

GRADUATION PROJECT

Degree in Dentistry

THE INFLUENCE OF LOWER INCISOR POSITION ON FACIAL PROFILE AESTHETICS

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Abstract

Introduction: In today's orthodontics, planning a treatment is no longer limited to only achieving functional occlusion, but also aims to improve facial aesthetics. The position of lower incisors is considered an important factor as it can influence the lower lip, chin contour and overall facial profile.

Objective: The aim was to investigate how changes in lower incisor position influence overall aesthetics. The secondary objectives were to evaluate the sagittal and angular position of the lower incisor according to the A-Pog line, to evaluate lower incisor inclination given by IMPA and to realise whether differences exist depending on skeletal class. **Methods:** A documentary literature review was carried out using primary research articles published between 2010-2025. PubMed, Medline and Science direct were used to perform searches. After screening and eligibility assessment, 10 in vivo studies were used for a qualitative analysis. **Results:** The reviewed studies showed that lower incisor position is associated with measurable differences in facial aesthetics, mainly through its effect on the lower lip, mentolabial region, chin contour and facial convexity. A-Pog measurements were useful clinically but not sufficient on their own. IMPA was found to be a valuable parameter but its interpretation depended on mandibular plane angle and skeletal pattern. Differences were also observed according to skeletal class and facial pattern. **Conclusion:** lower incisor position has influencing power on facial profile aesthetics and should be evaluated as part of an individualised orthodontic diagnosis that considers skeletal pattern, soft tissue response and aesthetics outcome.

Keywords

Orthodontics, lower incisor, facial aesthetics, IMPA, cephalometric analysis, lip posture.

Resumen

Introducción: En la ortodoncia actual, la planificación del tratamiento no solo busca lograr una oclusión funcional, sino también mejorar la estética facial. La posición de los incisivos inferiores es importante porque puede influir en el labio inferior, el contorno del mentón y el perfil facial. **Objetivo:** Investigar cómo los cambios en la posición de los incisivos inferiores influyen en la estética global. Como objetivos secundarios, se evaluó la posición sagital y angular del incisivo inferior según la línea A-Pog, su inclinación mediante el IMPA y las diferencias según la clase esquelética. **Métodos:** Se realizó una revisión bibliográfica con artículos originales publicados entre 2010 y 2025. La búsqueda se realizó en PubMed, Medline y ScienceDirect. Tras aplicar los criterios de inclusión y exclusión se incluyeron 10 estudios in vivo para el análisis cualitativo. **Resultados:** Los estudios revisados mostraron que la posición de los incisivos inferiores se asocia con cambios medibles en la estética facial, principalmente por su efecto sobre el labio inferior, la región mentolabial, el contorno del mentón y la convexidad facial. Las mediciones relacionadas con A-Pog fueron clínicamente útiles, aunque insuficientes por sí solas. El IMPA fue un parámetro valioso, pero su interpretación depende del ángulo del plano mandibular y del patrón esquelético. También se observaron diferencias según la clase esquelética y el patrón facial. **Conclusión:** La posición de los incisivos inferiores influye en la estética del perfil facial y debe tenerse en cuenta dentro de un diagnóstico ortodóncico individualizado.

Palabras clave

Ortodoncia, incisivo inferior, estética facial, IMPA, análisis cefalométrico, postura labial.

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1. Introduction

1.1 Background and Rationale

1.1.1 Importance of Facial Aesthetics in Orthodontics

Contemporary orthodontic practice has shifted considerably from a purely occlusion-centred approach. Patients now present with expectations that extend beyond functional correction to include improvements in facial proportions and profile balance. The position of the lips relative to the chin, the convexity of the profile, and the overall harmony of the lower facial third all contribute to patient self-perception and post-treatment satisfaction. As a result, achieving a favourable facial aesthetic outcome has become an integral part of orthodontic treatment planning.

Historically, orthodontic treatment planning relied heavily on dental and skeletal analysis with limited consideration of the soft tissue envelope. Advances in cephalometric and three-dimensional imaging have since demonstrated that tooth movements produce measurable changes in the overlying soft tissues. The lower incisors illustrate this well. Although not prominently visible during smiling, they exert considerable influence on lower lip posture and chin projection. Displacements of even a few millimetres at this level can alter the sagittal appearance of the lower facial third. Cephalometric analysis has proved that changes in lower incisor inclination are usually accompanied with changes in the shape of soft tissue profile. In a study, it was found that a major forward inclination of the lower incisor was linked to a more convex profile, suggesting that the lips and chin happened to be projected more prominently (1). Other research comparing patients before and after functional orthodontic treatment found that changes in the positions of both upper and lower incisors were associated with measurable improvements in perceived facial balance and attractiveness (2). These studies confirm that tooth position influences facial aesthetics and highlight the importance of considering the profile when planning orthodontic movements.

1.1.2 Facial Profile Analysis and Its Parameters

The facial profile shows how the teeth, jaws and soft tissues relate to one another in the side view of the face. Orthodontists use cephalometric analysis to study this relationship. This method provides angular and linear measurements, such as the SNA, SNB and ANB angles, which describe jaw positions and the mandibular plane and E-plane distances, which help evaluate facial type. These parameters form the basis for diagnosing skeletal class I, II and III patterns and planning. Other than bone and dental angles, soft tissue measurements give valuable

information about how the face appears externally. Angles such as the nasolabial angle, mentolabial angle and the Z-angle describe the relationships between the lips, chin and nose. In a recent cephalometric study, the Z-angle proved to be one of the most reliable indications of profile convexity and overall facial harmony when lower incisor position was considered (1). Another investigation found that patients with high, mandibular plane angle tended to show smaller changes in the soft tissue profile after dental movement compared with those with a low mandibular plane angle (3). This suggests that each patient's growth pattern affects how tooth movement influences facial appearance. Taken together, these observations indicate that the interplay between skeletal framework, dental position and soft tissue drape is both complex and patient specific. The degree to which a given tooth movement translates into a visible facial change depends on vertical and sagittal growth patterns, among other variables. Orthodontic treatment planning must therefore extend beyond occlusal correction and incorporate a systematic evaluation of soft tissue balance.

1.1.3 Role of Incisor Position in Facial Aesthetics

The position and inclination of the incisors are among the most influential dental factors affecting the facial profile. The upper incisors are often the main focus of aesthetic analysis, but the lower incisors have a major role in shaping the lower facial third and in supporting the lower lip and chin. Their sagittal and angular positions can affect how far forwards the lips project and how the chin and lower facial contour appear. Research has shown that differences in lower incisor inclination correspond closely to variations in facial shape and soft tissue projection. One study comparing patients with different vertical growth types reported that the position of the lower incisors strongly influenced profile cephalometric indicators such as the Z angle (1). Another analysis of adults with different facial patterns showed that brachyfacial individuals tended to have more upright lower incisors than dolichofacial individuals, suggesting that facial type influences tooth inclination (4).

Several studies analysing different malocclusion types have also confirmed that the sagittal and angular position of the lower incisors vary significantly with skeletal class and facial pattern, indicating that incisor inclination adapts to maintain functional and aesthetic balance (5). From a clinical perspective, the position of the lower incisors carries more weight than is often appreciated in routine diagnosis. Proclination or retraction of these teeth directly modifies lower lip support and chin projection, altering the perceived balance of the profile. On the other hand, the alveolar bone in this region is frequently thin, the periodontium has limited tolerance for excessive movement, and post-treatment stability must be maintained. An awareness of

these anatomical and biological constraints, together with their aesthetic implications, is therefore necessary for predictable treatment outcomes.

1.2 Anatomy and Biomechanics of the Lower Incisors

1.2.1 Anatomical considerations

The lower incisors are in the anterior segment of the mandibular dental arch. Their roots typically lie within the mandibular symphysis and are surrounded by the alveolar bone, periodontal ligament (PDL), and soft tissues of the lower lip and chin. The thickness of the alveolar housing around these teeth is often thin, especially on the labial side, which means that tooth movement must be planned with care to avoid pushing the roots beyond the bony boundaries.

Studies using cone beam computed tomography (CBCT) have shown that the buccal bone plate supporting the mandibular incisors can be less than 1mm thick at 3 and 6mm apical levels in many cases, indicating a reduced margin for safe movement (6). In another CBCT study, the labial and lingual bone around the lower incisors changes in different ways during orthodontic movement, the alveolar bone often responded to incisor retraction or proclination, but not always in full harmony with tooth movement (7). These findings emphasise that the anatomical limits of the alveolar process must be considered when planning incisor positioning, since movement beyond those limits may lead to dehiscence, fenestration, or gingival recession. In terms of root relation to mandibular structures, the lower incisors are near the mental foramen and the incisive canal in some individuals. While this is more important for surgical and implant planning, it underscores the fact that the mandibular anterior region is complex and that tooth movement may have anatomical constraints beyond just alveolar bone thickness.

1.2.2 Biomechanics and Orthodontics Implications

From biomechanical standpoint, moving the lower incisors involves applying forces and moments through the bracket arch wire system, which transmit through the PDL and into the alveolar bone. When a tooth is moved, resorption occurs on the pressure side and bone formation on the tension side of the PDL. This is classical “pressure tension theory” of orthodontic tooth movement. However updated work proposes that the alveolar bone may respond not only through bone turnover but also by bending or deformation, a concept sometimes described as the “alveolar bending hypothesis” (8). For the lower incisors, proclination (tilting the crown forward) or retroclination (tilting back) will alter the inclination relative to the mandibular plane and this changes the load on the alveolar bone and soft tissues. For example, a finite element study of mandibular incisors found that as the initial incisor

mandibular plane angle increased, the moment on the crown shifted from lingual to labial direction, indicating different force systems and higher risk of root movement towards thin labial bone(9). This means that in patients with already upright lower incisors, additional proclination may push the roots toward the labial cortex, increasing the risk of bone loss or gingival problems.

In addition, during intrusion or extrusion movements of lower incisors, care must be taken because interconnected structures such as soft tissue envelope and chin posture may also respond. Biomechanical analyses indicate that bodily movement (translation) of the lower incisor requires careful control of the movement/force (M/F) ratio, to reduce uncontrolled tipping and root apex displacement. If uncontrolled tipping occurs, the root may press into the alveolar bone plate, leading to thinning or bone dehiscence (10). Clinical research supports these biomechanical insights. A study examining the alveolar bone of lower incisors after orthodontic treatment found that both proclination and retraction were associated with reduction in total bone thickness, especially on the lingual side of the incisors (11).

In sum, the biomechanics of moving lower incisors are influenced by anatomical boundaries (thin alveolar bone, proximity to cortical plates), force systems (translation vs tipping), and the individual's growth pattern and soft tissue response. Recognising these factors helps explain why changes in lower incisor position may influence not only occlusion but also facial profile aesthetics.

1.3 Determinants of Facial Profile Aesthetics

1.3.1 Skeletal and Soft Tissue Relationships

Facial profile aesthetics is dependent on a complicated relationship between face bones, teeth positions and overlying soft tissue. The skeletal framework builds the base of facial form, while soft tissue layer which includes the muscles, fat and skin provide a more visible contouring that can influence how the face appears. Small differences in jaw size, inclination or tooth positioning can have noticeable effect in the appearance of the face. Sagittal relationship between mandible and maxilla is an important decider for profile balance. A well aligned relationship between the jaw tends to produce a straight or slightly convex profile, which is often perceived as harmonious. In contrast, a retruded mandible can result in a convex profile while a protruded mandible can produce a concave appearance. These skeletal relationships are typically seen through cephalometric measurement by using the SNA, SNB and ANB angles, this describes the anterior posterior jaw positioning. Soft tissues do not always follow the skeletal structures exactly, and their thickness and elasticity influence how underlying bone movements

are expressed externally. For example, when incisors are retracted, the lips may move backward but not by the same amount as the teeth. A study using 3D facial imaging found that only about 40% of the dental movement was reflected in soft tissue change around the lips, showing that the soft tissue response is variable and patient specific (12).

The skeletal-soft tissue relationship varied by age, sex and ethnicity. Male patients, for example, generally appear with thicker soft tissue over the chin and nasal region compared to females, this can result in a more noticeable profile appearance (13). Well-documented ethnic variations also exist, for example, east Asian populations happen to exhibit a more protrusive soft tissue profile compared with Caucasian populations, which directly affects standardised aesthetic values and treatment objectives (14).

Recognising these demographic variations is essential for creating treatment plans that are tailored to the individual patient rather than based on a single population standard.

1.3.2 Perception of Aesthetic Profiles

Aesthetic perception of the facial profile is inherently subjective, shaped by cultural standard, individual preferences and social belief. Orthodontists, other dental professionals and lay observers usually diverge from what constitutes “ideal” in their assessments. Generally, a straight or slightly convex profile is considered the most harmonious across many populations, but preferences can be different depending on cultural background and current beauty standards. Different studies have researched on how changes in the dental and skeletal structures can and may affect the perceived attractiveness. In one digital simulation study, profiles were changed incrementally by repositioning the lower incisors and both orthodontists and general population rated the images for aesthetics, the results showed that even small changes in lower incisor inclination could greatly influence facial balance, with slightly retracted lower incisors often being rated as more attractive than excessively proclined ones (15). Another study using manipulated facial images found that profile with moderate lip projection were rated as more aesthetically acceptable than those with very flat or very protrusive lips (16). These findings suggest that the public’s perception of beauty tends to favour balanced and natural looking proportions rather than the opposite. Age also plays a role in aesthetic standards. Younger individuals often prefer profiles with fuller lips and softer contours, while older adults may prefer straighter, more mature looking profiles. Aesthetic standards can also change over time due to media and cultural influences which highlights the importance of considering social context when talking about treatment goals (17).

When it comes to clinical evaluation, orthodontists must balance these subjective preferences with biological and mechanical limits. Over retraction of incisors for example, might improve facial convexity on a cephalogram but can flatten the lips excessively, resulting in an unesthetic or aged appearance. Similarly, excessive proclination may cause lip stress and disrupt facial balance. The key to achieve a satisfying result for the patient is to understand how lower incisor position affect both cephalometric values and subjective aesthetic standards.

1.3.3 Interplay Between Dental, Skeletal, and Soft Tissue Factors

Facial aesthetics is not regulated by any single anatomical variable but rather emerges from the precise relationship between skeletal, dental and soft tissue structures. The incisors occupy an important position at the interface of all three components which accounts for the disproportionate influence their position exerts on profile appearance. Displacement of the lower incisors produces a domino effect of soft tissue responses involving the lower lip and chin, with measurable consequences for overall profile convexity.

A CBCT based study found that proclination of lower incisors cause visible changes in lip morphology and mentolabial angle which were associated with shifts in profile perception (18). Another clinical study comparing skeletal class I and class II patients showed that when lower incisors were retracted, the soft tissue chin and lower lip moved backward resulting in a more concave lower face profile (19). These results support the idea that lower incisor movement can have visible impact on how the face is perceived, proving the need to plan such movements carefully. Growth direction and facial biotype introduce additional variability into this relationship. In dolichofacial patients, the soft tissue tends to be thinner and exhibits a diminished response to underlying skeletal and dental changes. Consequently, a given magnitude of tooth movement may produce less visible alteration of the facial profile in these patients than in brachyfacial individuals, who typically present with thicker, more responsive soft tissue layers. This has direct implications for the predictability of aesthetic outcomes and the expectations communicated to the patient during treatment planning.

1.4 Clinical Relevance of Lower Incisor Position

1.4.1 Diagnostic Considerations

The lower incisors have a major influence on both facial aesthetics and occlusal function, which makes their evaluation a central part of orthodontic diagnosis. Several angular and linear cephalometric measurements are used to describe their position, including the incisor mandibular plane angle (IMPA), the distance of the incisor tip to the NB line (L1-NB), and the relationship of the incisor root to the A-Pog line. These values help clinicians identify whether the teeth are protrusive, retrusive, or within the ideal alveolar range (20). Accurate diagnosis is essential because incorrect positioning of the lower incisors can lead to both functional and aesthetic problems. Excessive proclination may cause lip protrusion, loss of periodontal support, or gingival recession, while too much retraction can flatten the facial profile and reduce lip fullness. A CBCT based study showed that the amount of alveolar bone surrounding the lower incisor decreases significantly when the teeth are positioned beyond the cortical boundary, increasing the risk of bone dehiscence and tissue recession (21). Another investigation that compared digital cephalometric norms across skeletal patterns found that an IMPA between 90° and 95° was associated with the most balanced facial profile and periodontal health (20).

With the rise of digital orthodontics, three-dimensional imaging and virtual simulation now make it possible to predict soft tissue response to tooth movement with much greater precision. Integrating 3D facial scans with CBCT data allows clinicians to visualise how changes in lower incisor inclination will affect the lips and chin, supporting better aesthetic and functional planning.

1.4.2 Treatment Planning Implications

The lower incisor position is a key factor influencing major orthodontic treatment decisions such as extraction planning, anchorage design, and amount of space closure. Adjusting their inclination can change the soft tissue profile and the perception of facial balance. In convex profiles or in cases with dental protrusion, controlled retraction of the lower incisors can reduce lip prominence and improve harmony. In contrast, in patients with flat or retruded profiles, maintaining or slightly proclining these teeth can prevent an unattractive, flattened appearance (22). Clinical evidence supports this idea, a prospective clinical study of adults undergoing extraction therapy found that lower incisor retraction resulted in an average decrease of 2mm in lower lip projection, producing a measurable improvement in facial balance (23). Another CBCT based study observed that excessive retraction could reduce the depth of the mentolabial sulcus and make the lower facial third appear overly concave (24). These results confirm that the

aesthetic consequences of incisor movement depend on both the amount and direction of tooth displacement. The stability of tooth position after treatment is another important consideration. Over retraction increases soft tissue tension and relapse risk, while excessive proclination predisposes to gingival inflammation and bone loss. A longitudinal follow up study showed that maintaining the lower incisor close to its pretreatment inclination was associated with better periodontal outcomes and fewer posttreatment changes in facial profile (25). These findings reinforce the importance of respecting the patients individual skeletal and alveolar limits during treatment. Orthodontic tooth movement should therefore aim for controlled bodily translation rather than uncontrolled tipping, particularly in anterior region. Proper torque control helps protect the alveolar bone and soft tissues, maintaining both periodontal health and facial aesthetics.

1.4.3 Integration with Facial Aesthetics

The aesthetic impact of the lower incisor position goes beyond occlusion and biomechanics. Since the lower incisors support the lips and define the contour of the chin lip area, their position affects the visual proportions of the lower third of the face. Even small changes in incisor inclination can subtly alter facial expression and attractiveness.

A 2025 digital simulation study analysed the effect of 1mm incremental retraction of the lower incisors on facial appearance and found that moderate movement produced the highest aesthetic ratings among both clinicians and general population, whereas excessive retraction reduced the perception of natural balance (26). Another study comparing pretreatment and posttreatment photographs concluded that the sagittal position of the lower incisors had a stronger influence on perceived attractiveness than skeletal jaw correction alone (27). These findings underline that aesthetic improvement in orthodontics depends more on achieving proportional harmony than on large, dramatic movements. In clinical practice, treatment decisions ultimately rely on a combination of quantitative cephalometric data and the clinician's subjective visual assessment of facial proportions. Contemporary three-dimensional planning software facilitates this process by enabling both clinician and patient to preview the anticipated soft tissue changes prior to the initiation of treatment.

2. Objective

Patients or study samples evaluated in orthodontic research, including different skeletal classes and facial patterns. **(P)** Variations in lower incisor position, including sagittal and angular changes assessed through cephalometric measurements such as A-Pog line and IMPA. **(I)** Different lower incisor positions, inclinations or skeletal classes, as well as comparisons between facial patterns and malocclusion groups. **(C)** Changes in facial profile aesthetics, including effects on lip position, mentolabial region, chin contour, facial convexity and overall profile harmony. **(O)**

Research Question

In orthodontic patients with different skeletal patterns and facial types, do variations in lower incisor position, assessed by cephalometric measurements such as IMPA, L1-NB and A-Pog distance produce differences in facial profile aesthetics and soft tissue response?

3. Materials and Methods

3.1 Study Design

A systemic bibliographic review was carried out using scientific literature following a structured methodology for identification, selection and analysis of related studies about the influence of lower incisor position in facial aesthetics. The design of the study was based on predefined criteria and respecting the inclusion and exclusion criteria.

3.2 Data Sources

The collected data are from secondary sources released between 2010 and 2025 to establish a good relevance and accuracy.

- Databases used: PubMed, Medline and ScienceDirect.
- Institutional and government websites: National Institute of Health

3.3 Search Strategy

A structured search was used with using keywords and search strings to find accurate results. The following were used:

Keywords used:

“Lower incisors”, “orthodontics”, “mandibular incisor”, “incisor inclination”, “incisor position”, “IMPA”, “cephalometric analysis”, “CBCT”, “facial profile”, “facial aesthetics”, “soft tissue profile”, “lip posture”, and “mentolabial angle” Searched strings used:

- “lower incisor AND incisor inclination AND facial aesthetics”
- “mandibular incisor AND cephalometric analysis AND facial aesthetics”
- “lower incisor position AND facial soft tissue AND orthodontic treatment”
- “lower incisors AND facial convexity AND aesthetic perception”

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion Criteria

- Study type: original research articles, human studies only, peer reviewed articles, and full text availability
- Human studies only.

- Full text availability in English
- Articles published between 2010 and 2025

3.4.2 Exclusion Criteria

- They are not available in English
- Do not assess facial profile or soft tissue outcomes
- Lack of clear methodology or do not provide enough data to extract measurable outcomes, ethic approval is missing when human participants are involved
- Study is not indexed in reliable scientific databases
- Show clear signs of publication bias, selective reporting or missing data essential for analysis

3.5 Screening Process

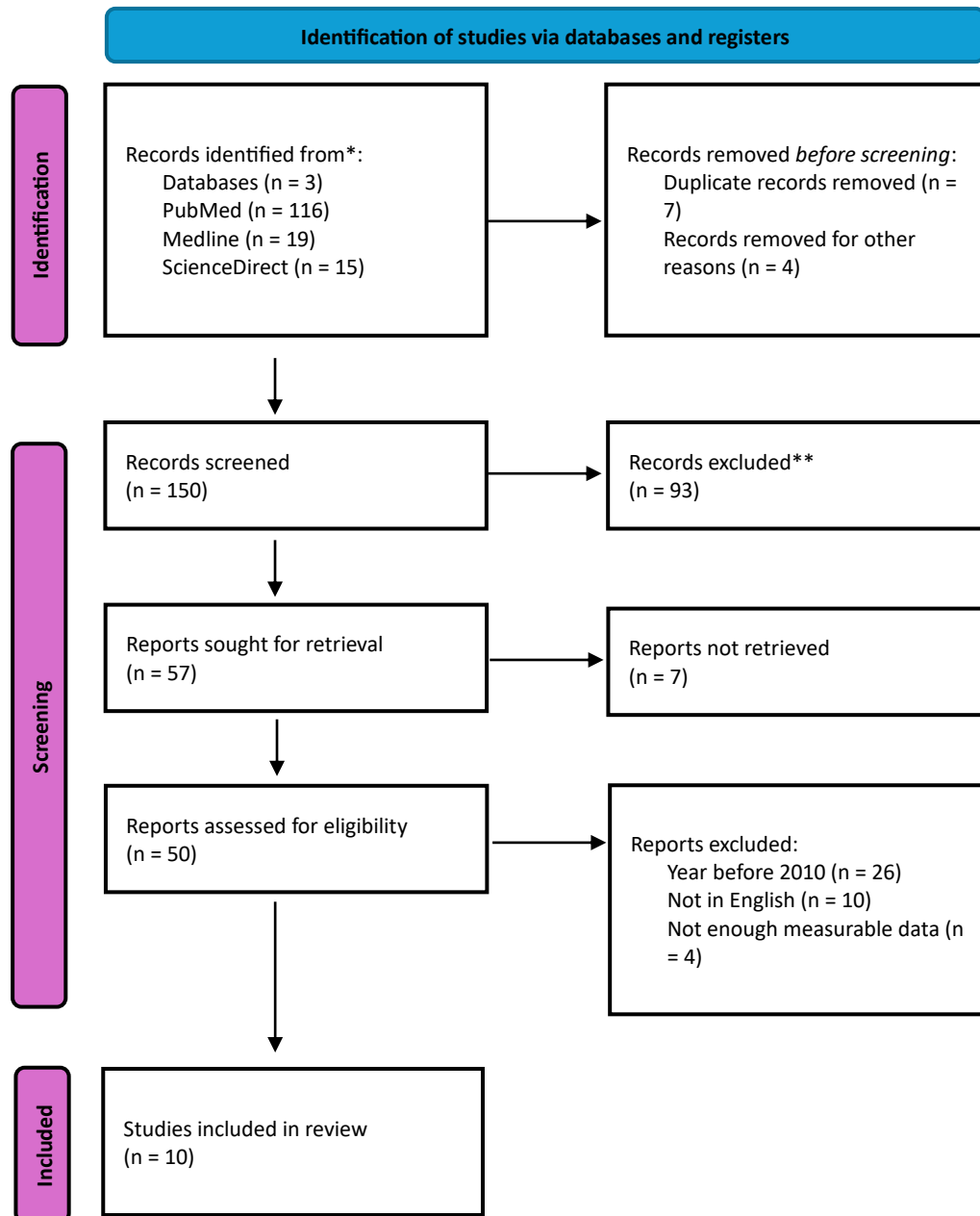
All records obtained from the database searched were imported into Zotero, which was used to organise the literature and automatically discard duplicates. The titles and abstracts of the collected articles were then screened to determine relevance, and studies that did not meet the inclusion criteria were excluded. Full text versions of the remaining articles were reviewed to confirm eligibility based on topic alignment, methodological quality, and the presence of measurable outcomes related to lower incisor position and facial profile aesthetics. The final set of eligible articles was then used for data extraction and analysis.

3.6 Data Extraction

For each study that met the inclusion criteria, key information was collected to support comparison and analysis. This included the author names, publication year, and overall study design, as well as details about the sample characteristics. Measurements related to lower incisor position, obtained through cephalometric or CBCT analysis, were recorded together with the soft tissue and aesthetic profile variables assessed in each study. Finally, the main findings describing the relationship between lower incisor position and facial profile aesthetics were summarised to allow a clear evaluation of the evidence.

4. Results

Figure 1. Prisma Flow Diagram



Author/Year	Review question	Definitions	Sample	Appraisal criteria	Synthesis of studies	Summary/Conclusion	Comments
Baik et al., 2022	Soft tissue changes comparison after the extraction of premolar due to the type of incisor movement	Classification of incisor movement based on axis change and apex retraction, tipping or translation	Retrospective cases of extraction with lip protrusion. Tipping sample n = 27 , Translation sample n = 26 , total n = 53 . Cephalograms taken before and after treatment.	In vivo study, measurable lower incisor movement description, soft tissue profile outcomes be measurable, groups to be defined, clear statistics.	Evidence added that each type of movement of lower incisors is linked to a unique profile outcome.	The bigger the root retraction and bodily movement were linked with greater posterior soft tissue adjustment and measurable profile changes.	Strength: Distinct group definition and comparison. Weakness: small sample size
Derwich et al., 2021	To assess the influence of sagittal positioning of lower incisors on facial profile convexity	The convexity of facial profile evaluated using Z-angle . Lower incisor position evaluated by cephalometric measures, e.g., IMPA and FMIA	Cross sectional cephalometric study. Total n = 200 patients aged 15-25 . Categorised by vertical growth pattern.	Defined cephalometric outcomes with visible growth pattern grouping and measurable profile outcomes.	Lays out direct diagnostic evidence allowing to link lower incisor position with convexity of profile.	Association of facial profile convexity with lower incisor sagittal position, also presenting the Z angle as a useful value for profile evaluation.	Strength: Big sample size and distinct cephalometric approach. Weakness: due to it being cross sectional design, it limits the cause effect conclusions.
Galdi et al., 2023	To suggest and assess cephalometric measurements to evaluate and describe sagittal lower incisor position in relation to skeletal indicators.	“Lower incisor-Pg” which is described as a linear measurement to assess the limits of anterior dentition.	In vivo. Analysed radiographs n = 1836 . Included analysis n = 1256 . Based on diagnostic assessment and not treatment based.	Clear definition of measurement and reported statistical testing, relevant for incisor position assessment.	Adds a method of diagnosis for lower incisor position, which supports explanation across skeletal patterns.	The given parameter changes with sagittal and vertical skeletal relationships and was illustrated as useful for evaluating the limits of incisor positioning.	Strength: Big sample size. Weakness: no direct facial aesthetic evaluation.
Hernandez-Sayago et al., 2013	To assess lower incisor inclination angle and position in different types of malocclusion and facial patterns.	The inclination of lower incisor is evaluated using multiple cephalometric studies including Tweed, Ricketts, and Jarabak analyses.	A cross sectional study. Total n = 90 of cephalograms. Grouped in skeletal malocclusion and facial pattern.	A well defined grouping, measurable variables of incisor, and statistical comparison.	Supports the idea that position of lower incisor differs from skeletal and facial pattern which ultimately can affect profile planning.	There were significant differences in the inclination of lower incisor across facial patterns and malocclusion groups.	Strength: Multiple patterns were compared. Weakness: No evaluation of pre-post treatment outcomes or direct aesthetic evaluation.
Huang and Li, 2015	To evaluate the correlations between cephalometric variables and facial profile attractiveness after treatment.	A subjective profile examination was done by using visual attractive scores. And an objective score based on cephalometric measures.	Premolar extraction for bimaxillary protrusion. Total n = 60 patients aged between 11-36 .	An inclusion of objective and subjective outcomes, with measurable cephalometric variables and defined sample.	It helps to provide evidence for the linking of measurable orthodontic changes to facial aesthetics.	There were reports of significant correlations between cephalometric variables which included the measurements of incisor and lip inclinations and attractiveness scores.	Strength: A combination of objective and subjective evaluation. Weakness: The outcome is a result of both upper and lower arches rather than just the mandibular incisors.
Lu et al., 2020	To assess and evaluate soft tissue changes in the chin area after a lower incisor retraction.	It was assessed by using soft tissue thickness and measurements of the area related to incisor retraction.	Retrospective study. Female adults with bimaxillary protrusion which were treated with 4 premolar extractions. Total n = 59 females, with mean age of 23.5 .	Clear pre-post comparison with measurable chin outcomes and incisor movement, statistically reported.	It gives evidence on how the retraction of incisor is associated with changes in lower soft tissue.	The retraction of soft tissue was associated with significant changes in the thickness of soft tissue, without area changes.	Strength: Focus on outcomes of the chin region. Weakness: An all female sample and retrospective design.

Maetevorakul and Viteporn, 2016	To identify the predictors of soft tissue profile changes after an orthodontic treatment of a Class II division 1.	The profile changes were described using X and Y coordinate system, which were based on cephalometric landmarks.	Class II division 1 patients aged between 8-16 . Total n = 104 . Different treatment approaches were included.	Measurable outcomes with regression methods.	Supports achieving which variables, including incisor-related variables, are in association with profile changes.	According to the study it has been reported that several factors, such as dental and skeletal variables, were associated with profile change.	Strength: Multiple variables were analysed. Weakness: growing patients can and mixed treatments can influence soft tissue changes.
Peng et al., 2025	To foresee the changes in incisor position and facial profile after an orthodontic treatment using machine learning.	The outcome of the model included changes in L1-MP and profile angles such as Z-angle and facial convexity measurements.	Retrospective study. Pre-post treatment cephalograms. Total n = 346 orthodontic patients.	A large sample with clearly defined variables.	It includes predictive evidence that helps link incisor movement variables with the outcomes of the profile across a large dataset.	According to the study, it reports that machine learning could foresee incisor and facial profile changes with reported performance measures and also identified the influential predictors.	Strengths: Large dataset.
Fang et al., 2023	Soft tissue lip response to anterior retraction between lip competent in comparison to incompetent patients.	Lip incompetence is defined by lip separation at rest in the cephalogram. It reports the ratio of incisor to lip changes.	A sample of females with Class II with all first premolars extracted. Total n = 40 , competent group n = 20 , incompetent group n = 20 , with mean age of 27.57 .	A clear group definition with measurable incisor and lip changes.	It helps to explain how the initial lip position changes the visible outcome of incisor movement on the profile.	In the lip incompetent patients, the lip retraction was greater and the relationship between incisor movement and lip changes were different between the groups.	Strength: A clinically relative grouping with clear reporting. Weakness: An only female sample with small sample size.
Liu et al., 2019	Evaluating 3D lip vermilion changes after extraction and non-extraction orthodontic treatment and to relate with incisor movement.	The outcome of the lip vermilion was measured using 3D parameters while including vermilion height, angles, fullness, and surface area.	A sample of female only aged between 18-26 . Total n = 47 . Maximum anchorage extraction (G1) group n = 18 , moderate anchorage extraction (G2) group n = 16 , non extraction (G3) group n = 13 .	3D soft tissue measures, the groups are defined in three different groups G1, G2, G3.	Adds 3D results of soft tissue changes that are linked with orthodontic tooth movement.	The extraction treatment groups presented reduction in vermilion height, fullness, and surface area, with correlations reported between incisor changes and lip shape changes.	Strength: 3D analysis of soft tissues. Weakness: A female only study, which limits generalisation.

Figure 2. Results Table

By respecting the literature search and screening process that was mentioned in methodology, ten research articles were found that respected the inclusion criteria mentioned and were chosen for the final analysis. The selected studies analysed the different aspects and analysis related to lower incisor position and its correlation with soft tissues or aesthetic outcomes. Only primary in vivo studies were used to ensure that the clinical orthodontic conditions were met.

The studies that were included were published between years 2013 and 2025. The sample sizes varied between each study ranging from small clinical samples to large retrospective datasets. Majority of the studies assessed patients that were being treated with fixed orthodontic appliances, and some focusing on premolar extraction which is commonly used to for protrusive treatments to improve the profile balance. The most used method to assess lower incisor position and the corresponding craniofacial structures were cephalometric analysis. Measurements such as mandibular incisor inclination and sagittal positioning in relation to skeletal reference planes were commonly used. Lip position, facial convexity, and profile related angles were parameters used to evaluate the soft tissue outcomes and changes.

Other methods were also incorporated in some studies to evaluate facial soft tissue changes, studies such as, 3D facial imaging techniques to assess the morphology of the lips and surface changes following an orthodontic treatment. In total, the studies that were used gave quantitative data in which they linked mandibular incisor positioning with measurable changes in facial profile characteristics.

5. Discussion

5.1 Influence of lower incisor position on overall aesthetics

Several of the included studies demonstrated that changes in mandibular incisor position were reflected in modifications of soft tissue structures such as the lower lip, mentolabial region, and facial convexity (1). These findings support the concept that lower incisor position plays an important aesthetic role in the appearance of lower third of the face (28).

Cephalometric based studies showed that sagittal positioning and inclination of the lower incisors were associated with profile measurements, including facial convexity and angular profile parameter (1). Lower incisor position was linked to facial convexity through parameters such as the Z-angle and other profile angles, with reported diagnostic accuracy for the Z -angle reaching an area under the curve of 0.957 and a cut off value of 68.0°, indicating high sensitivity of 94.1% and specificity of 84.3% for profile assessment (1). At the same time, studies that evaluated subjective aesthetic outcomes reported that profile attractiveness was associated with a combination of incisor position, lip position, and chin morphology, including variables such as lower incisor tip position relative to the AP plane, lip position relative to the E-line, Pg-NB distance, and mentolabial angle (29).

Treatment based studies further supported this relationship demonstrating the orthodontic movement of incisors leads to measurable soft tissue changes (30). In extraction cases, anterior retraction resulted in posterior movement of the lips and changes in facial parameter (31). Differences in the type of incisor movement also influenced the extent of these changes (31). Greater lower incisor root apex retraction of 5.31 mm in translation cases compared with 0.26 mm in tipping cases was associated with greater posterior displacement of soft tissue point B of 3.25 mm versus 1.25 mm and changes in the mentolabial sulcus angle of -8.13° versus +5.89° (31). these values indicates that both the magnitude and the type of lower incisor movement influence visible profile changes (31), nonetheless the relationship between lower incisor movement and soft tissue response was not uniform across all studies. Variability was observed depending on initial soft tissue characteristics (32). In cases with lip competence, greater lip retraction was observed than in competent cases, with lower lip changes of 5.57 mm compare with 4.28 mm, and stronger correlations between lower incisor retraction and lower lip displacement were reported only in the incompetent group (32). This pattern in consistent with other studies showing that prediction of soft tissue response depends not only on tooth movement, but also on baseline lip thickness, lip posture, gender, and skeletal variables (28).

Three dimensional analyses also confirmed that changes in anterior tooth position were associated with alterations in lip morphology (33). Extraction treatment resulted in reductions in total vermilion area approximately 20.84% in maximum anchorage cases and 13.88% in moderate anchorage cases, together with decreases in vermilion height, fullness, and central bow angle, whereas no significant changes in vermilion were found in the non extraction group (33). Although this study gave greater emphasis to upper incisor inclination, it still reinforced the broader finding that anterior tooth position affects visible facial soft tissue form. Similar conclusions were observed in studies focusing on lower lip and chin response after retraction, where changes in thickness and profile contour were also documented (30,31).

5.2 Sagittal and angular position of the lower incisor according to the A-Pog line

The evaluation of lower incisor position relative to the A-Pog line showed that sagittal relationships can be associated with facial aesthetic outcomes, although this association was not emphasised equally in all studies. In the studies where lower incisor position was assessed relative to sagittal reference planes, lower incisor tip to the AP plane was one of the variables associate with post treatment profile attractiveness, together with upper and lower lip position to the E-line, Pg-NB distance, mentolabial angle, and sulcus depth (29). In addition, lower incisor position and inclination relative to the A-Pog plane were reported to differ significantly across facial patterns, particularly between brachyfacial and dolichofacial groups (5).

Despite this, the contribution of lower incisors to aesthetic outcomes appeared to be less dominant than some other dentofacial variables in treatment based analyses (29). In bimaxillary protrusion patients, stronger correlations with profile improvement were found for upper incisor retraction and upper incisor inclination changes, even though lower incisor position relative to AP plane also showed associations with post treatment aesthetic score (29). This suggests that lower incisor position according to the A-Pog or AP framework is relevant, but its clinical impact must be interpreted together with maxillary incisor position and soft tissue balance (29). The limitations of sagittal reference systems such as A-Pog were also highlighted in diagnostic analyses. It was pointed out that linear parameters such as A-Pog and NB are influenced by the position of the maxilla and upper cranial structures, which may reduce their value as isolated measures of true lower incisor position (34). For this reason, a new linear measurement, Pogonion, was proposed, and its mean value was reported as 3.2 ± 4.0 mm (34). this value increased by 0.45 mm for each degree increase in ANPg and by 0.36 mm for each degree increase in SN-GoGn, indicating that sagittal and vertical skeletal relationships influence how sagittal lower incisor positions in expressed (34). Comparison with treatment based studies

further support the clinical relevance of sagittal lower incisor positioning. Orthodontic retraction of anterior teeth produced measurable posterior movement of soft tissues, including lower lip displacement and changes in chin morphology, confirming that sagittal lower incisor movement is reflected in facial profile alteration (30–32). In addition, the extent of these changes varied according to baseline soft tissue characteristics, particularly lip competence, which means that visible effect of sagittal lower incisor position is not the same in every patient (32).

5.3 Sagittal and angular position of the lower incisor according to IMPA

The use of IMPA as a measure of lower incisor inclination was consistently reported across the included studies and provided important information regarding the relationship between incisor position and facial profile. Variations in IMPA were associated with differences in skeletal pattern and facial morphology (34). IMPA was significantly higher in low-angle patients than in high angle patients, while profile related parameters such as the Z angle and FMIA decreased as skeletal vertical dimension increased (1). This supports the use of IMPA as a clinically relevant measure in the assessment of lower incisor position.

Cross sectional analyses also showed that lower incisor inclination varied significantly across different malocclusion types and facial patterns (1,5). Statistically significant differences were reported for lower incisor inclination relative to the mandibular plane, occlusal plane, and anterior cranial base and IMPA was one of the measures that differentiated the subgroups (5). Class III dolichofacial cases showed significantly lower IMPA values, while Class II dolichofacial cases showed higher values than several of the other groups (5). These findings support the concept of dentoalveolar compensation and indicate that lower incisor inclination is not a fixed value across skeletal conditions.

Treatment studies demonstrated that changes in IMPA are associated with soft tissue changes. In Class II extraction cases, the competent group showed a larger mean reduction of -6.53°, while the incompetent group showed a larger mean reduction of -11.03°, and both groups displayed significant lower lip retraction (32). In addition, treatment studies that compared tipping and translation demonstrated that angular change alone does not fully describe the aesthetic response, since greater root movement produced more posterior soft tissue displacement and a different mentolabial sulcus response (31). Although the correlation between IMPA and facial aesthetics was not linear across all studies. It was emphasised that IMPA remains strongly influenced by mandibular plane morphology, which means that similar IMPA values may correspond to different actual lower incisor positions in patients with different

skeletal patterns (34). This limitation explains why some diagnostic studies proposed complementary measurements such as Lower Incisor-Pg rather than relying on IMPA alone (34). Predictive analyses further reinforced the importance of lower incisor inclination. Changes in L1-MP were predicted with an R^2 of 0.84, and the most influential predictors included baseline L1-MP, ANB and extraction pattern (26). At the same time, changes in profile variables such as the Z-angle and facial convex angle were also modelled, showing that lower incisor inclination is part of a broader system linked to facial aesthetics (26). These predictive findings are consistent with the cephalometric and treatment studies that identified lower incisor inclination as one of the variables associated with soft tissue profile change.

5.4 Differences according to skeletal class

Differences in lower incisor position according to skeletal class were consistently reported across the included studies, indicating that skeletal relationships influence both incisor inclination and its aesthetic implications. Significant variation in lower incisor inclination and position was observed across skeletal malocclusion and facial patterns (5). In one cross sectional analysis, lower incisor position and inclination differed significantly according to malocclusion and individual facial pattern, and in the subgroup analysis, differences were observed between Class II and Class III cases as well as among brachyfacial, mesofacial, and dolichofacial patterns (5). These differences were interpreted as adaptive dentoalveolar responses to skeletal discrepancies. Lower incisor proclination was associated with delayed mandibular position, whereas retroclination was found in more forward mandibular skeletal patterns, which fits the mechanism of dentoalveolar compensation described in diagnostic studies (5). This trend was also reflected in the larger cephalometric sample in which Class II subjects showed a mean lower incisor-Pog value of 6.3 ± 3.7 mm, compared with 2.9 ± 3.5 mm in Class I and -0.9 ± 3.9 mm in Class III subjects (34).

The influence of skeletal class was also evident in treatment studies. In skeletal Class II cases treated with extraction and anterior retraction, soft tissue responses differed according to baseline lip competence, and lower lip retraction was both greater and more strongly correlated with lower incisor movement in competent group (32). In Class II Division 1 patients, profile change after orthodontic treatment was also shown to depend on multiple factors, including lower incisor inclination ANB angle, and lower lip thickness, with prediction of lower lip protrusion at labrale inferius reaching an R^2 of 0.403 indicating that both dentoalveolar and skeletal variables contribute to soft tissue outcomes in Class II cases (28). These findings show

that skeletal class influences not only the initial position of the lower incisors but also the magnitude and direction of soft tissue changes following orthodontic treatment (28). Predictive analyses further confirmed the role of skeletal variables in determining treatment outcomes. Variables such as ANB angle, mandibular plane angle, and lip related measurements were identified as key contributors in models predicting changes in both incisor position and facial profile parameters (26). In particular, ANB was among the most influential predictors for changes in lower incisor inclination, while lip position relative to the E-plane contributed strongly to changes in facial convexity and Z-angle (26). These results support the idea that skeletal relationships are directly linked to both dental movement and facial aesthetic outcomes.

Comparisons across the included studies also showed that similar lower incisor positions may produce different facial profiles depending on skeletal pattern (1,5,34). In cephalometric analyses, identical or similar incisor inclinations were associated with different profile convexity values depending on vertical and sagittal skeletal relationships (1,34). This indicates that the aesthetic effect of lower incisor position cannot be evaluated independently of the skeletal framework (1,5,34). In addition, diagnostic studies demonstrated that skeletal classification affects how lower incisor position should be interpreted clinically. Linear and angular measurements such as IMPA and A-Pog were shown to vary with skeletal pattern, and their values must be interpreted within the context of craniofacial morphology rather than as absolute norms (1,5,34). This is particularly relevant in cases with marked vertical discrepancies, where mandibular plane angle may alter the apparent inclination of the lower incisors (1,34).

6. Conclusion

Based on the reviewed literature, this study supports the idea that lower incisor position has a noticeable influence on facial aesthetics. The findings show that changes in lower incisor position are reflected mostly through soft tissue responses involving the lower lip, mentolabial region, chin contour, and facial convexity. In total, the evidence shows that lower incisor position contributes to facial balance not as an isolated factor, but as part of the relationship between dentoalveolar structures, soft tissues and skeletal pattern.

- The literature reviewed shows that differences in lower incisor position do impact the aesthetic outcome. The effect is mainly visible when lower incisor movement changes the lip support, profile convexity and the balance of the lower third of the face. The discussion also presented that the aesthetic response varies depending on the patient, since it depends on the type of orthodontic movement, the amount of retraction or inclination change and the patient's initial soft tissue characteristic.
- The sagittal and angular position of the lower incisor based on the A-Pog line was proved to be clinically relevant, although not sufficient on its own. The lower incisor position relative to AP-based reference systems is associated with profile attractiveness, but this relationship must be considered together with lip position, chin morphology and maxillary dentition. In addition, the discussion highlighted that AP-based linear measurements may be influenced by maxillary and cranial reference structures, this explains why complementary measurements such as Lower Incisor-Pg are suggested.
- IMPA was proven a useful and frequently used parameter for the evaluation of lower incisor inclination. Its analysis must be made carefully, since similar IMPA values may represent different actual incisor positions in patients with different mandibular plane angles and skeletal patterns. Although using IMPA is supported as an important and useful measure, not as the only indicator when it comes to planning treatment with an aesthetic goal.
- The lower incisor position and inclination vary across skeletal malocclusions and facial patterns, and that skeletal class also influences how soft tissues may respond to incisor movement. This suggests that lower incisor position should always be interpreted within the wider craniofacial pattern of the patient.

In conclusion, the objectives of this study were defined successfully, and the available evidence supports an individualised orthodontic approach in which lower incisor position is evaluated in relation to facial aesthetics, skeletal pattern and soft tissue response.

7. Limitations

This review came with some limitations which should be considered. The chosen studies were different in design, sample size, age group treatment protocol and methods of measurement, which made comparing them directly more difficult. Some articles were cross sectional while others were retrospective treatment studies. Furthermore, lower incisor position was not accounted in the same way in all papers, since some used IMPA or A-Pog related measures, while others used different cephalometric references.

The finding for soft tissue outcomes could not be compared by using a single measure as there were different variations used to assess this outcome for example some studies focused on the position of the lip and facial convexity, while others examined chin morphology, mentolabial angle or three-dimensional lip changes.

Study samples were also another limitation. Several articles included female only patients, specific ethnic group or a certain malocclusion type, this limits how widely the results can be.

8. Sustainability

In a healthcare environment sustainability is based on balancing quality of care, how to responsibly use resources and take the long term well being of the patient into consideration. A better understanding on how lower incisor position in orthodontics can affect facial aesthetic may support a more appropriate and sustainable approach to treatment planning by assisting the clinicians to select the more efficient and effective approaches.

This topic follows the **Sustainable Development Goal 3** which is **Good Health and Well Being**, a more accurate and precise orthodontic planning can help to improve treatment outcomes, patient satisfaction and the quality of care that is given. While lower incisor position is evaluated carefully in relation to facial profile, skeletal pattern and soft tissue response, treatment decisions may become more accurate, precise and individualised. From a more practical perspective, an improved prediction of aesthetic result may reduce unnecessary tooth movement, repeated adjustments and retreatment, this would help lower the chairside time, material use and additional clinical procedures. Additionally, it may also improve communication with patients by forming a more realistic expectations from the start.

Overall, using evidence based knowledge about lower incisor position and facial aesthetics may help towards a more efficient, predictable and sustainable orthodontic practice.

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