

Developing and Validating a Tool to Assess Orthodontists' Awareness and Clinical Use of Maxillary Molar Distalization

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Abstract

Background

Distalizers are common orthodontic appliances used to correct malocclusions by moving molars distally. This intervention is frequently indicated to facilitate arch space acquisition or to achieve optimal dental alignment, particularly in patients with crowding or Class II malocclusions.

Objective

To develop a validated and reliable electronic questionnaire consisting of 15 items aimed at evaluating orthodontists' awareness and experience regarding maxillary molar distalization.

Participants and methods:

This cross-sectional study was carried out in compliance with STROBE (STrengthening the Reporting of OBservational studies in Epidemiology). The surveyed orthodontists were asked to complete a validated and reliable electronic questionnaire consisting of 15 questions highlighting various aspects of molar distalization.

Results

In accordance with the content and face validation findings, the questionnaire was altered by eliminating the non-valid items, adding, or changing items, and combining certain categories. The total number of respondents to this survey was 120 orthodontists. The majority of them use molar distalization (76.66%). Class II malocclusion was considered the main indication for using molar distalizers (60%). Skeletally anchored molar distalization devices were mostly preferred (45%). Patient non-compliance and biological factors (slow tooth movement) were considered the primary failure factors from the respondents' point of view (20.84% and 30% respectively).

Conclusion

Most orthodontists prefer molar distalization for correcting Class II malocclusions in permanent dentition stage. Intra-alveolar skeletally supported distalizers are favored. The importance of three-dimensional imaging in treatment planning is emphasized to prevent irreversible alveolar bone damage.

Introduction

Orthodontic correction for malocclusions may involve teeth extraction for alignment and teeth retraction, or molar distalization as an alternative non-extraction approach [1, 2].

Various devices for maxillary molar distalization have been introduced, but many have limitations like compliance issues, aesthetic problems, and anchorage loss, potentially impacting treatment success [3, 4]. Temporary anchorage devices (TADs) have significantly enhanced anchorage augmentation efficiency, especially during molar distalization, and recently used to accelerate tooth movement [5–7]. However, molar distalization is not advised for dolichocephalic people due to the risk of clockwise jaw rotation and increased lower anterior facial height [8].

A questionnaire is a crucial tool for gathering information on individuals' perceptions, awareness, and opinions, requiring careful manipulation and expert verification [9]. To ensure accurate responses, the validated questionnaire should be straightforward to comprehend and able to evaluate the aspects it was designed to test [10]. The Content Validity Index (CVI) is a quantitative test used to ensure questionnaire content is relevant and adequately addressed, conducted by a panel of at least three experts using two validation cycles [11]. Face validation, on the other hand, is a qualitative technique that assesses the questionnaire's content representativeness based on its readability, feasibility, uniformity in formatting, and language clarity [12, 13].

There are many conflicting opinions in the literatures concerning several aspects of molar distalization approach and a conspicuous lack of evidence concerning a rare and late side effects. Therefore, this observational study was designed to develop, validate and implement a questionnaire to assess orthodontists' perception and experience to maxillary molar distalization.

Participants and methods

Study design:

The STROBE guidelines for the presentation of cross-sectional studies were followed to describe this study [14].

Part 1: Questionnaire development and validation process:

Design the questionnaire:

A pool of questions investigating several aspects of molar distalization including indications, diagnosis, planning, methods, advantages, limitations, and complications were implemented to be used in this questionnaire in its initial draft. The target group for questionnaire content and face validation was consisting of a quota sample of ten orthodontic specialists with a varying degree of experience (more than 10 years) working in educational and health sectors.

Content and face validation procedure:

The following steps were followed to develop a relevant, valid and understandable questionnaire based on a previous study [15].

Step 1: The initial round of experts' content and face validation:

A panel on content validity was formed by orthodontics specialists, where they rated questionnaire questions using a 4-point Likert scale, with items scoring 1 or 2 considered irrelevant and 3 or 4 considered relevant.

The content validity index (CVI) was utilized to quantitatively assess items/questionnaires, with the number of experts assigning a score of 3 or 4 to each item divided by the total number of experts, and to maintain validity, each item must receive a 3 or 4 score from at least 8 specialists, with an accepted I-CVI level of > 0.78 .

The validity of the questionnaire was evaluated by averaging the I-CVI for each item. The S-CVI level that is advised and recognized is 0.9 [11]. The experts were invited to join a face validity panel to evaluate the questionnaire's appropriateness and readability. They provided with ten questions plus an open-ended question to add their comments and suggestions to modify the questionnaire. A 4-point Likert (score 1 = strongly disagree, score 2 = disagree, score 3 = agree, and score 4 = strongly agree) was employed for this approach.

Step 2: Questionnaire modification

Based on the first step outcome, the questionnaire was modified by adjusting some items, removing the invalid ones ($I-CVI < 0.78$), and merging others.

Step 3: Second round of content validation by experts

To evaluate the updated questionnaire, the same specialists were also asked to participate in a second round of content validation.

Reliability test and retest:

Ten specialist orthodontists were asked to assess the test-retest reliability of the updated questionnaire within 1 week apart.

Part 2: Questionnaire distribution:

Following the establishment of its validity and reliability, the questionnaire was pilot tested with five orthodontists. Subsequently, the questionnaire was utilized to assess the molar distalization perception and experience among orthodontist in electronic-based form thereby minimizing the potential for interviewer-induced bias. A Google form was designed comprising two sections: Demographic data section which contain three questions (gender, experience, academic degree), and molar distalization section comprised form 15 questions that highlight the indications, types, diagnosis, limitations, and complications of molar distalization appliances. The eligibility criteria for participating orthodontists required them to be registered members of the Orthodontic Society and to have a minimum of two years of clinical practice experience. The Google form was sent through social media groups dedicated to orthodontists. Responses were collected and analyzed between February 2025 and June 2025, with two reminders notifications sent during this timeframe.

The sample size was calculated using SurveyMonkey based on the total registered members in the Orthodontic Society, which consisted of 150 members. Using a 95% confidence interval and a 5% margin of error, the estimated sample size required for the study was calculated to be 109 participants.

Statistical analysis

Direct communication was used to gather all responses (first and second round content validation and face validation forms), which were then saved as an Excel spread sheet (Excel, Microsoft Office Professional Plus 2019, Washington, USA). I-CVI and S-CVI values were used to determine content validity, while the proportion of satisfying agreement ratings for each form question was used to evaluate face validation. Cohn's Kappa test was used to check the reliability of the questionnaire.

The primary analysis of the orthodontists' questionnaire responses was descriptive, displaying percentages and frequencies. Percentages were reported as proportions of the total for each survey question. The data was analyzed using SPSS statistics software (version 25; IBM, Armonk, NY).

Results

The first round of content validation revealed that 18 items were considered valid ($I-CVI \geq 0.78$), while 6 items were invalid ($I-CVI < 0.78$). As a result, these non-valid items were removed from the questionnaire. The S-CVI for the overall questionnaire was 0.95, which was above the threshold (0.90) for questionnaire validity (Table 1).

Table 1
First round content validation by 10 orthodontic specialists

No.	Questionnaire item	I-CVI	Validity
1	Do you use molar distalizers in your practice?	1.0	Valid
2	What is/are the reasons of not using molar distalizers in your practice?	0.6	Non-valid
3	Which type of distalizer do you most commonly use?	0.8	Valid
4	What is your preferred method for molar distalization?	0.8	Valid
5	Which distalization approach do you find more efficient?	1.0	Valid
6	In case you prefer skeletal anchorage distalizers, where do you prefer to place the TADs?	0.9	Valid
7	In your experience, what is the most common indication for distalization?	1.0	Valid
8	What age group do you typically treat with distalizers?	1.0	Valid
9	What factors do you consider when choosing a distalizer for a patient?	1.0	Valid
10	How long, on average, does the distalization phase last in your treatment?	0.9	Valid
11	Do you typically use distalizers in combination with other appliances?	1.0	Valid
12	What challenges do you face when using distalizers?	1.0	Valid
13	How do you assess the success of distalization in your practice (clinic)?	1.0	Valid
14	What is your preferred way of managing relapse after distalization?	0.6	Non-valid
15	What do you consider the main advantage of using a distalizer over other methods (e.g., extractions)?	1.0	Valid
16	What percentage of your patients require distalization during treatment?	0.9	Valid
17	Which distalizer do you find offers the best patient compliance?	0.5	Non-valid
18	What is your preferred anchorage method when using a distalizer?	0.6	Non-valid
19	Do you incorporate 3D imaging or digital tools in planning distalization?	0.8	Valid
20	Which diagnostic tools do you rely on most when deciding to use a distalizer?	1.0	Valid
21	Which manufacturer or system do you prefer for distalization appliances?	0.6	Non-valid

No.	Questionnaire item	I-CVI	Validity
22	Would you recommend distalizers as part of treatment for other orthodontists?	0.6	Non-valid
23	What complications do you most commonly encounter with distalizers?	1.0	Valid
24	What is the most common reason for distalization failure in your experience?	1.0	Valid
S-CVI/Ave		0.95	

With a 98 percent overall agreement rate, the questionnaire was deemed sufficient in terms of face validation. The following changes were recommended by several experts to make some elements more appropriate:

- Removing three non-valid items (2, 14, 17, 18, 21, 22).
- Merging some items into single item (3,4,5) and (19,20).
- Addition of option (I don't use distalizers) to some items (3,5,8–13, 15–20, 23–24).

Consequently, the validated questionnaire contained 15 items. During the second round of validation process, the new draft questionnaire with the modified items was resent to the ten specialists again after two weeks. All items were considered valid ($I-CVI \geq 0.78$), and the overall questionnaire had perfect content validity ($S-CVI/Ave = 100$). For the reliability test and retest, good question reliability was shown by the Cohn's kappa test, which had the lowest score of 0.7 for any questionnaire item.

Orthodontists' response to the questionnaire:

The total number of respondents to this survey was 120 orthodontists, and their demographic data represented in Table 2. The percentage of female to male orthodontists were almost equal (47.5% and 52.5%, respectively). Similarly, both less experienced and more experienced orthodontists (35.83% and 33.34%, respectively). The majority of the participants have an academic degree either M.Sc. or Ph.D. (51.66% and 11.66% respectively).

Table 2
Demographical data of the participants

Parameters		N	%
Gender	Male	63	52.5
	Female	57	47.5
	Total	120	100
Years of experience	< 5	43	35.83
	5–10	37	30.83
	> 10	40	33.34
	Total	120	100
Academic degree	Certificate or diploma	44	36.68
	M.Sc.	62	51.66
	Ph.D.	14	11.66
	Total	120	100

Table 3 represent the frequencies and percentages of the orthodontist's perception toward molar distalization. Almost three-quarters of participants use molar distalization in their clinical practice (76.66%). Class II malocclusion was considered the main indication for using molar distalizers (60%). About one third of the respondents (36.67%) found that about 10–25% of their patients require molar distalization. The preservation of tooth structure was considered the main advantage of molar distalization approaches (40.84%). While both patient compliance issue and soft tissue irritation were considered the main complications associated with distalization approach (31.28% and 26.4%, respectively). Additionally, patient non-compliance and biological factors (slow tooth movement) were considered the primary failure factors from the respondent point of view (20.88% and 30%, respectively). Furthermore, patient compliance and long treatment duration were the main challenges that faced the orthodontists during distalization process (21.67% and 24.16%, respectively).

Table 3
Orthodontists response frequencies and percentages to molar distalization perception

Orthodontists' response frequency and percentages to molar distalization perception									
1. Do you use molar distalizers in your practice?									
Yes		92	76.66%	No			28	23.34%	
2. In your experience, what is the most common indication for distalization?									
Class II malocclusion.		72	60%	Crowding correction.			32	26.67%	
Overjet reduction.		16	13.33%	Other			0	0%	
3. What percentage of your patients require distalization during treatment?									
Less than 10%	34	28.33%	25–50%	12	10%	I don't use distalizers	28	23.33%	
10–25%	44	36.67%	More than 50%	2	1.67%				
4. What do you consider the main advantage of using a distalizers over other methods (e.g., extractions)?									
Non-invasive	26	21.66%	Shorter treatment time	10	8.34%	I don't use distalizers	28	23.33%	
Preserves tooth structure	49	40.84%	Higher patient satisfaction	7	5.83%				
5. What complication do you most commonly encounter with distalizers? (You can choose more than one option)									
Patient compliance issues	51	31.28%	Root resorption	13	7.98%	I don't use distalizers	28	17.18%	
Anchorage loss	28	17.2%	Soft tissue irritation	43	26.4%				
6. What is the most common reason for distalization failure in your experience?									
Patient non-compliance	25	20.88%	Poor diagnosis or planning	14	11.7%	I don't use distalizers	28	23.33%	
Appliance malfunction	17	14.17%	Biological factors (e.g., slow tooth movement)	36	30%				
7. What challenges do you face commonly when using distalizers?									
Patient compliance.	26	21.67%	Long treatment duration.	29	24.16%	I don't use distalizers	28	23.33%	
Appliance breakage or discomfort.	15	12.5%	Difficulty achieving desired results.	22	18.34%				

Table 4 represent the frequencies and percentages of the orthodontist's molar distalization clinical experiences. Clinical observation was the main approach to decide proceeding with distalization method and assess its progress while the digital tools are still not commonly used among orthodontists (52.05% and 8.17% respectively). Most of the clinician (31.66%) prefer to commence the distalization process at adolescent (12–18 years), and the severity of malocclusion was considered main factor during their treatment planning (40.8%). For those who use molar distalization, the majority of them prefer skeletally anchored molar distalization devices and found them to be most efficient in achieving the desired outcome, while the removable appliances such as headgear and clear aligner were not well received (45% and 2.5% respectively). The vestibular sites of oral cavity (Intra and extra alveolar) were preferred to place miniscrews compared to the palatal sites (84% and 16% respectively). Almost half of the respondents (53.34%) prefer to use their distalizers devices together with fixed orthodontic appliance in a single phase, and it usually take 6–12 months on average to achieve Class I molar relation (48.34%).

Table 4

Orthodontists response frequencies and percentages to molar distalization clinical experiences

1. Which diagnostic tool/s do you rely on most when deciding to use a distalizers? (You can choose more than one option)								
Lateral cephalogram	38	18.45%	Study models	23	11.16%	I don't use distalizers	28	13.59%
3D CBCT scans	39	18.94%	Clinical examination	78	37.86%			
2. How do you assess the success of distalization in your practice? (You can choose more than one option)								
Clinical observation	102	52.05%	Digital scans and measurements	16	8.17%	I don't use distalizers	28	14.28%
Cephalometric analysis	25	12.75%	Patient feedback and aesthetic improvement	25	12.75%			
3. What age group do you typically treat with distalizers?								
Pre-adolescent patients (under 12 years).	5	4.17%	Adults (18 + years).	22	18.34%	I don't use distalizers	28	23.33%
Adolescents (12–18 years)	38	31.66%	All age groups	27	22.5%			
4. What factor do you consider primarily when choosing a distalizers for a patient?								
Patient compliance	19	15.8%	Duration of treatment	15	12.5%	Cost	0	0%
Severity of malocclusion	49	40.8%	Patient's age	9	7.5%	I don't use distalizers	28	23.33%
5. Which type of distalizers do you most commonly use?								
Fixed (e.g., pendulum, distal jet).	35	29.17%	Skeletal anchorage devices (mini-implants).	54	45%			
Removable (e.g., headgear, clear aligners)	3	2.5%	I don't use distalizers	28	23.33%			
6. In case you use skeletal anchorage distalizers, where do you prefer to place the TADs?								
Interradicular buccal alveolar bone.	43	35.83%	Extra-alveolar (Infra-zygomatic crest).	58	48.33%			
Interradicular Palatal alveolar bone.	7	5.84%	Anterior palatal area.	12	10%			

1. Which diagnostic tool/s do you rely on most when deciding to use a distalizers? (You can choose more than one option)								
7. Do you typically use distalizers in combination with other appliances?								
Yes, with fixed braces	64	53.34%	No, I use distalizers independently	12	10%	I don't use distalizers	28	23.33%
Yes, with aligners	5	4.17%	Rarely	11	9.16%			
8. How long, on average, does the distalization phase last in your treatment?								
Less than 6 months	23	19.16%	12 to 18 months	9	7.5%	I don't use distalizers	28	23.33%
6 to 12 months	58	48.34%	More than 18 months	2	1.67%			

Discussion

In modern orthodontics, non-extraction procedures are gaining popularity due to the development of less invasive and more effective treatment techniques. One such procedure is maxillary molar distalization, which has benefited from advancements in mechanotherapy [16].

Designing the questionnaire:

It was established that the target group of a questionnaire is an important part during designing the questionnaire [17]. The present study used a questionnaire designed for orthodontists to assess their perception and report their experience of maxillary molar distalization. The questionnaire aimed to cover aspects such as indications, diagnosis, planning, methods, screening, limitations, and complications, as there is a lack of survey studies on this topic. Observational studies are more appropriate for routine medical practice because clinical trials are unable to address all important questions about a given intervention, such as the benefits and harms, also detection of rare or late adverse effects of treatments [18, 19].

Content and face validation by experts:

Validity of a questionnaire is crucial for its precision, accuracy, and understanding of the instrument. It requires both qualitative and quantitative validation techniques. Improving the validity process by adding inter-professional experts can gather more opinions and ratings, strengthen some items, and lower others [20]. The study assessed language clarity and readability during face validation, a crucial step in questionnaire modifications. Previous studies recommended second round validation after 10 days for item validity. Accordingly, experts were invited for content validation after a two-week interval [21].

Orthodontist's perception and clinical experience toward molar distalization:

Most orthodontists favored molar distalization for correcting Class II malocclusion. This is supported with the evidence that 50% of young and adolescents in the U.S have Class II malocclusion with 95% of cases could be corrected by molar rotation, distalization, and expansion [22, 23].

A key finding of the study was that most orthodontists rely on clinical examinations for distalization decisions and progress assessment, rather than 3D radiographs. Earlier study reported that bone dehiscences and fenestrations are among the serious and frequently irreversible unfavorable consequences of failure to maintain the teeth inside the alveolar [24]. Thus, CBCT is crucial to obtain essential information on boundary conditions accurately for planning tooth movement [25].

Most clinicians recommend waiting until full permanent dentition stage (except third molar) is reached before starting molar distalization, as evidence suggests it is not affected by second or third molar eruptions [26]. Although earlier studies suggest that distalization should start before second molar eruption for greater distal movement, shorter treatment duration, and less anchorage demands. However, patients with erupted second molars have less distal molar tipping and often lack sufficient space for eruptions. Orthodontists must consider these factors when selecting the appropriate time for molar distalization [27, 28].

Orthodontists consider malocclusion severity in treatment planning to decide on molar distalization approach and appliance type. Conventional appliances can provide half-unit distal movement; however, skeletal anchoring devices or mesial movement of a lower molar may be required if more than half-cusp molar correction is required [29, 30, 31]. This explains the preference of participating orthodontists for skeletally supported molar distalizer devices over other types.

The placement sites of TADs for the skeletally supported molar distalizers could affect the efficiency of molar distalization [32]. The survey found that orthodontists prefer intra-alveolar sites for TADs placement, despite evidence suggesting infrazygomatic and palatal TADs are more effective for molar distalization due to short treatment duration, great distalization, and less molar tipping [1, 32]. Buccal interradicular TADs are suitable for small distalization due to their position preventing simultaneous movement of adjacent teeth.

Interestingly, most orthodontists preferred molar distalization with fixed orthodontic attached to other teeth simultaneously. There are conflicting opinions on this subject, while some believed more teeth improve resistance to reactive forces, others reported anterior anchorage loss and less distal movement of the maxillary first molar when using orthodontic brackets [33, 34]. However, placing fixed brackets during distalization may reduce treatment time and allow for additional force sources [34].

The average time to achieve a Class I molar relationship was 6–12 months, according to the study. This is in line with a meta-analysis which shows that, depending mostly on the necessary distalization, a half-

to-full cusp Class II molar relationship can be corrected with intraoral distalization in 5–11 months [32, 35, 36].

Strength and limitation of the study

The strengths of the study:

- In an attempt to make the questionnaire as reliable as feasible, it was piloted and modified in response to comments prior to final dissemination.
- The questionnaire was web-based Google form filled by the participants without any interference thus avoiding the response bias.

The limitations of the study:

- Sample size was small and limited to the membership of single society.
- The study did not validate orthodontists' responses with clinical records or outcomes, making it difficult to assess the accuracy of their self-reported awareness and practices.
- Low response rate because the questionnaire was sent electronically, which is known to have lower response than in-person questionnaire (30% vs 57%) [37].

Conclusions

Most orthodontists prefer molar distalization for correcting Class II malocclusions, mainly relying on clinical examinations rather than CBCT imaging. They typically wait until full permanent dentition is achieved before starting treatment. Skeletally supported distalizers and intra-alveolar TADs placements are favored, though challenges like patient compliance and slow movement persist. Incorporating advanced imaging and optimizing appliance strategies could improve treatment outcomes.

Declarations

Ethics approval and consent to participation:

This study was conducted in accordance with the ethical standards of (Baghdad University/College of Dentistry). Ethical approval was obtained from ethical approval committee at Baghdad University/College of Dentistry (No.1020425). Participation in the survey was voluntary, and informed consent was obtained from all respondents prior to data collection. All respondents were anonymized, and no identifiable personal information was collected or reported.

Consent for publication:

Not applicable.

Data availability:

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests:

The authors declare no competing interests.

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Authors contribution:

M.S. and M.A. conceived and designed the study. M.S. wrote the study protocol and obtained funding. M.A. obtained ethical approval. M.S. collected and interpreted the data and prepared the first draft of the manuscript. K.H. and D.B. contributed to revising the final manuscript and proofreading. All authors critically revised the manuscript and approved the final version.

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