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INTRUSION ARCHES IN ORTHODONTICS – A REVIEW

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ABSTRACT

Orthodontic intrusion is a common treatment strategy for management of orthodontic functional and aesthetic issues, such as deep bite and gummy smiles. This review includes current literature on dental intrusion, including types, clinical findings, tissue reactions following the application of force, and indications and contraindications. The fixed and removable appliances used for intrusion are succinctly described in this review article.

Keywords : orthodontic intrusion, intrusion arches, deepbite, gummy smile

INTRODUCTION

Charles J.Burstone defined intrusion as "apical movement of the geometric center of the root in respect to the occlusal plane or a plane based on the long axis of the tooth"[1], whereas Nikolai defined intrusion as "a translational form of the tooth movement directed apically and parallel to the long axis".[2]

Dental intrusion often constitutes an integral part of orthodontic treatment in order to improve sagittal and vertical incisor relationships, to correct interincisal angle and consequently, the gingival line and restore the esthetics of smiling.[3]

In general, intrusion as an orthodontic therapeutic manipulation may mean: Orthopedic intrusion, surgical superior maxillary displacement, and intrusion of a single tooth or groups of teeth.[4]

For many years, dental intrusion was considered impossible or problematic and was associated with numerous side-effects from the periodontium and cementum (root resorption). However, in recent years successful orthodontic intrusion is clinically documented and is considered a safe procedure, provided that the magnitude and direction of forces are carefully monitored.[5]

Intrusion at the initial stages of treatment with or without auxiliary means is proposed independently of the therapeutic technique followed, such as Begg, tip-edge, or bioprogressive.[6-8]

INTRUSION ARCHES

COMPONENTS OF INTRUSION ARCHES[9]

The components of intrusion arches are as follows :

- The posterior anchorage unit,

- Anterior segment and
- Vestibular segment.

The buccal segment consists of first molar and premolars, which are so levelled to house rigid stainless steel wire of full dimensions (0.021 × 0.025 in. SS). Transpalatal and translingual arches are used to reinforce the anchorage to counteract reactionary forces generated by the utility arches. The triple buccal tube is required on maxillary molar bands and double buccal tube on mandibular molar bands for the use of utility arches. The sectional buccal segment wire is housed in the main edgewise tubes while utility arch is housed in auxiliary tubes.

The anterior segment consists of four incisors requiring intrusion. Absolute alignment of anterior teeth is not necessary when performing intrusion since minor alignment can happen coincidently with an intrusion.
Intrusion arches can be made from non-heat-treated, 0.016 × 0.016 in. blue elgiloy wire or 0.017 × 0.025 in. TMA (titanium–molybdenum alloy) or 0.016 × 0.022 in. TMA wires. Using TMA wires allow the design of the intrusion arch to be simplified that eliminates a need of helices to achieve the low load–deflection rate. It is recommended to avoid placing the wire into the slots as it may lead to an expression of the torque present in the wire.[10] The incisal segment is ligated to the anterior aligning wire or placed incisal to the brackets. Connecticut Intrusion Arches (CTA) are available in preformed wires made of highly resilient shape memory nickel–titanium alloys (CNA, Beta III Nickel-Free Archwire).

TYPES OF INTRUSION ARCHES[9]

The intrusion of the upper and lower incisors, without significant extrusion of the buccal segment, has been described by Ricketts, Burstone and Nanda using continuous intrusion arches as follows:
1. Utility arch of Ricketts
2. Intrusion arch by Burstone
3. Connecticut intrusion arch (CTA)
4. Intrusion with anchorage derived from a mini screw

➢ RICKETTS' UTILITY ARCH[9,11]

Introduced more than 50 years ago, the utility arch proposed by R. M. Ricketts is a versatile system of upper and lower intrusion, which can be modified for simultaneous retraction of the anterior teeth.

Other contemporary intrusion arches seem to have evolved keeping the principles of force system of Ricketts utility arch. Better understanding through research on force analysis and development of TMA wires have helped to devise arches which require a fewer activation.

The utility arch can be employed to serve different objectives when it is in a passive or active state.

Passive utility arch is used to perform the following functions:

- It maintains arch length in mixed dentition and prevents worsening of the vertical bite.
- It can help to attain proper transverse development of the maxillary dentition by keeping the arch from deleterious influence of the buccinator mechanism.
- In permanent dentition, it is primarily used to preserve anchorage and maintain the bite.

Active utility arch can be modified to perform the following functions:

- Active intrusion of the maxillary anterior teeth.
- Active intrusion of the mandibular anterior teeth.
- Intrusion and protraction. This type of movement is required to align and intrude retroclined maxillary central incisors such as in class II division 2 malocclusion.
- For anterior intrusion and retraction
- Can be used during retraction or at finishing. Ricketts utility arch is made from non-heat-treated 0.016 × 0.016 in. blue elgiloy wire.

➢ BURSTONE INTRUSION ARCH[1,9]

Charles J Burstone recommended intrusion arch prepared from 0.017 × 0.025 in. TMA wire to generate consistently low forces for a longer duration for the effective intrusion. It is desirable that the forces be generated by a spring mechanism with a low load-deflection ratio in a determinate force system. Therefore, Burstone suggested that intrusive segment of the archwire not be seated in the bracket system rather it is tied to an anterior segment in a piggyback fashion. The use of wires made from alloys that have high memory and low loaddeflection rates, produce small increments of deactivation over time and thus reduce the number of reactivation appointments.

➢ CONTINOUS INTRUSION ARCH[9]

Burstone intrusion arch when activated causes extrusion of the buccal segment and intrusion of the anterior segment. Extrusion of the molars is caused by the moment, which is generated in the opposite direction to the intrusive force. The extrusive force magnitude on molars is same as that of intrusion force. In frontal view, the extrusive force is delivered buccal to the centre of resistance of the maxillary molars which creates a moment that can increase the maxillary arch width. Extrusive forces are in part counteracted by the forces of occlusion generated during chewing.

Several modifications in this mechanism have been proposed to maximise anterior intrusion and minimise the extrusion of the molars and unfavourable effects on molar arch width. These are:

1. Increasing the size of the buccal segment by splinting the buccal segment in the sectional arch.

2. Keeping the intrusive force on the anterior segment as low as possible.

3. Counteracting the extrusive force on the buccal segment. A high-pull headgear (which is actually not required when forces are kept low except in high angle cases where anchorage control is difficult) can be used. Vertical molar control can be attained with enhanced anchorage supported with mini screw implant, thus eliminating a need for extraoral anchorage.

4. A passive trans-palatal arch is used to maintain inter-molar distance or counteract the contraction forces on the arch width.

It is not clear that what amount of force is considered optimal for the effective intrusion of the anterior segment. Commonly, 10–20 g of force/tooth is advocated for maxillary anterior intrusion.[12,13]

➢ THREE-PIECE INTRUSION ARCH[9,14]

Three-piece base arch[14] is useful in those clinical situations where a continuous type of intrusion arch is contraindicated. When incisors are undue flared, the application of intrusive force at the brackets tends to further worsen their axial inclinations by producing a large counter clockwise moment. The three-piece utility arch is advantageous, for it shifts the point of application of force more distal, close to the lateral incisors which are the anticipated centre of resistance of the group of teeth.

The three-piece intrusion arch consists of the following parts:

- The posterior-anchorage unit
- The anterior segment with a posterior extension
- The intrusion cantilevers
- A power chain/elastic

➢ CONNECTICUT INTRUSION ARCH (CTA)[9,15]

CTA was developed at Dental School, University of Connecticut and introduced as preformed nickel–titanium wires in 1998. The CTA was essentially designed for the intrusion of anterior teeth.

It can also be utilised to perform other functions with suitable modifications:

- Molar tip back for enhanced anchorage and class II correction
- For incisor flaring (Class II Div 2 cases)
- Correction of minor open bite
- Levelling of anterior occlusal cants

The CTA is available as preformed arch made of 0.016 × 0.022 in. and 0.017 × 0.025 in. separately for maxillary and mandibular arches with anterior segment length of 34 mm and 28 mm. The arches are made from NiTi alloy nickel free β III CNA, which is considered a material of choice for the properties of delivering light, continuous forces under large activations, high memory and low-load-deflection rate. CTA arches are expected to deliver a force of 40–60 g apically along the centre of resistance to perform anterior intrusion.

The force is generated by activating the V bend, which is placed mesial to the first molars. The incisors should have a point contact with the intrusion arch for effective intrusion without flaring. The arch is passively cinched back to prevent incisor flaring. Transpalatal arches are recommended to maintain arch width and enhance molar anchorage.

➢ INTRUSION WITH ANCHORAGE DERIVED FROM MINISCREW[9]

Intrusion with an application of force directly on incisors from mini screws is effective in the successful intrusion of maxillary incisors. It can be accomplished by application of light continuous force generated from superelastic NiTi closed coil springs that can generate intrusion force of 80 g. Two mini screws of usually 1.2 mm in diameter and 6 mm in length are placed distal to the maxillary lateral incisors at the mucogingival junction. Polat-Ozsoy et al.[16] have reported a true intrusion of upper incisors with a clinically acceptable change in the axial inclination of the upper incisors.

Anterior space closure in a continuous wire mechanism can be achieved where retraction forces are generated from mini screws, which are placed in the buccal vestibules. Force vectors are designed to enhance anterior intrusion while anterior retraction is in progress. This method has been found useful in greater vertical control over conventional methods like J-hook headgear.[17]

CONCLUSION

Intrusion is the tooth movement that occurs in apical direction and whose center of rotation lies at infinity. It is a common orthodontic treatment approach employed for managing orthodontic esthetic and functional problems, including gummy smile, open bite and deep bite.

Different types of intrusion arches can be used for intrusion of anterior teeth in patients with gummy smile and deep bite and for intrusion of molars in case of open bite. For many years,

dental intrusion was considered impossible or problematic and was associated with numerous side-effects from the periodontium and cementum (root resorption). However, in recent years successful orthodontic intrusion is clinically documented and is considered a safe procedure, provided that the magnitude and direction of forces are carefully monitored.

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