

# Approaches to correct lower lip sucking in preschool children: a clinical study on effectiveness, oral health-related quality of life impact, and malocclusion improvement

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## ABSTRACT

**Objectives:** To determine the most effective ways to correct lower lip sucking in preschool children, minimizing impacts on their Oral Health-Related Quality of Life (OHRQoL) and improving malocclusion.

**Materials and Methods:** 83 children aged 3–6 years were divided into behavioral therapy (Group A, n = 27), lip bumper therapy (Group B, n = 27), and Twin Block therapy (Group C, n = 29) groups. After 6 months of treatment, oral exams, model analysis, cephalometrics, and the Early Childhood Oral Health Impact Scale (ECOHIS) were used for assessment.

**Results:** Success rates in Groups A, B, and C were 33.33%, 73.08%, and 96.43%, respectively ( $P < .05$ ). Groups A and B had no significant measurement differences ( $P > .05$ ). Group C showed significant changes in overjet, SNA, SNB, ANB, U1SN, and L1MP ( $P < .05$ ). The ECOHIS scores of all groups first rose, then fell ( $P < .05$ ).

**Conclusions:** Twin Block appliances are highly effective for correcting lower lip sucking. They have a higher success rate than other methods and can reduce skeletal malocclusion severity in children with specific dental conditions. (*Angle Orthod.* 0000;00:000–000.)

**KEY WORDS:** Lip sucking; Preschool children; Early Childhood Oral Health Impact Scale (ECOHIS); Behavioral therapy; Lip bumper; Twin Block

## INTRODUCTION

Lower lip sucking is a prevalent nonnutritive sucking habit among children. When it persists beyond the age of three, it can have detrimental effects on craniofacial development and dental health. This may lead to problems such as maxillary incisor proclination, mandibular incisor retroclination, increased overjet and overbite, a retrusive mandibular position, and a higher risk of malocclusion and dental trauma.<sup>1–4</sup> Early intervention is crucial to prevent these complications and ensure proper craniofacial growth.<sup>5,6</sup>

In clinical practice, various methods are used to correct lower lip sucking habits in children. These include rewards and positive reinforcement, aversion techniques such as using bitter-tasting agents, and orthodontic appliances such as lip bumpers and lip training devices. However, effectiveness may be limited in cases with significant mandibular retrusion or severe skeletal discrepancy. Also, the issue of habit recurrence and mixed parental satisfaction with treatment outcome highlight the need for alternative approaches. The Twin Block appliance, a well-known functional orthodontic device, has an advantage in addressing

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mandibular retrusion. It promotes balanced growth and improves the facial profile by guiding the mandible forward and optimizing perioral muscle forces. Although it may cause some unintended tooth movement, this may be beneficial in treating a malocclusion caused by lower lip sucking.<sup>7,8</sup>

Despite the availability of these treatment options, evidence-based guidelines for preschool-aged children are scarce.<sup>9</sup> Additionally, the impact of orthodontic interventions on the oral health-related quality of life (OHRQoL) of preschoolers has not been systematically studied. The Early Childhood Oral Health Impact Scale (ECOHIS) is a validated tool for assessing OHRQoL in young children through parental reports, making it suitable for evaluating the broader implications of orthodontic treatments.<sup>10–14</sup> This study aimed to compare the effectiveness of different interventions in stopping lower lip sucking habits while minimizing the negative impact on the OHRQoL of preschool children. It was hypothesized that the Twin Block appliance would more effective than other methods for ceasing lower lip sucking habits, while simultaneously improving skeletal malocclusion and OHRQoL.

## MATERIALS AND METHODS

### Sample

This study was approved by the Ethics Committee of Qingdao Women and Children's Hospital and was registered at ClinicalTrials.gov. Prior to participation, all legal guardians were thoroughly informed about potential risks, and written informed consent was obtained.

The sample size was calculated using PASS software (version 11.0) based on preliminary data from a pre-experiment. With an alpha error of 0.05, a study power of 80%, and an attrition rate of 20%, at least 20 participants were required per group. Children who visited the orthodontic department at Qingdao Women and Children's Hospital between 2016 and 2023 and met the following criteria were included: (1) Preschool children aged 3–6 years; (2) Habit of lower lip sucking; (3) Absence of dental trauma, anterior crossbite or open bite; (4)  $\leq 2$  missing primary incisors per maxillary or mandibular arch; (5) No systemic diseases; (6) Parents with sufficient literacy and comprehension skills to understand the questionnaire and willing to provide informed consent.

A total of 83 children were initially included. Based on pretreatment oral examinations and model analysis, children with an overjet of  $\geq 5$  mm and an ANB angle of  $\geq 6^\circ$  received treatment with a modified Twin Block appliance. The remaining children, according to their guardians' preference, underwent either behavioral therapy or lip bumper treatment. All participants

were divided into three groups: Group A (behavioral therapy), Group B (lip bumper therapy), and Group C (Twin Block therapy).

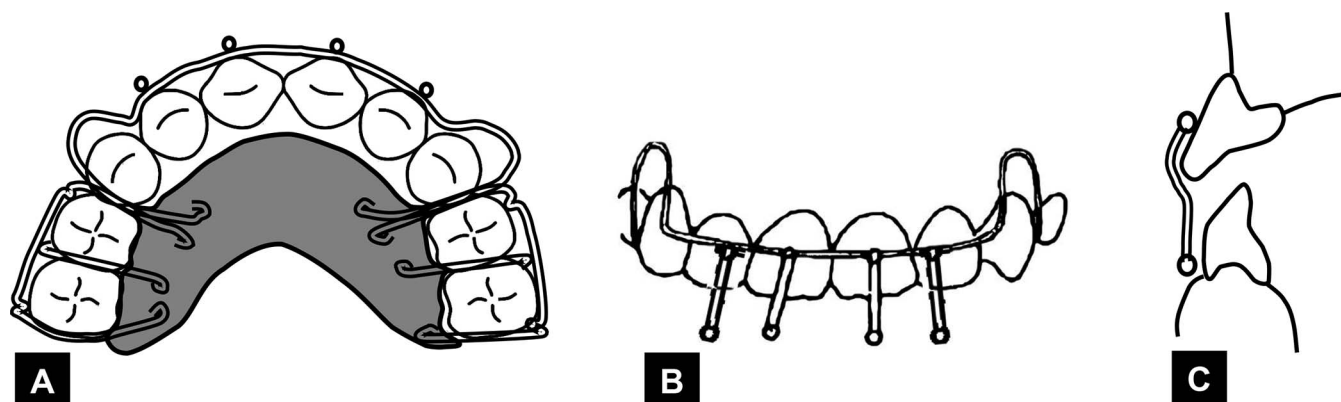
Randomization was not used in this study to safeguard patient rights. Instead, treatment allocation was based on guardians' preferences, which might have introduced some subjectivity and bias. To reduce this limitation, a standardized protocol was established. All guardians were provided with comprehensive and unbiased information about treatment options to make an informed decision between behavioral therapy and lip bumper treatment. Baseline characteristics, such as age, gender, and initial malocclusion severity, were compared between the two groups to ensure their equivalence. During data analysis, statistical adjustments were made to account for confounding factors related to subjective treatment allocation, enhancing validity of the study.

### Intervention Methods

**Behavioral Therapy Group:** Parents were guided to praise the child when the sucking habit was absent. They were also advised to give pleasant treats and surprises when the child refrained from sucking for an extended period and to stop television or bedtime stories when sucking occurred. A bitter-tasting solution was applied to the lower lip at night to discourage the habit. Children in this group attended monthly follow-up visits.

**Lip Bumper Therapy Group:** The appliance was designed with Adams clasps and interproximal hooks on the maxillary posterior teeth for stable retention. A double-curved labial arch was placed on the labial side of the upper anterior teeth, and the lip bumpers were soldered at the central incisors (Figure 1). The lip bumper extended to the mandibular vestibular fold, supporting the lower lip and allowing natural adjustment of the lower anterior teeth. The appliance was worn continuously except during meals and for performing oral hygiene, and monthly follow-ups were conducted for adjustments, including using the double-curved labial arch to apply force to retract the upper anterior teeth.

**Twin Block Therapy Group:** Treatment started with bite reconstruction. The total mandibular advancement and vertical opening were less than 10 mm, aiming for an edge-to-edge relationship of the upper and lower anterior teeth and a vertical opening in the posterior region that exceeded the resting space by 2–3 mm. The appliance (Figure 2) was worn continuously except during meals and oral hygiene, and monthly follow-ups were carried out for adjustments.



**Figure 1.** Images of the lip bumper appliance. (A) Occlusal view. (B) Frontal view. (C) Lateral view.

### Efficacy Evaluation

After 6 months of treatment, all children were evaluated based on the following criteria:

(1) Success rate: Successful treatment was defined as cessation of the sucking habit and parental satisfaction. Failure was defined as a lack of significant improvement in ceasing the sucking habit and parental dissatisfaction. The success rate was calculated as: success rate = (number of successful cases/total cases)  $\times$  100%.

(2) Oral examination and model analysis: Oral examination and model analysis were performed before treatment (T0) and 1 month after treatment completion (T2). A vernier caliper was used to measure changes in anterior overjet.

(3) Cephalometric measurement: Lateral cephalometric radiographs were taken at T0 and T2. SNA, SNB, ANB, U1SN, and L1MP angles were measured using Dolphin software (Version 11.8).

(4) Negative impact on OHRQoL: The Chinese version of ECOHIS was used to evaluate OHRQoL. Parents completed the ECOHIS at three time points: before treatment (T0), 1 month after treatment initiation (T1), and 1 month after treatment completion (T2). The ECOHIS has 13 items, divided into the Child Impact Section (CIS) and the Family Impact Section (FIS). Each item was rated on a scale from 0 to 5, and the total score ranged from 0 to 65, with higher scores indicating a greater negative impact on OHRQoL. Questionnaires with more than two “don’t-know (5)” responses in the CIS or one response in the FIS were excluded, and another child was included.

### Statistical Analysis

SPSS (version 22.0, IBM, Armonk, NY, USA) was used for statistical analysis. All measurements were performed by the same clinician, and repeat measurements were conducted at a two-week interval to assess reliability using a paired *t*-test. Categorical

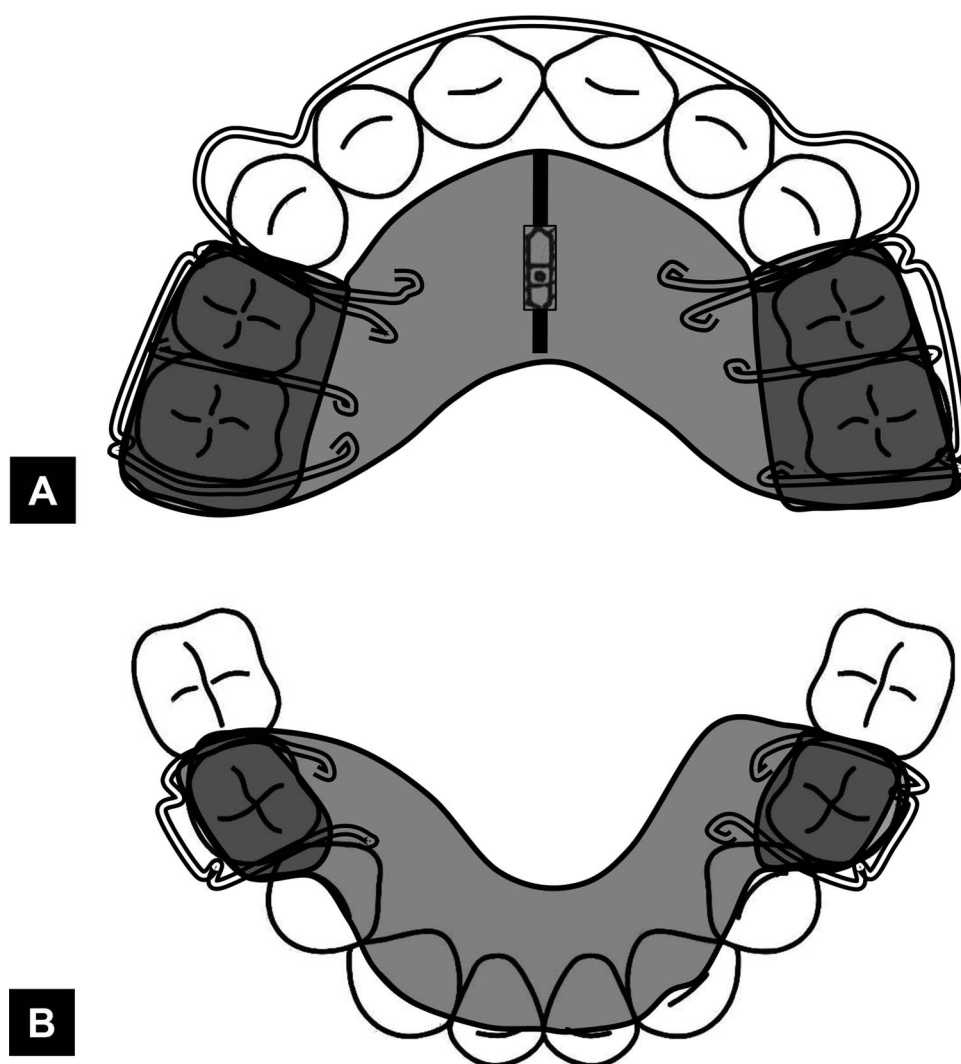
variables were presented as frequencies and percentages, whereas continuous variables were expressed as means and standard deviations. The specific statistical tests are noted in the tables. Effect size (ES) was used to represent the meaningful magnitude of changes. An *IESI* < 0.3 indicated a small difference, *IESI* = 0.3–0.8 indicated a moderate difference, and *IESI* > 0.8 indicated a large difference.<sup>15</sup> The significance level for all tests was set at *P* < .05.

### RESULTS

In this study, six children were lost to follow-up (four from Group A, one from Group B, and one from Group C). Ultimately, 77 patients were analyzed (Tables 1 and 2). The Cronbach’s alpha of the ECOHIS scales was 0.815, indicating high reliability. The success rates for ceasing the lip-sucking habit were 33.33% in Group A, 73.08% in Group B, and 96.43% in Group C, with statistically significant differences among the groups (Table 2). No recurrence was detected among successfully treated patients during the 6-month follow-up.

From before to after treatment (Table 3), Group A showed no statistically significant differences in overjet, SNA, SNB, ANB, U1SN, or L1MP. Group B had decreases in the mean values of overjet and U1SN after treatment, but these changes were not statistically significant. In Group C, treatment led to significant decreases in overjet, SNA, ANB, and U1SN, along with significant increases in SNB and L1MP.

Before treatment (Table 4), Group C had significantly greater overjet and ANB values compared to Groups A and B. SNA was greater in Group C than in Group B, and SNB was smaller than in Groups A and B. After treatment, Group C had a smaller overjet compared to Groups A and B, a larger SNA compared to Group B, and a greater L1MP compared to Group A. From T0 to T2, Group C had larger changes in overjet, SNB, ANB, U1SN, and L1MP compared to



**Figure 2.** Images of the Twin Block appliance. (A) Maxillary appliance. (B) Mandibular appliance.

Groups A and B, and Group B had a greater change in U1SN than Group A.

Analysis of ECOHIS scores (Table 5 and Figures 3A–3C) showed that the total scores in all three groups initially increased and then decreased, with significant differences across different treatment periods. In Group A, CIS changes from T0 to T1 and T1 to T2 were significant, but not from T0 to T2. FIS changes were significant from T0 to T2 and T1 to T2, but not from T0 to T1. In Group B, all changes in CIS and FIS across treatment periods were significant. In Group C, CIS

changes were significant across all treatment periods, whereas FIS changes were not significant from T0 to T1 but were significant from T1 to T2 and T0 to T2.

The CIS and total scores of each group showed a large positive effect size (ES) from T0 to T1, indicating a significant increase in ECOHIS scores, especially in Groups B and C. All groups had negative ES from T1 to T2, reflecting a decline in CIS, FIS, and total scores. From T0 to T2, all groups had negative ES for CIS, FIS, and total scores, meaning an overall decline (improvement) in ECOHIS scores.

Before treatment (Table 6 and Figures 3D–3F), there were no significant differences in CIS among the groups, but FIS and total scores in Group C were higher than those in Groups A and B. After 1 month of treatment, CIS, FIS, and total scores in Group A were smaller than in Groups B and C. At the end of treatment, CIS showed no significant differences among

**Table 1.** Characteristics of the Participants<sup>a,b</sup>

|            | Group A     | Group B     | Group C     | P Value           |
|------------|-------------|-------------|-------------|-------------------|
| Female (n) | 14          | 15          | 17          | .878 <sup>a</sup> |
| Male (n)   | 13          | 12          | 12          |                   |
| Age (y)    | 4.53 ± 0.94 | 4.90 ± 1.12 | 4.78 ± 1.32 | .585 <sup>b</sup> |

<sup>a</sup> Chi-square test.

<sup>b</sup> One-way analysis of variance.

**Table 2.** Success Rates for Correcting Lower Lip Sucking

|                      | Group A | Group B | Group C | Comparison, <i>P</i> Value <sup>a</sup> |        |      |
|----------------------|---------|---------|---------|-----------------------------------------|--------|------|
|                      |         |         |         | A/B                                     | A/C    | B/C  |
| Treatment success, n | 9       | 19      | 27      |                                         |        |      |
| Treatment failure, n | 14      | 7       | 1       |                                         |        |      |
| Loss to follow-up, n | 4       | 1       | 1       |                                         |        |      |
| Success rate, %      | 33.33   | 73.08   | 96.43   | 0.035                                   | <0.001 | .042 |

<sup>a</sup> Chi-square test.

the groups, but FIS and total scores in Group A were higher than in Group C.

## DISCUSSION

The findings from this study showed that behavioral therapy, maxillary lip bumper appliance, and Twin Block appliance can correct lip-sucking habits in preschool children. The Twin Block group had the highest success rate, even though it had more severe skeletal and dental malocclusions initially. Behavioral therapy, although noninvasive and suitable for home use, had the lowest success rate, with only about one-third of patients overcoming the habit. This indicates the need for careful clinical assessment when choosing this approach. Combining a maxillary lip bumper appliance with behavioral therapy might have improved treatment success rates but, due to concerns about patient and parental cooperation, this was not explored in this trial, and long-term follow-up of successfully treated patients is needed.

Analysis of overjet and cephalometric measurements showed that the Twin Block group had the most severe dental and skeletal malocclusions before

treatment, while the other two groups had similar degrees of malocclusion to each other. After Twin Block appliance treatment, significant improvements were observed in overjet, inclination of the upper and lower anterior teeth, and maxillary skeletal relationships, approaching or reaching normal ranges. This shows the ability of Twin Block therapy to correct lower lip-sucking habits and reduce malocclusion severity. Behavioral therapy and the maxillary lip bumper appliance showed no significant changes in dental or skeletal measurements, suggesting limited effectiveness in improving malocclusion.

For children treated with the Twin Block appliance, an average reduction of 5.97 mm in overjet and 3.63° in ANB was observed over 6 months. Additionally, no dual bite was observed after careful examination at the end of treatment and 6-month follow-up. This improvement exceeded the changes reported in other studies for patients in the early permanent dentition (4.40 mm overjet reduction and 1.78° ANB reduction) and was achieved in a shorter duration (typically 1 year).<sup>16</sup> This suggests that the Twin Block appliance is particularly effective for children with greater growth

**Table 3.** Intragroup Comparison of Overjet and cephalometric changes from T0 to T2

|                  | T0           | T2           | T2-T0        | t Value | <i>P</i> Value <sup>a</sup> |
|------------------|--------------|--------------|--------------|---------|-----------------------------|
| Group A (n = 23) |              |              |              |         |                             |
| Overjet, mm      | 3.80 ± 0.97  | 3.96 ± 1.08  | 0.16 ± 0.53  | -1.29   | .214                        |
| SNA, °           | 81.16 ± 1.66 | 81.01 ± 1.35 | -0.15 ± 0.58 | 1.12    | .278                        |
| SNB, °           | 77.29 ± 1.71 | 77.10 ± 1.68 | -0.18 ± 0.75 | 0.33    | .743                        |
| ANB, °           | 3.92 ± 1.15  | 3.90 ± 1.22  | -0.01 ± 0.32 | 0.03    | .978                        |
| U1SN, °          | 96.08 ± 4.03 | 96.03 ± 4.25 | -0.05 ± 0.37 | 0.04    | .971                        |
| L1MP, °          | 86.23 ± 6.16 | 86.12 ± 5.48 | -0.10 ± 1.57 | 0.06    | .956                        |
| Group B (n = 26) |              |              |              |         |                             |
| Overjet, mm      | 4.66 ± 1.64  | 4.44 ± 1.34  | -0.22 ± 0.78 | 1.37    | .184                        |
| SNA, °           | 80.59 ± 2.35 | 80.49 ± 2.40 | -0.11 ± 0.56 | 0.94    | .358                        |
| SNB, °           | 76.70 ± 2.63 | 76.67 ± 2.40 | -0.02 ± 0.79 | 0.03    | .974                        |
| ANB, °           | 3.69 ± 1.40  | 3.82 ± 1.36  | 0.12 ± 0.46  | -0.31   | .760                        |
| U1SN, °          | 97.96 ± 9.73 | 96.11 ± 7.73 | -1.85 ± 2.85 | 0.73    | .469                        |
| L1MP, °          | 87.47 ± 5.45 | 88.06 ± 4.98 | 0.60 ± 1.48  | -0.40   | .694                        |
| Group C (n = 28) |              |              |              |         |                             |
| Overjet, mm      | 8.41 ± 1.80  | 2.44 ± 1.02  | -5.97 ± 1.42 | 22.24   | <.001                       |
| SNA, °           | 82.53 ± 2.48 | 82.07 ± 2.33 | -0.45 ± 0.67 | 3.58    | .001                        |
| SNB, °           | 74.84 ± 2.42 | 78.05 ± 2.33 | 3.21 ± 1.32  | -5.05   | <.001                       |
| ANB, °           | 7.65 ± 1.35  | 4.03 ± 0.93  | -3.63 ± 1.26 | 11.50   | <.001                       |
| U1SN, °          | 99.32 ± 6.04 | 94.58 ± 5.36 | -4.75 ± 2.01 | 3.05    | .004                        |
| L1MP, °          | 86.39 ± 6.65 | 90.93 ± 5.49 | 4.54 ± 2.17  | -2.78   | .007                        |

<sup>a</sup> Paired-samples *t*-test.

**Table 4.** Intergroup Comparison of Overjet and Cephalometric Measurements<sup>a</sup>

|             | Group A (n = 23) | Group B (n = 26) | Group C (n = 28) | P Value <sup>a</sup> | Comparison, P Value <sup>a</sup> |        |       |
|-------------|------------------|------------------|------------------|----------------------|----------------------------------|--------|-------|
|             |                  |                  |                  |                      | A/B                              | A/C    | B/C   |
| T0          |                  |                  |                  |                      |                                  |        |       |
| Overjet, mm | 3.80 ± 0.97      | 4.66 ± 1.64      | 8.41 ± 1.80      | <.001                | 0.717                            | 0.001  | .001  |
| SNA, °      | 81.16 ± 1.66     | 80.59 ± 2.35     | 82.53 ± 2.48     | .007                 | 0.243                            | 0.064  | .005  |
| SNB, °      | 77.29 ± 1.71     | 76.70 ± 2.63     | 74.84 ± 2.42     | .001                 | 0.798                            | 0.002  | .004  |
| ANB, °      | 3.92 ± 1.15      | 3.69 ± 1.40      | 7.65 ± 1.35      | <.001                | 0.850                            | <0.001 | <.001 |
| U1SN, °     | 96.08 ± 4.03     | 97.96 ± 9.73     | 99.32 ± 6.04     | .320                 | 0.670                            | 0.287  | .775  |
| L1MP, °     | 86.23 ± 6.16     | 87.47 ± 5.45     | 86.39 ± 6.65     | .756                 | 0.788                            | 0.996  | .802  |
| T2          |                  |                  |                  |                      |                                  |        |       |
| Overjet, mm | 3.96 ± 1.08      | 4.44 ± 1.34      | 2.44 ± 1.02      | <.001                | 0.258                            | <0.001 | <.001 |
| SNA, °      | 81.01 ± 1.35     | 80.49 ± 2.40     | 82.07 ± 2.33     | .029                 | 0.708                            | 0.223  | .026  |
| SNB, °      | 77.10 ± 1.68     | 76.67 ± 2.40     | 78.05 ± 2.33     | .077                 | 0.798                            | 0.325  | .070  |
| ANB, °      | 3.90 ± 1.22      | 3.82 ± 1.36      | 4.03 ± 0.93      | .816                 | 0.968                            | 0.938  | .802  |
| U1SN, °     | 96.03 ± 4.25     | 96.11 ± 7.73     | 94.58 ± 5.36     | .543                 | 0.999                            | 0.657  | .586  |
| L1MP, °     | 86.12 ± 5.48     | 88.06 ± 4.98     | 90.93 ± 5.49     | .011                 | 0.464                            | 0.009  | .137  |
| T2-T0       |                  |                  |                  |                      |                                  |        |       |
| Overjet, mm | 0.16 ± 0.53      | -0.22 ± 0.78     | -5.97 ± 1.42     | <.001                | 0.478                            | <0.001 | <.001 |
| SNA, °      | -0.15 ± 0.58     | -0.11 ± 0.56     | -0.45 ± 0.67     | .095                 | 0.975                            | 0.225  | .115  |
| SNB, °      | -0.18 ± 0.75     | -0.02 ± 0.79     | 3.21 ± 1.32      | <.001                | 0.871                            | <0.001 | <.001 |
| ANB, °      | -0.01 ± 0.32     | 0.12 ± 0.46      | -3.63 ± 1.26     | <.001                | 0.740                            | <0.001 | <.001 |
| U1SN, °     | -0.05 ± 0.37     | -1.85 ± 2.85     | -4.75 ± 2.01     | <.001                | 0.025                            | <0.001 | <.001 |
| L1MP, °     | -0.10 ± 1.57     | 0.60 ± 1.48      | 4.54 ± 2.17      | <.001                | 0.423                            | <0.001 | <.001 |

<sup>a</sup> One-way analysis of variance, Tukey's honestly significant difference.

potential, as their enhanced remodeling capacity permits increased adjustments to the bite blocks during follow-ups. However, for those with shorter dental arches, greater emphasis on appliance retention is required. In cases where lower lip-sucking leads to severe malocclusion, reducing the number of interproximal hooks on the lower anterior teeth and modifying the maxillary palatal baseplate may leverage the Twin Block appliance side effects to correct the malocclusion.

This study was the first to specifically assess the impact of various orthodontic treatments on OHRQoL in preschool children. ECOHIS score analysis showed

that, before treatment, the Twin Block group had the highest FIS and total scores, suggesting that more severe malocclusions have a greater negative impact on children's OHRQoL, mainly in the family dimension rather than the child's dimension. This is because preschool children are less self-conscious and less sensitive to esthetic differences. These findings were in agreement with those of Foster Page et al.<sup>17</sup> and O'Brien et al.<sup>18</sup>, which suggested that malocclusions have a minimal impact on the OHRQoL of preschool children but exert a significant negative influence on the psychosocial aspects, particularly emotional well-being and social interactions, in children aged

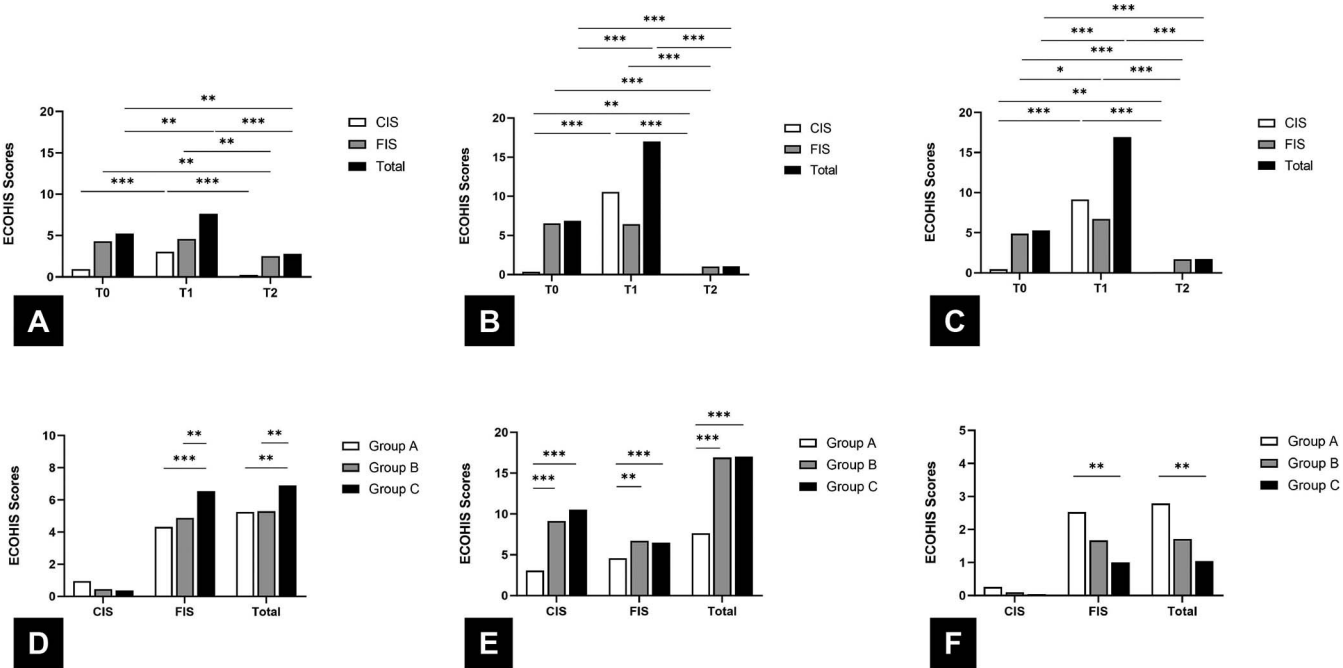
**Table 5.** Intragroup Comparison of ECOHIS From T0 to T2<sup>a-c</sup>

|                  | T0          | T1           | T2          | p value <sup>c</sup> | Comparison, <i>P</i> Value <sup>c</sup> |        |        | Effect Size (ES) |       |       |
|------------------|-------------|--------------|-------------|----------------------|-----------------------------------------|--------|--------|------------------|-------|-------|
|                  |             |              |             |                      | T0/T1                                   | T0/T2  | T1/T2  | T0-T1            | T1-T2 | T0-T2 |
| Group A (n = 23) |             |              |             |                      |                                         |        |        |                  |       |       |
| CIS <sup>a</sup> | 0.95 ± 1.05 | 3.05 ± 1.00  | 0.26 ± 0.55 | <0.001               | <0.001                                  | 0.065  | <0.001 | 2.05             | −3.46 | −0.82 |
| FIS <sup>b</sup> | 4.32 ± 1.87 | 4.58 ± 1.09  | 2.53 ± 1.79 | <0.001               | 0.878                                   | 0.005  | .001   | 0.17             | −1.38 | −0.98 |
| Total            | 5.26 ± 1.94 | 7.63 ± 1.49  | 2.79 ± 2.12 | <0.001               | 0.001                                   | 0.001  | <0.001 | 1.37             | −2.64 | −1.22 |
| Group B (n = 26) |             |              |             |                      |                                         |        |        |                  |       |       |
| CIS              | 0.45 ± 0.60 | 9.15 ± 3.20  | 0.10 ± 0.31 | <0.001               | <0.001                                  | 0.005  | <0.001 | 3.78             | −3.98 | −0.73 |
| FIS              | 4.88 ± 1.70 | 6.71 ± 3.28  | 1.67 ± 1.49 | <0.001               | 0.017                                   | <0.001 | <0.001 | 0.7              | −1.98 | −2.01 |
| Total            | 5.29 ± 1.63 | 16.92 ± 5.53 | 1.71 ± 1.55 | <0.001               | <0.001                                  | <0.001 | <0.001 | 2.06             | −3.92 | −1.68 |
| Group C (n = 28) |             |              |             |                      |                                         |        |        |                  |       |       |
| CIS              | 0.36 ± 0.56 | 10.54 ± 3.58 | 0.04 ± 0.19 | <0.001               | <0.001                                  | 0.006  | <0.001 | 2.86             | −3.06 | −0.81 |
| FIS              | 6.54 ± 1.48 | 6.46 ± 1.60  | 1.00 ± 1.05 | <0.001               | 0.953                                   | <0.001 | <0.001 | −0.05            | −4.41 | −3.58 |
| Total            | 6.89 ± 1.73 | 17.00 ± 4.54 | 1.04 ± 1.20 | <0.001               | <0.001                                  | <0.001 | <0.001 | 2.5              | −3.66 | −1.67 |

<sup>a</sup> CIS indicates Child Impact Section; ECOHIS, Early Childhood Oral Health Impact Scale.

<sup>b</sup> FIS indicates Family Impact Section.

<sup>c</sup> Friedman test, Wilcoxon signed-rank test.



**Figure 3.** ECOHIS scores. (A) Group A. (B) Group B. (C) Group C. (D) ECOHIS scores at T0. (E) ECOHIS scores at T1. (F) ECOHIS scores at T2. ECOHIS indicates Early Childhood Oral Health Impact Scale.

11–14 years. This could be attributed to the fact that preschool children are generally less self-conscious and less sensitive to esthetic differences, particularly regarding the anterior teeth.<sup>19</sup> Lower lip-sucking, being a long-term nonnutritive habit, is often retained by many children at this age, with little regard for the occlusal and esthetic alterations resulting from improper tooth alignment. Additionally, preschool children are generally unaware of the long-term esthetic, psychological, and financial consequences that these habits or malocclusions may entail as they age.<sup>20</sup>

All three treatment approaches had a negative impact on OHRQoL initially, but these effects were significantly reduced posttreatment. One month into treatment, parents reported more negative impact on the child’s OHRQoL than on the family. Behavioral therapy had the least negative impact on OHRQoL at this stage. After treatment, the Twin Block appliance was more effective in reducing the negative impact on OHRQoL compared to behavioral therapy, suggesting it may be the preferred option for treating children with severe skeletal malocclusion.

**Table 6.** Intergroup Comparison of ECOHIS<sup>a-c</sup>

|                  | Group A     | Group B      | Group C      | P Value <sup>c</sup> | Comparison, P Value <sup>c</sup> |        |      |
|------------------|-------------|--------------|--------------|----------------------|----------------------------------|--------|------|
|                  |             |              |              |                      | A/B                              | A/C    | B/C  |
| T0               |             |              |              |                      |                                  |        |      |
| CIS <sup>a</sup> | 0.95 ± 1.05 | 0.45 ± 0.60  | 0.36 ± 0.56  | .078                 | 0.085                            | 0.063  | .699 |
| FIS <sup>b</sup> | 4.32 ± 1.87 | 4.88 ± 1.70  | 6.54 ± 1.48  | <.001                | 0.350                            | <0.001 | .001 |
| Total            | 5.26 ± 1.94 | 5.29 ± 1.63  | 6.89 ± 1.73  | .002                 | 0.999                            | 0.008  | .005 |
| T1               |             |              |              |                      |                                  |        |      |
| CIS              | 3.05 ± 1.00 | 9.15 ± 3.20  | 10.54 ± 3.58 | <.001                | <0.001                           | <0.001 | .574 |
| FIS              | 4.58 ± 1.09 | 6.71 ± 3.28  | 6.46 ± 1.60  | .001                 | 0.004                            | <0.001 | .919 |
| Total            | 7.63 ± 1.49 | 16.92 ± 5.53 | 17.00 ± 4.54 | <.001                | <0.001                           | <0.001 | .639 |
| T2               |             |              |              |                      |                                  |        |      |
| CIS              | 0.26 ± 0.55 | 0.10 ± 0.31  | 0.04 ± 0.19  | .068                 | 0.090                            | 0.059  | .934 |
| FIS              | 2.53 ± 1.79 | 1.67 ± 1.49  | 1.00 ± 1.05  | .007                 | 0.134                            | 0.002  | .073 |
| Total            | 2.79 ± 2.12 | 1.71 ± 1.55  | 1.04 ± 1.20  | .006                 | 0.116                            | 0.002  | .075 |

<sup>a</sup> CIS indicates Child Impact Section; ECOHIS, Early Childhood Oral Health Impact Scale.  
<sup>b</sup> FIS indicates Family Impact Section.  
<sup>c</sup> Friedman test, Wilcoxon signed-rank test.

Early detection of harmful habits is crucial for preventing malocclusion and ensuring proper craniofacial growth.<sup>6,21</sup> Parents should be informed about treatment options, and the child's mental well-being should be considered during treatment. When treating preschool children, child-friendly and easy-to-apply methods should be chosen. In this study, removable rather than fixed orthodontic appliances were used to correct lower lip-sucking, aiming to minimize discomfort and psychological distress from the intervention.

## CONCLUSIONS

- The maxillary lip bumper appliance and Twin Block appliance are more effective than behavioral therapy in correcting lower lip-sucking habits in preschool children.
- The Twin Block appliance can also reduce the severity of skeletal malocclusions.
- Correcting the lip-sucking habit significantly improves the OHRQoL of preschool children.

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