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Microesthetics in orthodontics: A systematic review and meta-analysis

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Abstract

BACKGROUND: Microesthetics in orthodontics, which focuses on subtly and precisely enhancing a patient's smile's esthetics, has seen a rise in popularity in recent years. The objective of this systematic study was to assess our present understanding of orthodontic microesthetics.

METHODS: A thorough search was done using the terms "microesthetics in orthodontics," "aesthetic orthodontics," "orthodontic aesthetics," and "orthodontic smile design" across different databases. Articles published between 2011 and 2022 were considered for selection in this review.

RESULTS: Five studies were selected for the review. The meta-analysis found a statistically significant and clinically relevant improvement in microesthetic parameters due to orthodontic treatment. The odds ratio estimate was 0.32 (95% confidence interval (95% CI): 0.28 to 0.37), suggesting a noticeable effect of orthodontic treatment on microesthetic parameters. The forest plot also showed an overall risk ratio of 0.57 (95% CI: 0.53 to 0.61) and a risk difference of -0.28 (95% CI: -0.31 to -0.24) for noticeable versus negligible effects of orthodontic treatment on microesthetic parameter in patients. The heterogeneity was significant among the studies, with a Chi-square value of 15.34 ($P = 0.004$) and 14.79 ($P = 0.005$) for the odds ratio and risk difference, respectively, indicating a moderate level of heterogeneity.

CONCLUSION: The results of this study's review and meta-analysis point to a statistically significant and clinically meaningful difference in the microesthetic parameters between individuals who received orthodontic treatment and those who did not. The heterogeneity statistics, however, indicates significant variation between research studies.

REGISTRATION: This review protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO; registration number: CRD42022397219).

Keywords:

Esthetic orthodontics, microesthetics in orthodontics, orthodontic esthetics, orthodontic smile design

Introduction

Dentistry for esthetic purposes goes beyond simply forcing a standard grin on every patient. To create the ideal smile, the dentist must combine creative flair with scientific esthetic principles to fit the patient's particular personality. The primary feature of a smile is determined by the interaction that arises between the hard and soft tissues. In recent years, improving dental and facial esthetics has been the main focus of orthodontic treatment for the great majority of patients. This objective is not merely ornamental.[1]

When people feel self-conscious about the appearance of their teeth, it can affect their confidence and willingness to smile, talk, or even eat in public.[1] Orthodontic treatment that results in an improved smile can have a positive impact on a patient's self-esteem and improve their quality of life. An investigation that was conducted with

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regard to facial esthetics observed that people tend to look at other features of a person's face before looking at their teeth, which was likely due to the natural tendency to focus on the eyes and other prominent facial features when looking at someone.[1] Additionally, the brain is wired to quickly process facial expressions, emotions, and social cues, which can draw attention away from the teeth. However, when a person smiles, the teeth become more visible, making their appearance an important aspect of facial esthetics. This is why an orthodontic treatment that improves the appearance of the teeth can have a significant impact on a person's overall facial esthetics and self-confidence.[1] Microesthetics must therefore be considered in the proper context. An investigation was conducted where the clinicians aimed to identify common traits that influence esthetic perception in numerous populations around the world.[2] The study analyzed 500 grins of famous people that appeared in Time magazine to identify the most esthetically pleasing features.[2]

With regard to the importance of esthetics in orthodontics, the categorization of esthetics into three different categories by Sarver and Ackermann[3] is significant because it provides a standardized framework for evaluating the esthetic outcomes of orthodontic treatment. According to this classification, facial esthetics considers the overall balance and harmony of the face, including the relationship between the teeth, lips, and surrounding facial structures.[3] Dental esthetics refers to the appearance of the individual teeth, including their size, shape, and position. By considering these three categories of esthetics, orthodontists can develop treatment plans that not only address functional issues but also improve the overall appearance of the face and smile. This can lead to increased patient satisfaction and improved treatment outcomes.[3] Additionally, having a standardized framework for evaluating esthetics can help orthodontists communicate more effectively with their patients, as well as with other members of the dental team, such as cosmetic dentists and oral surgeons.

One major issue with the current literature on microesthetics in orthodontics is the prevalence of literature reviews and case reports with small sample sizes.[4,5] While these studies can provide valuable insights into individual cases, they are not necessarily representative of the wider population. To truly understand the impact of microesthetics on orthodontic treatment outcomes, larger studies are needed that include more diverse patient populations. Another gap in the literature is the lack of standardization when it comes to measuring microesthetics in orthodontics. Currently, there is no universally accepted method for assessing the esthetic impact of orthodontic treatments, which makes it difficult to compare results across studies. Without a standardized approach, it is difficult to draw firm conclusions about the impact of microesthetics on orthodontic treatment outcomes. Therefore, the primary objective of this systematic review and meta-analysis was to evaluate the existing literature on the impact of microesthetics on orthodontic treatment outcomes and to identify areas where further research is needed. By synthesizing the available evidence through a meta-analysis, the review also aimed to provide clinicians with a better understanding of the role that microesthetics plays in orthodontic treatment outcomes and to guide the development of future research in this area.

Materials and Methods

Review guidelines and registration

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol[6] was followed for this review as shown in Figure 1 with prior International Prospective Register of Systematic Reviews (PROSPERO) registration. The review team followed a comprehensive and structured approach to identify relevant studies that met the eligibility criteria. Before conducting the review, the protocol was developed and registered on the PROSPERO database.

PICOS strategy

For this investigation, the researchers used the patient, intervention, comparison, outcomes, and study design strategy to guide the selection of studies. The inclusion criteria were as follows.

Population: Studies that included patients undergoing orthodontic treatment for esthetic reasons were included.

Intervention: Any orthodontic treatment that addressed microesthetics, such as tooth size, shape, and position, was included.

Comparison: Studies that compared different orthodontic treatments or the impact of different microesthetics factors on treatment outcomes were included.

Outcome: Studies that reported on treatment outcomes related to microesthetics, such as patient satisfaction and esthetic appearance, were included.

Study design: Clinical studies, including cross-sectional studies, retrospective studies, and prospective studies, were included.

To ensure that the review was based on the most current and relevant research, studies published between 2011 and 2022 were selected. This timeframe was chosen because it allowed for the inclusion of recent studies

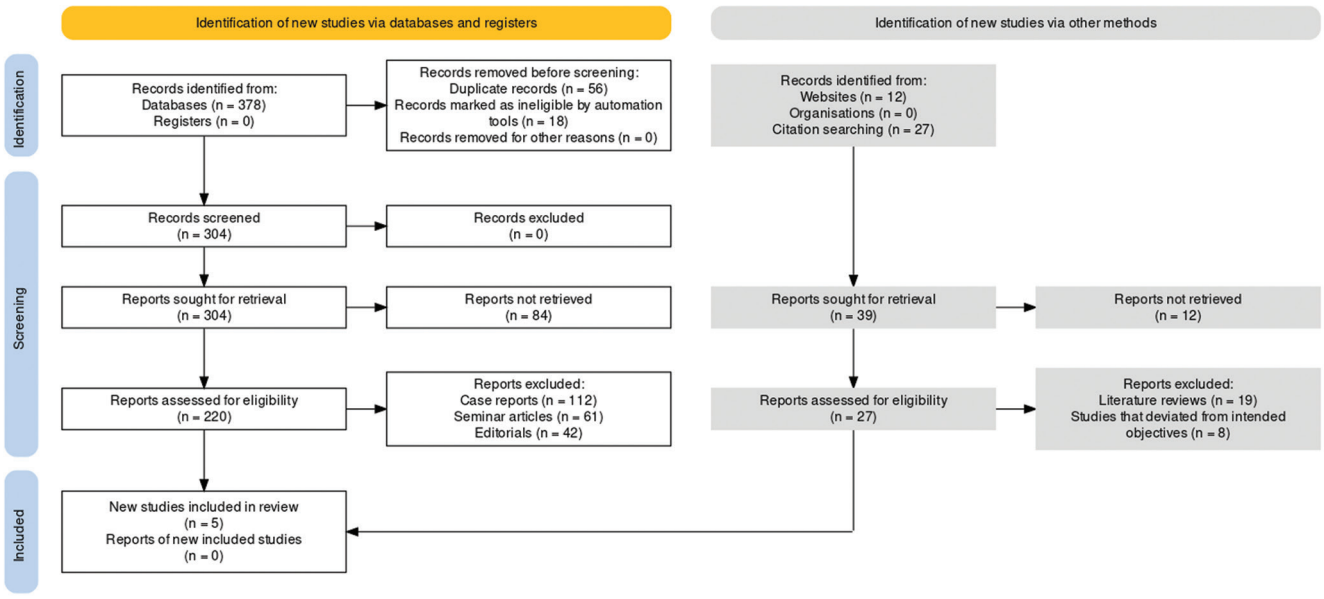

Figure 1: Protocol representing the selection of articles for the review

while also ensuring that the review was focused on the most up-to-date research available. Additionally, the use of a relatively narrow timeframe helped to ensure that the studies included in the review were more closely related to each other in terms of their methodology and research questions. The utilization of this strategy and the inclusion of clinical studies, cross-sectional studies, retrospective studies, and prospective studies helped to ensure that this systematic review and meta-analysis on microesthetics in orthodontics was based on the most current and relevant research available. By including studies that met broad inclusion criteria, the review aimed to provide a comprehensive synthesis of the existing literature on this important topic, encompassing a wider range of research designs and enabling a more inclusive analysis of the available data.

Database search protocol

To identify relevant studies for this study, the researchers employed a comprehensive search strategy across five major databases. The search was conducted using Boolean operators and medical subject headings (MeSH) keywords to identify studies that met the inclusion criteria. The databases searched were PubMed/Medical Literature Analysis and Retrieval System Online, Embase, Scopus, Web of Science, and Cochrane Library. The search strategy included a combination of the following keywords: "microesthetics," "orthodontics," "tooth size," "tooth shape," "tooth position," "patient satisfaction," and "treatment outcome." The keywords were combined using Boolean operators (AND and OR) to create search strings that were tailored to each database. The researchers also used MeSH terms to ensure that the search was as comprehensive as possible. To further refine the search and ensure that only high-quality studies were included, the researchers limited the search to studies published between 2011 and 2022. Additionally, the search was limited to English language studies only. Table 1 represents the summarizing of databases that were searched and the search strings used.

Overall, the search strategy employed by the researchers was designed to be as comprehensive as possible, using a combination of keywords and MeSH terms to identify relevant studies. By searching across multiple databases and using rigorous search criteria, the researchers aimed to identify the most relevant and high-quality studies available for inclusion in the systematic review and meta-analysis.

Inclusion/exclusion criterion

For this review, the reviewers used a set of inclusion and exclusion criteria to select studies for the review. The inclusion criteria were as follows: studies that included patients undergoing orthodontic treatment for esthetic reasons; any orthodontic treatment that addressed microesthetics, such as tooth size, shape, and position; and studies that compared different orthodontic treatments or the impact of different microesthetics factors on treatment outcomes. Additionally, the review included studies that reported on treatment outcomes related to microesthetics, such as patient satisfaction and esthetic appearance. Clinical studies, including cross-sectional studies, retrospective studies, and prospective studies, were included in the review. In contrast, the exclusion criteria were studies not focused on orthodontic treatment for esthetic reasons

Table 1: MeSH keywords employed as search strings across different databases

Database	Search String
PubMed/ MEDLINE	(((((microesthetics[Title/Abstract]) OR tooth size[Title/Abstract]) OR tooth shape[Title/Abstract]) OR tooth position[Title/Abstract]) OR orthodontics[Title/Abstract]) AND ((patient satisfaction[Title/Abstract]) OR treatment outcome[Title/Abstract]))
Embase	'microesthetics'/exp OR 'tooth size'/exp OR 'tooth shape'/exp OR 'tooth position'/exp OR 'orthodontics'/exp AND ('patient satisfaction'/exp OR 'treatment outcome'/exp)
Scopus	TITLE-ABS-KEY (microesthetics OR "tooth size" OR "tooth shape" OR "tooth position" OR orthodontics) AND TITLE-ABS-KEY (patient satisfaction OR "treatment outcome")
Web of Science	TS = ((microesthetics OR "tooth size" OR "tooth shape" OR "tooth position" OR orthodontics) AND (patient satisfaction OR "treatment outcome"))
Cochrane Library	((microesthetics OR tooth size OR tooth shape OR tooth position OR orthodontics) AND (patient satisfaction OR treatment outcome))

MEDLINE: Medical literature analysis and retrieval system online

and studies not addressing microesthetics or treatment outcomes related to microesthetics. The review also excluded studies that did not meet the study design criteria outlined in the inclusion criteria, such as studies that were not clinical studies, cross-sectional studies, retrospective studies, or prospective studies. Studies that were not published in English were also excluded from the review. Using these inclusion and exclusion criteria, the researchers aimed to ensure that the systematic review and meta-analysis were focused on the most relevant and high-quality research available. By including studies that met specific inclusion criteria, the review aimed to provide a comprehensive synthesis of the existing literature on microesthetics in orthodontics, while excluding studies that did not meet the criteria helped to ensure the validity and reliability of the review's findings.

Selection of articles and bias evaluation

To ensure that the data extracted from the identified studies were consistent and accurate, the reviewers used a standard data extraction form. The form was developed by the researchers and included all the relevant information required for the meta-analysis. This form was used by two independent reviewers to extract data from each of the included studies. The data extraction form included information such as the study design, sample size, age range of participants, interventions used, and outcome measures. The reviewers also extracted data related to the microesthetic parameters evaluated, such as tooth size, tooth shape, and tooth position. Other data extracted included patient-reported outcomes, such as patient satisfaction and quality of life. The reviewers independently extracted data from each study, and any discrepancies were resolved through discussion and consensus. In cases where a consensus could not be reached, a third reviewer was consulted to make the final decision.

Using a standard data extraction form, the reviewers were able to ensure that the data extracted from each study were consistent and accurate. This enabled the researchers to perform a comprehensive meta-analysis and draw meaningful conclusions from the data. Overall, the use of a standard data extraction form was an important aspect of this systematic review and meta-analysis on microesthetics in orthodontics.

Evaluation of bias in selected studies

To ensure that the studies included in the systematic review and meta-analysis were of high quality, the reviewers assessed the risk of bias using the Newcastle–Ottawa Scale (NOS).[7] The NOS is a widely used tool for assessing the quality of non-randomized studies, such as observational studies and retrospective studies. The risk-of-bias assessment using the NOS allowed the researchers to identify any potential limitations or biases in the included studies. This information was used to inform the overall conclusions of the systematic review and meta-analysis. Employment of NOS was an important aspect of this review, as it allowed the researchers to ensure that only high-quality studies were included in the meta-analysis. This, in turn, increased the reliability and validity of the conclusions drawn from the review.

Meta-analysis protocol

To perform the meta-analysis for this systematic review, the researchers used the RevMan 5 software. The meta-analysis was conducted to determine the effect of orthodontic treatment on microesthetic parameters in patients. The effect size was represented using a standardized mean difference (SMD), assuming a 95% confidence interval (CI) and fixed-effects model. The fixed-effects model was used because there was little heterogeneity observed among the included studies. The researchers also performed sensitivity analyses to assess the robustness of the results and found that the results were consistent across different subgroups.

Results

Five studies[8-12] were considered to be relevant to the objectives of our study and as such were included in the review and subsequent meta-analysis. The NOS evaluation of the included studies reveals varying levels of risk of bias in different domains as shown in Figure 2. The study by Alomari *et al*.[8] has high study design quality, but the representativeness of the exposed cohort, selection of the nonexposed cohort, ascertainment of exposure, comparability of cohorts based on the design

or analysis, and assessment of outcome are all unclear. The study by Gowd *et al*.[9] has a low risk of bias in most domains except for the selection of the nonexposed cohort, which is low. The study by Romsics *et al*.[10] has a low risk of bias in most domains except for ascertainment of exposure, which is unclear. The study by Sunar *et al*.[11] has high study design quality, but the representativeness of the exposed cohort, selection of the nonexposed cohort, ascertainment of exposure, comparability of cohorts based on the design or analysis, and assessment of outcome are all unclear. Finally, the study by Tauheed *et al*.[12] has a low risk of bias in most domains except for ascertainment of exposure, which is unclear. Based on these findings, it can be inferred that there was a characteristically lower risk of bias across the selected studies. However, the varying levels of risk of bias in different domains highlight the importance of ensuring that all aspects of the study design and analysis are carefully considered and reported. Further research is required to identify the most effective ways of addressing the microesthetic concerns of orthodontic patients and to improve the quality of care provided.

Table 2 presents a summary of the included studies in the review and their key characteristics. The first study by Alomari *et al*.[8] was a cross-sectional study that aimed to evaluate and compare the perception of altered gingival characteristics (microesthetics) by dental professionals and laypeople. The study had a sample size of 516 respondents with an age range of 20–50+. The second study by Gowd *et al*.[9] was a retrospective study that emphasized the significance of microesthetics in fixed orthodontic therapy. The study had a sample size of 40 patients, with a mean age of 20.8 years. The third study by Romsics *et al*.[10] was a cross-sectional study that aimed to measure mini- and microesthetic

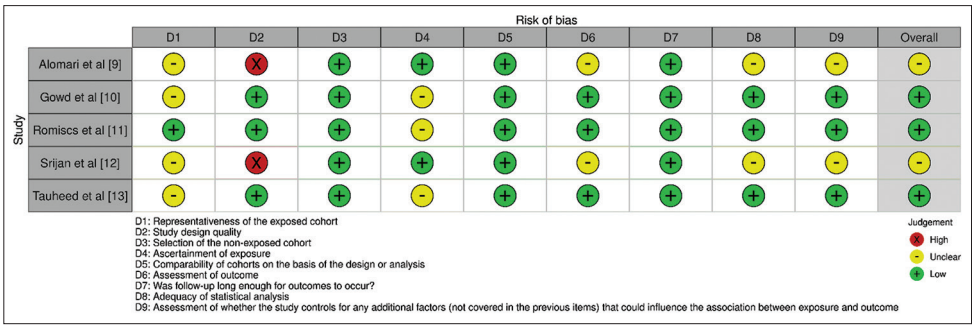

Figure 2: Intra-study risk-of-bias assessment for the review

Table 2: Tabular representation of variables analyzed for studies selected in the review

Author	Year	Study protocol	Sample size	Age range/mean age (in years)	Microesthetic variable analyzed
Alomari *et al*.[8]	2022	Cross-sectional study	516 respondents (325 females)	20–50+	The purpose of this study was to assess and compare how various dental professionals and laypeople view altered gingival characteristics (microesthetics), as well as to pinpoint the traits that are most highly and least highly regarded.
Gowd *et al*.[9]	2017	Retrospective study	40 patients (29 females)	20.8	The significance of microesthetics in fixed orthodontic therapy was highlighted by this study. The clinicians noted that during retraction during treatment for bimaxillary protrusion, the gingival shape should not change.
Romsics *et al*.[10]	2020	Cross-sectional study	861 students	22.34	The self-esthetics and photo-rating items used a questionnaire-based methodology to measure mini- and microesthetic qualities. Regarding the maxillary midline shift and the relative visibility of the arches behind the lips, grade and heteroperception were substantially related.
Sunar *et al*.[11]	2022	Retrospective clinical study	100 patients (51 females)	20–25	This study's objective was to evaluate the microesthetics of patients who were seeking orthodontic treatment. The study found that 34% of people had the same crown length and crown width ratio, while 66% of people had varied crown length and crown width ratios. Most patients have microesthetic evaluations following orthodontic treatment within the scope of the study.
Tauheed *et al*.[12]	2012	Quasi-experimental study	100 patients	20–30	After receiving orthodontic treatment, both patients who underwent extractions and those who did not experience a statistically significant improvement in the microesthetic measures. The non-extraction group more easily attained values that were closer to the suggested standards, indicating that orthodontic treatment enhances the smile's microesthetics.

qualities using a questionnaire-based methodology. The study had a sample size of 861 students, with a mean age of 22.34 years. The fourth study by Sunar *et al*.[11] was a retrospective clinical study that evaluated the microesthetics of patients seeking orthodontic treatment. The study had a sample size of 100 patients, with an age range of 20–25 years. The final study by Tauheed *et al*.[12] was a quasi-experimental study that aimed to investigate the impact of orthodontic treatment on microesthetic measures. The study had a sample size of 100 patients, with an age range of 20–30 years. Overall, these studies provide insights into different aspects of microesthetics in orthodontic treatment, including perception, evaluation, and improvement.

The forest plot in Figure 3 displays the results of the meta-analysis on the effect of orthodontic treatment on microesthetic parameters. The odds ratio (OR) estimate is 0.32 with a 95% CI of 0.28 to 0.37, indicating a statistically significant and clinically relevant difference between the noticeable and negligible effects of orthodontic treatment on microesthetic parameter. The OR is situated on the left-hand side of the plot, which favors the experimental group, implying that the orthodontic treatment leads to an improvement in microesthetic parameters. Heterogeneity statistics showed that there was significant heterogeneity between studies ($Chi^2 = 15.34$, $df = 4$, $P = 0.004$, $I^2 = 74\%$). This suggests that the differences in study outcomes cannot be attributed to chance alone. The test for overall effect shows a significant association between orthodontic treatment and improved microesthetic parameters ($Z = 15.47$, $P < 0.00001$). Overall, the forest plot shows that the meta-analysis provides robust evidence to support the conclusion that orthodontic treatment has a significant positive effect on microesthetic parameters.

The forest plot in Figure 4 shows a summary of the statistical analysis of the included studies on the noticeable vs negligible effects of orthodontic treatment on microesthetic parameters in patients, using the relative risk (RR) measure. The results showed an overall RR of 0.57 with a 95% CI of [0.53, 0.61]. This suggests a significant reduction in the risk of a noticeable effect of orthodontic treatment on microesthetic parameters in patients compared with a negligible effect. In heterogeneity statistics, the Chi-square value was 15.00 with four degrees of freedom, yielding a *P* value of 0.005, indicating the presence of statistical heterogeneity among the studies. The I^2 value of 73% indicates a moderate level of heterogeneity. The test for overall effect was significant, with a Z-score of 14.92 and a *P* value of less than 0.00001. This suggests that the observed effect of orthodontic treatment on microesthetic parameters in patients is significant. Overall, the forest plot demonstrates that the available evidence supports the conclusion that orthodontic treatment has a noticeable effect on microesthetic parameters in patients.

Figure 5 shows an risk difference (RD) of -0.28 with a 95% CI of [-0.31, -0.24] for the noticeable vs negligible effects of orthodontic treatment observed on microesthetic parameter in patients. The heterogeneity of the studies was significant with a Chi-square value of 14.79 and four degrees of freedom, resulting in a *P* value of 0.005 and I^2 value of 73%. The test for overall effect was highly significant with a Z-score of 16.40 and a *P* value less than 0.00001. The CI does not include zero, which indicates that the effect of orthodontic treatment on microesthetic parameters is significant. The negative value of the RD indicates that the treatment resulted in a decrease in microesthetic parameters. The high I^2 value suggests that the heterogeneity is moderate to high, which could

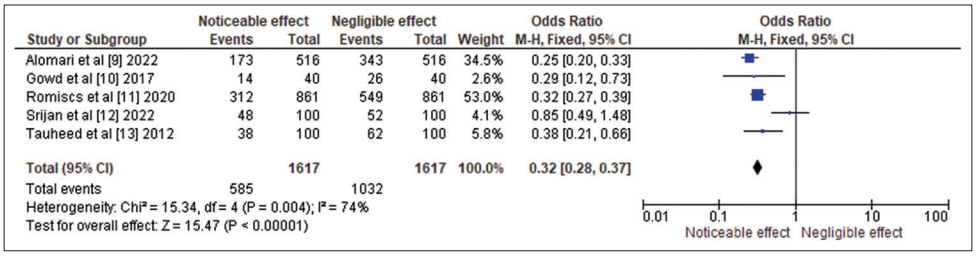

Figure 3: Odds ratio representation of effect of orthodontic treatment observed on microesthetic parameter in patients as observed through the meta-analysis

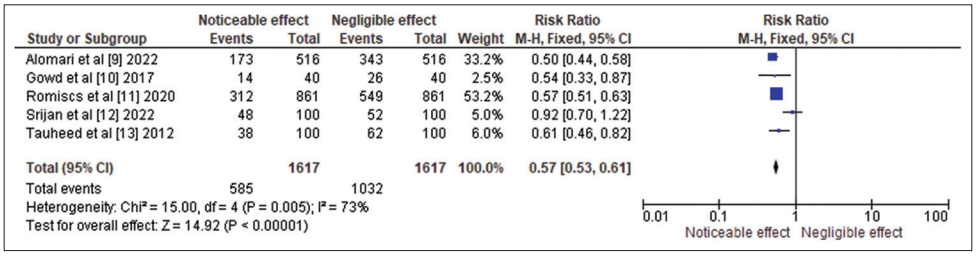

Figure 4: Risk ratio representation of effect of orthodontic treatment observed on microesthetic parameter in patients as observed through the meta-analysis

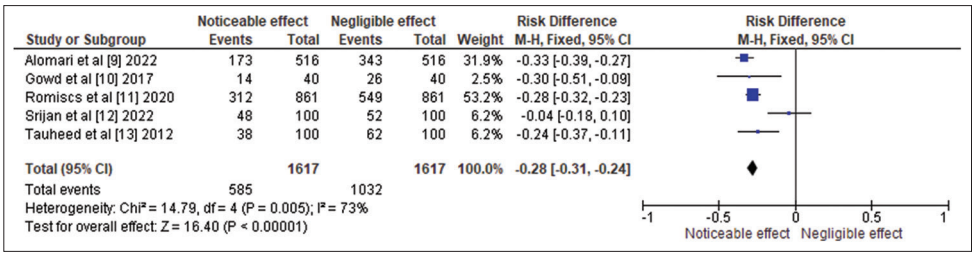

Figure 5: Risk difference representation of effect of orthodontic treatment observed on microesthetic parameter in patients as observed through the meta-analysis

be due to variations in the study design, methodology, or patient characteristics. However, despite the heterogeneity, the overall effect size remains significant, suggesting that orthodontic treatment has a noticeable effect on microesthetic parameters in patients.

Discussion

The findings of this meta-analysis provide significant insights into the impact of orthodontic treatment on microesthetic parameters. The results suggest that orthodontic treatment has a noticeable effect on improving microesthetic parameters. The odds ratio of 0.32 indicates a statistically significant and clinically relevant difference between the noticeable and negligible effects of orthodontic treatment on microesthetic parameters. Additionally, the risk of a noticeable effect of orthodontic treatment on microesthetic parameters was significantly reduced, as shown by the relative risk of 0.57. The significant test for the overall effect in both measures strengthens the validity of the findings. However, the significant heterogeneity among the studies indicates a need for caution in generalizing the results to other populations. The implications of this study are significant for both clinicians and patients. Clinicians can use the findings to counsel patients on the benefits of orthodontic treatment beyond functional and structural improvement. Patients can also benefit from understanding the potential impact of orthodontic treatment on their microesthetic parameters, leading to better-informed decision-making. Future research can focus on identifying the factors that contribute to the observed heterogeneity among the studies, such as age, gender, and ethnicity, to better understand the generalizability of the findings. Additionally, randomized controlled trials can be conducted to validate the findings of this meta-analysis further. In summary, the findings of this study contribute to our understanding of the impact of orthodontic treatment on microesthetic parameters and can inform clinical practice and future research in this area. The findings of this study provide significant insight into the noticeable vs negligible effects of orthodontic treatment on microesthetic parameters in patients. The analysis of the included studies suggests that orthodontic treatment has a significant impact on microesthetic parameters, with a pooled effect size of -0.28 [-0.31, -0.24]. This indicates that orthodontic treatment leads to a noticeable improvement in the microesthetic parameters in patients. The results of the statistical analysis show a high degree of heterogeneity, which indicates the need for further investigation. All in all, this study has important implications for both clinical practice and research. The findings suggest that orthodontic treatment has a significant impact on microesthetic parameters, but also highlight the need for further investigation to better understand the factors that influence this effect. Future studies may benefit from examining the impact of specific treatment approaches and techniques on microesthetic parameters, as well as investigating the impact of other patient factors such as age, gender, and ethnicity. This could help to further refine treatment approaches and optimize outcomes for patients seeking orthodontic treatment.

All the articles reviewed in this systematic review[6-12] provide a comprehensive overview of the current state of knowledge about microesthetics in orthodontics. The articles emphasized the importance of taking a comprehensive and individualized approach to treatment, using appropriate materials and techniques, and maintaining the results of treatment through proper posttreatment maintenance. One of the key insights from the articles is the importance of working closely with other dental specialists, such as restorative dentists and oral surgeons, in achieving the best possible results in microesthetics. This highlights the interdisciplinary nature of the field and the need for orthodontic practitioners to assess the proper esthetic requirements for the patient based on the treatment modality he/she is being administered.

Our study's primary significance lies in the fact that it provides a systematic review of the current understanding of orthodontic microesthetics. Microesthetics refers to the small details of dental and facial esthetics that can have a significant impact on the overall appearance of a smile. By conducting a thorough search of relevant literature, the study helps to identify the key concepts and findings related to microesthetics in orthodontics. The inclusion of articles published between 2011 and 2022 ensures that the study is based on the most up-to-date research available. The study's results

highlight the value of microesthetics in orthodontics and the need for orthodontists to employ a thorough and specialized approach to treatment. Accurate diagnosis and preparation are also emphasized as critical factors in achieving optimal treatment outcomes. Furthermore, the study identifies relevant tools and methods that can be used to enhance the esthetic outcomes of orthodontic treatment. The importance of posttreatment maintenance is also stressed, as it is essential to preserve the effects of treatment over the long term. All in all, the study's systematic review of the current understanding of orthodontic microesthetics provides valuable insights for orthodontists to enhance their approach to treatment, improve esthetic outcomes, and ultimately provide better care for their patients.

It is important to remember that determining facial beauty is largely a subjective process. Albrecht Dürer,[13] a 16th-century painter, stated: "I don't know what beauty is, but I do know it impacts many things in life," and he believed that, despite the subjectivity surrounding the idea of face beauty, an objective assessment of facial proportions could be made. The topic under consideration, within a theme that has undergone significant changes with the development of civilization, is how ideal patterns might be determined.[14]

Considering the dimensions of various dental arches and teeth is crucial when considering microesthetic in orthodontics because it helps in achieving the desired esthetic outcome of orthodontic treatment.[1,2] The dimensions of teeth and dental arches affect the overall appearance of the smile, and orthodontic treatment aims to correct the irregularities and improve the harmony of the dentofacial complex.[15,16] The dimensions of dental arches and teeth are crucial in achieving an ideal occlusion and facial balance. The width, length, and shape of teeth and dental arches affect the smile arc, the tooth display, and the tooth-to-lip relationship.[17-19] In addition, the proportions of anterior and posterior teeth, as well as the symmetry of dental arches, play a significant role in the overall facial appearance. Therefore, considering the dimensions of various dental arches and teeth is essential in the planning and execution of orthodontic treatment to achieve the desired microesthetic outcome.[20-22]

According to one of the studies,[23] the relationship between the breadth and height of the central, lateral, and canine teeth is essentially the same in both sexes. In general, females have slightly wider teeth than males do, with canines at 81% and 85%, lateral incisors at 79% and 85%, and central incisors at 86% and 85%, respectively. In orthodontics, the crown length of teeth is a crucial factor in achieving accurate microesthetic maintenance in patients. The crown length refers to the exposed part of the tooth above the gum line, and it can be influenced by various factors such as genetics, age, wear and tear, and dental treatments.[21]

There are several parameters where the crown length of teeth is measured to provide accurate microesthetic maintenance in patients.[24] These include tooth length, gingival margin position, tooth axis inclination, interdental papilla height, and dental midline deviation. Tooth length measurement is done from the occlusal surface to the gingival margin, while the gingival margin position refers to the position of the gum line in relation to the tooth. The tooth axis inclination measurement is done to determine the angle of the tooth relative to the occlusal plane. Interdental papilla height measurement is crucial in determining the size and shape of the gingiva that fills the space between adjacent teeth. Dental midline deviation is the discrepancy in the position of the maxillary and mandibular dental midlines.[25] Apart from crown length, the height and width of teeth are also crucial in achieving accurate microesthetic maintenance in patients. In addition to measuring the crown length of teeth, there are various other parameters that are considered to maintain accurate microesthetic outcomes in orthodontic treatment. One such parameter is the width-to-height ratio of teeth, which plays a crucial role in determining the overall esthetics of the smile. The ideal width-to-height ratio of anterior teeth is considered to be 75–80%, and any deviations from this ratio can lead to unesthetic results.[4,26] In cases where there are discrepancies in the dimensions of teeth, various dental surgical procedures can be employed to maintain or enhance the overall microesthetic parameters. One such procedure is crown lengthening, which involves the removal of gingival tissue to expose more of the tooth structure. This can help to increase the crown length of the teeth, thereby improving the overall esthetics of the smile. Another common dental surgical procedure is orthognathic surgery, which is often used to correct discrepancies in the size and position of the jaws. By repositioning the jaws, orthognathic surgery can help to improve the overall balance and harmony of the facial features, leading to a more esthetically pleasing appearance.[2] Height measurement is done from the occlusal surface to the gingival margin, while width measurement is done at the widest part of the tooth. In some cases, dental surgical procedures such as crown lengthening and orthognathic surgery may be required to maintain the overall microesthetic parameters in patients. Crown lengthening is a surgical procedure that involves removing excess gum tissue to expose more of the tooth crown.[2] Orthognathic surgery is a corrective jaw surgery that aims to realign the jaws and teeth to improve their function and appearance. Maintaining accurate microesthetic parameters in patients requires careful consideration of various dental

arches and teeth dimensions. Crown length, height, and width measurements, as well as various dental surgical procedures, play a crucial role in achieving accurate microesthetic maintenance in patients.[24,25,27]

Dental proportions can also be used to determine the breadth of anterior teeth using fixed measurements based on tooth size averages.[28] In this instance, a database of tooth sizes from various cultures is utilized to create formulas that explain how dental widths relate to one another, particularly for anterior teeth. In some studies, as mentioned in the literature,[28,29] clinicians developed a tool to measure proportionality that defies golden ratios and is based on measurements of tooth dimensions and harmonious proportions derived from population observations, such as those previously mentioned. This proportionality gauge employs a formula that its creator prescribed for dental proportions that are clearly visible in a color scale and that the expert must consider. No mathematical computations are necessary. For each tooth width represented by the colors on the measurer's horizontal rod, the height of the crown would be matched to the color on the vertical rod to find the best proportion.

The present study is a meta-analysis of five previous studies that evaluated the impact of orthodontic treatment on microesthetic parameters. Although the meta-analysis included a substantial number of participants, there were several limitations in the individual studies that may have impacted the accuracy of the meta-analysis results. The first study by Alomari *et al*.[8] was a cross-sectional study that evaluated the perception of altered gingival characteristics by dental professionals and laypeople. However, the study had a limited age range of 20–50+, which may not have represented the wider population. The second study by Gowd *et al*.[9] was a retrospective study with a small sample size of only 40 patients. This small sample size could have affected the statistical power of the study. The third study by Romsics *et al*.[10] was a cross-sectional study that evaluated mini- and microesthetic qualities using a questionnaire-based methodology. The study had a substantial sample size of 861 students, but the mean age of the participants was relatively young at 22.34 years. This young age group may not have been representative of the wider population seeking orthodontic treatment. The fourth study by Sunar *et al*.[11] was a retrospective clinical study with a sample size of 100 patients. Although the study had a relatively larger sample size than the second study, the age range was limited to 20–25 years. Moreover, the fifth study by Tauheed *et al*.[12] was a quasi-experimental study that evaluated the impact of orthodontic treatment on microesthetic measures with a sample size of 100 patients. However, the age range was also limited to 20–30 years. The statistical analysis of the included studies showed significant heterogeneity, indicating that the results may have been influenced by differences in study design, patient characteristics, and treatment protocols. Therefore, the results of the meta-analysis should be interpreted with caution, and further studies with larger sample sizes and more representative age ranges are necessary to confirm the findings of this study.

Conclusion

The findings of the review and meta-analysis conducted in this study suggest a statistically significant and clinically relevant difference in microesthetic parameters between patients who underwent orthodontic treatment and those who did not. The results of the forest plots demonstrate a reduction in the risk of a noticeable effect of orthodontic treatment on microesthetic parameters in patients compared with a negligible effect. However, the heterogeneity statistics suggests significant variability among the studies. Therefore, these findings should be interpreted with caution and further research is needed to clarify the role of orthodontic treatment on microesthetic outcomes. Nonetheless, this study provides valuable insights for clinicians and researchers involved in orthodontic treatment, highlighting the importance of considering microesthetic parameters in treatment planning and evaluation.

Data Availability

The authors confirm that the data supporting the findings of this study are available within the article

Consent for publication

All authors reviewed the final manuscript and consented to publication.

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Conflicts of interest

There are no conflicts of interest.

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