GRADUATION PROJECT

Degree in Dentistry

EFFECTIVENESS OF CLEAR ALIGNERS IN THE CORRECTION OF DEEP BITE: A LONGITUDINAL STUDY

Madrid, academic year 2025/2026

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RESUMEN

Introducción: una mordida profunda es una mala oclusión común caracterizada por una superposición vertical excesiva de los incisivos superiores sobre los dientes inferiores cuando están en oclusión céntrica. Se considera una de las condiciones más difíciles de tratar con éxito en todos los grupos de edad y están influenciada por factores genéticos, ambientales y conductuales. Antecedentes: Los pacientes con mordida profunda se tratan con alineadores, extruyendo los dientes posteriores y instruyendo los dientes anteriores, o una combinación de ambos. Los alineadores son una alternativa a los tratamientos más tradicionales en ortodoncia. **Objetivos:** El objetivo principal de esta investigación fue analizar las contribuciones dentales versus esqueléticas a la corrección de la mordida profunda. **Metodología:** este estudio retrospectivo analizó radiografías cefalométricas tomada antes (TO) y después del tratamiento (T1). Todas las imágenes fueron evaluadas mediante el software WebCeph utilizando los análisis de Rickestts, Tweed y Eastman para valorar las relaciones esqueléticas y dentales, incluyendo la altura facial, la inclinación de los incisivos y la sobre mordida. **Resultados:** 13 pacientes fueron tratados con alineadores para la mordida profunda, en su mayoría con maloclusión Clase II. El tratamiento promedio 80 alineadores y duro entre 1 y 4 años, requiriendo fases de refinamiento en todos los casos. **Conclusión:** Invisalign corrige eficazmente la mordida profunda principalmente mediante cambios dentales, con mínimos efectos esqueléticos. La duración del tratamiento varia y a menudo requiere refinamientos, dependiendo de la gravedad del caso y la colaboración del paciente. La planificación individualizada es esencial, a pesar de los protocolos estandarizados.

PALABRAS CLAVE

Alineadores transparentes, mordida profunda, dentoalveolar, esquelético

ABSTRACT

Introduction: A deep bite is a common malocclusion characterized by excessive vertical overlap of the upper incisors over the lower teeth when they are in centric occlusion. It is considered one of the most difficult conditions to treat successfully across all age groups and is influenced by genetic, environmental and behavioral factors. Background: Patients with deep bite are treated using aligners, extruding the posterior teeth and guiding the anterior teeth, or a combination of both. Aligners are an alternative to more traditional orthodontic treatments. **Objectives:** The main objective of this study was to analyses the dental versus skeletal contributions to the correction of deep bite. **Methodology:** This retrospective study analyzed cephalometric radiographs taken before (TO) and after treatment (T1). All images were evaluated using WebCeph software, applying the Ricketts, Tweed and Eastman analyses to assess skeletal and dental relationships, including facial height, incisor inclination and overbite. **Results:** Thirteen patients were treated with aligners for deep bite, the majority of whom had Class II malocclusion. Treatment involved an average of 80 aligners and lasted between 1 and 4 years, requiring refinement phases in all cases. **Conclusion:** Invisalign effectively corrects deep bite primarily through dental changes, with minimal skeletal effects. The duration of treatment varies and often requires refinements, depending on the severity of the case and the patient's cooperation. Individualized planning is essential, despite standardized protocols.

KEYWORDS

Clear aligners, deep bite, dentoalveolar, skeletal.

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1. INTRODUCTION

1.1 Definitions

1.1.1 Deep bite

A deep bite is frequently encountered and is one of the hardest malocclusions to manage successfully across all age groups.
Deep bite defined as an excessive vertical overlap of the lower incisors by the upper incisors in centric occlusion. (1)
Genetics, environmental and behavior factor contribute to deep bite.

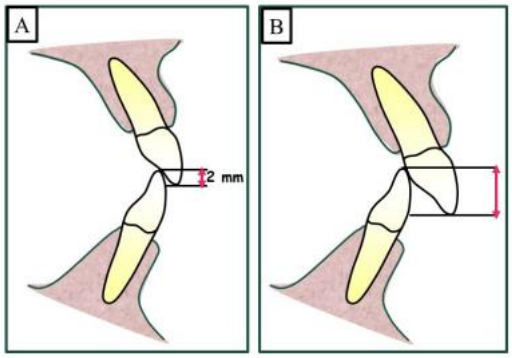


Figure 1. Class II

Dysgnathia is Characterized by a molar relationship in which the upper first molar is positioned more forward than the lower first molar. (as shown by red arrows) (A), This usually leads to an increased overjet, meaning there is a noticeable horizontal gap between the upper and lower front teeth. (red arrow shows the space between the front teeth) (B).

Deep bite can be dentoalveolar or skeletal discrepancies or a combination of both, and it can be combined to anteroposterior malocclusion (class II or class III), and a lateral malocclusion (lateral crossbite) or anterior crossbite.

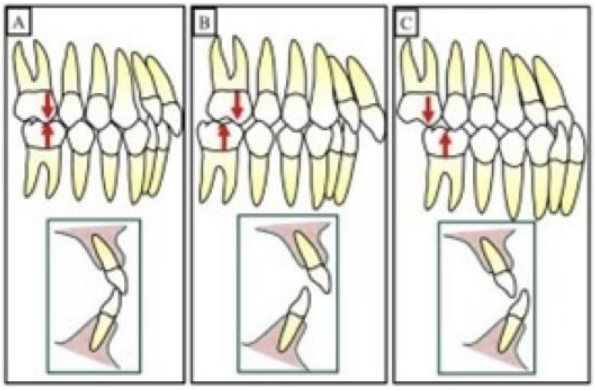


Figure 2. A diagrammatic imagen illustrating Angle Classes. Class I, II, and III. In Class I molar relationship (A).

Dentoalveolar deep bite is characterized by over-eruption of the anterior teeth, under-eruption of the posterior teeth, and an excessive overbite, a loss of the posterior teeth, alterations in the morphology of the teeth (2)
Deep bite has a global prevalence estimated between 10 % to 20 % all age, 5% to 15% in children, 10% to 20% in adolescents and 15% to 25% in adults, varying with genetics, environmental and behavior factors.

This malocclusion must be diagnosed as early as possible to avoid periodontal involvement, abnormal function, bruxism, and temporo-mandibular joint disturbance (3)

1.1.2 Vertical growth patterns

Deep bite involves both skeletal and dental discrepancies.
Skeletal deep bite is linked vertical growth, often with forward mandibular rotation and reduced lower facial height.
Dentoalveolar deep bite results from incisor overeruption, molar undereruption, or both.
Class II division 2 presents the most severe frorm. With excessive overbite and retroclined upper incisors covering the lower incisors,

1.2 Transformation of appliance technology

The different methods of correction of the deep bite can include the upward movement of the back teeth, the downward repositioning of the front teeth into the gums, or a combination of both approaches. It can also include the forward tilting of the front teeth, and is some cases, it may need to be managed through surgical.

1.2.1 Traditional appliances

The correction of the deep bite by extrusion of posterior teeth is indicated in horizontal growth patient.

This correction can be done by Bionator, bite plane, svec bite plane, myofunctional appliance (twin block, activator…) which allowed to open the anterior bite.



Figure 3. anterior bite plane

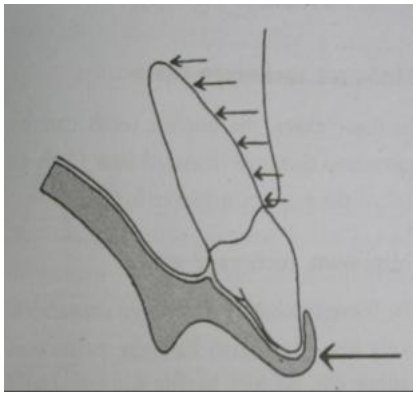


Figure 4. Such as the Sved bite plane

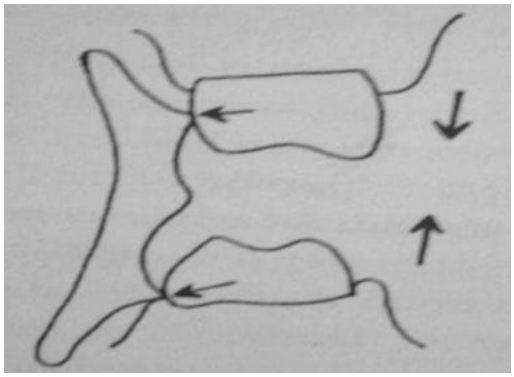


Figure 5. An activator to encourage molar extrusion. (1)

The intrusion of anterior teeth can be done with braces, and the force should pass through center of resistance if we don't want any buccal tipping. (1)

In terms of force application, light and controlled forces are used around 15-20g for each upper incisor and 10-15 g for each lower incisor.

We must have special attention to avoid resorption of apical root by applying light forces every six weeks (1)

1.2.2 Emergence of Clear Aligners as an alternative treatment/ Clear aligner appliance with bite ramp



Figure 6. Clear aligner appliance with bite ramp

Clear aligners have significantly improved the treatment of deep bite. Correction typically relies on a combination of intruding the front teeth and extruding the posterior teeth to achieve a balanced occlusion.

These movements are made possible through specific aligner features. For example, active attachments can generate extrusive forces on mandibular premolars and molars to help flatten the curve of Spee. Additionally, pressure areas within the aligners are designed to apply targeted intrusive forces on the incisors. Bite ramps placed on the palatal surfaces of the upper incisors and/ or canines function similarly to bite turbos, aiding in discussion.

Tooth intrusion with clear aligners is achieved through carefully controlled vertical forces delivered progressively by a series of aligners, allowing for precise and gradual tooth movement.

1.3 Facial profile.

1.3.1. The role of facial aesthetic in contemporary orthodontics.

Correcting a deep bite is crucial for achieving a harmonious facial profile and a stable, well-balanced occlusion, and it should be initiated at a very start of the leveling phase. A dental deep bite may appear in both short-faced and long faced individuals, and addressing it is key to effectively to reducing the overjet, particularly in class II divisions 1.

1.3.2 Esthetic in the incisor lip relationship

One of the key elements in achieving the attractive smile patients desire is ensuring that the teeth are properly aligned and this alignment is in harmony with the lips.

The most attractive smile are usually those in which the upper lip rests at the level of the gum line of the upper central incisor, creating a balanced and harmonio us appearance.
Smile dynamics are generally classified into three categories based on the degree of maxillary incisor and gingival display: low, average and high (6)



Figure 7. Smile types: (A) Average smile, (B) high smile, and (C) low smile (original)

1.3.3 Profile analysis assessment

The assessment of the profile can be evaluated by using various methods, including cephalometric analysis,3D facial scanning, study model and standardized facial photography. Cephalometric analysis using upper lateral radiographs is widely used in orthodontics and plays a key role in both diagnosis and treatment planning, because skeletal and dental components play a critical role in craniofacial assessment and the planning of orthodontic treatment.

Analyzed landmarks include sella (S) nation (N), anterior nasal spine (ANS), point A (A), posterior nasal porion (PNS), point B (B), gonion (Go), menton (Me), gnathion (GN), orbital (Orr) and porion (Po), and dental landmark (U1 tip), (U1 Apex), (L1 tip), (L1 Apex) (7)
These parameters allow the orthodontist to make skeletal and dentoalveolar linear and angle measurements to determine whether the deep bite is skeletal, dental or a combination of both.

1.4 Justification

Deep bite is a common and challenging malocclusion requiring control of incisor intrusion and/ or molar extrusion. While traditionally treated with fixed appliances, clear aligners are increasingly used for their aesthetics and comfort, although evidences on their predictability remains limited.

A longitudinal evaluation is needs to determine the effectiveness and stability of deep bite correction with clear aligners, helping guide treatment planning and understand their capabilities in managing vertical discrepancies.

1.5 Hypothesis

Research has shown that clear aligners are affective in managing mild to moderate dentoalveolar deep bite cases. However, their reliability in treating more severe dentoalveolar deep bites or cases with a skeletal component is still uncertain.

1.6 Research question

Will treatment with clear aligner and their features will be able to correct the severe dentoalveolar deep bite and skeletal deep bite? How does individual growth patterns will impact the treatment ?

2. OBJETIVE

2.1 Main objective

The main objective of this study was to evaluate how effective clear aligners are in orthodontic treatment in patients with complete deep bite, using pre- and post-treatment lateral cephalometric radiographs

2.2 Secondary objectives

- To analyze the relative dental and skeletal contributions to deep-bite correction using clear aligners.
- To quantify the amount and rate of deep-bite reduction (including incisor intrusion and molar extrusion) obtained during treatment with clear aligners.
- To determine the treatment duration required to achieve deep-bite correction with clear aligners

3. MATERIAL AND METHODS

3.1 Material

3.1.1 Sample size

The sample consisted of thirteen patients, aged between 14 and 36 years, with an average of 26.1 years, all of whom were treated using clear aligners. These cases were selected from the International Case Gallery of Align Technology, and the final number of patients was based on those met the established inclusion criteria.

3.1.2 Exclusion and inclusion criteria

3.1.2.1 Exclusion criteria

- Patients with unspecified age
- Patients younger than 13 years or with primary dentition
- Patients treated with auxillary techniques
- Patients with bad hygiene
- Poor cooperation with the orthodontist instructions

3.1.2.2 Inclusion Criteria

- Patients older than 13 years with complete deep bite
- Patients treated exclusively with clear aligners
- Complete pre- and post- treatment records including lateral cephalometric radiographs
- No prior orthodontic treatment
- Good cooperation with the orthodontic treatment

3.2 METHODS

3.2.1 Methods of data collection

This research was designed as a retrospective observational study, using cephalometric radiographs obtained from patient records. The radiographs were collected at two different stages:

- (TO) Pre-treatment: Taken before initiating treatment.
- (T1) Post-treatment: Taken immediately after completing treatment.

All radiographs were analyzed with WebCeph using Ricketta, Tweed, and Eastman analyses to ensure standardized and accurate measurements.

These analytical methods made it possible to evaluate facial height, the inclination of the incisors, and vertical discrepancies in both the jaws and teeth, including the degree of overbite.

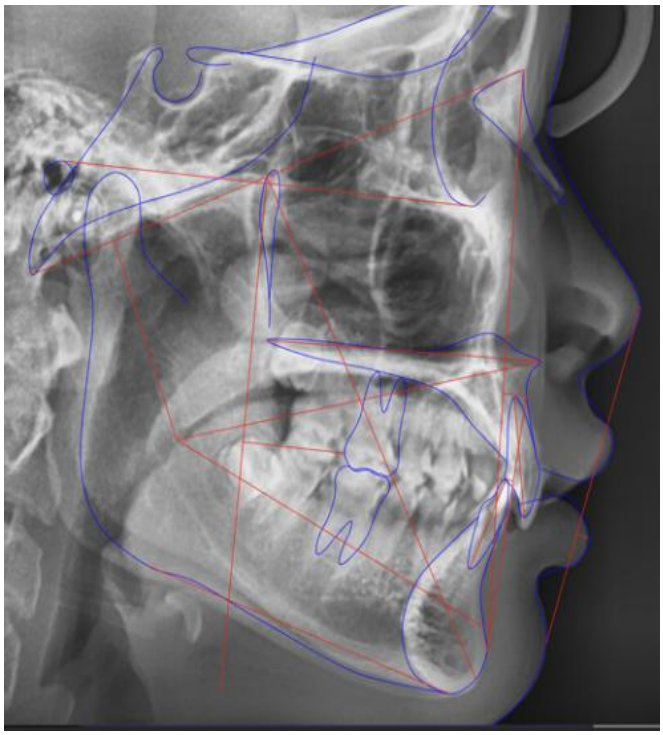


Figure 8. Cephalometric evaluation of patient 10541 was performend at TO using Recketts method in WebCeph

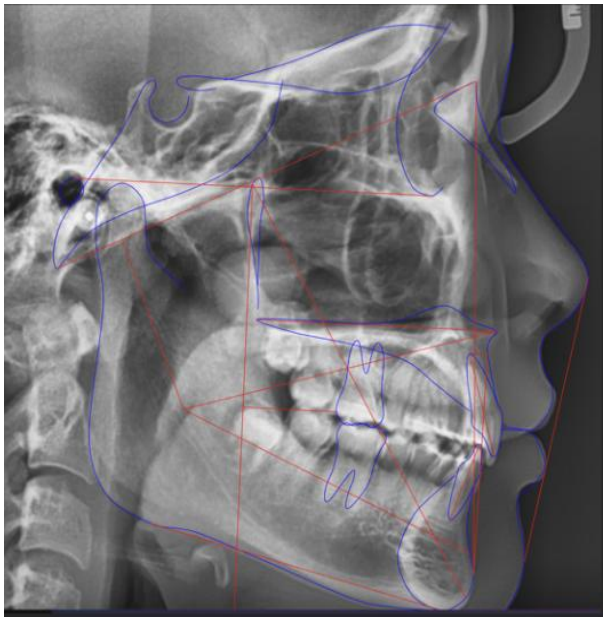


Figure 9. Cephalometric evaluation of patient 10541 was performed at T1 using the Ricketts method in WebCeph.

Figures 8 and 9 present the Ricketts analysis, including key angular measurements such as ANS-Xi-PM and the facial axis (FA), used to evaluate anterior facial height, along with the interincisal angle for dental assessment.

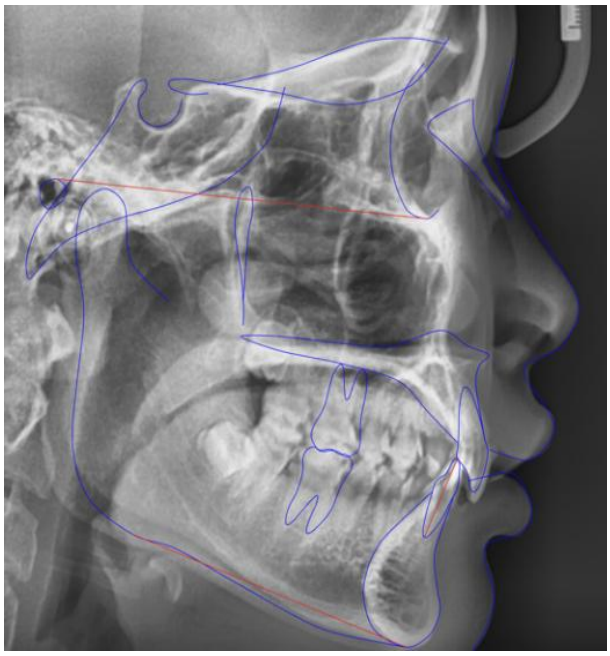


Figure 10. Tweed cephalometric analysis of patient 10541 at TO in WebCeph.

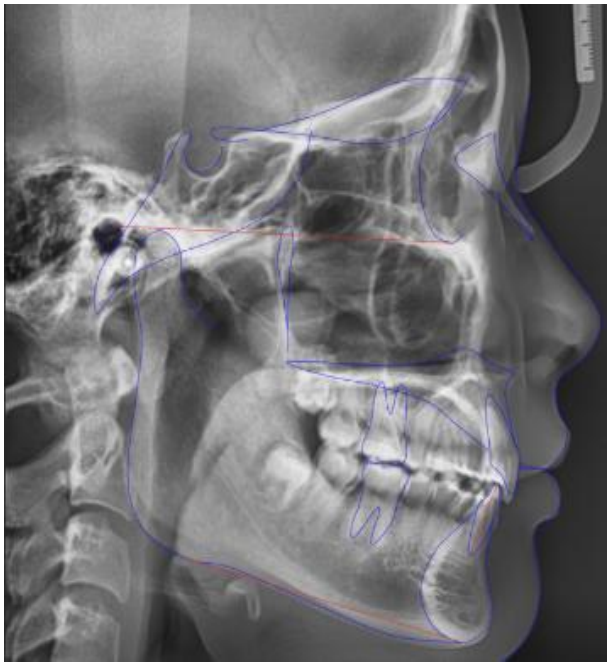


Figure 11. Tweed cephalometric analysis of patient 10541 at T1 in WebCehp.

Figure 10 and 11 present the tweed analysis, emphasing vertical dimension (FMA, skeletal measurement) and lower incisor inclination (IMPA and FMIA) (tweed triangle).



Figure 12. Cephalometric analyses of patient 10541, using Eastman method performed in WebCeph, Shows the TO.

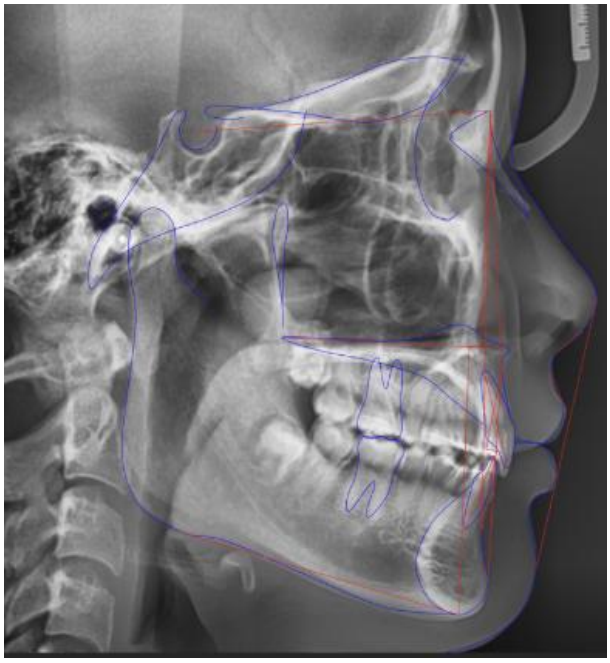


Figure 13. Cephalometric analyses of patient 10541, using Eastman method performed in WebCeph, show the T1.

Figures 12 and 13 show the Eastman analysis applied to the patient lateral cephalogram, which was useful for evaluating lower anterior face height (skeletal) and U1 to maxillary plane angle, L1 to mandibular plane angle, interincisal angle (dental measurement).

All radiographs were analyzed by one operator and independently checked by an orthodontist to reduce measurement errors.

The following cephalometric variables were measured to assess skeletal and dental changes.

Skeletal variable:

1. FMA indicates the vertical growth pattern and the facial type (dolichofacial, mesofacial, brachyfacial) (8)
2. ANS-XI-PM evaluates the vertical facial pattern (9)
3. FA (facial axe) measures facial growth direction (vertical vs horizontal) (9)
4. Lower anterior face height (9)

Dental variable:

1. U1–maxillary plane angle: assesses upper incisor inclination (proclination/retroclination).
2. L1–mandibular plane angle: assesses lower incisor inclination.
3. Interincisal angle: evaluates the relationship between upper and lower incisors.
4. Overbite: vertical overlap of upper and lower incisors in occlusion.
5. Occlusal plane: inclination of the occlusal plane.
6. U1–palatal plane: vertical position of upper incisor relative to palatal plane.
7. L1–mandibular plane: vertical position of lower incisor relative to mandibular plane.

4. RESULTS

A total of 13 patients, age between 14 years and 36 years, were evaluated before (TO) and after treatment (T1) with clear aligners for deep bite correction. Most patients presented Class II malocclusions with deep bite, while a few cases showed Class I malocclusion associated with deep bite and dental crowding

The sample included 3 males and 10 females. On average, about 80 aligners were prescribed per patient (range: 36-128) for both the maxillary and mandibular arches. In most cases, a similar number of aligners was used for the upper and lower arches, indicating comparable levels of tooth movement, except for one case with a notable difference. Most patients changed their aligners weekly, although some followed a schedule of every 10 days or up to two weeks, depending on individual treatment needs.

The total treatment duration ranged from one to four years, varying according to the complexity of each case and reflecting individualized treatment planning. All patients required refinement phases with additional aligner, with extended the overall treatment time.

CASE	AGE	SEX	MAX Aligners	MAND Aligners	WEAR Interval	TREATMENT (months)
1C	16	F				25
2C	14	M	72	39	10days	26
3C	34	F	104	104	1week	13
4C	29	F	89	89	1week	27
5C	36	F	97	97	1week	27
6C	30	F	78	78	10 days	14
7C	33	F	104	104	1week	13
8C	21	F	56	56	10days	13
9C	24	F	36	39	1week	14
10C	31	F	75	66	1week	20
11C	34	F	146	85	1-2 weeks	45
12C	20	M	110	114	1week	41
13C	19	F	128	110	10/14 days	54

Table 1: Description of the 13 patients (F: Female, M: Male, Max: maxillary and Mand: mandibular)

Cephalometric comparisons examined both skeletal (FMA, ANS-XI-PM, FA, Lower Anterior Face) and dental (U1, L1, Inter-incisal Angle, Overbite) parameters.

	FMA	Ans-Xi PM	FA	U1	L1	I/i	overbite	occlusal	U1/Palat plane	L1/Mand Plane
C1	15,3°	39,9°	94,1°	99°	93,3°	150,7°	6,2mm	9,9°	29,2mm	40,2mm
C1	12,9°	38,4°	96,3°	106,9°	97,5°	142,5°	1,8mm	15,3°	35,8mm	19,8mm
C2	12,1°	35,9°	90,4°	127,9°	97,8°	121,5	5,4mm	7,3°	31,2mm	38,2mm
C2	13,3°	38,1°	90°	110,8°	99,6°	138°	2,2mm	13,9°	31,1mm	36,1mm
C3	22,4	42,4°	86,4°	91,2°	85,9°	157,4°	6,1mm	15,9°	29,2mm	38,1mm
C3	26,2°	45°	87,3°	96,1°	90,8°	144,8°	3,2mm	17,1°	29,5mm	37,2mm
C4	15,7°	42,3°	91°	107,3°	87°	149,9°	5,2mm	12,5°	32,8mm	40,3mm
C4	17,1°	42,6°	90,6°	109,5°	92°	140,5°	1,6mm	14,9°	32,9mm	37,8mm
C5	27,2°	45,2°	87,4°	116°	93,6°	124,8°	5,1mm	21,7°	26,9mm	38,2mm
C5	28,8°	46°	85,7°	97,1°	90,8°	146,7°	1,6mm	31,1°	36,2°	36,2mm
C6	15,8°	42,2°	89,9°	97,1°	89,3°	160,1°	5,2mm	12,1°	28,5mm	42,1mm
C6	15,5°	42,4°	89,5°	102,9°	97,1°	146,4°	2,3mm	14,1°	27,7°	38,8°
C7	17,4°	42,1°	92,5°	105,4°	86,1°	146,9°	4,7mm	13,1°	32,7mm	39,7mm
C7	18°	45°	88,2°	106,2°	92°	145,4°	3mm	18,6°	34,8mm	40,4mm
C8	15,6°	39,3°	89,6°	105,3°	88,5°	150°	3,2mm	10,9°	26,8mm	39mm
C8	15	38,9°	89,7°	106,9°	96,3°	141,6°	1,1mm	13,7°	27,1mm	38,2mm
C9	28,4°	44,6°	89,7°	112,7°	83,9°	137,7°	3,8mm	16,7°	29,5mm	40,4mm
C9	28,3°	45,8°	88,9°	114,7°	90,7°	128,6°	2,3mm	19,9°	30mm	40,1mm
C10	17,4°	41,4°	88,4°	105,1°	95,9°	145,3°	5,4mm	13,8°	31,7mm	40,6mm
C10	17°	43,2°	88°	106°	102,9°	136,2°	2,2mm	17,6°	32mm	39,3mm
C11	26,8°	49,6°	86,6°	101,4°	95,6°	135,7	9,2mm	4,9°	53mm	39mm
C11	24,2°	48,8°	85,8°	104,6	101,6°	130,2°	3,3mm	23,9°	38,7mm	43,5mm
C12	27,3°	51,5°	80,4°	115,4°	95,2°	124°	4,8mm	15,3°	35,5mm	44,8mm
C12	27,2°	54,8°	79,8°	102,7°	90,8°	139,5°	0,9mm	21,4°	38,5mm	47,4mm
C13	22,4°	48,4°	82°	103,2°	100,5°	134,6°	5,3mm	4,7°	35,8mm	46,4mm
C13	21,6°	47,7°	81,9°	99,1°	98°	142,3°	2,3mm	13,9°	28mm	42,8mm

Table 2: Cephalometric values of the 13 patients before and after treatment

The two measurements which analyses the degree on incisor intrusion with the treatment are U1/Palatal plane and L1/Mandibular plane in mm.
When the value of L1/ Mandibular plane decrease, it shows that the correction of the deep bite is by intrusion.

But many factors can interfere in these values, proclination of the incisor or the class II malocclusion.

Shows the average changes in key cephalometric measurements by comparing values at TO and T1. For each variable, the mean values before and after treatment (± standard deviation) are presented, along with the mean change (Delta) and the corresponding p-values.

Measure	Unit	TO (mean ±SD)	T1 (Mean ±SD)	Delta	p- evalue
FMA	degrees	20,4 ± 5,59	20,28 ± 5,97	-0,12	0,9582
Ans-Xi-Pm	degrees	43,41 ± 4,19	44,34±4,65	0,93	0,5894
FA	degrees	88,31 ± 3 .84	87,85 ± 4,11	0,22	0,771
U1	degrees	106,86 ± 9,55	104,72 ± 5,23	-4,32	0,4845
L1	degrees	92,12 ± 5,05	95,01 ± 4,94	-0,11	0,153
I/i	degrees	140,71 ±12,49	141,72 ± 7,11	-5,38	0,8021
Overbite	mm	5,35 ± 1,41	2,14 ± 0,74	-0,67	0,000000165*
Occlusal	degrees	12,98 ± 4,28	16,90 ± 3,57	-0,71	0,0356*

Table 3: Presents the mean values of cephalometric measurements before and after treatment, highlinghting those that are statistically significant.

The most notable finding in this group was observed in the overbite, which decreased from a mean of 5.35 ± 1.41 mm at TO to 2.14 ± 0.74 mm at T1 ($p < 0.0000002$).
This reduction of 0,67 indicates that clear aligner therapy was affective in correcting the excessive vertical overlap commonly seen in Class II/1, Class II/2, and some Class I cases.

The change was both clinically and statistically significant ($p<0.0000002$), highlighting the effectiveness of aligners in reducing deep overbite.

The measurement of the angle between of the occlusal plane with SN shows also a measurable difference($p<0,05$) between T0 and T1. We notice that the p-value of L1 is 0,153 and the mean between T0 and T1 increased from 92,12±5,05 to 95,01 ± 4,94 which explain that the increasing of the mean of occlusal plane between T0 and T1 is due to the proclination of lower incisor.

Regarding the skeletal parameters, since the p-value is much higher than the standard significant level (0.05), the difference between the two means is not statistically significant.
This indicate that there is no evidence of a meaningful difference on the skeletal correction of Deep bite with the aligners. The main changes with the aligners are dental values.

5.DISCUSSION

5.1 Skeletal modifications and profile adaptations

The results indicate that the treatment of the Deep bite with the aligners involve more than just moving teeth, it often requires a delicate balance of dental movements that can influence the lower third of the face.

While aligners are primarily tooth-moving tools, their skeletal effects are usually secondary to how they reposition the jaw and manage the vertical dimension.
If the aligners plan focuses on extruding teeth molars, it creates a “wedge” effect. This causes the mandible to rotate downward and backward.

It results an increase in the lower anterior height. This is effective for “short face” patients (brachyfacial) but must be managed carefully in “long face” patients to avoid making the chin look recessed.

5.2. Dental effects and incisor control

Most studies indicate that deep bite is difficult to treat with clear aligners, although opinion in the literature vary. (13)
A review by Konstantinos Papadimitriou found that Invisalign is effective, particularly for tipping and rotational movements (12).

Deep bite correction can be predictable when proper clinical protocols are followed, and accurate 3D digital planning is essential for reliable results (12).

1. Lower anterior intrusion when the smile arc is adequate.
2. Posterior tooth extrusion.
3. Leveling the curve of Spee in 3D.
4. Use of thick, rectangular posterior attachments (horizontal, gingival bevel).
5. Bite ramps on upper incisors for lower incisor intrusion.
6. Pressure areas on lower incisors.
7. Controlled forward inclination of upper and lower incisors.
8. Strong posterior occlusal contacts.
9. Class II elastics with a vertical component attached to aligners (11).

(Since aligners need retention to express vertical movements, such as extrusion of posterior teeth or intrusion of anterior teeth, we need to use horizontal rectangular attachment(4mm) with gingival beveled, to improve the Surface of force application to premolars and canines and to prevent dislodgement of aligners during an anterior intrusion).

5.3 Limitations of the study

The study has several limitations. The small sample size limits generalizability; a larger sample would increase statistical power.

This study presents a single-arm clinical evaluation of Invisalign outcomes, focusing on independent efficacy of the appliance without a comparative reference group.

Due to the lack of a concurrent control group (example treatment with fix appliance, using utility arch), comparisons were drawn from historical cohorts in the literature; however, this approach inherently limits the strength of the evidence.
Long-term stability of deep bite correction is important. Despite good short-term results, retention must be evaluated.

All the cases were published in the Invisalign gallery that met the inclusion and exclusion criteria. And we have to consider that the cases were treated by different doctors.

5.4 Comparative study published in the literature.

This retrospective study analyzeg cephalometric radiographs taken before (TO) and after treatment(T1).

All images were evaluated with WebCeph using Ricketts, Tweed, and Eastman analyses. Resuls show thst deep bite correction with aligners involves coordinated dental movements that may also influence the facial third.

5.4.1 The first study published in Clinical Oral Investigations (21 May 2025), is about the systematic review of effectiveness and accuracy of clear aligners (CA)in treatment of dental and skeletal deep bite. (Fatima HUSSEIN (12)

The study included patient with dental and/or skeletal deep bite treated with clear aligners, using prospective or retrospective designs. Risk of bias was assessed with the ROBINS-I tool.

Clear aligners are effective for mild to moderate dentoalveolar deep bites, but their effectiveness in skeletal cases remains uncertain.
Planned outcomes often differ from actual, requiring overcorrection or refinements. Due to study limitations, it is still premature to consider aligners superior for deep bite correction.

5.4.2 The second study published by Enzo Pasciuti (13) is about the new protocol of the treatment of deep bite with Aligners.

The method is based on programmed tooth movement using the ‘’frog staging`` protocol, with retention attachments and an overengineered final setup.
This study shows that the deep bite is difficult to treat with aligners, and anterior intrusion and posterior extrusion are difficult to achieve.

Krieger et al stated that the vertical movements of intrusion and extrusion are more difficult with aligner (14).

According to a review by Konstantinos Papadimitriou, Invisalign is effective for tipping and rotational movements. Deep bite correction is easier when anterior intrusion is combined with proclination, and frog staging may improve predictability, although it increases the number of aligners.

Deep bite treatment with clear aligners can be predictable when following the proper protocol: -conventional horizontal attachments,
-by working the Setup (overcorrect)and

-by staging (In deep bite correction, tooth movements are guided using ‘’frog staging’’ to intrude the anterior teeth).

However, further analysis and more cases using this protocol are still required.

5.4.3 The third studies is about the deep bite correction with the Invisalign System: A case -Series Study (15)

This retrospective case series analyzed pre and post treatment cephalometric radiographs of 37 adult deep bite patients treated with a standardized protocol. A total of 19 variables were measured, and the Wilcoxon test assessed significant changes.

The study evaluates dental and skeletal effects of deep bite correction with Invisalign. Results show effective correctio mainly through posterior extrusion and anterior intrusion, with minimal skeletal changes.

Treatment should be individualized despite standardized protocols. Bite ramps were used in all cases to aid bite opening and control forces, while anterior intrusion was performed in masse with patient specific forces.

5.4.4 The fourth studies aimed to compare the clinical effectiveness and patient satisfaction of clear aligner therapy versus conventional fixed appliances in the treatment of deep bite malocclusion (16)

The study followed a prospective design at the National Hospital of Odonto-Stomatology in Hanoi, including patients treated with clear aligner or traditional braces. Treatment effectiveness was assessed through duration, overbite and overjet improvement, and cephalometric outcomes, while patient satisfaction was measured using a structured questionnaire.

Both clear aligners and conventional braces can effectively treat deep bite malocclusion. The treatment with Clear Aligner is shorter but they increased the proclination of upper incisor and the satisfaction of patient are higher.

Braces provide better vertical control, so treatment should be chose based on individual patient needs.

6. CONCLUSIONS

1. Invisalign is an effective for correcting deep bite mainly through posterior extrusion and anterior change, with minimal skeletal effects.

2. Cephalometric results show that correction is largely due to incisor proclination, molar extrusion, and changes in the occlusal plane rather than true intrusion.

3. Treatment duration variables widely (13-54 months) and often requires additional aligners, depending on case severity and patient compliance.

4. Although standardized protocols are helpful, treatment must be individualized to avoid unwarted side effects.

7. SUSTAINABILITY

From an environmental standpoint, aligner therapy embodies both ecological challenges and opportunities. While the production of single-use aligners relies on plastic-based materials, the integration of digital workflows—most notably intraoral scanning—significantly reduces the reliance on conventional impression materials and the repeated fabrication of plaster models. This digital consolidation optimizes resource utilization, decreases material waste, and minimizes storage requirements within clinical settings. Moreover, the reduced frequency of in-office appointments associated with aligner treatment contributes to a measurable decrease in patient-related travel emissions, thereby enhancing the overall sustainability profile of this therapeutic approach.

Clear aligners offer notable advantages in aesthetics and comfort compared with conventional functional appliances. Their discreet appearance and improved wearability can positively influence self-esteem and facilitate psychosocial integration, particularly during sensitive phases of development. In addition, patients and their families benefit from digital monitoring systems that enable remote supervision of treatment progress, thereby reducing the frequency of in-office visits and alleviating time-related and transportation burdens.

8. REFERENCES

1. Jain N. Deep bite: its classification, etiology, clinical features, diagnosis & treatment modalities. International journal of health sciences. 2021 Dec 31;222–9.

2. Nezar Watted, Lone IM, Osayd Zohud, Midlej K, Proff P, Iraqi FA. Comprehensive Deciphering the Complexity of the Deep Bite: Insight from Animal Model to Human Subjects. Journal of Personalized Medicine [Internet]. 2023 Oct 8;13(10):1472–2. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10608509/

3. Lone IM, Midlej K, Osayd Zohud, Paddenberg E, Krohn S, Kirschneck C, et al. Global Map of Skeletal and Dental Malocclusion Prevalence: From Classes to Continents. Journal of Dentistry & Oral Disorders. 2024 Mar 8;10(1).

4. Upadhyay M, Nanda R. Management of Deep Overbite Malocclusion. Elsevier eBooks. 2015 Jan 1;133–46.

5. Daokar S, Agrawal G. Deep Bite Its Etiology, Diagnosis and Management: A Review. Journal of Orthodontics & Endodontics. 2016;02(04).

6. Do J, Bittencourt RC, Mascarenhas D, Passeri R, Mattos CT. Impact of incisor display and lower lip height on aesthetic perception and age estimation [Internet]. 2025. Available from: https://www.researchgate.net/publication/391726027_Impact_of_incisor_display_and_lower_lip_height_on_aesthetic_perception_and_age_estimation .

7. Camci H, Salmanpour F. Cephalometric Evaluation of Anterior Cranial Base Slope in Patients with Skeletal Class I Malocclusion with Low or High SNA and SNB Angles. Turkish Journal of Orthodontics. 2020 Sep 7;33(3):171–6.

8. Kumari L, Das A. Determination of Tweed's cephalometric norms in Bengali population. European Journal of Dentistry. 2017 Jul 1;11(03):305–10.

9. Bae E, Kwon H, Kwon O. Changes in longitudinal craniofacial growth in subjects with normal occlusions using the Ricketts analysis. The Korean Journal of Orthodontics. 2014;44(2):77.

10. Jamilian A, Showkatbakhsh R. Treatment of maxillary deficiency by miniscrew implants – a case report. Journal of Orthodontics. 2010 Mar;37(1):56–61. 10'.

11. Greco M, Rombolà A. Precision bite ramps and aligners: An elective choice for deep bite treatment. Journal of Orthodontics. 2021 Jul 27;146531252110341.

12. Dimitriou A, Mousoulea S, Gkantidis N, Kloukos D. Clinical effectiveness of Invisalign® orthodontic treatment: a systematic review. Progress in Orthodontics [Internet]. 2018 Sep 28;19(1). Available from: https://progressinorthodontics.springeropen.com/articles/10.1186/s40510-018-0235-z

13. Pasciuti E, Coloccia G, Inchingolo AD, Patano A, Ceci S, Bordea IR, et al. Deep Bite Treatment with Aligners: A New Protocol. Applied Sciences. 2022 Jul 2;12(13):6709.

14. Krieger E, Seiferth J, Marinello I, Jung BA, Wriedt S, Jacobs C, et al. Invisalign® treatment in the anterior region. Journal of Orofacial Orthopedics / Fortschritte der Kieferorthopädie. 2012 Aug 11;73(5):365–76.

15. Spillers T, Walma DAC, Spillers JD, Kau CH, Christou T. Deep Bite Correction with the Invisalign System: A Case-Series Study. European Journal of Dentistry. 2025 Jun 24;

16. Pham TT, Pham THT, Tran CB, Nguyen VA, Hoang V. Clinical effectiveness and patient satisfaction of clear aligner therapy in deep bite malocclusion: A randomized clinical trial. Medicine [Internet]. 2026 Feb;105(1):e46623. Available from: https://pubmed.ncbi.nlm.nih.gov/41496114/

17.ANNEXES