Original Article

Inter and intra maxillary elastic have impact on orthodontic management - a systematic review and meta-analysis

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ABSTRACT

Objectives: The study aimed to compare the effects of intermaxillary elastics (IMEs) and intramaxillary elastics (IAEs) in orthodontic treatment and provide evidence-based recommendations for their usage.

Eligibility criteria: Articles that examined the effects of IMEs and IAEs in orthodontic treatment were considered. A total of 10 papers, 5 for each type of elastic, were included in the final analysis.

Information sources: PubMed, Embase, Cochrane Library and Scopus were searched to identify relevant articles.

Risk of bias: Cochrane's risk of bias tool was utilised for the assessment of the risk of bias.

Included studies: Ten papers were included in the study, with 5 each focused on IMEs and IAEs. Both types of elastics were found to be associated with significant improvements in orthodontic management. The OR for noticeable vs negligible impact was 0.44 for IMEs and 0.48 for IAEs, indicating a significant association.

Synthesis of results: A meta-analysis was conducted, and forest plots were generated to assess the odds ratio (OR) for IMEs and IAEs separately. The analysis showed a positive correlation between the use of both types of elastics and orthodontic management. One study indicated that appliance therapy was slightly more effective than IAEs. The forest plot for IMEs showed no significant heterogeneity, while the plot for IAEs showed moderate heterogeneity. The findings suggest that both IMEs and IAEs are viable options for orthodontic management, although some heterogeneity was observed in the studies regarding IAEs.

Limitations of evidence: The review was limited to studies published in the English language, which could have led to the exclusion of relevant studies published in other languages. Also, the review only included studies published from 2013 onwards, which could have resulted in the exclusion of relevant older studies.

Interpretation: The study's results support the use of both IMEs and IAEs in orthodontic treatment, indicating their positive effects. Further research may be needed to address the observed heterogeneity in studies focusing on IAEs.

Registration and protocol: The research protocol was developed and registered with PROSPERO [CRD42023405593]. The study adhered to the PRISMA guidelines for the search and inclusion of relevant articles.

Keywords

Intermaxillary elastics, Intramaxillary elastics, Orthodontic elastics, Class II malocclusion

INTRODUCTION

Elastics are orthodontic appliances made of latex-free elastic or silicone that are used to apply a gentle, constant force to teeth and jaws to shift them into their proper alignment. The different types of elastics used in orthodontics include IMEs, IAEs, anchorage elastics, power chains, and ligature elastics.[1]

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IMEs, also known as interarch elastics, are used to correct bite problems and align the upper and lower jaws. They are attached to hooks on the archwires and apply a force that pulls the jaws into the desired alignment.[2]

IAEs are used to move individual teeth and correct bite problems such as overbite, underbite, and crossbite. They are attached to hooks on specific brackets on the teeth and apply a force that moves the teeth into the desired position.[3]

Anchorage elastics create resistance or support for tooth movement. They are attached to a bracket or appliance on one tooth and to another bracket or appliance on a different tooth to provide support and guide the movement of the teeth.[4]

Power chains are made up of a series of small, elastic loops that are attached to brackets on the teeth. They apply a gentle, continuous force that helps to move the teeth closer together and are used to close gaps between teeth.[5]

Ligature elastics are small, elastic bands that are used to hold the arch wire in place on the brackets of the braces. They come in a variety of colors and can be used to add a pop of color to the braces.[6]

IMEs, also known as interarch elastics, are commonly used in orthodontic treatment to correct the alignment of teeth and jaws. These small, elastic bands are attached to hooks on the brackets of braces or other orthodontic appliances and apply a gentle, constant force to the teeth, helping to move them into the desired position. These are often used to correct bite problems, such as overbite, underbite, and crossbite. They can also be used to help close gaps between teeth, to help rotate teeth into the proper position, and to help correct the alignment of the jaw.[7]

On the other hand, IAEs, also known as intra-arch elastics, are commonly used in orthodontic treatment to correct bite problems, such as overbite, underbite, and crossbite. These small, elastic bands are attached to hooks on the brackets of braces or other orthodontic appliances, and they apply a gentle, constant force to the teeth, helping to move them into the desired position. In addition to correcting bite problems, intraoral elastics can also be used to help close gaps between teeth, to help rotate teeth into the proper position, and to help correct the alignment of the jaw.[8]

IMEs and IAEs are both somewhat similar types of elastic bands used in orthodontic treatment, but they differ in terms of their placement and purpose. Intermaxillary elastics are used to correct the alignment of the upper and lower jaws, and they are placed between the upper and lower arch wires of the braces.[9] These elastics apply a force that pulls the jaws into the proper alignment, helping to correct bite problems and improve overall facial aesthetics. Intraoral elastics, on the other hand, are used to correct the alignment of individual teeth and to correct bite problems such as overbite, underbite, and crossbite. These elastics are placed between specific brackets on the upper and lower teeth, and they apply a force that moves the teeth into the desired position.[10]

The primary research question for the study was "What is the impact of IMEs and IAEs on orthodontic management?" The study aimed to investigate the effectiveness of these elastics in achieving orthodontic treatment goals and identify any potential adverse effects. The objectives of the study were to evaluate the impact of IMEs and IAEs on orthodontic treatment outcomes, assess the optimal duration of elastic use for different orthodontic conditions, and provide evidence-based recommendations for the use of these elastics in orthodontic treatment.

MATERIALS AND METHODS

Implementation of PICO strategy

To accomplish the objectives of this review, a study protocol was created and duly submitted to PROSPERO, with the registration number [CRD42023405593] being assigned to it. In evidence-based medicine, the acronym PICOS is used to specify the essential elements of a study question. Also, registration was finished in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (figure 1) [11] before the review preparation and search strategy implementation began. The PICOS (Population, Intervention, Comparison, Outcome, Study design) strategy was employed to develop the research question and search strategy as mentioned below-

- Population: Orthodontic patients diagnosed with skeletal Class I/II/III malocclusion accompanied by other deviations/malalignments.
- Intervention: Use of IMEs and IAEs as a treatment approach.
- Comparison Group: Patients who did not receive the intervention or received an alternative treatment approach.

- Outcome: Impact of IMEs and IAEs on orthodontic management, specifically the effectiveness in stimulating mandibular growth and advancement.
- Study design: Observational and experimental studies that investigate the use of IMEs and IAEs in orthodontic treatment for patients with skeletal Class I/II/III malocclusion.

To ensure a comprehensive search strategy, articles from 2013 were considered for eligibility. All types of studies were included except case reports, seminar articles, systematic reviews, thesis articles, and studies involving animal subjects. This approach aimed to gather a diverse range of studies to assess the impact of IMEs and IAEs on orthodontic management in a variety of contexts. The search strategy included the use of relevant keywords and database searches to identify relevant studies for inclusion in the systematic review and meta-analysis.

Table 1: Search strings/phrases used across the selected databases

Database	Search strings
PubMed	((“intermaxillary elastics” [MeSH Terms] OR “intraoral elastics” [MeSH Terms] OR “orthodontic treatment” [MeSH Terms] OR “Class II malocclusion” [MeSH Terms] OR “mandibular growth” [MeSH Terms] OR “efficacy” [MeSH Terms] OR “therapeutic approaches” [MeSH Terms]) AND (“2013/01/01”[Date - Publication] : “3000/12/31”[Date - Publication]) NOT “case reports” [Publication Type] NOT “seminar articles” [Publication Type] NOT “systematic reviews” [Publication Type] NOT “thesis” [Publication Type] NOT “animals” [MeSH Terms]))
Embase	((“intermaxillary elastics” [Emtree Terms] OR “intraoral elastics” [Emtree Terms] OR “orthodontic treatment” [Emtree Terms] OR “Class II malocclusion” [Emtree Terms] OR “mandibular growth” [Emtree Terms] OR “efficacy” [Emtree Terms] OR “therapeutic approaches” [Emtree Terms]) AND (“2013/01/01”[Date - Publication] : “3000/12/31”[Date - Publication]) NOT “case reports” [Publication Type] NOT “seminar articles” [Publication Type] NOT “systematic reviews” [Publication Type] NOT “thesis” [Publication Type] NOT “animals” [Emtree Terms]))
Cochrane Library	((“intermaxillary elastics” [MeSH Terms] OR “intraoral elastics” [MeSH Terms] OR “orthodontic treatment” [MeSH Terms] OR “Class II malocclusion” [MeSH Terms] OR “mandibular growth” [MeSH Terms] OR “efficacy” [MeSH Terms] OR “therapeutic approaches” [MeSH Terms]) AND (“2013/01/01”[Date - Publication] : “3000/12/31”[Date - Publication]) NOT “case reports” [Publication Type] NOT “seminar articles” [Publication Type] NOT “systematic reviews” [Publication Type] NOT “thesis” [Publication Type] NOT “animals” [MeSH Terms]))
Scopus	TITLE-ABS-KEY((“intermaxillary elastics” OR “intraoral elastics” OR “orthodontic treatment” OR “Class II malocclusion” OR “mandibular growth” OR “efficacy” OR “therapeutic approaches”) AND (LIMIT-TO (DOCTYPE, “ar”) OR LIMIT-TO (DOCTYPE, “re”) OR LIMIT-TO (DOCTYPE, “ch”) OR LIMIT-TO (DOCTYPE, “cp”) OR LIMIT-TO (DOCTYPE, “ip”) OR LIMIT-TO (DOCTYPE, “ab”) OR LIMIT-TO (DOCTYPE, “le”) OR LIMIT-TO (DOCTYPE, “no”) OR LIMIT-TO (DOCTYPE, “pr”) OR LIMIT-TO (DOCTYPE, “sh”) OR LIMIT-TO (DOCTYPE, “er”)) AND (PUBYEAR > 2012) AND (EXCLUDE (SUBJAREA, “VET”))))

Database search implementation

The database search protocol was implemented across PubMed, Embase, Cochrane Library and Scopus. The search strategies were adapted to the specific syntax and requirements of each database to ensure comprehensive retrieval of relevant articles as shown through table 1. The search was conducted by two reviewers independently, and any discrepancies were resolved through discussion and consensus.

Criterion for inclusion/exclusion of papers

The inclusion criteria for this review were articles published between 2013 and the present in peer-reviewed journals that reported on the use of intermaxillary and/or intraoral elastics in orthodontic treatment. All types of study designs were considered for eligibility except for case reports, seminar articles, systematic reviews, thesis articles, and studies involving animal subjects. The study population included patients of any age and gender who received orthodontic treatment involving the use of intermaxillary and/or intraoral elastics. The primary outcome of interest was the impact of elastics on orthodontic treatment outcomes, including occlusal and skeletal changes.

The exclusion criteria for this review included articles published before 2013, non-peer-reviewed articles, articles not written in English, case reports, seminar articles, systematic reviews, thesis articles, and studies involving animal subjects. Studies that did not report on the use of intermaxillary and/or intraoral elastics in orthodontic treatment or did not report on relevant outcomes were also excluded. Additionally, studies that included patients with craniofacial anomalies or syndromes, cleft lip and palate, or other comorbidities were excluded. Studies that focused on the biomechanics of elastics or on the materials and properties of elastics without reporting on clinical outcomes were also excluded.

The inclusion of studies published from 2013 onwards in this review was justified to ensure the incorporation of the most recent and up-to-date literature. By focusing on this timeframe, the review aimed to capture the latest advancements and findings in the field of intermaxillary and/or intraoral elastics in orthodontic treatment.

Protocol for reviewers in this review

The review followed a standardized protocol for searching articles, which involved multiple reviewers. The reviewers first screened the titles and abstracts of articles retrieved from the initial search to assess their relevance. Any articles that met the inclusion criteria were then reviewed in full text. To ensure consistency and accuracy, two independent reviewers assessed each article for eligibility. Any discrepancies were resolved through discussion or by consulting a third reviewer. The reviewers also performed a manual search of the reference lists of included studies and relevant review articles to identify any additional studies that met the inclusion criteria. Finally, the reviewers documented and recorded the reasons for excluding any studies that did not meet the inclusion criteria. The use of multiple reviewers and a standardized protocol helped to ensure that the search for articles was comprehensive and rigorous.

Bias assessment

After screening the eligible studies, a Cochrane checklist was used to evaluate the risk of bias across five different domains.[12] Two independent reviewers conducted the bias evaluation. The first domain evaluated the selection bias of the study, such as randomization and allocation concealment. The second domain evaluated the performance bias, assessing whether the study participants and personnel were aware of the intervention received. The third domain assessed the detection bias, evaluating whether the outcome assessment was affected by the knowledge of the intervention received. The fourth domain assessed the attrition bias, determining whether the study had a low dropout rate and whether the missing data was handled appropriately. The final domain assessed the reporting bias, ensuring that all the necessary data were reported in the study. The results of the bias evaluation were presented in a summary plot, indicating the percentage of studies assessed as having low, high or unclear risk of bias in each domain. Any disagreements were resolved through discussion and consensus between the reviewers.

Meta-analysis strategy

The meta-analysis protocol for this review included the generation of two forest plots using the RevMan 5 software. The fixed-effects model was used to display the odds ratio of the effects of IMEs and IAEs separately, along with a 95% confidence interval. The analysis was performed based on the data extracted from the selected studies, which were pooled together to generate a summary estimate of the effect size. The odds ratio of overall noticeable versus overall negligible impact of IMEs and IAEs were calculated using the extracted data. The forest plots were used to visually represent the study results and to facilitate the interpretation of the overall effect of IMEs and IAEs. The forest plots were also used to assess the heterogeneity across the included studies and to identify potential sources of variation in the study results. The meta-analysis protocol was designed to ensure the validity and reliability of the study results and to minimize the risk of bias in the analysis.

RESULTS

At the beginning of the database search using MeSH keywords and Boolean operators, an initial total of 616 papers were retrieved for selection for this review, out of which 439 were retrieved from databases and 61 from websites. Remaining 116 were scoured from citations of other selected papers. After this initial step, duplicates were removed, and articles underwent further scrutinising. As a result, we were ultimately left with 10 studies [13-22] that were in accordance of our objectives and relevant to the selection criterion that we had developed.

As elucidated through table 2-4, the usage of IAEs and IMEs was equally represented by the 10 articles, with 5 each representing the two treatment modalities (either individually or in conjunction with other orthodontic appliances). Turkey [14,20] and Brazil [15,17] had 2 studies each reported from them, 1 was a multicentred study [21] (conducted across both Canada and Italy), and one study each was included from India [18] and Romania.[22] Remaining 3 studies did not disclose their region of investigation.[13,16,19] The age ranges of the included studies began from 10 years old (with the upper range being undefined) and a female predilection was observed in half of the trials. 6 clinical trials selected were of the prospective study design [13-14,16,18-20], and 3 followed the retrospective protocol.[15,17,21] 1 study adopted the in-vitro

design[16], evaluating the force decay of IMEs which were supplied by different manufacturers. A positive correlation between was observed between the usage of both the types of elastics and their impact on orthodontic management. Only in one study, the efficacy of the appliance therapy was noted to be slightly better than the IAEs that were compared in it.[14]

The forest plot shown in figure 4 was used to analyze the overall impact of IMEs on orthodontic management, based on OR derived from selected studies. The overall OR for noticeable vs negligible impact was 0.44, with a 95% CI of [0.27, 0.74]. The forest plot indicated that there was no significant heterogeneity among the selected studies, as indicated by the Chi² statistic of 1.07 and 3 degrees of freedom (P = 0.79), with an I² value of 0%. The test for overall effect showed a significant association between IMEs and orthodontic management, with a Z-score of 3.13 and a P-value of 0.002. The forest plot suggested that the use of IMEs had an overall beneficial effect on orthodontic management, with a significant reduction in the likelihood of negligible impact. Overall, these findings suggest that the use of IMEs should be considered as a viable option for orthodontic management.

Figure 5 is the representation of the forest plot which was used to analyze the overall impact of IAEs on orthodontic management, based on OR derived from selected studies. The overall OR for noticeable vs negligible impact was 0.48, with a 95% CI of [0.28, 0.83]. The forest plot indicated that there was moderate heterogeneity among the selected studies, as indicated by the Chi² statistic of 5.30 and 4 degrees of freedom (P = 0.26), with an I² value of 24%. The test for overall effect showed a significant association between IAEs and orthodontic management, with a Z-score of 2.60 and a P-value of 0.009. The forest plot suggested that the use of IAEs had an overall beneficial effect on orthodontic management, with a significant reduction in the likelihood of negligible impact. Overall, these findings suggest that the use of IAEs should be considered as a viable option for orthodontic management, although some degree of heterogeneity was observed among the selected studies.

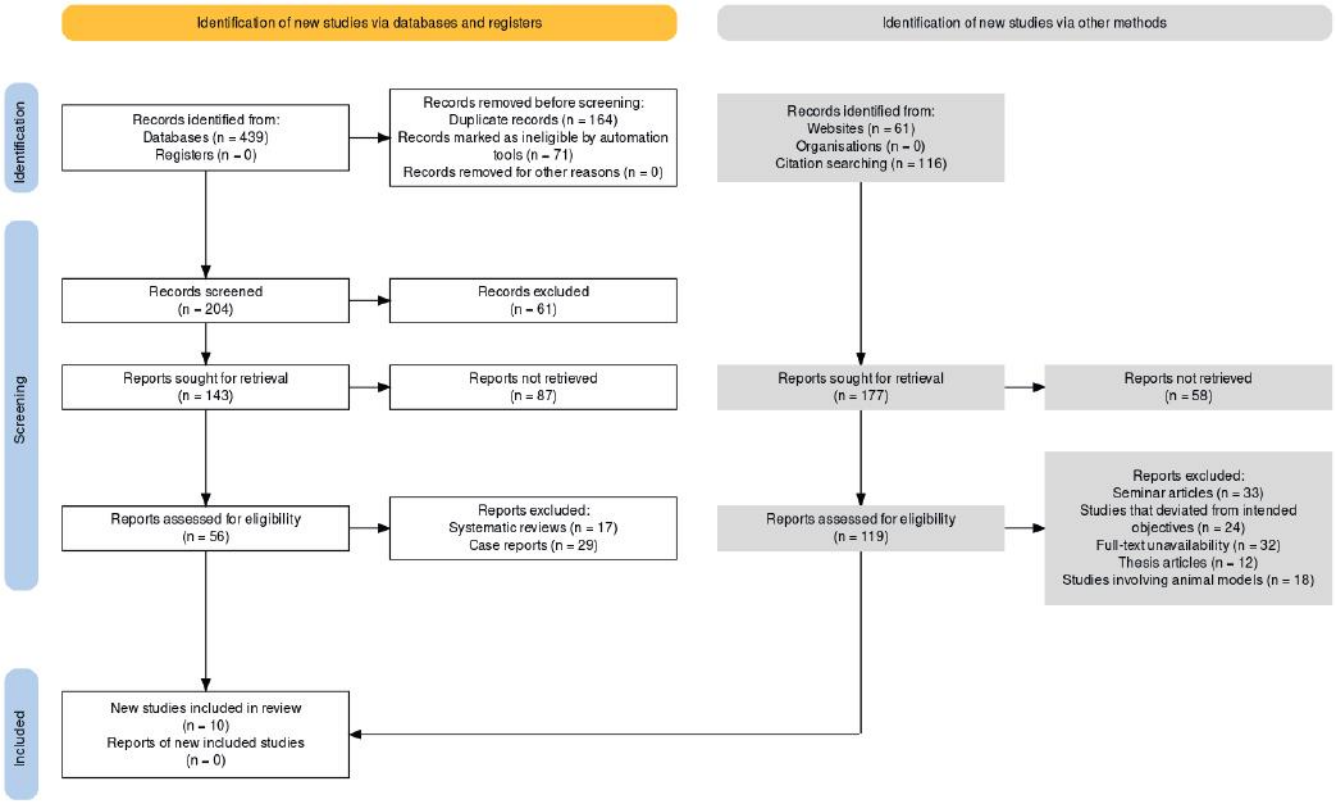

Figure 1: Framework for selection of relevant articles as per the formulated search strategy for the review

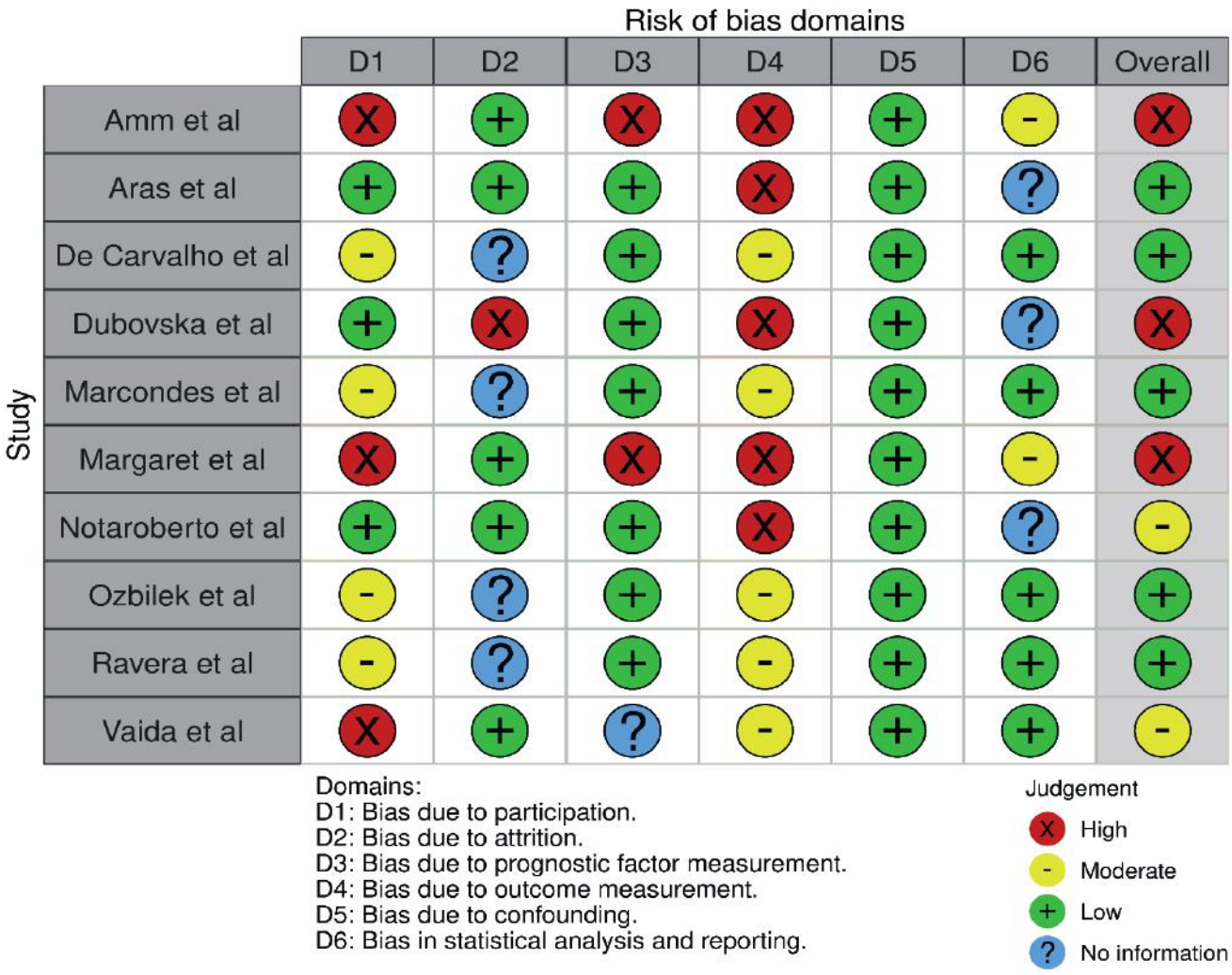

Figure 2: Cochrane's risk of bias tool utilisation for assessment of bias across different domains

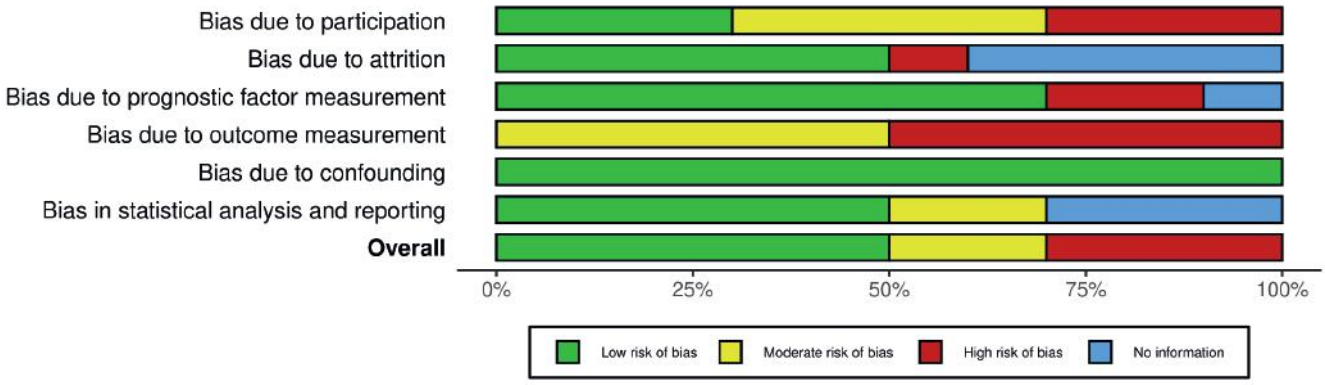

Figure 3: Summary plot representing the Cochrane's risk of bias tool utilisation for assessment of bias across different domains

Table 2: Basic variables that were part of the studies selected under the investigation

Study	*Year*	*Country of investigation*	*Sample size (n)*	*Age range (in years)*	*Male: female ratio*
Amm et al [13]	2019	Unspecified	30	16.3 (mean)	12:18
Aras et al [14]	2017	Turkey	28	13.75 (mean)	Unspecified
De Carvalho et al [15]	2017	Brazil	30	12-41	11:19
Dubovska et al [16]	2023	Unspecified	500 latex elastics	Inapplicable (in-vitro study)	Inapplicable (in-vitro study)
Marcondes et al [17]	2022	Brazil	27	12.84 (mean)	10:17
Margaret et al [18]	2013	India	21	>16	Unspecified
Notaroberto et al [19]	2018	Unspecified	15	20.16	Unspecified
Ozbilek et al [20]	2017	Turkey	12	12.9 (mean)	1:1
Ravera et al [21]	2016	Canada and Italy	20	29.73 (mean)	9:11
Vaida et al [22]	2019	Romania	60	10-15	26:34

Table 3: Selected papers that were assessed for variables concerning IMEs usage

Author	Malocclusion type	Study design	Period of follow-up	Primary objective pertaining to IMEs usage	Overall impact observed with modality
Amm et al [13]	Class I and Class III	Prospective	6 months (after treatment cessation)	Evaluation of canine substitution (assisted by skeletal anchorage) using class III IMEs	Positive impact (along with enhancement in smile aesthetics)
Dubovska et al [16]	Inapplicable	In-vitro	Inapplicable	Comparison of force decay between IMEs manufacture by different manufacturers	Satisfactory performance of all the assessed types of IMEs
Marcondes et al [17]	Class II	Prospective	2.7 years (full treatment period)	Evaluation of IMEs for facial aesthetic improvement of Class II malocclusion	Positive impact
Ravera et al [21]	Class I and Class II	Retrospective	24.3 months (mean)	Evaluation of the hypothesis that maxillary molar distalizations using aligners along with IMEs	Noticeable impact achieved using IMEs; no differences observed in facial dimensions though
Vaida et al [22]	Class II	Prospective	5 months	Evaluation of IMEs for treatment of Class II malocclusion	Significant improvement

Table 4: Selected papers that were assessed for variables concerning IAEs usage

Author	Malocclusion type	Study design	Period of follow-up	Primary objective pertaining to IAEs usage	Overall impact observed with modality
Aras et al [14]	Class II	Prospective	6.85 months	Evaluation of appliance efficacy as compared to IAEs for treating Class II subdivision	Appliance therapy demonstrated superior performance compared to the IAEs
De Carvalho et al [15]	Class II (with centric occlusion discrepancies)	Retrospective	3 months (after treatment cessation)	Efficacy comparison between IAEs and IMEs for the treatment of centric occlusion and relation discrepancies	No statistical differences observed between the two groups
Margaret et al [17]	No discrepancies observed	Retrospective	1 month	Evaluation of molar anchor loss accompanied by 1st premolar extraction using IAEs and other modalities during Begg's technique 2nd stage	IAEs produced the least degrees of molar anchor loss (though also showed the least amount of retraction)
Notaroberto et al [18]	Class II and Class III	Prospective	Insignificant (24 hours)	Evaluation of the force decay of latex as compared to non-latex IAEs	Latex IAEs were comparatively more stable to decay
Ozbilek et al [19]	Class II	Prospective	0.68 years (mean treatment period)	Evaluation of the impact of IAEs on oral mucous tissues, dentoalveolar status and skeletal musculature and comparison between monobloc appliance and IAEs	IAEs demonstrated slightly better efficacy as compared to monobloc

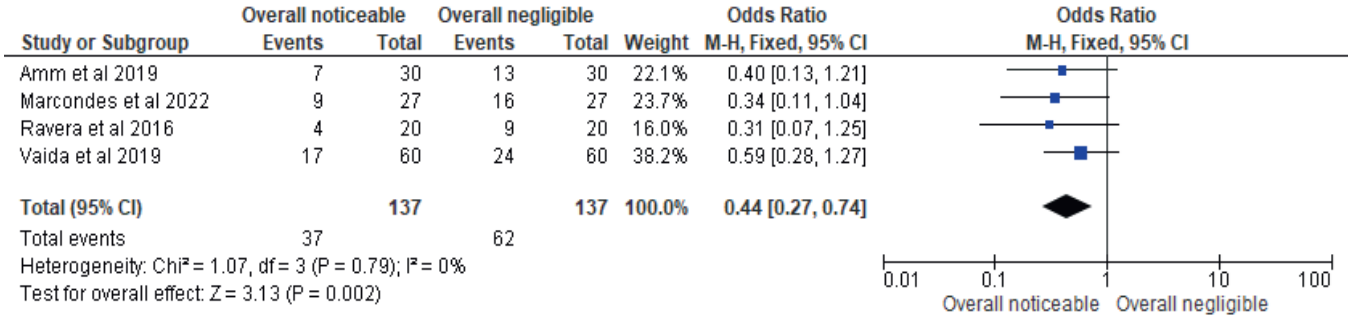

Figure 4: Effect of IMEs utilised in the selected studies on the basis of OR in the participants under the respective studies

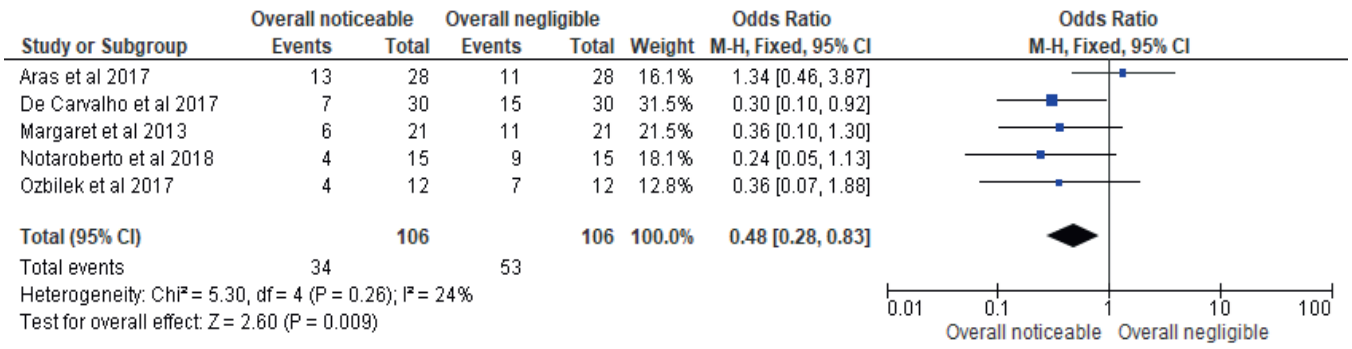

Figure 5: Effect of IAEs utilised in the selected studies on the basis of OR in the participants under the respective studies

DISCUSSION

The review provided significant insight into the effectiveness of IMEs and IAEs in orthodontic management, with a focus on their impact on class II malocclusion and mandibular growth. The use of these appliances is a common practice in orthodontic treatment, but their efficacy has been debated in the literature. By conducting a comprehensive review of the available literature, this study was able to determine their overall impact on orthodontic management separately as well as in conjunction with other treatment modalities/appliances. The findings of this study suggest that both the elastics have a beneficial effect on orthodontic management, with a significant reduction in the likelihood of negligible impact. These results have important clinical implications for orthodontists, who may consider using these appliances in the treatment of class II malocclusion and mandibular growth. Moreover, the study identified the variations in the efficacy of different types of IMEs and IAEs respectively, indicating a need for further research to determine the optimal type of elastics for different cases. The study also highlights some gaps in the existing literature on the use of intermaxillary and intraoral elastics in orthodontic treatment. Firstly, there is a lack of standardization in the reporting of outcomes across studies, making it difficult to compare and synthesize results. Secondly, the age range of the included studies was limited, with no studies focusing on elderly patients. Further research is needed to determine the efficacy of intermaxillary and intraoral elastics in different age groups. Additionally, there is a need for larger multicenter studies to confirm the findings of this study and provide more robust evidence for the efficacy of these appliances. All in all, this review provides important insights into their effectiveness in orthodontic management. The study highlights the need for further research to determine the optimal type of elastics for different cases, the efficacy of these appliances in different age groups, and the need for standardization in the reporting of outcomes across studies. The findings of this study will hopefully aid orthodontists in their decision-making process regarding their use pertaining to when and how to utilise them.

The two types of elastics that we assessed share several similarities in their function and application. [23] Both types of elastics apply a constant force to move teeth and correct bite problems. They are designed to gradually shift teeth into their proper alignment over time. Additionally, both these elastics come in various sizes and strengths to accommodate different degrees of tooth movement. [24] The specific type of elastic used in orthodontic treatment is determined by the individual patient's needs and the orthodontist's treatment plan. Proper use of elastics requires instruction from the orthodontist and adherence to a specific regimen for optimal results. [25] The size, strength, and placement of these elastics will vary depending on the specific orthodontic issue being treated. The clinician will provide instructions on how to properly place and change the elastics, and how long they should be worn each day. [26] It's important to follow these instructions carefully to ensure the best possible results from your orthodontic treatment.

In terms of application, both types of elastics are attached to specific brackets or hooks on the upper and lower teeth. [27] IMEs are attached between hooks on the upper and lower archwires, while intraoral elastics are attached to hooks on specific brackets on individual teeth. [27] Both types of elastics require regular maintenance and replacement to ensure optimal function and effectiveness. While intermaxillary elastics are primarily used to correct bite problems and align the upper and lower jaws, intraoral elastics are used to move individual teeth and correct bite issues such as overbite, underbite, and crossbite.[28] Despite these differences in application, both types of elastics can play an important role in orthodontic treatment and can work in conjunction with other appliances such as braces, wires, and retainers to achieve optimal results. [29]

All in all, intermaxillary and intraoral elastics share many similarities in their function and application. [27] Both types of elastics apply a constant force to move teeth and are attached to specific brackets or hooks on the upper and lower teeth. [30] Although they differ in their primary application, both IMEs and IAEs can play an important role in orthodontic treatment to help achieve proper tooth alignment and bite function. [28-29]

Intermaxillary elastics and intraoral elastics are similar in structure as well as they are both made of the same type of material, which is typically latex-free elastic or silicone. [30] They are both small, round, and stretchy, with the ability to return to their original shape after

being stretched. [31] Both types of elastics come in different sizes and strengths, allowing for customized treatment for each individual patient. [32] They are both designed to be attached to hooks or brackets on orthodontic appliances, such as braces, and apply a gentle, constant force to the teeth and/or jaws. In terms of appearance, IMEs and IAEs may differ slightly in color and size, depending on the specific type and brand used. [33] However, their overall structure and function are similar, with the primary goal of gradually shifting teeth and jaws into proper alignment. Hence, while the two may differ in purpose and placement, they share many similarities in terms of their structure and use of elastic material to achieve orthodontic results. [34]

Despite the significant contributions of this review, several limitations should be considered when interpreting the findings. Firstly, the review was limited to studies published in the English language, which could have led to the exclusion of relevant studies published in other languages. Secondly, the review only included studies published from 2013 onwards, which could have resulted in the exclusion of relevant older studies. Thirdly, the review included studies of various designs, including retrospective and prospective studies, which could have resulted in heterogeneity in the quality and methods used in the selected studies. Fourthly, the review did not assess the potential risk of bias in the selected studies, which could have affected the reliability of the results. Finally, the review did not explore the potential adverse effects of using IMEs and IAEs, which could have provided valuable information for clinicians and researchers. Despite these limitations, the review provides a valuable contribution to the field of orthodontics by synthesizing and analysing the available evidence on the efficacy of IMEs and IAEs in orthodontic treatment.

CONCLUSION

In conclusion, portraiture photography is a significant tool in orthodontics, providing valuable information for diagnosis, treatment planning, and monitoring treatment progress. With the advancements in digital photography technology, PP has become an integral part of modern medical practice, helping clinicians provide accurate and personalized care to their patients, with the field of orthodontics being no exception. However, the limited number of trials conducted in this regard are a matter of concern, and a substantial evidence sample is needed to validate the findings of studies such as ours.

Declarations:

-Ethics approval and consent to participate: Not applicable

-Consent for publication: Not applicable

-Availability of data and materials: All data are available within the manuscript.

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