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Comparative Evaluation of Anterior Open Bite Closure Using Clear Aligner Therapy vs Fixed Mechanotherapy- A Systematic Review

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KEYWORDS

Anterior Open Bite, Clear Aligner Therapy, Fixed Mechanotherapy, Temporary Anchorage Devices, Molar Intrusion, Mandibular Autorotation

ABSTRACT:

Introduction - Anterior open bite (AOB) is a complex malocclusion often requiring careful biomechanical control. While orthognathic surgery has been the gold standard for skeletal cases, non-surgical approaches such as clear aligner therapy (CAT) and fixed mechanotherapy with temporary anchorage devices (TADs) have gained importance.

Aim - This systematic review aimed to evaluate and compare the primary mechanisms of anterior open bite (AOB) correction in adults treated with clear aligner therapy (CAT) versus fixed mechanotherapy with temporary anchorage devices (TADs).

Methods - Following PRISMA guidelines, a comprehensive search was conducted across PubMed, Google Scholar, Science Direct, and Cochrane up to April 2024. Studies involving adult patients with AOB managed with CAT or fixed appliances with TADs were included. A total of 12 studies met the eligibility criteria. Data on cephalometric changes, treatment modality, and biomechanical mechanisms were extracted and analyzed.

Results -The mean initial open bite across studies treated with CAT was ~1.5 mm, with closure achieved primarily through maxillary and mandibular incisor extrusion (average: 1 mm and 0.8 mm, respectively). Limited posterior intrusion (<1 mm) and minimal mandibular autorotation (~0.5°) were observed. In contrast, patients treated with fixed appliances and TADs presented with larger baseline open bites (~3 mm) and demonstrated significant posterior molar intrusion (1–3 mm), resulting in consistent mandibular autorotation (≈2°) and greater overbite correction. Anterior extrusion was minimal and not statistically significant in TAD-supported treatments.

Conclusions - CAT is effective for mild to moderate AOB correction, primarily by controlled incisor extrusion, but provides limited posterior intrusion and mandibular autorotation. Fixed mechanotherapy with TADs remains superior for managing severe or skeletal open bites, as it enables reliable posterior intrusion and stable autorotation.

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Careful case selection is critical to optimize outcomes. Further prospective randomized clinical trials are needed to strengthen the evidence base.

1. INTRODUCTION

Open bite malocclusion is one of the most challenging orthodontic problems to treat, as it arises from a combination of multiple etiological factors including genetic, dental, skeletal, functional, soft tissue, and deleterious oral habits. Skeletal anterior open bite (AOB) is distinguished from other types by specific craniofacial characteristics, such as increased lower anterior facial height, reduced posterior facial height, increased gonial and mandibular plane angles, and greater maxillary molar dentoalveolar height.[1]

In adult patients, management of AOB poses additional challenges since growth modification is no longer possible. Traditionally, orthognathic surgery—most commonly LeFort I osteotomy with maxillary impaction—has been considered the gold standard for treating skeletal open bites, as it achieves bite closure by inducing mandibular autorotation. However, surgical interventions are associated with significant risks, costs, and patient reluctance. Consequently, alternative non-surgical approaches, such as orthodontic camouflage through molar intrusion, have been explored.[2-3]

Vertical control remains a critical issue in orthodontic treatment, especially in hyperdivergent patients where fixed appliance therapy often leads to unfavorable outcomes, such as mandibular clockwise rotation and reduced chin projection. Over the years, several approaches—including headgear, chincups, active vertical correctors, bite blocks, and multiple-loop archwire techniques—have been proposed to achieve posterior intrusion. Despite these innovations, many of these methods are limited in their effectiveness for nongrowing adults with severe vertical dysplasia due to inadequate anchorage and side effects.[4-6]

The advent of temporary anchorage devices (TADs), such as miniscrews and miniplates, has significantly improved vertical control by providing absolute anchorage for molar intrusion. Molar intrusion with skeletal anchorage has been shown to achieve mandibular autorotation and bite closure comparable to orthognathic surgery[9], with miniscrews offering advantages of immediate loading, simple placement and removal, and reduced patient costs.[10] Optimal placement sites for miniscrews include the infrazygomatic crest, interradicular areas, and paramedian palatal regions, depending on bone availability.[11]

In parallel, patient demand for aesthetic and comfortable treatment options has led to the wide spread use of clear aligners. Initially indicated for simple cases without skeletal discrepancies, aligners have evolved considerably with improved biomechanical control, making them increasingly applicable to more complex malocclusions, including AOB. Unlike fixed appliances, aligners appear to have less posterior extrusion effect, and some studies have suggested a posterior bite-block effect contributing to open bite closure.[12,13]

Nevertheless, the underlying mechanisms of open bite correction with aligners remain unclear. Some studies[13] attribute correction to incisor extrusion, while others[12] report mandibular autorotation associated with molar intrusion. Comparative research produced conflicting evidence, with some studies[4] suggesting that aligners may provide vertical control comparable to fixed appliances with adjunctive TADs.

Given these inconsistencies, there is a need to systematically evaluate the available evidence. Therefore, the primary objective of this systematic review was to assess and compare the dental and skeletal changes and their primary mechanism associated with anterior open bite correction using clear aligners and fixed mechanotherapy with or without TADs.

The following questions will be answered in this systematic review:

1. What is the primary mechanism for anterior open bite closure in adults with Clear Aligner therapy?
2. What is the primary mechanism for anterior open bite closure in adults with Fixed Mechanotherapy with Tads?
3. Which amongst the two types is most effective in correction of anterior open bite in adults with hyperdivergent growth pattern?

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2. MATERIAL & METHODS

TABLE I: Eligibility criteria for study selection

Types of studies	• Randomized clinical trials • Retrospective or prospective controlled/un-controlled trials of anterior open bite using clear aligner therapy or fixed mechanotherapy with TADs
Participants	Adults Patients with - Anterior open bite - Class I & II malocclusion - Hyperdivergent growth pattern
Intervention	• Clear Aligner therapy • Fixed mechanotherapy with TADs
Outcome measure	Comparision of primary mechanism for anterior open bite closure using Clear aligner therapy vs Fixed mechanotherapy with TADS

Table II: PICO format

Population / Problem	Adult patients with anterior open bite
Intervention	Open bite closure with posterior segment intrusion
Comparison	Clear Aligner therapy and Fixed mechanotherapy with TADs
Outcome	Comparative evaluation of the primary mechanism of anterior open bite closure between aligners and fixed mechanotherapy with TADs.

- This systematic review was based on the PRISMA guidelines, and the main question was defined with the PICO format (Table II):
- A search of the keywords (Clear Aligner Therapy AND Anterior open bite) OR (Fixed mechanotherapy with TADs AND Anterior open bite) AND (Anterior open bite in Adults) was conducted on search engines like PubMed, Google Scholar and Cochrane Library till April 2024. Inclusion criteria for this systematic review included all Randomized Controlled and Un-Controlled Trials, all non-randomized controlled and un-controlled trials, prospective and retrospective studies, articles published till April 2024, articles published in English language and articles with full text available.
- The selection process was independently conducted by 2 researchers, and their results were compared to identify discrepancies. When the abstract did not provide enough information to make a decision, the articles were completely analyzed. Inter-examiner conflicts were resolved by discussion of each article to reach a consensus regarding all selection criteria. At first, all the searched articles were screened according to their title and potentially irrelevant articles were excluded. The abstracts were then read and analyzed according to the eligibility criteria and the full-text of selected articles was precisely reviewed. The final articles were selected. The reviewers contacted the authors in case of insufficient data regarding the aforementioned articles. A data extraction form was designed and two reviewers filled out the form independently.
- The quality of each article was scored by using an adapted version of 3 methods previously used by Fudalej and Antoszewska[14] Cozza et al[15] and Chen et al[16]. The following characteristics were evaluated: Study design, Sample size, Sample description, Error analysis, and Statistical Analysis.

3. RESULTS

After the electronic database search, 120 studies were retrieved from PubMed, 5680 from Google Scholar, 844 from Science Direct. After application of the initial inclusion and exclusion criteria and elimination of studies indexed in more than 1 database, 243 were retrieved. The full texts were accessed, and all articles with patients (age < 18 years), were excluded. Therefore, 12 studies fulfilling all inclusion and exclusion criteria were included in this systematic review (Fig.1)

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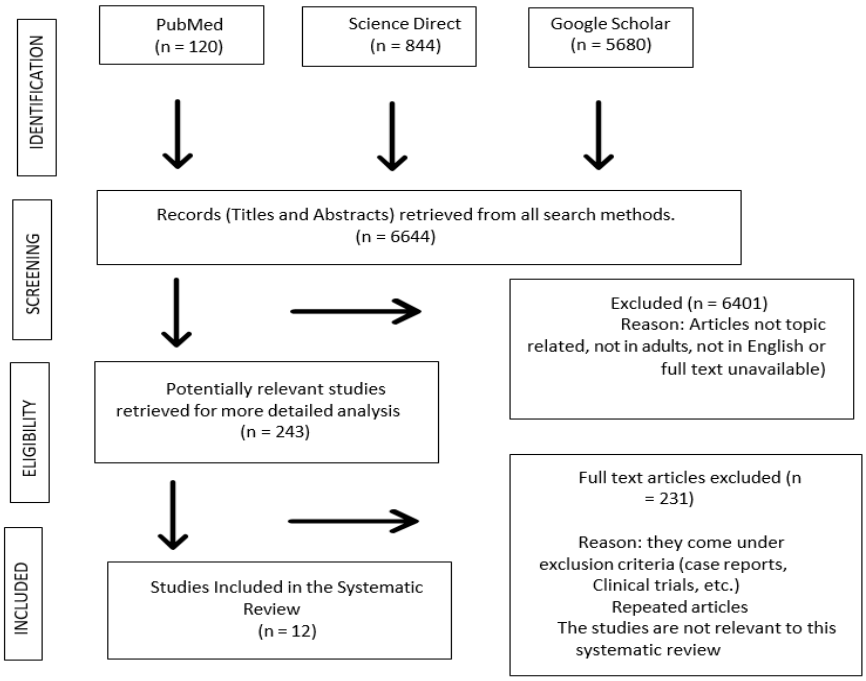

FIG 1: PRISMA Flow Diagram

From the remaining articles, we independently extracted the following data: Author names, Year of publication, Type of treatment and cephalometric parameters: Open bite, U1 – PP, L1 – MP, U6 – PP, L6 – MP and SN – MP at T0 (Pre treatment) and T1 (Post treatment).

TABLE III – RESULTS

SR.NO	AUTHOR	YEAR OF PUBLICATION	SAMPLE SIZE	TYPE OF STUDY	TYPE OF TREATMENT	AGE/MEAN AGE
1	Brett Peter Steele et al[2]	April 2022	34	Retrospective	CAT vs Fixed meachnotherapy with MSPI	> 18 yrs
2	Bella Shen Garnett et al[4]	January 2019	53	Retrospective	CAT vs Fixed meachnotherapy	> 18 yrs
3	Sylvain Chamberl and et al[17]	April 2024	34	Retrospective	CAT vs Fixed meachnotherapy	> 18 yrs
4	Shuka Moshiri et al[12]	April 2017	30	Retrospective	CAT	28.81 years
5	Michaela Pokorná et al[2]	2022	30	Retrospective	CAT	20 years
6	Roozbeh Khosravi et al[18]	April 2017	12	Retrospective	CAT	> 18 years
7	Kayla Harris et al[13]	2020	45	Retrospective	CAT	30.73 ± 8.0 years
8	Heeyeon Suh et al [19]	May 2022	69	Retrospective	CAT	> 18 years

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9	Chunlei Xun et al [20]	January 2007	12	Prospective	Fixed mechanotherapy with miniscrews	18.7 years
10	Hakan Turkahraman [21]	October 2016	20	Prospective	Hyrax with zygomatic miniplate	18.68 ± 2.80 years
11	Man-Suk Baek et al [22]	May 2010	9	Retrospective	Fixed mechanotherapy with miniscrews	23.7 years
12	Eiman S. Marzouk et al [9]	July 2016	26	Prospective	Fixed mechanotherapy with miniplates	19 – 28 years

TABLE IV – RESULTS FOR ALIGNERS

SR NO.	AUTHORS & YEAR OF PUBLICATION	PARAMETERS											
		OPEN BITE		U1-PP		L1 - MP		U6 - PP		L6 - MP		SN-MP	
1	Brett Peter Steele et al [2] -2022	-2.18 ± 1.38	0.6 ± 0.9	30.23 ± 5.07	31.72 ± 5.31	40.3 ± 5.72	41.3 ± 5.79	25.4 ± 4.56	25.1 ± 4.53	31.2 ± 4.96	31.2 ± 5.2	39.52 ± 6.97	39.36 ± 6.91
	▲ T	**2.78 ± 1.15**		**1.48 ± 0.79**		**0.99 ± 0.96**		**- 0.3 ± 0.88**		**-0.01 ± 1.75**		**-0.16 ± 1.11**	
2	Bella Shen Garnett et al [4] – 2019	-1.57 ± 1.24	0.71 ± 0.94	31.07 ± 3.27	32.04 ± 3.08	40.7 ± 3.76	41.5 ± 3.63	24.8 ± 2.71	24.8 ± 2.73	31.4 ± 3.55	31.3 ± 3.64	44.43 ± 5.14	45.15 ± 5.31
	▲ T	2.28 ± 1.55		0.97 ± 1.31		0.82 ± 1.07		0.01 ± 1.3		−0.09 ± 1.16		0.71 ± 1.29	
3	Sylvain Chamberland et al [17] - 2024	-0.87 ± 0.50	1.47 ± 0.27	32.28 ± 0.78	32.9 ± 0.84	46.0 ± 0.89	47.2 ± 0.92	25.6 ± 0.67	26.2 ± 0.61	36.2 ± 0.98	35.9 ± 0.93	38.4 ± 1.35	38.22 ± 1.38
	▲ T	2.33 ± 0.56		0.63 ± 0.38		0.63 ± 0.38		0.56 ± 0.37		-0.34 ± 0.64		-0.25 ± 0.45	
4	Shuka Moshiri et al [12] - 2017	-1.8 ± 1.2	1.5 ± 0.9	30.7 ± 2.8	31.2 ± 2.6	38.3 ± 2.8	39.1 ± 3.1	25.4 ± 2.2	25.0 ± 2.3	31.3 ± 2.5	30.7 ± 2.4	40.8 ± 7.2	39.9 ± 6.9
	▲ T	3.4 ± 1.4		0.5 ± 2.0		0.8 ± 1.2		-0.4 ± 1.4		-0.6 ± 1.4		-0.9 ± 1.5	
5	Michaela Pokorná et al [23]- 2022	−1.16 ± 1.04	1.55 ± 0.91	31.10 ± 4.40	32.0 ± 4.30	43.7 ± 4.5	44.1 ± 4.40	26.5 ± 3.29	25.8 ± 2.71	34.3 ± 3.94	34.6 ± 4.81	37.6 ± 7.40	37.11 ± 7.18
	▲ T	2.71		0.95		**0.38**		-0.66		0.31		-0.58	
6	Roozbeh Khosravi et al [18] - 2017	-1.1 ± 1.00	0.2 ± 0.9	29.6 ± 3.7	30.3 ± 3.8	42.8 ± 3.6	43.5 ± 4.1	23.5 ± 3.4	23.6 ± 3.6	33.1 ± 2.9	33.3 ± 3.7	36.5 ± 8.0	36.9 ± 7.0
	▲ T	1.3 ± 0.6		0.7 ± 1.2		0.8 ± 1.0		0.1 ± 1.0		0.2 ± 1.1		0.4 ± 1.7	

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7	Kayla Harris et al [13] - 2020	-1.21 ± 1.15	2.15 ± 0.79	-	-	41.0 ± 3.57	41.5 ± 3.69	-	-	33.2 ± 3.19	32.8 ± 3.07	33.38 ± 5.54	32.64 ± 5.34
	▲ T	3.27 ± 1.09		-		0.53 ± 0.74		-		-0.39 ±0.76		-0.73 ±0.94	
8	Heeyeon Suh et al [19] - 2021	-2.21 ± 1.39	1.09 ± 0.80	29.80 ± 2.83	31.01 ± 2.92	37.3 ± 3.37	38.7 ± 3.85	24.9 ± 2.38	24.6 ± 2.44	33.8 ± 2.78	33.7 ± 2.82	41.07 ± 7.41	40.64 ± 7.41
	▲ T	3.30 ± 1.43		1.20 ± 0.93		1.36 ± 1.30		-0.36 ± 0.58		-0.12 ±0.47		-0.42 ± 0.95	

It was observed that all the studies included samples had an initial open bite with an average of 1.5 mm. The primary mechanism for closure of anterior open bite was mainly through extrusion of anteriors with an average of 1mm for upper incisor extrusion and 0.8 mm for lower incisor extrusion. Only few studies observed intrusion of posterior segment with clear aligners with an average of < 1mm. Mandibular autorotation was observed in 6 out of 8 studies with an average of 0.5° in anti-clockwise direction.

TABLE V - RESULTS FOR FIXED MECHANOTHERAPY WITH TADs

SR NO.	AUTHORS & YEAR OF PUBLICATION	PARAMETERS											
		OPEN BITE		U1-PP		L1 - MP		U6 - PP		L6 - MP		SN-MP	
		T0	T1	T0	T1	T0	T1	T0	T1	T0	T1	T0	T1
1	Brett Peter Steele et al[2] - 2022	-3.03 ± 1.7	0.93 ± 0.87	31.54 ± 3.7	31.99 ± 3.83	42.49 ± 4.45	42.54 ± 4.48	26.18 ± 2.46	24.3 ± 2.74	34.4 ± 4.07	33.6 ± 3.75	40.94 ± 5.99	38.7 ± 65.58
	▲ T	3.96 ± 1.52		0.45 ± 1.54		-1.13 ± 5.88		-1.82 ± 1.51		-0.74 ±1.39		-2.19 ± 1.89	
2	Bella Shen Garnett et al [4] - 2019	-1.3 ± 1.22	0.46 ± 0.93	30.95 ± 2.32	31.48 ± 2.69	41.59 ± 3.66	41.46 ± 3.63	25.24 ± 1.84	24.9 ± 2.2	32.3 ± 3.55	32.5 ± 4.03	43.15 ± 3.83	43.26 ± 4.62
	▲ T	1.75 ± 1.54		0.53 ± 1.26		−0.13 ± 1.37		−0.25 ± 0.85		0.16 ± 1.07		0.11 ± 1.82	
3	Sylvain Chamberland et al [17] - 2024	-2.86 ± 0.47	1.46 ± 0.20	34.67 ± 0.74	34.98 ± 0.76	44.50 ± 0.99	44.13 ± 0.99	26.66 ± 0.63	25.1 ± 0.55	35.1 ± 0.93	34.4 ± 0.83	43.23 ± 1.50	41.73 ± 1.50
	▲ T	4.32 ± 0.50		0.31 ± 0.29		-0.37 ± 0.42		-1.48 ± 0.30		-0.71±0.54		-1.55 ± 0.41	
4	Chunlei Xun et al[20] - 2007	-2.2 ± 0.9	2.0 ± 0.3	32.2 ± 1.9	33.5 ± 2.5	46.3 ± 2.7	47.6 ± 3.1	26.3 ± 2.2	24.5 ± 2.0	37.4 ± 3.4	36.2 ±	45.6 ± 5.8	43.3 ± 5.1

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											3.3		
	▲ T	4.2 ± 0.9		1.3 ± 1.0		-1.4 ± 3.3		-1.8 ± 0.7		-1.2 ± 0.7		-2.3 ± 0.8	
5	Hakan Turkkahraman et al[21] -2016	−4.34 ± 1.71	0.48 ± 0.86	31.30 ± 3.23	31.60 ± 2.30	40.30 ± 3.06	40.67 ± 2.11	27.18 ± 3.15	23.5 ± 1.73	31.8 ± 2.88	32.3 ± 1.80	43.95 ± 6.68	41.70 ± 5.42
	▲ T	4.82±1.53		0.30±0.48		0.37±0.36		−3.59±1.34		0.54±0.37		−2.25±1.91	
6	Man-Suk Baek et al[22]- 2010	-3.91 ± 1.65	1.65 ± 0.82	31.50 ± 2.67	32.56 ± 2.12	43.58 ± 2.46	45.17 ± 2.78	26.88 ± 1.12	24.50 ± 1.64	-	-	45.44 ± 4.11	43.41 ± 4.41
	▲ T	5.56 ± 1.94		1.05 ± 1.40		1.59 ± 2.10		-2.39 ± 1.76		-		-2.03 ± 1.5	
7	Eiman S. Marzouk et al [9] - 2016	-4.75 ± 2.27	2.18 ± 0.48	-	-	44.05 ± 2.79	45.62 ± 2.82	28.27 ± 2.55	25.2 ± 2.14	34.4 ± 1.27	34.8 ± 1.35	49.05 ± 3.90	46.91 ± 3.89
	▲ T	6.93 ± 1.99		-		1.57 ± 0.07		-3.04 ± 0.79		0.43 ± 0.53		-2.13 ± 0.21	

It was observed that all the studies included samples had an initial open bite of an average of 3 mm. The primary mechanism for closure of anterior open bite was mainly through intrusion of upper posterior segment and the amount of intrusion was directly proportional to the severity of initial open bite. Intrusion of posterior segment lead to anticlockwise rotation of mandible resulting in closure of anterior open bite. Although there was extrusion of anterior segment but it was not statistically significant in all the included studies.

Comparing the results observed for CAT group and fixed mechanotherapy with TADs it is evident that the primary mechanism of anterior open bite closure using CAT was extrusion of incisors compared to Fixed mechanotherapy with TADs where the primary mechanism for anterior open bite closure was posterior segment intrusion.

TABLE VI : QUALITY ASSESSMENT OF THE SELECTED ARTICLES

Sr No.	Authors and year of publication	Sample Design (0-3)	Sample Size (0-1)	Sample Description (0-2)	Error Analysis (0-1)	Statistical Analysis (0-2)	Quality score (0-9)	Judged Quality Standard
1.	Brett Peter Steele et al [2] - 2022	0	1	2	0	2	5	Medium
2.	Bella Shen Garnett et al [3] - 2019	0	1	1	0	2	4	Medium
3.	Sylvain Chamberland et al [17] - 2024	0	1	2	0	2	5	Medium
4.	Shuka Moshiri et al [12]- 2017	0	1	2	0	2	5	Medium
5.	Michaela Pokorná et al[23] - 2022	0	1	2	0	2	5	Medium

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6.	Roozbeh Khosravi et al[18] - 2017	0	0	2	0	2	4	Medium
7.	Kayla Harris et al [13] - 2020	0	1	1	0	2	4	Medium
8.	Heeyeon Suh et al [19] - 2021	0	1	2	0	2	5	Medium
9.	Chunlei Xun et al [20] - 2007	1	0	1	0	2	4	Medium
10.	Hakan Turkkahraman et al [21] -2016	1	1	1	0	1	4	Medium
11.	Man-Suk Baek et al [22] - 2010	0	0	2	0	2	4	Medium
12.	Eiman S. Marzouk et al [9] - 2016	1	1	2	0	2	6	Medium

According to each criterion for quality analysis, the following results were obtained:

- Study design: Only 3 studies were prospective clinical trial and rest were retrospective studies described in detail.
- Sample size: The authors of 9 out of 12 studies performed sample-size calculation or had sample sizes larger than or equal to 15 patients.
- Selection description: 7 studies gave proper sample description including age, type of growth pattern, initial open bite etc.
- Error analysis: None of the studies performed and described the method error results.
- Statistical analysis: The authors of 10 studies performed detailed analysis

4. DISCUSSION

This systematic review aimed to evaluate and compare the primary mechanisms of anterior open bite closure in adults using clear aligner therapy (CAT) versus fixed mechanotherapy with temporary anchorage devices (TADs), based on evidence from peer-reviewed orthodontic literature. While clear aligner methodology has evolved substantially in recent years, there remains limited high-quality evidence supporting its biomechanical reliability, particularly in complex malocclusions such as anterior open bite. The Invisalign G4 algorithm, introduced in 2011, emphasizes incisor extrusion with reciprocal posterior forces; however, the effectiveness of these programmed forces in producing planned tooth movements has not been consistently verified. This distinction in treatment biomechanics is crucial for understanding the differing outcomes between CAT and conventional fixed appliances.

The studies included in this review consistently demonstrate that CAT achieves anterior open bite closure primarily through the extrusion of maxillary and mandibular incisors. In a multicentre retrospective study, Steele et al.[2] reported that although CAT and miniplate-supported posterior intrusion (MSPI) with fixed appliances improved overbite in all patients, CAT failed to induce significant posterior molar intrusion, which is essential for mandibular autorotation. Similarly, Garnett et al.[3] observed that incisor extrusion with CAT was minimal (<1 mm), yet sufficient to achieve overbite correction, particularly in mild to moderate anterior open bites.

Additional studies by Khosravi et al.[18] and Chamberland et al.[17] support the conclusion that CAT is effective in controlling vertical dimension through incisor extrusion rather than molar intrusion. However, Harris et al.[13] reported extrusion of both upper and lower incisors with significant maxillary and mandibular molar intrusion, leading to counterclockwise mandibular rotation, though the posterior intrusion was unintentional and unrelated to planned movements. Their findings aligned with Moshiri et al.[12], who observed mandibular molar

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intrusion (0.6 mm), mandibular incisor extrusion (0.8 mm), and minimal changes in the maxilla, suggesting stronger effects in the mandibular arch, possibly due to more IPR. Pokarna et al.[23] found greater but nonsignificant maxillary intrusion than planned and smaller mandibular intrusion, noting that intrusion is easier to achieve in the maxilla due to lower bone density, while anterior tooth movement had a greater role in bite closure. Similarly, Heeyon Shu et al.[19] showed that aligners achieved limited but consistent molar intrusion and vertical control, with small maxillary intrusion (0.4–0.6 mm) and partial mandibular intrusion. This aligns with the general trend that anterior tooth movement drives most of the bite closure in CAT, whereas posterior tooth intrusion is limited and sometimes inconsistent.

In contrast, fixed mechanotherapy with TADs produced more predictable molar intrusion: Steele et al., Xun et al.[2], and Chamberland et al.[17] reported maxillary molar intrusion ranging from 1.48 to 1.8 mm and mandibular molar intrusion from 0.7 to 1.2 mm. Higher intrusion values (2.39 – 3.59) reported in studies by Turkkahraman et al.[21], Marzouk et al.[9], and Baek et al.[22] were associated with more severe initial open bites, necessitating greater posterior intrusion for functional and esthetic correction. Minor intrusion reported in a study by Garnett et al.[3] can be attributed to limited TAD application and less severe baseline open bite. Importantly, mandibular autorotation was consistently observed in fixed appliance cases, averaging nearly 2°, while negligible in CAT cases, further underscoring the biomechanical differences between these treatment modalities.

The collective evidence suggests a clear divergence in mechanisms of anterior open bite correction between CAT and fixed appliances with skeletal anchorage. CAT is primarily effective in mild to moderate cases through controlled incisor extrusion, offering predictable vertical control without requiring skeletal anchorage or auxiliary devices. Conversely, fixed mechanotherapy with TADs enables intentional posterior intrusion, resulting in mandibular autorotation and more substantial overbite closure, which is particularly advantageous in severe or skeletal open bites. Understanding these biomechanical distinctions is essential for treatment planning, as inappropriate selection of CAT in cases requiring significant posterior intrusion may lead to suboptimal outcomes. This review is limited by the retrospective design of most studies, variability in case severity, and methodological differences, highlighting the need for prospective trials and RCTs.

5. CONCLUSION

Even though there are insufficient studies in the existing literature regarding the anterior open bite correction using CAT, from the available data we can conclude that, primary mechanism for anterior open bite closure using CAT is extrusion of anteriors while there is very limited amount of posterior intrusion using CAT and primary mechanism for anterior open bite correction using fixed mechanotherapy with TADs is intrusion of posteriors while there is no difference in amount of intrusion either with miniplates or miniscrews. Therefore, according to the results of the present systematic review CAT should be indicated in patients with mild to moderate anterior open bite and where extrusion of anterior dentoalveolar segment is favourable.

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