

Skeletal and dental changes after bone-borne versus tooth-borne surgically assisted rapid palatal expansion in subjects with maxillary transverse deficiency: A systematic review and meta-analysis

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Abstract

The objective of the study was to determine the difference in skeletal and dental effects of bone-borne (BB) versus tooth-borne (TB) surgically assisted rapid palatal expansion (SARPE) in subjects with maxillary transverse deficiency (MTD).

The present review included randomized controlled trials (RCTs), non-RCTs and cohort studies. A systematic search was conducted in online databases (i.e., PubMed®, Dentistry & Oral Sciences Source, CINAHL Plus, and Cochrane Central Register of Controlled Trials (CENTRAL)) for articles published up to January 2023. The outcome was estimated using the weighted average difference and 95% confidence intervals (CIs). The heterogeneity of the studies was assessed using Cochran's heterogeneity test (I^2 test). The meta-analysis was conducted using the RevMan software, v. 5.3.5.22.

The qualitative and quantitative synthesis incorporated 7 articles that satisfied the inclusion criteria. The skeletal and dental expansion was assessed pre- and post-expansion in 249 patients who underwent SARPE with BB and TB appliances. Five studies were included in the meta-analysis to measure skeletal expansion in the first premolar and first molar regions. The analysis revealed no statistically significant differences between the study groups (mean difference: -0.16 ; 95% CI: $-0.34, 0.67$). To measure dental expansion, 7 studies were included in the meta-analysis, and no significant differences were observed between them (mean difference: -0.29 ; 95% CI: $-0.77, 0.19$).

This systematic review and meta-analysis revealed no differences in skeletal and dental expansion in patients who underwent SARPE with BB and TB appliances.

Keywords: surgically assisted rapid palatal expansion, SARPE, tooth-borne, bone-borne

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Highlights

- The study quantifies skeletal and dental expansion to support appliance selection in surgically assisted rapid palatal expansion (SARPE) treatment planning by oral surgeons and orthodontists.
- The analysis included 7 studies that met predefined inclusion criteria for qualitative and quantitative assessment.
- There was no statistically significant difference in skeletal and dental expansion between bone-borne and tooth-borne appliances.

Introduction

In orthodontic clinics, maxillary transverse deficiency (MTD) is a frequently observed condition.^{1–3} Proffit and White stated that 30% of adult orthodontic patients had MTD.⁴ The reported prevalence of MTD is 8–18% in children and 10% in adults.^{5–7} In Argentina, the prevalence of MTD in primary dentition was found to be 0.3%.⁸ Gungor et al. reported a prevalence of 15.6% in the Turkish population,⁹ while Nainani and Relan documented a prevalence of 5.5% in the Indian population.¹⁰ Additionally, a study conducted by van Wyk and Drummond revealed a prevalence of 10.4% within a South African population.¹¹ Dacosta and Utomi further substantiated that a higher incidence of MTD was evident among women compared to men.¹²

Maxillary transverse deficiency, with its resulting sequelae, can present with decreased intercanine and intermolar widths, and unilateral or bilateral crossbites with deep and narrow palatal vaults.^{13,14} It can further lead to crowding, excessive buccal corridors, non-carious cervical wear of teeth, periodontitis, and imbalances in facial musculature.^{15–17} To avoid these unfavorable manifestations and achieve a stable occlusion, it is essential to provide patients with a normal transverse skeletal relationship.¹⁸

In adolescents, rapid maxillary expansion (RME) has proven to be the most successful orthodontic approach for addressing transverse maxillary discrepancies.^{19,20} This therapeutic method involves opening the midpalatal suture and widening the maxillary arch.²¹ However, with increasing age, the fusion of the midpalatal suture and adjacent articulations leads to resistance to the forces of expansion appliances.²² The utilization of these appliances in adults can result in a greater impact on dental than skeletal effects. Furthermore, these appliances can cause several side effects, including dental crown tipping, dehiscence, periodontal damage, root resorption, and instability of the achieved results.^{23,24} In non-growing individuals, surgically assisted rapid palatal expansion (SARPE) is indicated to overcome the hindrance from the ossified sutures and resulting side effects.²⁵

Surgically assisted rapid palatal expansion is a reliable technique for the treatment of MTD in skeletally mature patients.²⁵ In this procedure, an osteotomy is performed,

and the sutures restricting the expansion are released. Subsequently, an expander is placed and activated until the achievement of the desired outcomes.²⁶ The expanders used after SARPE to perform activation depend on the preference of the practitioner. These appliances can be broadly categorized into bone-borne (BB) and tooth-borne (TB) expanders.²⁷

After the SARPE procedure, TB appliances are banded to the teeth without requiring additional invasive procedures. They provide satisfactory results.²⁸ However, studies have demonstrated that when these conventional TB expanders are used, the expansion forces are applied through the teeth, thereby complicating the control of the relapse of the expanded segments during the consolidation period.^{29,30} Moreover, they can often result in dental tipping, alveolar bone dehiscence and periodontal damage.²⁹ Mommaerts introduced the BB SARPE technique to avoid these undesired side effects.³¹ The BB expanders directly transmit the expansion forces to the palatal region, causing more skeletal and less dental effects.³² Additionally, they can prevent the relapse of the expanded bony segments in the consolidation period.³³

During the literature search, we identified several systematic reviews that evaluated skeletal and dental effects following SARPE.^{26,34} Upon conducting an in-depth review of these studies, it became evident that the available research lacked comprehensive data to assess expansion in the anterior region. Moreover, the studies that were included in previous reviews did not have a comparative design. Consequently, we conducted this systematic review while taking into account the limitations of previous studies to thoroughly evaluate the qualitative and quantitative aspects of studies within the scope of our review. Few randomized controlled trials (RCTs) that have evaluated skeletal and dental changes after BB versus TB SARPE have contradictory or unclear results.^{28,32} Hence, this systematic review and meta-analysis was performed to generate strong evidence.

Objectives

The current review aimed to collect data and develop high-quality evidence. The review question was as follows: Is there a difference in skeletal and dental effects of BB compared to TB SARPE in subjects with MTD?

Material and methods

Eligibility criteria

The review question was developed in accordance with the PICOS (Population, Intervention, Comparison, Outcomes and Study design) criteria. The population comprised orthodontic patients who underwent SARPE, while BB expanders served as the intervention group and TB expanders were designated as the comparison group. The outcomes assessed included skeletal and dental changes.

The present review encompassed RCTs, non-RCTs and cohort studies. Case reports, case series, reviews, case–control, single-arm longitudinal, and animal studies were excluded from the analysis.

Search strategy

Major health databases (i.e., PubMed®, CINAHL Plus, Cochrane Central Register of Controlled Trials (CENTRAL), Dentistry & Oral Sciences Source) were extensively searched for articles published up to January 2023. Additionally, unpublished and grey literature, along with Google Scholar, were searched manually. The following Medical Subject Headings (MeSH) were used: (“Orthodontics”[MeSH] orthodontic*OR dental OR dentistry OR) AND (Skeletal OR soft tissue OR airway OR suture opening comparison) AND (Surgically assisted rapid maxillary expansion OR mini-screw assisted rapid palatal expansion OR SARPE OR SARME OR surgically assisted rapid palatal expansion OR MARPE OR bone-anchored rapid palatal expansion).

Study selection and data extraction procedure

The systematic review included RCTs, non-RCTs and cohort studies that evaluated primary outcomes of skeletal and dental changes. The obtained results were transferred after the literature search to EndNote™ X 9.2 software (Clarivate, Philadelphia, USA) for citation management. Two independent authors (LK and HQ) performed a two-phase selection process to scrutinize the results. In the 1st phase, titles and abstracts of the articles were reviewed. The full texts of studies that remained after the initial screening were then evaluated in the 2nd phase. In the event of a discrepancy between the 2 authors, the 3rd author (WI) was consulted. The 3rd author repeated the selection process. The results revealed a high degree of agreement across all examinations (intraclass correlation coefficient (ICC) = 0.88). The data was entered into a standardized proforma. The veracity of the data was assessed, and any inconsistencies were resolved by the reassessment of the original studies (Fig. 1).³⁵

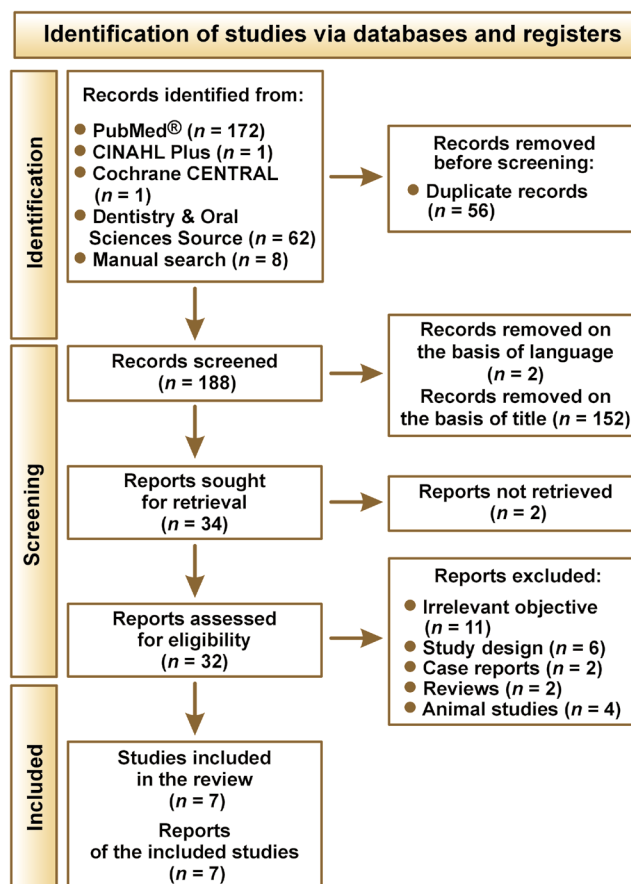


Fig. 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)³⁵ flowchart of the study

CENTRAL – Central Register of Controlled Trials.

Effect measures and synthesis of results

The data analysis encompassed a systematic assessment of skeletal and dental changes, with a focus on the canine, first premolar and first molar regions. The outcomes were based on the assessments conducted in individual studies. The results of these studies were then meticulously analyzed with regard to the aforementioned regions. For quantitative data, a meta-analysis was performed using Review Manager (RevMan), v. 5.4 (Cochrane Collaboration, London, UK). The I^2 statistic was used to determine the heterogeneity between the studies. Random- and fixed-effects models were utilized for the analysis of the summary effect.

Assessment of the risk of bias in individual studies

The Cochrane’s risk of bias (RoB 2.0) assessment tool³⁶ was used for the assessment of RCTs. The RoB 2.0 tool comprises multiple domains that allow for the classification of RCTs into low, unclear and high risk of bias categories. The Newcastle–Ottawa scale³⁷ was utilized to determine the quality of a non-RCTs and cohort studies.

Assessment of certainty

The GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach³⁸ was utilized to ascertain the overall strength of evidence of the systematic review after assessing the individual included studies.

The GRADE tool evaluates the included studies based on their research design, risk of bias, inconsistencies, and any imprecision or indirectness for each outcome. The tool categorizes the outcomes into extremely low, low, moderate, or high-quality evidence (Table 1).

Results

Selection process and characteristics of the included studies

The initial search yielded 244 citations. After the elimination of duplicates, the number of citations was reduced to 188. Further scrutiny was conducted on the basis of titles, abstracts and language, which further reduced the number of articles to 34. Following a thorough examination of the full texts of the papers, 7 articles were deemed suitable for inclusion in the systematic review and meta-analysis. The selection process is outlined in Fig. 1. Of the 7 articles selected for inclusion, there were 4 RCTs, 1 non-RCT and 2 cohort studies. All the included studies compared the dental and skeletal changes after SARPE with BB and TB expanders. A comprehensive summary of the individual studies is presented in Table 2.

Assessment of the risk of bias within and across studies

The risk of bias was assessed for the RCTs using the 5 domains of the RoB 2.0 tool. All RCTs exhibited a low risk of bias in the 3rd and 5th domains. For the 1st and 4th domains of the RoB tool, studies by Koudstaal et al.³⁹ and Kayalar et al.⁴⁰ exhibited a low risk. However, studies by Landes et al.³² and Zandi et al.²⁸ had a high risk of bias in these domains. Overall, 50% of the studies^{39,40} had some concerns, while the remaining papers demonstrated a high risk of bias (Fig. 2).^{28,32}

The Newcastle–Ottawa scale was used to assess the quality of evidence in 3 studies.^{41–43} The analysis revealed that all studies had a good quality of evidence (Table 3).

Results of individual studies

In their study, Landes et al. assessed the effects of skeletal and dental expansion in the first and second molar and premolar regions after SARPE with BB or TB expanders.³² The authors measured pre- and post-expansion on cone-beam computed tomography (CBCT). Additionally, the researchers assessed buccal and lingual vestibular bone resorption in the first premolar and first molar regions. The BB group comprised 24 participants, while the TB group contained 26 subjects. A comparison revealed a statistically significant difference in the skeletal expansion and buccal vestibular bone resorption in the first premolar region between the BB and TB groups. The BB group demonstrated a higher degree of skeletal expansion. However, the TB group exhibited greater vestibular bone resorption.³²

Three of the included studies conducted their analyses on 3D cast models.^{39,41,43} These studies assessed dental expansion in the canine, first premolar and first molar regions. Koudstaal et al. found a statistically significant difference in skeletal expansion in the first molar region, exhibiting increased expansion in the BB group.³⁹ Barone et al. observed a statistically significant difference in dental expansion in the first molar region, showing greater expansion in the TB group.⁴³ All 3 studies exhibited insignificant differences for dental expansion in the canine region.

Kayalar et al. performed their studies on CBCT, dividing 20 subjects equally into BB and TB groups.⁴⁰ Along with the skeletal and dental expansion, they also evaluated periodontal changes in the first premolar and first molar regions in subjects who underwent SARPE with BB or TB appliances. Furthermore, the post-expansion root length changes were assessed in conjunction with the intermolar and interpremolar angulations. The measurements were taken at 3 different time intervals: at baseline; after the expansion; and 6 months after the retention phase of expansion. A comparison of post-expansion changes between the BB and TB groups revealed significant differences in anterior dental expansion, first molar dental angulation, buccal and lingual alveolar bone thickness, and tooth

Table 1. Assessment of the quality of the evidence using the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach

Studies, <i>n</i>	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Summary of findings			
							patients, <i>n</i>		relative effect	certainty of evidence
							BB	TB		
5	RCT/non-RCT	not serious	not serious	not serious	not serious	none	86/170 (50.6%)	84/170 (49.4%)	not estimable	⊕⊕⊕⊕ high
2	cohort studies	not serious	not serious	not serious	not serious	none	35/79 (44.3%)	44/79 (55.7%)	not estimable	⊕⊕○○ low

RCT – randomized control trial; BB – bone-borne; TB – tooth-borne; CI – confidence interval.

Table 2. Characteristics of studies included in the review

Study	Study design	Sample size	Surgical procedure	Expander appliance	Primary outcome	Secondary outcome	Outcome assessment
Landes et al. 2009 ³²	RCT	total: 50 BB: 24 TB: 26	bipartite median or tripartite paramedian osteotomy	BB: TPD and MWD TB: HE	skeletal and dental expansion in the first and second premolar regions, and in the first and second molar regions	dental tipping, vestibular bone resorption	CBCT
Koudstaal et al. 2009 ³⁹	RCT	total: 46 BB: 25 TB: 21	Le Fort I with midline osteotomy	BB: TPD and BAD TB: HE	skeletal and dental expansion in the first premolar and first molar regions, dental expansion in the canine region	dental tipping	3D scanned cast models
Laudemann et al. 2010 ⁴¹	cohort study	total: 34 BB: 18 TB: 16	Le Fort I with midline osteotomy	BB: TPD and MWD TB: HE	dental expansion in the canine, first premolar and first molar regions	dental tipping, attachment loss	3D scanned cast models
Nada et al. 2012 ⁴²	cohort study	total: 45 BB: 17 TB: 28	Le Fort I with midline osteotomy	BB: TPD TB: HE	skeletal and dental expansion in the first premolar and first molar regions, dental expansion in the canine region	none	CBCT
Zandi et al. 2014 ²⁸	RCT	total: 30 BB: 15 TB: 15	Le Fort I with midline osteotomy	BB: TPD TB: HE	skeletal and dental expansion in the first premolar and first molar regions, nasal floor width	none	CBCT
Kayalar et al. 2016 ⁴⁰	RCT	total: 20 BB: 10 TB: 10	Le Fort I with midline osteotomy	BB: hybrid RME TB: HE	skeletal and dental expansion in the first premolar and first molar regions	dental tipping, root resorption, vestibular bone resorption	CBCT
Barone et al. 2020 ⁴³	non-RCT	total: 24 BB: 12 TB: 12	Le Fort I with midline osteotomy	BB: BAD TB: HE	dental expansion in the canine, first premolar and first molar regions	none	3D scanned cast models

TPD – transpalatal distractor; MWD – maxillary widening device; HE – Hyrax expander; BAD – bone-anchored device; RME – rapid maxillary expander; CBCT – cone-beam computed tomography.

Study	Experimental	Comparator	Outcome	Weight	D1	D2	D3	D4	D5	Overall
Landes et al.	BB expanders	TB expanders	expansion	1	⊖	⊖	⊕	⊖	⊕	⊖
Koudstaal et al.	BB expanders	TB expanders	expansion	1	⊕	⊕	⊕	⊕	⊕	⊕
Zandi et al.	BB expanders	TB expanders	expansion	1	⊖	⊕	⊕	⊖	⊕	⊖
Kayalar et al.	BB expanders	TB expanders	expansion	1	⊕	⊕	⊕	⊕	⊕	⊕

D1 Randomization process
 D2 Deviations from the intended interventions
 D3 Missing outcome data
 D4 Measurement of the outcome
 D5 Selection of the reported result

⊕ low risk
 ⊕ some concerns
 ⊖ high risk

Fig. 2. Assessment of the risk of bias using the Cochrane's risk of bias (RoB 2.0) assessment tool for randomized controlled trials

BB – bone-borne; TB – tooth-borne.

Table 3. Assessment of the risk of bias using the Newcastle–Ottawa scale for non-randomized controlled trials and cohort studies

Study	Sample size	Selection	Comparability	Outcome
Laudemann et al. ⁴¹	34	★★★	★	★★★
Nada et al. ⁴²	45	★★★	★	★★★
Barone et al. ⁴³	24	★★★	★	★★

good quality – 3 or 4 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain; fair quality – 2 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain; poor quality – 0 or 1 star in selection domain OR 0 stars in comparability domain OR 0 or 1 stars in outcome/exposure domain.

length of the first premolars. A statistically significant difference in dental expansion within the first premolar region was identified, demonstrating greater expansion in the TB group. However, posterior dental expansion in the first molar region was comparable in both groups.

Zandi et al.²⁸ and Nada et al.⁴² measured the dental and skeletal expansion in the first premolar and first molar regions in 30 and 45 participants, respectively. All participants underwent SARPE with BB or TB expanders. The latter also evaluated dental expansion in the canine region and found a statistically significant difference in this parameter between the 2 groups. Dental and skeletal expansion in other regions were comparable in both groups.

Meta-analysis

Five studies^{28,32,39,40,42} were included in the meta-analysis to measure the extent of skeletal expansion in the first premolar and first molar regions of the BB and TB groups who underwent SARPE. Due to significant heterogeneity, the random-effects model was used for the synthesis of data from the first premolar region. No significant differences were observed (mean difference: 0.25; 95% confidence interval (CI): –0.27, 0.76) (Fig. 3). For the analysis of data in the first molar region, a fixed-effects model was employed. However, no statistically significant differences were observed between the groups (mean difference: 0.16; 95% CI: –0.34, 0.67) (Fig. 4).

The meta-analysis was conducted on a total of 7 studies, with the objective of measuring dental expansion in the first premolar and first molar regions in the BB and TB groups. Given the presence of significant heterogeneity among the studies, the random-effects model was used for the synthesis of data from the first premolar

region. The analysis revealed an absence of statistically significant differences (mean difference: -0.67 ; 95% *CI*: $-1.45, 0.11$) (Fig. 5). A fixed-effects model was used for the analysis of data from the first molar region. No statistically significant differences were observed between the 2 groups (mean difference: -0.29 ; 95% *CI*: $-0.77, 0.19$) (Fig. 6).

Four studies^{32,39,42,43} were included in the meta-analysis to measure dental expansion in the canine region in the BB and TB groups. Due to significant heterogeneity in the data, the synthesis was performed using a random-effects model. The analysis revealed no statistically significant differences between the groups (mean difference: 0.05 ; 95% *CI*: $-0.50, 0.60$) (Fig. 7).

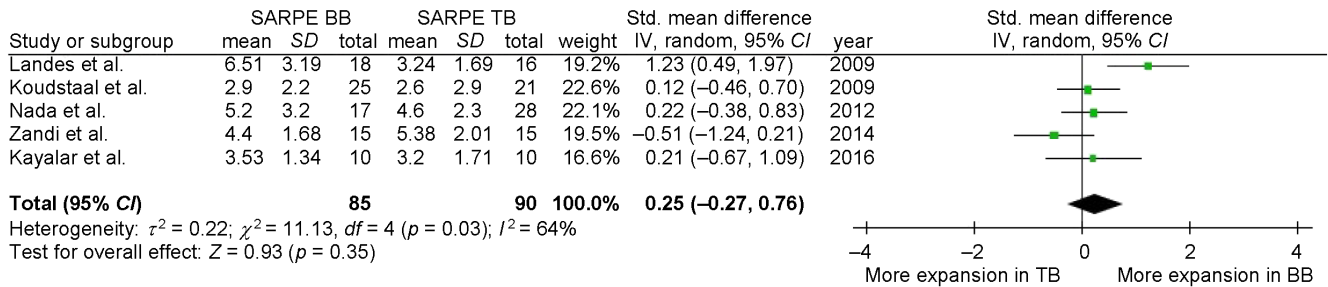


Fig. 3. Forest plot depicting the mean difference in skeletal expansion in the first premolar region between bone-borne (BB) and tooth-borne (TB) expanders after surgically assisted rapid palatal expansion (SARPE)

SD – standard deviation; CI – confidence interval; df – degrees of freedom.

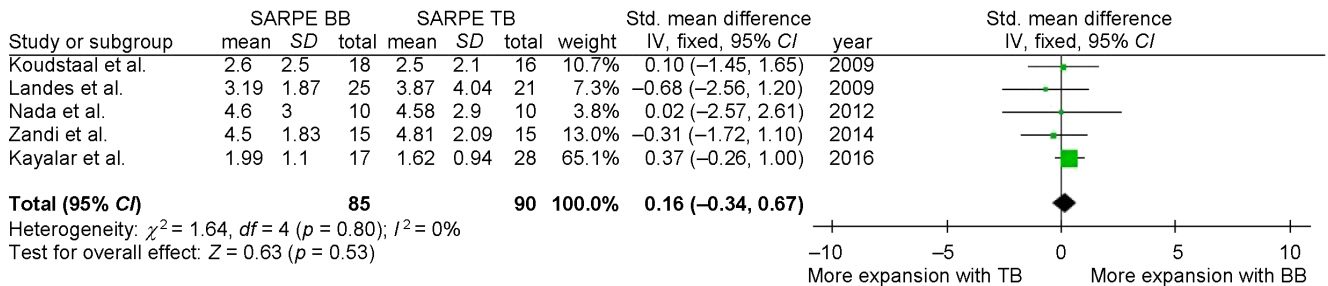


Fig. 4. Forest plot depicting the mean difference in skeletal expansion in the first molar region between BB and TB expanders after SARPE

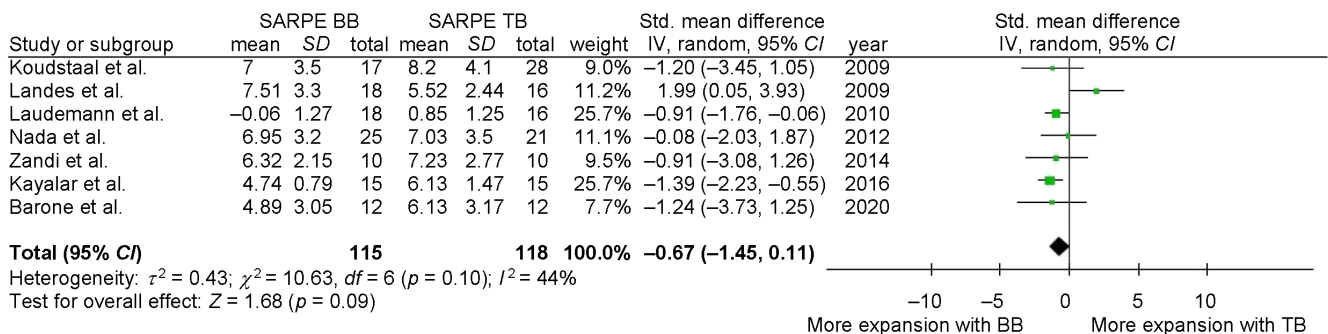


Fig. 5. Forest plot depicting the mean difference in dental expansion in the first premolar region between BB and TB expanders after SARPE

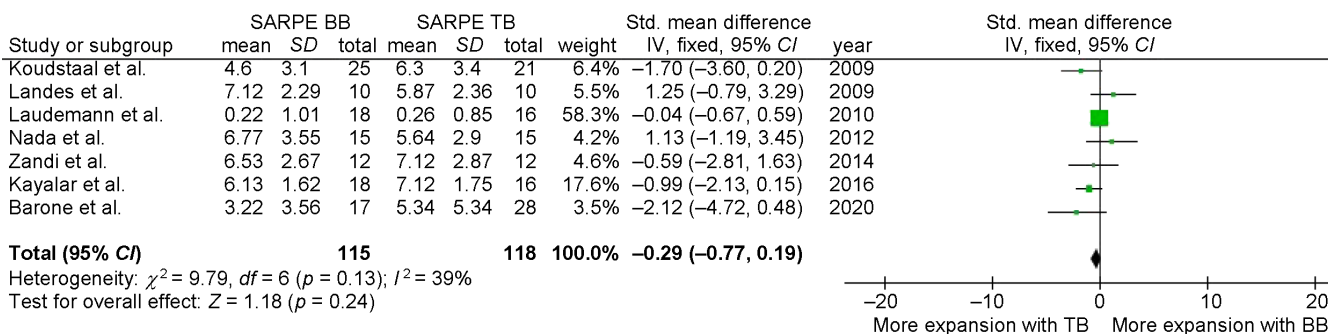


Fig. 6. Forest plot depicting the mean difference in dental expansion in the first molar region between BB and TB expanders after SARPE

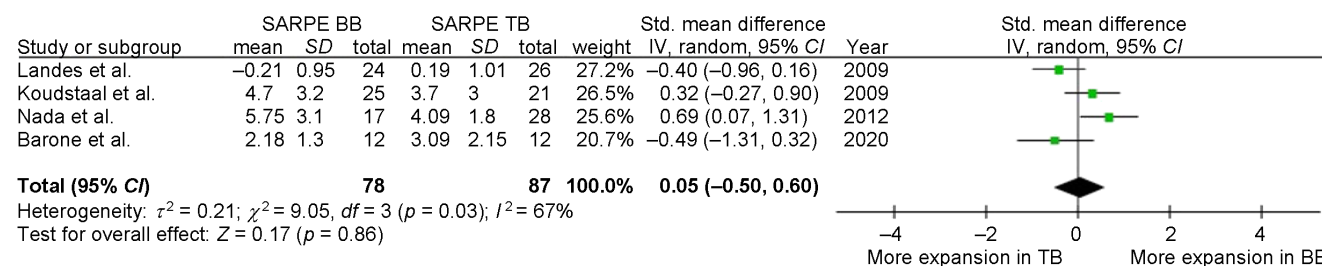


Fig. 7. Forest plot depicting the mean difference in dental expansion in the canine region between BB and TB expanders after SARPE

Assessment of the certainty of the evidence

The GRADE tool was employed to assess the findings from the included studies. The results demonstrated no differences in the expansion between the 2 techniques. The evaluation of the certainty of the evidence revealed that the clinical trials were of high quality, while the cohort studies were of low quality. Therefore, the significance of the findings of this review should be interpreted with caution (Table 1).

Discussion

This systematic review and meta-analysis compared skeletal and dental changes after BB and TB SARPE in subjects with MTD. The results showed that the dental and skeletal parameters in the transverse dimension were comparable between the 2 treatment modalities. The results hold strong evidence as only studies employing CBCT were considered. The clinical significance of the evidence obtained from this systematic review is highlighted by the GRADE scoring of all the clinical trials as high-quality strong evidence, while cohort studies provided low-quality evidence. To create strong evidence for skeletal expansion in the premolar and molar regions, we quantitatively analyzed the findings of 5 clinical trials by meta-analysis.^{28,32,39,40,42} The Newcastle–Ottawa scale revealed that a non-RCT and cohort studies included in this systematic review and meta-analysis had good quality evidence.

In the adolescent patient population, maxillary expansion can be achieved through the use of TB appliances, either by slow or rapid expansion. In these patients, sutures are not yet fully fused, and the zygomaticomaxillary complex is in the process of development.⁴⁴ However, in adults, the fusion of intermaxillary and circummaxillary sutures is complete. Tooth-borne maxillary expansion after the maturation of these sutures mainly results in dentoalveolar effects rather than orthopedic effects. Thus, in adults, stable maxillary expansion can only be achieved through surgical interventions, such as maxillary osteotomy or SARPE. Both techniques involve a horizontal osteotomy of the lateral wall of the maxilla, with the separation of the lateral nasal wall, disarticulation of the nasal

septum, and a palatal osteotomy. However, the maxilla is downfractured in a multiple-piece maxillary osteotomy, whereas SARPE does not involve this downward repositioning. Surgically-assisted rapid palatal expansion is a less complex and more physiological approach, and it provides a greater range of expansion due to tissue regeneration.⁴⁵ Although maxillofacial surgeons perform the surgery, the range of expansion is guided by an orthodontist with the help of surgical guides. Novel methods have been introduced to enhance the accuracy of these surgical guides, such as the use of 3D-printed resins like BioMed Amber.⁴⁶

In order to create strong evidence for skeletal expansion in the premolar and molar regions, a quantitative analysis was performed on the findings of 5 clinical trials through meta-analysis.^{28,32,39,40,42} Among all the included studies, only Landes et al. claimed that skeletal expansion is more pronounced in interpremolar width with BB transpalatal expander and maxillary widening device as compared to the TB Hyrax expander.³² In this study, the surgical technique could be the primary factor contributing to significant skeletal expansion. The osteotomy technique employed in this study was either a bipartite median approach between the central incisor and bilaterally along the nasal septum or a tripartite paramedian approach between the lateral incisors and canines.³² In the remaining 4 clinical trials, which demonstrated insignificant skeletal improvement in inter-premolar width, SARPE was performed as three-piece Le Fort I with midsagittal suture osteotomy. In all the studies, the appliance used for TB expansion was the Hyrax expander.

It has been well-documented that not only the mid-palatal suture but also multiple sutures of the maxilla can contribute to arch constriction.^{6,7,25} Interestingly, a significant skeletal intermolar expansion was observed in the findings of Nada et al., who reported greater skeletal expansion with transpalatal distractor as compared to the Hyrax appliance.⁴² The analysis of dental expansion after SARPE involved assessing the tipping of the molars and premolars in all the included studies. All 7 studies included in this systematic review assessed dental expansion in the first premolar and first molar regions. The study by Kayalar et al. demonstrated that the TB Hyrax expander resulted in greater premolar tipping compared to the hybrid maxillary expander.⁴⁰ Surprisingly, increased molar tipping after SARPE was found in the

study by Barone et al.⁴³ These findings can be explained by the use of tooth-anchored appliances in these studies. Additionally, the buccal equilibrium resisted the skeletal suture opening of the maxilla, which requires heavy forces. Hence, it was concluded that an appliance attached to a tooth resulted in buccal tipping of molars before the skeletal opening of the suture.

Limitations

Among the included studies, Nada et al. assessed long-term treatment effects, with an analysis conducted 6 months after expander removal.⁴² However, Landes et al. measured short-term postoperative effects and expansion after the treatment with TB and BB appliances.³² The difference in follow-up duration could have influenced the findings. However, a meta-analysis was performed to eliminate these confounding factors. The majority of literature on the comparison of BB and TB expansion after SARPE are cross-sectional studies or literature book reviews. A comprehensive literature search yielded 5 clinical trials and 2 cohort studies that assessed these changes in longitudinal form. However, these studies had small sample sizes, which is the major limitation of this systematic review. The strength of this study lies in its exclusive inclusion of studies that employed CBCT as the assessment criterion, which is regarded as the gold standard.

To establish whether there is a difference between BB and TB SARPE, randomized clinical trials with larger sample sizes and longer follow-up periods should be conducted.

Conclusions

Within the limitations of insufficient evidence, this systematic review and meta-analysis concluded that there was no difference in skeletal and dental expansion in SARPE with BB and TB appliances. Due to the scarcity of available data, further studies are required to definitively ascertain clinical benefits of one treatment over another.

Trial registration

The current systematic review protocol has been registered with PROSPERO (CRD42022371097).

Ethics approval and consent to participate

Not applicable.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Use of AI and AI-assisted technologies

Not applicable.

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