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A Short Review of Intrusion Arches in Orthodontics

Mini Review

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Author Details

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Abstract

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. This review includes the types of dental intrusion, the biomechanics of intrusion in orthodontic treatment and various methods for achieving successful orthodontic intrusion without causing any detrimental effects to tooth.

Keywords: Deep bite; Intrusion; Open bite

Introduction

Intrusion is one of the most difficult tooth movement and has always been a challenge to orthodontist. Charles J. Burstone defined intrusion as "Apical movement of the geometric center of the root with respect to the occlusal plane or a plane based on the long axis of the tooth" [1] while Marcotte has defined it as "tooth movement that occurs in an axial (apical) direction and whose center of rotation lies at infinity. It is an axial type of translation" [2]. Likewise, Nikolai has defined intrusion as "A translational type of the tooth development guided apically and parallel to the long hub" [3]. One of the major challenges while treating Class II malocclusion is the correction of deep overbite. It can be accomplished in various ways which includes extrusion of posterior teeth or intrusion of anterior teeth or a combination of both.

Types of Intrusion [4]:

True intrusion: It is achieved by moving the root apices of the anterior teeth closer to the bony base.

Relative intrusion: It is achieved by preventing eruption of anterior teeth while the mandible grows and the posterior teeth erupt.

Apparent intrusion: It is achieved by extrusion of the posterior teeth which causes the mandible to rotate down and back in the absence of growth.

Biomechanics of Intrusion Arches [5]:

To obtain true intrusion, an intrusive force should be directed through the center of resistance of anterior teeth. So, the point of force application is very critical. Normally, intrusive force is applied to the labial surface of anterior teeth which produces a moment that tends to flare the crowns forward and move root lingually. Therefore, it is important to tie the intrusive arch back so as to prevent the incisors from flaring.

In cases with markedly proclined incisors, an intrusive force will create a large moment. So, in such cases, incisors should be retracted first to improve their axial inclination before initiating the intrusive mechanics.

Force for Intrusion:

Since the intrusive force is concentrated over a small area at the apex, extremely light forces are needed to produce appropriate pressure within the periodontal ligament during intrusion.

Burstone, suggested 50 grams of intrusive force for upper central incisors, 100 grams for central and laterals and 200 grams for six upper anteriors. He advocated use of 40 grams for four lower incisors and 160 grams for all six lower anteriors [6]. Proffit has suggested 10-20 grams of force for intrusion.4

Various Intrusion Arches:

The following intrusion arches are reviewed in this discussion:

1. Utility Arch
2. Continuous Intrusion Arch

3. Three - Piece Intrusion Arch
4. Burstone Intrusion Spring
5. K – SIR appliance
6. Connecticut Intrusion Arch
7. Intrusion Arch of Quiros
8. Lingual Arch

Utility Arch [7]: It was designed by Robert M. Ricketts. It consists of continuos wire that extends across both the buccal segments, but engages only the first permanent molars and four incisors. Utility curves are created from chrome-cobalt wire (eg. Blue elgiloy wire). With 0.018” slots, the proper size of wire for mandibular curve is either 0.016” x 0.022” or 0.016” x 0.016” wire and for maxillary curve 0.016”x 0.022” wire is prescribed. For 0.022” slots, 0.019”x 0.019” wire can be utilized in either curve.

Fundamental segments of utility arch:

A. Molar segment
B. Posterior vertical segment
C. Vestibular segment
D. Anterior vertical segment
E. Incisal segment (Figure 1).

Figure 1: Segments of utility arch.

It is activated by placing a tip back bend in the molar segment or by placing an occlusally directed gable bend in the posterior aspect of the vestibular segment (Figure 2).

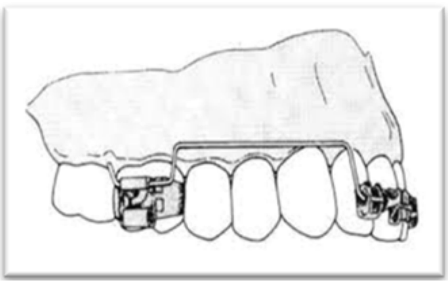

Figure 2: Utility Arch.

Continuous intrusion arch [1]: It was designed by Charles J. Burstone. Posterior teeth are joined together by a heavy wire, 0.017” x 0.025” stainless steel wire. Intrusive arch consists of TMA wire of 0.016” x 0.022” or 0.017” x 0.025” dimension. A step down bend is placed mesial to molar tube to the canine bracket. For activation, the intrusive spring is tied to the wings of brackets of incisors (Figure 3).

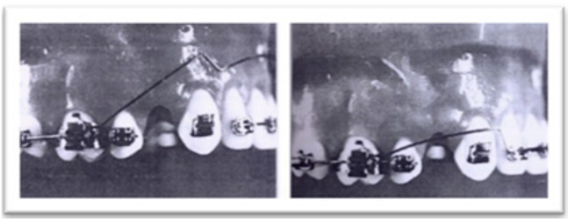

Figure 3: Continuous Intrusion Arch.

Three – piece intrusion arch [8]: It was designed by Charles J. Burstone. In this design, posterior segment are joined together by a heavy wire, 0.017” x 0.025” stainless steel wire. Anterior segment is also joined with a heavy wire, 0.021” x 0.025” stainless steel wire. Anterior segment has got distal part which extends to distal end of canine bracket where it forms a hook. This design also consists of cantilever or intrusion spring made from 0.017” x 0.025” TMA wire which is bent gingivally mesial to molar tube and a helix is formed. On the mesial end of the cantilever, a hook is formed which is engaged to the hook of anterior segment through which the intrusive force is applied on the anterior segment. Cantilever is activated by making a bend mesial to the helix at molar tube and then cinched back (Figure 4).

Figure 4: Three – Piece Intrusion Arch.

Burstone intrusion spring [1]: It was designed by Charles J. Burstone. The upper and lower arches have to be levelled and aligned and a rigid stainless steel wire of 0.017” x 0.025” dimension is engaged. Intrusion springs are made from 0.017” x 0.025” TMA wire without helix or 0.017” x 0.025” stainless steel wire with a helix. Wire is bend gingivally mesial to the molar tube and a helix is formed. For activation, the mesial end of the spring is bend into a hook and is engaged distal to lateral incisor (Figure 5).

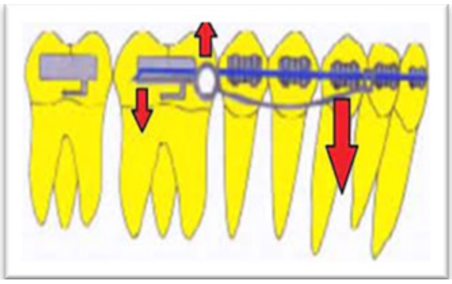

Figure 5: Intrusion Spring.

K – SIR appliance [9]: It was designed by Varun Karla. It is a modification of the segmented loop mechanics and brings about simultaneous retraction and intrusion of anterior teeth. It is a continuous 0.019” x 0.025” TMA arch wire with closed 7mm x 2mm U-loop at the extraction site. To obtain bodily movement and prevent tipping of teeth into the extraction space a 90° V bend is placed in the arch wire at the level of U-loop. This V-bend, when centered between the 1st molar and the canine during space closure, produces two equal and opposite moments to counter the moments caused by activation force of closing loop. An off centered 60° V-bend located posterior to the inter-bracket distance produces an increased posterior clockwise moment on the 1st molar which augments molar anchorage as well as intrusion of anterior teeth (Figure 6).

Connecticut intrusion arch [10]: It was designed by Ravindra Nanda, Robert Marzban and Andrew Kuhlberg. It is fabricated from a nickel titanium alloy with wire size of 0.016” x 0.022” or 0.017” x 0.025”. The basic mechanism for force delivery is a V bend that lies just anterior to molar brackets. In most of the cases, the Connecticut intrusion arch is not placed in the slots of the anterior braces. In the anterior segment, a sectional rectangular archwire is placed in the slots from one lateral incisor to other. Over this wire the anterior segment of connecticut intrusion arch is ligated for activation (Figure 7).

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Figure 6: K – SIR Appliance.

Figure 7: Connecticut Intrusion Arch.

Intrusion arch of quiros [11]: It was designed by Oscar Quiros. It is fabricated with 0.017” x 0.025” stainless steel wire or 0.016” x 0.022” TMA wire. The arch is made with anterior segment placed more gingivally than posterior segment which will make the intrusion of anterior teeth possible. The difference in level of anterior and posterior segment will be established by the amount of intrusion needed. Due to its design it acts like a very elastic spring that will physiologically intrude the anterior teeth (Figure 8).

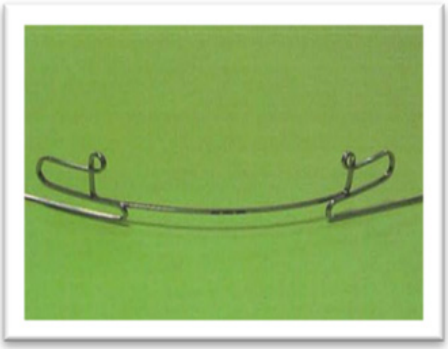

Figure 8: Intrusion Arch of Quiros.

Lingual arch [12]: It was designed by Winston Senior. It is fabricated with 0.036” stainless steel wire. Lower lingual arch is soldered to first molar bands. Four elastic chains are attached to the anterior bridge of lingual arch. After cementation of the arch, the elastics are stretched to four lingual buttons on lower incisors. These buttons should be bonded as far as possible from the gingival margin to facilitate intrusion (Figure 9).

Figure 9: Lingual arch for intrusion.

Conclusion

Understanding the basic biomechanical principles involved in producing controlled tooth movement enables to achieve successful orthodontic treatment outcomes which are more predictable and consistent. Multiple arch wire designs and different alloys of various dimensions are the variable factors which can result in the appliance delivering intraoral force of varying magnitude. The choice of appliances and techniques used by practitioners differs among individuals. However, the fundamental forces and moments they produce are universal.

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