# Dentoskeletal Effects Produced By Twin Block Appliance And Its Modifications In Randomized Control Trials In Children Aged 10-14 Years: A Systematic Review

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**KEYWORDS**
*Twin Block Appliance, Dentoskeletal Effects, Randomized Controlled Trials, Children.*

**ABSTRACT**
**Background:** Malocclusions are multifactorial in origin and primarily associated with genetic and environmental factors. Several systems have been employed to classify malocclusions, the most accepted being Angle's classification. It includes three classes, of which class II is crucial to the current review. According to Angle, Class II malocclusion represents the distal relationship of the mandible with maxilla. Class II malocclusion is characterized by retrognathic mandible, a prognathic maxilla or a combination of both. Various appliances can rectify this malocclusion, one of which is twin block appliance. The twin block appliance consists of maxillary and mandibular acrylic plates with bite blocks that posture the mandible forward on closure and is indicated for the correction of Class II malocclusions.This appliance has been adapted in conventional and modified versions to produce effective results.
Objectives: This review was done to inspect the dentoskeletal effects produced by twin block appliance and its modifications in randomized control trials in children aged 10-14 years
**Methods:** A literature search was conducted using PubMed, Scopus, Clarivate Analytics' Web of Science and Cochrane databases. Eligibility criteria followed the PICO questions. This review planned to include "randomized controlled trials" with cross-over designs or parallel-group. Participants in this review are children who have no systemic condition and are aged from 10-14 years with clinical diagnosis of Angles class II division I malocclusion was included regardless of gender and race. Two independent reviewers (AP, VP) performed study selection, data extraction and appraisal. It was presented it in "characteristics of studies table" and disagreements of primary reviewers were resolved by a third reviewer (SP) The risk of bias was assessed by the revised Cochrane risk-of-bias tool for randomized trials and discrepancies in risk of bias assessment were resolved by fourth reviewer (ATP).
**Results:** Three randomized clinical trials (RCTs) were included in the review. All studies fulfilled the PICO criteria. There were no significant differences in the reported outcomes between investigated treatments in all included RCTs. All of the included studies reported the most critical outcome being correction of class II, division 1 malocclusion. Patients of all the included studies showed good compliance.
**Conclusions:** The systematic review sheds light on the dentoskeletal effects produced by twin block appliance and its modifications. The review brings us to the conclusion that the twin block appliance has great potential for producing profound dentoskeletal changes in children aged 10-14 years. The review also discusses the modifications of twin block appliance which show good potential to bring about desired dentoskeletal effects. It is also

interesting to notice that certain components such as the labial bow may be omitted and addition of components such as southend clasps and torqueing springs may provide better control over incisor movement as well as movement of associated skeletal counterparts. Hence it is prudent to incorporate the modifications of this in appropriate clinical scenarios.

## INTRODUCTION

Malocclusions are of multifactorial origin and in most cases, there is no single etiological cause. There are many causes that are interacting with each other, and overlapping one another. However, two main components can be defined in their aetiology, which are genetic predisposition, and exogenous or environmental factors, which includes all the elements capable of conditioning a malocclusion during craniofacial development. It is important that the clinician studies these multifactorial phenomena, to neutralize them, thus achieving the success of the treatment and avoiding subsequent recurrences. [1]

According to Angle, Class II is that malocclusion in which there is a distal relationship of the lower jaw with respect to the upper one. Class II malocclusion may result in a retrognathic jaw, a prognathic maxilla, or a combination of both. Class II Division 1 is characterized by increased prominence and proclination of the upper incisors, in which the bite is likely to be deep. Thus, the retrognathic profile and excessive protrusion, require that the facial muscles and tongue to adapt to abnormal patterns of contraction [1]

The mandible can be stimulated to grow and consequently improve malocclusions. Many variables affecting growth and its inherent unpredictability make it difficult to use growth stimulation reliably. (1)A functional appliance works on the malocclusion by employing the activation of neuromuscular reflexes to guide the developing jaws and erupting teeth of children into more acceptable relationships.[2]

Evidence has been gathered that shows the greatest effects of functional appliances occur when the peak in mandibular growth is included in the treatment period. In particular, investigations by Petrovic et al found the action of these appliances are most favourable when these appliances are used during the ascending portion of the individual pubertal growth spurt.[3]

Functional appliances that are available for the correction of Class II skeletal and occlusal disharmonies are Bionator, FR-2, removable Herbst appliances and Twin block. Among these, the Twin-block originally developed by William J. Clark has gained increasing popularity during the last decade. The twin block appliance consists of maxillary and mandibular acrylic plates with bite blocks that posture the mandible forward on closure, and it is indicated for the correction of Class II malocclusions characterized in part by mandibular skeletal retrusion.[4]

The main objective of therapy with Twin-block appliance is to induce lengthening of the mandible by stimulating increased growth at the condylar cartilage. It has been demonstrated that the effectiveness of functional treatment of mandibular growth deficiencies strongly depends on the biological responsiveness of the condylar cartilage, which in turn depends on the growth rate of the mandible. The rate of mandibular growth is not constant throughout the juvenile and adolescent periods, with the existence of a pubertal peak in mandibular growth described previously in classical cephalometric studies. The onset, duration, and intensity of the pubertal spurt in mandibular growth vary on an individual basis. [5]

Twin block therapy aims to improve the functional relationship of the dentofacial structures by eliminating unfavourable developmental factors and improving the muscle environment that envelops the developing occlusion. By altering the position of the teeth and supporting tissues, a new functional behaviour is established that can support a new position of equilibrium. [6]

Thus, the present systematic review aims to evaluate and compare the effectiveness of twin block appliance and its modifications in producing dentoskeletal effects in children aged 10-14 years.

## METHODOLOGY

This systematic review was conducted in compliance with Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA). To ensure transparency and reproducibility of this systematic review, a protocol titled “Dentoskeletal effects produced by twin block appliance and its modifications in randomized control trials in children aged 10-14 years: A systematic review” was registered with the International Prospective Register of Systematic Reviews (PROSPERO) - CRD42023363923

Selection criteria.

The research question was framed as follows: Are the modifications of twin block appliance effective in producing dentoskeletal effects in children aged 10-14 years in comparison with conventional twin block appliance?
The focused question was defined using PICOS method and described as follows:
PICOS characteristics:
1. Population: trials including patients in the age group of 10-14 years
2. Intervention characteristics: modifications of the twin block appliance in patients having class II division I malocclusion
3. Control: conventional twin block appliance group
4. Outcomes: Skeletal and dental changes produced by the appliances
5. Study design: Only randomized clinical trials (RCTs) were included in the present review.

The search was limited to English language. Letters to the editor, case reports, case series invitro studies animal studies, reviews, non-randomized studies (NRSs), cohort studies and case-control studies were excluded.
Search strategy
An extensive literature search was performed using PubMed, Cochrane, Scopus and Clarivate Analytics' Web of Science databases. Eligibility criteria followed the PICOS questions. This review planned to include "randomized controlled trials" with cross-over designs or parallel-group.
The search strategies used keywords to find published studies. The terms used were as follows:
(((((dental changes) AND (skeletal changes)) OR (dentoskeletal changes)) AND (twin block appliance)) AND (modifications of twin block))
Selection of studies
All the titles and abstracts of the identified studies were independently assessed by two reviewers (AP, VP) independently. If an abstract was unclear, the full paper was accessed to determine eligibility for inclusion. Full texts of the articles grouped as "uncertain" and "included" were obtained and assessed. Finally the total number of included studies was arrived at after exclusion at various levels. The reasons for the exclusion of studies were recorded at each stage. Any ambiguity between the review authors was resolved by consensus with the third reviewer (SP).

Data extraction.
A standardised form was used by two reviewers (AP, VP) for recording of data from the included studies.
The following parameters were excerpted from the studies:
1. General information (study citation, year research published, country and funding source)
2. Study characteristics (study design, operator, study site, number of procedure visits, in vivo or in vitro)
3. Malocclusion status (class ii, division 1 malocclusion)
4. Patient characteristics (setting, age, gender, number of participants recruited in each group, and number of participants on follow-up)
5. Intervention characteristics (twin block appliance and modifications of the appliance)
6. Control (twin block appliance intervention group.)
7. Outcomes (Skeletal and dental changes)

The authors of the study were contacted in cases of insufficient information. The extracted data was presented it in "characteristics of studies table" and disagreements of primary reviewers were resolved by a third reviewer (SP) The risk of bias was assessed by the revised Cochrane Collaboration tool (RoB2 assessment tool) for randomized trials and discrepancies in risk of bias assessment were resolved by fourth reviewer (ATP). (Table 1 to Table 5)
Risk of bias assessment.
The Cochrane Collaboration's risk-of-bias assessment tool was used to rate the ROB of RCTs. The ROB ratings were used to create an overall assessment of the ROB for these articles. The six key ROB domains used were:
1. The randomization processes
2. Deviations from intended interventions
3. Missing outcome data
4. Outcome measurement
5. Selective outcome reporting
6. Other biases.

A low ROB was when all of the key domains of bias were judged to have low risk. A ROB rated as "some concerns" had at least one key domain judged as some concerns. A high ROB had at least one key domain judged to have a high risk of bias.

## RESULTS

### LITERATURE SEARCH METHODS

The initial searches using the keywords yielded 174 articles across the electronic databases namely using PubMed, Cochrane, Scopus and Clarivate Analytics' Web of Science databases. The search was limited to records written in English and duplicates were excluded. The remaining 115 papers were subjected to title and abstract screening. Of these, 105 papers were excluded on the basis of their title and abstract and the remaining 10 records were extracted for full text eligibility. After full text screening, 7 records were excluded due to the nonexistence of a direct comparison between investigated groups or data of interest. Three studies (Yaqoob et al., 2012; Trenouth et al., 2012, Gill et al., 2005) were included in the review and the complete selection process is illustrated using the PRISMA flow diagram.7 studies have been excluded [7-20] (Fig 1 and fig 2)

**Fig 1: Prisma flow chart**

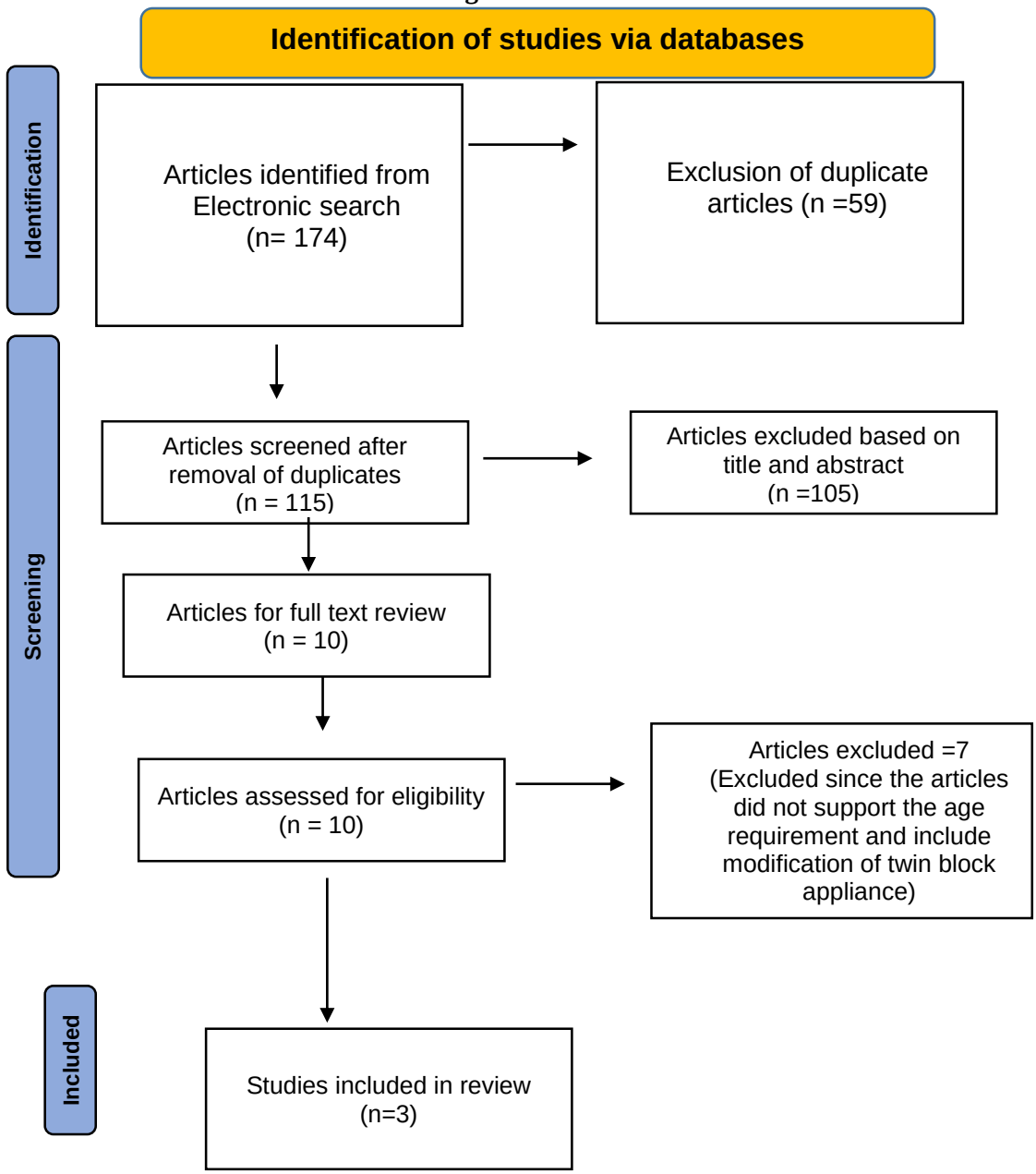

**Table 1: Overview of included studies**

| OVERVIEW OF INCLUDED STUDIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| author and year | study design | sample size | age of participants | type of malocclusion | number of participants who completed study | intervention | duration | outcome measures |
| yaqoob et al(2012) | RCT | 64 | 10-14 years | Angle's class II division I malocclusion | 60 | twin block appliance with and without labial bow | 12 months | The outcome was measured on the basis of changes in UI,LI,SNA,SNB and ANB cephalometric points. |
| trenouth et al(2012) | RCT | 52 | 10-14 years | Angle's class II division I malocclusion | 43 | twin block appliance with and without south end clasp | 12 months | The outcome was measured on the basis of changes in UI,LI,SNA,SNB and ANB cephalometric points. |
| gill et al(2005) | RCT | 70 | 9-30 years | Angle's class II division I malocclusion | 60 | twin block and mini block appliance | 12 months | The outcome was measured on the basis of changes in SN-Max.Pl,UI-Max. Pl,LI-Mand. Pl |

**Table 2: Overview of excluded studies**

| overview of excluded studies | | | | |
|---|---|---|---|---|
| studies | year | study design | intervention | reason for exclusion |
| Ghaffar F et al | 2022 | RCT | Twin Block Appliance and the AdvanSync2 Appliance | RCT compares twin block appliance with a different system |
| Mandall N et al | 2022 | RCT | twin block appliance | only twin block appliance is evaluated |
| Parekh J et al | 2019 | RCT | twin block appliance | only twin block appliance is evaluated |
| Alhammadi MS et al | 2019 | RCT | functional appliances | discusses skeletal and pharyngeal airway changes. Dental changes not evaluated |
| Lee RT et al | 2007 | RCT | Twin Block and Dynamax | RCT compares twin block appliance with a different system |
| O'brien k et al | 2003 | RCT | Herbst or twin-block appliances: | RCT compares twin block appliance with a different system |
| O'brien k et al | 2003 | RCT | Twin-block appliance: | only twin block appliance is evaluated |

**Table 3: Overview of dentoskeletal changes**

| overview of dentoskeletal changes | | | |
|---|---|---|---|
| GROUP 1 | conventional twin block appliance | conventional twin block appliance | conventional twin block appliance |
| UI | -10.13 | -12 | - |
| LI | 4.63 | 6.9 | - |
| SNA | -1.03 | -0.4 | - |
| SNB | 1.83 | 2.4 | - |
| ANB | -2.83 | -2.6 | - |
| SN-Max. Pl | - | - | -0.2 |
| UI-Max PI | - | - | -5 |
| LI-Mand PI | - | - | 1.3 |
| GROUP 2 | twin block appliance without labial bow | twin block appliance with southend clasp | miniblock appliance |
| UI | -7.73 | -6.1 | - |
| LI | 5.33 | 3 | - |

| | | | |
|---|---|---|---|
| SNA | -0.03 | -0.8 | - |
| SNB | 2.63 | 3.2 | - |
| ANB | -3.07 | -3.5 | - |
| SN-Max. Pl | - | - | -0.1 |
| UI-Max PI | - | - | -1.9 |
| LI-Mand PI | - | - | 2.4 |

**Table 4: Risk of bias assessment**

| RISK OF BIAS ASSESSMENT | | | |
|---|---|---|---|
| DOMAINS | YAQOOB ET AL | TRENOUTH ET AL | GILL ET AL |
| Bias arising from the randomisation process | LOW | LOW | LOW |
| Bias due to deviations from intended interventions | LOW | LOW | LOW |
| Bias due to missing outcome data | LOW | LOW | LOW |
| Bias in measurement of the outcome | LOW | LOW | LOW |
| Bias in selection of the reported result | LOW | LOW | LOW |
| Overall bias | LOW | | |

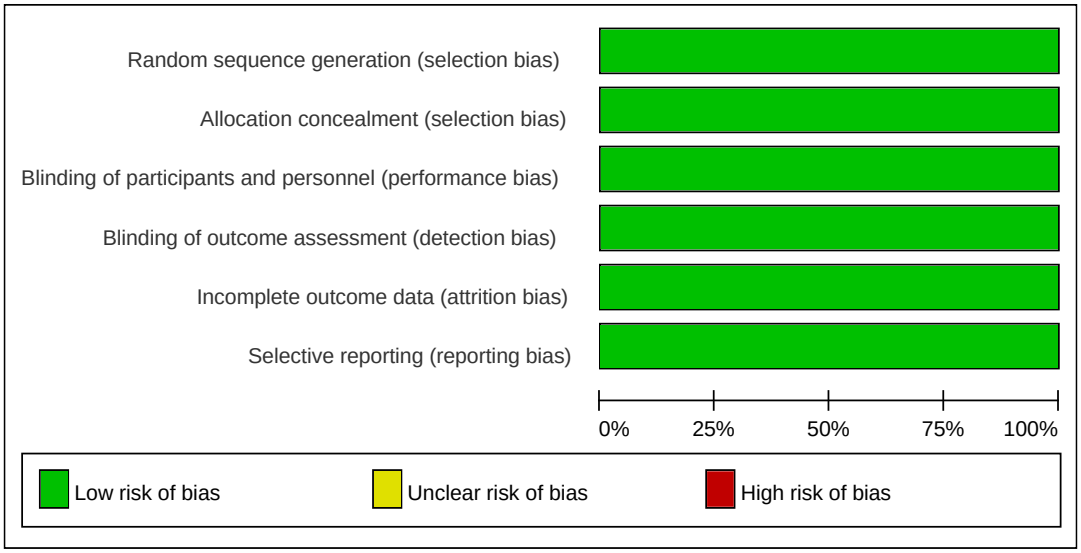


**Fig 2: Risk of bias graph: Percentages demonstrating review authors' evaluation of each risk of bias item across all collected literatures.**

**Table 5: List of abbreviations**

| ABBREVIATION | MEANING | UNIT OF MEASURE |
|---|---|---|
| UI | Upper incisor angle | Degrees |
| LI | Lower incisor angle | Degrees |
| SNA | Sella-nasion point A angle | Degrees |
| SNB | Sella-nasion point B angle | Degrees |
| ANB | point A -nasion-point B angle | Degrees |
| SN-Max. Pl | Sella-Nasion-maxillary incisor point | Degree |
| UI-Max PI | maxillary incisor point | Degree |
| LI-Mand PI | Mandibular incisor point | Degree |

**DISCUSSION**

Functional appliances contribute to Class II correction in growing patients through a combination of dentoalveolar and skeletal effects. Skeletal change has been shown to account for approximately one-third of the decrease in overjet that is seen in successful cases, with the remainder predominantly maxillary incisor retroclination. Anterior repositioning of pogonion is desirable when mandibular retrognathia contributes to a Class II malocclusion; however, excessive dentoalveolar and rotational changes may limit this anterior translation of the mandible.

The original design of the Twin Block appliance consists of maxillary and mandibular acrylic plates with bite blocks and incorporated a maxillary labial bow. However, in an attempt to maximize skeletal and dental effects of the appliance, many clinicians choose to omit/ incorporate newer components. Alternative modifications have been investigated in an attempt to promote skeletal change and dental changes, including torquing spurs on the upper incisors and Southend clasps.

According to Yaqoob et al (2012), both conventional and modified twin block appliance designs were effective in producing complete or partial correction of the overjet during the period of observation. This correction was achieved by a combination of dentoalveolar and, to a lesser extent, skeletal change. Dentoalveolar changes included retroclination of the maxillary incisors, proclination of the mandibular incisors, mesial movement of the mandibular buccal segments, and distal movement of maxillary buccal segments. A limitation of this study is that it analysed only short-term effects of the Twin Block appliance. Long-term follow-up will be required to ascertain whether the reported changes are permanent. Advocates of incorporating a labial bow within the core design of a CTB argue that it can aid retention, facilitate retroclination of a proclined upper labial segment, and maximize overjet reduction. Opponents suggest that the labial bow compromises aesthetics and can result in overcorrection of the incisors, increasing the interincisal angle, deepening the overbite, maximizing dentoalveolar change, and compromising potential skeletal change. Overall, the results of this investigation would suggest that in white children with a moderate Class II division 1 malocclusion, the Twin Block appliance performs similarly in terms of dentoalveolar and skeletal change when designed with or without a labial bow. .[6]

According to Trenouth et al (2012), the presence of a Southend clasp reduced the level of upper incisor retroclination by almost half during Twin-block appliance treatment. An important secondary finding was that the presence of a Southend clasp reduced the amount of lower incisor proclination. There was also a small, but statistically significant enhancement in the skeletal correction, as measured by change in the ANB angle, in the Southend clasp group. In this study, the labial bows were entirely passive, their effects being the same in both groups, hence any differences were due to the presence or absence of the Southend clasps. In fact, a recent prospective randomized trial has shown that the presence or absence of a labial bow had no effect on maxillary incisor retraction or skeletal change. The main limitation of the study was that operators were not blinded to appliance selection; however, the Southend clasp was passive and required no adjustment, making the management of both designs of appliance identical. .[7]

Gill et al (2005) designed the study in a manner where the conventional Twin Block appliance group acted as a positive control group. The Mini Block appliance showed less-favourable mandibular growth response as some patients failed to posture their mandibles forward because of the reduced vertical dimension of the appliance bite-blocks. This might explain why a number of patients in this group showed no change or a negative change in ANB angle. Another reason for the less-favourable response in the Mini Block group could be that these patients were not as compliant as those wearing the Twin Block appliance. Patients in the Mini Block group might not have liked the appearance of their appliances because of the labial incisal coverage produced by the torqueing spring. Ideally, microelectronic monitoring should have been used to assess compliance in both treatment groups. The TB group experienced a significantly greater reduction in overjet compared with the MB group. This improved overjet reduction was associated with significantly greater forward movement of pogonion and greater retroclination of the maxillary incisors. No significant intergroup difference was found for changes in total anterior facial height and mandibular incisor proclination. There was considerable individual variation in appliance effects within both groups.[8]

The current systematic review has several limitations:

1. a small number of included studies
2. only inclusion of studies published in English
3. heterogeneity of included studies precluded the use of meta-analysis

However, the following parameters were considered as the strengths of the current review:

1. Registered protocol in the PROSPERO database

2. literature search, data extraction and a process conducted by two independent reviewers and
3. critical appraisal of included studies using the revised Cochrane risk-of-bias tool for randomized trials also conducted by two reviewers independently

**CONCLUSION**

The systematic review sheds light on the dentoskeletal effects produced by twin block appliance and its modifications. The review brings us to the conclusion that the twin block appliance has great potential for producing profound dentoskeletal changes in children aged 10-14 years. The review also discusses the modifications of twin block appliance which show good potential to bring about desired dentoskeletal effects. It is also interesting to notice that certain components such as the labial bow may be omitted and addition of components such as southend clasps and torqueing springs may provide better control over incisor movement as well as movement of associated skeletal counterparts. Hence it is prudent to incorporate the modifications of this in appropriate clinical scenarios.

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