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Intrusion Using Mini Impants: Review Of Literature

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ABSTRACT

Achieving precise tooth movement is fundamental for optimal functional and aesthetic results in orthodontics. Among the most challenging movements is intrusion, which involves the vertical movement of a tooth or group of teeth into the alveolar bone. Intrusion is commonly indicated in patients with deep bite, supra-erupted molars, or skeletal discrepancies requiring posterior intrusion for bite correction and facial improvement.

The introduction of mini-implants/temporary anchorage devices (TADs), has significantly transformed orthodontic biomechanics by providing absolute anchorage and minimizing unwanted reciprocal tooth movements.[2] These small screw-like devices, typically 1.2–2.0 mm in diameter and 6–12 mm in length, can be inserted into alveolar or extra-alveolar bone with minimal surgical intervention and removed after treatment. They are available in titanium alloy, stainless steel, cobalt-chromium, or zirconia and can withstand orthodontic forces without requiring osseointegration, making them highly versatile

KEYWORDS: Biomechanics of Intrusion with Mini-Implants, Placement Sites and Considerations

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INTRODUCTION

Achieving precise tooth movement is fundamental for optimal functional and aesthetic results in orthodontics. Among the most challenging movements is intrusion, which involves the vertical movement of a tooth or group of teeth into the alveolar bone. Intrusion is commonly indicated in patients with deep bite, supra-erupted molars, or skeletal discrepancies requiring posterior intrusion for bite correction and facial improvement.[1]

The introduction of mini-implants/temporary anchorage devices (TADs), has significantly transformed orthodontic biomechanics by providing absolute anchorage and minimizing unwanted reciprocal tooth movements.[2] These small screw-like devices, typically 1.2–2.0 mm in diameter and 6–12 mm in length, can be inserted into alveolar or extra-alveolar bone with minimal surgical intervention and removed after treatment. They are available in titanium alloy, stainless steel, cobalt-chromium, or zirconia and can withstand orthodontic forces without requiring osseointegration, making them highly versatile.[2]

Intrusion can be broadly classified as anterior and posterior . Anterior intrusion is used to correct deep overbite and excessive gingival display, whereas posterior intrusion is often indicated in cases of anterior open bite or excessive vertical maxillary growth.[3] Posterior molar intrusion, in particular, facilitates counterclockwise mandibular rotation, improving facial balance and occlusal relationships. Segmental approaches allow precise control of force vectors, while en-masse intrusion with TADs enables simultaneous overbite correction and incisor inclination adjustment.[4]

Mini-implants can be placed in several sites depending on the treatment goal: paramedian palate or inter-incisor region for anterior intrusion, or buccal shelf/infrazygomatic crest/interradicular regions for posterior intrusion. Forces are typically delivered via elastomeric chains, NiTi coil springs, or power arms.[5] Biomechanically, TADs allow for direct application of intrusive forces near the center of resistance, minimizing tipping and extrusion of adjacent teeth. This direct anchorage eliminates reliance on patient compliance compared to conventional appliances such as headgear or bite blocks.

The magnitude of force is critical: light, continuous forces of 10–20 g per tooth are recommended to achieve pure intrusion and minimize risks of root resorption and periodontal damage.[6] Use of wires with low load-deflection rates ensures force constancy, promoting predictable and efficient tooth movement.

The main objectives of mini-implant-assisted intrusion include:

- Correction of deep bite by intruding overerupted incisors.

- Correction of anterior open bite by molar intrusion.
- Achieving a balanced smile line and harmonious facial proportions.
- Establishing proper occlusal function and stability.

The clinical benefits of mini-implants include reduced appliance complexity, independence from patient compliance, faster treatment progress, and improved control over tooth movement.[5] Success, however, depends on careful case selection, correct implant positioning, good oral hygiene, and continuous monitoring to detect early complications such as screw loosening or root resorption.[6]

Overall, mini-implants have revolutionized intrusion mechanics, offering predictable, efficient, and minimally invasive treatment solutions. When used judiciously, they provide superior functional and aesthetic results and contribute to long-term stability of orthodontic outcomes.

DISCUSSION

Mini-implants, or temporary anchorage devices (TADs), have transformed orthodontic biomechanics by providing absolute anchorage for controlled tooth movement, including intrusion. Intrusion plays a crucial role in correcting deep bites, vertical maxillary excess, and supra-erupted teeth, thereby improving occlusal function and facial aesthetics. Compared to traditional methods, mini-implants offer minimal need for patient compliance, precise force delivery, and predictable results, making them the preferred choice for both adolescents and adults.[2]

Biomechanics of Intrusion with Mini-Implants

The goal of intrusion is to achieve true vertical movement of teeth into the alveolar bone without tipping or extrusive side effects. Mini-implants allow direct application of light, continuous forces (10–20 g per tooth), which are considered optimal for preventing root resorption and periodontal damage.[6] Because the anchorage is skeletal, reactive forces on adjacent teeth are eliminated, ensuring bodily intrusion and long-term stability.

Compared with conventional mechanics (utility arches, J-hooks, reverse curve of Spee), which distribute forces through teeth and may cause extrusion of anchor teeth, mini-implants concentrate forces on the target teeth and allow force application closer to the center of resistance, minimizing tipping moments.[3]

Placement Sites and Considerations

The placement of mini-implants plays a crucial role in their effectiveness. Common sites for insertion include the interradicular spaces between maxillary or mandibular central and lateral incisors, and between the premolars and molars when posterior intrusion is needed. In cases requiring anterior intrusion, mini-implants are often positioned in the anterior palate or between the maxillary central and lateral incisors to provide vertical forces directly to the target teeth [17].The selection of implant placement depends on anatomical considerations, including bone density, root proximity, and gingival thickness, which influence primary stability and force distribution.

ADVANTAGES:

- Minimal patient compliance
- Versatality in application
- Predictability outcomes

Clinical Applications and Effectiveness

Mini-implants are commonly used for the intrusion of incisors in deep bite cases and molars in patients requiring posterior intrusion for open-bite correction. Park et al. demonstrated the effectiveness of mini-implants in intruding maxillary incisors in deep bite cases, achieving an average intrusion of 2-3 mm over six months [18]. The ability to produce bodily movement without significant tipping is a major advantage over traditional mechanics, which often result in undesirable side effects such as extrusion of adjacent teeth.

Additionally, a randomized clinical trial by Deguchi et al. compared mini-implants with conventional mechanics, such as utility arches and J-hooks, demonstrating that mini-implants provided significantly greater and more controlled intrusion [9]. The study highlighted that mini-implants led to predictable and stable results, with minimal need for patient compliance. For posterior intrusion, Lin et al. found that the use of bilateral mini-implants in the posterior maxilla resulted in a mean molar intrusion of 1.5-2 mm, contributing to improved anterior open-bite correction [19]. Posterior intrusion is particularly beneficial in controlling excessive vertical growth in hyperdivergent patients, thereby enhancing facial aesthetics and stability. The ability to intrude molars effectively has also been linked to improvements in temporomandibular joint (TMJ) function, as occlusal plane alterations may relieve strain on the TMJ structures.

DISADVANTAGES OF CONVENTIONAL METHODS OF INTRUSION:

Comparative Advantages Over Conventional Methods Traditional methods for intrusion, such as removable bite planes, utility arches, and reverse curve archwires, often rely on patient compliance and produce unwanted tipping forces. Mini implants eliminate these drawbacks by providing direct and localized forces, ensuring true intrusion rather than extrusion of adjacent teeth [11]. Furthermore, TADs facilitate intrusion in both growing and non-growing patients, expanding treatment options for adult

orthodontic cases [20]. The precise control afforded by mini-implants also reduces treatment time compared to conventional methods, as force application remains consistent without the variability introduced by patient-dependent appliances.

A significant advantage of mini-implants is their ability to distribute forces symmetrically, thereby preventing asymmetric intrusion that could lead to occlusal canting. Research by Jambi et al. demonstrated that mini-implant-supported intrusion resulted in better occlusal stability and reduced the need for additional compensatory mechanics [21]. Furthermore, the predictability of mini-implant mechanics allows for better integration with comprehensive orthodontic treatment plans, including pre-surgical orthodontics for orthognathic surgery cases.

Root Resorption and Periodontal Considerations

One concern with intrusion mechanics is the risk of root resorption. Mini-implant-supported intrusion has been found to be associated with a lower incidence of root resorption compared to conventional mechanics. A CBCT-based study by Yao et al. indicated that controlled force application via mini-implants led to significantly less apical root resorption than continuous archwire mechanics [22]. Root resorption is primarily influenced by excessive force application, and the ability to precisely control force magnitude with mini-implants mitigates this risk.

Additionally, proper force levels help maintain periodontal health, reducing the risk of marginal bone loss and inflammation. Periodontal assessments before and during mini-implant treatment are essential to ensure that soft tissue irritation, infection, and peri-implantitis are minimized. Studies have shown that mini-implants placed in keratinized gingiva have lower failure rates compared to those in non-keratinized mucosa, emphasizing the importance of site selection for long-term success [2].

Anterior Intrusion

Mini-implants are typically placed in the paramedian palate or interradicular spaces between central and lateral incisors. This position provides favourable force vectors for symmetric intrusion of 4–6 anterior teeth. Placement site is chosen based on bone density, root proximity, and gingival thickness, which affect primary stability and long-term success.[7]

Posterior Intrusion

For molar and premolar intrusion, implants may be inserted into the buccal interradicular space, buccal shelf, or infrazygomatic crest, with optional palatal implants for better anchorage. A transpalatal arch (TPA) may be used to counteract buccal tipping moments when palatal implants are not placed.[8]

Advantages of Mini-Implant Intrusion

- Absolute anchorage - no unwanted reciprocal tooth movement
- Minimal patient compliance compared to headgear or bite blocks
- Precise, localized force application leading to true intrusion
- Reduced treatment duration and improved efficiency
- Applicability in adults where growth modification is not possible
- Better vertical control in hyperdivergent cases

Randomized clinical trials have shown that mini-implant-assisted mechanics achieve greater and more predictable intrusion than utility arches or J-hooks, with significantly fewer side effects.[9]

Clinical Applications

Deep Bite Correction

Maxillary or mandibular incisor intrusion of 2–3 mm can be achieved within 6–9 months using mini-implants.[1] Intrusion improves smile esthetics, levels the curve of Spee, and prevents further traumatic occlusal contacts.

Posterior Intrusion for Open-Bite Correction

In hyperdivergent patients, posterior molar intrusion produces counterclockwise mandibular rotation, reducing anterior open bite and improving facial proportions. Bilateral implants with or without palatal support provide predictable molar intrusion of 1.5–2 mm.[10]

Single-Tooth Intrusion

For supra-erupted molars (due to loss of antagonists), one buccal and one palatal implant are preferred to prevent buccal tipping moments. If only one implant is used, a TPA or auxiliary appliance should counteract the moment to avoid occlusal canting.

Gummy Smile Management

Mini-implant-assisted intrusion is a minimally invasive alternative to gingivectomy or orthognathic surgery in cases of dentoalveolar extrusion–related gummy smiles. Intrusion of maxillary incisors by 2–3 mm can significantly reduce gingival display and improve esthetics.[5]

Comparison with Conventional Methods

Conventional mechanics often produce unwanted side effects such as tipping, extrusion of anchor teeth, or increased treatment time due to patient non-compliance. In contrast, mini-implants:

- Deliver continuous forces independent of patient effort
- Produce symmetrical intrusion, reducing risk of occlusal canting
- Provide more stable results and better integration with comprehensive orthodontic plans, including pre-surgical orthodontics.

Implant-Supported Intrusion for Single and Multiple Teeth
Intrusion of a Single Tooth : Mini-implants are highly effective for intruding a single tooth, such as an overerupted incisor or canine. The biomechanics involve:

Intrusion of a single anterior tooth- Single Implant: One mini-implant is placed near the target tooth, typically in the interradicular space or the palate, depending on the tooth's location.

Intrusion of a single posterior tooth : A posterior tooth (eg maxillary molar) which has supraerupted because of loss of the opposing tooth needs to be intruded for achieving optimal replacement of missing opposing tooth and normalising function. In such clinical situations, one mini-implant can be placed buccally either mesial or distal to the tooth in the inter dental bone. This buccal placement of implant would not only exert an intrusive force but also a buccal tipping force because of its moment. In order to negate the buccal flaring tendency, its optimal to place a second implant on the palatal aspect, either in the mesial or distal aspect.

The preferred placement site for buccal implant for intruding a maxillary first molar is mesial and palatal implant on the distal aspect, since there is sufficient bone on the mesial side and reduced divergence of roots when compared to the distal side. If there is economic problems associated with the usage of two implants, a transpalatal arch low on the palatal side should be enough to counteract the buccal tipping moment.

Direct Force Application: A light, continuous force is applied directly to the tooth using elastic chains or nickel-titanium springs, ensuring controlled and predictable intrusion.[16]

Intrusion of Multiple Teeth: For cases requiring intrusion of multiple teeth, such as deep bite correction or open-bite management, multiple mini-implants may be used. The number of implants depends on the number of teeth being intruded and the force required:

Anterior Intrusion: For intruding maxillary or mandibular incisors, one or two mini implants are typically placed in the anterior region (e.g., between the central and lateral incisors or in the anterior palate) [2]

Posterior Intrusion:
Unilateral: Intrusion of multiple posterior teeth would require segmental mechanics. It is always necessary to segment the archwire into major and minor (intruding) segment to achieve true intrusion without creating detrimental tooth movement on adjacent teeth that don't require intrusion.

For intruding molars and/or premolars on one side, its mandatory to have more than one implant on the buccal side and one palatal implant in the interradicular region of on-plant in the midline. If a clinical scenario requiring intrusion of two premolars and one molar on one side of maxilla; it would be prudent to have one implant either mesial or distal to the molar and another between the premolars on the buccal side and one between the second premolar and first molar on the palatal aspect. If there is another molar to be included, then it would be necessary to place the second implant on the buccal aspect between the molars. The clinician should apply uneven force from the two implants keeping in mind the root surface area of the teeth to be intruded. Premolars would require less force when compared to molars. An even force from both the implants to the premolars and molars would cause higher intrusion of premolar teeth and cant in the occlusal plane.[15]

Bilateral:
Bilateral intrusion of maxillary posterior teeth would require implants on the both the buccal sides with a transpalatal arch (TPA) to counter the buccal tipping tendency. If the patient cannot tolerate the low TPA, then implants can be placed on palatal aspect to provide enough anchorage to prevent buccal flaring of teeth.[15]
Force Distribution: Each implant can support the intrusion of 2-3 teeth, depending on the force magnitude and the bone density at the implant site

Biological Response and Root Resorption
Root resorption is a common concern during intrusion. CBCT studies show that mini-implant-assisted intrusion causes less apical root resorption compared to continuous archwire mechanics, likely due to controlled force levels.[12]

Maintaining forces within the optimal range is key to preserving periodontal health. Placement of implants in keratinized gingiva reduces inflammation and failure rates. Regular periodontal evaluation during treatment ensures early detection of soft-tissue irritation or infection.[13]

Long-Term Stability and Retention
Mini-implant-assisted intrusion demonstrates **lower relapse rates** than conventional mechanics, attributed to better control of

tooth movement and reduced tipping.[4]

Retention Strategies

- **Anterior intrusion:** fixed lingual retainers or bonded retainers
- **Posterior intrusion:** occlusal equilibration and long-term monitoring to prevent supra-eruption
- **Adjunctive splints:** nighttime occlusal splints may be used in severe cases to maintain vertical dimension

Retention must be individualized based on initial malocclusion and treatment goals.

Posterior Intrusion Biomechanics and Palatal Anchorage

Molar intrusion requires higher force levels and additional anchorage. Palatal implants are advantageous because:

- They engage dense cortical bone for excellent stability
- Allow symmetrical force distribution, preventing occlusal canting
- Provide versatility when combined with buccal implants to achieve controlled intrusion

Palatal anchorage is particularly beneficial in open-bite cases and has been shown to improve TMJ function by altering the occlusal plane.[14]

Fig 1: Intraoral images showing intrusion mechanics using mini implants.Pre -treat ment and post treatment

Fig 2: Anterior Intrusion mechanics

Fig 3:Use of ligature based mechanism to control intrusion forces

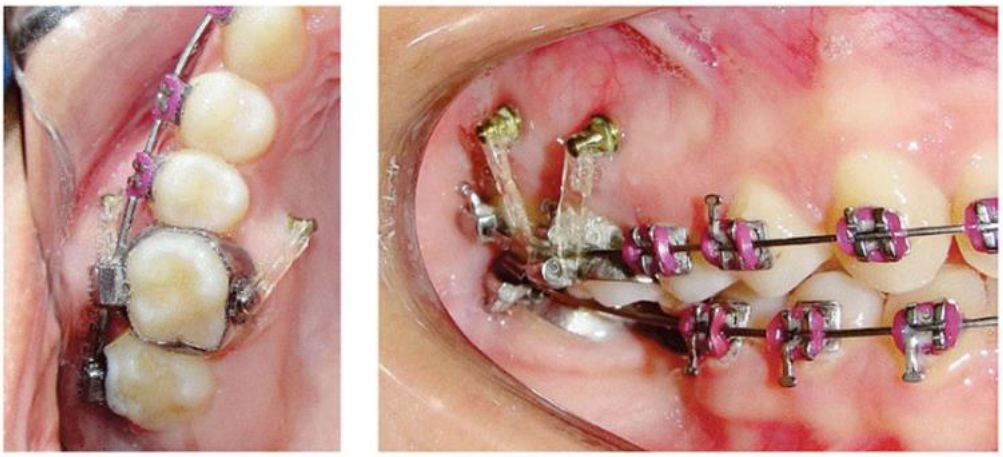

Fig 4: Application of elastics and coil springs to induce intrusion

Fig 5: Occlusal view of maxillary arch showing bilateral mini implant supported intrusion mechanics with transpalatal arch stabilization

Potential Complications and Their Management

Complication	Risk Factors	Prevention/Mitigation
Root resorption	Excessive force, off-center force vector	Use light (10–20 g) continuous force; monitor roots radiographically
Mini-implant failure	Poor bone density, non-keratinized mucosa	Choose sites with sufficient bone; use proper insertion torque
Soft-tissue irritation	Placement in movable mucosa, improper hygiene	Prefer keratinized gingiva, provide hygiene instructions
Peri-implantitis/infection	Plaque accumulation	Antimicrobial rinses, regular follow-up
Relapse	Inadequate retention	Fixed retainers, occlusal splints, long-term monitoring

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