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International Journal of Oral Health Dentistry

Journal homepage: www.ijohd.org



Review Article

Application of mini-implants in invisible orthodontics

Nausheer Ahmed^{DOI}¹, Nikhil P M^{DOI}^{1,*}, Abrar Younus A^{DOI}¹, Haritha U^{DOI}¹, Shreya Shetty K^{DOI}¹, Ranjan R Bhatt¹

¹Dept. of Orthodontics and Dentofacial Orthopedics, Government Dental College and Research Institute, Bangalore, Karnataka, India



ARTICLE INFO

Article history:

Received 10-02-2022

Accepted 18-05-2022

Available online 11-06-2022

Keywords:

Orthodontic

Extraoral

ABSTRACT

The control of anchorage is essential in orthodontic treatment of adult patients. Complex tooth movements in lingual appliances and aligners require anchorage planning. Mini-screws enable the orthodontists to have good control over tooth movement in all three dimensions, while preserving the patient's aesthetics. This article describes various clinical cases performed through aligners and lingual appliances by using mini-implants.

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1. Introduction

In contemporary orthodontic practice, patient's perspective on orthodontic treatment has changed significantly since the advent of invisible orthodontic appliances. Recent studies have shown that there are increased numbers of adult patients seeking orthodontic care due to the influence of invisible appliances giving esthetic look. There are various esthetic appliances available in the market today such as lingual system, clear aligners, ceramic brackets, composite brackets and so on. Among these lingual system and clear aligners are rated higher by patients when compared to conventional metal and ceramic brackets due to their superior esthetic appearance.^{1,2}

Orthodontic anchorage is defined as resistance to unwanted tooth movement (Proffit). Each patient requires specific anchorage planning before the start of treatment, to preserve the anchorage successfully and to avoid round tripping. Traditionally, extraoral devices were used for anchorage preparation, which demanded high patient cooperation. The introduction of mini-implants has

eliminated this problem by providing absolute anchorage control; they are esthetic as well as patient-friendly compared with traditional extraoral devices. Therefore, anchorage control in invisible appliances can be achieved successfully now with the help of mini-implants. However, this is a challenging task for the clinician to achieve successful results clinically by combining these two.³

This review article will provide an insight about the application of mini-implants in invisible orthodontics.

2. Sites of Mini-Implants Placement:⁴⁻⁶

2.1. In Maxilla

2.2. Anterior maxilla

Studies have shown that the preferable site for mini-implant placement is the anterior palate. Due to the following reasons:

1. Thick cortical bone available in this region
2. Presence of sufficient amount of attached gingiva
3. Site of placement – away from the roots
4. Doesn't hinder orthodontic tooth movement

*Corresponding author.

E-mail address: nikhilpm584@gmail.com (Nikhil P M).

The optimal site for the placement of mini implants in the labial aspect of anterior maxilla is 6mm from the alveolar crest between central and lateral incisors. The location becomes safer with the placement being more anterior and apical.

2.3. Posterior maxilla

The available sites for the placement of mini-implants in the inter-radicular region of posterior maxilla in the order of maximum safety to the least are as follows:

1. 2-8 mm from the alveolar crest in the palatal side, between the maxillary first molar and second premolar.
2. 2-5 mm from the alveolar crest in the palatal side, between the maxillary first and second molar.
3. 5-11 mm from the alveolar crest in both the buccal or palatal side, between the first and second premolar.
4. 5-11 mm from the alveolar crest in both the buccal or palatal side, between the canine and first premolar.
5. 5-8 mm from the alveolar crest in the buccal side, between the first molar and second premolar.

2.4. In mandible

2.5. Anterior mandible

The optimal site in the mandibular anterior region for mini-implant placement is 6mm from the alveolar crest between the lateral incisor and canine.

2.6. Posterior mandible

The available sites for the placement of mini-implants in the inter-radicular region of posterior mandible in the order of maximum safety to the least are as follows:

1. 2-11 mm from the alveolar crest in the buccal side between the first and second molar.
2. 2-11 mm from the alveolar crest in the buccal side between the first and second premolar.
3. 11 mm (over 8mm due to root proximity) from the alveolar crest in the buccal side between the first molar and second premolar.
4. 11 mm (over 8mm due to root proximity) from the alveolar crest in the buccal side between the canine and first premolar.⁴⁻⁶

3. Lingual Orthodontics

Pierre Fauchard in 1726 suggested that lingual surfaces can be used to treat malocclusion. Pierre Joachim Lefoulon in 1841 gave the first lingual arch appliance which was designed for aligning the teeth and expansion of the arch.⁷

In the 1970s Kinja Fujita from Japan started using the lingual appliance for the patient who was a martial art practitioner. In 1975 Craven Kurz along with Jim Mulick

started using the lingual appliance in the USA separately. He used plastic brackets that were bonded onto the lingual surfaces of the tooth. He got this idea due to the request from his patient for non-visible orthodontic treatment who was an employee in the bunny playboy club.^{8,9}

4. Uses of Mini-Implants in Lingual Orthodontics

In lingual orthodontics, mini-implants can be inserted on either the buccal or palatal sides. Since the main appliance is on the lingual side, placing mini-implants on the lingual aspect makes it easy for direct engagement of elastic chains between the archwire hooks and the mini-implants head.¹⁰

4.1. In sagittal plane¹¹

4.1.1. Retraction of anteriors

After alignment of the dental arches, mini-implants are placed in the palatal sites depending on the need for retraction of maxillary anterior teeth. A power arm is fabricated (usually with 0.032×0.032 - in TMA wire) and tied onto the mini-implant head with ligature wire. A power chain is used to deliver retraction force from the hook of the power arm to the hook on the canine. At this stage, the maxillary six anterior teeth should be stabilized as a unit for en masse retraction (Figure 1 a & b).

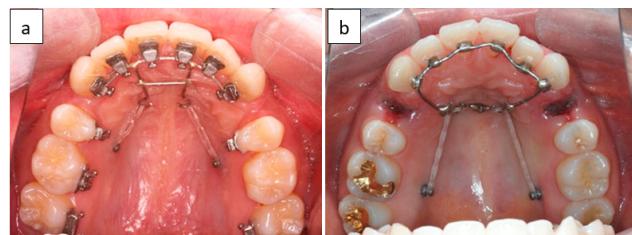


Fig. 1: Retraction of anterior segment is carried out with the help of two mini-implants placed in the interradicular position

4.1.2. Distalization

After alignment of the arch, mini-implants are placed in the mid palatal region to distalize the maxillary dentition bodily by direct or indirect anchorage. Distalization force is applied parallel to the occlusal plane and through the centre of resistance of the maxillary dentition. A power arm is fabricated and tied onto the head of the mini-implant with ligature wire. Crimpable hooks are attached to the archwire between the canine and first premolar and a power chain is applied. (Figure 2 a, b & c)

4.2. In transverse plane

4.2.1. Constriction of the arch

After alignment, the scissor bite is corrected by placing a mini-implant in the midpalatal region, and an appropriate

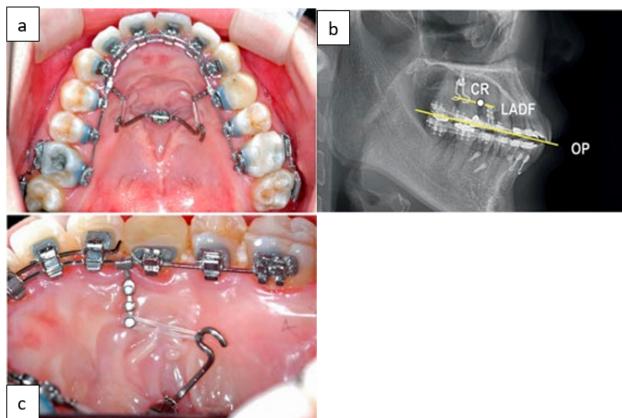


Fig. 2: En masse distalization carried out with the help of mini-implants placed in the mid palate

form of power arm is fabricated with 0.032×0.032 -in TMA wire and it's tied to the maxillary right posterior brackets and activated. Due to the inward force of the power arm, the posterior segment moves palatally resulting in constriction of the arch. (Figure 3 a, b)

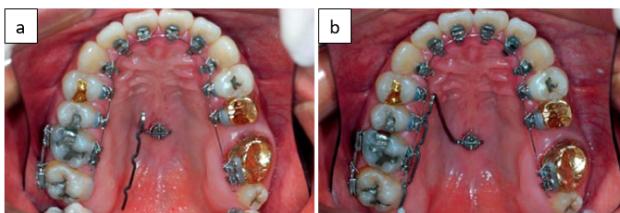


Fig. 3: Activated power arm from the implant head is engaged into the bracket to constrict the arch.

4.3. In vertical plane

4.3.1. Intrusion of arch

After alignment of the dentition, mini-implants are placed in the midpalatal region, with hooks on canines and first molars of the maxillary arch. An appropriate 0.032×0.032 -in stainless steel power arm is fabricated and placed into the mini-implant. The position of the hooks and the form of the power arm are determined by using the lateral cephalogram. This will determine the application of anterior and posterior forces through the power chain attachment; force vector should pass through the center of resistance of the maxillary dentition which would move the maxillary arch posteriorly and superiorly at the same time (Figure 4 a, b,c).¹¹

5. Clear Aligners

The history of clear aligners is traced back to 1947 when Dr. H.D. Kesling first proposed a clear vacuum-formed tooth-positioning appliance for minor tooth movement.¹² The

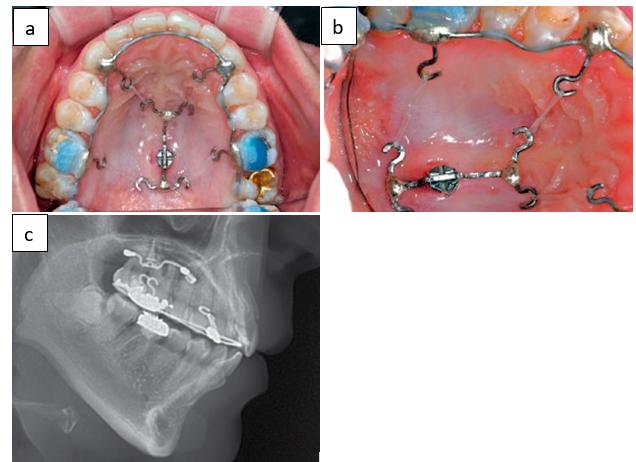


Fig. 4: a,b,c: Intrusion is carried out with the help of mid palatal mini-implants

Invisalign system introduced by Align Technology draws its inspiration from the principles of Kesling, Nahoum, and Raintree Essix. In 1997 Zia Chishti and Kelsey Wirth in San Jose, California cofounded Invisalign.^{13,14}

Clear aligners are progressively utilized by orthodontists in recent years. Originally directed to treat minor dentoalveolar problems in adults, this approach became more challenging once applied to achieve complex orthodontic movements like intrusion of posterior teeth, extrusion of anterior teeth, torque application, and anteroposterior discrepancies. Specifically, clinicians encountered difficulties with the bodily movement of teeth, particularly in cases involving extraction of four premolars requiring definite anchorage management. Mini-implants are currently being employed as adjuncts to clear-aligner treatment.¹⁵

6. Intrusion^{15,16}

Correction of deep overbite using clear aligners is a difficult task. With the use of mini-implants, it is possible to achieve intrusion of single as well as en-mass intrusion in deep bite and open bite cases (Figure 5 a, b).

Single tooth intrusion is done by using a single attachment placed on premolar tooth; elastic chain is given to the mini-implant head from the attachment. This provides the necessary intrusion force on the premolar teeth. By giving the attachments on the posterior segment and triangular elastic from the implant head to the attachments, en mass intrusion of the posterior segment has been done (Figure 5 c).

Two mini-implants are placed in the anterior region of the maxilla between lateral incisors and canines; extra hook attachment is made in the aligner with respect to the tooth of interest. By placing the elastic chain from the hook in the aligner to the implant head, intrusion of the maxillary

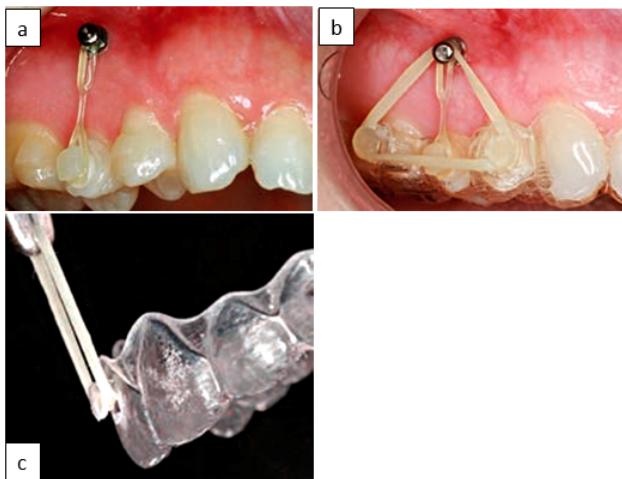


Fig. 5: a,b,c: Intrusion of the teeth done with the help of traction provided from the implant head into the attachment present in the aligner

anterior teeth to a desired amount is achieved successfully.

7. Retraction^{15,16}

Unilateral en masse retraction is done by placing mini-implants between the first and second molar on palatal region. Closed coil retraction spring extended from the mini-implant head into the power arm bonded to the palatal surface of the first premolar is used for en masse retraction guided by aligner tray (Figure 6).



Fig. 6: En masse retraction is done with the help of mini-implants placed in the palate

Unilateral en masse retraction is done with the help of mini-implants and elastics. Mini-implants are inserted bilaterally between the roots of the upper second premolar and first molar in the buccal region; notches are made in the aligner tray mesial to upper canines. Class I elastics are attached from mini-implants to notches in the aligner tray. Class II elastics are given from maxillary tray notches to bonded buttons on the lower first molars.

8. Derotations

A mini-implant is placed near to the rotated tooth. Buttons are bonded on the buccal surface of rotated tooth and lingual surfaces of rotated and adjacent teeth. By engaging the elastic chain from the mini-implant into the buccal button and between the lingual buttons, couple force is applied which aids in its derotation (Figure 7 a,b).^{15–17}

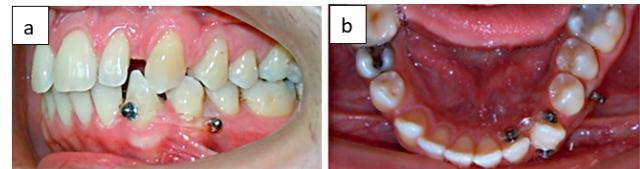


Fig. 7: a, b: Derotation of the canine done with the help of mini-implants

9. Canine Impaction

Surgical exposure of canine should be done, mini-implant is placed between the central and lateral incisors and two buttons are bonded; one on the exposed canine crown surface and another on lower canine tooth. Traction is given with the help of elastics placed from the head of mini-implant to the buccal attachment on impacted canine, which helps to guide the canine into the occlusion (Figure 8 a,b).¹⁸

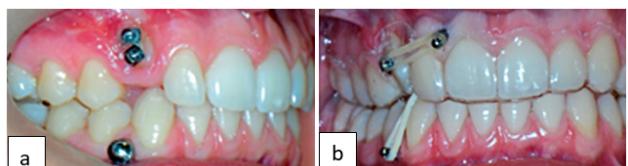


Fig. 8: a, b: Canine impaction is carried out by using mini-implants

10. Conclusion

Invisible appliances have revolutionized the field of dentistry with more adult patients seeking orthodontic care. With the application of mini implants as anchor savers, the drawbacks of Invisible appliances have been resolved to a greater extent. By combining these together we are able to treat complex cases more effectively and efficiently with good clinical success rate without compromising patient's demands on esthetics.

11. Source of Funding

None.

12. Conflict of Interest

The authors declare no conflict of interest.

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Author biography

Nausheer Ahmed, Professor and Head  <https://orcid.org/0000-0001-8466-9403>

Nikhil P M, PG Student  <https://orcid.org/0000-0002-5695-4458>

Abrar Younus A, PG Student  <https://orcid.org/0000-0002-5720-9185>

Haritha U, PG Student  <https://orcid.org/0000-0003-3554-8650>

Shreya Shetty K, PG Student  <https://orcid.org/0000-0002-8028-5426>

Ranjan R Bhatt, PG Student

Cite this article: Ahmed N, Nikhil P M, Younus A A, Haritha U, Shetty K S, Bhatt RR. Application of mini-implants in invisible orthodontics. *Int J Oral Health Dent* 2022;8(2):95–99.