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SKELETAL AND DENTAL EVALUATION FOLLOWING TREATMENT OF DEEP OVERBITE USING REVERSE CURVE OF SPEE ARCH-WIRE AND POSTERIOR BITE BLOCK: A CASE SERIES

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ABSTRACT

Background: One of the most common vertical malocclusions is deep overbite which is excessive vertical overlap of the maxillary incisors over the mandibular incisors and it is multifactorial; it is caused by overeruption of incisors, infra eruption of posterior teeth, genetic susceptibility and environmental factors. In order to get the best outcomes while preserving facial harmony, deep overbite correction is still a difficult part of orthodontic treatment, necessitating careful consideration of treatment mechanics.

Objective: To evaluate the skeletal and dental changes following treatment of deep overbite using reverse curve of Spee (RCS) arch-wire combined with posterior bite blocks.

Methods: RCS arch-wires and posterior bite blocks placed beyond the freeway space were used to treat five patients (two males and three females; mean age 15–21 years) with increased overbite. At baseline (T0) and after the leveling and alignment stage (T1), lateral cephalometric radiographs were analyzed. Overbite reduction, curve of Spee flattening, upper incisor inclination (U1-NA angle and mm), lower incisor inclination (L1-NB angle and mm), and vertical dimensional changes were among the parameters assessed.

Results: All cases demonstrated significant overbite reduction (mean: 1.4mm), curve of Spee flattening (mean: 1.1mm), and no net change in mean L1-NB angle (0.00°). Posterior bite blocks effectively prevented excessive molar extrusion while maintaining facial vertical dimensions.

Conclusion: The combination of RCS arch-wire and posterior bite blocks provides an effective treatment modality for deep overbite correction with predictable dental and skeletal changes while preventing undesirable posterior extrusion.

KEYWORDS: Deep overbite, reverse curve of Spee, posterior bite block, orthodontic treatment, case series

INTRODUCTION

Deep overbite, characterized by excessive vertical overlap of the maxillary incisors over the mandibular incisors, is one of the most prevalent malocclusions, affecting 13–57% of different populations.1,2 It can compromise periodontal health, temporomandibular joint function, and facial esthetics, making its effective correction a clinical priority12,17. Vertical facial growth patterns significantly influence its presentation, with backward mandibular rotation commonly associated with its development.14

The curve of Spee, first described in 1890, is the anteroposterior occlusal curvature of the mandibular arch.3,9 An accentuated curve is commonly associated with deep overbite, and its depth correlates significantly with overbite magnitude.1,15Leveling this curve is therefore a central objective of deep overbite treatment.

RCS arch-wires are widely used for leveling through anterior intrusion and posterior extrusion,5,8 but leveling by continuous archwire mechanics predominantly results from posterior extrusion, raising concerns about vertical stability and relapse.4,18,21

Excessive posterior extrusion causes backward mandibular rotation, increasing anterior facial height and compromising long-term outcomes.14,22 Posterior bite blocks have been proposed as an adjunct to limit this extrusion: Iscan and Sarisoy demonstrated that passive bite blocks effectively control posterior dentoalveolar eruption6, and finite element analyses confirm that deeper RCS wires without vertical control generate excessive molar-extruding forces19. Post-treatment stability of curve of Spee correction is strongly influenced by the degree of posterior extrusion during treatment.1,23 This case series presents five patients treated with RCS arch-wires and posterior bite blocks, evaluating skeletal and dental changes following the leveling and alignment phase.

2. Case Presentations

Case 1: Patient complained of spacing in his upper and lower front teeth region.

Chief Complaint: The patient presented with deep overbite and spacing in upper and lower front teeth affecting his facial esthetics and function.

- Clinical Examination:
- Initial overbite: 4mm
- Curve of Spee: 3mm
- Freeway space: 3mm

Mild maxillary and mandibular spacing

Cephalometric Analysis (T0):

- SNA: 88°
- SNB: 82°
- ANB: 6°
- Mn-Mx: 15°

Treatment Plan: Comprehensive orthodontic treatment using 0.022" slot preadjusted edgewise appliance with RCS arch-wire progression and 3.5mm posterior bite blocks positioned beyond the calculated freeway space.

Results at T1 (Post-Leveling and Alignment):

- Overbite: Reduced to 2mm (2mm reduction)
- Curve of Spee: Flattened to 1mm (2mm improvement)
- L1-NB angle: Decreased from 32° to 30° (2° decrease)
- L1-NB mm:Decreased from 7mm to 4mm
- U1-NA angle: Decreased from 21° to 19°
- U1-NA mm: Decreased from 4mm to 2mm
- L1-MP: Decreased from 48° to 44°
- L6-MP: Remained stable at 34°
- U1-NF: Decreased from 22mm to 21mm
- Freeway space: Maintained at 3mm
- Controlled posterior extrusion with no excessive invasion of freeway space

Case 2:

Chief Complaint: Patient complained of poor facial aesthetics and reduced lower incisor show.

Clinical Examination:

- Initial overbite: 4mm
- Curve of Spee: 2.5mm
- Freeway space: 2mm
- Competent lips with mild mentalis strain

Cephalometric Analysis (T0):

- SNA: 85°
- SNB: 82°
- ANB: 3°
- Mn-Mx: 27°

Treatment Plan: Fixed orthodontic treatment with emphasis on overbite reduction while maintaining facial harmony. RCS arch-wire combined with 3mm posterior bite blocks.

Treatment Progress: Standard arch-wire progression was followed with incorporation of RCS mechanics during the leveling phase. Posterior bite blocks were adjusted to account for the patient's smaller freeway space.

Results at T1:

- Overbite: Reduced to 3mm (1mm reduction)
- Curve of Spee: Flattened to 2mm (0.5mm improvement)
- L1-NB angle: Increased from 32° to 35° (3° increase)
- L1-NB mm: Increased from 5mm to 7mm
- U1-NA angle: Maintained at 25°
- U1-NA mm: Maintained at 5mm
- L1-MP: Decreased from 44° to 42°
- L6-MP: Decreased from 31° to 30°
- U1-NF: Increased from 28mm to 29mm
- Freeway space: Maintained at 2mm
- Improved facial profile with enhanced lip competency

- Patient reported improved speech clarity (see Figure 1).

Case 3:
Chief Complaint: Patient complained of irregularly placed teeth in his upper and lower front teeth region.
Clinical Examination:
- Initial overbite: 4mm
- Curve of Spee: 4mm
- Freeway space: 3mm

Cephalometric Analysis (T0):
- SNA: 85°
- SNB: 79°
- ANB: 6°
- Mn-Mx: 29°

Treatment Plan: Correction of deep overbite using RCS arch-wire and 4mm posterior bite blocks.
Treatment Progress: Treatment focused on controlled overbite reduction. The adequate freeway space allowed for appropriate posterior bite block placement.

Results at T1:
- Overbite: Reduced to 3mm (1mm reduction)
- Curve of Spee: Flattened to 3mm (1mm improvement)
- L1-NB angle: Increased from 36° to 37° (1° increase)
- L1-NB mm: Decreased from 9mm to 7mm
- U1-NA angle: Decreased from 41° to 30°
- U1-NA mm: Decreased from 11mm to 7mm
- L1-MP: Decreased from 44° to 42°
- L6-MP: Remained stable at 30°
- U1-NF: Decreased from 27mm to 26mm
- Freeway space: Maintained at 3mm
- Improved anterior function

Case 4:
Chief Complaint: Increased gingival show on smiling.
Clinical Examination:
- Initial overbite: 6mm
- Curve of Spee: 2mm
- Freeway space: 2mm

Cephalometric Analysis (T0):
- SNA: 82°
- SNB: 75°
- ANB: 6°
- Mn-Mx: 24°

Treatment Plan: Conservative approach focusing on overbite reduction with minimal changes to existing dental relationships. RCS arch-wire with 3mm posterior bite blocks.
Treatment Progress: Treatment emphasized controlled anterior intrusion. Posterior bite blocks were crucial in this case to prevent any unwanted vertical changes.

Results at T1:
- Overbite: Reduced to 4mm (2mm reduction)
- Curve of Spee: Flattened to 1mm (1mm improvement)
- L1-NB angle: Decreased from 27° to 25° (2° decrease)
- L1-NB mm: Decreased from 9mm to 6mm
- U1-NA angle: Decreased from 33° to 28°
- U1-NA mm: Decreased from 9mm to 4mm
- L1-MP: Decreased from 48° to 45°
- L6-MP: Remained stable at 37°
- U1-NF: Decreased from 31mm to 30mm
- Freeway space: Maintained at 2mm
- Anterior function significantly improved (see Figure 2).

Case 5:
Chief Complaint: Deep bite affecting facial aesthetics and function.

- Clinical Examination:
- Initial overbite: 4mm
- Curve of Spee: 3mm
- Freeway space: 3mm

Cephalometric Analysis (T0):

- SNA: 82°
- SNB: 81°
- ANB: 1°
- Mn-Mx: 25°

Treatment Plan: Orthodontic treatment with RCS arch-wire and 3.5mm posterior bite blocks for overbite correction.

Results at T1:

- Overbite: Reduced to 3mm (1mm reduction)
- Curve of Spee: Flattened to 2.5mm (0.5mm improvement)
- L1-NB angle: Decreased from 33° to 32° (1° decrease)
- L1-NB mm: Decreased from 9mm to 7mm
- U1-NA angle: Decreased from 36° to 33°
- U1-NA mm: Decreased from 12mm to 10mm
- L1-MP: Decreased from 47° to 45°
- L6-MP: Remained stable at 34°
- U1-NF: Increased from 28mm to 30mm
- Freeway space: Maintained at 3mm
- Improved facial esthetics and function

Table 1. Descriptive Statistics of Skeletal and Dental Parameters at T0 and T1

Variable	T0 Min	T0 Max	T0 Range	T0 Mean ± SD	T1 Min	T1 Max	T1 Range	T1 Mean ± SD
SNA	82	88	6	84.40 ± 2.510	81	87	6	83.80 ± 2.775
SNB	75	82	7	79.80 ± 2.950	74	83	9	79.00 ± 3.674
ANB	1	6	5	4.40 ± 2.302	2	7	5	4.60 ± 1.949
Mn–Mx	15	29	14	24.00 ± 5.385	17	31	14	25.60 ± 5.273
L1–NB (°)	27	36	9.0	32.00 ± 3.240	25	37	12.0	31.80 ± 4.658
L1–NB (mm)	5	9	4.0	7.80 ± 1.789	4	7	3.0	6.20 ± 1.304
U1–NA (°)	21	41	20.0	31.20 ± 8.136	19	33	14.0	27.00 ± 5.339
U1–NA (mm)	4	12	8	8.20 ± 3.564	2	10	8.0	5.60 ± 3.050
Overbite	4	6	2.0	4.40 ± 0.894	2	4	2.0	3.00 ± 0.707
Curve of Spee(COS)	2.0	4.0	2.0	2.90 ± 0.742	1.0	3.0	2.0	1.90 ± 0.894
L1–MP	44	48	4.0	46.20 ± 2.049	42	45	3.0	43.60 ± 1.517
L6–MP	30	37	7.0	33.20 ± 2.775	30	37	7.0	33.00 ± 3.000
U1–NF	22	31	9.0	27.20 ± 3.271	21	30	9.0	27.20 ± 3.834
Freeway Space	2	3	1	2.60 ± 0.548	—	—	—	Not Reported consistently
Bite Block Height	3.0	4.0	1.0	3.40 ± 0.418	—	—	—	Not applicable

The descriptive analysis of parameters between T0 and T1 is summarized in Table 1. Cephalometric landmarks are illustrated in Figure 3. Skeletally, minimal changes were observed: SNA decreased slightly (84.40 ± 2.51 to 83.80 ± 2.77), SNB remained stable (79.80 ± 2.95 to 79.00 ± 3.67), and ANB showed marginal increase (4.40 ± 2.30 to 4.60 ± 1.95), suggesting predominantly dentoalveolar rather than skeletal effects. The Mn–Mx angle showed a mild increase (24.00 ± 5.39 to 25.60 ± 5.27). Dentally, U1–NA decreased markedly (31.20 ± 8.14 to 27.20 ± 6.91°; 8.20 ± 3.56 to 5.60 ± 3.05 mm), and L1–NB linear measurement reduced (7.80 ± 1.79 to 6.60 ± 0.55 mm) with angular inclination unchanged, indicating controlled bodily retraction. Overbite reduced from 4.40 ± 0.89 to 3.00 ± 0.71 mm and the curve of Spee from 2.90 ± 0.74 to 1.80 ± 0.84 mm. Posterior parameters L6–MP and U1–NF remained stable, confirming preservation of posterior anchorage and vertical control (Figure 4).

Table 2. Comparison of Skeletal Parameters Between T0 and T1 Using Paired t-test

Variable	Mean Difference (T0–T1)	SD	SE	95% CI (Lower)	95% CI (Upper)	t-value	df	p-value	Interpretation
SNA	0.600	0.894	0.400	-0.511	1.711	1.500	4	0.208	Not significant
SNB	0.800	1.304	0.583	-0.819	2.419	1.372	4	0.242	Not significant
ANB	-0.200	1.304	0.583	-1.819	1.419	-0.343	4	0.749	Not significant
Mn–Mx	-1.600	0.548	0.245	-2.280	-0.920	-6.532	4	0.003	significant

Paired analysis of skeletal parameters (Table 2) showed no statistically significant changes in SNA (−0.60°, p = 0.208), SNB (−0.80°, p = 0.242), or ANB (−0.20°, p = 0.749), confirming sagittal skeletal stability. The Mn–Mx angle increased significantly by 1.60° (p = 0.003; 95% CI: −2.28 to −0.92), indicating a mild but significant increase in vertical divergence. Overall, skeletal effects were limited to a modest vertical change, with sagittal jaw relationships remaining stable.

Table 3. Comparison of Dental Parameters Between T0 and T1 with Paired Correlation Analysis

Variable	T0 Mean ± SD	T1 Mean ± SD	Mean Difference (T0–T1)	95% Cl of Difference	t	df	p-value (Correlation)
L1–NB (°)	32.00 ± 3.240	31.80 ± 4.658	0.20	-2.49 to 2.89	0.206	4	0.847
L1–NB (mm)	7.80 ± 1.789	6.20 ± 1.304	1.60	-0.97 to 4.17	1.725	4	0.160
U1–NA (°)	31.20 ± 8.136	27.00 ± 5.339	4.20	-1.02 to 9.42	2.232	4	0.089
U1–NA (mm)	8.20 ± 3.564	5.60 ± 3.050	2.60	0.18 to 5.02	2.982	4	0.041
Overbite	4.40 ± 0.894	3.00 ± 0.707	1.40	0.72 to 2.08	5.715	4	0.005
Curve of Spee (COS)	2.90 ± 0.742	1.90 ± 0.894	1.00	0.24 to 1.76	3.651	4	0.022
L1–MP	46.20 ± 2.049	43.60 ± 1.517	2.60	1.49 to 3.71	6.500	4	0.003
L6–MP	33.20 ± 2.775	33.00 ± 3.000	0.20	-0.36 to 0.76	1.000	4	0.374
U1–NF	27.20 ± 3.271	27.20 ± 3.834	0.00	-1.76 to 1.76	0.000	4	1.000

Dental parameters (Table 3) showed highly significant changes. U1–NA angle decreased markedly (Z = −5.000, p < 0.001), L1–NB angle and linear measurement both decreased significantly (p = 0.015 and p = 0.003), and L1–MP decreased significantly (p = 0.001). Both overbite and curve of Spee reductions were highly significant (p < 0.001). Posterior parameters L6–MP (p = 0.518) and U1–NF (p = 0.414) remained stable, confirming that bite opening was achieved through anterior segment modification without unwanted molar extrusion. Correlation analysis revealed strong T0–T1 associations for L1–MP (r = 0.980), L6–MP (r = 0.991), and U1–NF (r = 0.969), indicating consistent and predictable treatment responses across patients (Figures 4 and 5).

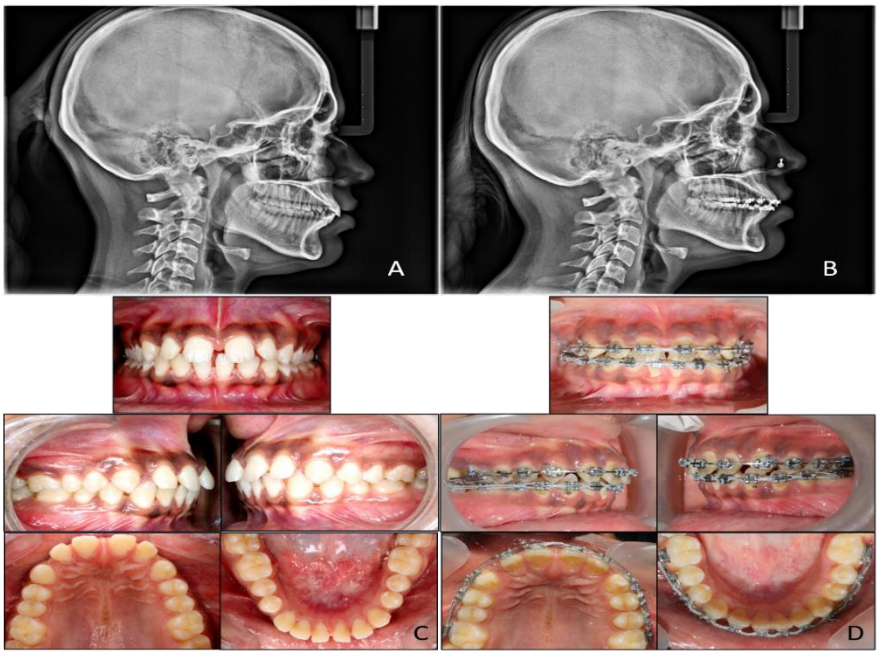


Figure 1: Representative cases showing treatment outcomes (Case 2). (A) Pre-treatment lateral cephalometric radiograph showing 4mm overbite and 2.5mm curve of Spee. (B) Mid-treatment radiograph demonstrating 1mm overbite reduction and curve of Spee flattening to 2mm. (C) Pre-treatment intraoral photograph showing deep overbite. (D) Mid-treatment intraoral photograph showing corrected overbite relationship.

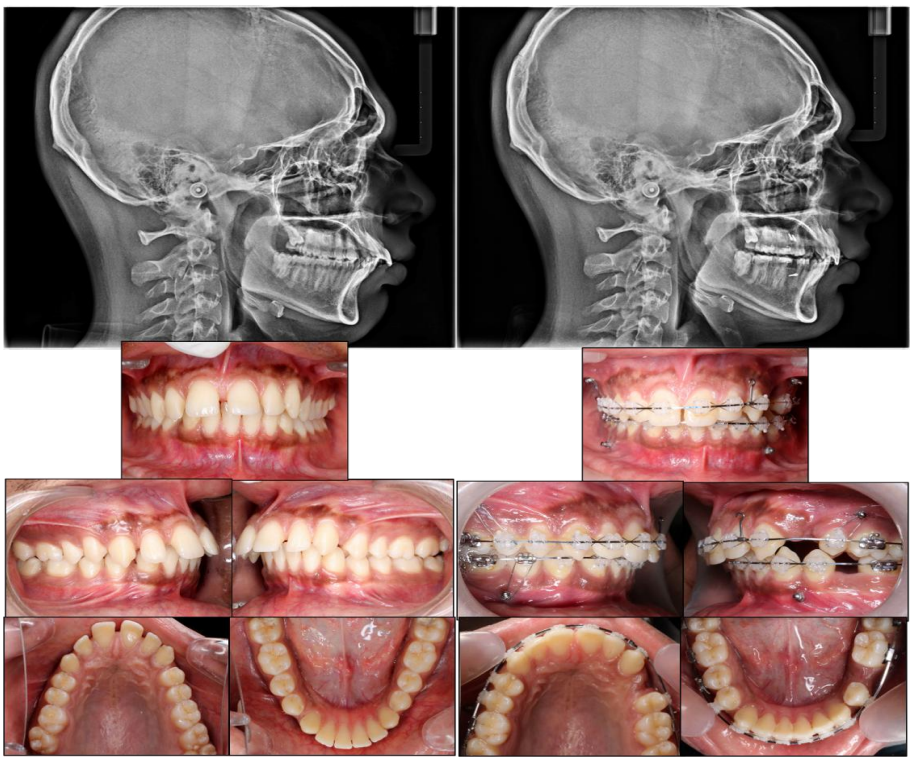


Figure 2: Representative cases showing treatment outcomes (Case 4). (A) Pre-treatment lateral cephalometric radiograph showing 6mm overbite and 2mm curve of Spee. (B) Mid-treatment radiograph demonstrating 2mm overbite reduction and curve of Spee flattening to 1mm. (C) Pre-treatment intraoral photograph showing deep overbite. (D) Mid-treatment intraoral photograph showing corrected overbite relationship.

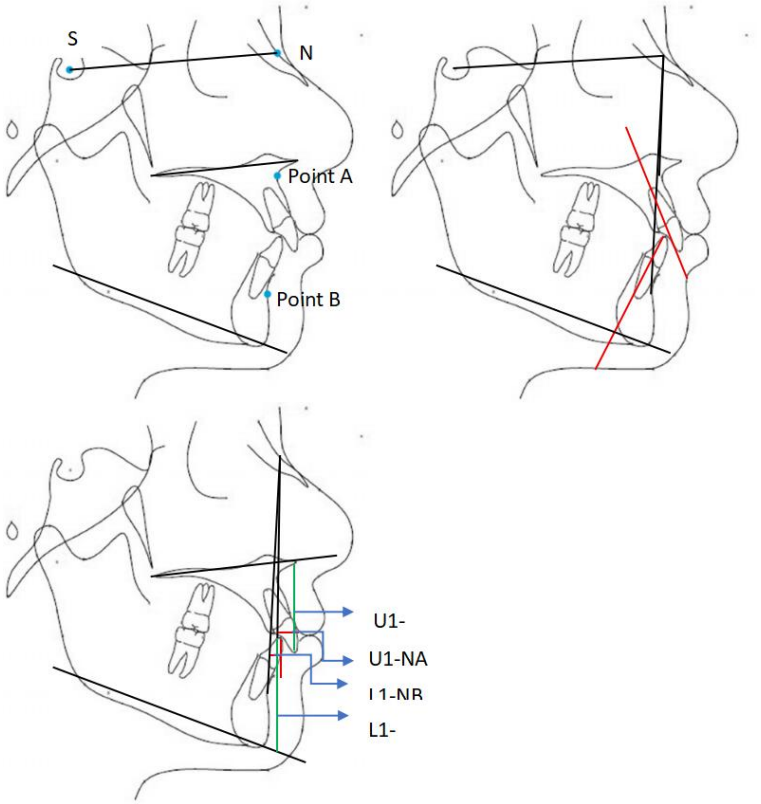


Figure 3: Cephalometric analysis and measurements. (A) Lateral cephalometric tracing showing all skeletal landmarks (S-Sella, N-Nasion, A-Point A, B-Point B) and mandibular plane used for the analysis. (B) Angular measurements illustrated: SNA, SNB, ANB, L1-NB, U1-NA, L1-MP (color coding: dental landmarks in red, reference planes as black lines). (C) Linear measurements illustrated: L1-NB (mm), U1-NA (mm), U1-NF, L6-MP.

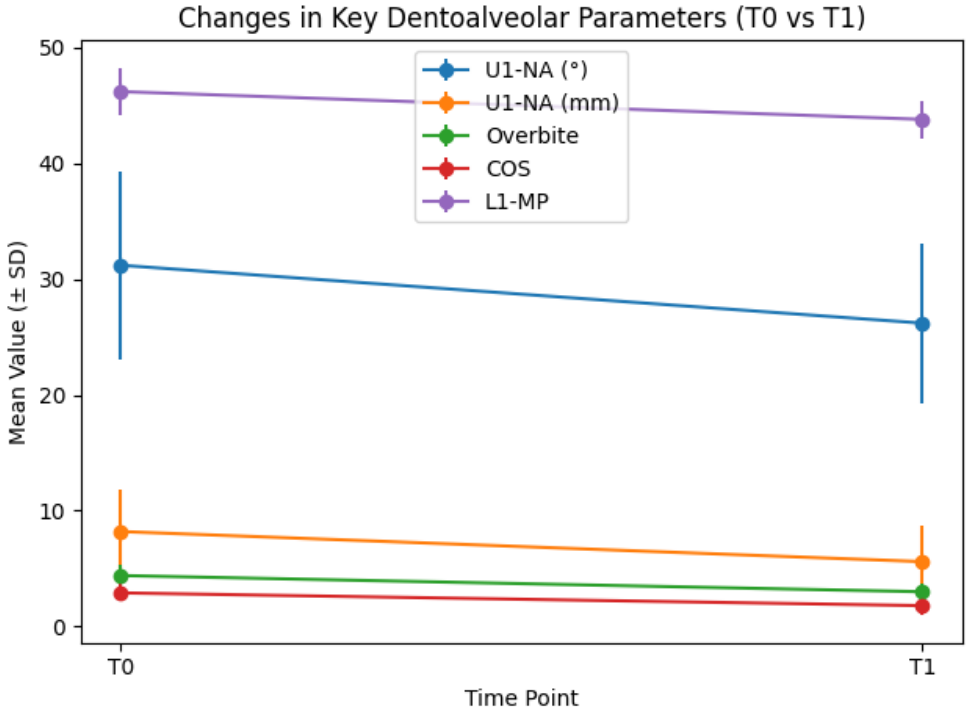


Figure 4: Line graph showing mean values of skeletal and dentoalveolar parameters (SNA, SNB, ANB, L1–NB, U1–NA, Overbite, Curve of Spee, L1–MP, L6–MP, U1–NF) at baseline (T0) and post-leveling (T1), illustrating the overall trend of treatment-related changes across all measured variables.

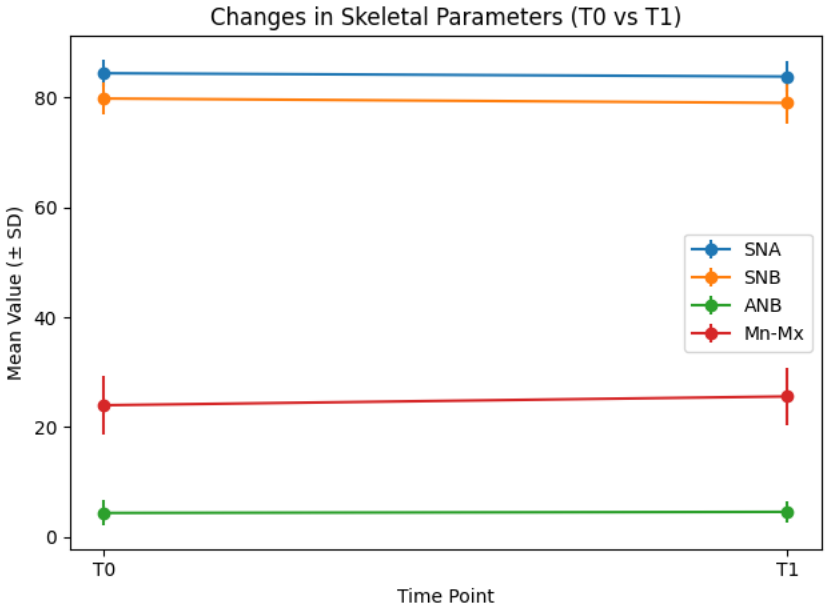


Figure 5: Scatter plot and correlation analysis illustrating the relationship between pre-treatment (T0) and post-treatment (T1) measurements for key dental parameters (L1–MP, L6–MP, U1–NF, L1–NB), demonstrating high intra-subject consistency and predictability of treatment response.

3. DISCUSSION

This case series demonstrates the effectiveness of combining RCS arch-wires with posterior bite blocks for deep overbite correction, with consistent and predictable outcomes across all five patients.

Overbite Reduction: All five cases achieved significant overbite reduction (mean: 1.4mm; representative radiographs in Figures 1 and 2), consistent with published RCS arch-wire studies reporting predominantly dentoalveolar correction with stable sagittal skeletal relationships (25,26).

Curve of Spee Management: Mean curve of Spee reduction was 1.1mm. Cases with smaller initial curves showed minimal change, confirming that the treatment does not induce unnecessary leveling. The extent of correction correlates with initial curve depth, consistent with Bernstein et al. (4) and confirmed by a recent meta-analysis (27).

Lower Incisor Inclination Control: The mean L1-NB angle showed no net change (0.00°), with individual responses ranging from proclination (+3°) to retroclination, reflecting the influence of initial positioning and individual biomechanics. The L1-NB linear measurement decreased by 1.2mm. Al-Zoubi and Al-Nimri (8) and Shakhtour and Al-Nimri (28) similarly reported variable incisor responses dependent on bracket prescription and wire material.

Upper Incisor Changes: Consistent upper incisor retroclination was observed (mean U1-NA decrease: 5.0°), effectively addressing pre-existing proclination and consistent with dentoalveolar compensation rather than skeletal change (20,25).

Vertical Dimension Control: Posterior bite blocks effectively prevented molar extrusion in all cases (mean L6-MP change: -0.2°), maintaining facial proportions and supporting long-term stability. Mucedero et al. (21) confirmed that bite block therapy significantly reduces molar extrusion at long-term follow-up, and a systematic review concluded that combined vertical control approaches yield superior outcomes over single-modality treatment (29).

Individual Treatment Response: Variable responses across cases reflect the influence of initial presentation and growth pattern, underscoring the value of individualized planning within a standardized protocol.

Comparison with Previous Studies

Our findings align with existing literature. Shannon and Nanda1 reported similar overbite reduction patterns without posterior bite blocks, while Yılmaz et al.19 demonstrated via finite element analysis that deeper RCS wires without vertical control produce excessive molar-extruding forces — effects mitigated in our series by bite block use. Bernstein et al.4 and Preston et al.30 found that continuous archwire leveling is predominantly driven by posterior extrusion, reinforcing the need for adjunctive vertical control. Sinha et al.25 confirmed that RCS mechanics reduce overbite primarily through dentoalveolar changes with stable sagittal skeletal relationships, consistent with our observations. While Al-Zoubi and Al-Nimri8 reported incisor proclination with RCS wires, our cases showed more variable responses including retroclination, likely attributable to the combined effect of bite blocks modifying the force system and differences in initial incisor positioning.28

Clinical Implications

Clinically, this combination offers predictable overbite reduction, controlled posterior extrusion, and versatile application across malocclusion types. Ideal candidates have adequate freeway space; patients with very short lower facial height may need bite block height modifications. In growing patients, bite blocks remain essential even though natural facial height increase may accommodate some posterior extrusion. Given the relapse propensity of curve of Spee correction, fixed lingual retainers are recommended for long-term stability (23,24).

4. CONCLUSION

The combination of RCS arch-wires and posterior bite blocks provides an effective, predictable method for deep overbite correction. Across five cases, mean overbite reduction was 1.4mm and curve of Spee leveling was 1.1mm, achieved primarily through controlled incisor intrusion rather than posterior extrusion. Posterior bite blocks successfully prevented molar eruption into the freeway space, maintaining vertical facial proportions. Sagittal skeletal relationships remained stable throughout treatment. Individual variability in incisor responses highlights the importance of customized planning within a standardized protocol. Future studies with larger samples, control groups, and long-term follow-up are needed to further validate these findings and optimize bite block placement protocols.

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