Comparative effect of the Myobrace appliance versus traditional functional appliances in treating a class II malocclusion: a systematic review and meta-analysis

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Objective: To investigate the clinical effect of the Myobrace appliance and traditional functional appliances in treating Class II malocclusions.
Methods: Six databases (PubMed, Web of Science, Cochrane Library, ClinicalTrials.gov, CNKI, and Embase) were searched to collect and compare articles regarding the effect of the Myobrace appliance and traditional functional appliances for treating Class II malocclusions in children. The literature in both the English and Chinese languages was systematically searched. Randomised controlled trials, non-randomised controlled trials, and retrospective studies were included. A meta-analysis was performed using the RevMan5.4.1 software.
Results: A total of 12 trials involving 577 patients were included in the quantitative synthesis analysis. The results indicated that, compared to a Twin-block group, the Myobrace group showed significantly smaller reductions in the SNA angle, smaller increases in Ar-Go and Go-Me (mm), and smaller decreases in overbite and overjet (mm) ($p < 0.05$ for all). Additionally, compared to an Activator group, the Myobrace group demonstrated a significantly smaller increase in the SNB angle ($p < 0.05$).
Conclusions: Moderate evidence suggests that the Myobrace appliance and traditional functional appliances were effective in correcting a Class II malocclusion, but the Twin-block appliance was more effective than the Myobrace appliance in inhibiting maxillary growth and reducing overjet and overbite, while the Activator was more effective in promoting mandibular growth.
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Introduction

A Class II malocclusion is characterised by a convex facial profile resulting from maxillary protrusion, mandibular retrusion, or a combination of both.[1] A Class II malocclusion affects approximately one third of the population[2] and influences an individual's quality of life, oral-facial function[3,4] as well as affecting psychological wellbeing due to its impact on facial appearance.[3–5]

Growth modification with functional appliances such as the Twin Block and Activator is often applied in the treatment of Class II growing patients.[6–8] However, these appliances have disadvantages, which include discomfort, speech difficulty, psychological embarrassment, and reduced aesthetics. These factors sometimes compromise a patient's compliance.

Since the 1990s, the Myobrace range of functional appliances has been established,[9] and has spread from Australia to more than 100 countries around the world.[10] The appliance often needs to be worn overnight and for one to two hours during the day.[11] Although controversial, the advantages of the Myobrace appliance is the promotion of mandibular growth compared with conventional functional appliances. It has been reported that the Myobrace appliance has a similar effect in promoting jaw growth compared with traditional functional appliances.[12] However, a contrary study has reported that the Myobrace appliance is not as effective as traditional functional appliances.[13] A recent systematic review compared the effect of Myobrace and the Twin Block on class II malocclusions in children, but the inclusion and exclusion criteria were ambiguous, and only five heterogeneous studies were identified which precluded a quantitative synthesis.[14]

Therefore, the aim of the present systematic review was to compare the treatment effect of the Myobrace appliance and traditional functional appliances in the treatment of Class II malocclusions.

Material and methods

This systematic review and meta-analysis adhered to the guidelines set forth by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[15]

Types of studies and participant characteristics

Studies,[16] involving both randomised controlled trials (RCTs) and non-randomised studies (NRS, with prospective and retrospective designs), that reported Class II malocclusion participants using the Myobrace appliance as an intervention, were included. The other types of reviews, case series, case reports, and studies lacking a comparative group were excluded. Additionally, studies involving participants with systemic diseases or craniofacial syndromes were not considered.

The primary outcomes assessed were overjet reduction, dental changes, and hard- and soft-tissue changes. No restrictions were applied regarding patient age nor gender, follow-up duration, the type of traditional functional appliances, or the number of participants.

Search strategy and study selection

Comprehensive search strategies tailored for MEDLINE were designed and accordingly modified to suit the remaining databases. Databases, including PubMed, Web of Science, Cochrane Library, ClinicalTrials.gov, CNKI and Embase were searched (Appendix I). A manual search was conducted through the references of the included articles to identify any additional relevant studies. The initial literature search was conducted in March 2024 and was updated in July 2024.

Unpublished literature was searched throughout 12 databases, including ClinicalTrials.gov, OpenGrey, the World Health Organization's International Clinical Trials Registry Platform, the Database of Abstracts of Reviews of Effects, Health Technology Assessment, the Translating Research into Practice Database, the International Federation of Pharmaceutical Manufacturers' Associations Clinical Trials Portal, the International Standardized Randomized Controlled Trial Number Registry, the U.K. National Research Registry, Eli Lilly and Company Clinical Study Registry and Results, OpenSIGLE, and the Pharmaceutical Industry Clinical Trials Database.

Data collection and analysis

Two independent investigators (Z.C. and J.R.) assessed the articles and extracted data according to the inclusion and exclusion criteria. Also evaluated was the methodological quality of the trials included in the present review. When disagreements arose, the investigators were required to provide detailed justifications for their judgments, and most discrepancies were resolved at this stage. For cases in which consensus was still not reached after the initial

discussion, a third investigator (J.L.) was consulted. Finally, by integrating all opinions, the final list of included studies and their methodological quality was determined.

RCTs were evaluated using methods outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Version 6.5, 2024), which considered six domains: (1) random sequence generation, (2) allocation sequence concealment, (3) blinding of outcome assessment, (4) incomplete outcome data, (5) selective outcome reporting, and (6) other sources of bias. Each domain's bias risk was classified as 'low risk', 'high risk', or 'unclear risk' per trial. Based on these evaluations, the overall bias risk of each RCT was categorised as 'low risk' (all key domains at low risk), 'high risk' (≥1 key domain at high risk), or 'unclear risk' (≥1 key domain at unclear risk).[16]

Non-randomised studies (NRS) were evaluated using the Methodological Index for Non-Randomized Studies (MINORS).[17] The MINORS tool consists of 12 items, each scored on a 0–2 scale (0: not reported, 1: reported but inadequate, 2: reported and adequate). The maximum possible score was 16 for non-comparative studies and 24 for comparative studies. The key aspects of assessed study quality included study design, selection criteria, outcome measurement, follow-up, and statistical analysis. Based on the scores, studies were categorised as high-quality (score≥17), medium-quality (score between 9 and 16), or low-quality (score ≤ 8) (Table II).

The quality of evidence related to review questions was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system, facilitated by GRADEprofiler 3.6 software from McMaster University, Ontario, Canada.

Statistical analysis

The meta-analysis was performed by two researchers using Revman 5.4 and Stata 17.0 software to ensure the accuracy of the results. Continuous variables were expressed as mean difference (MD) and its 95% confidence interval (CI), and I^2 was used to evaluate heterogeneity. If the heterogeneity was low ($P \geq 0.1$, $I^2 \leq 50\%$), a fixed-effects model was used for meta-analysis; if statistically significant heterogeneity existed ($P < 0.1$, $I^2 > 50\%$), the source of heterogeneity was explained and a random-effects model was performed.[18]

Results

Study characteristics

A total of 48 full-text articles were assessed for relevance. After applying the inclusion and exclusion criteria, 35 studies were excluded, and 13 trials (n = 674 participants) were included in the qualitative analysis[12,13,19–29] (Figure 1 and Appendix II). An ongoing study was identified on ClinicalTrials.gov; however, attempts to obtain data from the corresponding author were unsuccessful at the time of writing this review.

Of the participants, 348 wore Myobrace appliances, 196 participants wore conventional functional appliances, and 130 did not use any appliance (Table I). Of the included studies, nine[12,19–23,26,27,29] were RCTs and four studies[13,24,25,28] were NRS. Eight studies compared the Myobrace appliance with the Twin-block; three studies compared Myobrace and the Activator; and two studies evaluated Myobrace's other treatment outcomes.

One study[29] claimed that there was no significant difference in the effectiveness of the Myobrace appliance and the Activator in correcting overjet, overbite, the sagittal molar relationship, and lip seal in a 6-month study, but the essential data were missing from the article. The corresponding authors were contacted via email to request their original experimental data, however, no response was received by the time of writing the present review. Consequently, this study[29] was only included in the qualitative analysis and excluded from the meta-analysis. Therefore, 12 studies were finally included in the meta-analysis, and comprised 577 participants (291 wore the Myobrace appliance; 116 wore a Twin-block; 40 wore an Activator; and 130 patients did not use any orthodontic appliance).

The results were categorised into skeletal measurements and dental measurements, including SNA, SNB, ANB, Ar-Go (mm), Go-Me (mm), overbite (mm), overjet (mm), U1-SN (°), U1-NA (°), U1-NA (mm), L1-MP (°), L1-NB (°), L1-NB (mm), U3-3 (mm), U6-6 (mm), L3-3 (mm), L6-6 (mm). Soft tissue measurements were not pooled due to the lack of results.

Risk of bias of the studies

A limitation of all RCTs is the impossibility of imposing blinding to either participants or personnel,

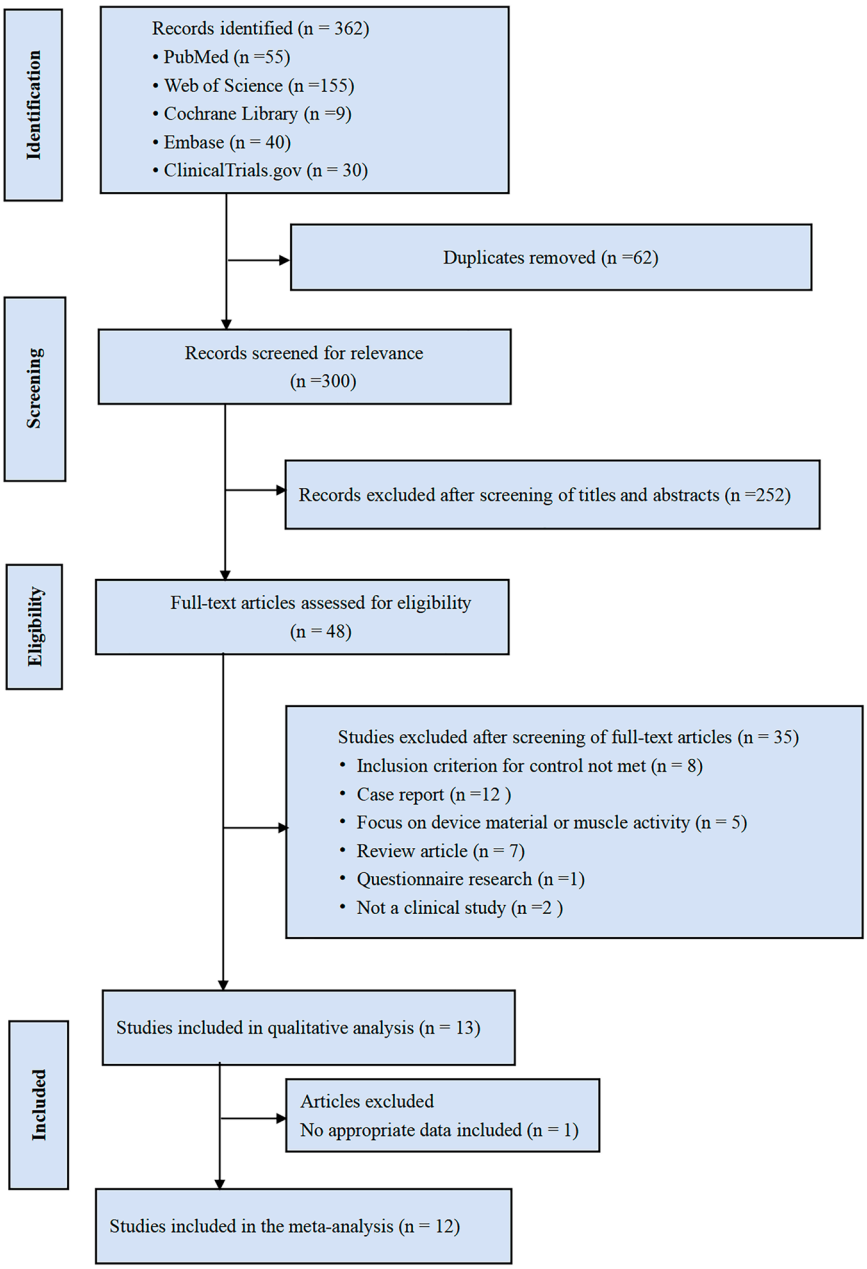

Figure 1. Study flowchart.

resulting in an assessment of a high risk of bias. Based on the Cochrane Collaboration's tool for assessing the risk of bias, the results of assessment for the RCTs are shown in Figure 2. For the NRS's assessment using the MINORS tool, the results showed that, of the four studies, two were of high quality and two were of medium quality (Table II). Appendix III details the risk of bias assessment reason for all included studies.

Meta-analysis of Myobrace versus Twin-Block

Statistically significant differences were observed in three out of the five skeletal measurements assessed. The meta-analysis indicated that the pooled mean difference (MD) was SNA (0.36°, 95% CI 0.06–0.66, P = 0.02), Ar-Go (-1.51mm, 95% CI -2.82– -0.15, P = 0.03), and Go-Me (2.19mm, 95% CI 0.37– 4.02, P = 0.02). The results suggest that the Myobrace appliance may be less effective than

Table I. Characteristics of the 13 included studies

	Study (Author year)	Country	Study design	Sample size	Age (years)	Myobrace group	Comparison group	Treatment time	Outcomes		
									Dentoalveolar	Skeletal	Soft tissue
1	Ramirez-Yañez 2007[25]	USA	NRS	120	8.3 ± 1.0	T4K® (n=60)	No treatment (n = 60)	6 months	U6-6(mm), U3-3(mm), L6-6(mm), L3-3(mm)	N/A	N/A
2	Cirgić 2015[30]	Sweden	RCT	97	7-14	Myobrace® (n=57)	Activator (n=40)	12 months	Overjet, Overbite	sagittal relation,	lip seal
3	Sun 2018[21]	China	RCT	20	8 -11	Myobrace® (n=10)	Activator (n=10)	6 months	L1-NB(mm), L1-NB(°) , U1-NA(mm), U1-NA(°) , Co-Pg, Overjet, Overbite	SNA, SNB, ANB	N/A
4	Idris 2019[22]	Syria	RCT	60	10.3 ± 1.4	T4K® (n=30)	Activator (n=30)	12-18 months	Overjet, Overbite, Ls to E, Li to E, U1-SN	SNA, SNB, ANB, N-Me, N-ANS, ANS-Me, MP-FH	N/A
5	Elhamouly 2020[26]	Egypt	RCT	20	9-12	T4K® (n=10)	Twin-Block (n=10)	18-24 months	Overjet, U1-FHP, L1-MP, Is-APog(mm), Ii-NB(mm), U6-PL.P (mm), L6-MP(mm), mi-PtV(mm), UAP(mm), LAP(mm)	N/A	N/A

6	Hanoun 2020[23]	America	RCT	43	11-14	T4F (n=21)	Twin-Block (n=22)	10-12 months	Overjet, Overbite, Sv_is (mm), Sv_ii (mm), Sv_ii (mm)	SNA, SNB, ANB, Sn-Man(°), MMPA(°)	N/A
7	Ji 2020[27]	China	RCT	25	9.1 ± 1.3	Myobrace® (n=13)	Twin-Block (n=12)	12 months	U1-SN(mm), U1-SN(°), L1-NB(mm), L1-NB(°), L1-MP, Overjet, Overbite	SNA, SNB, ANB, FH-MP, NP-FH	N/A
8	Xie 2020[19]	China	RCT	22	9.7 ± 1.3	Myobrace® (n=11)	Twin-Block (n=11)	12 months	U1-NA mm), U1-NA (°), L1-NB (mm), L1-NB (°), Po-NB (mm),	SNA, SNB, ANB, FMA, FH-MP, Y-axis (°), NP-FH (°), SN-FH (°)	N/A
9	Chen 2021[28]	China	NRS	40	12.43 ± 0.76	Myobrace® (n=20)	Twin-Block (n=20)	6 months	U1-SN, L1-MP	SNA, SNB, ANB, FH-MP, Y axis, NP-FH	CmSnLs(°), A'Ls-FH(°), IMsLs-FH(°), IMsLs-FH(°), LiB'Pg'(°), GSnPg'(°)
10	Johnson 2021[31]	UAE	RCT	20	10.40 ± 1.89	Myobrace® (n=10)	Twin-Block (n=10)	9 months	U1-NA (mm), U1-NA (°), L1–NB (mm), L1-NB (°), U1–SN, Overjet, Overbite, U6-6(mm), L6-6(mm)	SNA, SNB, ANB, NA-Pog, PP-MP, Ar-Gn, Go-Ar, Go-Me	N/A

Table I. continued

									Outcomes		
	Study (Author year)	Country	Study design	Sample size	Age (years)	Myobrace group	Comparison group	Treatment time	Dentoalveolar	Skeletal	Soft tissue
11	Habumugisha 2022[24]	China	NRS	145	7.41 ± 1.21	Myobrace® (*n*=75)	No treatment (*n*=70)	12 months	U1-NA (°), L1-NB(°), Overjet, Overbite, U6-6(mm), U3-3(mm), L6-6(mm), L3-3(mm)	SNA, SNB, ANB, FH-MP, SN-GoGn, S-Go	N/A
12	Çoban Büyükbayraktar and Camcı (2023)[13]	Turkey	NRS	36	12.14 ± 1.23	Myobrace® (*n*=18)	Twin-Block (i=18)	12-16 months	U1-NA (mm), U1-NA (°), L1–NB (mm), L1-NB (°), U1-SN (°), Overjet, Overbite, Pg–NB (mm), FMA (°)	SNA, SNB, ANB, FMA (°), FMIA (°),	Upper lip-E line, Lower lip-E line
13	Madian 2023[12]	Egypt	RCT	26	9 – 12	Myobrace® (*n* = 13)	Twin-Block (*n*=13)	16 months	N/A	SNA, SNB, ANB, Wits appraisal, FMA	pharyngeal airway area

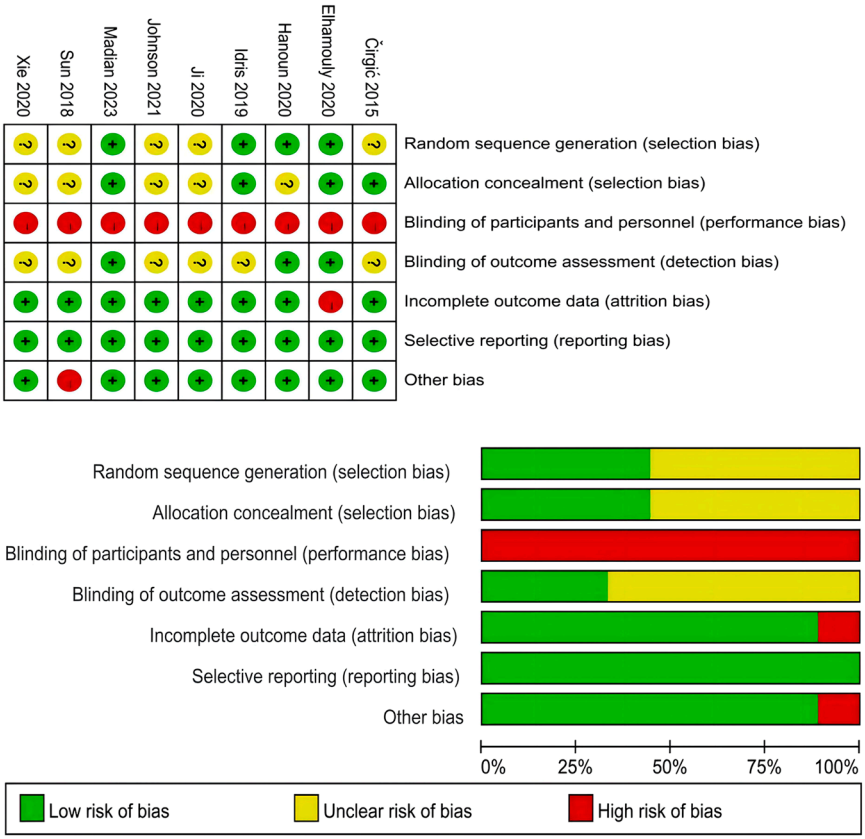

Figure 2. Risk of bias.

Twin-Block appliances in inhibiting maxillary growth and promoting mandibular ramus advancement. However, in promoting mandibular body growth, the Myobrace appliance appears to be superior to the Twin-Block appliance (Figure 3-1).

Statistically significant differences were found in two of the eight dental measurements analysed. The meta-analysis indicated that the pooled mean difference (MD) was overbite (0.83mm, 95% CI 0.10–1.55, P = 0.03), and overjet (1.45mm, 95% CI 0.10–2.79, P = 0.03). These might indicate that the Myobrace appliance is less effective than Twin-Block appliances in reducing overjet and overbite in Class II malocclusion patients (Figure 3-2).

There were no statistically significant differences observed in the other cephalometric parameters (Figure 3-1 and 3-2).

Meta-analysis of Myobrace versus activator

Statistically significant differences were observed in one out of the three skeletal measurements assessed. The meta-analysis indicated that the pooled mean difference (MD) was SNB (-0.86°, 95% CI -1.51– -0.21, P = 0.009). These may indicate that the Myobrace appliance was inferior to Activator appliances in promoting mandibular growth. No statistical difference was found in the other cephalometric parameters (Figure 4).

Meta-analysis of the Myobrace for transverse expansion

The meta-analysis showed no statistically significant difference between the Myobrace group and the no-treatment control group for the U3-3 (mm) (cuspal distance of the cuspids on both sides of the maxilla), U6-6 (mm) (central fossa distance of the first molar on both sides of the maxilla), L3-3 (mm) (cuspal distance of the cuspids on both sides of the mandible), or L6-6 (mm) (central fossa distance of the first molar on both sides of the mandible). These results suggest that the effect of the Myobrace appliance on increasing the transverse width of the maxillary and mandibular dental arches is weak (Figure 5).

Table II. Summary of risk bias of Non-Randomized Study (NRS) included in the study based on Methodological Index for Non-Randomized Studies (MINORS) scores (0-8 points: low quality; 9-16 points: medium quality; 17-24 points: high quality)

Assessment criteria	Ramirez-Yañez (2007)[25]	Chen (2021)[28]	Habumugisha (2022)[24]	Çoban Büyükbayraktar and Camcı (2023)[13]
Clear research objectives	2	2	2	2
Continuity of inclusion of patients	2	2	2	2
Expected data collection	2	2	2	2
Outcome indicators reflect appropriately research purpose	2	2	2	2
Outcome measure objectivity	0	1	2	2
Whether the follow-up time was sufficient	2	2	2	2
The rate of lost to follow-up	0	0	0	2
Whether to estimate the sample size	0	0	1	2
Whether the control group was appropriate	2	2	2	2
Whether the control group is synchronized	0	0	2	0
Intergroup baseline	1	0	2	0
Reliability of data statistics	2	2	2	2
Total	15	15	21	20
Quality level	Medium	Medium	High	High

Table 2. Summary risk bias of NRS.

Grading of evidence

The majority of the evidence was assessed to be of a moderate level (Appendix IV).

Discussion

A Class II malocclusion is a prevalent relationship problem in adolescents[19] and a previous study has shown that approximately 32.6% of 700 subjects presented with a Class II malocclusion.[2] The present systematic review focused on 13 articles involving a total of 674 patients. According to current knowledge, this is the first systematic review to evaluate the comprehensive effectiveness of the Myobrace appliance in the treatment of a Class II malocclusion in comparison with the Twin-Block, Activator and a no-treatment control group.

Myofunctional devices were initially proposed by Robin in 1902 and Anderson in 1908 with the aim of promoting growth in patients with a mandibular deficiency.[22] Myofunctional appliances have been used extensively, especially in the treatment of Class II malocclusions.[32,33] Several types of myofunctional appliances commonly used include the Twin-block, Activator appliances, and the Myobrace appliance.[2,22,29,34]

Similar to other functional appliances, the Myobrace elongates the fibres of the mandibular protractor muscles.[33] When using the 'Trainer' appliance, the muscles remain stretched. During a sleep period (10–12 hr), the diameter of blood vessels is reduced, which hinders adequate blood flow and decreases blood oxygen levels and metabolism. The result is the accumulation of lactic acid leading to muscle fatigue. Upon removal of an appliance, the overextended muscles become hyper-contractible, which causes both forward and backward movement of the mandible.[33] The Myobrace appliance is designed to provide a comprehensive effect, including guidance

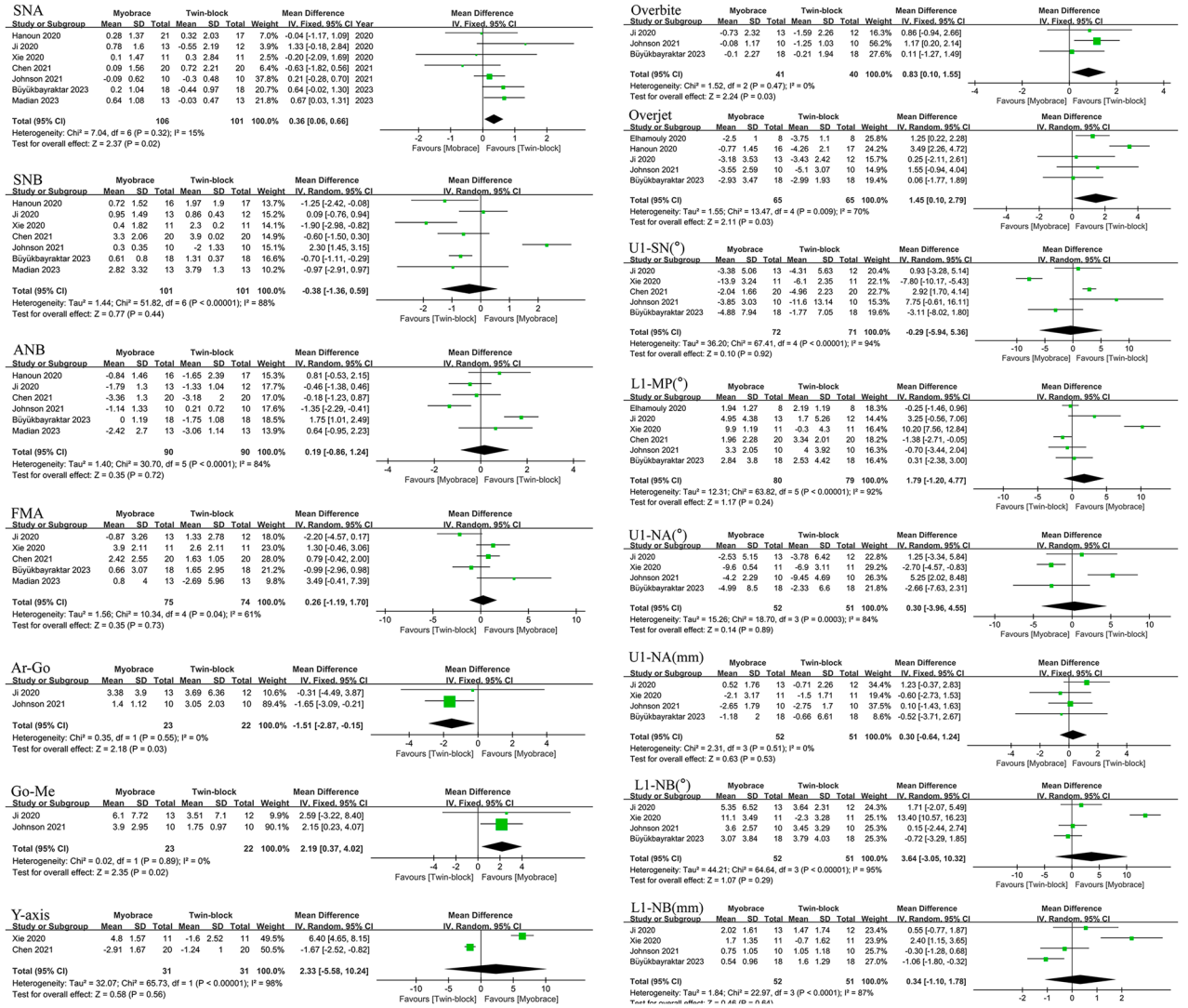

Figure. 3 -1. Skeletal change between patients treated with Myobrace and Twin-Block appliances. Figure 3-2. Dentoalveolar change between patients treated with Myobrace and Twin-Block appliances.

of tooth development, training of muscle function, and early intervention.[23,35] The appliance is user friendly, easy to remove and to clean plus allows for the correction of dental alignment and habits without the need for fixed appliances.[36]

Of the included studies, the reported treatment effects often incorporated skeletal and dental measurements. For example, the skeletal measurements usually included SNA, SNB, ANB, Ar-Go (mm), Go-Me (mm), FH-MP (°), NP-FH (°), *Y*-axis (°).[12,13,19–24,27,28] The dental measurements usually included overbite (mm), overjet (mm), U1-SN (°), U1-NA (°), U1-NA (mm), L1-MP (°), L1-NB (°), L1-NB (mm), U3-3 (mm), U6-6 (mm), L3-3 (mm), L6-6 (mm).[13,19–28] In relation to soft tissue changes, there were only a few studies which reported changes in the lip seal, Gla-Sub-Pg (°), nasolabial angle (Cl.Sn.SLS), mentolabial angle (Li.Ils.Pog), upper lip-E line, lower lip-E line.[13,28,29] Changes in the pharyngeal airway area were only reported in one study.[12] Based on the current meta-analysis, traditional functional appliances demonstrated a more significant effect than the Myobrace appliance in reducing overbite and overjet, decreasing the SNA angle, and increasing the SNB angle; however, the Myobrace appliance showed a similar effect compared with a conventional functional appliance in reducing the ANB angle. Although quantitative results demonstrated that Twin Block appliances achieved a 1.45 mm greater reduction in overjet and a 0.83 mm greater reduction

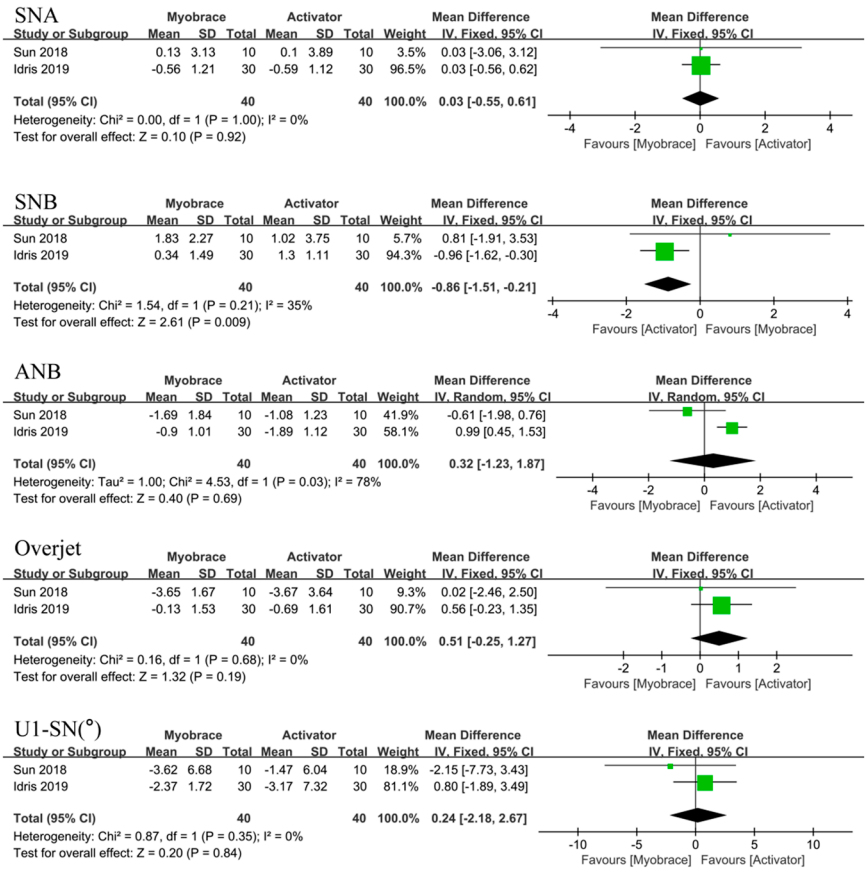

Figure 4. Skeletal and dentoalveolar change between patients treated with Myobrace and Activator appliances.

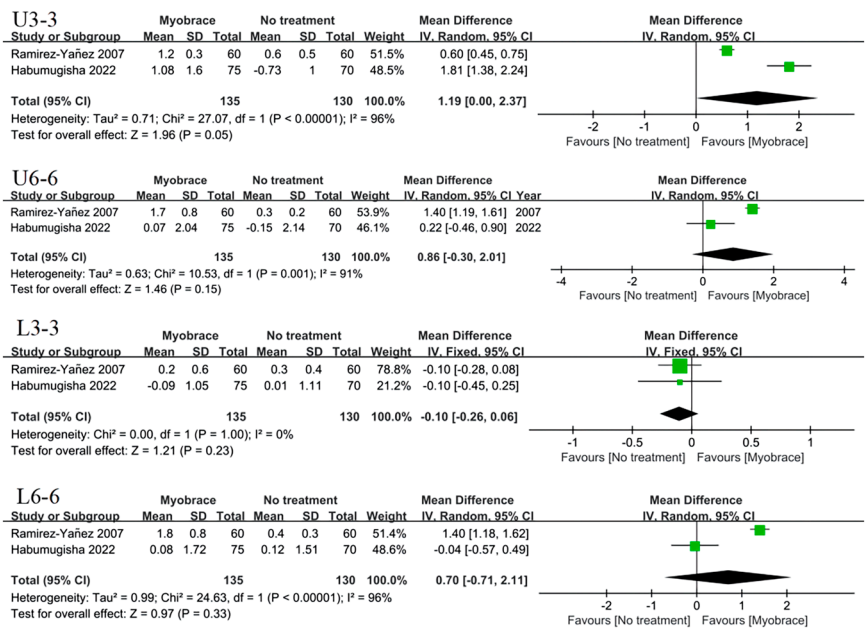

Figure 5. Skeletal and dentoalveolar change between patients treated with Myobrace and untreated controls.

in overbite compared to the Myobrace appliance, some clinicians contend that these differences may not reach the threshold of clinical significance, particularly considering evidence suggesting that initial differences may not persist long-term.[37] A notable advantage of the Myobrace appliance is its lower cost, as it eliminates the need for impressions and laboratory work.[30] However, this conclusion is based on a single RCT, which highlights the need for further studies to evaluate its cost effectiveness. The potential cost savings could be particularly appealing to clinicians, especially those in remote areas without laboratory access, and the elimination of impressions may benefit early childhood treatment.

A previous study also showed that the Myobrace appliance and the Twin Block had similar effectiveness in treating a Class II malocclusion.[31] However, an earlier study reported that conventional functional orthodontic appliances were slightly more effective than the Myobrace appliance in reducing the ANB angle, which decreased by 1.92° in a Twin Block group and 1.34° in a Myobrace group.[23] Both appliances promoted an increase in mandibular body length and contributed to the correction of the Class II malocclusion.[23] In relation to soft tissue changes and the convexity of the facial angle, the Twin Block showed a greater effect than the Myobrace appliance.[38] In addition, the Myobrace appliance did not seem to have a significant effect on arch expansion compared to natural growth in the no treatment group.

The Myobrace appliance showed limited efficacy in treating a Class II malocclusion compared with conventional functional appliances like the Twin-Block or Activator, which indicated that these findings are of clinical significance. The modest effect size of the Myobrace appliance suggests that it may be more appropriate for patients with a mild-to-moderate malocclusion or those seeking an economic treatment approach. In contrast, traditional functional appliances may provide better outcomes, particularly for moderate-to-severe Class II cases, due to their ability to deliver more direct and consistent forces to dental and skeletal structures.

Compared with traditional functional appliances, the Myobrace appliance eliminates the need for impressions and subsequent laboratory work.[32] It is small, comfortable, and enables children to adapt more quickly.[39] Moreover, it costs less than conventional functional appliances.[40]

Patient compliance is critical for the success of functional treatment, and maintaining motivation throughout a treatment period is essential. Poor compliance can lead to delayed or less effective treatment outcomes, and may incur slower occlusal progress or failure to achieve intended corrections.[39] An inconsistent use of the Myobrace appliance may impair its ability to promote dental and skeletal changes, including correcting a Class II malocclusion and improving jaw alignment.[26] This can result in longer treatment durations, more frequent clinical visits, and potentially the need for additional interventions, thereby increasing overall treatment costs. With proper patient co-operation, functional treatments (such as Myobrace) can also help reduce the risk of future relapse.[29]

Patient compliance with the Myobrace appliance is an important consideration, as it is generally associated with high dropout rates and poor adherence.[22,23] For example, a large Swedish RCT reported a 70% unsuccessful treatment rate in the Myobrace group.[37] The looseness of the appliance, which creates a gap between teeth and the appliance particularly during sleep, may contribute to the high failure rate. Moreover, the Myobrace appliance can interfere with speech and daily activities, causing inconvenience and requiring significant adjustment, which delays treatment and hinders its effectiveness.[22]

It is also noteworthy that in some studies, patients who did not adhere to the prescribed wearing protocol were excluded from analysis, and only those who followed the established wearing protocol were included. This approach fails to accurately represent the real clinical setting, as some patients may be unable to consistently and fully adhere to their treatment regimen in their daily lives. Consequently, the results of the study may be subject to selection bias and fail to accurately reflect the treatment outcomes of a typical patient. Such selective exclusion may result in an overestimation of the treatment effect, thereby limiting the external validity and clinical applicability of the study findings.

It is important to note that the majority of current studies on the Myobrace appliance lack sufficient follow-up, with only two studies reviewed for six months to one year.[12,28] However, the two studies did not report dental and skeletal changes after follow-up. A limitation of short-term follow-up is that it may not allow for a comprehensive evaluation of long-term

stability and changes in treatment effects. During childhood and adolescence, oral and facial structures undergo significant growth.[41,42] A follow-up period of only 6 to 12 months may fail to capture the full impact of ongoing growth on a treated occlusion. For example, mandibular growth may continue post-treatment, potentially altering corrected overjet and overbite. While the Myobrace appliance aims to guide muscle function and skeletal development, the long-term effects of its intervention on craniofacial growth remain unclear.

Patient compliance was reported in only a limited number of Myobrace studies.[22,26,37] Many studies did not document the number of operators nor their experience levels, which may be potential sources of bias. Additionally, selection bias was likely in participant recruitment and inclusion criteria. The variability in selection processes across studies potentially led to unrepresentative samples and affected the generalisability of the results. Although stringent inclusion criteria were applied to mitigate this, inherent biases in the original studies remain.

The present review has several limitations. The small number of included studies warrants caution in interpreting the results. Some studies were retrospective, and relied on pre-existing data, which may introduce selection bias. The lack of random subject allocation and blinding of participants and staff further increases the risk of performance bias. Additionally, the scarcity of studies assessing long-term outcomes, particularly post-retention results, significantly limits the ability to comprehensively evaluate the stability of Myobrace treatment.

Future research should examine how patient factors such as age, compliance, and malocclusion severity influence treatment outcome stability, soft tissue changes, psychological outcomes, patient satisfaction, anxiety, and self-esteem. High-quality, well-designed clinical trials are crucial for developing definitive clinical recommendations for Myobrace appliances.

Conclusions

Moderate evidence suggests that the Myobrace appliance and traditional functional appliances are effective in correcting a Class II malocclusion, but the Twin-Block appliance is more effective than the Myobrace appliance in inhibiting maxillary growth and reducing overjet and overbite, while the Activator better promotes mandibular growth. The Myobrace appliance offers a cost-effective, less invasive treatment option but may not be suitable for all cases, particularly a severe Class II malocclusion. In contrast, traditional appliances like the Twin-Block and Activator may provide superior dental and skeletal outcomes.

Conflict of interest

The authors declare that there is no conflict of interest.

Declarations

The authors declare that they have no competing interests.

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Author's contribution

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Appendix I. Search strategy

Table A. Search strategy for Medline via PubMed (n=55)	
#1	"Myobrace" [Title/Abstract]
#2	"The Trainer System" [Title/Abstract]
#3	"Trainer for Kids" [Title/Abstract]
#4	"T4K"[Title/Abstract]
#5	#1 or #2 or #3 or #4
Table B. Search strategy for EMBASE (n=40)	
#1	'Myobrace'
#2	'The Trainer System'
#3	'Trainer for Kids'
#4	'T4K'
#5	#1 OR #2 OR #3 OR #4
Table C. Search strategy for Web of Science (n=155)	
#1	TI: (Myobrace)
#2	TI: (The Trainer System)
#3	TI: (Trainer for Kids)
#4	TI: (T4K)
#5	#1 or #2 or #3 or #4
Table D. Search strategy for CENTRAL (The Cochrane Library) (n=9)	
#1	Myobrace:ti,ab,kw
#2	"The Trainer System":ti,ab,kw
#3	"Trainer for Kids"):ti,ab,kw
#4	T4K:ti,ab,kw
#5	#1 or #2 or #3 or #4
Table E. Search strategy for ClinicalTrials.gov (n=30)	
#1	Myobrace
#2	"The Trainer System"
#3	"Trainer for Kids"
#4	T4K
#5	#1 OR #2 OR #3 OR #4
Table F. Search strategy for China National Knowledge Infrastructure (n=73)	
#1	篇关摘: Myobrace (精确)
#2	篇关摘: MRC 矫治器(精确)
#3	篇关摘: T4K 矫治器(精确)
#4	#1 OR #2 OR #3

Appendix II. Articles excluded from the review

Number	Article	Reason for exclusion
1	Levrini L, Salone GS, Ramirez-Yanez GO. Pre-Fabricated Myofunctional Appliance for the Treatment of Mild to Moderate Pediatric Obstructive Sleep Apnea: A Preliminary Report. J Clin Pediatr Dent. 2018;42(3):236-9.	Inclusion criterion for control not met
2	Dinkova M. Vertical Control of Overbite in Mixed Dentition by Trainer System. Journal of IMAB - Annual Proceeding (Scientific Papers). 2014;20:648-54.	Inclusion criterion for control not met
3	Levrini L, Persano R, Piantanida S, Carganico A, Deppieri A, Naboni G, et al. The Effects of the Myobrace(®) System on Peripheral Blood Oxygen Saturation (SpO(2)) in Patients with Mixed Dentition with Oral Dysfunction. Dent J (Basel). 2023;11(8).	Inclusion criterion for control not met
4	Alhasyimi AA, Syahfik I. Growth Modification of Developing Class II Division 1 Malocclusion Using Myofunctional Appliances. Case Rep Dent. 2023;2023:8201195.	Case report
5	Rezky Oktaviyani R, Harun A, Wesley K, Iriani F, Nurwahidah A, Sulfina H, et al. Myobrace versus twin block in the treatment of class II malocclusion in Children: A systematic review. Saudi Dent J. 2024;36(5):661-4.	Review article
6	Ahn ES, Kim AH, Shim YS, An SY. Oropharyngeal Airway Three-dimensional Changes after Treatment with Myobrace in Class II Retrognathic Children. Iran J Public Health. 2017;46(2):265-7.	Case report
7	Cheng HW, Ho CT, Kao CT. A useful method to correct early unilateral posterior crossbite. J Dent Sci. 2022;17(3):1401-2.	Case report
8	Aggarwal I, Wadhawan MC, Dhir V, Kumar A. Myobraces: Say No to Traditional Braces. Int J Oral Care Res. 2016;4(1):82-5.	Review article
9	Achmad H, Auliya N. Management of Malocclusion in Children Using Myobrace Appliance: A Systematic Review. F1000Research. 2024;13:53.	Review article
10	Mohammed H, Ćirgić E, Rizk MZ, Vandevska-Radunovic V. Effectiveness of prefabricated myofunctional appliances in the treatment of Class II division 1 malocclusion: a systematic review. Eur J Orthod. 2020;42(2):125-34.	Review article
11	Achmad H, Horax S, Singgih M, Samad R, Sumintarti S, Rieuwpassa I, et al. The effectiveness of myobrace on the treatment of malocclusion and bad habits in children. Int J Health Sci. 2022:4073-82.	Review article
12	Anastasi G, Dinnella A. Myobrace System: a no-braces approach to malocclusion and a myofunctional therapy device. Webmed Cent Orthod. 2014;5:WMC004492.	Review article
13	Ramirez-Yañez GO, Flutter J, editors. Facial Symmetry Improves After Treating Malocclusions with the Myobrace™ System. Ec Dental Science. 2016; 712.	Inclusion criterion for control not met
14	Rautela M, Aeran H, Dhawan P. Myobrace: From braces to no braces. Guident. 2017;10(9),28.	Case report
15	Elnaili SA, Bushwigeer SS, Alzway AA, editors. Myobrace as an alternative to conventional orthodontics treatment. 2019.	Not a clinical study
16	Wishney M, Darendeliler MA, Dalci O. Myofunctional therapy and prefabricated functional appliances: an overview of the history and evidence. Australian dental journal. 2019;64(2):135-44.	Review article
17	Ahn ES, Kim AH, Shim YS, An SY. Oropharyngeal Airway Three-dimensional Changes after Treatment with Myobrace in Class II Retrognathic Children. Iran. J. Public Health. 2017;46(2):265-7.	Not a clinical study
18	Dinkova M. Vertical control of overbite in mixed dentition by Trainer system. J IMAB. 2014 Oct-Dec;20(5):648-54.	Case report
19	Tripathi NB, Patil SN. Treatment of class II division 1 malocclusion with myofunctional trainer system in early mixed dentition period. The journal of contemporary dental practice. 2011;12(6):497-500.	Case report

Appendix II. continued

Number	Article	Reason for exclusion
20	Uysal T, Yagci A, Kara S, Okkesim S. Influence of pre-orthodontic trainer treatment on the perioral and masticatory muscles in patients with Class II division 1 malocclusion. Eur J Orthod. 2012;34(1):96-101.	Focus on muscle activity
21	Quinzi V, Gallusi G, Carli E, Pepe F, Rastelli E, Tecco S. Elastodontic Devices in Orthodontics: An In-Vitro Study on Mechanical Deformation under Loading. Bioengineering. 2022;9(7).	Focus on material properties
22	Yagci A, Uysal T, Kara S, Okkesim S. The effects of myofunctional appliance treatment on the perioral and masticatory muscles in Class II, Division 1 patients. World J Orthod. 2010;11(2):117-22.	Focus on muscle activity
23	Cheng HW, Ho CT, Kao CT. A useful method to correct early unilateral posterior crossbite. J Dent Sci. 2022;17(3):1401-2.	Case report
24	Dinu S, Buzatu R, Macasoi I, Popa M, Vlad CS, Marcovici I, et al. Toxicological Profile of Biological Environment of Two Elastodontic Devices. Processes. 2021;9(12):2116.	Focus on material properties
25	Satygo EA, Silin AV, Ramirez-Yañez GO. Electromyographic muscular activity improvement in Class II patients treated with the pre-orthodontic trainer. J Clin Pediatr Dent. 2014;38(4):380-4.	Focus on muscle activity
26	Tripathi NB, Patil SN. Treatment of class II division 1 malocclusion with myofunctional trainer system in early mixed dentition period. J Contemp Dent Pract. 2011;12(6):497-500.	Case report
27	Saccomanno S, Antonini G, D'Alatri L, D'Angelantonio M, Fiorita A, Deli R. Patients treated with orthodontic-myofunctional therapeutic protocol. Eur J Paediatr Dent. 2012;13(3):241-3.	Case report
28	Pachori Y, Navlani M, Gaur T, Bhatnagar S. Treatment of skeletal class II division 1 malocclusion with mandibular deficiency using myofunctional appliances in growing individuals. J Indian Soc Pedod Prev Dent. 2012;30(1):56-65.	Case report

Appendix III. Risk of bias assessments in the included studies

Item	Authors' judgment	Description
Ramirez-Yañez 2007[25] (NRS)		
Aim of the study clear	2	Comments: The author gives a clear research purpose
Inclusion of consecutive patients	2	Comment: Patients who met the inclusion criteria were included during the study period
Prospective collection of data	2	Comments: The authors collected the indicators set out in the research plan
Endpoints appropriate to the aim of the study	2	Comments: The bone and tooth measurements in the outcome measures appropriately reflect the purpose of the study
Unbiased assessment of the study endpoint	0	Comments: The evaluation process of outcome indicators is not described
Follow-up period appropriate to the aim of the study	2	Comments: Patients in both groups were treated long enough, with the total duration of treatment lasting 1.3 ± 0.5 months
Loss to follow-up less than 5%	0	Comments: As a retrospective study, no loss of follow-up was involved
Prospective calculation of the study size	0	Comment: The author did not estimate the sample size
An adequate control group	2	Comments: The setting of the control group fits the purpose of the study
Contemporary groups	0	Comments: As a retrospective study, the experimental group and the control group were not conducted at the same time
Baseline equivalence of groups	1	Comment: Before the experiment, the authors compared the experimental group with the control group, but did not give detailed data. Quote: "Thus, each patient in the treated group had a matched control from normative data with respect to age, sex and observation period."
Adequate statistical analyses	2	Comment: The statistics match the type of study
Total	15	Medium
Cirgić 2015[30] (RCT)		
Random sequence generation	Unclear	Comment: Insufficient information to judge.
Allocation concealment	low	Quote: " An informed written consent was obtained from the parents and randomization was performed by lottery."
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	Unclear	Comment: Insufficient information to judge.
Incomplete outcome data addressed	low	Comments: Although there were missing data, the missing data was similar in the experimental group and the control group, and the missing amount was small enough to affect the final results.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.

Appendix III. continued

Item	Authors' judgment	Description
Sun 2018[21] (RCT)		
Random sequence generation	Unclear	Comment: Insufficient information to judge.
Allocation concealment	Unclear	Comment: Insufficient information to judge.
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	Unclear	Comment: Insufficient information to judge.
Incomplete outcome data addressed	low	Comment: No data missing
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	High	Comments: The sample size was too small, only 20 cases, so other bias was considered high.
Idris 2019[22] (RCT)		
Random sequence generation	low	Quote: "Sixty participants were selected randomly out of the 188 possible candidates using a computer-generated list of random numbers with the aid of SPSS."
Allocation concealment	low	Quote: "Allocation concealment was performed using opaque sealed envelopes which contained the assigned group for each patient and were not opened till the onset of the trial."
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	Unclear	Comment: Insufficient information to judge.
Incomplete outcome data addressed	low	Comments: Although there were missing data, the missing data was similar in the experimental group and the control group, and the missing amount was small enough to affect the final results.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.
Elhamouly 2020[26] (RCT)		
Random sequence generation	low	Quote: "The twenty children were randomly assigned in a 1:1 ratio using a computer-generated list of random numbers to one of the two groups."
Allocation concealment	low	Quote: "An opaque envelope that was opened after seating the participant was used for allocation."
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	low	Quote: "Two outcome assessors were blind to the appliance used during their evaluations of the X rays and the study models. Additionally, the statistician was blind to the appliances used in the group analysis."
Incomplete outcome data addressed	High	Comments: There were two patients lost to follow-up in the experimental group and the control group, which reached 20% of the total number of cases.

Appendix III. continued

Item	Authors' judgment	Description
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.
Hanoun 2020[23] (RCT)		
Random sequence generation	low	Quote: "The prospective parallel design study involved a simple randomization using an online randomization tool."
Allocation concealment	Unclear	Comment: Insufficient information to judge.
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	low	Quote: "The radiographs were re-coded so that the grouping and any identity were obscured to the investigators."
Incomplete outcome data addressed	low	Comments: No subjects dropped out and data was missing.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.
Ji 2020[27] (RCT)		
Random sequence generation	Unclear	Comment: Insufficient information to judge.
Allocation concealment	Unclear	Comment: Insufficient information to judge.
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	Unclear	Comment: Insufficient information to judge
Incomplete outcome data addressed	low	Comment: No data missing.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.
Xie 2020[19] (RCT)		
Random sequence generation	Unclear	Comment: Insufficient information to judge.
Allocation concealment	Unclear	Comment: Insufficient information to judge.
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	Unclear	Comment: Insufficient information to judge.
Incomplete outcome data addressed	low	Comment: No data missing.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.
Chen 2021[28] (NRS)		
Aim of the study clear	2	Comments: The author gives a clear research purpose
Inclusion of consecutive patients	2	Comment: Patients who met the inclusion criteria were included during the study period

Appendix III. continued

Item	Authors' judgment	Description
Prospective collection of data	2	Comments: The authors collected the indicators set out in the research plan
Endpoints appropriate to the aim of the study	2	Comments: The bone and tooth measurements in the outcome measures appropriately reflect the purpose of the study
Unbiased assessment of the study endpoint	1	Comments: Measured and evaluated by the author alone, which is too subjective.
Follow-up period appropriate to the aim of the study	2	Comments: The total duration of treatment in both groups lasted 10 to 12 months
Loss to follow-up less than 5%	0	Comments: As a retrospective study, no loss of follow-up was involved
Prospective calculation of the study size	0	Comment: The author did not estimate the sample size
An adequate control group	2	Comments: The setting of the control group fits the purpose of the study
Contemporary groups	0	Comments: As a retrospective study, the experimental group and the control group were not conducted at the same time
Baseline equivalence of groups	0	Comments: The authors did not describe the differences between the two groups before the trial began
Adequate statistical analyses	2	Comment: The statistics match the type of study
Total	15	Medium
		Johnson 2021[31] (RCT)
Random sequence generation	Unclear	Comment: Insufficient information to judge.
Allocation concealment	Unclear	Comment: Insufficient information to judge.
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	Unclear	Comment: Insufficient information to judge.
Incomplete outcome data addressed	low	Comment: No data missing.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.
		Habumugisha 2022[24] (NRS)
Aim of the study clear	2	Comments: The author gives a clear research purpose
Inclusion of consecutive patients	2	Comment: Patients who met the inclusion criteria were included during the study period
Prospective collection of data	2	Comments: The authors collected the indicators set out in the research plan
Endpoints appropriate to the aim of the study	2	Comments: The bone and tooth measurements in the outcome measures appropriately reflect the purpose of the study
Unbiased assessment of the study endpoint	2	The cephalometric radiographs were analyzed by a calibrated investigator with Dolphin 11.5 The investigator was blinded to the information of patients. The landmarks of cephalometric radiographs are shown in Figure 2.

Appendix III. continued

Ramirez-Yañez 2007[25] (NRS)		
Item	Authors' judgment	Description
Follow-up period appropriate to the aim of the study	2	Comment: Follow-up time is enough Quote: "Our study lasted for 13.0 ± 1.1 months."
Loss to follow-up less than 5%	0	Comment: The study involved 224 patients and was completed by 204 patients. The loss of follow-up rate is higher than 5 percent.
Prospective calculation of the study size	1	Comment: The author mentions an estimate of sample size, but the information is insufficient
An adequate control group	2	Comments: The setting of the control group fits the purpose of the study
Contemporary groups	2	Comments: Control group and experimental group were conducted at the same time.
Baseline equivalence of groups	2	Quote: "There were no statistical differences in the average age, sex, ANB°, and SNA° among the three groups (P > 0.05)."
Adequate statistical analyses	2	Comment: The statistics match the type of study
Total	21	High
Çoban Büyükbayraktar and Camcı (2023)[13] (NRS)		
Aim of the study clear	2	Comment: The author gives a clear research purpose
Inclusion of consecutive patients	2	Comment: Patients who met the inclusion criteria were included during the study period
Prospective collection of data	2	Comment: The authors collected the indicators set out in the research plan
Endpoints appropriate to the aim of the study	2	Comment: The authors collected the indicators set out in the research plan
Unbiased assessment of the study endpoint	2	Quote:"A single investigator (H.C.) performed measure ments without knowing which group each x-ray belonged to."
Follow-up period appropriate to the aim of the study	2	Comment: Follow-up time is enough Quote: "analyze the changes after one year of treatment."
Loss to follow-up less than 5%	2	Comment: There were no missing data according to the results
Prospective calculation of the study size	2	Quote:"Te sample size calculation using the G Power software revealed that at least 32 patients were required (efect size=0.8, α=0.05, and 1–β=0.90)"
An adequate control group	2	Comments: The setting of the control group fits the purpose of the study
Contemporary groups	0	Comment: As a retrospective study, the experimental group and the control group were not conducted at the same time
Baseline equivalence of groups	0	Comment: The authors did not describe the differences between the two groups before the trial began
Adequate statistical analyses	2	Comment: The statistics match the type of study
Total	20	High
Madian 2023[12] (RCT)		
Random sequence generation	low	Quote: "Twenty-six children were randomly assigned in a 1:1 ratio using a computer-generated list of random numbers to one of the two groups."

Appendix III. continued

Item	Authors' judgment	Description
Allocation concealment	low	Quote: "When a patient was deemed as eligible for enrollment, the patient was assigned to a treatment group using opaque and sealed envelopes containing the allocation number."
Blinding of participants and personnel	High	Comment: Blinding of participants and personnel is impossible.
Blinding of outcome assessment	low	Quote: "The researcher and the statistician who evaluated the data were blinded."
Incomplete outcome data addressed	low	Comment: No data missing.
Free of selective reporting	low	Comments: The indicators selected by the authors for observation before the experiment were fully reported during the experiment.
Other Bias	low	Comments: No other bias was detected.

Appendix IV. GRADE profile table

Author(s):

Date: 2024-08-04

Question: MRC vs TB for [Malocclusion]

Settings:

Bibliography: . [Myobrace] for [Malocclusion]. Cochrane Database of Systematic Reviews [Year], Issue [Issue].

Quality assessment							No of patients			Effect		
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	MRC	TB	Relative (95% CI)	Absolute	Quality	Importance
SNA (Better indicated by lower values)												
7	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	106	101	—	MD 0.36 higher (0.06 to 0.66 higher)	⨁⨁⨁⨁o MODE RATE	
SNB (Better indicated by lower values)												
7	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	101	101	—	MD 0.38 lower (1.36 lower to 0.59 higher)	⨁ooo VERY LOW	
ANB (Better indicated by lower values)												
6	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	90	90	—	MD 0.19 higher (0.86 lower to 1.24 higher)	⨁ooo VERY LOW	
FMA(°) (Better indicated by lower values)												
5	randomised trials	no serious risk of bias	serious[3]	no serious indirectness	serious[1]	none	75	74	—	MD 0.26 higher (1.19 lower to 1.7 higher)	⨁⨁oo LOW	
Ar-Go(mm) (Better indicated by lower values)												
2	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	23	22	—	MD 1.51 lower (2.87 to 0.15 lower)	⨁⨁⨁o MODERATE	
Go-Me(mm) (Better indicated by lower values)												
2	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	23	22	—	MD 2.19 higher (0.37 to 4.02 higher)	⨁⨁⨁o MODERATE	
Y-axis(°) (Better indicated by lower values)												
2	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	31	31	—	MD 2.33 higher (5.58 lower to 10.24 higher)	⨁ooo VERY LOW	

Overbite(mm) (Better indicated by lower values)											
3	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	41	40	—	MD 0.83 higher (0.1 to 1.55 higher)	⊕⊕⊕o MODERATE
Overjet(mm) (Better indicated by lower values)											
5	randomised trials	no serious risk of bias	serious[3]	no serious indirectness	serious[1]	none	65	65	—	MD 1.45 higher (0.1 to 2.79 higher)	⊕⊕oo LOW
U1-SN(°) (Better indicated by lower values)											
5	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	72	71	—	MD 0.29 lower (5.94 lower to 5.36 higher)	⊕ooo VERY LOW
U1-NA(°) (Better indicated by lower values)											
4	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	52	51	—	MD 0.3 higher (3.96 lower to 4.55 higher)	⊕ooo VERY LOW
U1-NA(mm) (Better indicated by lower values)											
4	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	52	51	—	MD 0.3 higher (0.64 lower to 1.24 higher)	⊕⊕⊕o MODE RATE
L1-NB(mm) (Better indicated by lower values)											
4	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	52	51	—	MD 0.34 higher (1.1 lower to 1.78 higher)	⊕ooo VERY LOW
L1-MP(°) (Better indicated by lower values)											
6	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	80	79	—	MD 1.79 higher (1.2 lower to 4.77 higher)	⊕ooo VERY LOW
L1-NB(°) (Better indicated by lower values)											
4	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	52	51	—	MD 3.64 higher (3.05 lower to 10.32 higher)	⊕ooo VERY LOW
SNA(°) (Better indicated by lower values)											
2	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	40	40	—	MD 0.03 higher (0.55 lower to 0.61 higher)	⊕⊕⊕o MODERATE
SNB(°) (Better indicated by lower values)											
2	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	40	40	—	MD 0.86 lower (1.51 to 0.21 lower)	⊕⊕⊕o MODERATE
ANB(°) (Better indicated by lower values)											
2	randomised trials	no serious risk of bias	very serious[2]	no serious indirectness	serious[1]	none	40	40	—	MD 0.32 higher (1.23 lower to 1.87 higher)	⊕ooo VERY LOW

U1–SN(°) (Better indicated by lower values)											
2	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	40	40	—	MD 0.24 higher (2.18 lower to 2.67 higher)	⊕⊕⊕o MODERATE
Overjet (Better indicated by lower values)											
2	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[1]	none	40	40	—	MD 0.51 higher (0.25 lower to 1.27 higher)	⊕⊕⊕o MODERATE
U3-3(mm) (Better indicated by lower values)											
2	observational studies	no serious risk of bias	very serious[1]	no serious indirectness	serious[2]	none	135	130	—	MD 1.19 higher (0 to 2.37 higher)	⊕ooo VERY LOW
U6-6(mm) (Better indicated by lower values)											
2	observational studies	no serious risk of bias	very serious[1]	no serious indirectness	serious[2]	none	135	130	—	MD 0.86 higher (0.3 lower to 2.01 higher)	⊕ooo VERY LOW
L3-3(mm) (Better indicated by lower values)											
2	observational studies	no serious risk of bias	no serious inconsistency	no serious indirectness	serious[2]	none	135	130	—	MD 0.1 lower (0.26 lower to 0.06 higher)	⊕ooo VERY LOW
L6-6(mm) (Better indicated by lower values)											
2	observational studies	no serious risk of bias	very serious[1]	no serious indirectness	serious[2]	none	135	130	—	MD 0.7 higher (0.71 lower to 2.11 higher)	⊕oooo VERY LOW

[1]75%≤I-square.

[2]The number of participants from the 4 studies totaled less than 400.

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