

Utility Arches In Orthodontics: A Review

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ABSTRACT

Background: Burstone C.J in 1977 developed the utility arch to align the curve of Spee in the mandible utilizing biomechanical principles. The utility arch is a crucial and versatile tool that assists in both interceptive and comprehensive orthodontic treatments. It can be used during different stages of orthodontic treatment, whether it is in mixed or permanent dentition. The utility arch was further adapted and refined by Ricketts and became an essential key component of Bioprogressive Therapy, a modern orthodontic treatment approach. The utility arch is particularly useful for intruding upper and lower incisors, as well as protruding and retruding anterior teeth. Ricketts utility arch is a appliance wire that is advantageous in effective control over the incisors and molars axial inclination along with effectual correction of deep bite, and anterior crossbite. It stabilizes teeth passively during mixed dentition. This review article focus on the different utility arches and there implementation in orthodontic treatment.

Keywords: Utility arch, Intrusion arch, Retrusion arch, Protrusion arch.

INTRODUCTION

The utility arch is an auxiliary arch wire that has been developed according to the biomechanical principles described by C.J. Burstone.^[1] It was later refined for incorporation into Bioprogressive therapy by Ricketts. Initially, it was developed to provide a method of leveling the curve of Spee in the mandible, but it has been adapted to perform functions beyond just lower incisor intrusion.^[2] It serves several purposes at different stages of orthodontic treatment. The utility arch is although a complete arch that extends across both buccal segments yet engages only the first molars and the 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. When using utility arches in combination with full arch appliances, it is necessary to have auxiliary tubes in a gingival position on the first molar bands.^[3] In a pre-orthopedic phase of treatment when the buccal segments are not banded, the main buccal tube or bracket on the first molar can be used to anchor the utility arch posteriorly. With the advent of TMA wires by Charles Burstone in 1981, properties like high spring back and high formability with low stiffness which yields large deflections for low forces came into play. Thus, utility arches are now fabricated with TMA wires.^[4]

Types of utility arches and their biomechanics:

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Ricketts utility arch (RUA):

It is also known as base arch, has been described as a resource to promote the intrusion of incisors in correcting overbite, mainly in the Bioprogressive technique. RUA effectiveness in obtaining real incisor intrusion has been confirmed.^[5] There have been reports, however, that intrusion is but one contributing factor among others, such as incisor proclination and molar extrusion, which occur during overbite correction using RUA. RUAs are usually made out of blue temper chromium-cobalt alloy (Elgiloy®), whose properties resemble those of steel, but with increased formability. Elgiloy composition comprises 40% cobalt, 20% chromium, 15% nickel, 15.8% iron, 7% molybdenum, 2% manganese, 0.16% carbon and 0.04% beryllium.^[6] After RUA fabrication heat treatment is not recommended as it would lead to increased force generation by the arch. RUAs are double binary intrusion arches featuring a greater moment in molars due to a caudal angle, and another moment in the anterior region, caused by lingual torque in the incisors. Given that the moments occur in the same direction, balance forces are summed. However, if anterior torque is applied buccally, moment will be created in opposition to the molar. Therefore, since molar and incisor moments will be in opposite directions, intrusion force will be diminished in the anterior region. If anterior buccal torque moment is greater than molar moment, incisors may undergo extrusion.^[7]

Passive Utility Arch:^[8]

As the name suggests, it is not meant to move the teeth in any direction and is not activated during treatment. The passive utility arch is used for stabilization or space holding. It is particularly useful during the mixed dentition phase as it allows the canines and premolars to erupt properly. It originates in the auxiliary tube on the first molar and immediately a 90° bend is placed anterior to the tube, followed by a posterior vertical step. An additional bend at a right angle forms a horizontal segment that runs parallel to the occlusal plane. A bend at the embrasure between the canine and the lateral incisor redirects the wire upward toward the occlusal surface. For the incisal segment, the wire is bent at a final 90° angle and positioned in the brackets of the upper anterior teeth. Any irregularities in the position of the upper anterior

teeth are usually corrected with a sectional leveling arch before a utility arch is placed. The archwire is continued similarly to the opposite molar. **(Fig.1)**

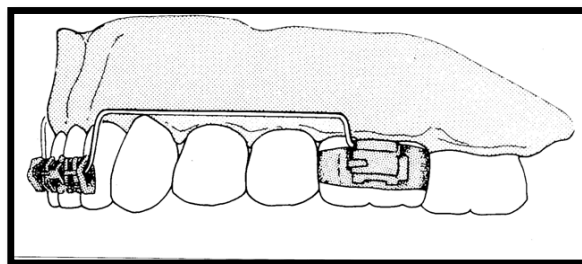


Fig. 1: passive utility arch with posterior vertical step fitting snugly against auxiliary tube on lower first molar

Intrusion Utility Arch:^[9]

The intrusion utility arch has a similar design to that of the passive arch, but it is activated to intrude the lower anterior teeth. A light continuous force is delivered post-activation. As with the passive arch, the intrusion arch is stepped down at the molars, passes through the buccal vestibule, and is stepped up at the incisors to avoid distortion from occlusal forces. Engaging the utility arch produces approximately 25g of force on each of the lower incisors; a force level considered ideal for lower incisor intrusion. The overall effect is an intrusion and torquing of the lower incisors, as well as a tipping back of the lower molars. Molar rotation and expansion or contraction of molar width can be achieved by activating the molar section of the arch. **(Fig.2)**

There is a slight retrusive activation of the arch by pulling the wire posteriorly and then twisting the end of the arch gingivally. Any type of utility arch can be activated for an intrusive movement by placing an occlusally directed gable bend in the vestibular segment.

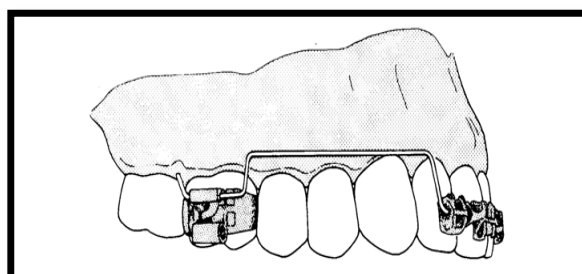


Fig. 2: Intrusion utility arch with posterior vertical step 5-8 mm anterior to auxiliary tube on upper first molar, allowing slight retrusive activation

Types of intrusion:^[9]

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

Relative intrusion: It is achieved by keeping the incisors where they are, while the mandible grows and the posterior teeth erupt.

Apparent intrusion: It is achieved by extrusion of the posterior teeth

Indication of intrusion in orthodontics:^[10,11]

- Intrusion of Anterior Teeth in Gummy Smile
- Deep Bite and Reduced Lower Facial Height
- Deep Bite and Increased Lower Facial Height
- Intrusion of Periodontally Involved Teeth
- The intrusion of Posterior Teeth.

Biomechanics Of Intrusion:

True intrusion is obtained when an intrusive force is directed through the center of resistance of the anterior teeth. Unfortunately this is difficult to accomplish; spatial relationship between center of resistance (CR) and point of force application (P.F.A) varies depending on labiolingual inclination of upper incisors intrusive force is normally applied to the labial surface of the incisors. This produces a moment which tends to flare the crowns forward and move the roots lingually. In cases where incisors are markedly proclined, an intrusive force creates a large moment. In these cases incisors should be retracted first to improve their axial inclination before intrusive mechanics are initiated. Thus the key to successful intrusion is light continuous force, which is directed towards the root apex of incisors.^[12] (Fig.5 & Fig.6)

Optimal Force For Intrusion:

Loading diagram of intrusive force is concentrated over a small area at the apex. For this reason extremely light forces are needed to produce appropriate pressure within the periodontal

ligament during intrusion. An optimal force is one that produces a rapid rate of tooth movements, without discomfort to the patient or any tissue damage. Optimal force range for intrusion has been a long time controversy. ^[12] Burstone(1977) 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.^[13]

Designs of intrusion arches:

There are two basic designs for an intrusion arch:

1. Continuous arch
2. Segmental intrusion arch

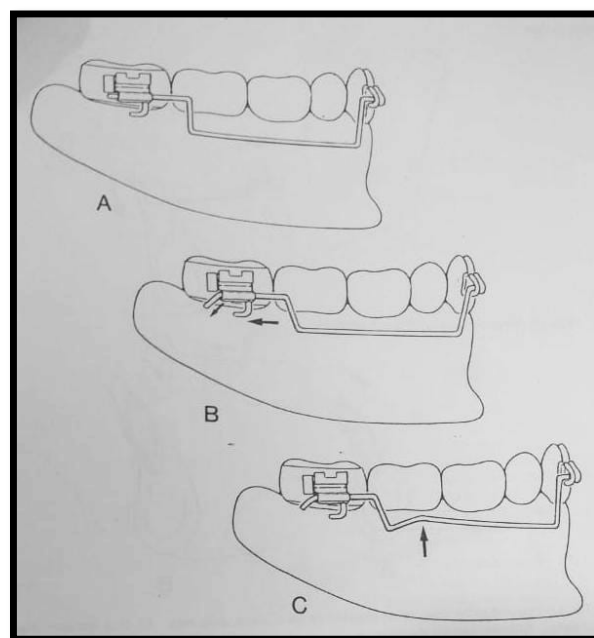


Fig. 5 Intrusion utility arch. A) The intrusion utility arch first is bent passively to the existing occlusion. Note that the posterior vertical segment lies at least 5 mm ahead of the auxiliary tube on the lower first molar. B) Retraction of lower incisors can be produced by grasping the distal end of the molar segment with a pair of Weingart pliers, pulling the segment posteriorly, and then turning the segment gingivally. C) Intrusive forces can be produced by using a loop-forming plier to place an occlusally-directed gable bend in the posterior aspect of the vestibular segment.

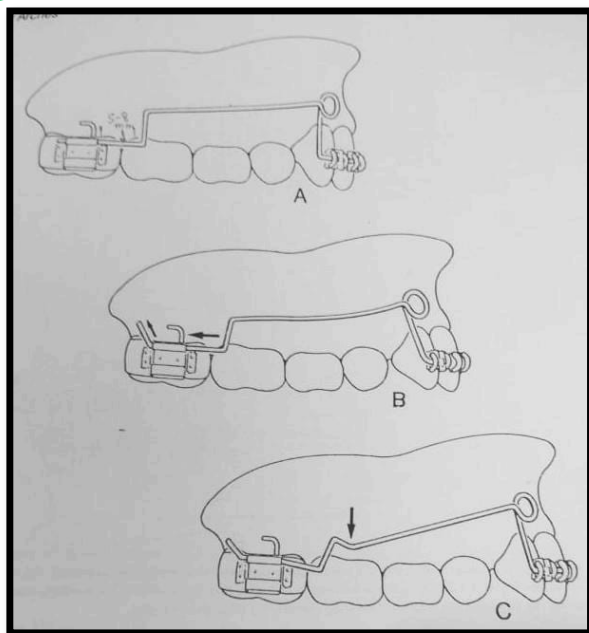


Fig.6 Sagittal view of maxillary retraction utility arch. A) Before activation. B) Retraction of the molar segment of the archwire. C) An occlusally-directed gable bend has been placed in the vestibular segment of the archwire to produce incisor intrusion. this point, a 90° bend is placed with a 142 arch-bending plier.

Retraction Utility Arch: [14]

Its utilization in retracting and intruding incisors is obvious in cases of upper incisor flaring. However, this type of mechanics helps retract the four anterior teeth as a unit, particularly in the maxilla. The retraction utility arch can close interproximal spaces while intruding and aligning the upper anterior teeth and correcting midline discrepancies. **(Fig. 3)** The retraction utility arch starts from the auxiliary tube on the molar, and about 5-8mm of wire protrudes forward before a posterior vertical step of 3-4mm is placed. The vestibular segment extends forward to the interproximal region between the lateral incisor and the canine. Here, a 90° bend is placed, and a loop is formed in which the anterior leg crosses behind the posterior leg. After a 5-8mm vertical step forward, another right-angle bend carries the wire across the front teeth. An anterior contour in the wire is made to simulate the arch form. [15]

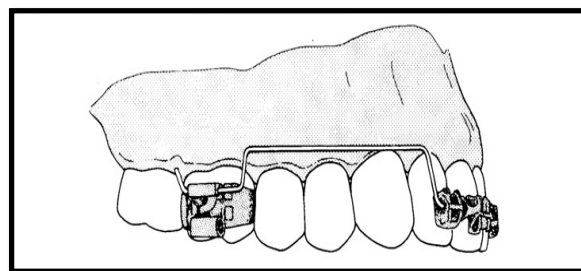


Fig. 3: Retraction utility arch. The loop anterior to the anterior vertical step is activated while the molar segment is retracted.

Protraction Utility Arch:

The protraction utility arch can be used to procline and intrude maxillary and mandibular incisors. In the permanent dentition, this type of archwire commonly is used for proclining and intruding maxillary incisors in class II division 2 patients, especially in those with an impinging overbite. This arch wire is used to provide clearance between the maxillary and mandibular incisors to allow for placement of brackets on the mandibular dental arch. The protraction utility arch also is used during the presurgical orthodontic phase of treatment to decompensate the position of the maxillary incisors in patients undergoing a mandibular advancement. [16,17]

Utilized for proclining upper and lower incisors, particularly for flaring and intruding maxillary incisors in Class II malocclusion cases. In contrast to the retraction utility arch, the posterior vertical step of the protrusion arch must be flush with the auxiliary tube. The vestibular segment traverses anteriorly to the interproximal region between the canine and lateral incisor. The anterior leg of the loop is positioned mesially, thus providing a canine offset.[18]The protrusive force is produced by tying the anterior segment of the utility arch into the anterior brackets. An occlusal-directed gable bend in the vestibular segment is used for intrusion. The anterior vertical step is 5-8mm long, the incisal segment runs through the incisor brackets. **(Fig 4)**

When the protrusion utility arch is passive, the anterior segment lies approximately 2mm anterior to the expected position in the incisor brackets. The protrusive force is produced by tying the anterior segment of the utility arch into the anterior brackets. An occlusally directed gable bend in the

vestibular segment can be used for intrusion. The protrusion arch is activated by removing the anterior segment from the brackets, bending the posterior vertical step forward from 90° to 45°, and replacing the arch wire in the brackets.

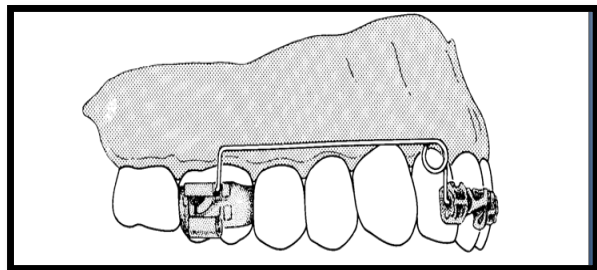


Fig. 4: Protrusion utility arch, with posterior vertical step fitting flush against auxiliary molar tube

DISCUSSION

Class II div 2 malocclusions represent a specific irregularity in bite characterized by a specific ratio of teeth and jaw bases & a distinct skeletal profile - Orthognathic maxilla and retrognathic mandible along with a horizontal growth pattern and skeletal deep bite.

As previously discussed, the orthodontic approach for the deep bite correction method includes intrusion of the anterior teeth, extrusion of the posterior teeth, or both. The biomechanics of the intrusion utility arch is useful in achieving both mechanisms.

For, class III malocclusions are usually growth-related discrepancies and surgery can be part of the treatment plan but due to patients' nonconformity, the surgery is not possible. Therefore, the purpose of this report is to orthodontically treat such patients with a Class III malocclusion non-surgically with the help of the utility arch. Also, it is important to use the lowest magnitude of force that is capable of intruding the incisors. If the magnitudes of forces are too high, the rate of root resorption will increase not the rate of intrusion and with intrusion utility arch it is possible to control the applied force.

CONCLUSION

The utility arch is a vital and indispensable component of orthodontic treatment which is highly efficient in intruding upper and lower incisors while effectively protruding and proclining the anterior

teeth. In addition, utility arches are extensively used in orthopedic and orthognathic surgical procedures.

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