

# The Effect of Tongue Crib versus Bonded spurs on Anterior Open Bite in Orthodontic Patients: A Systematic Review and Meta-Analysis.

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**Abstract - Objective:** To compare the effect of tongue crib and bonded spurs on anterior open bite in orthodontic patients.

**Methods:** This is a systematic review which includes randomized clinical studies, comparative and prospective studies published from the year January 2005 to May 2025. The search period was intentionally extended from to capture early foundational trials on habit-breaking appliances. These studies compared the effect of two habit breaking appliances that is tongue crib and bonded spurs on anterior open bite on the basis of six chosen parameters namely overbite, overjet, angle SNA, angle SNB, angle ANB, and mandibular plane angle. The assessment of the risk of bias of the included clinical trials was done by a tool developed by the Cochrane Collaboration. This review is on the basis of Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines.

**Results:** On database selecting a total of 13 studies were chosen of which 7 were randomized control trials, 5 were prospective studies and 1 was comparative study.

**Conclusion:** Both the tongue crib and bonded spurs had similar effects in early treatment of anterior open bite with respect to the following parameters: overjet, overbite angle SNA, angle SNB, angle ANB, and mandibular plane angle.

**Index terms:** Anterior open bite, Oral habit, Tongue thrusting.

## Introduction-

Anterior Open Bite is a type of malocclusion which is defined as the absence of vertical contact between opposing teeth segments, leads to considerable functional and aesthetic issues, often impacting a patient's self-confidence and reinforcing the importance of appropriate treatment.<sup>1</sup> The etiology of Anterior Open Bite is multifactorial, including oral habits, abnormal size or function of the tongue, oral breathing, vertical growth pattern and congenital or acquired diseases.<sup>2,3</sup> Among the most frequent habits is the tongue thrusting habit which is characterized by protruding of the tongue through the anterior teeth during swallowing, speech, and while the tongue is at rest which may cause an anterior open bite to occur.

Considering the fact that the tongue position or activity is greatly responsible for difficulty in achieving long term stability of anterior open bite treatment<sup>4</sup>, mechanical approach that would keep the tongue shielded from the anterior teeth and thereby help the tongue attain a modified backward posture would be a great help in not only treating anterior open bite, but also eliminate and eradicate the etiological factor. Two such appliances namely the Tongue crib and Bonded Lingual Spurs have been found to be of great clinical importance in doing the same.

Tongue crib was given by Haryett et al in 1970.<sup>5</sup> It results in closure of anterior open bite by successfully keeping the tongue pressure away from the anterior teeth and serving as a reminder to the patient to discontinue oral habits.<sup>2</sup> The appliance aids in eliminating harmful oral habits and produces effects such as palatal tipping of the maxillary incisors, an increase in overbite, and improved dentoalveolar development of the maxillary and mandibular incisors.<sup>2,3</sup> Also, it has been reported that this appliance is a source of irritation, generates discomfort, violates the patient's space and is not well tolerated by the patients and the parents. On the other hand, Bonded Spurs which were initially described by Rogers<sup>8</sup> are also found to allow normal development of the anterior dentoalveolar region by establishing an immediate nociceptive or proprioceptive reflex to help the tongue attain a modified backward posture.<sup>8</sup> Thus a neurophysiological tongue adaptation process is set after using tongue spurs.<sup>8</sup> They have some apparent advantages of being small in size of about 3mm in length, low cost, esthetics, no laboratory preparation and easy installation.<sup>3</sup> These spurs are associated with the risk of getting aspirated and causing tongue ulceration.

A scenario of uncertainty has been encountered owing to the clinical effects of both the appliances as of which of the two would serve the patient with maximum clinical benefits and would be minimally invasive. Since there is an inflow of both the merits as well as shortcomings of both the habit breaking appliances that is the tongue crib and the bonded spurs, it calls for a need to evaluate that which amongst the two is the most reliable and clinically efficient which is this review's main focus.

#### **Material and methodology:**

##### Registration of Protocol

The protocol for this Systematic review was prospectively registered on PROSPERO ([www.crd.york.ac.uk/PROSPERO](http://www.crd.york.ac.uk/PROSPERO); CRD4202510101

##### Aims and objectives

The primary aim was to evaluate the clinical and skeletal effects of tongue crib and bonded spurs and compare them.

##### Objectives:

- 1) To identify the existing studies that explore the clinical and skeletal parameters after installation of the tongue crib and bonded spurs.
- 2) To conduct a quantitative synthesis of the gathered data to ascertain the effect of tongue crib and bonded spurs on overbite, mandibular plane angle and ANB angle.

## PICOS structure

Based on patient/participants, intervention/exposure, comparison/control, and outcome and study design (PICOS). According to these criteria, the question that guided this review is “The effect of Habit breaking appliance on anterior open bite in orthodontic patients”

P- Participants included are anterior open bite patients I -Intervention is Tongue crib appliance

C- The control group is Bonded spur appliance

O- Outcomes is closure of open bite

S- Study design included randomized control trials (RCTs), Controlled clinical trials (CCTs), Comparative and prospective studies.

## Eligibility Criterion and Study Selection

Two authors searched electronic databases on PubMed, Medline and Cochrane Library. Additional sources (Google Scholar, clinicaltrials.gov) were manually searched for additional trails or protocols till 31<sup>st</sup> May 2025 with keyword or combination: Anterior Open Bite, Oral Habit, Tongue thrusting. The summary of the search strategies of all the databases is given in table no 1.

## Data Extraction

Primary information from the studies was extracted. This included author, year of publication, study design, sample size, parameters used for evaluation.

## Data Analysis

A tool developed by the Cochrane collaboration has been used for assessment of risk of bias in this study.

## Study Selection

Study Selection was conducted by two independent reviewers simultaneously. The initial scanning of the titles and abstract was performed and studies were eliminated if they did not meet the inclusion and exclusion criteria. Then the full text articles were rectified for independent evaluation on the basis of the selected 6 parameters i.e. overjet, overbite angle SNA, angle SNB, angle ANB, and mandibular plane angle. The study selection process according to PRISMA guidelines is shown in Figure 3. Any disagreement regarding study was resolved by consensus with a third reviewer.

## Ethics declarations

This systematic review is based on publicly available data from previously published studies. No new patient data were collected, and no ethical approval was required. All included studies were reviewed for compliance with ethical standards and appropriate consent procedures.

## Risk of Bias Assessment of Included Randomized Controlled Trials:

To determine the RCTs' validity, a tool developed by the Cochrane Collaboration was used to assess the risk of bias in clinical trials. The reviewer utilized this tool to evaluate the risk of bias in the included studies, considering factors such as random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment (including intention-to-treat analysis), handling of incomplete outcome data, selective reporting of outcomes, and other possible sources of bias, such as design flaws and contamination bias. The methodological quality of each study was classified as low, high, or unclear risk as portrayed in Figure 1 and risk of bias summary in Figure 2.

## Meta-Analysis:

1) Forest Plot depicting comparison of changes in overbite in tongue crib and bonded spur group as depicted in Figure 4.

Meta-analysis was performed on four studies that qualified with the required data outcome that could be analysed quantitatively. A forest plot has been used to visually represent the results of the overall comparison. With the meta-analysis conducted for selected studies, heterogeneity was more than 50% ( $I^2 = 67\%$ ); hence, a random effects model was applied. The change in overbite measurement among subjects treated with palatal/lingual crib did not differ significantly from that of the lingual spur group with a standardized mean difference of 0.39 (95% CI = -0.17 to 0.95; Z value = 1.38;  $p=0.17$ ).

2) Forest Plot depicting comparison of changes in mandibular plane angle in tongue crib and bonded spur group as depicted in Figure 5.

Meta-analysis was performed on four studies that qualified with the required data outcome that could be analyzed quantitatively. A forest plot has been used to visually represent the results of the overall comparison. With the meta-analysis conducted for selected studies, heterogeneity was lower than 50% ( $I^2 = 29\%$ ); hence, a fixed effects model was applied. The change in mandibular plane angle measurement among subjects treated with palatal/lingual crib did not differ significantly from that of the lingual spur group with a mean difference of 0.12 (95% CI: -0.19 to 0.43; Z value = 0.79;  $p = 0.43$ ).

3) Forest plot depicting the comparison of changes in ANB angle between the tongue crib and bonded spur groups as depicted in Figure 6.

Meta-analysis was performed on four studies that qualified with the required data outcome that could be analyzed quantitatively. A forest plot has been used to visually represent the results of the overall comparison. With the meta-analysis conducted for selected studies, heterogeneity was greater than 50% ( $I^2 = 73\%$ ); hence, a random effects model was applied. The change in angle ANB measurement among subjects treated with palatal/lingual crib did not differ significantly from that of the lingual spur group with a mean difference of  $-0.46$  (95% CI:  $-1.07$  to  $0.16$ ; Z value =  $1.46$ ;  $p = 0.14$ ).

Although overjet, SNA, and SNB were evaluated across included studies, insufficient homogeneous data prevented quantitative synthesis. However, qualitative analysis indicated no statistically significant differences between the two appliances.

### Discussion:

Anterior open bite (AOB) is a particularly challenging malocclusion, both in its etiology and management. It is frequently attributed to non-nutritive sucking habits, such as thumb sucking, tongue thrusting, and improper tongue posture, all of which contribute to disturbances in the vertical development of the dentoalveolar structures. In growing individuals, early intervention aimed at habit interception is considered critical for long-term success. Among the various treatment modalities available, tongue crib and bonded spurs are widely used as habit-breaking appliances. Both function as physical barriers that discourage aberrant tongue function and thereby promote spontaneous dental changes.

This systematic review compared the effectiveness of tongue crib and bonded spur appliances in treating anterior open bite, focusing on both dental and skeletal parameters. The primary outcome evaluated was the improvement in overbite, with secondary outcomes including overjet, cephalometric angular measurements (SNA, SNB, ANB), and mandibular plane angle.

The pooled results indicated that the improvement in overbite between the two groups was not statistically significant, with a standardized mean difference of  $0.39$ . This aligns with the findings of Rossato et al.<sup>1</sup> and Canuto et al.<sup>3</sup>, who reported comparable dentoalveolar responses between the two appliances. Juliana et al.<sup>13</sup>, however, noted that while bonded spurs reduced the open bite in all patients, only 53.8% achieved a positive overbite after 12 months of treatment, highlighting individual variability in response to treatment.

Notably, all studies consistently attributed overbite correction predominantly to dentoalveolar effects, rather than skeletal changes. This observation supports the rationale for initiating treatment during growth phases, when the dental arches are more adaptable and the potential for long-term correction is higher. The importance of early intervention is further emphasized by the potential for neuromuscular adaptation, especially when combined with habit-breaking appliances and myofunctional therapy.

In terms of overjet, Canuto et al.<sup>3</sup> observed a significantly greater reduction in the bonded spur group, likely due to enhanced palatal tipping of the maxillary incisors. This suggests that bonded spurs may exert a more direct and immediate effect on incisor inclination compared to tongue cribs. Interestingly, the tongue crib group demonstrated contrasting effects on incisor inclination, possibly due to differences in force application and patient compliance.

Cephalometric analysis revealed minimal changes in skeletal parameters (SNA, SNB, ANB), with no statistically significant differences between groups. These findings were supported by multiple studies (Rossato et al.<sup>1</sup>, Canuto et al.<sup>3</sup>, Dias et al.<sup>12</sup>, Juliana et al.<sup>13</sup>), reinforcing the concept that both appliances primarily exert dental rather than skeletal changes. The slight change in angle ANB (SMD: -0.46) and mandibular plane angle (SMD: 0.12) between groups also failed to reach statistical significance, further validating the dental nature of the corrections achieved.

Another important aspect to consider is long-term stability. Although both appliances demonstrated favourable short-term outcomes, the limited 12-month follow-up period in the included studies does not allow definitive conclusions regarding relapse or retention. The risk of relapse in anterior open bite cases remains high, particularly when the causative habit is not fully addressed or when neuromuscular patterns are not re-trained. This highlights the need for adjunctive approaches such as myofunctional therapy, speech therapy, and patient education to reinforce appropriate oral posture and muscular function.

Moreover, treatment success in anterior open bite cases is multifactorial. Factors such as age at treatment initiation, severity of the open bite, patient compliance, and the presence of skeletal discrepancies can significantly influence outcomes. For example, patients with a strong vertical growth pattern or increased mandibular plane angle may have a higher tendency for relapse, irrespective of the appliance used.

From a clinical perspective, both tongue crib and bonded spurs are effective tools for habit interception and initial open bite correction. However, the choice between the two should be individualized based on patient age, compliance, esthetic concerns, comfort, and risk of soft tissue irritation. Bonded spurs, being fixed and less bulky, may offer better compliance in non-cooperative patients but can cause discomfort due to direct contact with the tongue. Tongue cribs, on the other hand, provide a more visible and active reminder to the patient and may be more appropriate when conscious habit correction is desired.

## Limitations

This review does have several limitations. The heterogeneity among the included studies, especially in terms of sample size, appliance design, outcome measures, and operator technique, limits the generalizability of the results. Additionally, none of the studies included long-term post-treatment follow-ups beyond 12 months, and blinding of participants and operators was generally absent, increasing the risk of bias.

## Conclusion

Tongue crib and Bonded spurs had similar effects in the early treatment of AOB with respect to the following parameters: Changes in the ANB, SNA, and SNB angles along with alterations in overjet and overbite, but this is all on the basis of the parameters as well as the studies chosen in this review.

**Figures and tables****Table 1: Study selection**

SR .N O	AUTHOR	YEA R	STUDY DESIGN	MEAN AGE	AGE RANG E	SAMPL E SIZE
1.	Eltager T, ElBardissy A <sup>9</sup>	2025	Randomized clinical trial	8.3 years	7-9 years	22
2.	Alawy SB, El-Desouky SS, Kabbash IA, Hadwa SM <sup>10</sup>	2025	Randomized clinical trial	Not reported	7-9 years	75
3.	Kraisiridej R, Suzuki B <sup>8</sup>	2022	Randomized clinical trial	10 years	9-11 years	23
4.	AbdalMonaem N, Shehata A, Haussein E, Abouelnour A, Abu-Shahba RY <sup>11</sup>	2022	Randomized clinical trial	9.3 years	6-10 years	25
5.	Dias FA, Oltramari PV, Almeida MR, Conti AC, Almeida RR, Fernandes TM <sup>12</sup>	2021	Randomized clinical trial	Not reported	7-10 years	99
6.	Rossato PH, Fernandes TM, Urnau FD, Conti AC, Almeida RR, Oltramari-Navarro PV <sup>1</sup>	2018	Randomized clinical trial	8.4 years	7-10 years	81

7.	Canuto LF, Janson G, de Lima NS, de Almeida RR, Cançado RH <sup>3</sup>	2016	Randomized clinical trial	9.31 years	6-11 years	68
8.	Leite JS, Matiussi LB, Salem AC, Provenzano MG, Ramos AL <sup>13</sup>	2016	Randomized clinical trial	8.45 years	5-10 years	39
9.	Cassis MA, de Almeida RR <sup>14</sup>	2012	Randomized clinical trial	Not reported	7-10 years	60
10.	Meyer-Marcotty P, Hartmann J <sup>15</sup>	2007	Randomized clinical trial	9.3 years	6-9 years	15
11	Torres F, Almeida RR <sup>5</sup>	2006	Randomized clinical trial	Not reported	9-12 years	60
12.	Pedrin F, de Almeida MR, de Almeida RR, de Almeida-Pedrin RR, Torres F <sup>16</sup>	2005	Randomized clinical trial	10 years	9-11 years	60
13.	Huang GJ, Justus R <sup>4</sup>	1989	Randomized clinical trial	Not reported	7-9 years	33

Figure 1: Risk of Bias assessment of the included randomized control trials.

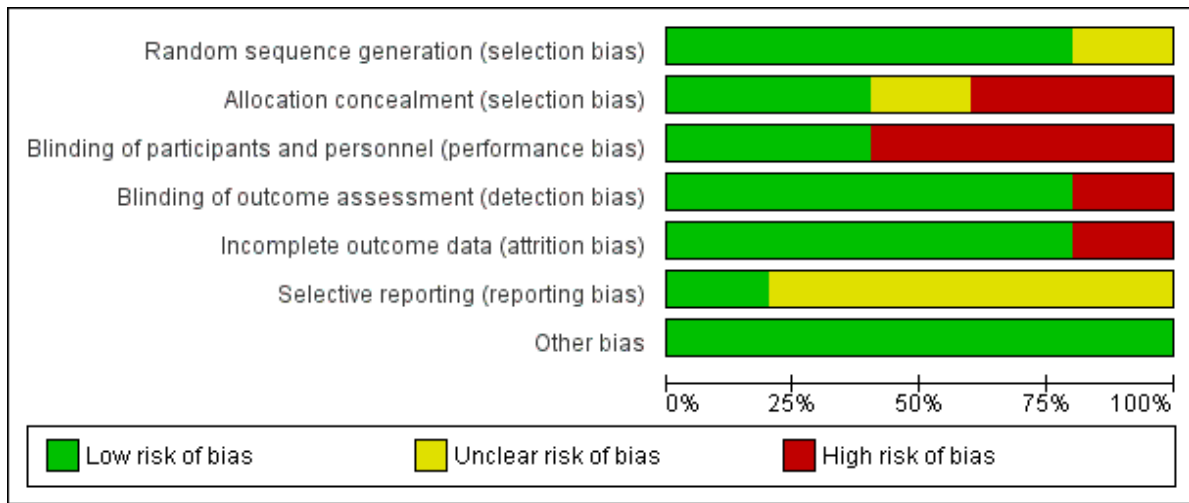
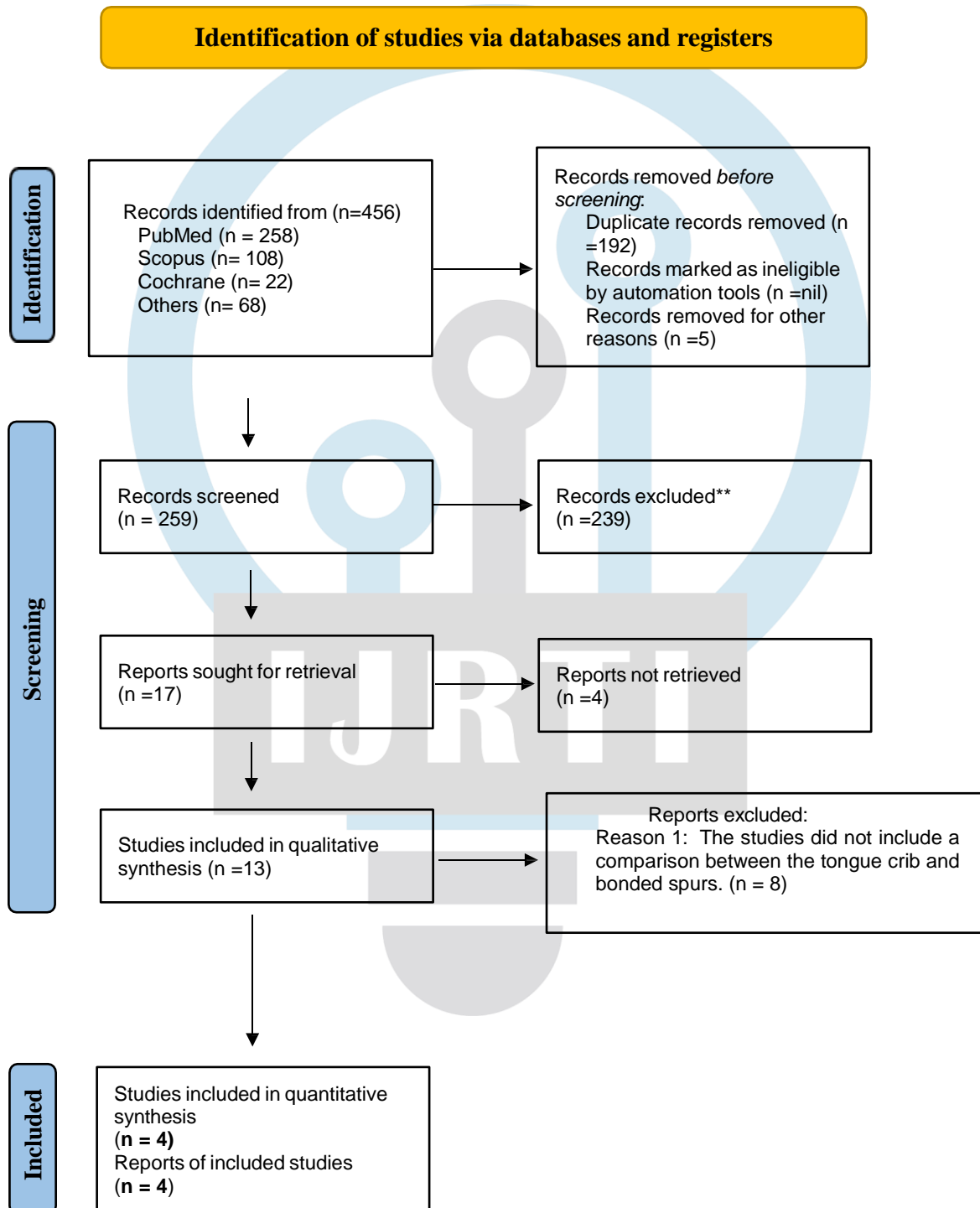


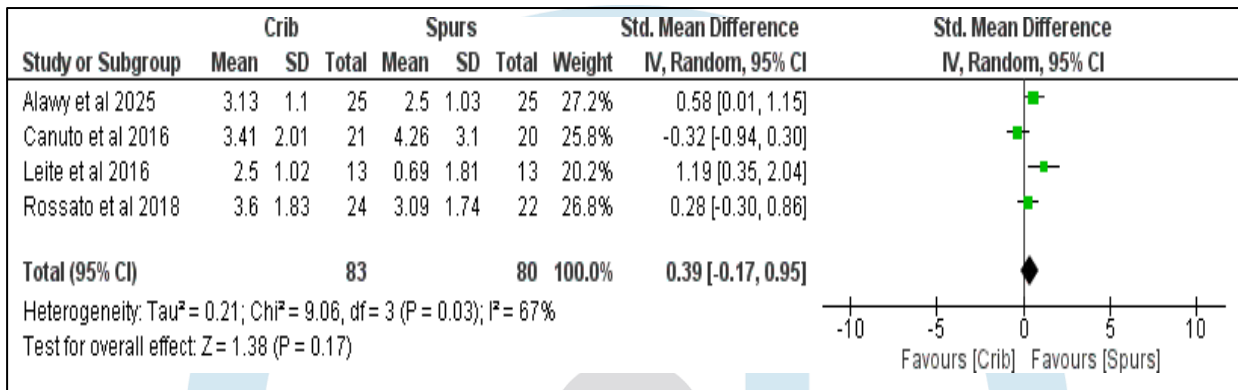
Figure 2: Risk of Bias summary

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Alawy et al 2025	+	+	-	+	+	+	+
Canuto et al 2016	?	-	-	-	+	?	+
Dias et al 2021	+	-	+	+	-	?	+
Leite et al 2016	+	?	+	+	+	?	+
Rossato et al 2018	+	+	-	+	+	?	+

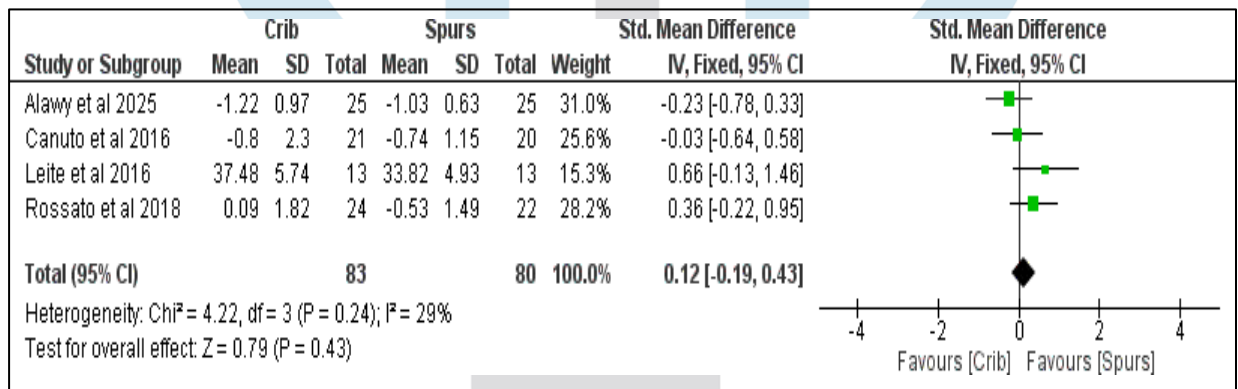
Figure 3: **PRISMA 2020 FLOW DIAGRAM**



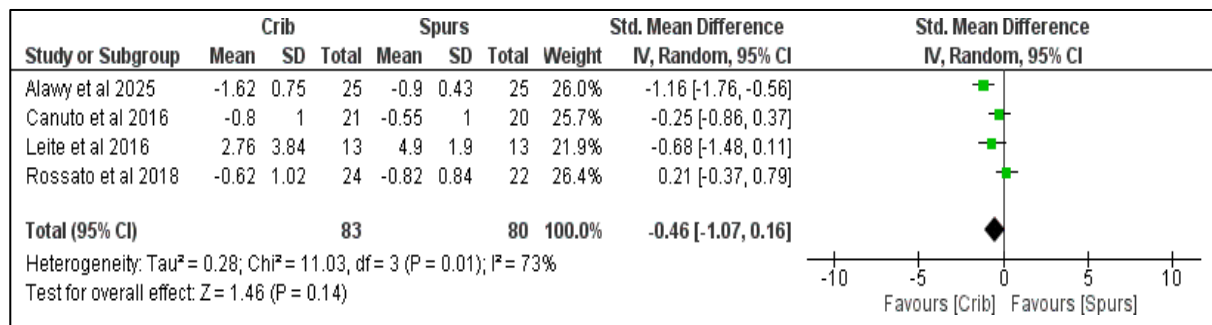
**Figure 4: Forest Plot depicting comparison of changes in overbite in tongue crib and bonded spur group**



**Figure 5: Forest Plot depicting comparison of changes in mandibular plane angle in tongue crib and bonded spur group**



**Figure 6: Forest Plot depicting comparison of changes in ANB angle in tongue crib and bonded spur group**



## References

1. Rossato PH, Fernandes TM, Urnau FD, de Castro AC, Conti F, de Almeida RR, Oltramari-Navarro PV. A randomized clinical trial on the dentoalveolar effects of different appliances in the early management of anterior open bite. *Angle Orthod.* 2018;88(6):684-691.
2. Worms FW, Meskin LH, Isaacson RJ. Open-bite. *Am J Orthod.* 1971;59(6):589-595.
3. Canuto LF, Janson G, de Lima NS, de Almeida RR, Cançado RH. Comparison of bonded and conventional lingual spurs in the treatment of anterior open bite. *Am J Orthod Dentofacial Orthop.* 2016;149(6):847-855.
4. Huang GJ, Justus R, Kennedy DB, Kokich VG. Stability of anterior open bite treated with crib therapy. *Angle Orthod.* 1990;60(1):17-24.
5. Torres F, Almeida RR, de Almeida MR, Almeida-Pedrin RR, Pedrin F, Henriques JF. Correction of anterior open bite with combined palatal crib and high-pull chin cup therapy: a prospective randomized study. *Eur J Orthod.* 2006;28(6):610-617.
6. Andrade I Jr, Araújo EA. Habit control: the role of function in open-bite treatment. In: *Recognizing and Managing Developing Malocclusions: A Problem-Oriented Orthodontic Approach*. Published April 14, 2025:225-237.
7. Moore J. *The ABC of Child Protection*. Routledge; 2018.
8. Kraisiridej R, Suzuki B, Suzuki EY. Dentoalveolar changes following the use of customized bonded shark-tooth-like spurs (JAWs) in adult anterior open bite patients. 2022;27(5): e2220448.
9. Eltager T, Bardissy AE, Abdelgawad F. Cessation of thumb/finger sucking habit in children using electronic habit reminder versus palatal crib: a randomized clinical pilot study. *BMC Oral Health.* 2025;25(1):27.
10. Alawy SB, El-Desouky SS, Kabbash IA, Hadwa SM. A randomized clinical study on the effects of tongue tamers and customized bonded spurs in the early treatment of anterior open bite. *BMC Oral Health.* 2025;25(1):76.
11. Abdal Monaem N, Shehata A, Houssein E, Abouelnour A, Abu-Shahba RY. A prospective cephalometric study on the management of Class III malocclusion using an orthodontic tongue crib appliance.
12. Dias FA, Oltramari PV, Almeida MR, Conti AC, Almeida RR, Fernandes TM. Two-year follow-up of early anterior open bite treatment: a randomized clinical trial on stability. *Braz Dent J.* 2021; 32:116-126.
13. Leite JS, Matiussi LB, Salem AC, Provenzano MG, Ramos AL. Effects of palatal crib and bonded spurs in early treatment of anterior open bite: a prospective randomized clinical study. *Angle Orthod.* 2016;86(5):734-739.
14. Cassis MA, de Almeida RR, Janson G, Aliaga-Del Castillo A, de Almeida MR. Stability of anterior open bite treatment with bonded spurs associated with high-pull chincup. *Orthod Craniofac Res.* 2018;21(2):104-111.
15. Meyer-Marcotty P, Hartmann J, Stellzig-Eisenhauer A. Dentoalveolar open bite treatment with spur appliances. *J Orofac Orthop.* 2007;68(6):510-521.
16. Pedrin F, de Almeida MR, de Almeida RR, de Almeida-Pedrin RR, Torres F. A prospective study of the treatment effects of a removable appliance with palatal crib combined with high-pull chincup therapy in anterior open-bite patients. *Am J Orthod Dentofacial Orthop.* 2006;129(3):418-423