time of adaptation and testing for patients concerning the type of food that fixed orthodontic appliances can tolerate. Thirdly, the initial phase of treatment may involve a period of overbite correction and, therefore, heavy occlusal forces may be applied to many of the bonded attachments[18]. In the current study, almost all of the participants either agree or strongly agree on the effect of types of food on bracket dislodgement. In addition, most of the

participants agreed that using intraoral elastics could cause bracket debonding since these devices apply forces from a certain direction that may ultimately lead to bracket dislodgement.

In a study investigating cooperation and compliance among adult patients during three stages of treatment, compliance was observed to improve during the middle, space closure/molar correction stage, but then to decline as the treatment progressed. Maintenance of oral hygiene is also gradually reduced with the progression of orthodontic treatment[19]. The frequency of broken appliances has been found to be one of 10 identified predictors of patient compliance [20]. Bracket failures are associated with poor appliance maintenance and hence poor patient adherence[21]. Despite this association of bracket failure with poor adherence, there does not appear to be any evidence to suggest that it can predict discontinuation of treatment[22]. Discontinued and abandoned cases are terminated prematurely before the intended outcome of the treatment has been achieved. However, most of the evidence regarding the discontinuation of orthodontic treatment is related to lack of compliance regarding oral hygiene instructions and missed appointments. The discontinuation rate was identified as 8% among orthodontic patients treated in NHS Primary Care Orthodontic Services England and Wales in 2013. Swedish papers reported discontinuation rates of between 4% and 15%, and in German studies, the rate ranged from 10%-20%[3]. Regarding the participants' perceptions on discontinuing treatment in patients with lack of compliance and multiple bracket dislodgements, 44.9% agreed, and 9% strongly agreed that treatment should be discontinued.

Regarding preventive measures to reduce bracket dislodgement, most participants considered giving instructions to encourage appropriate food consumption to help prevent bracket debonding. Additionally, repeating instructions on appliance care to children and their parents can reduce the incidence of bracket dislodgement. Educating patients on compliance is considered one of the main factors for increasing patient compliance[11].

Dislodged brackets can be used for rebonding. For economic reasons, brackets that become debonded during orthodontic treatment are generally rebonded after removing composite adhesive using sandblasting, mechanical grinding, adhesive burning, and lasers[24]. Some in vitro studies have reported the bond strength of the rebonded bracket does not decrease after rebonding[1,25]. The literature also reported that postponing rebonding of dislodged brackets does not affect the bond strength. Postponing rebonding to the next visit has not been found to affect the SBS significantly[26]. In the current study, half of the participants agreed with re-using the debonded brackets for rebonding.

One of the limitations of the current study was the inability to investigate the relationship between the orthodontists' perception and awareness levels regarding bracket failure and bracket failure among their patients. Furthermore, the study did not investigate perceptions of patients and their parents on bracket dislodgement, which would have given a broader perspective and deeper insight on the bracket dislodgement problem.

Conclusion

The orthodontists in this study considered that orthodontists bear the least responsibility for bracket failure during fixed orthodontic treatment. Additionally, they considered food consumption instructions as the best method for preventing bracket failure. Years of experience were associated with the bracket failure rate and the number of appointments needed for rebonding brackets during fixed orthodontic treatment. Further studies are necessary to assess the perceptions of patients and their parents on bracket dislodgement. Furthermore, the results of this study need to be verified by relating the orthodontists' responses on bracket failure to the incidence of failure among patients treated by these orthodontists.

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