

## Recent Ways for Incisor Intrusion during Orthodontic Treatment

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**Citation:** Maher Al-balaa, Hua Xianming (2019) Recent Ways for Incisor Intrusion during Orthodontic Treatment. J Dent Oral Care Med 5(2): 202

**Received Date:** September 10, 2019 **Accepted Date:** December 17, 2019 **Published Date:** December 19, 2019

### Abstract

Deep overbite has been an enigmatic puzzle in orthodontics, the nature of this malocclusion to relapse has been of great concern to the clinician. The deep bite in the permanent dentition may be caused by inherent factors or factors acquired during the life of that dentition. This paper provides an overview and information for approaching the ways of intrusion. In addition to also comparing the efficiency of incisor intrusion in conventional methods to recent methods.

**Keywords:** Deep Overbite; Intrusion; Conventional Methods; Recent Methods

### Introduction

The mandible growth has been influenced by the development of deep overbite which has led to more than 40 years of investigations [1]. Deep overbite is defined as an excessive amount of overlap of the lower incisors by the upper incisors in centric occlusion [2].

Normal overbite exists when the incisal edge of the mandibular incisors contacts slightly or above the cingulum of the maxillary incisors, which is approximately 1-3mm or one third of the clinical crown of the mandibular incisors [2].

Deep overbite is the most common malocclusion in children and adults [3]. According to a study conducted by Proffit and Fields (2007), "overbite that is more than 5 mm is found in nearly 20% of children and 13% of adults" [4]. Correction of deep overbite in class two treatments is a huge challenge whose amount of intrusion, varies from patient to patient [5]. The treatment plan depends on many factors such as smile line, incisor display, and vertical dimension [6]. In orthodontics treatment, various methods have been provided for deep overbite correction however, any treatment must be carefully specified for each patient, based on the factors that cause malocclusion as well as an analysis of the most effective treatment method.

Preventing a corrected deep overbite from relapse is one of the most important challenges for orthodontists. When no accurate identification of the etiologic factors is performed, treatment relapse is common.

The skeletal and dental patterns of deep overbite have been investigated in several studies. One of the studies about the morphology in deep and open bite patients conducted by Trouten *et al*, revealed that deep overbite was associated with decreased gonial angle, deep curve of spee, decreased posterior maxillary dimension, downward rotation of the palatal plane, in addition to forward positioning of the ramus [7].

The incisors intrusion of a deep overbite is an important stage during orthodontic treatment and is ideal in cases of gummy smile, deep mandibular curve of Spee associated with a long lower facial height and the lip length may be relatively short in relation to the vertical dimension it is not desirable to increase the vertical dimension by extrusion of the posterior teeth, because the incisors intrusion can maintain the vertical dimension. However Non-surgical correction of deep overbite focuses on intrusion of anterior teeth, extrusion of posterior teeth or both [5,8-10].

The aim of this overview is to provide information for approaching the ways of intrusion. In addition, we also compare the efficiency of incisor intrusion in conventional methods to recent methods.

## Treatment option

Incisor intrusion usually involves appliances such as:

### A. Conventional ways

1. Utility arches [11].
2. Three-piece base intrusion arches [12].
3. Reverse curved arches [13].

Conventional methods usually involves labial tipping of the anterior teeth and extrusion of posterior teeth, which result into these arches [8,9,13]

### B. Advanced ways

1. Mini-screws implant anchorage [14]
2. Clear aligner technology (Invisalign appliance Santa Clara, Calif) [15].

## Utility Arch

Dr Ricketts [16] who first described the utility arch as a way to intrude teeth. Ricketts method of overbite correction primarily used a Utility arch constructed from 0.016 x 0.016-inch, square-edged, non-heat treated blue Elgiloy wire for better control for axial inclination of the incisors while intrusion [17] (Figure 1). Recommends its use with conventional mechanics treatments, to avoid the negative effects from the use of reverse curve arch that extends treatment period. This is because it's a multi-sectional appliance that works independently and simultaneously on the molars and the incisor sector. This procedure is effectively levels deep curves, obtaining incisor intrusion in brief periods without negative effects. The utility arch works in three sectors at the same time so any activation that happens, will have action and reaction effects, which must be neutralized in order to obtain only the movement we want [18].

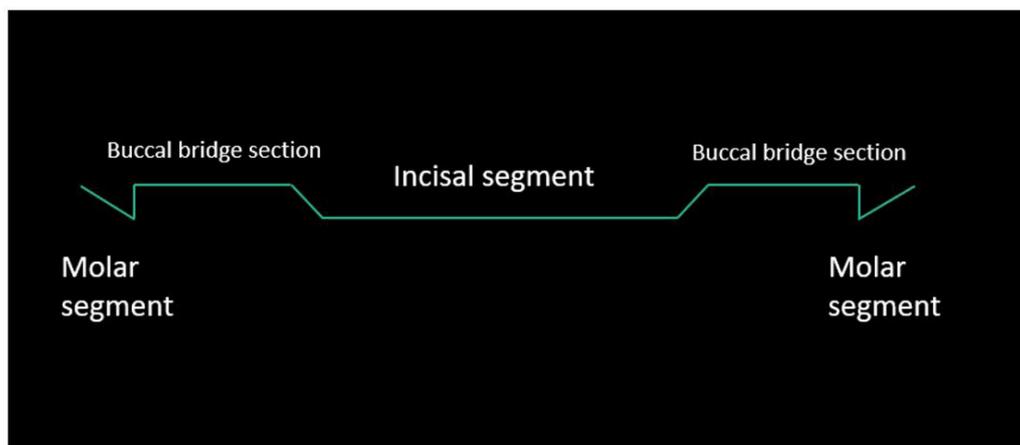
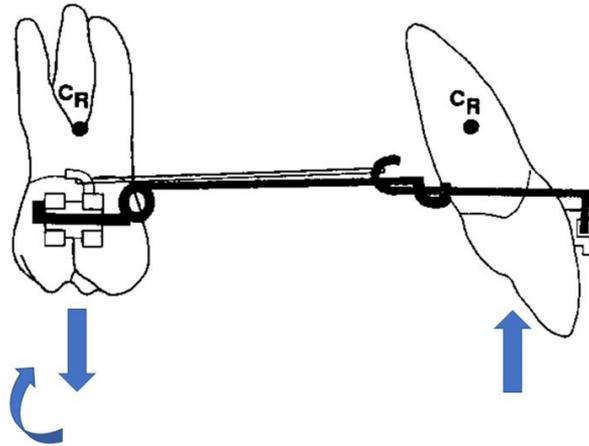


Figure 1: Parts of the utility arch

The utility arch is effective according to Dave and Sinclair [17] for overbite correction, minimally increasing mandibular plane angle and anterior facial height. Mandibular incisors show more flaring and anterior bodily movement. More than 1mm of mandibular incisors intrusion was noted, maxillary incisors extrusion by 0.8mm was noted, 2.5 mm of maxillary molar extrusion was also noted. Another study done by McFadden *et al* [19], shows that incisor intrusion is effective using the Utility arch, while it was discovered that a significant root shortened during the treatment using a low force (25g). The treatment time was significantly related to the amount of root shortening observed for both the maxillary and mandibular incisors. This tells us that the time period is related to a root shortening however, the sample size in this study was short. Gordon [20] and Otto [21] measured the effectiveness of Rickett's method of intrusion cephalometrically and found it to be valid. The patient's facial type appeared to have no significant influence upon the amount of intrusion seen; overbite reduction was due to more than intrusion alone. Another studies show that utility arch causes intrusion and possible torquing of the incisors as well as tipping back, of the molars [22-24].

## Three-Piece base Intrusion Arch

It is the modification of Burrstone intrusive arch that designed to produce pure intrusion with maximum control of the molar extrusion by controlling the intrusive force, specific attachment of the intrusive arch to the anterior segmented arch instead of engaging to the anterior brackets. A heavy rectangular stainless steel (about 0.018x0.025" or larger) arch-wire is attached to the anterior brackets, 2-3mm between the distal extensions and center of resistance of the anterior teeth. An intrusive force is applied with 0.017x0.025" TMA tip back springs (Figure 2) [25]. Distal light force delivered by Class1 elastic to the anterior segment is used to alter the direction of the intrusive force on the anterior segment. Three-piece base arch has simultaneous control of tooth movement in the vertical and sagittal planes, with a low load, and low force [26].

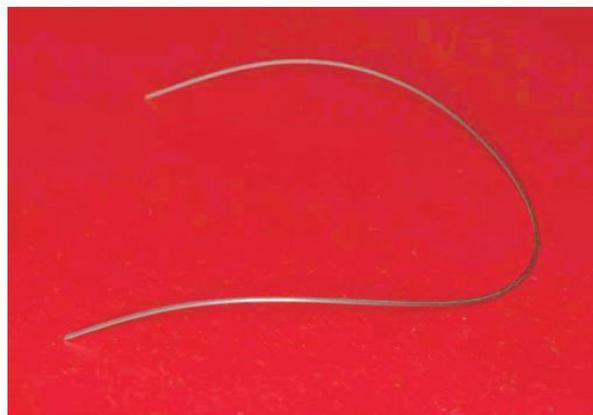


**Figure 2:** Diagrammatic representation of 3piece base Intrusion arch. Anterior segment extends 2 to 3 mm Distal to the center of resistance (CR) of anterior teeth. Force acts through center of resistance

True intrusion without axial inclination change is obtained by directing the intrusive force through the center of resistance of the anterior teeth. Since displacement of the intrusive force away from the center of resistance will result in either flaring or up righting of the incisors, careful evaluation is necessary to monitor the axial inclination of the anterior teeth during intrusion. Optimal magnitudes of force 150g is recommended for intrusion of four incisors [27,28]. Low forces are used during intrusion to minimize root resorption and decrease side effects on the reactive unit. It has been documented that the use of heavier forces will not increase the rate of intrusion [29-31]. Shroff *et al.* [32] observed that loss of anchorage rarely happens because of the tip-back moment on the posterior teeth. Another study done by the same author shows that, genuine intrusion may not always be predictably achieved in Utility arch. In contrary, the use of three-piece intrusion arch can be predictable [32].

### Reverse curved arch

The reverse curve of Spee is an arch that has been used in orthodontics for Spee curve leveling in deep bite patients (Figure 3). It mainly causes extrusion of the posterior teeth. However, there may be undesirable changes in the axial inclinations of the buccal teeth and flaring of the incisors the force system cannot control by the operator [33,34].



**Figure 3:** Reverse curve of Spee rectangular wire for upper arch

Ricketts [16] recommends that to avoid the negative effects from the use of reverse curve arch, the treatment period extended, should use the Utility arch. AlQabandi *et al.* [33] evaluate in their study the effect of the reverse curve of Spee in rectangular and round wire, no significant differences between the two wires. However, lower incisor proclination occurred by uncontrolled tipping around a center of rotation slightly apical to the center of resistance. Lower incisor proclination was significantly correlated with reduction in intercanine width and reduction of crowding. While only 41% of the variability of lower incisor proclination could be accounted for by the variables used in this study.

### Mini-Screw Implant Anchorage

Mini-screws have a successful rate in clinical orthodontics [35]. Advantages include immediate loading, different placement sites, relatively simple placement and removal, placement in interdental areas where traditional implants cannot be placed and less expenses for patients [36].

For anterior intrusion they placed a surgical vitallium bone screw just below the anteriornasal spine and used elastic thread to elevate the maxillary central incisors approximately 6 mm and tip them labially 25° [37]. Moreover, two mini screws, 1.2 mm in

diameter and 6 mm in length, were placed distal to the maxillary lateral incisors (Figure 4), the screws were loaded with medium super elastic NiTi closed coil springs and an intrusion force of 80 g [38].

The studies show that mini-screw implants' anchor can be loaded with forces of up to 500 g and yet stay intact until the end of the treatment [39]. Previously, two case reports have been published showing that mini-screw implant anchorage supported incisor intrusion [40,41]. Further more, in a clinical study that incorporated the records of some patients in this study, it was shown that true incisor intrusion can be achieved with simple mechanics via mini-screws with only minimal protrusion of the anterior teeth [42].

Polat-Ozsoy *et al.* [38] found that True intrusion of upper incisors can be achieved using mini screw anchorage. During the application of intrusive force, the axial inclination of the upper incisors showed minimal change, which was considered to be clinically acceptable, root resorption, was not seen as a consequence of incisor intrusion.

Aydogdu and Ozosy [43] observed that, the incisor intrusion that was achieved using TAD-supported segmented arch wire was no different than the movement achieved by the conventional intrusion utility arch.

However, studies with a large number of samples and long-term follow ups are needed in comparative clinical studies on the effects of mini-screw supported incisor intrusion and conventional ways (Figure 4).

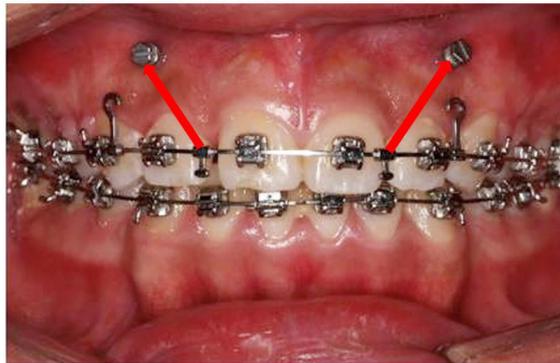


Figure 4: Application of mini-screws distally in maxillary lateral incisors

### Clear Aligner Technology (Invisalign)

The Invisalign appliance designed by 'Align Technology, Santa Clara, Calif', is a series of computer designed clear plastic which fit closely over the labial, lingual (palatal), and occlusal surface of the teeth (Figure 5) [44]. Incrementally moving to their respective correct position. Patients need to wear each aligner for at least 20 hours daily with a routine two-week change. Each aligner is designed to move a tooth or small group of teeth about 0.25-0.3mm [45,46]. Orthodontic treatment with the Invisalign appliance is more esthetically appealing to some patients when compared with conventional fixed appliances, because of that the demand for this treatment method is increasing [47]. The Invisalign technique has long been used to treat mild to moderate orthodontic cases [48,49]. Recently, it has been used successfully in more complex cases [50,51] (Figure 5).



Figure 5: Aligner appliance for upper and lower teeth

17 years and counting, the strategies have been developed to better manage the overbite. For example, an early strategy to prevent bite deepening was the removal of occlusal coverage on the 2nd molars. Align Technology recently developed new treatment options including special designing of attachments and virtual bite ramps. Attachments are composite buttons attached to the buccal surfaces of the teeth, and they come in different shapes to assist the tooth movement. Specifically, these attachments increase retention, transmit desirable force to the teeth and support auxiliary functions such as placement of elastics [52]. Feasible bite ramps function similar to bite plates or bite turbos. These bite ramps incorporated into the maxillary aligner, contact with the mandibular incisors to dis-contact the posterior teeth. For anterior intrusion cases, the G5 pressure areas are placed on any incisor requiring intrusion incisors automatically.

Optimized anchorage attachments on pre-molars are also placed automatically these attachments provide anchorage to support incisors intrusion. However, deep overbite correction via anterior intrusion only, precision bite ramps are not needed Dr. L.Joffe [47] mentions in his study that the overbite can be reduced by intrusion of the incisor. Other studies show that the clear aligner effectively controls anterior intrusion however, the risk of bias was moderate for six studies and unclear for others [53]. Khosravi *et al* (2017) [54] observed in their study that deep overbite has been reduced by intrusion of maxillary incisors and proclination of mandibular incisors. However, clear aligner appliance evidence supporting the effectiveness of these treatment modalities is limited to case reports and case series. Studies with larger samples and better designs are required to understand the mechanism by which the clear aligner appliance manages the vertical dimension [55].

## Conclusion

A successful correction of deep overbite requires a clinical examination thorough cephalometric analysis, in addition to a complementary diagnosis, treatment plan among the various available options as well as the use of appropriate mechanotherapy followed by a proper retention protocol. During the treatment planning, considerations should be given to the soft tissue, skeletal pattern, stability, occlusal plane, interocclusal space, treatment time and age of the patient. In adults, deep overbite can be corrected by many ways like intrusion of incisors, extrusion of posteriors, combination of incisors intrusion and posterior extrusion, proclination of incisors or even surgically. However, it should be decided which method will be more beneficial or help improve the patient's facial appearance and functional efficiency.

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