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Position with Precision: Planned Incisor Position- A Review

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Abstract

The concept of "ideal" facial proportions has long motivated efforts to establish objective parameters for orthodontic treatment. Central to successful orthodontic outcomes is the position of the incisors — both upper and lower — in harmony with the underlying skeletal bases and overlying soft tissues, thus contributing to facial aesthetics, functional occlusion, and treatment stability. This review traces the historical evolution of incisor-position planning from the early work of Edward H. Angle through Cecil C. Steiner, Robert M. Ricketts and William Arnett, to modern concepts such as the "planned incisor position" (PIP) as articulated by Richard P. McLaughlin and colleagues. The review discusses the antero-posterior, vertical, and torque components of incisor position; the role of dental and skeletal compensations in different malocclusion classes; the impact of incisor position on smile aesthetics; and clinical considerations for achieving stable long-term results. Contemporary research on objective incisor position norms is also summarized. The evidence suggests that although precise normative values may vary with skeletal pattern, gender and ethnicity, a well-planned incisor position is a critical cornerstone of orthodontic diagnosis and treatment planning.

Keywords: Incisor Position, Review, Precision

1. Introduction

Though the concept of facial beauty is inherently abstract, orthodontic research and clinical practice have long sought objective methods to assess ideal proportions of the human face. The success of orthodontic treatment is closely related to changes in the soft-tissue profile, as tooth movements, particularly of the incisors, influence lip posture, chin contour and overall facial balance. Orthodontists must pay due attention to the position of the incisors in order to integrate the dentition into a harmonious relationship between hard and soft tissues, thereby achieving stable long-term treatment results.[1]

Paradigm shift

It started with Angles molar relation to McLaughlin's Planned Incisor position. Fig 1

Angle's Occlusal Key (1906)

In 1906, Edward H. Angle proposed that the upper first molars represent the "key to occlusion," and that once the molar relationship is achieved, the remainder of the dentition should align into a proper occlusion. However, this paradigm did not explicitly address individual incisal position relative to soft-tissue aesthetics, and in some cases, achieving correct molar relationships still led to protrusive incisors and unattractive soft-tissue profiles.[2]

Steiner (1953)

Cecil C. Steiner introduced a cephalometric analysis in 1953, in which he first related incisor position to facial environment through the NA (upper incisor) and NB (lower incisor) lines. His method provided individualized angular and linear measurements for incisors, taking into account the projected dental base discrepancy and the prominence of the bony chin. The classic norms from Steiner include U1 to NA: 4 mm and 22°, and L1 to NB: 4 mm and 25°.[3]

Ricketts (1960)

Robert M. Ricketts recognised the importance of the A–Pog line (A-point to Pogonion) as a reference to which the denture bases and anterior teeth should be functionally related. He emphasised the relationship of incisor position relative to the mandible and lower third of the face, and that incisor position must change as jaw relationships evolve.[4]

Arnett (1993)

William Arnett advanced the concept by starting treatment planning from the upper incisor position. He introduced analysis using the True Vertical Line (TVL) and established target norms for incisal position: upper incisors at –9 mm (females) and –12 mm (males) to the TVL; lower incisors at –12 mm (females) and –15 mm (males). This aimed to achieve a 3 mm overjet and optimise lip-teeth relationships.[5]

McLaughlin (2000) – Planned Incisor Position

Richard P. McLaughlin defined "Planned Incisor Position (PIP)" as the intended end-of-treatment position for the upper incisors. His framework emphasised that in an era where alignments may be achieved easily, what distinguishes the specialist orthodontist is the ability to precisely position the incisors in all three planes of space to achieve both functional and aesthetic excellence. [6]

Why Is Incisor Positioning So Critical?

In modern orthodontics, a well-positioned incisor contributes to enhanced anterior aesthetics, which is ultimately what drives many patients to seek treatment. Moreover, by comparing the starting position of the upper and lower incisors with the PIP at the end of treatment, anchorage control requirements and potential mechanical strategies can be determined. When incisors are improperly positioned — either excessively proclined or retroclined — soft-tissue balance may be compromised, lip support may be suboptimal, and long-term treatment stability may be jeopardised. [7,8,9]

Dental and Skeletal Changes & Compensation

To determine and visualise the position of the upper incisor, one must first observe how these teeth can be compensated in different skeleto-facial patterns in untreated subjects. For instance, in a study of untreated subjects, bibby found that in Class II cases the upper incisors were retroclined, whereas in Class III cases

they were proclined; lower incisors showed a similar proclination in Class I and II and an upright or retroclined position in Class III relative to Class I/II.[10] This indicates that incisor positioning must account for skeletal compensation.

Components of PIP (Table 1)

1. Anterior- Posterior component
2. Vertical component
3. Torque component

Antero-Posterior Component

The Arnett analysis relates upper incisor position to the True Vertical Line (TVL). In that framework the measurement MXI–TVL (distance from upper incisor tip to TVL) is targeted at –9 mm (females) and –12 mm (males) (Fig 2). Other studies have related the upper incisor to the A–Pog line or the NA line; for example, the upper incisor position has been cited as approximately +6 mm to A–Pog in normal subjects.[11] However, reference planes vary with growth, so incumbent caution is required.

Vertical Component

Vertical positioning of upper incisors is also quantified in the Arnett analysis: an overbite of approximately 3 mm is targeted (Fig 3), with upper incisor exposure being 4 mm below the relaxed upper lip in males and 5 mm in females.[5] Vertical positioning is key to achieving a pleasing smile line, lip support and proper overbite/overjet relationships.

Torque (Inclination) Component

Traditionally, upper incisor torque has been related to the maxillary plane, with 110°–115° being a typical goal. [6] (Fig 4) The Arnett analysis relates upper incisor torque to the upper occlusal plane and provides slightly different values for males and females. The torque requirement must be varied depending upon the underlying skeletal pattern: for example, anterior torque compensation is typically necessary in high-angle Class I cases, and in Class II or III cases unless orthognathic surgery is intended.

To provide a more systematic view, Fastlicht (2000) proposed the “facial tetragon”, consisting of four angles: upper incisor to palatal plane; lower incisor to mandibular plane; inter-incisal angle; and maxillary/mandibular plane angle. Dividing the tetragon by the occlusal plane produces two triangles which aid torque analysis in different skeletal patterns.[12]

Clinical Considerations – Steps in PIP

When planning for PIP, clinicians systematically consider:

1. **Set the PIP for the upper incisors** (A/P, vertical and torque)
2. **Plan lower incisor position** relative to upper incisors and skeletal bases
3. **Consider the remaining lower dentition** and anchorage mechanics
4. **Consider the remaining upper dentition and finishing mechanics**

Planned Incisor Position in Different Skeletal Classes
PIP for Class II (Fig 5)

Stage 1

- PIP for Upper Incisors
- Decide ideal A/P, torque, and vertical position of upper incisors.
- Check if ideal position is achievable.
- If not → aim for acceptable position via orthodontics or consider maxillary surgery.
- Finalize PIP for the case.

Stage 2

- Check if lower incisors can align with **upper PIP**.
- If not achievable by orthodontics →
- Modify upper PIP (if possible),
- Accept less-than-ideal relationship, or
- Consider **mandibular surgery**.

Stage 3

- Position lower teeth to fit planned lower incisor position.
- Manage spacing/crowding – decide if **extractions** needed.
- Use **dental VTO** to guide decisions.
- **Primary factors:** crowding, curve of Spee, midlines.
- **Secondary factors:** expansion, molar distalization, IPR, 'E' space.
- Consider acceptable lower incisor proclination.

Stage 4

- Align remaining upper teeth to the planned incisor position.
- Address crowding/spacing and use appropriate mechanics for premolars and molars.
- Dental VTO guides canine and molar positioning.

PIP for Class III (Fig 6)

Stage 1- Decide Ideal Position of upper incisors.

- Check Achievability – Can we reach it?
- If Yes → Orthodontics to reach ideal position.
- If No → Aim for Acceptable Position with orthodontics.
- If still Not Possible → Maxillary Surgery to achieve acceptable position.

- Finalize PIP based on findings.

Stage 2-lower Incisor Position vs PIP

- Can lower incisors be aligned with upper PIP?
- Achievable with orthodontics alone?

Class III (mandibular excess):

- *Probably* if growth is favorable.
- *Possibly* but may need to **wait and observe growth** before deciding.

Stage 3 – Remaining Upper Teeth (Class III Planning)

- Evaluate upper teeth before lower.
- If upper premolar extractions needed → usually extract lower 1st premolars.
- If no upper extraction → consider lower arch options.
- Goal: position remaining upper teeth to fit PIP.
- Prefer to avoid upper arch extractions for easier mechanics.
- Use dental VTO to confirm molar/canine movement.

Stage 4 – Remaining Lower Teeth (Class III Planning)

- Position lower teeth to fit planned lower incisor position.
- Assess need for lower extractions (crowding or incisor retraction).
- Lower premolar extractions aid retraction & Class III mechanics.
- Use dental VTO to guide decisions.
- In some cases, consider second molar extractions.

Smile Esthetics and the Smile Arc

The **smile arc**—the curvature of the incisal edges relative to the lower lip—is key. Goldstein differentiated the "youthful smile," with a curved incisal edge, from the "older smile," appearing flat.[13] Appropriate bracket placement can maintain or restore a pleasing smile arc. (Fig 7)

Facial animation and the smile are central to perceived attractiveness. Traditional measures correlated incisor inclination to skeletal planes, but current philosophy emphasizes soft-tissue determinants during smiling.[14]

The figure illustrates potential limitations of traditional methods used to measure maxillary incisor inclination. (Fig 8)
(a) The maxillary incisor long axis, drawn from the incisal tip to the root apex, and the labial face tangent differ in orientation.

(b) Anatomical reference planes, such as the maxillary plane, show individual variability in inclination, influencing long-axis measurements but not necessarily the labial face tangent.
(c) Variations in crown–root angulation can cause discrepancies between the tooth's long axis and crown orientation.
(d) Significant differences may exist between the long-axis inclination and the labial surface tangent of the crown—the latter being more relevant to facial esthetics and smile design.

Fredericks proposed that the ideal labial inclination of maxillary incisors parallels the nasion–pogonion plane, with the most esthetic inclination being 80°–90° to the true horizontal.[15]

Maxillary Incisor Position and Facial Reference Lines

Recent research aligns maxillary incisor positioning with forehead reference lines. Using the **Forehead's Anterior Limit Line (FALL)** and the **Glabella Line (G-line)**, ideal incisor position correlates closely with forehead inclination.

Mean distances were FA–FALL = 1.8±1.9 mm and FA–G-line = –2.4±1.8 mm.[16]

This relationship underscores the importance of soft tissue and facial reference in defining incisor position. (Fig 9)

A retrospective study developed prediction models to customize maxillary incisor positioning based on dentoskeletal and soft tissue characteristics in 244 Chinese women with esthetic post-treatment profiles. Cephalometric analyses revealed that the ideal anteroposterior incisor position varied according to sagittal skeletal pattern. Significant influencing factors included the ANB angle, midface protrusion, nasal tip projection, chin development, and incisor inclinations. Multiple linear regression using the distance from the maxillary central incisor to the nasion–pogonion plane proved accurate for treatment planning. The authors concluded that individualized assessment, rather than reliance on average norms, should guide incisor positioning in orthodontic treatment.[17]

Orthognathic Surgery Implications

In orthognathic planning, the lip–incisor relationship serves as the cornerstone of diagnosis.[18] Determining incisor position in all three planes of space establishes the foundation for skeletal repositioning. All surgical and orthodontic movements are coordinated to achieve this ideal incisor location, ensuring optimal esthetic and functional outcomes.

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