Systematic Review

Effectiveness and accuracy of clear aligners in non-extraction Class II correction: a systematic review of maxillary molar distalization and rotation in the permanent dentition

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ABSTRACT

Objectives: To evaluate the effectiveness and accuracy of clear aligners (CA) in maxillary molar distalization and rotation for nonextraction Class II correction in the permanent dentition.

Materials and Methods: This systematic review of the literature (2015–2024) followed PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines. Studies included orthodontic patients in the permanent dentition with dental Class II, mild or no skeletal discrepancies, 2–6 mm crowding, treated with CA without extractions (except maxillary third molars) or adjunctive therapies beyond Class II elastics. Data focused on maxillary molar distalization, rotation, accuracy, and complications. Risk of bias was assessed using ROBIN-I, with evidence level graded per the SBU protocol.

Results: Sixteen studies were categorized into Group A (initial aligner or distalization outcomes) and Group B (including refinements). Group B reported greater accuracy and distalization due to sequential distalization protocols, Class II elastics, and refinements. After refinements, CA achieved 1.84–2.98 mm of maxillary molar distalization with 85% maximum accuracy. First-molar rotation reached 8.09°, with 78.4% maximum accuracy. No significant vertical skeletal changes were observed. Challenges included anterior anchorage loss, buccolingual tipping of upper molars, and patient compliance monitoring. Methodological variability and participant demographics prevented a meta-analysis.

Conclusions: CA effectively achieves maxillary molar distalization and rotation in nonextraction Class II patients. Sequential distalization protocols and refinements improve treatment outcomes, whereas early incorporation of Class II elastics, combined molar movements, and compliance monitoring may enhance treatment efficiency. (*Angle Orthod*. 2025;00:000–000.)

KEY WORDS: Clear aligners; Accuracy rate; Maxillary molar distalization and rotation; Class II elastics; Sequential distalization; Refinements

INTRODUCTION

Clear aligners (CA) have revolutionized orthodontics, offering a discreet and comfortable alternative to traditional braces.[1,2] Their increasing popularity is driven by technological advancements such as SmartForce, SmartTrack, and Smart Stage, developed by Align Technology (Santa Clara, California, USA).[3,4] These innovations have improved treatment predictability and expanded the applicability of aligner-based therapy to address more complex cases beyond simple Class I malocclusions.[5]

Class II malocclusion, which affects nearly 20% of the global population,[6,7] has traditionally been treated with extractions, functional appliances, or maxillary molar distalization.[8,9] CA offers a nonextraction alternative for Class II correction via simultaneous molar distalization and mesiobuccal molar rotation.[10–12] Recent studies reported on maxillary molar distalization achieving an average of 1.5–3 mm[12–15], with predictability rates ranging from 68% to 88%,[10,13–15] whereas molar rotation reached 6°–8.09° with predictability rates ranging from

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41% to 78%,[5,11,16,17] consequently demonstrating that CA may be a viable option for correcting half- to full-cusp Class II molar relationships without tooth extractions.[13,18,19]

The thickness of aligners and the resulting "Bite Block" effect, which ensures effective vertical control during maxillary molar distalization, is another advantage of CA.[20,21] However, achieving distalization often involves partial translation, necessitating consideration of mesiodistal and buccolingual crown tipping to optimize outcomes and minimize potential side effects.[5,18,19,22]

Despite increasing evidence supporting the efficacy of CA in orthodontic treatment, a lack of systematic reviews addressing outcomes related specifically to maxillary molar distalization and rotation persists.[15,23,24] Variability in patient demographics, treatment protocols, and measurement methodologies complicate interpretation of results and hinder the establishment of standardized treatment guidelines.[24,25] Additionally, challenges such as anchorage control[12,26] and discrepancies between predicted and achieved outcomes remain subjects of ongoing debate.[27-30]

This systematic review aimed to synthesize comprehensively the current evidence on maxillary molar distalization and rotation using CA for nonextraction Class II correction without adjunctive appliances such as orthodontic mini screws or hybrid therapies, except for the use of Class II elastics. By analyzing studies conducted between 2015 and 2024, this review sought to evaluate the effectiveness, accuracy, and clinical implications of CA for molar distalization and rotation. It also examined the role of Class II elastics and the refinement phase in optimizing treatment outcomes.

MATERIALS AND METHODS

Study Design

This systematic review adhered to PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines. Eligible studies included randomized clinical trials (RCTs), controlled clinical trials (CCTs), and prospective and retrospective studies published between 2015 and 2024. Exclusion criteria were systematic reviews, meta-analyses, observational studies, case reports, non-English publications, animal studies, and in vitro research.

Participants

Studies evaluating maxillary molar distalization and rotation using CA in orthodontic patients with permanent dentition, dental Class II occlusion, Class I or mild Class II skeletal patterns, and crowding $\leq$ 6 mm were included. Due to limited data, studies of maxillary molar rotation extended to include dental Class I, minor Class III and unidentified dental classification. Exclusion criteria were patients requiring maxillary arch expansion, those with periodontal disease, systemic conditions, cleft lip/palate, tooth extraction (except maxillary third molars), or treatment involving adjunctive appliances beyond Class II elastics.

Search Strategy

Search terms included "Clear aligner", "Invisalign", "maxillary molar", "distalization", "rotation", "Class II", "non extraction", "systematic review", "mini screw" and "case report" were combined using Boolean operators (AND/OR/NOT) across Google Scholar, Cochrane, and PubMed databases (Table 1).

Data Processing and Collection

Two reviewers (the first two authors) independently screened titles and abstracts to exclude irrelevant studies. Full-text articles were then assessed for eligibility, with disagreements resolved through discussion or consultation with additional collaborators (the third and last authors). Extracted data included the author, year of publication, study design, participant demographics, intervention and protocols, main objectives and outcomes (Tables 2, 3, and 4).

Quality Assessment

Risk of Bias. The Risk of Bias in Non-randomized studies-of Interventions (ROBIN-I) tool was used to evaluate study quality across seven domains. The overall risk of bias was determined as the outcome, with interpretations detailed in Table 5.

Quality of Evidence. All included studies were graded using criteria adapted from the Bondemark scoring system.[31] The final level of evidence was concluded based on the protocol established by the Swedish Council on Technology Assessment in Health Care (SBU)[15,31] (Table 6).

Criteria for Grading of Assessed Studies.

Grade A. High Value of Evidence (all criteria should be met).

- Randomized clinical study or a prospective study with a well-defined control group.
- Defined diagnosis and endpoints.
- Diagnostic reliability tests and reproducibility tests described.
- Blinded outcome assessment.

Table 1. Search Strategy and Results

Database	#	Search Term	Results
PubMed	1	("orthodontic patients" OR "non extraction" OR "Class II") AND ("maxillary molar" OR "clear aligner" OR "Invisalign")	258
	2	#1 AND ("distalization" OR "clear aligner" OR "Invisalign")	215
	3	#1 AND ("rotation" OR "clear aligner" OR "Invisalign")	173
	4	#1 AND ("rotation" OR "distalization")	110
	5	(#1) AND (#2) AND (#3) AND (#4)	60
	6	(#5) NOT (("systemic review" OR "miniscrew" OR "case report"))	48
Cochrane Library	1	("orthodontic patients" OR "non extraction" OR "Class II") AND ("maxillary molar" OR "clear aligner" OR "Invisalign")	89
	2	#1 AND ("distalization" OR "clear aligner" OR "Invisalign")	67
	3	#1 AND ("rotation" OR "clear aligner" OR "Invisalign")	43
	4	#1 AND ("rotation" OR "distalization")	49
	5	(#1) AND (#2) AND (#3) AND (#4)	16
	6	(#5) NOT (("systemic review" OR "miniscrew" OR "case report"))	14
Google Scholar		("maxillary molar" OR "Class II") AND ("clear aligner" OR "Invisalign") AND (rotation OR distalization)	553

Grade B. Moderate Value of Evidence (all criteria should be met).

- Cohort study or retrospective cases series with defined control or reference group.
- Defined diagnosis and endpoints.
- Diagnostic reliability tests and reproducibility tests described.

Grade C. Low Value of Evidence (one or more of the following conditions).

- Large attrition.
- Unclear diagnosis and endpoints.
- Poorly defined patient material

RESULTS

Study Selection

The initial search identified 1695 studies. After screening titles and abstracts, 48 studies were selected for full-text review. After the application of inclusion and exclusion criteria, 16 studies were included in the final analysis (Figure 1).

Study Characteristics

The 16 studies were categorized into two groups based on their post-treatment definition (Table 2):

- **Group A:** Post-treatment outcomes assessed after completing the initial aligner set or the maxillary molar distalization.
- **Group B:** Post-treatment outcomes assessed after completing the entire treatment, including refinements.

Three studies (A2, A3, B15) were prospective, non-randomized trials, whereas the remaining were retrospective. Sample sizes ranged from seven to 80, totaling 452 patients. All participants were in permanent dentition with maxillary second molars, mild Class II or no skeletal discrepancies, and crowding ranging between 2 and 6 mm. Treatment primarily involved CA for Class II (N = 249) correction via maxillary molar distalization and rotation, without extractions or adjunctive therapies except Class II elastics. Participants with Class I (N = 84), Class III (N = 4), and unidentified molar classification (N = 115) were included for control, or studies focused on accuracy and maxillary molar rotation. Treatment duration varied from 5.5 to 19.07 months in Group A, to 14–28.8 months in Group B. Imaging methods included lateral cephalograms (A10, B11, B13, B14, B15), digital scans or casts (A1–A9, B12), and cone beam computed tomography (CBCT; A6, B14, B16) (Table 2).

Qualitative Analysis of the Included Studies

None of the included studies achieved Grade A rating, as none of the three prospective studies assessed outcomes with blinded operators. Three studies were rated as having a low level of evidence due to specific limitations: limited statistical power resulting from small sample sizes (A6), high variability in results with large standard deviations (B12), and poorly defined interventions including the protocol (B14) (Table 7). As a result, the overall level of evidence in this review was categorized as level 3-limited evidence (Table 6).

However, all 16 studies were found to have a moderate overall risk of bias according to the ROBIN-I tool. Factors such as reliable measurement methods (A1, A7, A8, B14–B16), validated tools (A2, A6, A8, A9, B11, B14–B16), and the use of blinded operators (B11, B13) contributed to measurement reliability and minimized bias. Despite these strengths, several

Table 2. Study Characteristics: Categorized as Group A (Post-Initial Set) and Group B (Post-Refinement), Followed by the Number of the Study[a]

Gr/No.	Author Study Design	Intervention	N (Pts)	M	F	Age (Mean ± SD) (Range)	Method
A1	Grunheid Retrospective	Invisalign	30	13	17	21.6 ± 9.8	Digital Cast
A2	Haouili Prospective	Invisalign	38	13	25	36 (N/A)	Digital Scan
A3	Saif Prospective	Invisalign	38	4	34	25.4 (N/A) (19–60)	Digital Scan
A4	Patterson Retrospective	Invisalign	80	22	58	35.25 ± 15.2	Digital Cast
A5	Taffarel Retrospective	Invisalign	32	7	25	35.47 ± 9.61	Digital Cast
A6	Lin Retrospective	Invisalign	7	N/A	N/A	26.64 ± 3.02	CBCT & Digital Cast
A7	Loberto Retrospective	Invisalign	49	22	27	14.9 ± 6.0	Digital Scan
A8	D'Anto (2023) Retrospective	Ordoline	16	4	12	25.7 ± 8.8	Digital Cast
A9	D'Anto (2024) Retrospective	Ordoline	45	21	24	29.2 ± 6.6	Digital Cast
A10	Mamani Retrospective	Invisalign	14	4	10	33.61 ± 8.57 (19–60)	Ceph
B11	Ravera Retrospective	Invisalign	20	9	11	29.73 ± 6.89	Ceph
B12	Lombardo Retrospective	F22 aligner	16	6	10	28.7 (N/A)	Digital Cast
B13	Caruso Retrospective	Invisalign	10	2	8	22.7 ± 5.3	Ceph
B14	Cui Retrospective	unclassified	18	N/A	N/A	27.8 ± 5.38 (18–38)	CBCT & Ceph
B15	Balboni Prospective	Invisalign	20	13	7	17.2 ± 3.2	Ceph
B16	Elfouly Retrospective	Invisalign	19	6	13	36.68 ± 13.5	CBCT

[a] Gr. indicates group; Pts, patients; M, Male; F, Female; L, lower; Mod, moderate, CBCT, Cone-beam computed tomography; Ceph, lateral cephalogram.

limitations were identified. These included a lack of patient compliance monitoring and operator validation (A1, A4, A5), data exclusion effecting sample size or quality (A2, B13), deviations in treatment protocols (A3, A5, A7), and selection bias, which was most prevalent in retrospective studies. Collectively, these factors contributed to a moderate risk of bias across each domain (Table 8).

Quantitative Analysis of the Included Studies

A meta-analysis was not feasible due to significant methodological heterogeneity across the studies, including variation in treatment protocols, patient demographics, and measurement methods.

Clinical Findings (Tables 3 and 4)

Accuracy. Eleven studies evaluated the accuracy of CA in the maxillary molar by comparing achieved vs planned tooth positions. For distalization, accuracy rates in Group A varied widely, ranging from 6.80% to 81.7%,[10,26–29] whereas Group B reported a single higher accuracy rate of 83% for first molar, and 85% for second molar.[13] Distal rotation of first molar showed similar accuracy across both groups, ranging from 77.5% to 78.4%,[10,16,17] except for one study reporting a lower accuracy of 43%.[5] Mesiodistal crown tip exhibited higher accuracy (48%–93.4%) compared to buccolingual crown tip (35%–58%).[5,17]

Accuracy was also observed in maxillary incisor extrusion (56%),[5] retroclination (57%–64.5%),[5,17] and retraction (65.5%).[28] Three studies concluded that CA treatment on Class II correction without tooth extractions showed varying results, ranging from inadequate[27,30] to high accuracy.[19]

Extent of Maxillary Molar Distalization and Rotation

In Group B, molar distalization achieved 1.84–2.98 mm at treatment completion, including refinements (cephalograms/CBCT)[13,18,20,22] with a significant improvement of

Table 2. Extended

Gr/No.	Tx Time (mo)	Tx Protocol: hr/d	CL I	CL II	CL III	Crowding	Objective of the Study
A1	11 ± 4	22/14	22	7	1	2 ± 2 mm	The difference between predicted and actual outcomes
A2	8.5	22/10	22	13	3	–	The efficacy of clear aligners on different types of tooth movement
A3	6.7 (3–11)	22/10	Cases requiring distalization			–	Predicted vs actual outcomes of maxillary molar distalization and anterior anchorage loss
A4	7	22/5–7	40	40	0	–	ABO score between Class I vs Class II malocclusion treated with clear aligners
A5	N/A	22/14	0	32	0	–	Treatment outcome using ABO score
A6	9.82/19.07	N/A	0	7	0	–	Dental and skeletal changes in Class II nonextraction cases compared to predicted plan
A7	5.5	16–22/7	0	49	0	<4	Anchorage loss during molar distalization focused on canine and premolar
A8	N/A	22/10		N/A		–	Predictability of maxillary molar distalization (2 mm prescribed) and derotation (11.6° prescribed)
A9	N/A	22/10		N/A		–	Predictability of rotation on several teeth when > 2° rotation is prescribed
A10	8.19–14.7	22/7	0	14	0	–	Differences between planned and actual maxillary molar distalization
B11	24.3 ± 4.2	22/10–14	0	20	0	≤4	Whether maxillary molar bodily distalization can be achieved with clear aligners
B12	N/A	22/14		N/A		<5	Accuracy of rotation, mesiodistal tipping, and vestibulolingual tipping of different tooth type
B13	16.8–28.8	22/10–14	0	10	0	Mild	The vertical dentoskeletal effects of maxillary molar distalization in Class II patients
B14	N/A	22/10	0	18	0	Mild-Mod	The molar distalization on skeletal, dentoalveolar and soft tissue changes in 3D space
B15	18 ± 4	22/7	0	20	0	≤6 L arch	The vertical dentoskeletal effects of maxillary molar distalization with prescribed molar intrusion (1 mm)
B16	N/A	22/10	0	19	0	–	Changes in angulation, inclination and rotation of maxillary molars after distalization

molar relation from Class II toward Class I (MR = 1.9 mm).[22] Group A distalization, similar to that observed in group B, achieved 1.30–3 mm when measuring on digital casts.[10,12,26] However, three studies reported less than 1 mm of distalization, with only one of these studies using cephalometric measurements.[27,29,30]

Statistically significant mesiobuccal molar rotation was observed, with first molars rotating 1.40° and second molars 3.08° (combined mean: 2.23°) alongside 2 mm distalization using Invisalign.[18] Ordoline aligners achieved rotation of 7.90°–8.09° (first molar) and 5.37°–6.40° (second molar) for mean planned rotations of 10°and 11.6°, without and with 2 mm of distalization, respectively.[10,16]

Complications

Anterior anchorage loss averaged 0.48 mm for central incisors, 0.45 mm for lateral incisors,[26] and 1.3 mm of mesial canine shift[12] after distalization. After refinement, maxillary incisors were retracted by 1.4–2.23 mm[13,20] and retroclined by 2.87°–13.2°.[13,20,22] Significant reduction in anterior overjet (1.3–1.72 mm),[21,28] ANB and SNA angles, and upper lip/E-line[13,20] were noted. Unexpected extrusion of maxillary incisors (0.30 mm) occurred in two studies, with and without Class II elastics.[19,28]

Maxillary molars exhibited no significant changes in mesiodistal angulation or vertical position.[13,18,20,22] However, significant increases in buccal crown torque were observed: 3.49° for first molars and 2.48° for second molars.[18,19] When 1 mm of intrusion combined with 2 mm of distalization was planned for the maxillary first molar, a significant reduction in FMA angle was observed, leading to counterclockwise rotation of the occlusal plane.[21]

DISCUSSION

Variability in study outcomes arose from differing definitions of "post-treatment." Group A studies focused on immediate outcomes after the initial aligner set or the

Table 3. Group A, Post-Initial Set. Overview of the Results and Conclusions of the Studies[a]

Author, Year, Study Design	Participant	Intervention/ Comparison/Statistic	Treatment Protocol	Main Outcomes Statistic Significant* ($P < .05$)
Grunheid et al., 2017, retrospective	30 pts; 13 M/17 F Mean age: 21.6 ± 9.8 y 22 CL I, 7 CL II, 1 CL III molar occlusion—all less than 2 mm, average crowding 2 ± 2 mm Compliance: N/A	Invisalign Scanned casts superimposition using a best-fit algorithm Diff. btw predicted and achieved tooth position	10 certified orthodontists and 12 orthodontic residents Nonextraction Invisalign treatment/ IPR/No overcorrection/ without Cl II el Average no. of aligners: N/A Average Tx time: 11 ± 4 mo	- The mean ± SD of the diff. btw predicted and achieved tooth position ■ *Facial-Lingual dimension* U1 = 0.45 ± 0.64 mm* (achieved more lingual positioned) U6 = 0.23 ± 0.62 mm*/1.45 ± 3.37°* (achieved more lingual positioned and buccal crown torque) U7 = 0.30 ± 0.79 mm*/2.13 ± 4.19°* (achieved more lingual positioned and buccal crown torqued) ■ *Mesial-Distal dimension* U6 = 0.27 ± 0.30 mm* /1.06 ± 1.40°* (achieved more distal positioned and distal crown tipped) ■ *Occlusal-gingival dimension* U1 = 0.30 ± 0.28 mm* (achieved more occlusal positioned) U7 = 0.13 ± 0.29 mm* (achieved more occlusal positioned) - All the statistically significant differences above were not considered clinically relevant (less than 0.5 mm, 2°), except the U7 buccal crown torque
Haouili et al., 2020, prospective	38 pts; 13 M/ 25 F Mean age: 36 y 22 CL I, 13 CL II, 3 CLIII comprised of 450 maxillary teeth Compliance: good, monitored	Invisalign SmartTrack Digital scans superimposition using a best-fit algorithm Diff. btw predicted and achieved tooth position	One experienced orthodontist Overcorrection was prescribed to achieve the best result clinically/ <1 mm IPR Average no. of aligners: 21 max/20 mand Average Tx time: 8.5 mo	- Accuracy rate (%) of U6 with regard to opposite direction ■ Distal/Mesial crown tip: 58/48 ■ Buccal/Lingual crown tip: 58/47 ■ Intrusion/extrusion: 35/38 ■ Mesial/Distal rotation: 43/43 - Accuracy rate (%) of U7 with regards to opposite direction ■ Distal/Mesial crown tip: 63/55* ■ Buccal/Lingual crown tip: 35/61 ■ Intrusion/extrusion: 50/41.5 ■ Mesial/Distal rotation: 42.5/41 - Accuracy rate (%) of U1 with regard to opposite direction ■ Distal/Mesial crown tip: 50/57.5 ■ Buccal/Lingual crown tip: 54/57 ■ Intrusion/extrusion: 33/56 ■ Mesial/Distal rotation: 61/55 - The higher accuracy of incisor extrusion and molar intrusion and low accuracy of incisor intrusion and molar extrusion suggests that Invisalign is more effective in bite closure, rather than bite opening. - 74%* of the randomly printed post-treatment models achieved an ABO passing score.
Saif et al., 2021, prospective	38 pts; 4 M/34 F Mean age 25.4 y 142 molars :71 U6/71 U7 subjected for distalization 228 anterior teeth:	Invisalign Digital scans superimposition on palatal rugae Diff. btw predicted and	Experienced orthodontists MAX molar distalization (prescribed mean value 2.6 mm) & ATT (56.3%)/ No Cl II el Average no. of aligners: 20	- The mean ± SD of distalizating actual value (center of tooth mass): ■ U6 = 1.81 ± 0.84 mm* ■ U7 = 1.85 ± 0.88 mm*

Table 3. Continued

Author, Year, Study Design	Participant	Intervention/ Comparison/Statistic	Treatment Protocol	Main Outcomes Statistic Significant* ($P < .05$)
	subjected for anchorage loss evaluation Compliance: assessed verbally	actual movement value	Average tx time: 6.7 mo (3.3–11 mo)	- The mean ± SD of amount of anterior anchorage loss (center of tooth mass): ■ U1 = 0.48 ± 0.44 mm* ■ U2 = 0.45 ± 0.38 mm* - The accuracy rate of distalization ■ U6 = 75.5% ■ U7 = 72.2% - A significant correlation detected between the amount of maxillary molar distal movement to the anterior anchorage loss of MAX incisors, but not canine
Patterson et al., 2021, retrospective	80 pts; matched samples Gr 1: Class I (n = 40; 11 M/ 29 F); mean age 38.70 ± 15.90 y Gr 2: Class II (n = 40; 11 M/ 29 F); mean age: 35.25 ± 15.21 y Cl II end-on and full-step molars including unilateral Cl II molars Compliance: N/A	Invisalign SmartTrack Digital model for ABO-digitally grading Diff. of pre-Tx/post (achieved) Tx/ predicted plan	One experienced orthodontist Cl II el/ATT/No overcorrection/ No IPR Average no. of aligners: 29.03 ± 10.75 (Cl II) 22.73 ± 5.45 (Cl I) Average Tx time: 7 mo	- The mean ± SD of achieved measurement/accuracy in Cl I Gr. ■ *AP direction*: 0.01 ± 0.33 mm*/ 1.25 ± 32.99% ■ *Overbite correction:* 0.48 ± 0.68 mm*/28.84 ± 35.99% - The mean ± SD of achieved measurement/accuracy Cl II Gr. ■ *AP direction:* 0.25 ± 0.63 mm*/ 6.80 ± 18.90% ■ *Overbite correction:* 1.23 ± 1.28 mm*/38.93 ± 39.30% - When set ABO passing score at ≤ 27, 47.5% of Cl I and 0% of Cl II posttreatment occlusions would pass. - Class II Gr required significantly more initial aligners and a greater percentage at refinement, indicating longer Tx time than Cl I Gr.
Taffarel et al., 2022, retrospective	32 pts; 7 M/ 25 F mean age 35.47 ± 9.61 y Cl II end-on and full-step molars; uni- and bilateral included Compliance: N/A	Invisalign SmartTrack Digital model for ABO digitally grading Diff. of pre-Tx/post (achieved)Tx /predicted plan	Four orthodontists Sequential distalization/with or without Cl II el/No overcorrection planned/ <1 mm IPR within each arch Average no. of aligners (MAX): 48 Average Tx time: N/A	- Significant differences were found in all patients for "pre and post Tx," "predicted plan and post Tx," and "pre and predicted plan" for AP movement of UR6 (AP16) and UL 6 (AP26) - The mean value of "the amount needed for AP/OB correction" measured at "pre tx/ predicted plan/post tx;" ■ *AP16* = 2.83/0.58/2.23 mm* ■ *AP26* = 2.72/0.61/2.13 mm* ■ *OB* = 3.65/1.70/3.20 mm* - Invisalign improved Cl II malocclusion score but failed to reach ABO standard score. It would be necessary to use additional aligners and increase the estimated treatment time to achieve the ABO standards. - No statistical difference in the total final scores for patients that used or did not use Cl II elastics for the sequential distalization.
Lin et al., 2022, retrospective	7 pts; Gender N/A Mean age: 26.64 ± 3.02 y	Invisalign Digital scan (STL) incorporated with	One experienced orthodontist Sequential distalization/with Cl II el/No overcorrection	- The accuracy of tooth movement in the good responder Gr.: ■ AP/vertical direction (%)

Table 3. Continued

Author, Year, Study Design	Participant	Intervention/ Comparison/Statistic	Treatment Protocol	Main Outcomes Statistic Significant* ($P < .05$)
	Mild to moderate, unibilateral Cl II molars with the largest OJ of 7.1 mm Unilateral CLII (n = 5) Bilateral CLII (n = 2) Compliance: the amount of OJ reduction dictated the type of responders	CBCT (DICOM) for superimposition via surface-based registration Diff. btw predicted and achieved tooth position	Average no. of aligners:N/A Average Tx time: 9.82 ± 2.04 mo for 4 good responder pts, and 19.07 ± 10.6 mo for 3 bad responder pts	■ U6 (MB cusp) = 63.8/NS ■ U6 (DB cusp) = 81.7/>100 ■ U6 (MP cusp) = 34.8/NS ■ U1 retraction = 65.5 / >100 (unexpected extrusion) - The accuracy of tooth movement in the bad responder Gr.: ■ AP / vertical direction (%) ■ U6 (MB cusp) = 27.8 / NS ■ U6 (DB cusp) = 31.1 / NS ■ U6 (MP cusp) = NS/ NS ■ U1 retraction = 20.5/ NS - The average overjet decreased insignificantly from 4.53 ± 1.52 mm to 2.81 ± 1.1 mm after treatment
Loberto et al., 2023, retrospective	49 pts; 22 M/27 F, Mean age of 14.9 ± 6 y (all subjects have second molars fully erupted) CL II dental and mild skeletal (4° < ANB < 7°), anterior crowding < 4 mm Compliance: 16% poor on Cl II el use, 89.8% good, 10.2% moderate on aligner use	Invisalign Digital scan superimposition on palatal rugae Diff. btw pre-post Tx	One operator 33% sequential distalization & ATT/ distalization planned until Cl I posterior occlusion achieved, along with mesial out rotation for U6/ Cl II el / midcourse aligners delivered Average no. of the aligners (MAX): 42.6 ± 4.4 Average time: 5.5 mo	- The mean ± SD of achieved distalization (MB cusp): ■ UR6 = 2.4 ± 3 mm* ■ UL6 = 2.4 ± 3.2 mm* - The mean ± SD of achieved distalization (DB cusp): ■ UR6 = 3 ± 3.2 mm* ■ UL6 = 2.2 ± 3.7 mm* - The mean ± SD of the mesial movement (cusp tip): ■ UR 3 = 1.5 ± 1.03 mm* ■ UL 3 = 1.15 ± 1.1 mm* - Nonsignificant movement of MAX premolars detected - Poor compliance pts with Cl II el showed major loss of anchorage
D'Anto et al., 2023, retrospective	16 pts; 4 M/12 F Mean age: 25.7 ± 8.8 y The samples received prescribed maxillary molar distalization and derotation Compliance: N/A	Ordoline clear aligners Digital casts superimposition using the global based fit method Diff. btw prescribed and achieved value	Clinical operators: N/A 50% sequential distalization & ATT / prescribed of 2 mm distalization & 11.6° derotation /Cl II el Average no. of aligners: N/A Average Tx time: N/A	- The mean ± SD of achieved distalization (MB/DBcusp) in mm: ■ U6 = 1.30 ± 0.88* / 1.42 ± 0.94* ■ U7 = 1.76 ± 1.14* / 1.54 ± 1.13* - The mean ± SD of achieved derotation (DB-MPa cusp): ■ U6 = 8.09 ± 4.80°* ■ U7 = 6.40 ± 4.14°* - The mean accuracy (%) of distalization (MB/DBcusp): ■ U6 = 68 / 71 ■ U7 = 80 / 70 - The mean accuracy (%) of derotation: ■ U6 = 77.5 ■ U7 = 62.7
D'Anto et al., 2024, retrospective	45 pts; 21 M/24 F mean age: 29.2 ± 6.6 y The sample comprised 390 teeth (190 mandibular; 200 maxillary) with prescribed rotations ≥ 2° Compliance: not assessed	Ordoline clear aligners Digital casts superimposition using the global best fit method Diff. btw prescribed and achieved value	Clinical operators: N/A Rotation prescribed with a mean of 10°/ ATT/IPR/ no Cl II el Average no. of aligners: N/A Average Tx time: N/A	- The mean ± SD of achieved derotation (DB-MPa cusp): ■ U6 = 7.90 ± 4.80°* ■ U7 = 5.37 ± 3.49°* - The mean accuracy (%) of derotation: ■ U6 = 78.4 ■ U7 = 60.7

Table 3. Continued

Author, Year, Study Design	Participant	Intervention/ Comparison/Statistic	Treatment Protocol	Main Outcomes Statistic Significant* ($P < .05$)
Mamani et al., 2024, retrospective	14 pts; 4 M/10 F Mean age 33.61 ± 8.57 y Skeletal type I or II with CL II molar, Tx aimed to achieve distalization of the maxillary molar by at least 1.5 mm Compliance: poor compliance pts excluded	Invisalign Cephalogram measurement and superimposition (manually) Diff. btw planned (CC) to actual (Ceph superimposed) movement	One experienced orthodontist Sequential distalization & ATT/prescribed of ≥ 1.5 mm distalization bilaterally/Cl II el Average no. of aligners: 49.14 ± 14.02 Average Tx time: N/A	- The mean ± SD of actual distalization (the most distal convex point): ■ U6 = 0.91 ± 0.28 mm ■ U7 = 0.86 ± 0.25 mm - The mean ± SD of actual mesiodistal tipping (a line drawn through the *most mesial and distal* convex crown-point): ■ U6 = 0.96 ± 3.50° ■ U7 = 1.63 ± 3.88° - The accuracy (%) of distalization: ■ U6 = 40.11* ■ U7 = 35.39* - Nonsignificant difference detected for mesiodistal tipping movement.

[a] Pts indicates patients; M/F, Male/Female; Gr, group; Diff, difference; btw, between; Tx, treatment; U6, upper first molar; U7, upper second molar; U1, upper central incisor; U2, upper lateral incisor; ATT, attachment; IPR, interproximal reduction; Cl II el, Class II elastic; mo, month; MAX, maxilla; MAND, mandibular; PTV, the pterygoid vertical plane.

molar distalization phase, aiming to isolate the effects of distalization while avoiding posterior anchorage loss during premolar and canine retraction. In contrast, Group B studies evaluated outcomes at the completion of treatment, including anterior tooth retraction, during which posterior anchorage loss was expected. Interestingly, Group B reported a greater and more consistent amount of distalization (1.84–2.98 mm), and, with higher accuracy rates (83%–85%), suggesting that factors beyond aligners contributed to Class II correction success.

In Group A, studies utilizing digital methods for measurement (casts/CBCT)[10,12,26,28] demonstrated greater distalization compared to a study relying on hand-traced cephalograms.[29] Among these, 33%–50% sequential distalization, with or without continuous Class II elastics, yielded superior outcomes.[10,12,26] The most favorable results, comparable to Group B, were observed in a study utilizing midcourse aligners.[12] However, two studies reported less than 1 mm of anteroposterior correction, failing to meet standard ABO-OGS scores.[27,30] Conversely, another study reported 74% of subjects passing ABO scoring, likely due to overcorrection, compliance monitoring, and a grading method using printed models rather than digital models.[5] These discrepancies suggest that the ABO scoring system may not be ideal for evaluating CA outcome, as digital vs physical cast evaluations differ,[27,32] and the aligner material thickness (0.75 mm LD30 Invisalign) can negatively impact total scores.[30]

Group B studies, with nearly double the treatment duration of Group A, consistently reported average distalization of 2–2.5 mm for first molars and 2.5–3 mm for second molars.[13,18,20,22] Superior results in Group B were likely due to refinements combined with sequential distalization (33%–50%) and Class II elastics. Posterior and anterior anchorage loss was not measured, as only final outcomes were reported. Typical Class II elastic-related complications, such as increased vertical skeletal dimension and maxillary incisor extrusion, were not detected.[13,20–22]

Few agreements were observed between both Groups, including increased buccal crown torque[18,19] and well-controlled mesiodistal crown tip of maxillary molars.[13,17,18,29] Additionally, CA demonstrated efficacy in maxillary molar rotation, up to 78% accuracy for first molar rotation.[16,17]The most notable rotation, up to 8.09°, was achieved using Ordoline CA, when 11.6° distal rotation was prescribed along with 2 mm distalization. Two studies using Invisalign did not report prescribed rotation and distalization but achieved 2–3 mm of distalization when combining the two movements.[12,18] Mesiobuccal rotation of the maxillary molar is crucial for Class II correction, as a 20° derotation can create approximately 2.5 mm of additional space.[33]

Clinical Implications

Sequential distalization begins by distalizing the upper second molars to two-thirds or half of the way. This is followed by sequential distalization of the upper first molars and premolars, with a 33% or 50% interval overlap between each tooth type, ultimately leading to en masse retraction of the anterior teeth or incisors to complete the treatment. This study supported combining this approach with refinements or midcourse aligners, which have demonstrated superior outcomes.

Table 4. Group B, Post-Refinement: Overview of the Results and Conclusions of the Studies[a]

Author, Year, Study Design	Participant	Intervention / Comparison/Statistic	Treatment Protocol	Main Outcomes Statistic Significant* ($P < .05$)
Ravera et al., 2016, retrospective	20 pts; 9 M/ 11 F Mean age: 29.73 ± 6.89 y Skeletal class I or CL II, a bilateral end-to-end CL II molar Compliance: satisfied-good, every 6 wk-monitored	Invisalign Cephalogram measurement and superimposition (digitally) Diff. btw pre-post Tx	Two board-certified orthodontists 33% sequential distalization prescribed for 0.25 mm per aligner/ATT /Cl II el started after the molar distalized/No IPR Average no. of the aligners: (MAX) 1st set aligners 42.6 ± 4.4, refinement 9.1 ± 2.2 Average Tx time 24.3 ± 4.2 mo	- Significant diff. ($P < .0001$) of: ■ 17 mcPtV = 2.52 mm (distalized) ■ 17 ccPtV = 2.12 mm (distalized) ■ 17 praPtV = 1.50 mm (distalized) ■ 17 vmraPtV = 1.67 mm (distalized) ■ 16 ccPtV = 2.03 mm (distalized) - Significant diff. ($P < .001$) of: ■ 16 praPtV = 1.84 mm (distalized) - Significant diff. ($P < .01$) of: ■ 16 vmraPtV = 1.48 (distalized) ■ 11 iePtV = 2.23 (retracted) - Significant diff. ($P < .05$) of: ■ ANB = 0.7°* (reduced) ■ 16 mcPtV = 2.25mm* (distalized) ■ 11^PP = 2.87°* (retroclined) - Nonsignificant changes were found in the vertical dimension of U1, U6, U7 and mandible and MD crown tipped of U6, U7
Lombardo et al., 2017, retrospective	16 pts; 6 M/ 10 F Mean age: 28.7 y All teeth in both MAX and MAND (345 teeth), crowding < 5mm per arch, complete dentition or with 4 missing teeth at the most Compliance: N/A	F22 aligners Digital model measurement based on occlusal plane Diff. of pre-Tx/post (achieved) Tx /predicted plan	Clinical operators: N/A The maximum movement planned for all teeth per aligner: 2° rotation, 2.5° torque and tip, 0.2 mm linear displacement / IPR/ ATT/ No Cl II el Average no. of the aligners: N/A Average Tx time: N/A	- The mean ± SD accuracy (%) of U molars: ■ MD tipping (n = 22): 93.4 ± 72.6 ■ Vestibulolingual tipping (n = 16): 52.5 ± 53.3* ■ Rotation of U molars (n = 18): 78 ± 61 - The mean ± SD accuracy (%) of U incisors: ■ MD tipping (n = 36): 76.7 ± 57.6* ■ Vestibulolingual tipping (n = 28): 64.5 ± 34.2*
Caruso et al., 2019, retrospective	10 pts; 2 M/8F Mean age: 22.7 ± 5.3 y Bilateral molar CL II or end-to-end molar, mild crowding, absence of mesial rotation of U6 Compliance: good	Invisalign Cephalogram measurement, blinded hand-traced Diff. btw pre-post Tx	One experience orthodontist 33% sequential distalization prescribed for 0.25 mm per aligner/ATT /Cl II el started after the molar distalized/ No IPR Average no. of the aligners: N/A Average Tx time: 1.9 ± 0.5y	- Significant reduction ($P < .0001$) of: ■ 6-PP = 2 ± 3 mm (distalized) ■ 7-PP = 3 ± 3 mm (distalized) ■ MR = 1.9 ± 1.52 mm (Molar Relation improved from Cl II towards Cl I) - Significant reduction ($P < .001$) in 1^PP (13.2°) indicated for an absence in anterior anchorage loss. - No significant differences observed for parameters related to vertical (SN ^GoGn, S-Go/N-Me) and sagittal (SNB, ANB) change of mandible indicating a good control of vertical dimension
Cui et al., 2022, retrospective	18 pts; mean age: 27.8 ± 5.38 y CL II mild-moderate crowding, bilateral distalization Compliance: N/A	Unclassified Clear aligner CBCT measurement and Cephalogram superimposition Diff. btw pre-post Tx	Clinical Operators: N/A 50% Sequential Distalization ATT, Cl II el, IPR : N/A Average no. of the aligners: N/A Average Tx time: N/A	- The mean ± SD of actual distalization (buccal groove to PTV): ■ U6 = 2.57 ± 1.15 mm* ■ U7 = 2.98 ± 1.84 mm* - A predictability rate of distalization: ■ U6 = 83.44 % ■ U7 = 85.14 %. - The mean ± SD retraction (U1-PTV) of U1 = 1.4 ± 0.25 mm* - The mean ± SD retroclination (U1-SN) of U1 = 7.04 ± 1.27°* - Nonsignificant changes detected on mesiodistal tipping and vertical movement of both U6 and U7 - Statistically significant* reduction in SNA angle and upper lip/E-line was evidenced
Balboni et al., 2023, prospective	20 pts; 13 M/7 F Mean age 17.2 ± 3.2 y Bilateral Cl II (up to 3 mm of molar relationship discrepancy), normal divergency Compliance: good, every 4 wk-monitored	Invisalign Tx during 2019-21 Cephalogram measurement, hand traced, digitized analysis Diff. btw pre-post Tx	One board-certified orthodontist 50% sequential distalization prescribed of 2.2 ± 0.4 mm distalization and 1 mm intrusion/ ATT/ CL II el after the molar distalized/ no IPR Average no. of the aligners (MAX): 1st set aligners 57 ± 5, refinement 19 ± 5 Average Tx time 18 ± 4 mo	- Significant reduction ($P < .05$) in; ■ N-me = 1.2 mm* (reduced) ■ Overjet = 1.3 mm* (reduced) ■ U6-ANSPNS = 0.9 mm* (intruded) - Significant reduction ($P < .01$) in; ■ FMA = 1.3° - Significant reduction ($P < .001$) in: ■ SN^POccl = 4.2° ■ POccl^PF = 3.1° ■ ArGo^GoMe = 3.4° - Distalizing maxillary molar with clear aligners allowed a good control of vertical dimension

Table 4. Continued

Author, Year, Study Design	Participant	Intervention / Comparison/Statistic	Treatment Protocol	Main Outcomes Statistic Significant* ($P < .05$)
Elfouly et al., 2024, retrospective	19 pts; 6 M/13F Mean age: 36.68 ± 13.50 y Half to full cusp Cl II molars with minimum of 2 mm actual distalization achieved Compliance: N/A	Invisalign CBCT superimposition Diff. btw pre-post Tx	Clinical operators: N/A 50% sequential distalization & ATT/Cl II el/no overcorrection Average no. of the aligners: N/A Average Tx time: N/A	- Both U6 and U7 can be distalized by 2 mm without significant changes on mesiodistal tip. - The mean ± SD of increased buccal crown torque (Coronal view) ▪ U6 = 3.49 ± 4.81°* ▪ U7 = 2.48 ± 5.15°* - The mean ± SD of achieved derotation (Axial view): ▪ U6 = 1.40 ± 3.32°* ▪ U7 = 3.08 ± 4.37°*

[a] Pts indicate patients; M/F, Male/Female; Gr, group; Diff, difference; btw, between; Tx, treatment; U6/16, upper first molar; U7/17, upper second molar; U1/11, upper central incisor; U2, upper lateral incisor; ATT, attachment; IPR, interproximal reduction; Cl II el, Class II elastic; mo, month; MAX, maxilla; MAND, mandibular; PTV, the pterygoid vertical plane; mc, mesial cusp; cc, center of the crown; pra, palatal root apex; vmra, vestibulomesial root apex; ie, incisal edge.

Clinicians should anticipate extended treatment durations to optimize Class II correction, as multiple aligner sets may be necessary.

To maximize distalization and derotation, incorporating at least 10° of mesiobuccal rotation into the distalization plan is recommended. Early and consistent use of Class II elastics during and after molar distalization helps prevent anterior anchorage loss, provided patient compliance is closely monitored.

Although CA effectively achieved 2–3 mm of maxillary molar distalization, particularly in hyperdivergent cases,[5,13,20–22] prescribed molar intrusion is recommended to promote counterclockwise mandibular rotation.[21] However, buccolingual tipping remains a challenge, especially for second molars.[17–19] Horizontal occlusal beveled attachments (4–5 mm) are recommended to enhance aligner grip over the typically small clinical crown and minimize unwanted buccal crown tip.[16,34]

Overcorrection was mentioned in only one of the studies reviewed, but without specifying the extent.[5] Although a recent publication suggested 20% overcorrection for all tooth movements,[35] given the accuracy rates observed in this review, 20% overcorrection is appropriate for mesiodistal crown tip and rotation, whereas 40%–50% is more suitable for distalization and lingual crown torque of maxillary molars, respectively. The overcorrection should be integrated into the initial aligner set to improve treatment efficiency.

Table 5. Interpretation of Overall Risk of Bias Judgment using ROBIN-I

- Low Risk: Comparable to a well-conducted randomized controlled trial (RCT).
- Moderate Risk: Some concerns, but the evidence is still relatively reliable.
- Serious Risk: Substantial issues compromise the study's credibility.
- Critical Risk: The study is too biased to provide useful evidence.

[a] Adapted from the Cochrane Handbook Chapter 25: assessing risk of bias in non-randomized studies (https://training.cochrane.org/handbook/current/chapter-25?utm_source=chatgpt.com).

Comparison with Previous Reviews

Earlier reviews of Rossini et al. (2003–2014)[15] and Inchingolo et al. (2016–2023),[23] reported 1.5 mm and 2.6 mm of upper molar distalization, respectively. Although the findings of Rossini et al. are less relevant due to outdated aligner materials, the results of Inchingolo et al. reflect generalized samples, including mixed dentition, extractions, and the use of orthodontic mini screws (TADs).

More recent meta-analysis by Shen et al.[24,36] reported that CA achieved maxillary molar distalization of 2.07 mm, distal crown tipping of 2.19°, and intrusion of 0.26 mm. However, concerns regarding sample overlap between studies (eg, Ravera et al. and Garino et al.)[20,34], and the inclusion of high-risk bias studies (eight out of 13) undermine the validity of these meta-analyses.

Table 6. Definitions of Evidence Level[a]

Level	Evidence	Definition
1	Strong	At least two studies assessed with level "A"
2	Moderate	One study with level "A" and at least two studies with level "B"
3	Limited	At least two studies with level "B"
4	Inconclusive	Fewer than two studies with level "B"

[a] Adapted from the Scandinavian Journal of Public Health Chapter 2: Methods used for the systematic literature search and for the review of relevance, quality, and evidence of studies (https://journals.sagepub.com/doi/10.1080/14034950410021826).

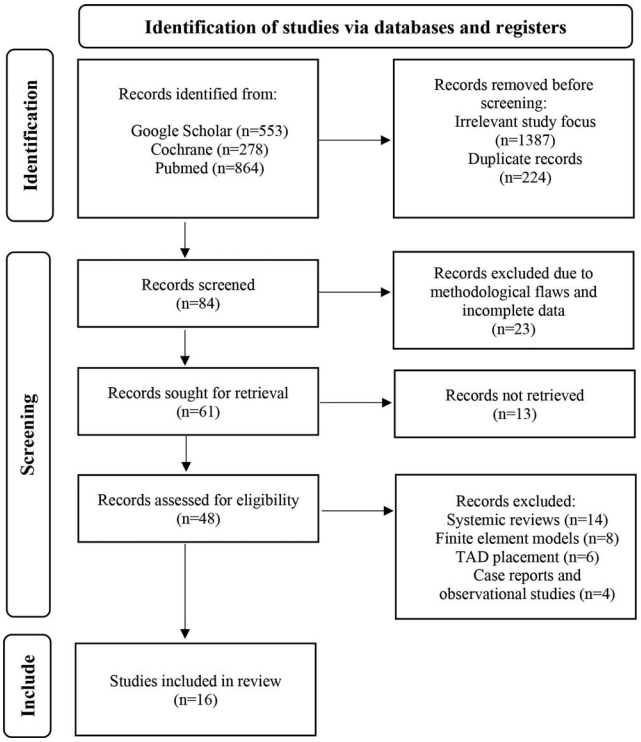

Figure 1. PRISMA flow chart.

Limitations and Future Directions

Variability among studies limited the feasibility of a meta-analysis in this review, with methodological differences contributing to inconsistent results. For instance, similar protocols produced widely differing distalization values: 0.9 mm (cephalogram) vs 2.5 mm (digital cast), depending on the measurement method,[12,29] Even within the same methodology (eg, cephalograms), results were difficult to compare due to variations in reference points, such as measuring from the most distal convex point of the molar versus the mesiobuccal cusp.[20,29] One study comparing achieved distalization using cephalograms to predicted digital plans (with different reference points)[29] may have underestimated predictability, which could have been more precisely assessed by directly comparing digital casts for achieved and predicted outcomes.

Participant demographics further influenced results. Younger patients achieved greater distalization (2.5 mm at a mean age of 14.9 years) than older patients (1.8 mm at a mean age of 25.4 years),[12,26] compliant patients demonstrated higher accuracy rates than noncompliant patients (63.8% vs. 27.8%),[28] and studies incorporating mesiobuccal rotation alongside distalization reported higher distalization values.[10,12]

Although accuracy reflected the prescribed treatment plan, none of the studies detailed these plans, particularly for the refinement phase. It remains unclear whether Group B studies achieved comparable distalization to Group A in the initial set and then gained additional movement during refinements. Comparing outcomes from the "end of the initial set" to the "completion of treatment, including refinements" within the same subjects would provide greater insight.

Future research should address these limitations by:

- Conducting randomized controlled trials (RCTs).
- Standardizing definitions for post-treatment phases.
- Implementing robust compliance monitoring systems.
- Using consistent digital methodologies such as CBCT or digital scans with reproducible landmarks.

Additionally, future studies should explore the effects of Class II elastics on the mandibular dentition, overcorrection strategies, adjunctive measures for maxillary arch expansion, and long-term stability.

Table 7. Evidence Grade According to Swedish Council on Technology Assessment in Health Care (SBU)

Author, Year	Grade
Grunheid et al., 2017[19]	B
Haouili et al., 2020[5]	B
Saif et al., 2021[26]	B
Patterson et al., 2021[27]	B
Taffarel et al., 2022[30]	B
Lin et al., 2022[28]	C
Loberto et al., 2023[12]	B
D'Anto et al., 2023[10]	B
D'Anto et al., 2024[16]	B
Mamani et al., 2024[29]	B
Ravera et al., 2016[20]	B
Lombardo et al., 2017[17]	C
Caruso et al., 2019[22]	B
Cui et al., 2022[13]	C
Balboni et al., 2023[21]	B
Elfouly et al.,2024[18]	B

CONCLUSIONS

- Clear aligners are an effective approach for nonextraction half- to full-cusp Class II correction, achieving predictable molar distalization and derotation.
- However, adjunctive measures, including sequential distalization protocols, Class II elastics, and refinements or midcourse aligners are critical for optimal outcomes.

Table 8. Overall Judgment Level on Risk of Bias (using ROBIN-I) for the 16 Included Studies Based on the Collective Assessment of the Seven Domains: ⊕, Low Risk; ⊖, Moderate Risk; ⚠, High Risk[a]

	Domains							
	Pre-Intervention		Intervention	Post-Intervention				
Study	Bias Due to Confounding	Bias in Selecting Participants	Bias in Classifying Interventions	Bias Due to Deviations From Intended Interventions	Bias Due to Missing Data	Bias in Measuring Outcomes	Bias in Selecting Reported Result	Overall Rob Judgment
A1	⊖	⊕	⊕	⊕	⊕	⊕	⊕	Moderate
A2	⊖	⊖	⊕	⊖	⊖	⊕	⊕	Moderate
A3	⊖	⊖	⊕	⊖	⊕	⊖	⊕	Moderate
A4	⊖	⊕	⊕	⊖	⊕	⊖	⊕	Moderate
A5	⊖	⊖	⊖	⊖	⊕	⊖	⊕	Moderate
A6	⊖	⊖	⊖	⊖	⊕	⊖	⊕	Moderate
A7	⊖	⊕	⊕	⊖	⊕	⊕	⊖	Moderate
A8	⊖	⊕	⊕	⊖	⊕	⊕	⊕	Moderate
A9	⊖	⊖	⊕	⊖	⊕	⊕	⊕	Moderate
A10	⊖	⊕	⊕	⊖	⊕	⊖	⊕	Moderate
B11	⊖	⊖	⊕	⊕	⊕	⊕	⊕	Moderate
B12	⊖	⊖	⊖	⊖	⊕	⊖	⊕	Moderate
B13	⊖	⊕	⊕	⊕	⊖	⊕	⊖	Moderate
B14	⊖	⊖	⊕	⊖	⊕	⊕	⊖	Moderate
B15	⊖	⊖	⊕	⊖	⊕	⊖	⊖	Moderate
B16	⊖	⊖	⊕	⊖	⊕	⊕	⊖	Moderate

[a] Adapted from University of Bristol homepage: Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I), page 19 (https://www.bristol.ac.uk/media-library/sites/social-community-medicine/images/centres/cresyda/ROBINS-I_detailed_guidance.pdf?utm_source = chatgpt.com).

- Incorporating overcorrection, combining distal rotation and lingual crown torque to the distalization plan, and closely monitoring patient compliance, may further enhance treatment efficiency.

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