CLINICAL APPLICATIONS OF MINI IMPLANT

Abstract

Mini-implants, also known as temporary anchorage devices (TADs), have emerged as a transformative innovation in the field of orthodontics, providing a robust and versatile means of achieving precise tooth movement. These small, screw-like implants, strategically placed within the jawbone, offer significant advantages over conventional anchorage methods such as headgear and elastics.

A primary application of mini-implants lies in cases demanding absolute anchorage, where tooth movement must occur without compromising the position of adjacent teeth. Mini-implants serve as steadfast anchor points, enabling orthodontists to execute controlled tooth repositioning without jeopardizing occlusal stability. This capability proves invaluable for correcting severe malocclusions, impacted teeth, and open bites.

Mini-implants also play a pivotal role in accelerating tooth movement, a technique known as accelerated osteogenic orthodontics (AOO). By strategically placing mini-implants, orthodontists can apply precise forces directly to the teeth, facilitating faster and more efficient tooth movement compared to traditional methods.

The clinical applications of mini-implants extend to a wide range of orthodontic procedures, including: Molar intrusion, Mesiodistal control, Space closure, Crossbite correction and Surgical orthodontics.

Mini-implants are generally well-tolerated by patients, with minimal discomfort during placement and removal. The procedure is typically performed under local anesthesia and requires no incision or

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sutures. Moreover, mini-implants boast a high success rate, with a low incidence of complications such as implant failure or infection.

In summary, mini-implants have revolutionized the field of orthodontics, offering a multitude of benefits over traditional anchorage methods. Their versatility, effectiveness, and patient-friendliness have solidified their position as a cornerstone of modern orthodontic treatment.

Keywords: Mini-implants, Orthodontics, Mesiodistal

The broad range of insertion sites available for mini-implants make them a more versatile option for skeletal anchorage, which allows for a wider range of indications compared to other options.

I. ANCHORAGE METHODS: DIRECT AND INDIRECT

Direct anchorage refers to a connection between the implant and the dental unit that need to be moved. This produces an anchorage that is solely supported by a mini-implant. Dependingon the desired treatment outcome, various modules can be employed to transmit forces fromthe implant to the dental unit.[2]

1. **Compression Spring (Figure 1):** A second arch wire or wire segment is always needed when using a compression spring (also known as an open coil spring) to stabilise it.

2. **Tension Spring (Figure 2):** Biomechanically, super-elastic nickel titanium (NiTi) springs (closed coil springs) are preferred over elastic chains because they provide a constant and consistent force. Depending on the tension spring's manufacturer and the mini-implant's head design, a stainless steelligature or Monkey Hook may be necessary for attaching the tension spring.

3. **Elastic Chain (Figure 3):** Tension mechanics with an elastic chain can be used quickly and easily.

   Lever- Arm: There are instances where the insertion of a mini-implant in the intended location may not be feasible due to anatomical limitations such as insufficient bone quality or lack of interradicular space. In such cases, lever-arm mechanics can be employed as a common solution to overcome these challenges.[2]

4. **Indirect Anchorage (Figure 4):** When using indirect anchorage, the miniscrew stabilises the dental anchorage unit, creating a dental anchorage segment that is reinforced by implants. The following are techniques for building indirect anchorage, depending on the specific requirements.[2,3]

   Segmented Arches and Cross Tubes: Dental anchorage can be strengthened using segmental wire extending from miniscrews that are inserted into cross tubes on the arch wire. The placement of the mini-implant should be done in the opposite direction from how the dental anchorage unit would move.[3]

5. **Segmental Arch and Bands with an Additional Slot (Figure 5):** Another option involves the use of segmental wires that are fastened to the mini-screw and then bent to fit into the horizontal auxiliary slot on a molar band.

6. **Connection with Quadhelix, Transpalatal Arch, and Horseshoe Arch (Figure 6):** A Quadhelix or a Transpalatal Arch can be stabilised using a palatally inserted mini-implant. Also, to prevent molar tipping, the transpalatal arch with indirect anchorage via a mini-implant in the median palatal suture can be used. It is possible to integrate the TPA/QH directly into mini-implants with very wide slots.[4]

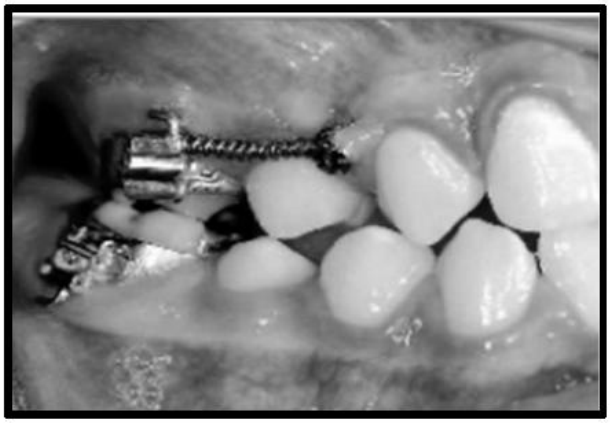

Figure 1: Compression Spring Is Used on Niti Segmented Arch (16 X 22") Between a Mini-Implant Placed Between Teeth 6 and 5 And Tooth 3 For Distalization and De-Rotation.

Figure 2: Direct Anchorage withNiti Tension Spring

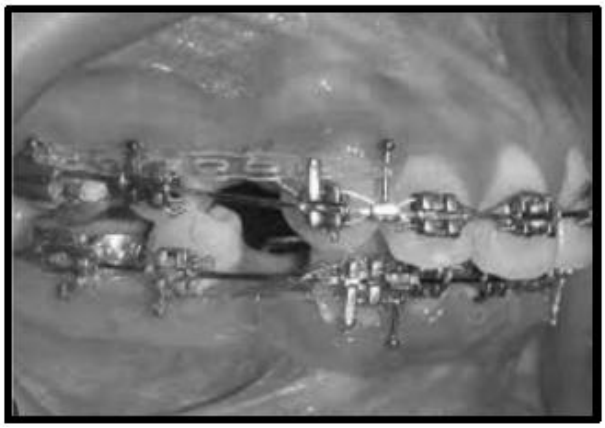

Figure 3: Elastic Chain DirectAnchorage for Mass Retraction

Figure 4: Using Miniscrew as an IndirectAnchorage while the Canine and Premolar Teeth are Being Distalize

Figure 5: Utilising Indirect Anchorage, A Cross-Slot Implant with EngagedWire Segment Allows Pre-Prosthetic Tooth Movement

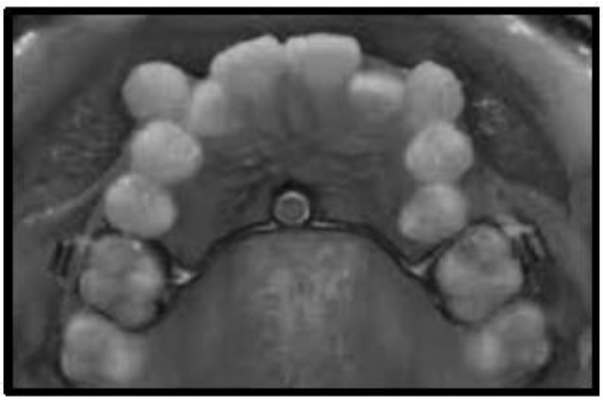

Figure 6: Transpalatal Arch Can Be Utilized Through Indirect Anchorage Via a Mini-Implant Inserted into The Median Palatal Suture.

II. CLINICAL APPLICATIONS OF MINI-IMPLANTS

1. Anterior Teeth's Anchorage

- **Maxilla Horizontal Plane:** To avoid lingual tipping of the maxillary anterior segment and maintain overjet, it is recommended to place a mini-implant in the palate. One mini-implant is typically enough to achieve bilateral protraction when treating conditions like agenesis of the upper lateral incisors (Figure 7). If the space closure is done asymmetrically, which applies an asymmetric, unilateral load to the dental anchorage unit, the placement of two mini-implants is required to offset any moment that might occur at the implant (Figure 8). The segmental arch, which is held in place by a light-cured composite, can benefit from light counter-activation to prevent a loss of anchorage.[5]

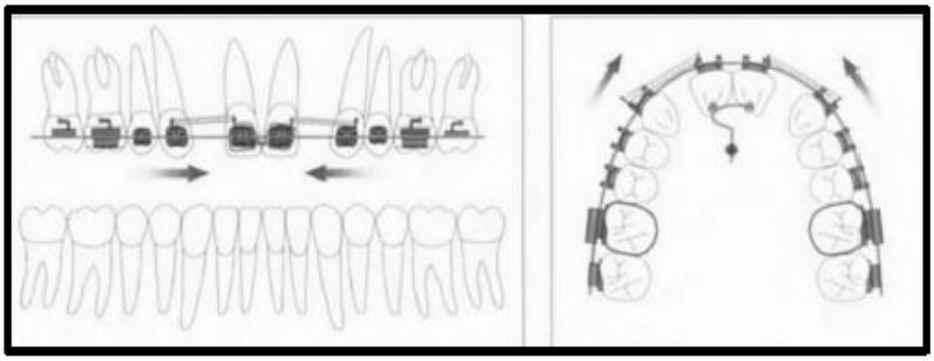

Figure 7: To Keep the Overjet in Place, A Mini-Implant Was Inserted Palatally and Connected to The Maxillary CentralIncisors By A 7x 25 SS Wire Segment. Light Cure Composite Is Used to Affix This Wire Segment to The Central Incisors.

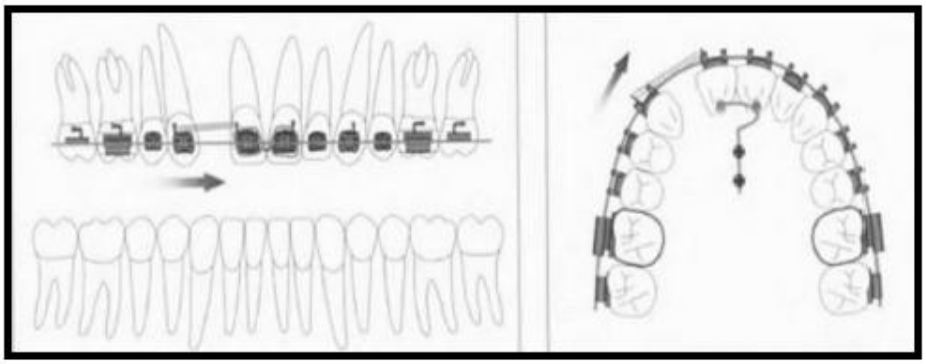

Figure 8: The Attempt to Close a Single Space Uses Two Mini-Implants as Anchorage And A 17 X 25 Ss Wire Segment And Light-Cured Composite To Join It To The Central Incisors.

- **The Vertical Dimension of the Maxilla:** To maintain the overbite and stabilise the vertical dimension, a mini-implant can be insertedinto the buccal cortical bone. Using a segmental arch with cross tube or a composite connection, the connection to the dental anchorage unit can be made. Use of the segmental arch in conjunction with a compression spring is possible for active anterior extrusion (Figure 9).[5,6]

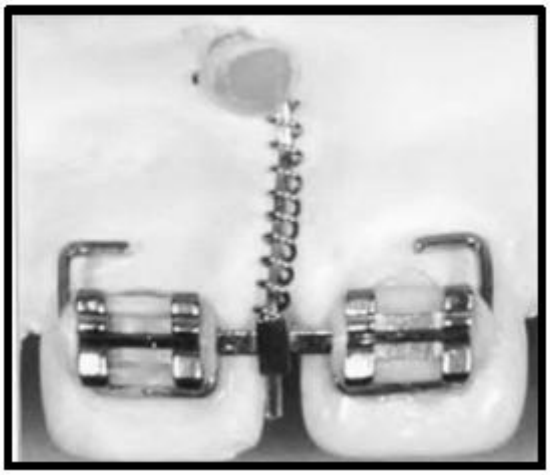

Figure 9: Extrusion May Be Produced by A CompressionSpring On The Wire Segment.

- **Mandible Horizontal Plane:** A mini-implant positioned near the posterior alveolar process can stabilise the mandibular anterior segment in the horizontal plane. When using a fixed functional appliance like the Herbst, Jasper Jumper, or even Class I intermaxillary elastics, limiting the protrusion or flaring of the mandibular anterior teeth is crucial. In such situations, the mandibular dentition may be "tied-back" to the mini-implant using ligation (Figure 10). A stable segmental arch is necessary if resistance to any anterior retraction is desired.[5,6]

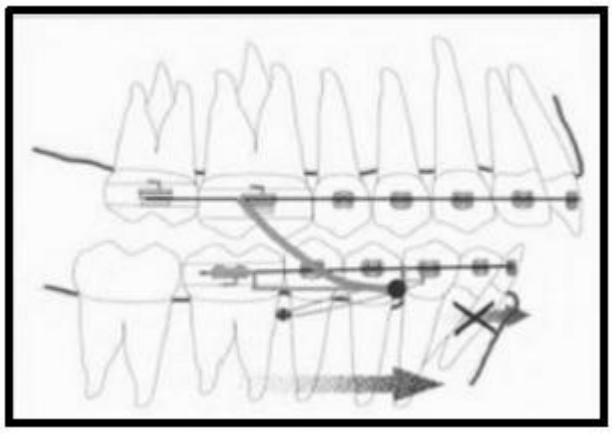

Figure 10: To Correct Class IIMalocclusion Using the HerbstAppliance, Mandibular Bilateral Mini-Implants Can Be Used To Prevent The Protrusion Of Front Teeth.

- **Anterior Tooth Intrusion or Extrusion:** If direct symmetrical intrusion is chosen, at least two mini-implants are required (Figure 11).The use of a tension spring or an elastic chain may cause gingival irritation or impingement if the incisors are retroclined (for example, Class I Division 2). It is suggested in that case to divert the tension spring using a rectangular segmental arch. One implant might be enough if an asymmetrical intrusion is desired. Buccal tipping of teeth can occur when force is exerted on the buccal point.[7,8]

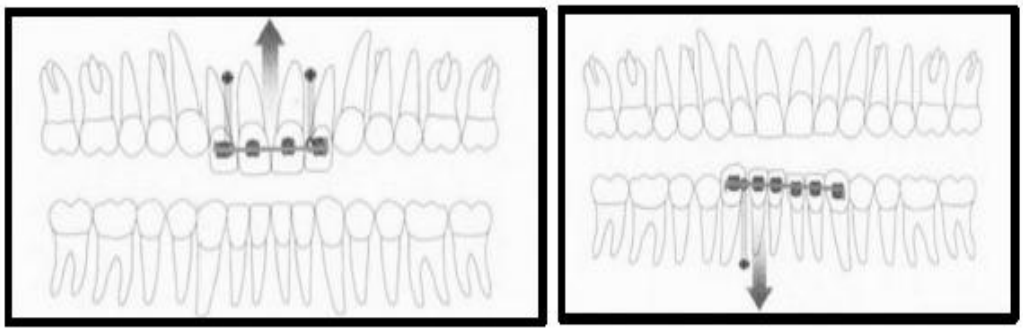

Figure 11: For Severe Protrusion, Use Rectangular Segmental Archwire to Divert Springs. Symmetrical Intrusion Needs Two Mini-Implants, While One Sufficesfor Asymmetrical Intrusion.

- **Anterior Teeth Retraction:** Mini-implant anchorage is a commonly used approach for retracting the maxillary anterior segment. However, when second molar bands are in place and sliding mechanics with hooks are used, there can be high frictional loads (Figure 12). To account for these loads, greater forces must be applied to the mini-implants. In cases with a deep bite, the mini-implants need to be placed as apically as possible in order to increase the resulting force vector, which causes the bite opening to increase the further they are placed apically, regardless of whether they are placed in the maxilla or mandible. [8]

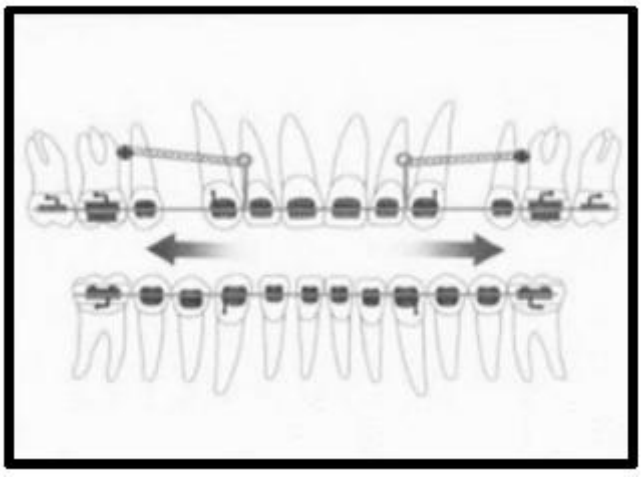

Figure 12: Maxillary First Premolar Extraction Is Followed by Sliding Mechanics for Anterior Teeth Retraction. Small Implants Adjacentto The First Molars Are Utilized for Anchorage.

- **Displaced Canine Correction:** The integration of displaced canines can also benefit greatly from mini-implants. To apply a posteriorly directed force on the maxilla, a suitable location for the mini-implant would be near the palatal suture (Figure 13). If the integration of the canines requires the greatest amount of anchorage, an insertion in the alveolar process may also be appropriate (Figure 14)[8,9]

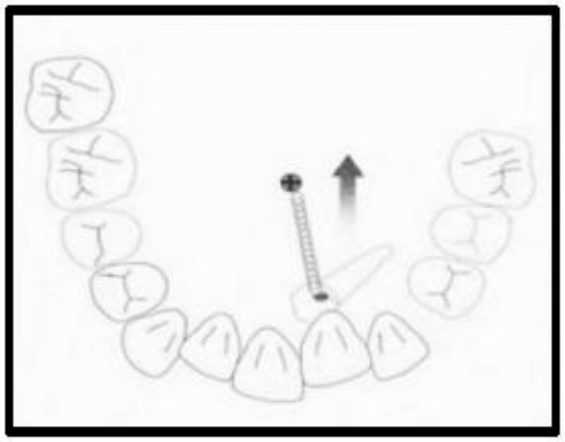

Figure 13: Utilising A Mini-Implant in The Posterior Midpalatal Suture,The Left Canine's Apically Displaced Position Was Distalized

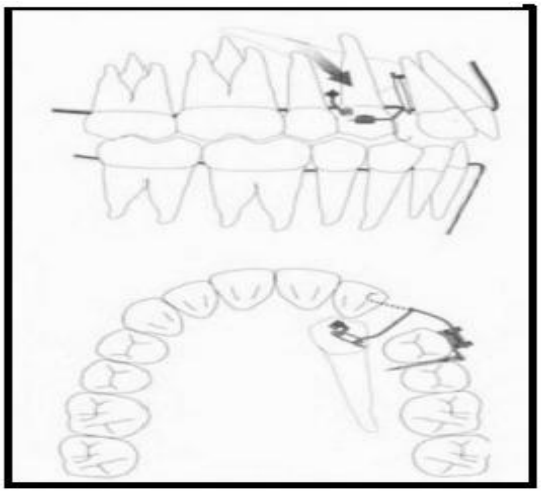

Figure 14: Left Canine Alignment with TMA Spring. First Premolar Is Anchored by The Mini-Implant That IsAttached to The Bonded Wire Segment.

2. Posterior Teeth

- **Posterior Teeth's Anchorage:** The quickest way to stop mesial migration of molars is to place a mini-implant behind themolar and tie it to the molar. When premolar and/or anterior teeth are going to be extracted, this is a possibility. However, the diminished bone quality and relatively thick gingiva distal to the maxillary molars, are a drawback. There is consequently a fairly high risk of implant loosening or early loss. Therefore, connecting two mini-implants in opposition to the direction of force application could prevent the possibility of unwanted anchorageloss. The option of attaching the molars to a mini-implant in the anterior median palate using a Horseshoe Arch or Quadhelix is also an option (Figure 15 and 16). The mini-implant is well supported by the bone, and the gingiva is thin and constrictive there. In contrast to placing the mini-implant in the alveolar process, there is no risk of root damage, which is an additional benefit. It may also be essential to anchor molars in directions other than the horizontal plane. [10]

With a Ricketts' utility arch, undesirable moments are applied to the anchoring molars when extruding or intruding anterior teeth. It is possible to prevent this reactive molar tipping by using mini-implants. A TPA connected to a miniimplant placed in the median palate can be used as an arch for anchorage (Figure 17).[10]

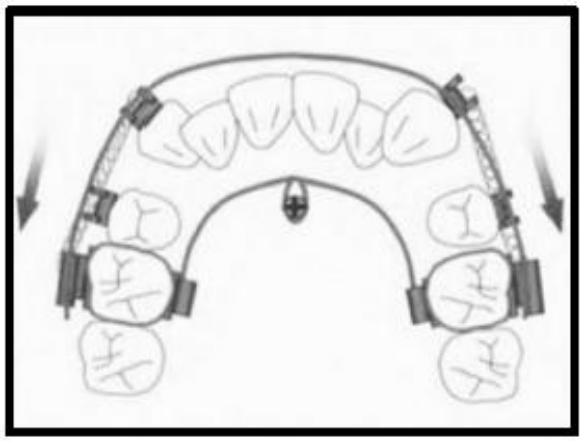

Figure 15: First Molar Anchorage with A HorseshoeArch and An AnteriorMidpalatal Implant

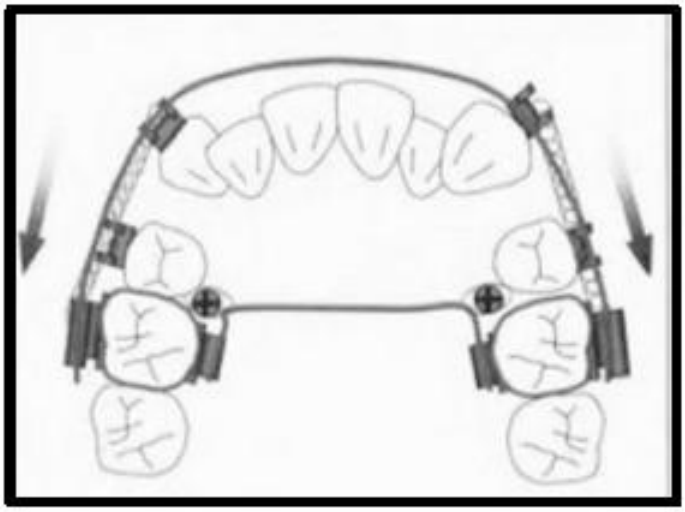

Figure 16: Using A Transpalatal Arch and Mini-Implants Near the Molars' Resistance Centres, Indirect Anchor Age Is Achieved.

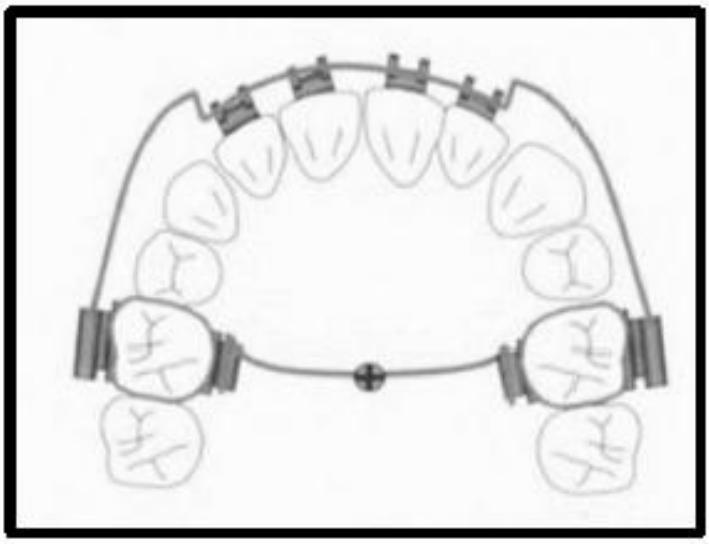

Figure 17: When Using a Utility Arch, The Mini-ImplantAnchored Transpalatal Arch Prevents Molars from Tipping.

- **Intrusion of Posterior Teeth:** The use of mini-implant anchorage has been a well-established technique for pre-prosthetic intrusion of hyper-erupted molars, as well as for the closure of open bites. To prevent buccal flaring during the intrusion of the molars, force needs to be applied to both the palatal and buccal surfaces of the teeth. This typically involves placing two mini-implants in the buccal alveolus, one mesial and one distal to the tooth to be intruded, and one mini-implant in the palate (Figure 18, 19).[10]

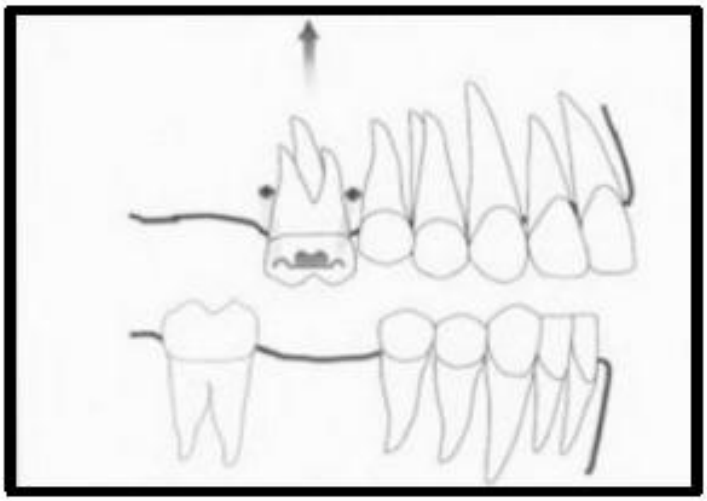

Figure 18: For Molar Intrusion, There Are Two Buccal Mini- Implants (Distal and Mesial to The Molar).

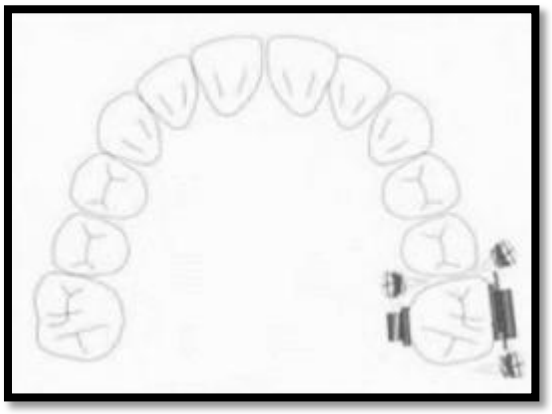

Figure 19: During Intrusion, Force is Applied Buccally and Mesially (In This Case, Near the AlveolarProcess) To Prevent The Molars From Tipping

- **Repositioning of Tipped Molars:** Mini-implant anchorage allows for the uprighting of tipped molars without the need for complete tooth banding. Uprighting of Tipped Molars: Mini-implant anchorage allows for the uprighting of tipped molars without complete tooth banding. Other than the tipped molars, no other teeth require the use of orthodontic appliances when using mini-screws. The mechanism could include a compression spring on a miniscrewed-supported segmental arch (Figure 20). The molar experiences an uprighting moment as a result of the coronal, eccentric force being applied. If the mini-implant is positioned vertically in the middle of the alveolar process, attaching a segmental arch wire for uprighting proves challenging unless a mini-implant with a bracket head design is used. An alternative would be to use light-cured composite to ligate or fasten a tiny bracket to the mini-implant's head. A compression spring on a segmental arch that is supported by the mini-screw may make up the mechanics (Figure 21). The molar experiences an uprighting moment because of the coronal, eccentric force that is applied. An alternative would be to use light-cured composite to ligate or join a little bracket to the head of the mini-implant.[10,11]

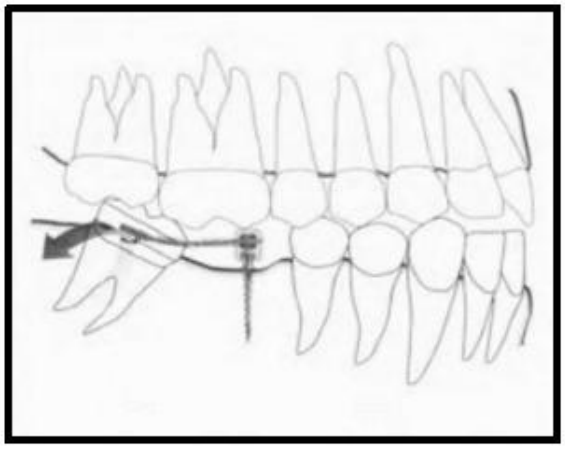

Figure 20: Using a Compression Spring on a Segmented Arch Wire, Uprighting Tipped Molars is accomplished by using a Mini- Implant and a Composite Retained Band Construction.

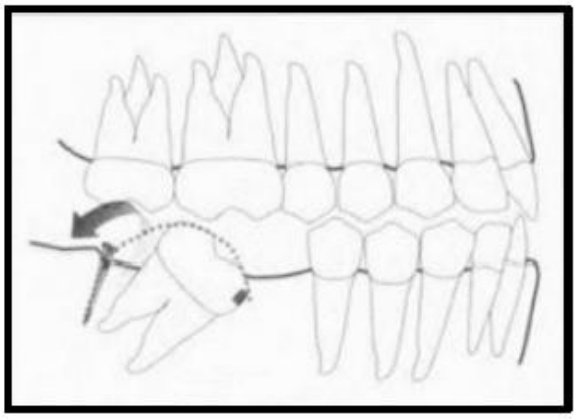

Figure 21: Molar Uprighting with an Elastomeric Chain and Distal Mini-Implant.

- **The Mesialization of the Posterior Teeth:** Particularly for mandibular molars, adequate anchorage is critical when mesial movement of the molar is required to predictably achieve the desired effect. After first molar extraction or in cases of premolar agenesis, the two most frequent circumstances requiring mesial molar movement occur. When there is no desire for anterior teeth to be retracted, Class I or II malocclusions require maximum anchorage for the anterior dentition.[12,13]

  If direct anchorage is used, a miniimplant is placed in the buccal alveolus process near the premolars. Mesially directed force is applied by connecting a NiTi tension (open coil) or elastic chain from the molars to the miniscrew (Figure 22). Mini-implants for protraction mechanics can also be inserted into the palate (Figure 23). The rotation control (hinge mechanics) of a TPA can be used if unilateral mesialization with sectional mechanics is desired.[14,15]

  The mechanics of indirect anchorage can also be used to mesialize molars. Miniimplants canbe attached to the dental anchorage unit either by fixing them with composite (Figure 24) or by using a short segmental arch in across tube on the base arch wire.[14]

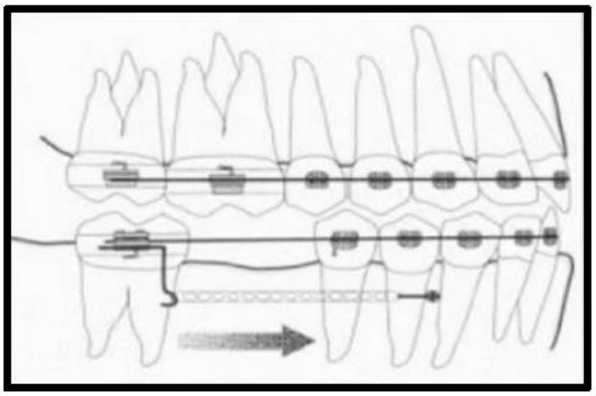

Figure 22: Mini-Implant in The Premolar Region Directly Anchors Molar Protraction, With an Elastic Module for Protraction Force and A Power Hook To Reduce Friction AndTipping.

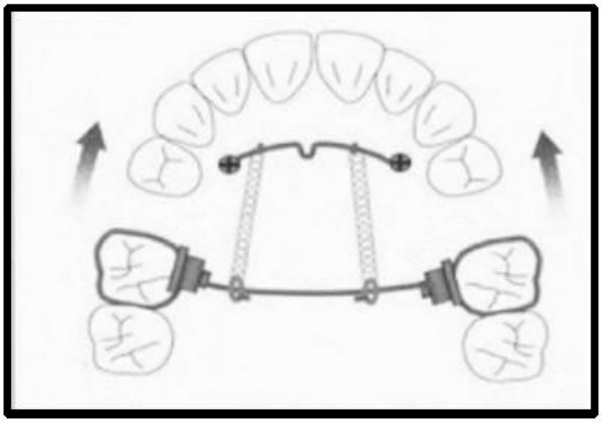

Figure 23: Two Transpalatal Arches, Mini-Implants, And Elastic Modules AreUsed for Maxillary Molar Protraction.

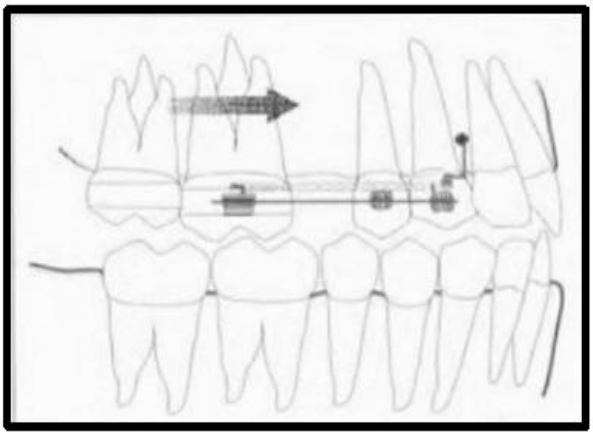

Figure 24: A Segmented Arch Wire and Composite Allow the Mini-Implant to Connect to The Dental Anchorage Unit.

- **Posterior Teeth Distalization:** Compression (open coil) spring, tube, and wire ligature can be used to distalize posterior teeth (Figure 25). If the distalization is solely intended to be implant-anchored, the tube must not be clamped down on the arch to prevent it from sliding. The tube can be firmly crimped to provide indirect anchorage. Additionally, mini-screws can be inserted into the palate for maxillary molar distalization. When the goal is to move the entire back teeth towards the back of the mouth (e.g., to address crowded front teeth), it may be necessary to remove the mini-screws and place them in a different spot once the molars have been moved backward. This is done to prevent the screws from obstructing the future retraction of the premolars (Figure 26).[16]

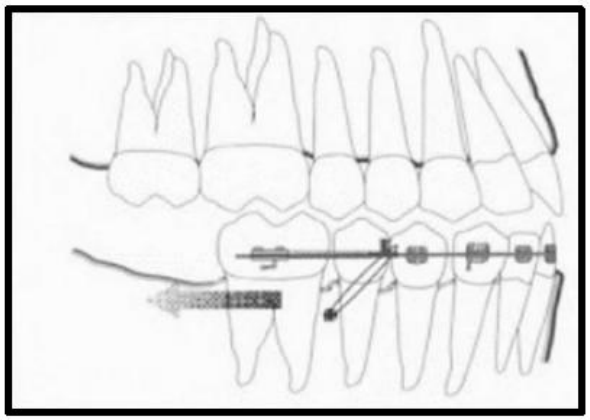

Figure 25: Distalizing the Molar Using Compression Spring, Tube, and Wire Ligature.

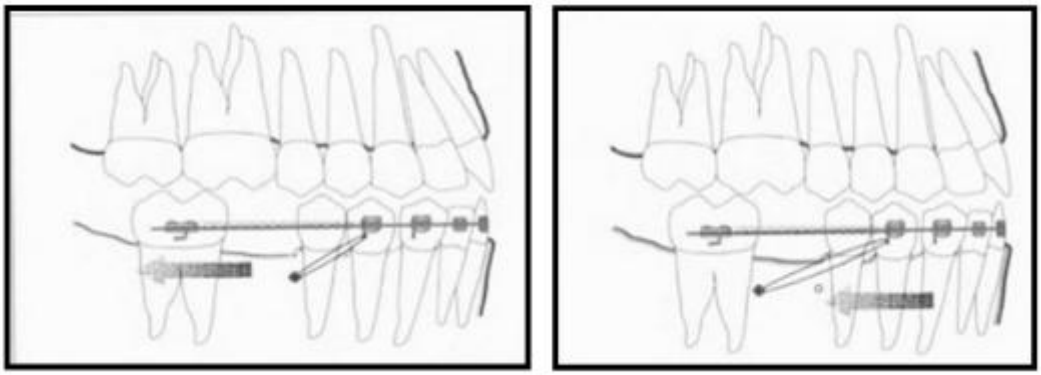

Figure 26: Distalization of The Buccal Segment Is Done Gradually with Small Steps. To Avoid Hindering Premolar Retraction, The Implant Should Only Be Relocated After Molar Distalization Is Complete.

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