## **BAND FORMATION**

Band secures its accompanying attachments, brackets, tubes, auxiliaries- in the correct relationship to tooth.

#### **Requirements of bands**

- Teeth that will receive heavy intermittent forces against the attachments. e.g. upper first molar. Teeth needing both labial and lingual attachments.
- Teeth with shorter clinical crowns.
- Tooth surfaces that are incompatible with successful bonding- amalgam restorations, porcelain veneers, enamel fluorosis.

#### **Requisites of bands**

- An orthodontic band must fit the contours of tooth as closely as possible:
- To enhances the placement of attachment in relationship to tooth
- Width of band material and cement in the interproximal space should be kept to a minimum
- There should be no cement on the occlusal margins, with subsequent collection of food debris an decalcification of tooth
- There should be no gingival overhangs

#### An orthodontic band should not extend subgingivally any more than necessary

- Over extension produces tissue irritation
- Osteoclastic activity of the bone, with the loss of alveolar process.

#### Band should not be too wide

- All around adaptation is virtually impossible, folding and creasing of band will result.
- Certain areas may fit but an "*umbrella effect*" may be experienced at other areas. This will result in wide cement lines on the gingival aspect and lead to marginal etching along the gingiva.
- Orthodontic band should be made of a material that is resistant to the deformation under stresses in mouth:
- Bands should posses sufficient "edge strength"
- Occlusal margins will not be displaced away from tooth contours during mastication
- Reduces the tendency for loosening of bands during orthodontic treatment

#### **Band material**

- Should be resistant to tarnish
- Should have enough springiness, that it can be forced over the height of contours of tooth and spring back slightly into undercut areas







#### Ideal band material should be

- Soft and ductile
- Stiff and strong
- Springiness

#### Chrome alloy band materials

• Chrome alloy bands have been refined continuously, so that today they are readily adapted to most teeth and possess the requisites of strength and cleanliness.



#### RMO roll band material (8 ft) are available in following sides -

- 0.125 x 0.003
- $0.150 \ge 0.004$
- 0.180 x 0.006
- 0.180 x 0.005
- 0.125 x 0.004

#### **INSTRUMENTS**

• Spot Welder



#### Band forming pliers, band cutting scissors, band pusher, band seater, band contouring plier



#### Separation of teeth

- Adequate separation of teeth is an essential prerequisite for any banding technique.
- Proper adaptation cannot be ascertained if tight contacts are present.
- Adequate separation also allows the bands to be fabricated much more rapidly and without much discomfort to the patient.

## Types of separators

- 1. Grass line ligature
- 2. Brass wire







4. Rubber bands-

3. Elastic threads

5. Elastic modules



Be

6. Mexican Elastic Separator



- 7. Coil Spring Separators
- 8. Sep-clip separator



9. NITI NEET Springs

#### 10. "C" Separation Maintainers

#### **Band formation**

Three methods-

- -Direct technique
- -Indirect technique
- -Preformed bands

#### **Direct technique**

- The actual band fabrication is almost identical for the direct and indirect technique the only difference being that the indirect band are made on plastic dies of the teeth.
- Most of the shaping of the band material in the direct technique is done directly on patient's teeth.

#### The technique of pinching

- Fold the strip of band material on itself to form a loop
- Grasp the ends with the No. 142 plier.
- Place the piece of folded material into the No. 155 plier of choice; i.e., right or left anterior or posterior
- Open the loop by pressing with the finger.
- With the No. 114 plier, placing the ball to the inside of the band, contour a section of the band material about the width of the labial or buccal surface of the tooth to be banded.
- Place the loop of the band over the crown of the tooth to be banded. Squeeze the beaks of the plier together, thus sliding he forming beak along the material toward the tooth.

## $\bigcirc$













#### Burnish the band.

- Put the final stretches on the band to give it the closest adaptation possible.
- While the beak is engaging the lingual surface of the tooth and being held quite tightly, rock the plier horizontally, making one edge of the forming beak the fulcrum.
- This edge of the beak will cause the band material to be pulled away from the tooth, then squeeze the plier tighter as it is returned to position.
- Vertical stretch -Holding the plier tightly, rock the beaks away from the tooth at the incisal or occlusal.
- Tighten and take up the slack on the return.
- Band is then removed from tooth and welded along the pinched seam as close as the electrodes allow.
- The excess is cut off, leaving a small remnant. The band is returned to tooth and the small remnant is folded flat against the lingual surface (folded flap method).
- Band is then replaced on the tooth carefully, in a position as near in which it was pinched as possible. Work it toward its place with the finger.
- Then use the amalgam plugger, and gently work the band down at different points around the edge.
- Finally, using the band driver and mallet, drive the band to its final seating.



















#### Position of band-

#### Maxillary central and lateral incisor

- Junction of middle and incisal third
- The lateral incisor band should be placed 1mm farther incisally than central incisor band.
- Incisal edge of the bands should be parallel to the incisal edges of respective teeth.

#### Lower central and lateral incisors

- Band material is 0.003 x 0.125 inch or 0.004 x 0.125 inch.
- Incisal edge of the band material is kept parallel to incisal edge of the tooth on the labial surface.

#### **Upper cuspids**

- A line contacting the contact points will indicate the horizontal position of the band.
- In order to obtain maximum retention and incisal bracket position, clinicians prefer an apron band labioincisal extension permits incisal offsetting of brackets on bands.

#### Lower cuspids

• Tooth normally leans mesially, thus band must be placed more gingivally on the distal.

#### Posterior teeth

- To place occlusal to the contact points on the slope of the marginal ridge, about a millimeter or less short of the crest.
- The positions mesially and distally hold true in the lower bicuspids and molars, as in the upper.

#### Upper bicuspids

- The proximal edges of the band should be festooned at the gingival edge to avoid tissue irritation and damage.
- Band material used is 0.004 x 0.150 inches.
- It is sometimes necessary to trim the distal occlusal portion slightly to prevent overhang of this portion over the marginal ridge.

#### **Lower Bicuspids**

- The mandibular second bicuspid is one of the most difficult bands to retain properly on the tooth, usually because of the extreme undercuts on the gingival portions of the tooth.
- Tweed arch ending pliers or No. 442 pliers to put a crimp or an undercut on the occlusal and gingival edges of the band.
- Band material is generally 0.004 x 0.150 inch, with the brackets preattached to the band material.







#### **Upper Molars:**

- On buccal surface than band should extend more inferior in mesial portion than on the distal portion of the tooth.
- The band must be driven farther gingivally on the distal so that it does not extend over the occlusal surface of the tooth.
- Band material 0.006 x 0.180 inch

#### Lower Molars:

- Band must extend quite low on the buccal surface.
- 0.005 x 0.180 inch band are used.

#### **Indirect band formation**

- Indirect bands are made on plastic dies of teeth.
- The band fabrication is almost identical as for the direct technique.

#### **Preformed bands**

- Bands are being shaped to approximate the anatomical contours of all teeth.
- Number of sizes available has been increased.
- First step in fitting the preformed bands is to select the size of band.
- Permanent marking on the mesial surface identifies the size and quadrant.



## **SOLDERING & WELDING**

## Soldering

*Soldering*: A group of processes that joining two different metals by heating them to a suitable temperature below the solidus of the substrate metal and applying a filler metal having a liquidus temperature not exceeding  $450^{\circ}$ C that melts and flows by capillary attraction between the parts without appreciably affecting the dimensions of the joined metals.

#### **TYPE OF SOLDE RING**

- Investment soldering
- Free hand soldering
- Infra red soldering

#### The most commonly used method orthodontics is -

- 1. Apply flux to the archwire.
- 2. Applying solder to brass wire. (Brass wire is fluxed, heated and then low fusing solder is applied.)
- 3. Relationship between (A) brass wire and (B) steel wire.
  - a. Starting time
  - b. At the time solder starts to flow
  - c. Wiping brass wire and flowing solder under the steel archwire
  - d. Returning brass wire to the flat surface of the steel
  - e. Using tweed loop forming plier to make a small neat loop out of soldered brass hook material.
- 4. Using tweed loop forming plier make a small, neat hook out of soldered brass wire which has been cut 3/16 inch.
- 5. Allow solder to flow along 1/8 inch of brass wire. With cutters remove excess solder and then with a file smooth brass wire end which has been cut.
- 6. Apply heat, using tip of flame approximately <sup>1</sup>/<sub>4</sub> inch from arch wire on brass wire and allow heat to be conducted from brass wire to steel arch wire.













#### Welding

Welding is the process by which the surfaces of metals are joined by mixing, with or without the use of heat.

**Cold welding** is done by hammering or pressure. An example of cold welding is the gold foil filling. **Hot welding** uses heat of sufficient intensity to melt the metals being joined. The heat source is usually an oxyacetylene flame or high amperage electricity.

#### **TYPES OF WELDING**

- Spot welding
- Pressure welding
- Laser welding
- Plasma welding

#### THEORY

Orthodontic spot welders employ the electrode technique to prevent changes in the physical properties of the components being joined.

Orthodontic welding is achieved by passing a large amount of current for a very short duration through an area of high resistance.

Heat is generated of a magnitude great enough to cause melting at the interface.

- Copper electrode Low resistance
- Stainless steel 50 times higher resistance than that of copper.
- Electrode
- Stainless steel interface: 2 times of S.S alone.
- Stainless steel

- Stainless steel interface: 4 times of S.S alone.

In spot welding the following three properties of the metal are favorable:

- A comparatively low melting point (approximately 1370° C.),
- High electric resistance,
- Low conductivity of heat.

The welding is done mechanically by gripping the seam between two snubnosed welding dies (electrodes) made of hardened copper, and passing low voltage high amperage current.

Heat developed is directly proportional to  $I^2 RT$  where,

- I The current
- R The resistance
- T Time of application

The volume of metal to be heated is definite for a given thickness of metal and the current and time must be controlled accurately.



It is easy to weld two sheets of metal of the same thickness, but the welding of sheets of markedly different thickness, or wire to wire or a tube to a sheet, is extremely difficult and therefore should be avoided. In such cases some orthodontists recommend the use of a special form of electrodes, but whether the results are truly favorable is somewhat doubtful.

#### **IMPROPER WELDING**

Improper welding can occur at the two extremes.

- Too low voltage -- parts may delaminate.
- Too high voltage -- the wire can become brittle.

#### OVERHEATING THE WIRES.

- 100% "set down" in the main archwire.
  - Cracks are formed around the hook as the wire is cooled.
  - This could lead to fracture if the archwire is bent
  - Recommend "set down" is typically less than 60%.

The wire will begin to melt and flow. When an active member such as a finger spring is welded, a weakening can occur because of the reduction in the cross-section of the spring.

#### **CLINICALAPPLICATIONS**

TMA can be welded for both passive and active use.

- Passive applications include stops and tieback hooks.
- The wires can be welded without loss of springback properties.

#### WELD QUALITY

- electrode pressure
- voltage setting
- duration of impulse
- contact resistance
- wire cross-section
- joint design
- orientation of the wires

However, the surface condition of the electrodes is another important variable.

## **ARCH FORMS**

#### 1. Bonwill concept

- Developed in 1885.
- The tripod shape of the mandible is formed by an equilateral triangle.
- Base between the condyles and the apex between the central incisors length of each side approx 4 inches.

#### 2. Bonwill Hawley concept

- Hawley in 1905,
- It is a modified Bonwill's concept.

#### 3. Angles line of occlusion

- Angle in 1906, described the *LINE OF OCCLUSION* "The line of greatest normal occlusal contact".
- In 1907, he rediscribed it as " the line with which in form and in position according to type, the teeth must be in harmony if in normal occlusion."

#### 4. Apical base concept

- Proposed by *Lundstorm*.
- He highlighted the need to consider the apical base when determining the arch form for the patient.

#### 5. Caternary arch form

- David Musich & James Ackerman(1973). Schulhoff(1997 lower arch.
- To measure Modified Boley Guage with a chain incorporated in it *CATANOMETER*.
- Caternary curve is the shape that the loop of a chain would take if it were suspended at a width across the first molars from 2 hooks.











#### 6. Brader arch form

- Brader in 1971, presented a mathematical model of dental arch form.
- Arch form was a trifocal ellipse, which was based on the shape of an egg- extremely resistant to collapse & produced stable arch form.

#### 7. Rocky mountain data system

It is a computer derived formula which relies upon measurements taken from intermolar width, inter cuspid width and arch depth as measured from the facial surface of the incisors to the distal surface of the terminal molar.

#### **Absence of Arch Symmetry**

- White also evaluated the symmetry of arches and the most conspicuous finding was the total absence of arch symmetry.
- Thus he advocated individualising arches by simple technique called "OCCLUSALMAPPING".
- Draw occlusal surfaces of teeth from xray or photos. Proximal contacts are marked and a line is drawn through the mesio-distal dimensions of each tooth & connecting the lines across the proximal contacts.
- This line represents the centre of the basic arch perimeter.

#### 8. Roth's tru arch form

- Developed from biologically and clinically derived broad curves which are referred to as "Natural or Non-Orthodontic".
- The Roth Tru Arch was derived from his extensive clinical testing & recording of jaw movement patterns in treated patients who were out of retention and had remained stable.
- This arch form mainly was wider by a few millimeters, primarily in bicuspid area when compared to Andrews normals and coincided exactly when superimposed on Ricketts pentamorphic arch forms.
- This arch form over corrects arch width slightly: over correction in all 3 planes of space is a part of Roth's end of fixed appliance therapy goal.

Bader hypothesized the arch form was a Trifocal Ellipse and PR=C Where, P=*Pressure*  $\hat{R} = Radius of curvature of$ ellipse curve at the pressure site C =Mathematical Constant













#### 9. Ricketts penta morphic arch form

• These Pentamorphic arch forms were such that they would fit most facial forms



#### 10. Mathematic & geometric models for arch forms

- Mathematic models have been used for describing arch forms.
- Lu(1964) claimed that the dental arch could be satisfactorily described by a polynomial equation of the 4<sup>th</sup> degree.
- *Sanin(1970)* investigated the size and shape of ideal arches and confirmed the views of Lu.
- *Pepe(1975)* analysed a sample of 7 models of normal occlusion by digitization and curve fits. The results showed that 4<sup>th</sup> order polynomial equations were better than caternary curve fits and also suggested that 6<sup>th</sup> degree polynomial equations appear to have potential as clinical indicators of arch form.
- *Cubic Spline Function* : used for modelling of various asymmetrical objects.
- Is an adaptation of the draftsmans spline. The mathematical adaptation of physical spline consists of a set of individual cubic polynomials between successive knot points and has been developed for use in describing normal dental arches



#### 11. Arch for determination using cone beam computed tomography

- *Braun etal (1966)* represented arch form by a complex mathematical formula known as "Beta Function".
- *McLaughlin & Bennet*, measured the center of each incisor incisal edge, cusp tips of canines and premolars and the M-D and D-B cusp tips of molars.

#### **TAPEREDARCH FORM**

• Narrow intercanine width, used in patients with narrow arches and gingival recession in premolar canine region.

#### **SQUAREARCH FORM**

• Used in cases with broad arches and those who require buccal uprighting

#### **OVOIDARCHFORM**

• Good reliable arch form for a majority of the cases. Advisable to stock wires in ovoid shape, which then can be altered depending on the case

#### **IDEAL ARCH BY**

#### EDWARD J GROMME

- STEP-1 Measurements of teeth of patient are recorded on a straight line bisected in the centre.
- STEP-2 a) Wire is cut from G-G'
  - b) Then bend is given with the help of turret from D D'.
- STEP-3 At point D and D'a sharp bend is made towards the lingual from mesial end of plier and then labial form distal end of plier
- STEP-4 Between D-E and D'-E' a quarter of a circle bend is given using turret.
- STEP-5 The long ends of the wire are pulled out with fingers at pint D and D'.
- STEP-6 Final bends turn the two archwire inwards at F-F'

## G F E DCB A DCDE' F'G STEP 1 STEP 2 STEP 2 STEP 4 D C C D' STEP 4







thoForm" II - Squar



## **Loops**

- Incorporation of loops in the archwire was revolutionized in 1915 by RAY ROBINSON who was an early advocate of light wires and light continuous forces by means of loops.
- Dr.R.H.W. STRANG was first to introduce loops in the edgewise technique.

These properties depend upon the following factors:

- 1. Diameter of wire (D)
- 2. Length of wire (L)  $F \alpha = \frac{D^4}{L^3}$ 3. Elasticity

Where F is force.

Various loop designs have been advocated

| 1. Open vertical loop                      | 12. Transverse loop                     |    |
|--|---|----|
| 2. Vertical loop                           | 13. MEAW                                |    |
| 3. Double vertical loop                    | 14. Rickett's canine retractor          |    |
| 4. Omegaloop                               | 15. PG (Paul Gjessing) retraction sprin | ıg |
| 5. Helical loop                            | 16. Delta loop                          |    |
| 6. Horizontal loop                         | 17. Closed vertical loop                |    |
| 7. Box loop                                | 18. Bull loop                           |    |
| 8. Bent in stop loop (Tweed)               | 19. The R (Rectangular) loop            |    |
| 9. Squashed vertical loop (Bull loop)      | 20. Vertical loop with helix            |    |
| 10. Combined vertical and horizontal loops | 21. Omega loop                          |    |
| 11. Delta loop                             | 22. T-Loop                              |    |
|  | 23. Opus loop                           |    |

#### **OPEN VERTICALLOOP**

- Dr.Robert.W.Strang(1933).
- It was used for retraction of anterior teeth.
- Height of the loop was 8mm.
- Use
  - Retraction of anterior teeth.
  - To open space
  - To rotate teeth
  - Labio-lingual deflection



#### Steps of formation for vertical open loop



#### VERTICAL LOOPS WITH HELIX

- Dr Morris Stones (1960)
- Main purpose is to increase the working range
- They can be used as expansion devices to create spaces for the alignment of a number of teeth or perhaps even all teeth in one arch.
- They can be used as highly elastic rotation devices for correction of one or multiple rotations.



• They can be used as expansion devices to distally drive canines in the treatment of malocclusions when four first premolars have been extracted.

#### **OMEGALOOP**

• Dr Morris Steiner (1960) - this loop is named so because of the resemblance to the Greek letter omega.



- The loop is believed to distribute the stresses more evenly through the curvatures instead of concentrating on the apex.
- Fabricated by using .0215X.028 arch wire It can be used as a stop and tieback.



#### **BENT IN STOP LOOP(Tweed)**

Used to maintain arch length.

Tweed recommends the use of a bent in stop loop, mesial to molar tube, whenever required. It has a slight mesial cant for tying the ligature wire.





#### Steps of formation for bent in stop loop



#### TWIN HELICALLOOP.

- This consists of a vertical loop with two adjacent helices at the top.
- The design of this loop permits the legs to touch each other, using minimal space in the interbarcket span.
- The presence of two helices provides additional wire, permitting greater force reduction and longer range of activity. Because of the position of the helices, this loop is activated by extension, or drawing the legs apart.
- This, in turn, follows the principle of activation the loop in the direction of the contour, in that extension of the legs continues to wind the two helices.



• It is used to shorten arch length where great range of activity is desired.

#### **Delta Loop**

- It was described by DrProffit.
- 0.016" x 0.022" 0.018 slot
- 0.018" x 0.025" 0.022 slot

#### THE ASYMMETRIC T LOOP

- This loop allows simultaneous bite opening and space closure.
- The anterior portion is smaller and engages the lateral incisor bracket.

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#### TEAR DROP LOOP

- MATERIAL-SS; DIMENSION-0.018"x0.025"
- The height of the tear drop loop is 5mm
- The loop is placed immediately distal to the lateral incisor brackets.
- The wire distal to the canine is reduced to0.016"x0.023", the purpose of reducing the posterior portion is so it can easily slide through the bicuspid brackets and molar tubes.
- ACTIVATION- after insertion the wire should extend 5mm distally from the molar tube.
- A 442 type wire bending plier is used.
- The distal extension of archwire is grasped with the pliers and pulled through the molar buccal tube, and then tipped distal to the tube at 45 degree in superior direction.
- The closing loop itself should be activated by 1mm.
- It is important to activate only 1 mm per appointment (every 4 weeks)

#### **RICKETT'S CANINE RETRACTOR**

- This is a combination of a double closed helix and an extended crossed T made with blue Elgiloy wire.
- It delivered 30-50gms per mm of activation.

#### ACTIVATION

• Activated by pulling 3-4mm each adjustment by pulling the wire through the tube and locking it with a simple bend.







#### Statically Determinate Retraction system (SDRS)

- Kwangchul Choy designed a variant of a cantilever spring made of 0.017 X 0.025 inch titanium molybdenum alloy wire.
- At full activation, the standard spring delivered 163 g with a loaddeflection rate of six g/mm.

#### **The Wave Spring**

- William Vogt in 2004.
- It is formed from superelasticNiTi alloy that delivers 90gms of force when extended.
- It is only 6mm long when in resting state and three times its length in activation state.
- When closed coil spring is activated it unwinds creating torque on attached teeth.
- It returns to its original form without permanent deformation.

#### The Snail Loop

- The snail loop is formed from 0.017" × 0.025" stainless steel wire by bending a simple omega loop into a spiral shape.
- The snail loop has the potential for twice as much activation as a stainless steel omega loop before undergoing permanent deformation.
- The outer portion of the snail loop is 8mm high and 6mm wide, and the inner portion is 6mm high and 3mm wide

#### The Box Loop

• The box loop was given by A.Sivakumar in 2006. This loop enables the orthodontist to produce well defined force system levels that lead to highly controlled tooth movements.

#### **Indications**

- Initial alignment of asymmetric crowding in early permanent dentition.
- Root paralleling during finishing
- Uprighting tipped molars











#### <u>R LOOP</u>

- It can be fabricated by using 0.017 x 0.025" TMA wire
- For a given tooth movement only one combination of force and moment is correct R Loop can be used for  $1^{st}/2^{nd}/3^{rd}$  order corrections.









С



C

A B







F

D





# T LOOP CHARLES J BURSTONE 1982 The basic configuration of the TMA loops consists of a0.017X0.025" TMA wire. BETA 5mm Posterior Alterior

0.017 × 0.025 inch T-lo

6th bend (3-prong pliers)

**Preactivation bends** 

Antirotation bends can be placed in the following areas-the ears, the vertical arms, and to a small extent to the horizontal arms producing an angle of  $120^{\circ}$ 

#### TYPES

**1. SEGMENTED** 

2. CONTINUOUS

The center position of the spring can be found by:

distance = (interbracket distance activation)/2

where distance = length of the anterior and posterior arms (distance from the center of the T loop to either the anterior or posterior tubes)

interbracket distance=distance between the canine and molar brackets.

Activation=millimeters of activation of the spring.







Preactivated spring

nd (3-prong pliers)

#### MUSHROOM LOOP ARCHES

- For 0.022" brackets, an  $0.017" \times 0.025"$  CNA archwire
- First, the legs of both mushroom loops are carefully separated by about 3mm, the torque on the distal legs is eliminated
- The loop should not be reactivated until at least 3mm of space has been closed, thus maintaining a more constant moment-to-force ratio.





#### POUL GJESSING CANINE RETRACTION SPRING

- Ani tip bend (Alpha) 15°.
- Beta bend  $12^{\circ}$  for II premolar,  $30^{\circ}$  for I molar.
- Anti rotation bend 35°.
- Distal sweep for molar.





#### **CONFIGURATION**

- It is made from  $0.016 \times 0.022$  inch stainless steel wire.
- With predominant element OVOID DOUBLE HELIX LOOP extending 10 mm apically, 5.5 mm width apically.
- The smaller occlusal loop with 2 mm diameter, incorporated to lower the levels of activation.





## **NITI CANINE RETRACTION SPRING**

#### • GIVEN BY YASOO WATANABE

- 0.016 x0.022 nitanal wire
- Light continous force.
- Activation up to 10 mm.
- Vertical closing loop and anti tip and antirotationmemorised by heat treating the wire in a electrical oven to 550° C for 15 min.

#### **OPUS LOOP**

- Raymond E Siatkowski (1997)
- The apical horizontal leg is 10mm long,
- The ascending legs at an angle of 70 degrees to the plane of the brackets
- The apical helix is on the leg ascending from the anterior teeth, (*that ascent must begin within* 1.5mm posterior to the most distal bracket of the anterior teeth being retracted)
- The spacing between the ascending legs especially the apical loops legs must be 1mm or less

#### KALRA SIMULTANEOUS INTRUSION AND RETRACTION ARCH

- VARUN KALRA (1998)
- WIRE MATERIAL- TMA
- DIMENSION- 0.019x0.025 TMA



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#### <u>K -Loop.;</u>

- Developed by ValrunKalra. Appliance design made of 0.017" X 0.025" TMA wire.
- The K-Loop mainly used for Molar Distalization.
- Activation -Legs of appliance bent down 20degree.
- Wire marked at mesial of molar tube distal of premolar bracket.





|                           |   | Length of wire<br>in simple loops |
|---------------------------|---|-----------------------------------|
| Helical Loop              | 0 | 10-14mm                           |
| Vertical Open Loop (Wide) |   | 12-17mm                           |
| Open Horizontal Boot Loop | l | 20mm                              |
| Horizontal "T" Open Loop  | T | 25mm                              |

|   |     | Longth of wire in<br>compound loops | Force per mm<br>of activation |
|---|-----|-------------------------------------|-------------------------------|
| Vertical Closed Helix Loop                  | _8  | 24mm                                | 120 gms/mm                    |
| Double Dolta Closing Loop                   | _4  | 36mm                                | 100 gms/mm                    |
| Double Vertical Crossed "T"<br>Closing Loop | -ff | 40mm                                | 80 gms/mm                     |
| Double Vertical Helical<br>Closing Loop     | 88  | . 60mm                              | 75 gms/mm                     |
| Double Closed Extended Helical              | - H | = 70mm                              | 50 gms/mm                     |

## ANCHORAGE

Anchorage control needs will differ from case to case. It is important to identify the needs for each individual case. The quality of the biological anchorage may be enhanced by selective modification of the position of the anchor teeth: cortical anchorage of the first molar (Ricketts), distal inclination of the molars (Tweed, Begg) and differential torque control (Burstone).

#### PRINCIPLES OF ANCHORAGE CONTROL

Anchor loss occurs in all 3 planes of space :

| Sagittal plane<br>- Mesial movement of molars,<br>- Proclination of anteriors | <ul> <li><u>Vertical plane:</u></li> <li>Extrusion of molars,</li> <li>Bite deepening due to anterior extrusion</li> </ul> | <ul> <li>Transverse plane:</li> <li>Buccal flaring due to over<br/>expanded arch form and<br/>unintentional lingual root<br/>torque,</li> <li>Lingual dumping of molars</li> </ul> |
|---|--|--|
| I THE REAL  | S. A.  | -MM-   |

There are two main aspects to anchorage control :

**<u>Reduction of anchorage needs during leveling and aligning</u>**. There is a need to minimize the factors which threaten anchorage and which produce unwanted tooth movements. This reduces the demands on anchorage.

<u>Anchorage support during tooth leveling and aligning</u>. Where necessary, there is a need to use anchorage support, such as palatal or lingual bars, to help to control certain teeth, or groups of teeth.

#### CONTROLOFANCHORAGE IN THE HORIZONTAL PLANE:

1) Anchorage control in the anterior segment

- a) Lacebacks for Antero-posterior canine control: Lacebacks are .010 or .009 ligature wires which extend from the most distally banded molar to the canine bracket. They restrict canine crowns from tipping forward during leveling and aligning. They are mainly used in premolar extraction cases, but they may also be required in some non extraction cases where there is a local threat to anchorage.
- b) Bendbacks for Antero-Posterior Incisor control: These are used as an important method of anchorage support, often in combination with lacebacks. If the archwire is bent back immediately behind the tube on the most distally banded molar, this serves to minimize forward tipping of incisors.

#### 2) ANCHORAGE CONTROL IN THE POSTERIOR SEGMENT

In certain cases, it may be necessary for the upper posterior segments to be limited in their mesial movements, maintained in their positions, or even distalized, to allow the anterior segments to be properly positioned in the face. Posterior anchorage control requirements are normally greater in the upper arch than in the lower arch owing to five main factors:

- The upper molars move mesially more easily than the lower molars
- The upper anterior segment has large teeth than the lower anterior segment.
- The upper anterior brackets have more tip built into them than the lower anterior brackets.
- The upper incisors require more torque control and bodily movement than the lower incisors, which only require distal tipping or uprighting.

#### **CONTROLOFANCHORAGE IN THE VERTICAL PLANE:**

#### A. **Incisor control**

- Avoid engaging the incisors when the canines have a negative angulation
- Utility arches

#### **B**. **Molar control**

- Upper second molar banding to be avoided initially (in high angle cases).
- Expansion if required should be achieved by bodily movement of the posterior teeth (in high angle cases).
- Transpalatal arch should be 2 to 3mm away from the palate.
- High pull or combi pull headgear to be used.
- Posterior bite planes or bite blocks.

#### **Upper Arch**

- 1. Headgear
- 2. Transpalatal Arch

#### Lower Arch 1. Lingual Arch

- 2. Class III elastics
- 3. Nance Holding Arch
- 3. Lip bumper

#### ANCHORAGE CONTROL IN THE LATERAL OR TRANSVERSE PLANE

- Maintenance of upper and lower inter-canine width. A.
- Correction of molar crossbite Β.
  - Rapid maxillary expander
  - Quad helix
  - Transpalatal arch

#### **INCREASING RESISTANCE TO DISPLACEMENT**

#### a. Increase the no. of teeth in anchorage unit: (increase root surface area)

This simple method will increase the root surface area in the anchorage unit. This means that the reactionary forces will now be spread over a large area thus reducing their displacement potential.

#### b. Create buccal segments

The posterior teeth are connected by rigid sectional arch wire(18x25 or 19x25). In the absence of brackets, a rigid sectional arch wire can be bonded to the teeth, to create abuccal segment, which acts like a large multirooted tooth generating a good posterior anchorage. A TPA or lingual arch further augments the anchorage by bridging the bilateral buccal segments across the midline.

#### Transpalatal Arch (TPA)















- Introduced by Robert a Goshgarian.
- Transpalatal Arch is made using a .036" S.S wire .
- It spans the palate between the upper 1<sup>st</sup> molars with a omega loop in the midline and is effective as an anchorage maintenance device as well as an active orthodontic appliance.
- Can be used for molar stablization and anchorage, correction of molar rotation, molar distalization and also for torquing the molars.
- They resist the mesial movement of molars and particularly the tendency of molars to rotate in a mesial direction around the palatal root.Can be fixed or removable
- Fixed soldered TPA is fabricated in 0.036" SS wire with the wire contacting the band in mesiolingual line angle.
- Removable TPA is fabricated in 0.032 round TMA or elgiloy wire.**Burstone (JCO 1988-1989) advocated use of 0.032 inch S.S or TMA**.
- The midline omega loop is usually oriented distally with 1-1.5mm clearance in the palatal area.

#### **Soldered TPA**

(Transpalatal Arch is made using a .036" wire with a center loop and wire solderd to molar bands )

#### **TPA for Molar Intrusion**

- It can provide vertical control by intrusion of molars.
- By placing omega loop in the mesial direction, and increasing the clearance in the palatal area, tongue pressure places an intrusive force on TPA.

#### Nance palatal arch

- Nance palatal arch isused in the upperarch as an anchorage device during levelling and alignment ,in molar distalization cases and a space maintainer.
- It consists of 0.036" SS wire connecting upper first molars and an anterior loop portion covered by acrylic, which rests on the slope of the anterior palate.
- It can provide sagittal anchorage reinforcement and is used as anchorage saver during levelling and alignment and during canine retraction.

#### Vertical Holding Appliance

- Vertical holding appliance is essentially a modification of the transpalatal arch with an acrylic pad.
- The VHA is fabricated with banded maxillary permanent first molars connected with a 0.040 inch chrome-cobalt wire with a dime -size acrylic button at the sagittal and vertical level of the gingival margin of the molar bands.
- Four helices are incorporated into the wire configuration for flexibility.
- The VHA use tongue pressure to reduce the vertical particularly useful in high angle patients where prevention of eruption of posterior teeth during mechanotherapy is difficult. In high angle patients, control of anterior vertical dimension was possible with this appliance compare to a group which used tip-back heads for the posterior teeth in conjunction with a high-pull anterior J-hook headgear.
- Ajodo. 2000 Evaluation of the vertical holding appliance in treatment of high-angle patients.







#### **Modification of TPA**

1. Modified TPA for molar intrusion

**Modified Transpalatal Arch**(M-TPA) For Intrusion Of Maxillary 2<sup>nd</sup> Molars, ORTHODONTIC CYBER JOURNAL, 2009

#### 2. Modified TPA and microimplant for molar intrusion

Intrusion of Supraerupted Maxillary First Molar Using Modified TPA and TAD's A Simple, Clinically Efficient Approach. IJCDS, 2013,

#### 3. TPA FOR DISTALIZATION

*Turk J Med Sci 2004, Asymmetric Maxillary First Molar Distalization with the Transpalatal Arch.* 

#### 4. TPA after expansion for retention











#### **HEADGEAR**

Headgear is an extra-oral appliance which makes use of cervical or cranial anchorage to apply forces to the jaws or teeth, with the purpose of growth modification or teeth movement.

#### **Components of Headgear**

The head gear - face bow assembly has three main components.

- 1. Face bow
- 2. The force element
- 3. The head cap or cervical strap.

Cervical pull Facebow, Combi Facebow and High-Pull facebow:



#### HIGH PULL HEADGEAR

• If force is passing through the centre of resistance of both maxilla and maxillary dentition then the growth of maxilla and its dentition is prevented.







- Can be used as a splint headgear to consolidate the maxillary arch by passing force in between the centre of resistance of in maxilla and maxillary dentition.
- In case force vector passes behind the centre of resistance of maxilla and maxillary dentition it would lead to tipping of occlusal plane down and skeletal component up.
- In case force vector passes in front of the centre of resistance of maxilla and maxillary dentition it would lead to tipping of occlusal plane and skeletal component up this is used in cases of deep bite cases.









#### **CERVICAL PULL**

- If the force from cervical pull passes in between the centre of resistance of the maxilla and maxillary dentition then it would lead to tipping of occlusal plane up and skeletal component down.
- In case the force from cervical pull passes from the centre of resistance of the maxillary dentition below the maxilla then it would lead to tipping skeletal component down and pushes the dental component distally. This configuration is used in cases of distalizing the molars or for anchorage reinforcement. It is viable in patients with low max mand plane angle.
- An easy way to get this configration is to bend the outer bow  $15^{\circ}$  to the occlusal plane.







• Some authors suggest that the cervical pull headgear can lead to extrusion of the molars hence rotate the mandible downward and backward, hence aggravating the class II condition. This is not seen as the condyle also grows which compensates for the molars extrusion







#### **COMBIPULL HEADGEAR**

• In case the force from combipull passes from the centre of resistance of the maxillary dentition below the maxilla then it would lead to tipping skeletal component down and distalize the dental component is used in cases of distalizing the molars. It offers considerable variation in determining the direction of force.

#### ASSYMETRICAL HEADGEAR

• Earlier for assymetrical distalization different amounts of force were used on the two sides. But it was found that the amount of

$$Ml = Flv X Dl$$

$$Mr = Fr X Dr$$
As
$$Dl > Dr$$
so
$$Ml > Mr$$

force acting on the teeth on both the sides remained the same.





#### HEADGEAR BENDING

- For symmetrical forces the outer bow should be ending symmetrically. Hooks are positioned on the outer bow can be adjusted by cutting and bending using heavy duty pliers after annealing the wire. In the Inner face bow a bayonet bend is generally given.
- Make sure that after putting elastic strap the inner bow is not touching patients cheek. Make sure the inner bow fits passively into the headgear tube, else can lead to loose bands. Make sure that the force level is optimum



#### SPLINT HEADGEAR

- In cases where restriction of the whole nasomaxillary complex along with its dentition is required we can give a splint headgear. It consolidates the entire max dentition hence all force is distributed throughout the maxilla.
- It consists of a splint made of bioplast or acrylic with headgear tubes embedde into it .

#### **ACTIVATOR HEADGEAR**

- Activator is given in the correction of skeletal class II. It causes the lower anteriors to flare, to prevent it, activator headgear was devised. It consists of an activator with headgear tubes on both sides embedded into the acrylic.
- The advantage of activator with headgear are
  - 1. Prevents the forward growth of the maxilla and its dentition at the same time pushes the mandible forward.
  - 2. Prevents the flaring of the lower anteriors which would have occurred in cases where activator alone is given

#### **PROTRACTION HEADGEAR**



#### EFFECTS OF REVERSE PULL HEADGEAR

- Correct the CO-Cr discrepancy usually seen in Class III Cases
- Maxillary skeletal and dental protraction
- Lingual tipping of the lower incisors particularly cases with anterior crossbite
- Redirect mandibular growth downward and backward causing a increase in lower anterior facial height

#### **AMOUNT OF FORCE APPLIED**

- Different authors have given different values.
- Force level to be maintained between 300-500 gms on each side. The higher value used for distalization.
- 10hrs/day for anchorage purpose.
- 14hrs/day for distalization purpose.
- •

## Lingual Arch



## Lip Bumper



## **Microimplant Anchorage**

Temporary anchorage devices (TADs) have emerged as a major development in orthodontics in recent years. Miniscrews appeared as the subject of encouraging research and case reports in the late 1990s. We have now been using them for several years, during which time they have become established as a very practicable part of orthodontics which is capable of dramatically expanding the scope of orthodontic treatment.

#### Self-Tapping vs Self-Drilling

Self-tapping mini-implant systems have a noncutting tip and therefore require a pilot hole of the same length as the implant.

It is not necessary, however, to tap a thread into the bone as in some dental implant systems because mini-implants have a self-tapping thread.

The difference of self-drilling systems is that the screws have a cutting tip that makes drilling a pilot hole unnecessary.



Self Tapping.



**Self Drilling** 

#### Possible sites for placement



**Clinical Cases** 

Incisor Intrusion



## Molar Uprighting

Molar Intrusion



Treatment of open bite with microscrew implant anchorage



**En-mass Retraction** 

Tooth Up righting



Deep Bite CorrectionA long crimp-on hook enabling distal traction without incisor intrusion.


# **Expansion in Orthodontics**

# **Slow Expansion Devices**

• Pierre Robin in 1902 was the first one who constructed incorp orated screw.

# **Coffin Spring**

Walter Coffin 1875

**NiTi expander** ROBERT MARZBAN JCO 1999 Aug





h

**NiTi expander** ROBERT MARZBAN JCO 1999 Aug





**W- arch** Ricketts - 1975



**Spring Jet** Aldo Carano JCO 1999 Sept





### Quad Helix and Bi Helix



Schwarz Appliance

Schwarz 1966 (GRABER NEWMEN)

Y plate

(GRABER NEWMEN)



**Rapid Palatal Expansion** 



Derischsweiler







Hass 1970

Issacson

Bidermann



Raymond P How (1982)



Patrick K Turley JCO 1988 May



Butterfly Expander for Use in the Mixed Dentition 1999



John L Spolyar(1984)



David Sarver AJODO 1989 June



A Fan-Shaped Maxillary Expander LUCA LEVRINI JCO NOVEMBER (JCO Oct 1999)

### **EXPANTION SCREWS**

### Hyrax expansion screw



**Telescopic or spring loaded screws** 

### Fan type expansion screw





## SURGICAL ASSISSTED MAXILLARY EXPANSION Technique of SAME









### **Trans palatal distraction**









Mandibular Expansion By Osteogensis GISELA CONTASTI JCO March 2001

# MANDIBULAR EXPANSION

Schwarz appliance - A.M Schwarz





## MOLAR DISTALIZATION

### Molar Distalization-

Molar distalization is a treatment procedure designed to provide space for alignment of teeth and achievement of ideal overjet and overbite as an alternative to premolar extraction.

### CLASSIFICATION

| EXTRA    | INTRAORAL  |  |  |  |
|----------|--|--|--|--|
| ORAL     | Non compliant patient appliance                            |  |  |  |
| Headgear | 1. Flexiblepalatally positioned distalization force system |  |  |  |
|          | A. The pendulum appliance and its modifications            |  |  |  |
|          | • Pendex appliance   |  |  |  |
|          | Hilgers palatal expander                                   |  |  |  |
|          | Mayes penguin design                                       |  |  |  |
|          | Hilgers phd appliance                                      |  |  |  |
|          | Grumrax appliance  |  |  |  |
|          | • VI.T-rex appliance                                       |  |  |  |
|          | • The tracey/hilgers MDA expander                          |  |  |  |
|          | M-pendulum appliance                                       |  |  |  |
|          | • K-pendulum appliance                                     |  |  |  |
|          | • Bipendulum and quad pendulum appliance                   |  |  |  |
|          | Bone supported pendulum appliance                          |  |  |  |
|          | B. The intraoral bodily molar distalizer                   |  |  |  |
|          | C. The simplified molar distalizer                         |  |  |  |
|          | D. The distal jet  |  |  |  |
|          | E. The keles slider  |  |  |  |
|          | F. Nance appliance with ni-ti coil springs                 |  |  |  |
|          | G. The fast back appliance                                 |  |  |  |
|          | 2. Flexible buccally positioned distalization force system |  |  |  |
|          | A. The Jones Jig and Modifications                         |  |  |  |
|          | • The Lokar appliance                                      |  |  |  |
|          | • modified sectional jig assembly                          |  |  |  |
|          | B. Ni-Ti coil springs                                      |  |  |  |
|          | C. Repelling magnets                                       |  |  |  |
|          | D. Ni - Ti wires   |  |  |  |
|          | E. Distalizing arches                                      |  |  |  |
| L        |  |  |  |  |

|    | A. | First Class Appliance   |
|----|----|---|
| 5. |    | Hybrid  |
|    | C. | P-Rax Molar Distalizer  |
|    | В. | New Distalizer  |
|    | A. | Veltri's distalizer   |
| 4. |    | Rigid palatally positioned distalization force system                 |
|    | В. | Nance appliance with NiTi coil spring                                 |
|    | A. | Piston Appliance  |
| 3. |    | Flexible palatally and buccllyy positioned distalization force system |
|    | G. | Carriere Distalizer   |
|    | •  | Acrylic distalization splints   |
|    | •  | Cetlin plate  |
|    | •  | Acco appliance  |
|    | •  | Lip bumper  |
|    | •  | Molar distalization bow   |
|    | •  | Multi-distalizing arch  |
|    | •  | Bimetric distalizing arch   |
|    | 1. | Activite distanzation spinits   |

### HEADGEAR

• Apart from anchorage control and restriction of growth of the maxilla the headgear can also be used for retraction of posterior teeth.

### **Cervical Headgear**

- The equivalent force system at the unit's center of resistance has an extrusive component, a distal component, and a large moment that tends to steepen the occlusal plane.
- Clockwise moment tips the molar crown distally causing extrusion of the upper molars





### **High-pull headgears**

- Force's line of action-is above the center of resistance of the maxillary first molar
- At the maxillary first molar's center of resistance, the headgear force • system has a distal component, an apically directed vertical component, and a large root-distal moment

### Straight-pull headgear

- OB located on the LFO would cause translation in a posterior and slightly superior direction.
- OB's above the LFO will produce posterior and extrusive forces and • clockwise moments.
- Outer bow along an LFO that is parallel to the maxillary occlusal plane will produce a pure posterior translation.

### **Asymmetric Headgear**

- Distal forces exist on both sides, but they are three times greater on the long outer bow side than on the short outer bow side.
- Lateral forces, directed towards the short outer bow side, exist with this headgear causing a crossbite tendency.

### A. Flexiblepalatally positioned distalization force system

### **THE PENDULUM APPLIANCE**

Introduced by Hilgers in 1992 Made with 0.32 inch TMA wire There are two TMA springs inserted in the acrylic, each spring consists of:

- recurved molar insertion wire
- a small horizontal adjustment loop
- a closed helix
- a loop for retention in the acrylic button

















### MODIFICATIONS OF THE PENDULUM APPLIANCE

- 1. Pendex appliance
- 2. Hilgers palatal expander
- 3. Mayes penguin design
- 4. Hilgers phd appliance
- 5. Grumrax appliance
- 6. T-rex appliance
- 7. The tracey/hilgers MDA expander
- 8. M-pendulum appliance
- 9. K-pendulum appliance
- 10. Bipendulum and quad pendulum appliance
- 11. Bone supported pendulum appliance

### **Pandex appliance**

There is midpalatal jackscrew.

Used when expansion of the maxillary arch is needed or to avoid the tendency toward transverse maxillary constriction during distalization.



### Hilgers palatal Expander

Given by Hilgers



### Mayes Penguin design

Given by Mayes in 1999

Differs from the Pendulum appliance in No expansion screw.

Distalizing arm of springs is as close and parallel to the root of the molar as possible, to prevent buccal or lingual movement while allowing distalisation of the tooth.



### The Hilgers PhD Appliance







### **GrumRax appliance**

It differs from Hilgers appliance-

- Occlusal rests on the first maxillary premolars are always present
- TMA spring includes horizontal adjustment loops
- There is no locking wire

### **T-Rex appliance**

Given by Snodgrass 1996



The Tracey/Hilgers MDA Expander (Mini-Distalizing Appliance)

M-Pendulum appliance

**K-Pendulum appliance** Kinzinger G in 2000









### The Bipendulum and Quad Pendulum appliance

- Kinzinger G in 2002
- Nance button and two removable pendulum TMA springs placed unilaterally or four removable springs placed bilaterally which allow the distalization of the second and first maxillary molars in sequence.

Bone supported pendulum appliance

Escobar et al 2007



### THE INTRAORAL BODILY MOLAR DISTALIZER Introduced by Keles and Sayinsu 2000

### THE SIMPLIFIED MOLAR DISTALIZER

-Walde 2003





### THE DISTAL JET

Introduced by Carano and Testa in 1996.

### THE KELES SLIDER





### NANCE APPLIANCE WITH NI-TI COIL SPRINGS

Introduced by - Reiner 1992



### Appliances with Flexible Buccally Positioned Distalization Force System

- The Jones Jig and its modifications
- Ni-ti Coil Springs used For Molar Distalization
- Magnets
- Ni-ti Wires used for Molar Distalization

JONES JIG Jones and White -1992







### • MODIFICATIONS OF THE JONES JIG

- $\Box$  The Lokar appliance
- □ Modified sectional jig assembly

### The Lokar appliance -

- By Scott in 1996
- Modified Sectional Jig Assembly

### NI-TI COIL SPRINGS USED FOR MOLAR DISTALIZATION



### MAGNETS AND MOLAR DISTALIZATION

### NI-TI WIRES USED FOR MOLARDISTALIZATION



K-Loop molar distalizer









### The nickel-titanium double loop system-

Giancotti and Cozza 1998



**U-shaped vertical loop** Vlock 1998



### DISTALIZING ARCHES, ACRYLIC DISTALIZATION SPLINTS

- Bimetric distalizing arch
- Multi-distalizing arch
- Molar distalization bow
- Lip bumper
- Acco appliance
- Cetlin plate
- Acrylic distalization splints
  - □ Acrylic splint with ni-ti coils
  - □ Removable molar distalization splint
  - □ C-Space Regainer
  - □ Carriere distalizer.

### **Bimetric Distalizing Arch/ Wilson's Modular Mechanics**

• Wilson 1978







### The Multi-Distalizing Arch

• Introduced by ortho organisers

#### The Molar Distalization Bow

Jeckel and Rakosi 1991 •

Lip bumper

Korn Lip Bumper

### ACCO

• Margolis

**Removable distalizing plate / Cetlin plate** 

### Acrylic Splint With Ni-Ti Coils

Manhartsberger 1994

### **Removable Molar Distalization Splint**

- Ritto •
- RMDS Type II -consists of
- RMDS type III • Ritto 2003

1.5 mm thick acrylic splint incorporating two clasps for retention to the first premolars and an Eureka spring with its lower point removed and tapered to allow insertion of a 0.045" molar tube.























### **C-Space Regainer**

• Kyu-rhim Chung in 2000



### **Carriere Distalizer**

• provides a rotation movement of the maxillary first molars around their palatal root and receive a distalization impulse resulting in bodily distal movement1





### Appliances With Flexible Palatally and Buccally Positioned Distalization Force System

- Piston appliance / Greenfield molar distalizer
- Nance appliance with ni-ti coil springs

### **Piston appliance**

• Greenfield 1995

### NANCE APPLIANCE WITH NI-TI COIL SPRINGS

• Puente 1997





### APPLIANCES WITH RIGID PALATALLY POSITIONED DISTALIZATION FORCE SYSTEM

- Veltri's Distalizer
- New Distalizer
- P-rax Molar Distalizer
- Distalizer Fast Back

### **VELTRI'S DISTALIZER**

• For maxillary second molar distalization

Consists of a Veltri sagittal expansion screw incorporating four extension arms, which are soldered bilaterally to the first and second maxillary molar bands

### **NEW DISTALIZER**

• Baccetti and Franchi 2000

### DISTALIZER FAST BACK

• C. Lanteri and F. Francolini.

### **P-RAX MOLAR DISTALIZER**

• Paz 2001

### Asymmetric Distalization with a TMA TPA

• Mandurino et al 2001

### Mandibular Arch Distalization

• Byloff 2000



## HYBRID APPLIANCES

#### FIRST CLASS APPLIANCE • Fortini et al 1999





### IMPLANTS FOR DISTALIZATON









### **UTILITY ARCHES**

### I) RICKETTS UTILITYARCH

### 1950's Robert Ricketts

### I) MAXILLARY INTRUSION UTILITY ARCH

A 0.016 x 0.022" Blue Elgiloy is used for upper utility arch. The maxillary utility arch has three activations in the molar section.

- 1) Tip back of  $45^{\circ}$ .
- 2) Distolingual rotation of  $10 \ 20^{\circ}$ .
- 3) Expansion of approximately 1 cm in each side.

The upper utility arch takes approximately 125 160 grams.



### **II) RETRACTION UTILITY ARCH**

Used in both the mixed and the permanent dentitions to achieve retraction and intrusion of incisors.

The retraction utility arch is used less commonly in the mandible. It may be placed, however, in patients with dentoalveolar anterior cross bite in whom there is some proclination and spacing of the mandibular incisors.

**FABRICATION** -: The retraction utility arch is formed like the intrusion utility arch. The only difference is that loop is incorporated in this arch wire.

**ACTIVATION** -: As with intrusion utility arch, there are two possible types of activation. First the wire is pulled 3-5 mm posteriorly with weingart pliers and then bent upward at an angle. Second, an occlusally directed gable bend in the vestibular segment is used to produce intrusion.

### **III) PROTRACTION UTILITY ARCH**

Used to procline and intrude maxillary and mandibular incisors.

### FABRICATION

It is fabricated like the retraction utility arch. Only difference is in formation of loop.







### ACTIVATION

When the protraction utility arch is passive, the anterior segment lies about 2-3 mm anterior to its ultimate position in the incisor brackets. Tying the anterior segment of the utility arch into the brackets produces the protrusive force. An occlusally directed gable bend in the posterior aspect of the vestibular segment produces intrusion.

The protrusion arch is reactivated by removing the anterior segment from the brackets, bending the posterior vertical step forward from  $90^{\circ}$  to  $45^{\circ}$  and replacing the arch wire in the bracket. Other adjustments can be made in both the anterior and posterior vertical steps to produce further activation.

### Modification of utility arch

1) Expansion utility arch



3) Utility arch with T or L Horizontal loop



2)Contraction utility arch



4) Contraction or advancing utility arch



**INTR** 

### I V ) USIONARCH

**Mulligan's** utility arch or 2 x 4 appliance is used for incisor intrusion and molar extrusion in deep bite cases. The archwire used is round 0.016" stainless steel. The bracket slot is 0.022 x 0.025".

MULLIGAN'S

The tipback bends or 'V' bend given to the arch wire for intrusive action on incisors and extrusive action on molars.



The tip back produces light intrusive forces on the incisors. In cases of growing patients the intrusive force should be light to hold the incisors at their positions. In adult patients with deep bite, heavier intrusive force is used for intrusion of the anteriors.



### IV) SIMULTANEOUS INTRUSION AND RETRACTION

### **APPLIANCE DESIGN**

The K-SIR (Kalra simultaneous Intrusion and Retraction) archwire given by **Varun Kalra**<sup>48</sup> is a modification of the segmented loop mechanics of **Burstone.** It is a continuous 0.019" x 0.025" TMA archwire with closed 7mm x 2mm U loops at the extraction sites.



### 20° antirotation bends placed in archwire just distal to U-loops. K-sir Archwire with TMA wire





### V) THE CONNECTICUT INTRUSION ARCH

### **APPLIANCE DESIGN**

The Connecticut intrusion arch (CTA) given by Ravindra Nandais fabricated from a nickel titanium alloy.

Two wire sizes bay be used: 0.016" x 0.022" and 0.017" x 0.025". The maxillary and mandibular versions have anterior dimensions of 34 mm and 25 mm, respectively.

|  | Maxillary | Mandibular |
|--|-----------|------------|
| Posterior dimension: Long<br>(Non extraction)                | 22 mm     | 22 mm      |
| Posterior dimension: Short<br>(Extraction & mixed dentition) | 15 mm     | 15 mm      |



### VI) BITE OPENING AND SPACE CLOSING ARCHWIRE

This arch wire is given by Leonard Bernstein. The purpose of this archwire is to provide an

upward and backward force in an arc-shaped motion to the maxillary central and lateral incisors with retraction force at the same time. By keeping a distal closing force on these teeth, the upward and backward force producing bite opening seems to be enhanced. 0.018" x slot bracket with



wires of 0.016, 0.018 and 0.016 x 0.022 gauge are most commonly used.



### CORRECTION OF DEEP BITE WITH EQUIPLAN QUAD HELIX COMBINATION

Dr. J. M. S. Pato developed the appliance in 1992 by attaching a planas equiplan to a quad helix or a transpalatal bar.

The palatal expander is inserted into the lingual tubes of the first molar bands or welded directly to the molar bands. The planas equiplan is attached to the anterior arms with acrylic or directly to the anterior helices of the Quad helix.

The equiplan quad Helix appliance can be used successfully in patients of any age with dental deep bite, in growing patients with skeletal deep bite. Its main advantage is that the fixed Quad

Helix expands the palate at the same time that the occlusal plane is unlocked, so that orthodontic movements can be performed without interference.

### A LINGUAL ARCH FOR INTRUDING AND UPRIGNTING LOWER INCISORS<sup>52</sup>

A simple lingual arch with elastomeric chain attached to lingual buttons on the incisors overcomes the problems of both sectional and full arches by creating equal downward force vectors that pass behind the centers of resistance of all four incisors.

### **Appliance design**

A 0.036" lower lingual arch is soldered to first molar bands. Distal extension forms occlusal rest on the second molars to prevent distal tipping of the first molars as the incisors are intruded.

Four elastic chains are attached to the anterior bridge of the lingual arch with the mosquito forceps. If intrusion is primary

goal and the teeth are already fairly upright, the elastic chains should come off the lingual arch on the labial side.







### SIMULTANEOUS INTRUSION AND RETRATION USING A THREE-PIECE BASE ARCH

Bhavana Shroff developed the appliance in 1997



MCNAMARA UTILITY ARCH James A Mcnamara in 1986 develop of utility arches



Passive utility arch,



Intrusion utility arch, with posterior vertical step 5-8 mm anterior to auxiliary tube on upper first molar.

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



Effect of intrusive forces on mandibular incisors: incisors are intruded while molars is tipped posteriorly.



Retraction utility arch, the loop anterior vertical step is activated while the molar segment is retruted.



### FIXED FUNCTIONAL APPLIANCE

### CLASSIFICATION

| FLEXIBLE FIXED<br>FUNCTIONAL<br>APPLIANCE | <b>RIGID FIXED FUNCTION APPLIANCE</b>                  | HYBRID FIXED<br>FUNCTIONAL APPLIANCE          |
|---|--|---|
| The Jasper jumper                         | Herbst appliance                                       | HYBRID FIXED FUNCTIONAL                       |
| J   | 1. Herbst (original)                                   | APPLIANCE                                     |
|   | 2. Banded Herbst                                       |   |
|   | 3. Cast splint Herbst                                  |   |
|   | 4 Acrylic splint Herbst                                |   |
|   | 5. Goodman's Modified Herbst                           |   |
|   | 6. Herbst (type II)                                    |   |
|   | 7 Herbst (type iv)                                     |   |
|   | 8 Ormco bite jumping appliance                         |   |
|   | 9 Flin lock Herbst appliance                           |   |
|   | 10 MALU (mandibular advancement locking unit)          |   |
|   | 11 Swedish style integrated Herbst (based on MALU)     |   |
|   | 12 MARS (Mandibular advancement repositioning splint)  |   |
|   | 12. MARS (Manufoural advancement repositioning spinit) |   |
|   | 14. CPI(Contilever bits jumper)                        |   |
|   | 15. Intrucion Herbet                                   |   |
|   | 15. Initiation Herost                                  |   |
|   | 17. IST (Integrated Supering Thereast)                 |   |
|   | 17. IST (Integrated Shoring Therapy)                   |   |
|   | 18. HUPS   |   |
|   |  |   |
|   | 20. Magnetic telescopic appliance                      |   |
|   | 21. Smith type I Herbst                                |   |
|   | 22. Smith type II Herbst                               |   |
|   | 23. Smith type III Herbst                              |   |
|   | 24. MCA (Mandibular corrector appliance)               |   |
|   | 25. Magnusson Herbst                                   |   |
|   | 26. Herbst Telescoping                                 |   |
|   | 27. Hanks telescopic Herbst                            |   |
| Amoric torsional coil                     | The Cantilevered Bite Jumper                           | Eureka spring™                                |
| The Adjustable Bite Corrector             | The Cantilevered Bite Jumper                           | Eureka spring™                                |
| The Scandee Tubular Jumper                | MALU Herbst Appliance                                  | The twin force bite corrector                 |
| The Klapper Super Spring                  | Flip-Lock Herbst Appliance                             | Forsus <sup>TM</sup> fatigue resistant device |
| The Bite Fixer                            | The Ventral Telescope                                  |   |
| The Churro Jumper                         | The Magnetic Telescopic Device                         |   |
|   | The Mandibular Protraction Appliance                   |   |
|   | 1. MPA 1   |   |
|   | 2. MPA II  |   |
|   | 3. MPA II  |   |
|   | 4. MPA IV  |   |
|   | The Universal Bite Jumper                              |   |
|   | The BioPedic Appliance                                 |   |
|   | The Mandibular Anterior Repositioning Appliance        |   |
|   | The IST Appliance                                      |   |
|   | The Ritto Appliance                                    |   |

JASPER JUMPER (prefabricated)

Given by Jaspar Jumper in 1987

Given by Amoric M in 1994

AMORIC TORSIONAL COIL (prefabricated)

### THE ADJUSTABLE BITE CORRECTOR (prefabricated)

Given by Richard P. West in 1995



### THE SCANDEE TUBULAR JUMPER (prefabricated)

Given by Saga Dental AS, Kongsvinger, Norway)

THE KLAPPER SUPER SPRING (prefabricated) Given by Lewis Klapper, 1999

THE BITE FIXER ( prefabricated ) Ormco 1717 West Collins Avenue

THE CHURRO JUMPER Given by Castañon R. et al in 1998













### **Fabrication of Churro Jumper**

A long as series of 15-20 symmetrical and closely placed circles are formed in a wire. The wire size is 0.032".

A turret is made by an acrylic handle, a headed nail, and a headless nail that approximates the thickness of an 1" wire and acts as an spindle around which the circles can be formed.

Once the Churro wire has 15-20 circles, and the ends are on the same side and in the same plane, the appliance is removed from the metal shaft, and new wires can be formed until a collection is available for completion.

A small disposable plastic syringe is filled with a mixed polyvinyl impression material that is injected into the lumen of the jumper. This fills the appliance with a material that does not restrict its flexibility, but prevents the coils from opening and pinching the tongue and cheeks as it functions.

- A buccal offset in the wire just is placed distal to the canine bracket so that the jumper also has buccal clearance, which permits unrestricted sliding along the wire.
- The length of the jumper is determined by the distance from the distal of the mandibular canine bracket to the mesial of the headgear tube on the maxillary molar band, plus 10-12mm.

This measurement is transferred to the Churro Jumper, with the coil closer to the canine bracket than to the headgear tube. A circle is then formed at each termination mark on the Churro wire, so that the coils of the jumper lie against the cheek and the terminal circles face the teeth. The maxillary circle is completely closed, but the mandibular circle is only partially closed to allow its placement over the mandibular archwire and subsequent closure.

- A pin made of annealed .036" wire is used to secure the maxillary circle through the distal of the headgear tube. The maxillary pin is pulled mesially through the headgear tube until the jumper has a slight buccal bow in it, and is then turned down.
- Initially, the pin is not cinched tightly against the tube, which improves patient comfort and allows space for later adjustments. At subsequent appointments, as the teeth move and adjust to the forces of the Churro Jumper, the headgear pin is pulled forward to reactivate it.
- The mandibular circle is placed over the mandibular archwire against the canine bracket.
- At the point of insertion of appliance the patient was on 0.019x0.025" stainless steel wire with an overjet of 5-6mm and mandibular arch was in distal occlusion.
- The wires are cinched back distal to the molars. Ends of the mandibular archwire be annealed and turned down distal to the terminal molars to act as tiebacks that will limit flaring of the mandibular incisors.

















#### THE HERBST APPLIANCE (prefabricated)

(Herbst E in 1910, Pancherz H in 1979)

The Herbst appliance was first described by Emil Herbst in 1905 at the Berlin Dental Congress. After that very little was written on this appliance until the end of the seventies when Hans Pancherz brought it back into discussion with the publication of a series of articles.

The Herbst appliance consists of two tubes, two plungers, axles and screws. The original device is a banded Herbst design. The Herbst appliance has undergone some changes in its original design but since the seventies has maintained its general shape with only a few modifications taking place with regard to methods of application (Type I, II and IV).

Type I is characterized by a fixing system to the crowns or bands through the use of screws. This is the most common form. It is necessary to weld the axles to the bands or crowns and then fix the tubes and plungers with the screws.

Type II has a fixing system that fits directly onto the archwires through the use of screws. This method of application has the disadvantage of causing constant fractures in the archwires. The lack of flexibility together with the difficulty in lateral movements and the stress placed on the archwires through activation causes fractures, especially in the lower arch.

Type IV has a fixation system with a ball attachment, which allows greater flexibility and freedom of mandibular movement. A disadvantage in relation to other similar appliances is the fact that it needs brakes to stabilize the joint. The brakes are small and sometime difficult to fit. When a fracture occurs or a brake is lost, the appliance becomes loose.

Modifications of herbst appliance

Herbst (original)

Banded Herbst

Cast splint Herbst Acrylic splint Herbst Goodman's Modified Herbst Herbst (type II) Herbst (type iv) Ormco bite jumping appliance Flip lock Herbst appliance MALU (mandibular advancement locking unit) Swedish style integrated Herbst (based on MALU)

MARS (Mandibular advancement repositioning splint) Standard bite jumping appliance CBJ(Cantilever bite jumper) Intrusion Herbst Universal bite jumping appliance IST (Integrated Snoring Therapy) HUPS OPM Magnetic telescopic appliance Smith type I Herbst Smith type II Herbst Smith type III Herbst MCA (Mandibular corrector appliance) Magnusson Herbst Herbst Telescoping Hanks telescopic Herbst











### THE CANTILEVERED BITE JUMPER

(prefabricated) (Ormco 1717 West Collins Avenue,)



1



(prefabricated)

(Saga Dental Supply A/S, postboks 216, Kongsviner, Norway)

### FLIP-LOCK HERBST APPLIANCE

### (prefabricated)

(TPOrthodontics, Inc, 100 Center Plaza, LaPorte, IN 46350).

The first generation was made from a dense polysulfone plastic but breakage occurred because of the forces generated within the ball-joint attachment.

In the second generation, the plastic was replaced with metal. However, fracture problems persisted.

The third generation is made of a horse-shoe ball join.

This system has proved to be more efficient than the previous models, both in terms of application as well as its resistance to fracture (Miller R., 1996).

### The Ventral Telescope (prefabricated )

(Professional Positioners, Inc., 2525 Three Mile Road, Racine Wisconsin 53404 1328).

### THE MAGNETIC TELESCOPIC DEVICE (prefabricated)

Ritto A.K in 1997

### THE MANDIBULAR PROTRACTION APPLIANCE

(Filho C., 1995, 1997, 1998) This is an RFFA which was developed to be quickly made up by the orthodontist in the laboratory.















Its advantages include ease of fabrication, low cost, infrequent breakage, patient comfort and rapid fitting. Another advantage it offers is that it can be made up at any time. This is helpful when there has been a failure in the supply of other commercially available appliances or if the orthodontist practices in an area where it is difficult to quickly obtain certain other alternatives.

The designer of the MPA developed three different types:

MPA I each side of the appliance is made by bending a small loop at a right angle to the end of an .032" SS wire. The length of the appliance is then determined by protruding the mandible and another small right-angle circle is then bent in an opposite direction. The appliance slides distally along the mandibular archwire and mesially along the maxillary archwire. Bicuspid brackets must be debonded.

Limited mouth opening is the major disadvantage.

MPA II This is made by making right-angles circles in two pieces of .032" SS wire. A small piece of slipped coil is slipped over one of the wires. One end of each wire is then inserted through the loop in the other wire. This version allows the mouth to open wider than the first version.

MPA III This version eliminates much of the archwire stress that occurs with the MPA I and II. It permits a greater range of jaw movement while keeping the mandible in a protruded position. It is adaptable to either Class II or Class III malocclusions. It resembles the Herbst by also incorporating a telescoping mechanism but is smaller insize. It requires more time to be built and a good electronic welder that does not darken or weaken the wire.





### MPAI

The first type of mandibular protraction appliance (MPA) requires stainless steel edgewise archwires in both arches.

The mandibular archwire requires stops such as circles, crimpable hooks, or loops distal to the cuspids to prevent direct contact between the appliance and the bonded brackets.

Mandibular Protraction Appliance I with stops placed in mandibular archwire distal to cuspids.

- Banding the cuspids and placing a connecting lingual arch allows the clinician to use the cuspid brackets as stops as well.
- Additionally, the lower archwire should have enough lingual torque in the anterior region to resist labial displacement of the lower incisors from the protrusive pressure of the appliance.
- It should be tightly cinched back with a tip-down distal to the mandibular tube or a ligature securely placed around a tieback loop that rests directly against the mandibular tube.

• The maxillary edgewise archwire doesn't need a stop, tieback, or special torque adjustment.

### Appliance construction

- Each side of the appliance is made by bending a small loop at a right angle to the end of an .032" stainless steel wire.
- The length of the appliance is then determined by protruding the mandible into a position with proper overjet, overbite, and midline correction and measuring the distance from the mesial of the maxillary tube to the stop on the mandibular archwire.
- Another small right-angle circle is then bent in an opposite direction into the other end of the .032" stainless steel wire.
- The angulation of these circle bends can vary to allow free sliding along the mandibular archwire.
- One appliance circle is placed over the maxillary archwire against the molar tube, and the other circle against the mandibular archwire stop. Both circles are then closed completely with a plier.

by coil.

sufficient torque in the anterior portion to resist labial incisor inclination and should have occlusally

steel wire. MPA2

loop. The maxillary edgewise archwire is made with an ordinary amount of anterior torque and with occlusally directed circles against the molar tubes. The mandibular edgewise archwire should have

The MPA No. 2 is fabricated by making right-angle circles in two pieces of .032" stainless steel wire.

A Appliance length measured from mesial of maxillary tube to mandibular archwire stop with mandible in proper protruded position. B Small right-angle loop bent in opposite direction into other end of .032" stainless

- A small piece of rigid coil or stainless steel tubing is slipped over one of the wire.
- The coils are made from .024" stainless steel wire with a Tweed loop-bending plier.
- One end of each wire is inserted through the other wire's loop, so that each wire passes through the other up to the limit of the wire coil.
- The coil prevents the two wires from interfering with each other andensures their correct
- relationship.

Coil of .024" stainless steel wire slipped over one wire. One end of each wire inserted through other wire's

cinched back by turning the archwire down distal to the mandibular tubes, or should have ligatures attached to tieback loops against the mandibular molar tubes. Travel of each wire limited by wire coil. Improper relationship of wires is prevented

directed circles placed about 2-3mm distal to each cuspid. The lower archwire should be firmly







B







A.Maxillary archwire has occlusally directed circles against molar tubes; mandibular archwire has occlusal circles 2-3mm distal to each cuspid.B.Measurement between mesial surface of maxillary molar tube and mandibular circle

The appropriate length of each wire assembly is determined by placing the archwires in the mouth and having the patient position the mandible with the correct overjet, overbite, midline, and molar

occlusion. The distance between the mesial surface of the maxillary molar tube and the mandibular circle is then measured on each side. This distance is transferred to each wire assembly, and attachment loops are bent in the wire ends for the maxillary and mandibular archwire circles.

#### Fabrication of MPA III

#### **Appliance Construction**

The parts needed for the construction of the MPA No. 3 (Fig. 3) are:

- Two maxillary tubes of .045" internal diameter, each about 27mm long
- Two maxillary loops of .040" stainless steel wire, each about 13mm long, with a loop bent into one end at an angle of about 130° to the horizontal
- Two mandibular rods of .036" stainless steel wire, each about 27mm long
- Four pieces of band material

• Two short lengths of annealed .036" stainless steel wire, each with a loop in one end, for attachingthe appliance to the maxillary molar headgear tube using a good electronic welder that does not darken or weaken the wire by annealing, weld eachmaxillary tube to a maxillary loop (Fig. 4). Weld two pieces of band material around the combinedwires; this will eliminate the need for soldering (Fig. 5). Prepare a stainless steel edgewise mandibular archwire by bending an "O" loop on each side distal tothe cuspid, winding the wire twice around a Tweed loop-forming plier (Fig. 6). I prefer at leastan .019" X .025" wire, but smaller and more flexible wires such as .016" X .022" and .017" X .025"have reportedly resisted breakage with the MPA No.

3.9Prepare each .036" mandibular rod by making a 90° bend at one end (Fig. 7). Place a small piece oftubing over the same end, then crimp and weld it so it stays fixed. Insert the longer leg of themandibular rod through the "O" loop in the archwire from the lingual. Manipulate the rod upward until it is nearly perpendicular to the wire

A. Annealed .036" pin bent down mesial to headgear tube. B. Maxillary tube attached mesial to headgear tube. C. Annealed pin inserted at mesial end of headgear tube



Maxillary loop welded to maxillary tube



Two pieces of band material welded around maxillary components.



Mandibular archwire with "O" loops distal to cuspids.



Mandibular rod with 90° bend at one end and small piece of tubing welded to shorter leg









### Fabrication of MPA IV

### Fabrication of Mandibular protraction appliance (MPA IV)

The appliance is fabricated as per the basic guidelines given by Filho in 2001, with modifications.

The MPA IV is made up of the following parts:

- 1. "T" tube
- 2. Upper molar locking pin
- 3. Mandibular rod
- 4. Mandibular archwire
- 1. Two needles of 10 and 16 gauge are used with longer tube of 10 and shorter tube of 16 gauge for T tube.
- 2. Two perpendicular sections of 10 and 16 gauge stainless steel needle are spot-welded to hold them in place until soldering.
- 3. Intersection of the longer and shorter tubes are soldered.
- 4. The excess of each shorter tube is cut off using a cutting disk. The excess tubing could be reused.
- 5. To maintain that the mandibular rod do not come out from the tube, a drop of silver solder is applied at the end of the longer tube.
- 6. The upper molar locking pin is fabricated by adding a small drop of silver solder to one end of a section of 19 gauge stainless steel wire. The solder drop is rounded off using a bur to make it as small and smooth as possible to avoid buccal irritation.
- 7. The molar locking pin is inserted into the smaller section of the "T" tube, and is pulled through it till the solder drop fits snugly in the tube. A reference point is marked on the molar locking pin with a pen where it emerged on the other side of the "T" tube.
- 8. The molar locking pin is then removed and bent gently at the reference mark. The molar locking pin is then inserted into the smaller section of the "T" tube. If the bend is found to be too acute, it is slightly deactivated with the plier.
- 9. The bend is then finished with a heavy plier so that the molar locking pin is parallel to longer portion of "T" tube.
- 10. Stainless steel rod of 0.070" diameter is used to prepare the mandibular rod. A small perpendicular bend is made at one end with help of heavy plier and a small drop of silver solder is applied on that end. The solder drop is finally finished with the bur.

The molar locking pin is cut to a manageable length, and annealed its tip so as to make it easy to bend during placement.

### THE UNIVERSAL BITE JUMPER (prefabricated)

(UBJ) (Calvez X, 1998)



### THE BIOPEDIC APPLIANCE

(GAC International, Inc., 185 Oval Drive, Central Islip, NY 11722 1402).

### THE MANDIBULAR ANTERIOR REPOSITIONING

### APPLIANCE

(MARA) (AOA, 13931 Spring Street, PO Box 725, Sturtevant, WI 53177).





**The IST Appliance** (prefabricated) (Sheu Dental, 58613 Iserlohn, Germany).



(Ritto A.K in 1998)

**THE CALIBRATED FORCE MODULE** Developed in 1988 by the CorMar Inc.

EUREKA SPRING<sup>TM</sup>

Given by De Vincenzo (1997)

**THE TWIN FORCE BITE CORRECTOR™** THE TWIN FORCE BITE CORRECTOR is a trademark of Ortho Organizers Inc., 1619s Rancho Santa Fe Rd. San Marcos CA92069.

FORSUS<sup>TM</sup> FATIGUE RESISTANT DEVICE ( prefabricated)

ALPERN CLASS II CLOSERS (prefabricated)

SABBAGH UNIVERSAL APPLIANCE(prefabricated)



















### **Midline elastics**

- Placement Maxillary lateral incisor ball hook to opposite mandibular lateral incisor ball hook.
- Force: 1/4; inch; 6 oz
- Uses
  - o To correct midline discrepancies
- When: Finishing archwires
- Time: 24 hours per day, except when eating.

### Anterior box elastics, class 2

- Placement Maxillary central incisor brackets to mandibular lateral incisor brackets
- Force: 3/16inch; 6 oz
- Uses
- o To close the bite in a Class II malocclusion
- When: In intermediate and finishing archwires
- Time: 24 hours per day, except when eating

### Anterior box elastics, class 3

- Where: Maxillary lateral incisor brackets to mandibularcentralincisor brackets
- Force: 3/16 inch; 6 oz
- Why: To close the bite in a Class III malocclusion
- When: Intermediate and finishing archwires
- Time: 24 hours per day, except when eating

### Lateral box elastics, class 2

- Where: Maxillary lateral incisor and canine brackets tomandibular canine and premolar brackets
- Force: 3/16 inch; 6 oz
- Why: To increase the overbite and improve the caninerelationships
- When: Finishing archwires, Class II malocclusion
- Time: 24 hours per day

### Lateral box elastics, class 3

- Where: Maxillary lateral incisor and canine brackets to mandibularlateral incisor and canine brackets
- Force: 3/16 inch; 6 oz
- Why: To increase the overbite and improve the canine positions
- When: Finishing archwires, Class III malocclusion
- Time: 24 hours per day.

### Buccal box elastics, class 2

- Where: Maxillary canine and premolar brackets to mandibular premolar brackets
- Force: 3/16 inch; 6 oz
- Why: To help level the mandibular arch and improve cusp-fossa interdigitation
- When: Maxillary finishing archwire, mandibular intermediate or final archwire, Class II malocclusion
- Time: 24 hours per day

### Buccal box elastics, class 3

- Where: Maxillary canine and premolar brackets tomandibular canine and premolar brackets
- Force: 3/16 inch; 6 oz
- Why: To help level the mandibular arch and improve cusp-fossa interdigitation
- When: Maxillary finishing archwire, mandibular intermediate or final archwire, Class III malocclusion
- Time: 24 hours per day















### **Trapezoid elastics, class 1**

- Where: Maxillary canine and premolar brackets tomandibular canine, first premolar, and second premolarbrackets (plus other configurations)
- Force: 3/16 inch; 6 oz
- Why: To help level the mandibular arch and improve cusp-fossa interdigitation in Class I malocclusion
- When: Finishing archwires
- Time: 24 hours per day

### **Triangular elastics, class 1**

- Where: Maxillary canine bracket to mandibular caninepremolararea (plus other • possible configurations)
- Force:1/8inch; 3.5 oz
- Why: Apply direct force to a single tooth in Class I cases
- When: Stabilized opposing archwire and a flexible archwire for the tooth to be moved
- Time: 24 hours per day

### **Countdown to retention**

- Where: Special attachment for specific malocclusion •
- Force: 3/4 inch; 2 oz(only this elastic is used)
- Why: Final posterior settling
- When: Usually the last 6 weeks of active treatment
- Time: 24 hours per day

### **Elastic attachment**

- For Class II malocclusion, the configuration is a W shape with a tail •
- W shape with a tail
- If additional anterior verbite correction is needed, anterior box elastics may be used.
- For Class III malocclusion, the configuration is an M shape with a tail
- Time: 24 hours per day
- For Class I malocclusion, the configuration is an M-1/2 shape
- Time: 24 hours per day

### Vertical "Spaghetti" Elastics

- Then, using 3/16", 2 or 3  $\frac{1}{2}$  ounce elastics, a series of triangular elastics are • placed between the two dental arches.
- The three arms of the triangular elastic include the distal bracket wing of one maxillary tooth, the mesial bracket wing of the tooth posterior to it and the entire bracket of the mandibular tooth closest to the two maxillary teeth

### Continuous elastics with class II pull

- When: For a class II pull •
- Force: <sup>3</sup>/<sub>4</sub>", 2 oz elastics is started over the lower second and upper first molar.
- Where: Elastic is twisted and engaged over the next two teeth, and sequence is repeated to the maxillary central incisor on the opposite side of the midline.

### Continous elastics with class III pull

- For a class III pull, a <sup>3</sup>/<sub>4</sub>", 2 oz elastics is started over the upper and lower second molars.
- The elastic is twisted between each pair of teeth and ends on central incisor on opposite of the midline.
- They should preferably be worn full time (24 hours/day) for maximum effect,

















### **Elastics in Beggs**

#### **Stage I elastics:**

- 1. Yellow elastics
  - Force:2-2 <sup>1</sup>/<sub>2</sub> ounces of force
  - Where: intrmaxillary circle in upper arch to mandibular first molar in the lower arch
  - Time -24 hrs,(to be replaced after every 24 hrs)

### S<u>tage II</u>

### Class I:Pink/green elastics

- Force levels:2<sup>1</sup>/<sub>2</sub>-3 oz
- Where: from cuspid circle to first molar in the same arch
- Class II / Class III elastics- To maintain the anteroposteriorocclusal relations of the buccal teeth

#### <u>Stage III</u>

- Blue elastic
- Where: cuspid circle to 1<sup>st</sup> molar
- 1 elastic per extraction space.
- 6 elastics are being worn in the shape of letter Z
- 2-2<sup>1</sup>/<sub>2</sub> oz
- When: Prevent the force exerted by vertical root torquing spurs in the upper auxillaryarchwire from moving whole of upper dental arch anteriorly

#### **Roadrunner elastics**

- Role of light Class II elastics light elastic force for longer periods (from 2 to 5 days), a very light Cl. II force is provided most of the time.
- Force: use of 3/8 ultra light elastics e.g., "road-runner elastics

### **EXTRAORALELASTICS:**

- Extra oral elastics are used with extra oral mechanic systems.
- These includes elastic modules, plastic chains and heavy elastics.
- They are used:
- From Face bow
- Anchorage from high pull strap to head gear (Jumbo elastics)
- From Face Mask
- Heavy elastics and plastic chain are used with the head gear

#### Sizes :

- Extra-Oral Elastic Extra Heavy :10mm (3/8) Inside Diameter
- Extra-Oral Elastic Extra Heavy : 12mm (1/2) Inside Diameter

#### **Prestretching:**

- Always consistent in size and force, activated force is reached when elastic is stretched 3x's its original size.
- Extra-Oral elastics are 16-ounces in force.









#### **Finishing and Detailing**

Good finishing and detailing is a prerequisite for functional and esthetic stability. For excellent finishing we need to begin with the end in mind

#### Dougherty (1976) outlined 17 factors to be considered in finishing and detailing.

- 1. Correction and over correction of anteroposterior jaw relationship.
- 2. Establish correct tip of upper and lower anterior teeth.
- 3. Establish correct torque of upper and lower anterior teeth.
- 4. Coordinating arch forms and arch widths.
- 5. Establish correct posterior crown torque.
- 6. Establishing marginal ridge relation and contact points.
- 7. Correction of midline discrepancies.
- 8. Establishing interdigitation of teeth.
- 9. Checking cephalometric objectives.
- 10. Checking root parallelism.
- 11. Maintaining closure of all spaces.
- 12. Evaluating profile and facial esthetics.
- 13. Checking for TMJ dysfunction's like clicking and locking.
- 14. Checking functional movements.
- 15. Determining of all habits have been corrected.
- 16. Correction of rotations and overcorrection when needed.
- 17. Establishing flat occlusal plane.

Rebecca Poling in 1999 gave following points to be checked for finishing the occlusion

Examination of the panoramic radiograph for root angle bends

Examination of the patient's facial form, incisor display, and gingival contours

Evaluation of coincidence of facial midlines with dental midlines and occlusal plane

Evaluation of the profile and anterior torque

Evaluation of the temporomandibular joints and function

Evaluation angle classification and overjet

Evaluation posterior transverse concerns

Evaluation vertical relationships

Evaluation spacing and tooth size relationships

Evaluation of maxillary anterior tooth positions

Evaluation maxillary right posterior segment and the maxillary left posterior segment

Evaluation of the mandibular anterior segment

Evaluation of the mandibular right and mandibular left posterior segments

Intraoral evaluation of alignment and interdigitation of the occlusion

# Checking the Parallelism of Roots and establishing Correct Tip of the Upper and Lower teeth Assessment of tip:

- A panoramic radiograph is obtained. The orthodontist examines the panorex for root parallelism and notes where, how, and to what degree to make root angle bends.
- For example, when the maxillary central incisors' roots are too divergent, the proximal contact is located too incisally and an unesthetic triangular black space is created. The orthodontist should make a "V" bend in the wire to upright the central incisors' roots bringing them together moving the proximal contact gingivally creating a normal gingival embrasure.
- If adjacent roots are too close together, a "tent" bend is made to move them apart. Another common problem area is in root angulation of maxillary second premolars and maxillary first molars.
- For example, when evaluating the marginal ridges of the maxillary second premolar and the maxillary first molar one may notice that the distal marginal ridge of the second premolar is much more gingival than the mesial marginal ridge of the first molar. When evaluating the panorex, it is noted that there is too much mesial root angulation of the maxillary second premolar. This could have resulted from difficult bracket positioning on a partially erupted maxillary second premolar so that the bracket might not be angulated far enough gingivally on the distal. The bracket on the maxillary first molar might be in an ideal position. This root and occlusal table relationship would result in a marginal ridge discrepancy that could be corrected by a root angle bend of the second premolar moving the root distally.

#### Effects of incorrect tip:

• Let us consider that a rectangle occupies a wider space when tipped than when upright. Thus, the degree of tip of incisors, for example, determines the amount of mesiodistal space they consume and, therefore, has a considerable effect on posterior occlusion as well as anterior esthetics

#### **Correction of tip**

#### a) In Standard Egdewise

**Second-order bends (Tip bends), Artistic bends (Esthetic bends) :** Bends to position anterior teeth for optimal esthetic appeal. With more flexible wire,  $2^{nd}$  order bend can be placed without any loop. But in case of stiff rectangular wire, loops should be placed to increase flexibility of wire.

Wire should cross the bracket at an angle to be effective for changing the angulation of tooth

Asymmetric height of anterior and posterior legs of loop provide desired angulation.

### b) In Preadjusted edgewise

Tip is one of the strengths of the preadjusted appliance. Nearly full expression of the bracket tip is expressed with relatively little effort, and tip bends are normally not needed

Additional first and second order bends required if brackets are positioned incorrectly.

### c) In begg'smechanotherapy

Uprighting spring: Also called as individual root spring. It has following components:

Shorter lever arm.

Larger, more resilient coils.

The angulation of the active arm and retentive arm is 135 degree.

The short lever arm carrying the hook should be set at an angle of 45 degree to the main archwire which will give a reasonable force.

The end of the spring which is placed in the pin channel of bracket may be cut to the length of that channel.

<u>Advantages</u>: Self retaining and being short they do not interfere with springs on adjacent teeth.

#### Long-arm uprighting springs.

Used when mesiodistal diameters of canine and premolars are small where it is not possible to place the short-arm type of uprighting springs without the hooks contacting each other.

# Establishing Correct Torque of the Upper and Lower anteriors Third-order bends (Torquing bends):

Twists in a rectangular archwire for labiolingual or buccolingual root movement of teeth or group of teeth.

Fig: crown and root inclination perpendicular to the line of occlusion.

### Types of torque

- (1) passive torque: which has no action or force on the tooth when engaged.
- (2) active torque: which has a definite action or force on the tooth when engaged.

#### Effects of incorrect torque/inclination:.

### Assesment of torque:

#### Torquing in standard edgewise

As a general rule, in order to construct a passive edgewise wire after leveling, an operator must have progressive lingual torque from the cuspid distal and labial torque in the incisal segment.

There are numerous methods by which this may be accomplished. Here we discuss the method described by Erman D Rauch (1959).










- A piece of edgewise wire is first inserted into the left molar tube and the wire is guided into the brackets around the arch to the right cuspid area.
- Each interproximal area, including the interproximal area of the right cuspid and premolar, is marked on the wire.
- Two or three marks should designate the interproximal area of the central incisors.
- After the wire is removed from the mouth, it is properly contoured on the arch former from cuspid to cuspid.
- At this time the wire should be checked to see that no adverse torque has been placed in the wire by manipulation with the arch former.

This is best done with the No. 442 pliers.

a) **Placing "V" bends**: The next step is to place a small "V" at the interproximal area of the lateral incisor and cuspid. This from which the operator will place labial torque for the incisal segment and progressive lingual torque for the buccal segments. Small "V" will act as the dead area of the wire



# b) Placing Labial Torque1



#### c) Removal of undesirable curvature

In checking with the No. 442 pliers, the orthodontist will observe that labial torque has been placed in the arch wire and that the buccal segments are parallel to one another.

However, the torqued area of this wire will have an undesirable curvature to the gingival.



#### d) Test the degree of labial torque

The arch is now carefully checked on typhodont. With arch wire in central and lateral brackets, distal legs should be higher than molar tubes. This is due to lingual root torque in anterior segment. Any discrepancy should be corrected at this

#### e) Placing Progressive Lingual Torque in buccal segment

With the small-beaked No. 442 pliers in the left hand the orthodontist should grasp the distal leg of the "V," and with another pair of small-beaked No. 442 pliers in the right hand he should grasp the buccal segment of the wire distal to the pliers in the left hand and in the region of the buccal tube.

With the pliers in the right hand, he should twist, the wire towards the occlusal surface.

This twisting will give the wire decided lingual torque in the molar area, but the torque will gradually diminish as it approaches the "V" area in the region of the cuspid.

Repeat the same procedure on opposite side.

# f) Test for proper Lingual Torque in buccal segment

To do this, the wire is placed in the left buccal tube; if the wire falls parallel to the right buccal tube, the left buccal segment is properly torqued. Then the right buccal segment is checked by reversing the procedure.



### Torquing in Preadjusted edgewise

It is often necessary to adjust the torque in the upper and lower anterior segments at various stages of treatment with a preadjusted appliance owing to

- The small segment of rectangular steel wire
- Play between wire and bracket.
- Varying anterior torquing needs of patients so that no single set of bracket torque values can meet the needs of all the cases seen in an orthodontic practice

Additional Torqueing in PEA is done by

# Single Tooth Torquing Plier set

# Torquing key

# **Torqueing turrets**

- TURRET It is used for preparation of arch wires with or without torque adjustment. It is available in six different versions and colors Blue, Black, Gold, Silver, Purple, Green. The wire slotted body is made of stainless steel.
- TURRET BLUE It is used For forming rectangular arch wires .016" up to .0215". TURRET BLACK It is used for forming rectangular arch wires with torque adjustments: 0° 10° 16° 23°. For use only with wire: .016"x.022".

TURRET - GOLD It is used for forming rectangular arch wires with torque adjustments:  $0^{\circ} - 7^{\circ} - 10^{\circ} - 13^{\circ} - 16^{\circ}$ . It is used for use only with wire: .018". TURRET - SILVER It is used for forming rectangular arch wires with torque adjustments:  $0^{\circ} - 7^{\circ} - 10^{\circ} - 13^{\circ} - 16^{\circ}$ . It is used for use only with wire: .022". TURRET - PURPLE It is used for forming rectangular arch wires with torque adjustments:  $0^{\circ} - 10^{\circ} - 13^{\circ} - 16^{\circ}$ . It is used for use only with wire: .022". TURRET - PURPLE It is used for forming rectangular arch wires with torque adjustments:  $0^{\circ} - 10^{\circ} - 16^{\circ} - 23^{\circ}$ . It is used for use only with wire: .016". TURRET - GREEN It is used for forming round arch wires: .014" - .016" - .018"

# Torquing key,



#### Single Tooth Torquing Plier set 442 Ribbon arch plier Establishing Connect Posterior Cr

# Establishing Correct Posterior Crown Torque

The buccolingual inclination of the posterior teeth is assessed by evaluating the relationship between the buccal and lingual cusps of the maxillary and mandibular premolars and molars. This relationship has been called the curveof Wilson. It has been described elsewhere as a gentle curvature with the lingual cusps being positioned slightly more apical than the buccal cusps. Upper palatal cusps to be situated below the occlusal plane, posterior buccal. In the lower arch, 1stroot torque - rectangular finishing wires & 2nd molars- if undesirable lingual tipping is present, - buccal crown torque to the rectangular archwires.

# Continuous posterior torque

A torquing activation placed at one point on the archwire for the entire buccal segment. This is performed by holding the archwire with two pairs of pliers very close to each other, and twisting appropriately.

Bend upward with left hand until distal leg on left side is bent to proper degree of torque. This places same degree of torque in entire posterior segment. Repeat same procedure on opposite side. This places lingual crown torque in this segment. To place lingual root torque follow the same technique, except downward with left hand instead of upward.





#### **Progressive posterior torque**

A gradually progressing torquing activation placed over the entire buccal segment. **Establishing Marginal Ridge Relationships and Contact** 

The marginal ridges are a good indicator of relative posterior vertical positioning. Primarily a function of bracket height. In the nonworn, nonrestored, nonperiodontally involved adolescent dentition, the marginal ridges are good guides for proper vertical relationships. If the marginal ridges of adjacent posterior teeth are positioned at the same level, then the cusps and the fossae of those teeth are also at the same level. If the marginal ridges are at the same relative level, then the cementoenamel junctions are at the same relative level. In this situation, the bone levels between adjacent teeth will beflat, and this produces a much healthier periodontal situation for the patient.

### **Correction in of vertical discrepancy**

a) Placement of **First-order bends** (vertical offsets)

Vertical step bends don't change angulation of tooth but correct vertical discrepancies of individual teeth.

#### Step bend

#### a) Repositioning of brackets

Repositioning of brackets as early as possible should be done if any vertical discrepancy because of improperly positioned bracket is noted. An .014" round wire can be used to correct after repositioning of brackets.

#### Coordination of Coordinating Arch Widths and Archform

Careful coordination of archwires from the beginning prevent unwanted and troublesome crossbites from developing. Most arch width discrepancies will thus be corrected by the time rectangular wires are used.

By the finishing stage of treatment, the lower arch form should be accurately established in the rectangular arch form. Evaluating the original cuspid position and the curve of Wilson in the lower arch is importantin determining the correct lower archform.

In cases with slight narrowing in the posterior segments near the end of treatment, a .045 in. arch wire (jockey wire) can be coordinated with the upper arch form and widened

approximately 6 mm per side can be secured to the upper arch in the headgear tubes. **Correction of Midline Discrepancies** 

Most minor midline discrepancies of 3mm or less can be easily corrected with rectangular wires in the finishing stage (greater discrepancies require attention earlier in treatment). Force: 1/4; inch; 6 oz

Why: To correct midline discrepancies

When: Finishing archwires

Time: 24 hours per day, except when eating

Midline elastics are usually worn with class 2 or class 3 elastics Wearing all three elastics simultaneously (midline, class 2, and class 3) can cause a cant of the occlusal plane.

#### Establishing the Alignment and Interdigitation of Teeth Maintaining the Closure of All Spac **Coordination of Tooth Fit**

For coordination of tooth fit, tooth size discrepancy is an important consideration. Boltons index for anterior /all teeth is to be calculated. In case of excess of upper anterior tooth mass relative to the lower anterior tooth mass, if enamel reduction is done in the upper arch too

early in treatment, spacing may result, which can only be corrected by the addition of bonding material.

If there is minimal crowding in the anterior segments, or if the Bolton analysis confirms that there is excess tooth size in the lower anterior segment, it is often advisable to carry out interproximal enamel reduction in the lower anterior region in the initial stages of treatment.

# Gingival form :

The presence of papilla between the maxillary central incisors is a key esthetic factor in any individual. Occasionally adults will have open gingival embrasures or black triangles spaces above contact areas that look unesthetic.

- This spaces is usually due to
- 1. If triangular tooth shape is the cause then flatten the incisal contact and close the space.
- If the roots angulation is divergent causing excessive space they should be corrected to descend the papilla down 2. and overcome the dark triangular spaces.
- If the roots angulation is divergent causing excessive space, they should be corrected, to descend the papilla 3. down and overcome the dark triangular spaces.















# **Evaluation of TMJ during finishing**

# Criteria for optimal functional occlusion:

- 1. Stable Centric Relation Condyles in a seated position
- 2. Maximum intercuspation of teeth in CR position
- 3. Relaxed and healthy musculature
- 4. When molars are in occlusion anteriors are in a very close approximation but do not touch.
- 5. Mandibular anteriors engage lingual surfaces of opposing maxillary aneteriors immediately with protrusive mandibular movements.
- 6. During lateral mandibular excursive movements, cuspids are in the best position to provide the main gliding inclines with no interferences on the balancing sides.

## Acceptable goals for CO-CR discrepency for orthodontic cases:

- Anterior posterior 1 mm
- Vertical 1 mm
- Transverse less than 1mm

Occlusal disharmonies cannot be studied in a functioning mouth because the muscles and nerve reflexes, often called neuromuscular avoidance mechanisms protect the teeth by over riding the joint guidance. Records taken in the seated condylar position and mounted on the articulator allow the joint and the tooth relationship to be evaluated without interference from neuromuscular avoidance mechanism.

# Signs and symptoms of occlusal interferences include:

- 1 .Excessive tooth mobility
- 2. Occlusal wear
- 3. TMJ sounds
- 4 .Limitation of opening or movement

# Determining if All Habits Have Been Corrected

The orthodontist should note the functional concerns of tongue thrusting, lip biting, digit sucking, mouth or nose breathing, nail biting, bruxism, clenching, or playing musical instruments with the mouth. This evaluation allows one to identify specific concerns regarding stability and to suggest the need for additional methods of retention to improve stability. Notations regarding the best form of retention can be made in the final section of the Form

#### Finishing in as given by Roth

At the conclusion of space closure .019x.026 double key hole loop archwires are removed and replaced by blue elgiloy .018x.025 ideal arches with exaggerated reverse and compensating curves with special torque adjustments to offset undersirable torque due to the exaggerated reverse and compensating curves. These wires are heat treated, tied in and cinched back.

They provide rapid root paralleling and leveling of the curve of spee and maxillary incisor lingual root torque.

Next .021x.025 steel wires have nothing bent into them other than archform. Occassionally if severe tipping has occurred, it may be necessary to 1) drop back to 0.018 special plus Australian wire after extraction site closure 2) resort to 0.016X0.022 yellow elgiloy 21/2 turns in line helix, to level and root parallel mandibular arch be fire using 0.018X0.025 blue elgiloy. Usually the 0.018X0.025 blue elgiloy or some type of

TMA or nitinol wire is all that is necessary to prepare the case for final finishing stages. When the patient als unfavourable posterior to anterior face height ratio of there is a short ramus, and extremely dolicofacial pattern, the resilient wire such as 0.018X0.025 heat treated blue elgiloy or even 0.018 Australian special plus may not be used. In these cases wire such as TMA in a 0.019X0.025 or nitinol or force 9 braided rectangular wire is used for root paralleling. Final finishing requires filling the bracket slot to get full bracket expression. After the large steel wire have been allowed to position the teeth the case is usually dropped down to maxillary and





mandibular force 9 wires and elastics are applied as needed. Roth prefers to use short class II elastics, which will not extrude the molars but will act effectively to create antero- posterior denture adjustment