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Intrusion Mechanics in Orthodontics

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Abstract:- Various methods for incisor intrusion and molar intrusion are discussed in detail in this review. These techniques involve applying different forces and mechanics to move teeth vertically into the jawbone.For incisor intrusion, methods such as utility arches, Connecticut intrusion arches, Burstone intrusion arches, K sir Arch, and tip back springs are utilized. Each of these methods employs unique mechanics to achieve the desired vertical movement of the incisors.On the other hand, molar intrusion techniques include the use of Temporary Anchorage Devices (TADs), headgears, biteplanes, magnets, maxillary intrusion splints, Invisalign, and active vertical correctors. These methods provide various approaches to intrude molars by applying force in different ways.The choice of intrusion method depends on factors such as the specific orthodontic case, treatment goals, and patient anatomy. Each technique has its own advantages, limitations, and indications for use in clinical practice..The aim of this overview is to provide information for approaching the ways of intrusion.

Keywords:- *Intrusion, Utility Arches, TAD's, K-SIR Arch.*

I. INTRODUCTION

Utilizing orthodontic intrusion is a widely utilized strategy for addressing both aesthetic and functional concerns in orthodontic care, including issues like excessive gum display (gummy smile) and deep overbites.1 Rectifying a deep bite can be achieved through diverse approaches, depending on the initial diagnosis and treatment aims

Correction of a deep bite can involve different methods of tooth adjustment, including the intrusion of front teeth. Intruding the anterior teeth to address a deep overbite might be recommended for patients who have an unaesthetic display of excessive upper incisors when their lips are at rest, typically around 5 to 8 millimeters..

➢ *Definition*

Acording to Burstone Intrusion involves the downward movement of the geometric center of a tooth's root (centroid) concerning either the occlusal plane or a plane aligned with the tooth's long axis. [2]According to Marcotte, intrusion is characterized by a tooth's movement in an axial (apical) direction, with its center of rotation located infinitely far away. This type of movement is considered an axial translation. Nicolai describes intrusion as a form of tooth movement where translation occurs apically and parallel to the tooth's long axis.[3]

➢ *Types[4]*

- True intrusion or absolute intrusion
- Pseudo intrusion refer to the labial tpping of the incisor around the centroid
- Relative intrusion occurs when the position of the incisors remains unchanged, but the mandible grows and the posterior teeth emerge. On the other hand, apparent intrusion is attained through the extrusion of the posterior teeth.

- *Absolute Intrusion*

Intruding the incisors exclusively without causing extrusion of the posterior teeth is achieved through the application of gentle and continuous force directed towards the apex of the tooth, which is crucial for successful intrusion. It is preferable to achieve pure and absolute intrusion using methods such as mini-implants, J-Hook headgear, bypass, and segmental mechanics.

- *Relative Intrusion*

This goal is attained by halting the eruption of the incisors while allowing vertical space for the posterior teeth to erupt due to natural growth. Techniques to achieve this include using continuous arch wires, integrating a reverse curve of Spee in the mandibular arch, and an exaggerated curve of Spee in the maxillary archwire. Additionally, methods such as anterior bite plates and Twin-blocks, where molar eruption is facilitated by adjusting the posterior blocks, are employed.

➢ *Indications*

- Intrusion of Incisors-Gummy smile, Deep bite with decreased
- Lower facial height, Tooth affected by periodontal disease,
- To correct Supraerupted molars, Anterior open bite.
- Tissue Reactions after the Application of Different Orthodontic Forces

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The process of tooth intrusion entails bone resorption, especially in the region around the tooth's apex. During this motion, all supporting structures experience pressure with minimal areas of tension. The primary stress is applied to the principal fibers through stretching.

II. OPTIMAL FORCE FOR INTRUSION

- Intrusive force values vary among authors from 15 to 200 g.
- Burstone(1977) suggested[5]
- 50 grams of intrusive force for - upper central incisors,
- 100 grams for - central and laterals
- 200 grams for - six upper anteriors
- 40 grams for - four lower incisors
- 160 grams for- all six lower anteriors

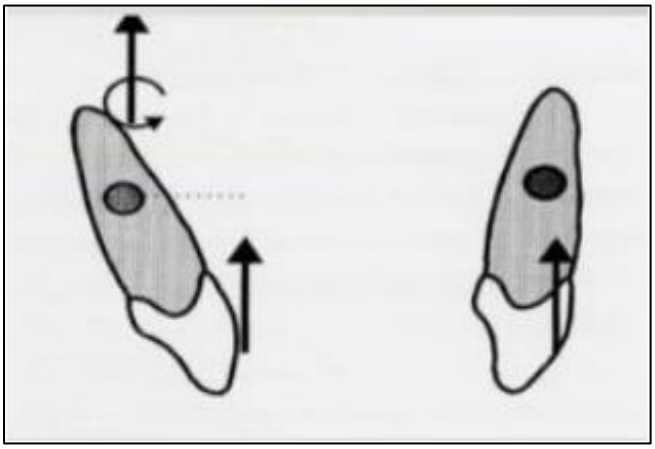

Fig 1 Centre of Resistance

➢ *Biomechanical Methods of Orthodontic Intrusion*

To achieve genuine intrusion using intrusion arches in biomechanics, precise force application is crucial, directed towards the center of resistance of the front teeth. When the force is applied through this point, it leads to the intrusion of the incisor segment. Conversely, if the force is applied labially to the center of resistance, it causes the crown to flare more towards the labial side.

➢ *Two Primary Mechanisms Exist in the Biomechanics of Intrusion: Continuous and Segmental.*

The continuous arch method entails creating an intrusion arch using either a stainless steel wire sized at 0.018 × 0.025 inches with a 2.5 mm helix or a plain titanium-molybdenum alloy wire sized at 0.017 × 0.025 inches. When dealing with protruding incisors, the arch is attached to the brackets of the central incisors or at the midpoint. By employing these techniques, correction of a deep bite involves a combination of incisor protrusion and intrusion. This strategy is especially advantageous for treating Class II, division 2 deep bite cases with mandibular retrusion in patients who are still growing..[7]

➢ *A Continuous Intrusion Arch can be used in Combination with a Straight Leveling Wire.*

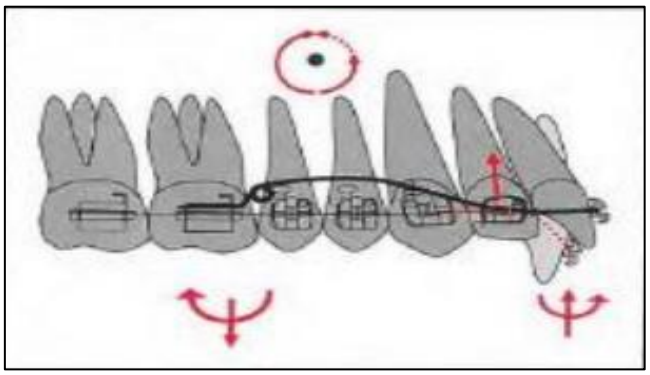

Fig 2 Continuous Arch Mechanics

➢ *Segmental Arch Mechanics:*

During the 1950s, Burstone pioneered the segmented arch technique, which involved utilizing various wire cross-sections within the same arch and wires that did not extend continuously from one bracket to the next. This segmentation enables authentic intrusive movement of the anterior teeth.The basic mechanism for intrusion consists of three parts:

- A posterior anchorage unit.
- An anterior segment.
- An intrusive arch spring.

➢ *Utility Arch*

In the early 1950s, Robert M. Ricketts introduced the utility arch primarily to rectify the curve of Spee in the lower jaw. Since then, its use has broadened to encompass a range of functions beyond mere intrusion of the lower incisors. It comprises a continuous wire extending across both buccal segments, engaging solely with the first molar and four incisors.[9]

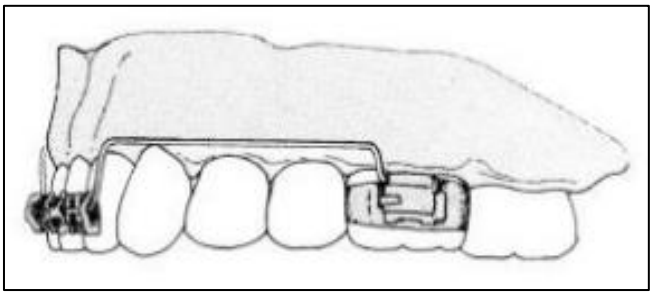

Fig 3 Rickets Utility Arch

Following Ricketts' recommendations, utility arches are typically crafted from chrome-cobalt wires, commonly referred to as blue Elgiloy wire. Rectangular wire is generally preferred over round wire to ensure better torque control and to prevent inadvertent tipping of the incisors. For a 0.018 opening mechanism, suitable wire sizes for the mandibular curve are either 0.016 x 0.022 or 0.016 x 0.016, while for the maxillary curve, a 0.016 x 0.022 wire is recommended. In the case of a 0.022 opening mechanism, a 0.019 x 0.019 wire can be utilized for either curve.[10]

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- Molar segments
- Posterior vertical segment
- Vestibular segment
- Anterior vertical segment
- Incisal segment

➢ *Activation*

A gable bend directed occlusally is incorporated into the posterior part of the vestibular segment of the arch wire. Bench has recommended the addition of a tip back bend in the molar segment.

➢ *The Four Types of Utility Arches are:*

- Passive Utility Arch
- Intrusion Utility Arch
- Retraction Utility Arch
- Protraction utility Arch

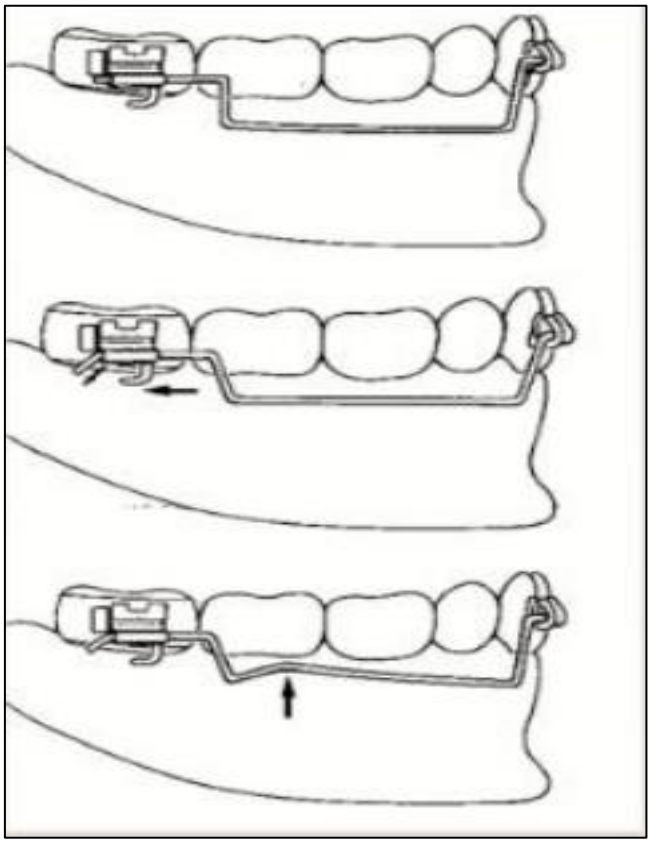

Fig 4 Activation of the Utility Arch

III. TIP BACK SPRINGS (INTRUSION SPRINGS)

➢ *Given by Burstone*

The upper and lower arches are stabilized using a sturdy stainless steel wire, ideally with dimensions of 17×25. Additional reinforcement for anchorage is provided by a Transpalatal Arch (TPA) and a lingual holding arch. Intrusion springs are crafted from either 0.017×0.025 titanium-molybdenum alloy wire without a helix or 0.017×0.025 stainless steel wire with a helix, ensuring optimal force application.

The wire is bent in a gingival direction near the mesial part of the molar tube, followed by the formation of a helix. The mesial end is fashioned into a hook and inserted distally to the lateral incisor.[11]

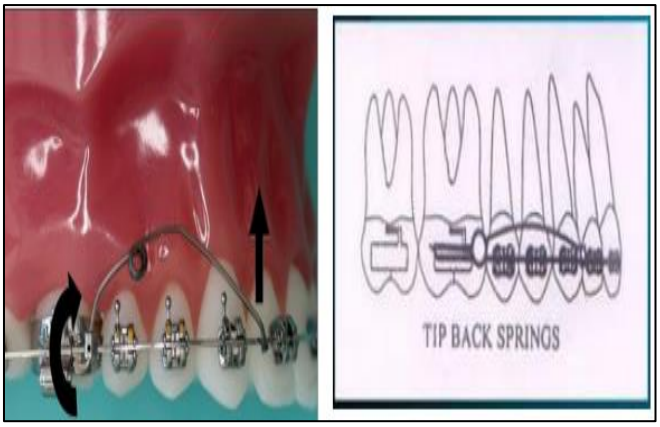

Fig 5 Tip Back Springs

➢ *Reverse Curved Arch*

The reverse curve of Spee is an orthodontic arch employed to level the Spee curve in patients with deep bites. It corrects deep bites by causing the posterior teeth to extrude and the anterior teeth to intrude and flare.[12]

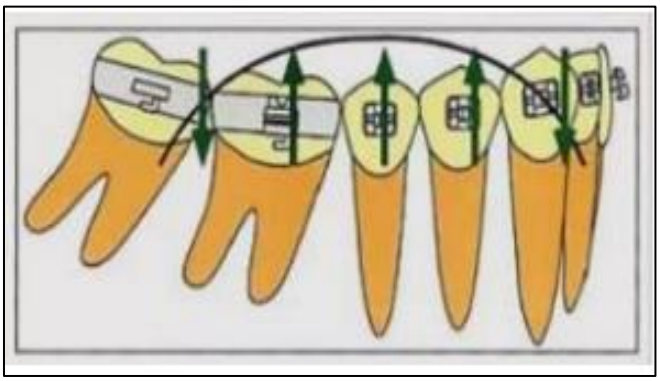

Fig 6 Reverse Curve of Spee

➢ *Connecticut Intrusion Arch*

The CTA is made from a nickel titanium alloy to leverage the benefits of shape memory, springback, and even distribution of light, continuous force.

Fig 7 Connecticut Intrusion Arch

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IIt combines features from both the utility arch and the traditional intrusion arch. It comes in two sizes: .016" X .022" and .017" X .025". The maxillary version measures 34mm in anterior dimensions, while the mandibular version measures 28mm.[13]

➢ *Mechanics*

The fundamental force delivery mechanism of the CTA involves a V-bend designed to deliver around 40-60g of force. Upon placement, the V-bend sits slightly in front of the molar brackets.

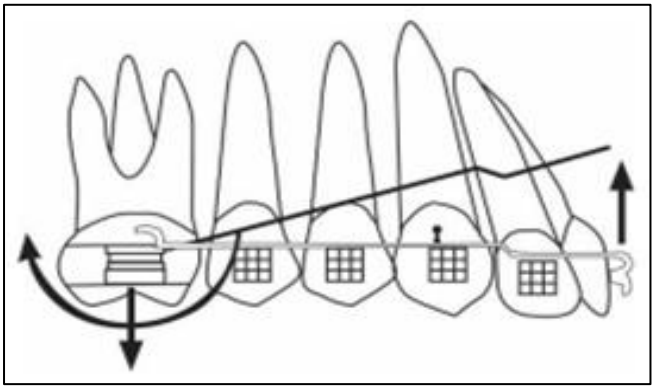

Fig 8 Connecticut Intrusion Arch Activated form

Activating the arch creates a straightforward force system, with a vertical force in the front area and a moment in the back region.

➢ *Burstone Intrusion Arch*

During the 1950s, Burstone introduced the segmented arch technique, wherein the wire within the same arch had various cross-sections. Burstone noted that one drawback of continuous arch therapy was its incapacity to achieve true intrusion.[14]

A 0.017x0.025 inch TMA wire is employed to generate gentle forces over an extended period to achieve effective intrusion. The arch is not placed into the anterior brackets. Instead, a single contact point in the anterior region enables precise calculation of force delivery, allowing application at the desired level relative to the position of the anterior segment's center of resistance.[15]Side-effects: Molar tip back

➢ *Three Piece Base Intrusion Arch*

This is an adaptation of Burstone's intrusive arch, aimed at achieving pure intrusion while maximizing control over molar extrusion..

Introduced by Shroff, lindauer and Burstone in 1995.[16]

- *Parts of Three Piece Intrusion Curve:-*

✓ Anterior section
✓ Posterior section
✓ Intrusion springs
✓ Distal part

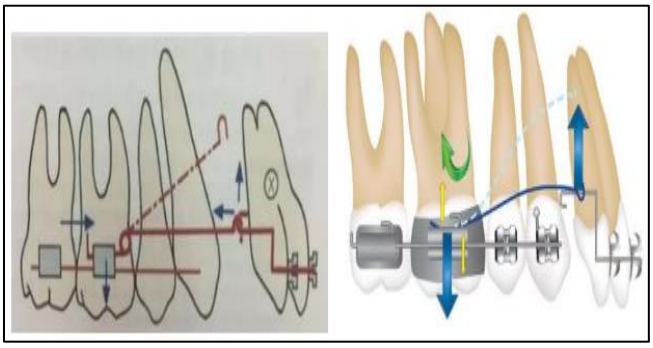

Fig 9 Three Piece Intrusion Arch

- *Anterior Segment with Posterior Section*

✓ It is bent downward towards the gingiva behind the lateral incisors, and then bent horizontally to create a step of around 3mm.
✓ The distal portion extends to the back end of the canine bracket, where it shapes into a hook using 0.021×0.025 stainless steel wire.

- *Posterior Segment*

✓ Aligned posteriors
✓ 0.017×0.025ss
✓ Transpalatal arch can be given for more consolodition

- *An Intrusive Force is Applied with 0.017x0.025" TMA Tip Back Springs.*

Distal light force can be delivered by Class1 elastic to the anterior segment to alter the direction of the intrusive force on the anterior segment.[17]

➢ *Kalra Simultaneous Intrusion Retraction*

The K-SIR (Kalra Simultaneous Intrusion and Retraction) archwire is an adaptation of the segmented loop mechanics introduced by Burstone and Nanda. It comprises a continuous TMA archwire measuring .019" X .025", featuring enclosed U-loops measuring 7mm X 2mm at the extraction sites..[18]

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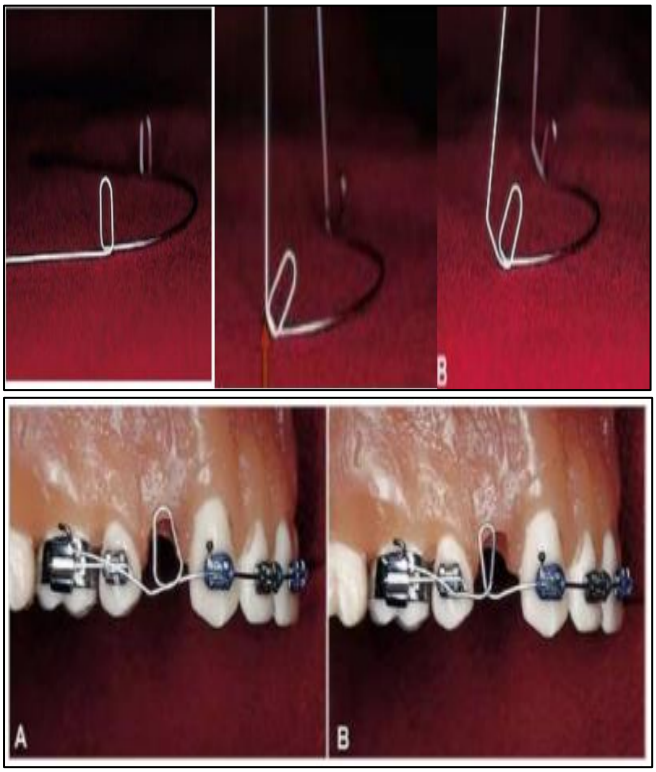

Fig 10 K – SIR Arch

A segment of TMA wire measuring .019×.025 is used to connect the first molar and second premolar. The archwire is bent back to activate a loop, creating a minimal separation between the mesial and distal legs, approximately 3mm apart.

➢ *J Hook Headgear*

Intrusion splint combined with high pull headgear - for whole arch intrusion. J hook can be applied to the maxillary teeth to retract and intrude the maxillary incisors.[19]


Fig 11 J Hook head gear

➢ *Temporary Anchorage Devices*

- *Anterior Intrusion with TADS*

As per Nanda, the optimal position for inserting Temporary Anchorage Devices (TADs) for anterior intrusion is between the roots of the canine and lateral incisors..[20]


Fig 12 TAD Intrusion

An E-Chain applies a gentle distal force to the anterior segment, modifying the intrusive force to facilitate genuine intrusion of the anterior teeth along their long axis.

- *Single Molar Intrusion with TADs*

Force should be balanced bucco lingually and mesiodistally for pure intrusion.[21]

✓ Insertion site[22]
✓ Buccally- mesial interdental area
✓ Palatally- distal interdental area

Additional miniscrews can be placed on either side of the alveolar slope to adjust the force direction

IV. CONCLUSION

For a long time, dental intrusion was thought to be either impossible or fraught with difficulties, often leading to various issues like damage to the supporting structures of the teeth and erosion of the tooth roots. However, recent clinical evidence has shown that orthodontic intrusion can be effectively performed with proper care, ensuring that the forces applied are closely regulated in terms of both intensity and direction.

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