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ENMASSE RETRACTION IN ORTHODONTICS – A REVIEW ARTICLE

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Abstract:
En masse retraction, a fundamental procedure in orthodontics, plays a pivotal role in achieving optimal treatment outcomes for patients with various malocclusions. This abstract presents a comprehensive review of en masse retraction techniques, their biomechanics, and clinical considerations. En masse retraction involves the controlled posterior movement of anterior teeth, facilitating the correction of crowding, spacing, and overjet. Traditional methods often included the use of sliding mechanics with conventional brackets and archwires. Recent advancements in orthodontic technology have introduced self-ligating brackets, temporary anchorage devices (TADS), and aligner systems, enabling orthodontists to tailor treatment approaches more precisely to individual patient needs. This abstract highlights the biomechanical principles underlying en masse retraction, emphasizing the importance of force systems, moment-to-force ratios, and anchorage control. The choice of mechanics, appliance systems, and auxiliary components can significantly impact treatment efficiency and outcome stability. Clinicians must consider factors such as skeletal and dental characteristics, treatment goals, and patient compliance when selecting an appropriate en masse retraction strategy. In conclusion, en masse retraction remains a crucial procedure in orthodontics, and its success is influenced by an understanding of biomechanical principles and careful consideration of patient-specific factors.
Keywords: en masse retraction, orthodontics, biomechanics, temporary anchorage devices, self-ligating brackets, aligner systems, treatment planning.

INTRODUCTION

Tooth extraction for orthodontic purposes has been a controversial topic for the past century [1–3]. This conflict is still brewing among orthodontists nowadays. Modern practitioners seem to have reached a middle ground when it comes to the decision to extract or not to extract [4, 5]. Space closure is one of the main stages of orthodontic treatment when extractions are undertaken as part of the treatment plan. It is a complicated multifactorial process that requires knowledge, skill, and experience to complete successfully [6]. Space closure can be achieved using one of the two methods, either sliding mechanics (frictional mechanics) or closing loops (frictionless mechanics).

The use of those two methods depends mainly on the treatment plan, appliance used, and the clinician's preference. Closing loops were mostly used for space closure with standard edgewise appliances [7, 8] due to the presence of archwire bends (i.e., first-, second-, and third-order bends) which made the use of any other method of space closure impossible [9]. The introduction of the pre-adjusted edgewise appliance by Andrews eliminated the need for these bends giving rise to what is known as the straight-wire technique [10] which allows for the use of sliding mechanics requiring movement between the archwire and the bracket, which is resisted by friction, binding and then notching [11]. Space closure using sliding mechanics can be achieved either by separately retracting the canine followed by the four incisors (two-step) or by en masse retraction of the whole anterior segment simultaneously [12].

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Method of space closure

1. Differential space closure, the capability of anterior retraction, posterior protraction or a combination of both.
2. Axial inclination control.
3. Control of rotation and arch width.
4. Optimum biologic response.
5. Minimum patient cooperation and
6. Operator's convenience

Retraction

Retraction is the most frequently used technique in space closure. The strategy used in retraction mechanics must be based on a careful diagnosis and treatment plan made according to the specific needs of the individual. Two step retraction and en mass retraction are two most used mechanics in anterior retraction. In two step retraction retraction of canine teeth is done followed by retraction of all four incisors and en mass retraction involves retraction of all six teeth[13] .

RETRACTION MECHANICS IN EDGEWISE

Once the extraction of the teeth is done orthodontist have to plan how to close the space. There are two schools of thoughts of retraction mechanism:

i. Two step canine retraction [Friction or frictionless mechanics)
ii. En-mass retraction [Friction or frictionless mechanics)

FRICTION MECHANICS

A tooth can be moved bodily only when force is applied such that it can pass through center of resistance. When a bracket is placed on a tooth and the force is applied at it, both force and moment is experienced by the tooth. The tooth moves in two planes due to this moment of force. The canine moves mesial out as force is applied buccal to center of resistance due to one moment. The second moment produces distal tipping of tooth is caused because force is applied occlusal to centre of resistance. A moment in opposite direction is produced due to interaction between the bracket and wire which counteracts this moment. When the tooth tips in distally it glides along the archwire till binding occur between the archwire and the bracket. This produces a couple at the bracket which results in distal root moment and hence uprighting of the tooth. As it uprights the moment decreases until the wire can no longer bind [14].

Advantage

- comfort to the patients and
- less time consuming (complicated wire bending is not required)

V – BEND SLIDING MECHANICS

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This was developed by Thomas F Mulligan, this approach is used for closing space by moving each teeth (canine retraction or molar protraction). He gave the concept of differential torque as a means of effective intraoral anchorage. It is obtained by applying unequal alpha and beta moments. An off center V- bend is used in a wire to create unequal moments with higher moment applied to the anchorage teeth.

The closer the bend is to the bracket shorter the wire and shorter wire has a higher bending moment than a longer wire. Therefore, a higher moment acts on the bracket which is closer to the V bend than the more distant bracket[15] .

METODS OF CANINE RETRACTION IN SLIDING MECHANICS[16-19]:

1. Elastic module with ligature
2. Elastomeric chain or power chain
3. Intra or inter maxillary elastics to kobayashi ligature
4. Coil springs (stainless steel or NiTi)
5. J-hook head gear
6. Sliding jig and traction
7. Mulligans v bend sliding mechanics
8. Magnet
9. Hycon device

Reducing friction in sliding mechanics

Reduction of friction can mainly be achieved either by decreasing the friction coefficient of the bracket or wire materials or by decreasing the force of ligation acting on the wire. The golden standard material to perform sliding mechanics is the combination of stainless steel brackets and wires. In recent years, several bracket manufacturers have been producing "reduced-friction" (or "friction-free") brackets. Other bracket systems that have been introduced with low friction properties include Synergy, Nu edge and Discovery brackets[20].

FRICTIONLESS MECHANICS

In frictionless mechanics, teeth are moved without the brackets sliding along the arch wire. Retraction is accomplished with loops or springs, which offer more controlled tooth movement than sliding mechanics. The force of a retraction spring is applied by pulling the distal end through the molar tube and cinching it back.[21] The important criteria to be considered for the use of closing loops are given as follows:

- Loop position
- Loop pre-activation and
- Loop design

1) The Broussard two force system

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The Broussard Two-Force Technique is predicated upon the philosophy that **one passive force,** the main arch wire, will establish and maintain the harmony, symmetry and arch coordination while the auxiliary springs will provide the second, **active force**. These auxiliary springs, under the guidance and control of the main arch wire, are used to move a tooth or a group of teeth.

2) Bimetric arch

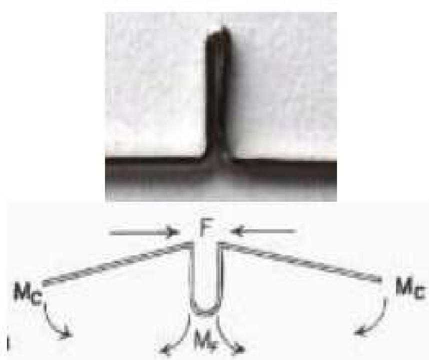
The external arch Bimetric System consists of modules of the Bimetric series which operate in an overlay fashion. The Bimetric Arches and Torquing Arches with their modules are designed to utilize the gingival .045" headgear tube. Anteriorly, they engage specially designed brackets which are bonded gingivally to the bands.

3) Bull loop

Dr. Harry Bull's procedure for cuspid retraction was to bring these teeth back bodily by means of a sectional arch. Closed vertical loop and was formed with 0.021” X 0.025” steel wire , 7 mm in height and, on an average, there is 18 mm of wire distal to the loop and 22 mm of wire mesial to the loop. In a lower sectional, the Bull loop is 5 mm in height and on the average, there is 20 mm of wire distal to the loop and 28 mm of wire mesial to the loop.

Activation:

Holding the eyelet loop between the parallel beak-closing plier and the vertical arm is bent toward the horizontal to place a gingival bend of 45° to 60° in the cuspid arm.

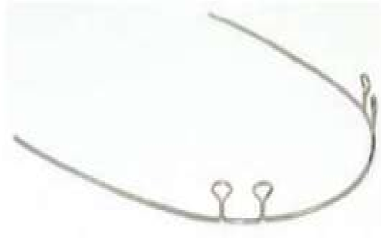


4) Compound loops

In Bio-progressive therapy, Bench RW designed various compound loops by combining a series of wire lengths and loop designs. It increases the amount of wire, the force is reduced and the duration of activation is increased. It includes the helical loop, open boot loop, double delta closing loop etc.

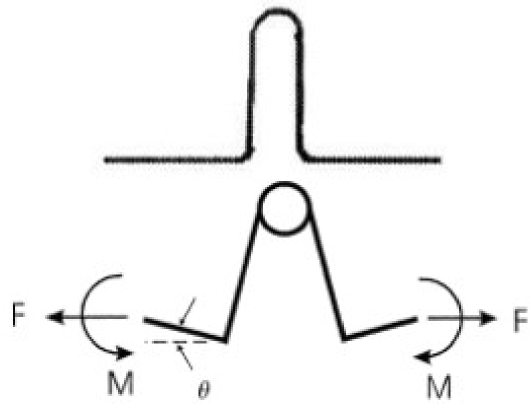
5)Double keyhole loop

This was introduced by John Parker. The double keyhole loop is 0.019” x 0.025” dimension, built out of round edge rectangular wire. The anterior teeth are generally retracted en masse as a group of six.



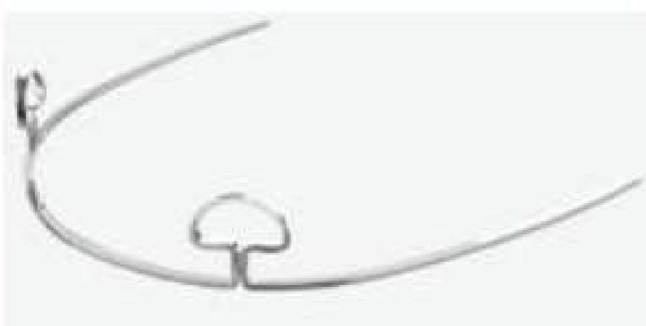
6) Vertical loop

It is simple in design and is usually fabricated of 0.016” stainless steel wire which is 6 mm high centered between the canine and second premolar brackets. Addition of helix to loop decreases the load deflection rate and placement of a gable bend in the horizontal legs of the vertical loop would increase the M/F ratio.



7) Mushroom loop

The M-Loop produces lower and more continuous forces which decreases the load-deflection rate. Wire dimensions are 0.017" X 0.025" CNA, although, for adults requiring lower force values, 0.016" X 0.022" may be preferred. Once engaged, the loop may be activated up to 5 mm.



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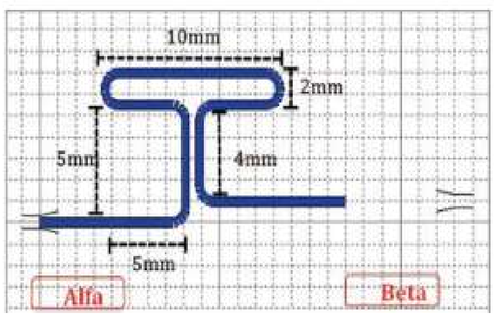
8) Tear drop loop

In 1983, Alexander RG used these Teardrop shaped loops in his vari-simplex discipline. The loops are placed distal to the maxillary lateral incisor bracket. Before placing the archwire in the mouth, the portion of the archwire distal to the closing loops is reduced approximately 0.001" in the anodic polisher, so that part of the wire can slide through the brackets easily during activation. Stainless steel tear drop loops are the most common design due to their ease of fabrication; however, they deliver very high forces with only 1 mm of activation.

9) T-Loop:

The 0.017” X 0.025" TMA T-loop, used for reciprocal space closure and given by Burstone. It generates high horizontal forces of approximately 350 gm. The key to its design is the attempt to make the moment-to-force ratio more constant. Because of anatomical limitations, it is not possible to sufficiently increase the loop to obtain the desired M/F ratio. Thus, it is necessary to add larger moments to the loop, obtained by means of pre-activation.



10) The K-SIR Arch

The Kalra Simultaneous Intrusion and Retraction (KSIR) archwire was designed by Varun Kalra is a modification of the segmented loop mechanics of Burstone and Nanda. It is a continuous 0.019" × 0.025" TMA archwire with closed 7 × 2 mm2 U-loops at the extraction sites.

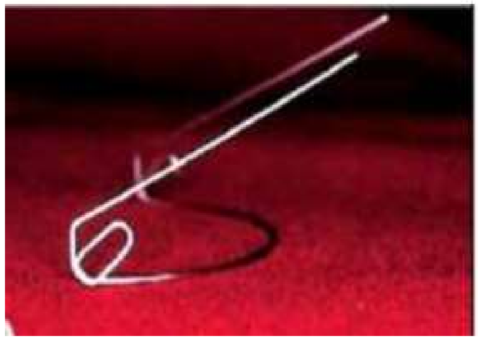
Indication :

K-SIR arch wire is for the retraction of anterior teeth in a firstpremolar extraction patient who has a deep overbite and excessive overjet and who requires both intrusion of the anterior teeth and maximum molar anchorage.

The archwire is inserted into the auxiliary tubes of the first molars and engaged in the six anterior brackets.

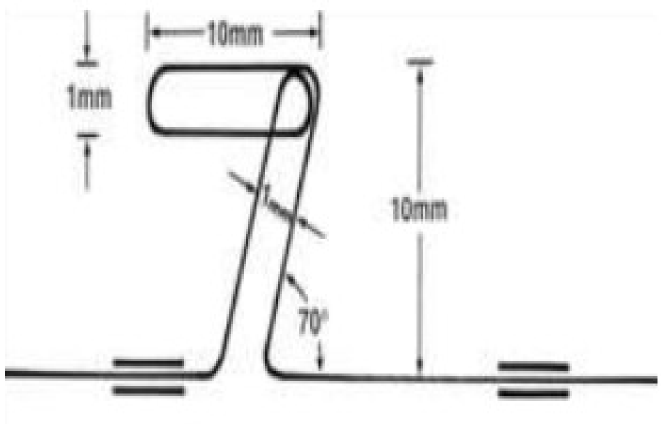
Activation:

It is activated about 3 mm so that the mesial and distal legs of the loops are barely apart. The second premolars are bypassed to increase the inter-bracket distance.



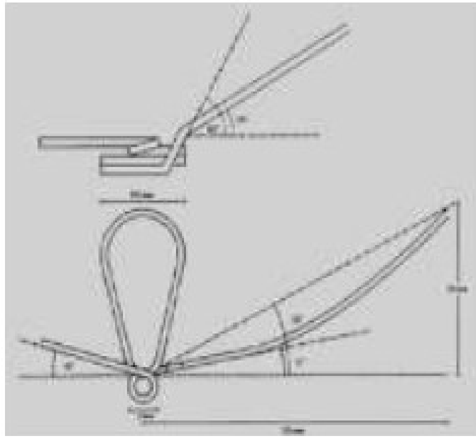
11) Opus loop

This loop was designed to deliver inherent moment to force ratio sufficient for en mass space closure via translation for teeth of average dimensions. As the loop M/F is high, no activation bends or bends in the formed loop need to be added before insertion.



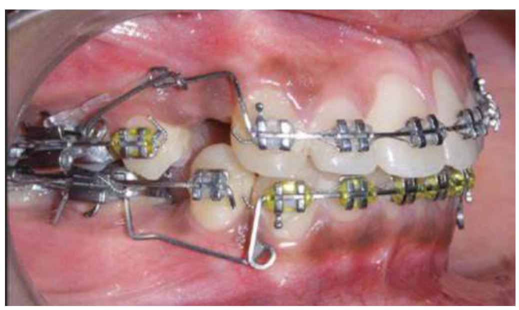
12) The Universal Retraction Spring

In 1985, Gjessing P designed a canine retraction spring. It was constructed from 0.016” X 0.022“ stainless steel wire, the principal element being a double ovoid loop 10 mm in height. The spring consists of a double ovoid helix of 10 mm height gingivally and with a smaller occlusally placed helix of 2 mm diameter. It is constructed in 0.016" × 0.022" SS wire and produces 160 gm of force for every 1mm of activation. Mesial extension of the spring is 15° to the horizontal plane. Distal extension of the spring is 12° to the horizontal plane with an anti-rotation bend of 30° in the distal extension.



13) Retrusion Utility Arch (3 Piece utility arch)

The retrusion utility arch can close interproximal spaces while intruding and aligning the upper anterior teeth and correcting midline discrepancies. The retrusion arch originates in the auxiliary tube on the molar, and 5-8 mm of wire should protrude anteriorly before a posterior vertical step of 3-4 mm is placed. The vestibular segment extends anteriorly to the interproximal region between the lateral incisor and the canine. The wire is pulled 2-3 mm posteriorly and then bent upward at a 90° angle[22].



Retraction in Begg

The Begg technique advocates a two-stage retraction-

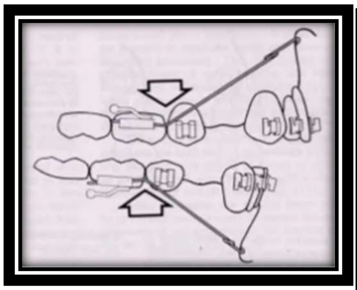
STAGE 1- Involves distal tipping of the anterior crowns with elastomeric threads and/or inter arch elastics.

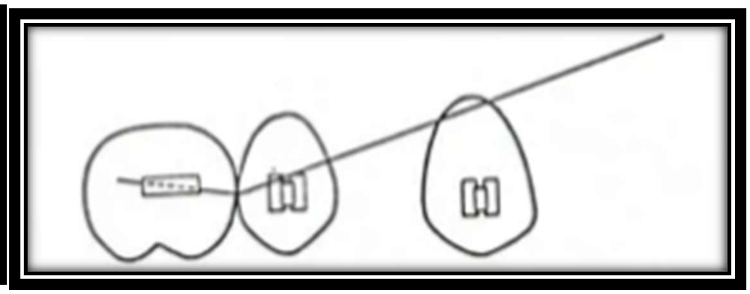
Objectives of Stage 1:

- Open anterior overbite.
- Overcorrect mesiodistal relationship of the buccal segments as necessary.
- Close any anterior spaces.
- Eliminate any anterior crowding.
- Overcorrect all teeth that require rotating.
- Correct posterior crossbite.

Biomechanics:

"V" bends or anchor bends are placed at molar to produce moment Molar anchorage bends are placed immediately posterior to the 2nd premolar bracket. Amount of bend varies from case to case. The leverage force incorporated on the incisors should be around 65mg.

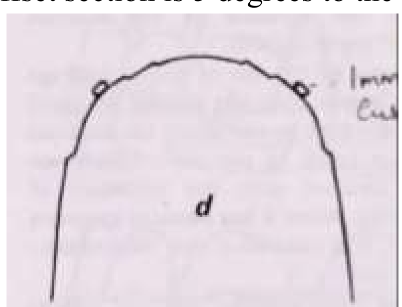




Bayonet bends:

It is inadvisable to use bayonet bends for active correction, because of the tendency for round archwire to rotate within bracket slots causing the bayonet bend to become ineffective or supply movement in wrong plane.

Commonly used passively to retain over rotation which is brought about via previously looped arch. They should be small and offset section is 5 degrees to the line of main arch.



Placement of Elastics:

The Class II elastics are engaged around the distal ends of the molar tubes or molar hooks and stretched anteriorly to engage the maxillary Intermaxillary hook mesial to the maxillary cuspid.

Class III elastics are worn from the maxillary molars to the intermaxillary hook mesial to the mandibular cuspid bracket. No horizontal (intramaxillary) elastics are applied during stage I.

Stage II-

Stage 2 involves lingual torquing of the anterior roots, for this purpose torquing auxiliaries are added.

Objectives:

- ✓ Completion of extraction space closure
- ✓ By continuing retraction of anterior teeth
- ✓ Correction of premolar rotations

- ✓ Completion of correction of midline discrepancies
- ✓ Maintenance of all anterior and posterior overcorrection achieved in stage I
- ✓ Continued correction of open bite

ENMASSE RETRACTION IN LINGUAL ORTHODONTICS

(SARDAC) technique regarding torque control and vertical movement during enmasse retraction in lingual orthodontics.. Simulated retraction was performed using the Orthodontic Measurement and Simulation System (OMSS). Lever arms were welded between the lateral incisor and canine brackets bilaterally on a 0.017"X0.025" inch maxillary lingual stainless- steel wire. Bilateral, nickel titanium coil springs were used to apply a retraction force of 1.5 N per side on para-median mini-screws, inter radicular mini-screws and to the first molar brackets. In some studies regarding the torque, the group where the force was applied between the 15 mm lever-arm and the first molar bracket, was the only group that showed statistically significant difference (palatal root torque) during en-masse retraction and the vertical movement, no statistically significant difference was found . SARDAC technique is predictable and efficient in controlling torque and vertical movement during en-masse retraction in lingual orthodontics.

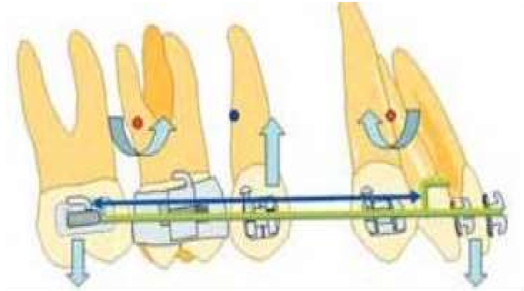
A)force was applied between the 15 mm arm and the paramedian screw. (B) force was applied between the 15 mm arm and the Interradicular screw. (C) force was applied between 15 mm arm and first molar tube.

RETRACTION WITH TADS

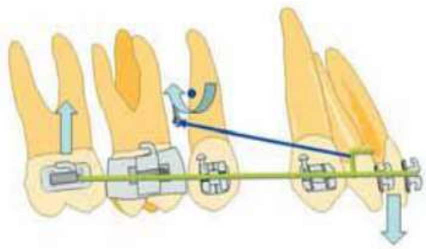
INDICATIONS OF TADs[23]:

- ➢ Find it difficult to cooperate by wearing headgear, intermaxillary elastics other traditional anchorage methods;
- ➢ Have the need for maximum anchorage on the upper arch, lower arch or both.
- ➢ Whose anchorage may be compromised by too few dental elements, due to root resorption or periodontal disease sequelae.
- ➢ Whose occlusal plane is tipped towards the anterior region.

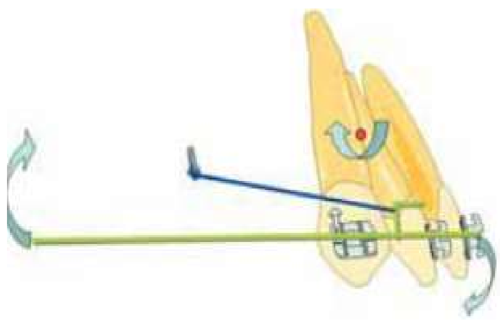
Anterior retraction with sliding mechanics is usually accomplished by placing elastomeric chain or nickel titanium springs between hooks on the anterior teeth and the second molars. 16



Anterior teeth retraction with sliding mechanics

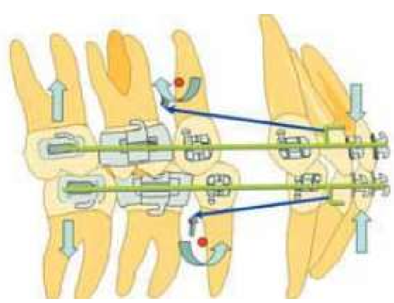


Retraction force with miniscrew anchorage produces rotation of entire arch around center of rotation (blue dot)



Rotation of anterior segment around center of rotation (red dot) in absence of friction in posterior segment.

In cases of severe protrusion, where absolute anchorage is required in both arches, these mechanics can produce posterior open bite and deep overbite.



simultaneous rotation of both arches during anterior retraction with miniscrew anchorage

Posterior Intermaxillary Elastics[23]:

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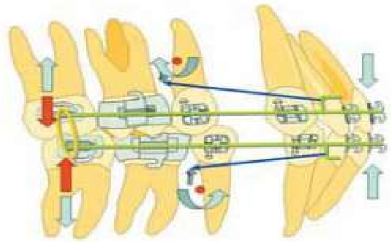
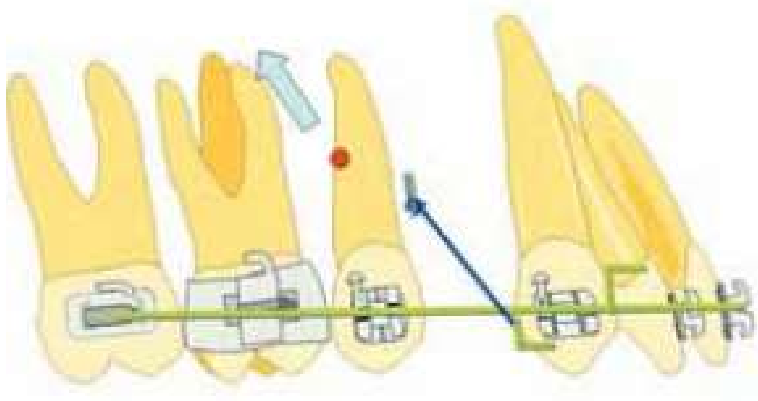
Placing intermaxillary elastics between the posterior teeth can be a solution. Light 3/16" intermaxillary elastics, worn only at night, can prevent posterior open bite. Because such elastics can extrude the posterior teeth, however, they are not recommended for patients with vertical skeletal patterns.



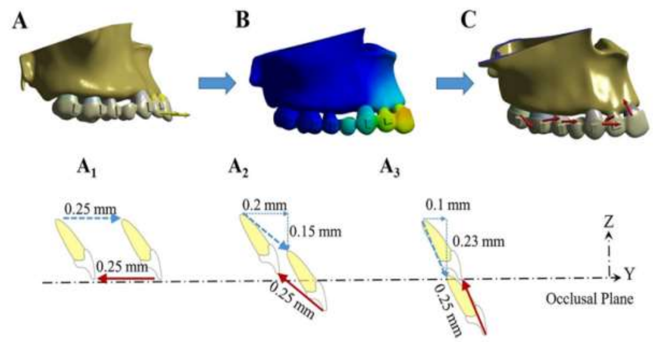
Vertical Retraction Forces :

In patients with gummy smiles or other factors favoring intrusion of an entire arch, more vertical retraction forces can be used to prevent occlusal plane rotation. Occlusally directed archwire hooks should be placed posterior to the canines. This method can also be used to control overbite during retraction in cases of deep overbite.



RETRACTION IN ALIGNERS

Clear aligners are not rigid enough to retain their original shape in space closure, which might result in torque loss and adverse extrusion of the anterior teeth [24-28]. Therefore, a certain amount of intrusion is intentionally added during the setup when the incisors are designed to be retracted. 0.25mm retraction. Upon this retraction protocol, both central and lateral incisors experienced maximum lingual displacement on incisal edges, while the root apex performed a movement in the labial direction, resulting in uncontrolled lingual tipping movement. In contrast, the canine and posterior teeth exhibited mesial inclination . Detailed analysis of anterior tooth displacement showed that both central and lateral incisors had distal crown and mesial root tipping . The lingual tipping movement was accompanied by extrusion.



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